(Un)promising Beginnings - Bagehot in the Land of the Waltz: Financial Crises and Lending of Last Resort in the Austro-Hungarian Empire (1868-1914)

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Dedication

This dissertation could have never been written without the continuous support and understanding of my family, in particular my parents and my siblings. The last years put us through several tests, with blows of fate that were at times hard to accept and even harder to embrace. It is a fact that I was away far too often and for far too long to support you in the same positive way you supported those in need. The very least I can do is to dedicate this thesis first and foremost to you: there are no words to express the gratitude I feel towards you. I hope to be able to make amends and contribute my share in the future. No doubt, I wish I had written up more rapidly to share this 20 December with you too, Opa: second to your birthday, I now have another reason to never forget this day of the year.

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nar, University of Cambridge Center for Financial History, Banque de France Economic Policy and Economic History Conference, Oxford Graduate Economic and Social History Seminar, Austrian Academy of Sciences Annual Meeting, Oesterreichische Nationalbank (OeNB), Oxford Business History Network, Magyar Nemzeti Bank and the Banco de España Rethinking Financial History Conference.

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General introduction

> My dearest Mother,
>
> I have added what I call waltzing to my other accomplishments. It differs from what other people call by that name, not only in the step which is of my own invention, but also in its having no relation whatever to the music, and by preserving its rotatory motion in a great measure by collisions with the other couples. It's very amusing running small French girls against some fellow's elbow, it's like killing flies years ago. There is, however, the inconvenience that one does not like to ask the same girl twice; she might say she had not insured her life, but if you are careful to select a fresh subject for each experiment, the pastime will succeed. I do not fancy it pleases the girls; he dances tout seul ('all by himself') I heard one of them say with great indignation to her female friends, as if a fellow of my age could be expected to keep time with her or with the music either, and it pleases me, it being a new, if not humane excitement, and is better than talking feeble philosophy in one of the way corners.
>
> Walter Bagehot
> Paris, October 1851[1]

When Emily Barrington (1915) first published her biography of Walter Bagehot more than a hundred years ago, she did probably not expect her brother-in-law's unpromising beginnings in the art of waltzing to inspire more than a handful of amused smiles. Although Bagehot's name had already reached fame during his lifetime due to his role as the the editor-in-chief of *The Economist*, one could have hardly imagined that his work would still resonate with policy-makers in 2017. Published in 1873, Bagehot's *Lombard Street* has become the epitome of the so-called "lender of last resort" (LLR)[2], a concept which continues to shape central bank policies in response to financial crises[3] today. The classical LLR as understood in this dissertation[4] is an ad-hoc or permanent institution which provides an elastic source of liquidity for the benefit of all financial intermediaries in the system during a liquidity crisis, when regular funding markets seize to function. As the monopoly issuers of currency, central banks are in a natural position to act as LLRs.

[1] This letter sent by Walter Bagehot to his mother was published by Emily Barrington (1915, p.192) in the extensive account she wrote of her brother-in-law's life. To avoid any misunderstandings, the author of this dissertation strictly disapproves of Walter Bagehot's rather disrespectful attitude towards women.

[2] As Humphrey and Keleher (1984, p.282) point, the term "lender of last resort" was coined by Sir Francis Baring in his 1797 treatise entitled *Observations on the Establishment of the Bank of England*. Baring spoke of the Bank of England as the "the dernier resort" for liquidity in times of crisis.

[3] Financial crises come in many different forms, degrees of severity, and are triggered by a large variety of causes, c.f. Claessens and Kose (2013); Allen et al. (2013). Hence, there is no universally accepted definition of financial crises. Yet, financial crises share some common dynamics that allow for their characterization as systemic events which affect the stability of many or most intermediaries in a given financial market following a fundamental re-evaluation of assets that back their short-term liabilities (Gorton and Ordoñez, 2014). Please refer to Chapter I of this dissertation for more details.

[4] Please refer to the literature reviews in Chapter II and Chapter III of this dissertation for alternative definitions of LLR.

Negative externalities during financial crises provide the main rationale for a lender of last resort. Financial crises usually entail "flights to safety". Following a negative (informational) shock, creditors begin to doubt the quality of the short-term debt they hold and rush to convert relatively risky portfolios into safe assets or even cash (Gorton and Ordoñez, 2014). To meet increased demands for liquidity, debtors are often forced to sell assets. Negative liquidity spirals develop when many market participants are forced to sell their assets simultaneously in order to meet short term liabilities (Brunnermeier, 2009). The resulting asset price decline may affect initially unrelated third parties in financial markets (Antinolfi et al., 2015). Ultimately, the cost of credit intermediation may rise substantially, transmitting the financial crisis to the real economy (Bernanke, 1983). To stem these negative externalities, the LLR can provide the financial system with unlimited (or at least a very large amounts of) cash in exchange for illiquid collateral. The LLR allows illiquid debtors to honor liabilities targeted by the run and thus addresses creditors' fears that their debtors will face illiquidity-induced insolvency (Diamond and Dybvig, 1983). Hence, the LLR can stop the incipient run and avert large scale asset sales with potentially severe macroeconomic consequences (Oehmke, 2014).

While there is some common ground in the literature, the meaning and aims of LLR constitute deeply contested questions, ever since Henry Thornton (1802) published his *Enquiry into the nature and effects of the paper credit of Great Britain*. A succinct history of thought on the concept of LLR helps trace out these debates. Thornton (1802) was the first to make a fully-fledged plea against central bank credit rationing during financial crises. Informed by the negative consequences of restrictive Bank policies during the crises of 1793 and 1797, he argued that the Bank of England should "allow for some special, though temporary, increase in the event of any extraordinary alarm or difficulty" (Thornton, 1802, p.259). Thus, although the canonical status of *Lombard Street* remains undisputed, Walter Bagehot (1873) should perhaps be considered as the popularizer rather than the creator of the LLR idea (Laidler, 2003, p.62). As Fetter (1965, p.274) put it, "Bagehot may not have said more than Francis Baring and Henry Thornton had said over sixty years before, but he said it in a way that carried conviction to a wider audience". After all, Bagehot (1873) was arguably the first to formulate rules how the LLR should be operationalized in practice.[5] More precisely, he advocated that during financial crises central banks acting as LLR should lend freely, at high interest rates, and in return for good collateral.[6].

Since 1873, the myriad rationalizations of Bagehot's principles have given rise to many myths and misunderstandings about the lender of last resort by diverting attention from the historical context in which these functions first emerged (Goodhart, 1999; Bignon et al., 2012). The debates on the significance and meaning of Bagehot's "rules" continue today. Nevertheless, at least for the first two of these rules, a lowest common denominator can be found. Bagehot's "free lending" principle is best read as a plea against credit rationing by the central bank. To halt a liquidity crisis, he argued that the LLR needs to propagate "the impression that though money may be dear, still money is to be had" (Bagehot, 1873, p.31). Second, Bagehot (1873, p.97) himself defined "good collateral" as financial paper which "in ordinary times is reckoned a good security"

[5]Goodhart (1999) mentions, however, that Thornton may also have to be credited for most of the content in Bagehot's principles.
[6]It should be noted that Bagehot (1873) never formulated these rules as a coherent set of principles. The principles are derived from various different passages in *Lombard Street*. For a discussion, c.f. Humphrey and Keleher (1984, p.297-305).

that is "commonly pledged and easily convertible". While this definition of good collateral remains vague, it is also timeless. Financial market perceptions about what constitutes good collateral change over time. Had Bagehot (1873) elaborated on a more specific definition, chances are discussions about a modern interpretation would have been fiercer. Either way, Bagehot's dictum to lend only against good collateral has led to the widely accepted view that the LLR should extend support to illiquid but not to insolvent loan applicants. For example, Castiglionesi and Wagner (2012, p.202) argue that "institutions without sufficient collateral were assumed to be insolvent and should, in Bagehot's view, be allowed to fail".[7] Finally, the concept of "high rates" has been found more difficult to explain. Some authors have argued that high rates constituted Bagehot's first line of defense against moral hazard deriving from the creation of a LLR (Crockett, 1996)[8], while other contributions suggest high rates mainly served to efficiently allocate limited central bank reserves in the context of a commodity money regime (Martin, 2009). A third interpretation holds that increased central bank interest rates during financial crises represented an attempt to dis-incentivize liquidity-hoarding in interbank markets (Bignon et al., 2012). This third view might be closest to Bagehot's own words, as he stated that high rates should "operate as a heavy fine on unreasonable timidity, and will prevent the greatest number of applications by persons who do not require it" (Bagehot, 1873, p.197).

For decades, central banks' role as a lender of last resort was considered a relic of the past with limited policy relevance (Tucker, 2014). In hardly any other area of economic policy-making, history and modernism remained so far, and for so long, removed from each other. Discussions about central bank independence and inflation-targeting increasingly monopolized the literature on central bank operations after the 1980s.[9] Only the recent crisis of 2007-08 reinvigorated the research and debate on LLR – but it did so "with a bang". The programme of the annual *Economic Symposium* organized by the Federal Reserve Bank of Kansas City in Jackson Hole serves as an indicator for the key topics identified by economic policy-makers in a given year. Since 2008, the LLR has been a topic of discussion in half of the symposia, with explicit mentions in nine of the research papers presented.[10] The utmost official policy hub for central banking and financial stability, the Bank of International Settlements (BIS), organized a conference entitled *Re-thinking the Lender of Last Resort* in 2014.[11] The Hoover Institution, one of the world's most prominent public policy think tanks, hosted a symposium on *Rules for the Lender of Last Resort* in 2015.[12]

[7] Goodhart (1999) opposes this interpretation on the grounds that differentiating between illiquidity and insolvency might be impossible. He also argues that this distinction makes no sense in the context of 19th discount window operations, when the decision whether to grant or refuse loans was taken only on the basis of the quality of bills submitted for discount. Chapter I of this dissertation elaborates on the argument in Goodhart (1999). Chapter III of this dissertation contains a discussion of discount window operations.

[8] For a definition of moral hazard, see further below. Chapter III of this dissertation focuses on moral hazard implications of LLR.

[9] For example, c.f. Alesina and Summers (1993) and Bernanke and Mishkin (1997).

[10] c.f. https://www.kansascityfed.org/publications/research/escp/symposiums/escp-archive; last accessed on 12 December 2017. Each symposium only allows for four to six paper presentations.

[11] c.f. https://www.bis.org/publ/bppdf/bispap79.htm; last accessed on 12 December 2017.

[12] c.f. https://www.hoover.org/events/conference-rules-lender-last-resort; last accessed on 12 December 2017.

Bagehot's principles served as a valuable inspiration for central bankers around the world during the recent crisis (Ugolini, 2017, p.114). According to Eichengreen (2016), this change in sentiment should not come as a surprise:

> The historical past is a rich repository of analogies that shape perceptions and guide public policy decisions. Those analogies are especially influential in crises, when there is no time for reflection. They are particularly potent when so-called experts are unable to agree on a framework for careful analytical reasoning. They carry most weight when there is a close correspondence between current events and an earlier historical episode.

At the same time, renewed academic interest in the LLR has pushed the boundaries of the concept and reignited hitherto unsettled debates. On the one hand, the LLR's comeback to the forefront of economic policy raised complex, seemingly new questions about the technical and operational side of last resort lending. Which types of collateral should be included in the pool of central bank eligible securities and should this pool be wide or narrow (Tucker, 2014)? Should liquidity assistance be extended to non-banks and unregulated "shadow banking" sectors, and if yes, under which conditions (Mehrling, 2011; Carlson and Wheelock, 2013; Dobler et al., 2016)? How can one address the stigma financial market participants conventionally attach to LLR assistance (Gorton and Metrick, 2013; Domanski et al., 2014)?[13] On the other hand, recent academic contributions have shown that we still lack a firm grip on some of the most fundamental challenges haunting LLR ever since the concept was first coined. Three questions stand out in this regard – and these questions lie at the core of this dissertation.

First, how can central banks acting as LLR distinguish illiquid from insolvent financial institutions (if at all), and is this distinction necessary for successful LLR? Domanski et al. (2014, p.60) suggest that making this distinction became a nearly impossible task during the recent crisis. Although many banks' net worth would have turned negative under distressed "fire-sale"[14] conditions, the same credit institutions could still be regarded viable as a going concern under the assumption that liquidity-induced default would be prevented by the LLR.[15] The distinction between solvency and illiquidity frequently blurs (Tucker, 2014): solvency is a (probabilistic) matter of perspective. Not only are insolvency and illiquidity difficult to disentangle, but the distinction neither appears to have motivated central banks' LLR policies during the crisis of 2007-08. The U.S. Federal Reserve's (FED) took several measures to mitigate distress in financial markets in 2007-08, but these measures were all motivated by concerns about negative externalities – rather than any explicit distinction between illiquidity and insolvency.[16] For example, to justify the establishment of the Asset Backed Commercial Paper (ABCP) Money Market Mutual Fund Liquidity Facility (AMLF), the FED referred to the large sums money market funds managed on behalf of all types of investors and emphasized the risk of negative liquidity spirals in case support were to remain absent.[17] Whether or not the institutions were insolvent was apparently

[13] Financial intermediaries might not have recourse to LLR facilities because they fear negative reputational consequences if their need for discount window liquidity becomes publicly known. This behaviour is mostly relevant for the U.S. case and is conventionally referred to as the stigma problem of LLR, c.f. Gorton and Metrick (2013).

[14] Fire sales may be defined as "rapid sales of assets in large amounts that temporarily depress their market prices", c.f. Begalle et al. (2016, p.513).

[15] c.f. Domanski et al. (2014, p.60).

[16] Please refer to Chapter I of this dissertation for a detailed discussion of the FED's measures and their justification.

[17] c.f. https://www.federalreserve.gov/regreform/reform-amlf.htm; last consulted on 8 December 2017.

no prime matter of concern at the time.[18] These observations raise the question whether the FED's approach can or needs to be reconciled with the standard view that only illiquid institutions should receive LLR support. After all, providing liquidity support to insolvent institutions might be costly, both in monetary terms if loans are not repaid, and in terms of setting negative incentives, e.g. by increasing *de facto* bail-out expectations in the future.

Second, once a case for support has been made, how should LLR be designed in order to be effective? Central banks can face constraints which obviate an elastic supply of liquidity during a crisis. Some of these constraints may be institutional or technical (Bindseil, 2009): access to central bank liquidity could be reserved to specific counterparties only, eligible collateral may be (too) narrowly defined or central bank cover ratios might inhibit a large increase in note issuance.[19] Historically, constraints also proved to be ideational: the Federal Reserve's policy reaction to the banking crises during the Great Depression in the 1930s has often been criticized on the account of wrong ideas (Friedman and Schwartz, 1963; Carlson and Wheelock, 2013). Others still are driven by market characteristics. Microeconomic theory suggests that quantity rationing can be the result of asymmetric information problems in financial markets (Stiglitz and Weiss, 1981). If any of these constraints result in a credit rationing LLR, they can lead to illiquidity-induced mass failures of banks during a financial crisis and trigger severe macroeconomic consequences. In this context, it is worthwhile noting that, since the crisis of 2007-08, the U.S. Dodd-Frank Act limited the FED's emergency powers under Section 13 (3) of the Federal Reserve Act. It prohibits emergency lending to insolvent borrowers and only allows for programs and facilities with wide eligibility[20] that have been approved by the Secretary of the Treasury.[21] It is an open question, as some authors suggest (Gorton and Metrick, 2013; Hautcoeur et al., 2014; Begalle et al., 2016), if the legislative change imposes new institutional constraints on the FED's LLR function and, if so, how these constraints may be addressed in case of an emergency.

No matter how successful it is in calming financial distress and independently of the concrete form it takes, the LLR always comes at a cost. A central bank which engages in free lending during crises provides financial institutions with an insurance against liquidity shocks. Insurance in turn invites moral hazard: it leads to a decline in the incentives for counterparties eligible for LLR support to take preventative actions to mitigate the risk they are being insured against (Freixas et al., 1999).[22] Moral hazard may generate large social costs. It undermines financial stability and thereby increases the probability of future crises. Moreover, if the LLR struggles to distinguish between illiquid and insolvent institutions, defaults on LLR loans need to be shouldered either by the central bank (and ultimately tax payers) or by junior debtors and shareholders.

[18] However, legislative changes suggest that it became a main post-crisis concern, c.f. next paragraph.

[19] Historically, institutional constraints often took the form of ratios regulating the relationship of central bank note issuance to specie reserves. Cover ratios served to bolster public confidence in the value-storing capacity of central bank notes (Jobst and Rieder, 2016). In the case of the Bank of England, these rules were conventionally suspended in times of crises, c.f. Bignon et al. (2012).

[20] In the LLR context, "wide eligibility" means that liquidity support cannot be targeted at or tailored to a specific institution or group of institutions.

[21] c.f. https://www.federalreserve.gov/newsevents/pressreleases/bcreg20151130a.htm; last accessed on 12 December 2017.

[22] As argued by (Carlson et al., 2015), moral hazard might not be a problem if the LLR responds exclusively to exogenous liquidity shocks. Please refer to Chapter III of this dissertation for a detailed discussion.

A third fundamental question thus resurfaced following the crisis of 2007-08: what are convincing techniques to tackle moral hazard deriving from the provision of LLR support? In an attempt to check moral hazard in the aftermath of the recent crisis, micro-prudential supervisors complemented revised capital requirements with new liquidity standards at the bank-level Carlson et al. (2015). The liquidity coverage ratio (LCR) introduced by Basel III requires banks to hold an amount of high-quality liquid assets (HQLA) sufficient to cope with a thirty day stress scenario affecting their funding situation (Bank of International Settlements, 2013). Since these minimum standards have to be met in normal times, they should counteract moral hazard deriving from expected LLR interventions during crises. The post-crisis approach appears to have superseded previously proposed mechanisms to deal with moral hazard in last resort lending. A long tradition in central bank practice focused on ways to increase the (expected) cost of relying on the lender of last resort: moral hazard, so the older argument goes, could be contained either by requiring banks to pay a "penalty rate" that makes accessing LLR support highly unattractive (Crockett, 1996) or by introducing an element of uncertainty ("constructive ambiguity") whether the LLR facility will be available in a crisis (Freixas, 2000). These traditional arguments have since been criticized on many accounts.[23] From this perspective, the relatively late turn to liquidity regulation seems puzzling: it raises the question why this approach was not chosen any earlier.

Although the themes discussed above are frequently presented as novel or unexplored, students of economic history will be aware that central banks have historically dealt with related challenges over and over again.[24] Indeed, it is difficult to escape the conclusion recently reached by Grossman and Rockoff (2015): economists appear to be always "fighting the last war" when it comes to the design of LLR. Too rarely do we look beyond the commonplaces captured in Bagehot's principles. Too often have we reinvented central bank practice already standard more than 100 years ago. This dissertation tackles the questions raised above by taking another stance. Its goal is to "prepare for the next war" by looking back at why and how we lost or won past struggles. Yet, I do not argue that history simply repeats itself and thus policy lessons from the past can be applied to modern day financial markets without the necessary "grain of salt". Rather, the starting point of this dissertation is the observation that our current views on LLR are so much shaped by condensed interpretations of past writings that we have lost track of the wealth of information the past itself still harbors.

In her biography of Walter Bagehot, Emily Barrington (1915, p.192) made clear that waltzing remained "an art which he never mastered, as he became giddy before any serious instruction could be made available". Much like Bagehot's unpromising beginnings in the art of waltzing (would have) called for substantial additional practice, central banks' ability to act as LLRs required many years of apprenticeship. Although Bagehot's letter suggests that his insufficient dancing skills may have generated some negative externalities for his company on the dancefloor, these externalities are surely minuscule compared to the high social costs generated by the absence of a fully-fledged LLR during some past financial crises. Founded in 1694, the Bank of England is

[23] Problems include adverse selection at high interest rates and time-inconsistency concerns. Please refer to Chapter III of this dissertation for a detailed discussion of these pitfalls.

[24] See Ugolini (2017) for a recent survey on these questions in historical context; c.f. also Bignon and Jobst (2017) and Jobst and Rieder (2016) on the question of collateral, Avaro and Bignon (2017), Flandreau and Ugolini (2014) and Anson et al. (2017) on the question of counterparty eligibility, and Gorton and Metrick (2013) on the stigma problem.

conventionally regarded as the first central bank to embrace a lender of last resort role (Grossman and Rockoff, 2015). However, the road to LLR was stony and non-linear for the *Old Lady of Threadneedle Street*, and the same may be said of other central banks slowly evolving into LLRs during the 19th century.[25] The Bank of England is known to have rationed credit in 1793, 1797, 1825[26], 1836 and once again in 1847 before assuming its role as LLR starting in 1857 (Bignon et al., 2012; Anson et al., 2017). Authors have ascribed the slow adoption of LLR responsibilities to several reasons, ranging from the private nature of the Bank and its limited responsibility beyond its shareholders (Capie, 2002), the constraint that the Gold Standard and other statutory rules exercised on its ability to expand the note supply in a crisis (Bignon et al., 2012) and usury rate legislation to the discrimination of borrowers resulting from the lack of harmonized lending standards (Calomiris et al., 2016).

In this dissertation, I analyze the path taken by a central bank located on the other side of the Channel, in the Land of Waltz: Austria-Hungary. Austria-Hungary is the name conventionally used for the Habsburg Empire in the period between 1868 and 1918, after the Austro-Hungarian Compromise of 1867 had separated the monolithic monarchy into two sovereign political entities. As of 1 January 1868, Austria and Hungary received independent Parliaments and fiscal autonomy, while remaining united "in the person of the common monarch" (Eddie, 1989, p.814), the maintenance of a common army, a common diplomatic corps and a single central bank as well as currency (Flandreau, 2001, p.16). The Austrian National Bank (*Oesterreichische Nationalbank*, OeNB) was established as a privately owned stock company and enjoyed the note-issuing monopoly for the entire territory of the Habsburg Empire ever since its foundation in 1816. To reflect the bi-national structure of the monarchy, the central bank was renamed Austro-Hungarian Bank (*Oesterreichisch-ungarische Bank* or *Osztrák-magyar bank*, OeUB) in 1878.

From the perspective of the literature on the LLR, there are three major reasons why the *Oesterreichische Nationalbank* is an enticing object of study. First, the OeNB's adoption of LLR functions, and its crisis management practices more generally, are very much under-researched in economic history. In his monumental contributions, Pressburger (1959a,b, 1962, 1969, 1972, 1973, 1976) provides detailed qualitative evidence on the history and evolution of the Bank between 1816 and 1923, including its policy stances during financial crises.[27] By transcribing a large number of original meeting protocols, Pressburger conveys a very useful and meticulous picture of the discussions the OeNB's management held during periods of crisis. However, he marshals almost no quantitative evidence and advances very little economic interpretation of the events in question: the author's approach is to let the archival protocols speak for themselves. More recent studies, in particular the work by Kövér and Pogány (2002) and Jobst and Kernbauer (2016), constitute excellent background readings on the topic. Yet, due to their very nature as long-term histories of the Bank, they dedicate only little space to explicit

[25] Grossman and Rockoff (2015) recently reviewed these journeys for the Bank of Japan, Banque de France, Bank of Prussia, Denmarks Nationalbank, Nederlandsche Bank, Bank of Finland, Norges Bank, Sweden's Riksbank, Banca d'Italia and the Federal Reserve.

[26] While it is often argued that the Bank lent more generously during the crisis of 1825, the Bank of England's discount rate was still subject to usury legislation at this point, inhibiting "Bagehot-style' free lending; c.f. Anson et al. (2017).

[27] More recently, Kernbauer (1991) has extended the official history of the OeNB until 1938.

discussions of financial crises and crisis policy. Schubert (1991), in contrast, goes into much more detail, but focuses exclusively on the *Creditanstalt* crisis of 1931.[28] In joint work with Clemens Jobst (Jobst and Rieder, 2016), I recently addressed the lack of a general survey perspective on the OeNB's role as a LLR between 1816 and 1931, condensing some findings of this dissertation. Testifying to the unpromising beginnings of the OeNB as a LLR, we show that free lending was historically the exception rather than the rule in Austria-Hungary. While Jobst and Rieder (2016) scratch the surface of the topic, the present dissertation will deliver the groundwork.

Second, the OeNB's role as a LLR is not only under-researched, it is also a highly relevant case that deserves to be added to the existing empirical literature on historical last resort lending. This literature is strongly dominated by studies on England and the United States[29], while past financial crisis management on the European continent largely remains to be explored.[30] Contributions on the English and American case proved crucial in advancing the literature on the design and effectiveness of LLR. It should be noted, however, that the peculiar structure of the dominating money and financial markets in London (Bignon et al., 2012), the very much decentralized institutional set-up of the U.S. Federal Reserve (Meltzer, 2003) or the parallel existence of a variety of regulators and safety nets (Mitchener and Jaremski, 2015; Calomiris and Jaremski, 2016) partly limit the external validity of conclusions based on these specific historical settings. For example, the nature of and relative weight given to moral hazard concerns is likely to depend on which type of financial intermediaries the central bank is dealing with in its LLR operations. If liquidity risk is not of particular concern, as has been argued for London discount houses and bill brokers in the 19$^{\text{th}}$ century (Ugolini, 2017), moral hazard prevention will likely have a different face than in the case of credit institutions which engage in conventional maturity transformation. In contrast to the Bank of England, the OeNB had always dealt with a wide array of counterparties, but at least since the 1860s the bulk of lending operations was dedicated to a fairly standard financial sector from a modern perspective: joint-stock banks, savings banks and credit cooperatives all issued callable short-term liabilities to lend long-term. Since 1878, the OeNB had a unique, centrally managed risk management framework and the Bank abode by harmonized lending standards for the entire Empire. In addition, the Austro-Hungarian case was free from other "distortions": separate banking supervision did not exist in the period of study (1868-1918) and no deposit guarantee schemes were in place yet.[31] Finally, the interior political stability following the Compromise of 1867 and the absence of major wars turns the 50 years of Austro-Hungarian dualism into an ideal playground for the study of central banking. By moving the focal point to a hitherto neglected central European case, my dissertation fills a gap in the international literature on the LLR.

[28] In other related work to this dissertation, Flandreau (2001, 2005) takes a bird's-eye view on the political economy of monetary policy-making in Austria-Hungary. Jobst (2009, 2010, 2014) looks at the exchange rate operations of the Austro-Hungarian Bank and documents the Bank's institutional set-up as a multinational central bank.

[29] Please refer to Chapter I and II of this dissertation for reviews of this literature.

[30] Recently, in-depth studies on historical LLR operations have appeared on Belgium (Buyst and Maes, 2008), France (White, 2011; Bignon et al., 2012; Bignon and Jobst, 2017) and Spain (Sotelo, 2017). White (2007), Riva and White (2011) and Hautcoeur et al. (2014) analyze crisis management techniques in France which go beyond the LLR concept as understood in this dissertation.

[31] Please refer to Chapter I and Chapter III of this dissertation for more information on the Austro-Hungarian banking sector, OeNB risk management and the composition of OeNB counterparties.

Third, the Austro-Hungarian record is exceptional with regard to the quality and coverage of qualitative, and above all quantitative sources on both the financial market side and central bank operations. In practice, data unavailability forced the prior literature on the historical LLR to take sides. On the one hand, the Bank of England Archive contains sheer unlimited, highly disaggregated data on the loans the central bank extended to its counterparties in London (Anson et al., 2017), covering all major financial crises (1847, 1857, 1866, 1878 and 1890) during the 19$^{\text{th}}$ century. Similar data is available for the Banque de France (Avaro and Bignon, 2017). However, balance sheet data and information on financial market participants is very scarce for both the English and the French case. English financial yearbooks do exist (e.g. *The Bankers' Almanac*), but they only have records for a fraction of financial counterparties and do not cover the most relevant intermediaries in the money market (discount houses and bill brokers). To the best of my knowledge, bank-level data is almost completely inexistent for France. On the other hand, for U.S. American credit institutions detailed bank-level balance sheet data is available.[32] Yet, while there is a wealth of qualitative evidence on central bank operations, information on loans extended by the Federal Reserve Banks is not (publicly) accessible.[33] Hence, studies on the effectiveness of LLR support during the Great Depression of the 1930s rely mainly on inferred policy differences between Federal Reserve districts (Richardson and Troost, 2009; Jalil, 2014). As I will discuss in the substantive chapters of this dissertation, the Austro-Hungarian case is unique in that at least for some (relevant) episodes precise quantitative data on both sides of the market are available to the researcher. In my dissertation, I exploit these data *inter alia* to provide the first analysis of a 19$^{\text{th}}$ century LLR intervention using both disaggregated balance sheet data and a precisely matched treatment indicator at the level of individual financial institutions.

This introduction has conveyed a bird's-eye view on my doctoral research project. I close the present introductory chapter by summarizing the precise research questions tackled in my dissertation and by explaining in detail the contributions my doctoral thesis makes to the literature in economics and economic history. My thesis is organized around three substantive chapters. They correspond to the three fundamental challenges for LLR raised above: the distinction between illiquidity and insolvency; constraints on free lending and the problem of effective LLR design; and the search for solutions to the moral hazard problem in last resort lending. Since these chapters draw and build on each other, an ordered reading is recommended. In principle, however, the three chapters were intentionally written as research papers that can be read individually.

My dissertation builds on a vast array of new (panel) data sets which I compiled from archives and other primary sources. *Inter alia*, I collected several bank-level balance sheet data sets, bank-level information on LLR support, stock market data on the level of individual company shares and information on central bank supervisory operations as applied to individual counterparties. All graphs, tables and econometric analyses in the present dissertation are based on these novel data sets. I explain my data contributions in detail in each of the chapters below, alongside their respective sources and the techniques I used to collect them.

[32] Historical American bank-level data has been exploited by countless studies since the 2000s. A necessarily selective list of examples includes Calomiris and Mason (1997), Carlson (2005), Richardson and Troost (2009), Jaremski (2010) and Carlson et al. (2011).

[33] Several exemptions from the Freedom on Information Act (FOIA) make it generally impossible to obtain these data, c.f. https://www.federalreserve.gov/foia/exemptions.htm; last accessed on 12 December 2017.

In order to evaluate policy responses to specific periods of financial distress, an in-depth knowledge of the context and dynamics at hand is indispensable. Chapter I sets the groundwork for this dissertation: it examines the causes of bank distress during the Austro-Hungarian *Gründerkrach* (founders' crash) of 1873. The *Gründerkrach* stands out as the most severe financial crisis which hit the Habsburg Empire during the 50 years of Austro-Hungarian dualism. Despite its severity, the crash of 1873 is surprisingly under-researched in modern economic history. Earlier contributions discount the explanatory power of economic theory or neglected to investigate the banking crisis in a systematic empirical way. In this chapter, I show that bank closures during the *Gründerkrach* were tightly connected to the collapse of a vibrant market for repurchase agreements (also called "repos") in Vienna. Repo loans were an essential part of banks' investment banking business model at the time: in order to boost the attractiveness of initial public offerings (IPOs), banks granted repo loans against equity shares they themselves had introduced to the market – with mostly brokers and stock market investors on the borrower side. I show that repos served the purpose of addressing concerns about after-market liquidity known to be important in IPO underpricing (Ellul and Pagano, 2006). In Chapter I, I estimate several cross-sectional and panel regressions, using binary response as well as semi-parametric survival models. Discussions of causal identification in bank failure models are rare and the literature often implicitly relies on the assumed exogeneity of shocks to banks' financial health. To address the problem of omitted variable bias more explicitly, I draw on a technique called "baseline hazard stratification". This method is the survival analysis analogue to a fixed effects estimator in panel regressions. It can be used to purge the model of unobserved heterogeneity at a specified group-level. To the best of my knowledge, I am the first to employ stratification techniques in the context of bank-level survival regressions.

My findings in Chapter I qualify the received wisdom that the *Gründerkrach* banking crisis derived mainly from a bursting real estate bubble which subsequently compromised the financial health of credit institutions. To the best of my knowledge, this study is the first to examine a historical repo market crisis and its consequences using microdata. Although economic historians point out that repo markets have existed for centuries (Flandreau and Sicsic, 2003; White, 2007), orthodox wisdom still holds that "repos as we know them were introduced to the U.S. financial market by the Federal Reserve in 1917" (Acharya and Öncü, 2011, p.323). Hence, these markets' microstructure, evolution and role during past financial disruptions are largely unexplored. This lack of previous research on historical repo markets has parochialized our knowledge of their structure and vulnerabilities prior to the crisis of 2007-08. Repos played a crucial role as catalysts of the most recent financial meltdown: "runs on repo" wreaked havoc in large parts of the U.S. shadow banking sector (Gorton and Metrick, 2012a; Martin et al., 2014). Lehman Brothers was forced to suspend payments and face bankruptcy when its short-term repo funding suddenly dried up in autumn 2008 (Copeland et al., 2014). Yet, repo markets remain virtually untouched by the post-2008 financial market reforms (Skeel, 2011; Saguato, 2017) and our awareness of systematic patterns in the causes and consequences of repo market instability is still limited ten years on.

This gap is disconcerting because repo markets play a crucial role in financial systems. They generate market liquidity for many types of securities, they represent a major funding source for market-making broker

dealers and they play a part in the smooth functioning of the general payment system (Baklanova et al., 2015). I argue that analyzing historical repo market disruptions can be one innovative way forward to enhance our understanding of recent developments. My findings corroborate work by Copeland et al. (2014) who emphasize the role of market microstructure in explaining the varying degrees of resilience to distress in different segments of the U.S. repo market. The Austro-Hungarian experience of 1873 suggests that repo markets with short maturities ("tenors") in which lenders themselves are susceptible to rapid funding withdrawals are prone to sudden break-downs of funding flows. Chapter I of my dissertation suggests that policy proposals arguing in favor of lengthening repo tenors and institutionalizing a last resort lending mechanism for these markets may be on the right track.[34]

Chapter I of this dissertation shows that banks, which were forced to sell the collateral in response to heavy funding withdrawals, had to write-off substantial portions of their repo portfolios and incurred heavy losses during the *Gründerkrach* of 1873. Therefore, the nature of bank distress in 1873 cannot be easily classified. Bank failures did not spring from a pure liquidity problem, nor did they derive from a simple solvency shock. Rather, repo lender distress emerged from the combination of several different shocks: bank-level liquidity and solvency problems paired with deteriorating market illiquidity. Chapter I thus raises the question whether and how policy could have mitigated bank distress during the crisis of 1873.

In Chapter II, I show that the Austrian central bank (*Oesterreichische Nationalbank*, OeNB) initially rationed credit through its discount facility during the peak of the *Gründerkrach* in May 1873. As the crisis evolved, however, the central bank did produce several specific policy responses that were primarily motivated by considerations to avoid negative externalities. In particular, the central bank coordinated and participated in an unconventional lender of last resort mechanism to stem the liquidity crisis. Facing the central bank's limited willingness to provide direct liquidity support, market participants joined forces to preempt large-scale fire sales during the *Gründerkrach*. Bankers, brokers and investment firms founded so-called *Aushilfs-Comités* (AHCs, support committees) in all major cities of the Habsburg Empire. The OeNB agreed to grant direct refinancing lines to these committees in return for the joint guarantees of their members and the creation of equity funds to cover up losses from the committees' lending activities. On the basis of these guarantees, the central bank even allowed AHCs to rediscount substandard paper.

The LLR solution devised in response to the *Gründerkrach* differed in design from the classical direct Bagehot-style LLR in that it interposed another layer between the central bank's standing facility and liquidity recipients. At the same time, the solution chosen in 1873 shared the principle of "wide eligibility" present in the classical LLR model because anybody could join an AHC and apply for a loan as long as a subscription to the equity fund was made. "Wide eligibility" and the explicit aim to stem a systemic problem rather than distress at individual institutions clearly distinguish the AHCs from so-called "life-boat operations" (Hautcoeur et al., 2014; Calomiris et al., 2016). Chapter II shows that this unconventional LLR effectively mitigated bank

[34]For these and similar policy proposals, c.f. Copeland et al. (2014); Oehmke (2014); Begalle et al. (2016).

distress during the *Gründerkrach*. In order to tease out the causal effect of the non-standard LLR intervention on bank survival, I use a two-stage inverse-probability-weighted regression adjustment (IPWRA) to address the problem of banks' endogenous selection into AHCs.

Chapter II argues that AHCs can be viewed as innovative solutions remedying the under-provision of a good particularly desirable in times of crises: central bank liquidity. They helped alleviate central bank credit rationing by addressing some of the trickiest aspects haunting LLR ever since the concept was first coined. First, on the most basic level, AHCs reduced risk management costs for the central bank by shifting borrower screening activities back to market participants. Second, AHCs tackled information asymmetries faced by the central bank in direct LLR. They made effective use of private information on liquidity recipients and had an inbuilt defense against moral hazard. *Aushilfs-Comités* constituted an ad-hoc alternative to direct LLR lending in the absence of an institutionalized central bank risk management and monitoring framework. Third, the AHCs provided an indirect way of temporarily enlarging the pool of collateral eligible for last resort liquidity. AHCs' joint guarantee structure and their equity funds limited the amount of additional risk a similar enlargement would have triggered for the central bank in a standard LLR setting. In addition, these two elements also addressed the moral hazard implications of the enlargement by making AHC members liable for losses. Thus, *Aushilfs-Comités* constitute a useful precedent for recent proposals to ensure LLR access to a wide range of market participants beyond the traditional banking system via market solutions or private-public partnerships (Acharya and Öncü, 2011). The structure and set-up of *Aushilfs-Comités* provided a straight-forward answer to the key questions of collateral financing, collateral liquidation and loss allocation which are conventionally cited in this regard (Begalle et al., 2016).

Chapter II of this dissertation analyzes the lender of last resort (LLR) in (in)action. It studies the unpromising beginnings of the Austro-Hungarian central bank as a LLR. While *Aushilfs-Comités* were designed in a way to minimize negative behavioral incentives for liquidity recipients, Chapter II only provides limited insight into how moral hazard was checked inter-temporally. If the creation of *Aushilfs-Comités* with OeNB support had become the general expectation in every crisis, credit institutions may have "banked" on this expectation. Of course, the very nature of AHCs as ad-hoc committees might have limited the rise of pernicious incentives. Yet, their ad-hoc nature also explains why more structural attempts at limiting moral hazard remained absent at the time: with a central bank hesitant to assume the role as ultimate liquidity provider in a crisis, there was no fully-fledged institutionalized LLR concerned with moral hazard. Over time, institutional changes allowed the OeNB to evolve into an institution up to the task: the Austrian central bank gradually adopted free lending practices towards the end of the 19th century.[35] This very evolution raises an obvious question: in the absence of explicit liquidity regulation, how, if at all, did the Bank address moral hazard deriving from the presence of its fully institutionalized LLR role? The purpose of Chapter III is to answer this question.

As discussed above, prior work on central bank practice and theoretical contributions suggest several mech-

[35]Please refer to Chapter III for a description of the institutional innovations necessary for the LLR to become credible.

anisms to mitigate moral hazard. Most of the previous contributions focused on ways to increase the (expected) cost of accessing the lender of last resort, either by requiring banks to pay a "penalty rate" (e.g. Crockett (1996)) or by introducing an element of uncertainty whether the LLR facility will be available in a crisis ("constructive ambiguity", e.g. Freixas (2000)). Chapter III explores a third mechanism: incentive systems. Ex-ante monitoring, combined with sanctions, can allow the central bank to prevent its counterparties from engaging in riskier behavior following the availability of last resort lending. Monitoring can also help the central bank to better dose LLR support when it is actually needed. I argue that the Austro-Hungarian Bank used a system of so called "credit limits" as an instrument to address moral hazard concerns. For every counterparty, the Bank set an individual maximum amount that the counterparty could borrow. *Prima facie*, the mere existence of credit limits might be interpreted as evidence that the earlier practice of credit rationing was still prevalent. The concept seems to fundamentally contradict the tenet of free lending. I show, however, that while credit limits were enforced during normal times, they were flexibly raised in the event of a well-understood exogenous liquidity shock. In this way, the Austro-Hungarian Bank abode by the principle of free lending while having a tool at hand to prevent the build up of excess risk in normal times. I thus argue that managing moral hazard deriving from the provision of LLR facilities required an operationalization of credit limits as "contingent rules".

Preventing the build-up of excess risk in normal times requires two elements. First, the central bank has to be able to monitor risk taking. I document the sophisticated system put in place by the Austro-Hungarian Bank. This system included the compilation of hard information like balance sheets and profit and loss statements by local branch offices as well as soft information obtained through local discount committees, regular visits by inspectors and an elaborate book-keeping system that allowed clerks to extract information from the bills submitted to the central bank. Second, the central bank has to be able to sanction banks that take excessive risks. Here I argue that the power of the Austro-Hungarian Bank to do so stemmed from the possibility to lower or cancel the credit limits it had accorded to its counterparties. *Ceteris paribus*, banks had an interest in obtaining a high credit limit. During normal times a higher limit facilitated liquidity management as banks could hold (interest earning) eligible bills instead of (unremunerated) cash, whereas in the event of stress a higher limit offered more breathing space before the central bank would have to be asked for an increase in the limit. In addition, I show that the central bank's willingness to increase the limit during a period of distress was conditional on a positive initial credit assessment. Even though the OeUB had no formal regulatory powers, the attractiveness of the central bank's discount window thus endowed the OeUB with some (informal) power to influence the banks' liquidity management by increasing or decreasing the banks' normal credit limit. I run regressions of credit limits on bank fundamentals providing suggestive evidence that the Austro-Hungarian Bank effectively adjusted credit limits as a function of the leverage and liquidity situation of its counterparties. These results are robust to several specifications, including bank-level fixed effects. Using exogenous variation in banks' exposure to liquidity shocks, I also show that the shock caused the central bank to tolerate transgressions and increase limits. To the best of my knowledge, Chapter III provides the first economic interpretation and empirical analysis of a central bank's historical credit limit framework.

Chapter I

A Historic(al) Run on Repo: Causes of Bank Distress during the Austro-Hungarian Gründerkrach of 1873

1.1 Introduction

This dissertation focuses on the role, design and effectiveness of central bank policy responses to financial crises. In order to evaluate policy responses to specific periods of financial distress, an in-depth knowledge of the context and dynamics at hand is indispensable. The present chapter sets the groundwork for this dissertation: it examines the causes of bank distress during the Austro-Hungarian *Gründerkrach* (founders' crash) of 1873. The *Gründerkrach* stands out as the most severe financial crisis which hit the Habsburg Empire during the 50 years of Austro-Hungarian dualism (1867-1918). The Empire's banking sector contracted severely in response to the crisis of 1873: by 1878, 30% of all Austro-Hungarian credit institutions in operation at the end of 1872 had terminally suspended their activities and 40% of the banking sector's total equity had evaporated.[36] Despite its severity, the crash of 1873 is surprisingly under-researched in modern economic history. Earlier contributions discount the explanatory power of economic theory or neglected to investigate the banking crisis in a systematic, empirical way[37].

Prima facie, one would expect 19$^{\text{th}}$ century crises such as the *Gründerkrach* to have little in common with more modern episodes of financial turmoil. Yet, although their proximate causes may differ, all systemic financial crises are characterized by similar dynamics (Gorton and Metrick, 2013). Market economies depend on the use, as transaction media, of "information-insensitive" short-term debt instruments issued by financial intermediaries (Gorton and Ordoñez, 2014). These instruments have in common that their exchange requires little or no information on the issuer or the underlying collateral in normal times: they are considered "safe assets" (Caballero et al., 2016). Financial crises are characterized by a flight out of these debt obligations into cash. These runs are systemic events in the sense that they affect many or most intermediaries in a given financial market. Runs constitute a rational response to shocks that cause creditors to doubt the ability of financial institutions to honor their debt contracts. These shocks may be very small in nature and might even be expected to happen only in the future (Gorton, 1988). It suffices that they are strong enough to make creditors question the quality of their claims, thereby turning previously "information- insensitive" into "information-sensitive" assets.

When uncertainty about asset values increases, the debt capacity of collateral – the amount of secured borrowing that can be sustained by an asset – can fall dramatically (Acharya et al., 2011). Creditors will be inclined to ration their funds and convert their previous holdings into safer and more liquid assets. In a systemic run, affected intermediaries are often unable to fully meet the large-scale scramble for cash they are facing. Financial institutions turn insolvent in the sense that they cannot honor their obligations without trying to sell assets (Gorton, 2012). If many intermediaries sell their assets simultaneously, however, fire sales[38] will

[36] For more details on the Austro-Hungarian banking sector at the time, c.f. Section 1.4 below and Chapter III of this dissertation.

[37] Two early exceptions are Steiner (1913) and Scheffer (1924). Matis (1971) is emblematic for the narrative approach taken in prior contributions. More recently, Kövér (2000) focused on Hungary only.

[38] Fire sales can be defined as "rapid sales of assets in large amounts that temporarily depress their market prices", c.f. Begalle et al. (2016, p.513).

result and asset values become depressed by "cash-in-the-market pricing"[39]. Financial institutions have to write down assets and incur losses: bank failures might ensue.[40]

One important element that distinguishes financial crises from one another is the form of short-term debt which is targeted during the episode under consideration. Historically, one might primarily think of conventional bank deposits in this context, but banks have also issued other instruments such as private notes. During the crisis of 2007-08, runs affected *inter alia* money market mutual funds (MMMF) shares (Duygan-Bump et al., 2013; Schmidt et al., 2016). The characteristics and microstructure of short-term debt markets also differ substantially. They are populated by different agents on both, the supply and the demand side, with varying degrees of sensitivity to distress and risk-bearing capacities. Following a shock, some funding markets are more prone to gradual adjustments while others can collapse outright.[41] Thus, a detailed understanding of the instruments targeted by a run, and their underlying market features, is crucial for formulating both real-time policy responses and *ex post* reforms. At its most basic level, the present chapter aims at generating this knowledge for the Austro-Hungarian crisis of 1873.

Drawing on a vast array of newly compiled archival data sets, I show that bank closures during the *Gründerkrach* were tightly connected to the collapse of a vibrant market for repurchase agreements (also called "repos"; very short-term, collateralized loans[42]) in Vienna. Repo loans, known to contemporaries as *Report*, *Prolongation* or *Kostgeschäft*, were an essential part of banks' investment banking business model at the time: in order to boost the attractiveness of initial public offerings (IPOs), banks granted repo loans against equity shares they themselves had introduced to the market – with mostly brokers and stock market investors on the borrower side. I show that repos served the purpose of addressing concerns about after-market liquidity known to be important in IPO underpricing (Ellul and Pagano, 2006). When a prime brokerage house and major repo borrower filed for bankruptcy on 8 May 1873, depositors started to run on banks, which they suspected to be heavily engaged in repo lending. The repo market collapsed: lenders suddenly pulled back from the market and no single repo transaction was recorded for more than six months. During the weeks and months following 8 May 1873, repo lending banks were forced to repossess and fire-sell depreciated collateral into illiquid markets, experiencing heavy losses. These findings qualify the received wisdom that the *Gründerkrach* banking crisis derived mainly from a bursting real estate bubble which subsequently compromised the financial health of credit institutions.

To the best of my knowledge, this study is the first to examine a historical repo market crisis and its consequences using microdata. Although economic historians point out that repo markets have existed for centuries (Flandreau and Sicsic, 2003; White, 2007), orthodox wisdom still holds that "repos as we know them

[39] "Cash-in-the-market pricing" occurs when the total liquidity available in a given market at a specific moment in time is (much) smaller than the total value of assets offered for sale, c.f. Allen and Gale (2007).

[40] As explained in Chapter II and Chapter III of this dissertation, the role of central banks as lenders of last resort is precisely to preempt the negative externalities of these fire sales by liquefying banks' illiquid assets and enabling them to honor their liabilities.

[41] The crisis of 2007-08 saw some segments of the U.S. repo market collapse, while, in others, margins evolved more gradually, c.f. Copeland et al. (2014). See Section 1.2 below for a more detailed discussion of this point.

[42] Technically, and also legally, repos are different from collateralized loans. For a precise definition of repos, please refer to Section 1.2 below.

were introduced to the U.S. financial market by the Federal Reserve in 1917" (Acharya and Öncü, 2011, p.323). Hence, these markets' microstructure, evolution and role during past financial disruptions are largely unexplored. This lack of previous research on historical repo markets has parochialized our knowledge of their structure and vulnerabilities prior to the crisis of 2007-08. Repos played a crucial role as catalysts of the most recent financial meltdown: "runs on repo" wreaked havoc in large parts of the U.S. shadow banking sector (Gorton and Metrick, 2012a; Martin et al., 2014). Lehman Brothers was forced to suspend payments and face bankruptcy when its short-term repo funding suddenly dried up in autumn 2008 (Copeland et al., 2014). Yet, repo markets remained virtually untouched by the post-2008 financial market reforms (Skeel, 2011; Saguato, 2017) and our awareness of systematic patterns in the causes and consequences of repo market instability is still limited ten years on.

This gap is disconcerting because repo markets play a crucial role in financial systems. They generate market liquidity for many types of securities, they represent a major funding source for market-making broker dealers and they play a part in the smooth functioning of the general payment system (Baklanova et al., 2015). I argue that analyzing historical repo market disruptions can be one innovative way forward to enhance our understanding of recent developments. My findings corroborate work by Copeland et al. (2014) who emphasize the role of market microstructure in explaining the varying degrees of resilience to distress in different segments of the U.S. repo market. The Austro-Hungarian experience of 1873 suggests that repo markets with short maturities ("tenors"), in which lenders themselves are susceptible to experience rapid funding withdrawals, are prone to sudden break-downs of lending flows. These conclusions could suggest that policy proposals arguing in favor of lengthening repo tenors and institutionalizing a last resort lending mechanism for these markets may be on the right track.[43]

The remainder of this chapter is structured as follows. Section 1.2 discusses the related literature in more detail. In this section, I formulate my hypotheses and I explain how this chapter contributes to the literature in more detail. Section 1.3 presents the data sources. All graphs, tables and the entire econometric analysis of this chapter are based on newly collected panel data sets. Section 1.4 establishes the historical setting for this study. In Section 1.5, I provide an in-depth explanation of the role of repo markets in banks' business models. Section 1.6 empirically investigates the impact of repo lending on banks' probability of failure during the *Gründerkrach* of 1873. I estimate several cross-sectional and panel regressions, using binary response as well as semi-parametric survival models. Discussions of causal identification in bank failure models are rare and the literature often implicitly relies on the assumed exogeneity of shocks to banks' financial health. An instrumental variable approach may be a solution for one particular regressor, but it is difficult to implement if many variables are of simultaneous interest. In an attempt to address the problem of omitted variable bias more explicitly, I draw on a technique called "baseline hazard stratification". This method is the survival analysis analogue to a fixed effects estimator in panel regressions. It can be used to purge the model of unobserved heterogeneity at a specified group-level. To the best of my knowledge, I am the first to employ stratification techniques in the context of bank-level survival regressions. Section 1.7 explores the channels to bank distress. I show that the

[43]For these and similar policy proposals, c.f. Copeland et al. (2014); Oehmke (2014); Begalle et al. (2016).

Austro-Hungarian repo market completely froze for several months during the crisis. I analyze the contribution of market microstructure to the break-down of the Austro-Hungarian repo market, using qualitative, as well as descriptive quantitative evidence. The section shows that a combination of funding pressures and market illiquidity was instrumental in triggering repo lender distress. Section 1.8 concludes.

1.2 Financial concepts and relevant literature

1.2.1 Repo runs and repo market microstructure

Repos constitute short-term secured loan agreements which are composed of two separate transactions: the borrower sells usually high quality, liquid securities to the lender in exchange for cash (1) and simultaneously agrees to repurchase them for a slightly higher price in the future (2). If expressed as a percentage of the initial sale price, the difference between repurchase price and sale price represents the interest rate for the repo loan (the "repo rate"). Should her counterparty default on the commitment to repurchase the securities at maturity, the creditor may be forced to sell the securities to other market participants at uncertain prices in the future. Hence, lenders in the repo market usually apply a so-called "haircut". The amount the lender agrees to pay in step (1) merely corresponds to some fraction of the actual value of the acquired securities. The haircut thus provides the lending party with a safety buffer against future price declines of the collateral.[44] Depending on their degree of sophistication, repo contracts may also contain a clause that enables the lender to place a margin call, i.e. to demand additional securities from the borrower if the market price of the collateral falls significantly at any moment before step (2) is completed. Since repos often have short maturities (mostly overnight) and are over-collateralized, these loans are considered very safe. They usually get rolled over at maturity, providing a continuous source of short-term funding for the borrower as well as a stream of interest payments for the lender.

Gorton and Metrick (2012a) argue that bank runs in our modern systems of "securitized banking" manifest themselves as wholesale funding withdrawals from investment and dealer banks in the form of rapidly increasing haircuts on repurchase agreements.[45] Their argument was inspired by the bankruptcy of Lehman Brothers, a US investment bank which was forced to suspend payments when its short-term repo funding suddenly dried up in the autumn of 2008. Copeland et al. (2014) have challenged this narrative as an accurate description of the dynamics during the 2008 financial crisis. They argue that "repo runs" as defined by Gorton and Metrick (2012a) only occurred in one specific repo market, namely the bilateral repo market, in which borrowers and lenders exchange cash and collateral directly with each other. Whereas the bilateral market was characterized by increasing safety margins, the so called tri-party repo market did not experience any noticeable increases in haircuts prior to the default of Lehman Brothers. In line with Martin et al. (2014), Copeland et al. (2014)

[44] Depending on the legal treatment of repos, it may be incorrect to speak of "collateral" in the context of a repo transaction. In most of the economic literature on the topic, however, "collateral" has become the standard term to designate the securities sold to the lender.

[45] A 100% haircut corresponds to a total withdrawal of funds from borrowers.

interpret the "repo runs" in bilateral markets depicted by Gorton and Metrick (2012a) as an equilibrating phenomenon that allowed lenders to gradually adjust to higher borrower default risk and liquidity risk. This adjustment was completely absent in the tri-party repo market, which suddenly collapsed when the financial troubles of Bear Stearns and Lehman Brothers (two important borrowers in the tri-party market) surfaced.

There are some obvious organizational differences between bilateral and tri-party repo markets. These differences include the presence of a clearing bank as the third party and more cumbersome margin adjustments in the tri-party market.[46] Yet, Copeland et al. (2014) argue that the inbuilt stickiness of haircuts in the tri-party repo market represents a symptom of the infrequent use of margin adjustments in this market, rather than a cause of the lack of changes in haircuts during the crisis of 2008. The authors hold that bilateral and tri-party repo markets actually display many similarities which would suggest very similar reactions to market distress: the two markets are characterized by similar loan contracts and collateral classes, and the very same financial actors appear in both markets. From this point of view, the apparent absence of safety margin adjustments and the subsequent precipitous collapse of funding flows in the tri-party market during the 2008 financial crisis remains a puzzle.

According to Copeland et al. (2014), a more detailed analysis of the microstructure of the two repo markets can shed light on their different resilience to distress. First, the authors point to fundamental differences in the ability and willingness of cash lenders in the two markets to deal with cases of borrower default. In contrast to the dealer banks active as lenders in the bilateral market, cash lenders in the tri-party market are *ex ante* less willing to lend funds when counterparty risk increases. Money market mutual funds (MMMFs) and securities lending cash pools, which make up an important portion of lenders in the tri-party market, are unprepared to take possession of and liquidate collateral upon borrower default. Their investment strategies are traditionally conservative and they view repo loans as safe short-term investments of their excess cash reserves. Instead of adjusting margins to higher risk environments, these investors prefer withdrawing funding altogether. The fact that MMMFs are even legally forbidden to possess some classes of securities which they commonly accept as collateral in the tri-party repo market conveys the impression that cash investors in this market do not seriously contemplate to lend funds to borrowers with nonzero default risk. Second, but related to the first point, the funding situation of lenders in the tri-party market is a special one, as money market mutual funds (MMMFs) and securities lending cash pools may themselves face withdrawal pressures from their own investors, and particularly so when financial markets are distressed. Consequently, tri-party repo lenders are highly intolerant to credit and liquidity risk because any negative rumors about their repo counterparties could induce their own investors to call in funding. Third, the maturity ("tenor") in the tri-party repo market is generally shorter than in the bilateral market. Clearing banks usually unwind tri-party repo loans every morning. Copeland et al. (2014) argue that this feature allowed lenders in the tri-party market to terminate loans literally overnight: the short maturity provided a degree of flexibility that can account for the precipitous decline in funding.

[46]The two clearing banks running the tri-party repo market in the U.S. are JPMorgan Chase and BNY Mellon. Haircuts in the tri-party market are set according to a pre-established protocol implemented by the clearing banks, which requires 24-48 hours prior notice to be altered. For a detailed discussion, c.f. Copeland et al. (2014).

Unfortunately, our current knowledge regarding these conjectures is still severely limited, not least because repo crises are rare events that only occur under extreme financial market distress. The narratives in Gorton and Metrick (2012a) and Copeland et al. (2014) are problematic in the sense that they are based on observations from a single event: the crisis of 2007-08. Moreover, data on the unregulated "shadow banking" sector, where most repo action takes place, are hard to find even for the most recent crisis (Gorton and Metrick, 2012b; International Capital Market Association, 2015). In this chapter, I contribute to the existing literature on the role of repo market microstructure by drawing attention to the previously completely disregarded wealth of information that is available on how these markets operated in the past. To be sure, I do not think that the surely large institutional and legal differences that separate modern repo markets from the Viennese one in 1873 can be easily glossed over. Rather, my argument is based on the more "transferable" features of short-term debt markets. All three core characteristics described by Copeland et al. (2014) are general enough so they can be checked against the features of the Austro-Hungarian repo market in the early 1870s. Even if (1) the unpreparedness or unwillingness to repossess collateral upon borrower default, (2) the vulnerability of lenders with regard to funding withdrawals, and (3) the presence of very short maturities are not sufficient conditions for a sudden market collapse, they appear to be crucial ones in the eyes of Copeland et al. (2014). If the authors' arguments bear external validity, my hypothesis would be that the basic underlying propositions should hold in different contexts too. Hence, I put these conjectures to a simple test. For this purpose, the present chapter provides a description of the rationale for repos in banks' business models (c.f. Section 1.5) and explains the repo market's structure as well as its dynamics during the *Gründerkrach* in detail (c.f. Section 1.7).

1.2.2 Linking repo market distress and lender default

While Lehman Brother's demise made it fashionable to explain the advent of borrower distress in the repo market[47], almost no attention has been paid to financial malaise on the lending side of repo markets. This gap is surprising in view of the agreement that the prevention of disorderly collateral liquidations by distressed lenders should be one of the top priorities of policy responses to emerging repo crises (Antinolfi et al., 2015). One reason for the absence of corresponding discussions in the literature may be that lender distress is rare in repo markets. Gorton and Metrick (2012a) argue that the augmentation of repo loans with collateral substitutes for deposit insurance in the wholesale funding markets of present day securitized banking systems.

Only a combination of concerns about borrower insolvency and market illiquidity can lead to a failure of this insurance mechanism. In theory, an anticipated economic downturn, rumors or even outright knowledge about borrower insolvency do not represent any risk, as long as the collateral exhibits low price volatility and benefits from a liquid market with low transaction costs. High market liquidity and low price volatility of the collateral enable lenders to terminate the repo contract without losses even if their borrower defaults. The inverse is true as well: in a world without default risk, the quality of repo collateral should be irrelevant as borrowers always

[47] For a selection of theoretical contributions explaining borrower distress, c.f. Acharya et al. (2011); Gorton and Ordoñez (2014); Martin et al. (2014).

pay their dues at maturity.[48] It follows that lender distress in the repo market has to be a direct consequence of the formal seizure and sale of collateral upon borrower default. Repo lender distress occurs only if the act of selling seized collateral generates losses which are either large enough to endanger the lender's financial viability immediately or create tangible prospects that the lender's business might become financially unsustainable in the future. For this chapter, I define borrower default broadly: it covers the seizure of collateral by the lender due to the borrower's inability to pay back a repo loan which is not rolled over at maturity and the latter's inability to meet a margin call in the case of longer-term loans. As a corollary, repo lender distress is directly connected to the driving forces behind a lender's decision whether and when to liquidate seized collateral upon borrower default. Lenders' leverage over the timing of collateral liquidation is crucial because it is the market price of collateral at the moment of sale which determines whether the proceeds from the liquidation net out the defaulted loan (or even lead to a residual liability of the lender vis-à-vis the borrower) rather than resulting in a residual claim on the borrower. Flexibility in terms of choosing the "right moment" for selling seized collateral can thus be a precious good.

Which factors increase or decrease this flexibility? At least three factors seem highly relevant. First, the timing of collateral liquidation is inextricably linked to how exactly repos are handled legally in a given (historical) context. For example, if repurchase agreements are treated as loan contracts corresponding to the right of lien (which is frequently applied to secured loans) rather than being separable into two different sale and purchase contracts, the lender never actually repossesses the collateral in the event of borrower default. Instead of legally acquiring the collateral, which instead remains the sole property of the borrower throughout, the lender may merely use it to compensate his outstanding debt claim where the compensatory action necessarily entails a sale of the collateral. This constellation explains why "seized" collateral must often be sold in the first place rather than being simply appropriated and substituted for the pending loan amount. More importantly, there might be stark differences among legal regimes concerning the authorization and execution of collateral liquidation. It is often forgotten that the exemption of repo collateral from automatic stay during borrower bankruptcy proceedings, i.e. the lender's right to immediate and free disposal over the repo collateral despite the opening of a bankruptcy procedure on the borrower, is only a fairly recent phenomenon even in the United States. It was not until 1984, when Congress first legislated to exempt certain highly liquid collateral classes from automatic stay; and it took twenty more years until the exemption from automatic stay was extended to mortgage-related securities in 2005 (Acharya and Öncü, 2011, p.330).

Besides the legal provisions governing repo collateral management, one would also expect the timing of collateral liquidation to obey certain (micro-)economic dynamics. In a model shedding light on the evolution of collateral prices during large-scale sales of illiquid securities, Oehmke (2014) parameterizes lenders' control over the timing of liquidation by drawing on so called "balance sheet constraints". Oehmke (2014) thinks of balance sheet constraints as either characteristics of a lender's current financial position which limit her capacity

[48] The successful nature of the U.S. Federal Reserve's (FED) interventions might be another reason for the absence of repo lender distress during the crisis of 2007-08. The Fed provided a double liquidity backstop for repo markets, c.f. Duygan-Bump et al. (2013) and the next subsection.

to hold onto seized collateral (e.g. a pressing need to convert assets into cash in order to respond to funding withdrawals) or regulatory requirements that force the lender to sell the collateral in order to meet minimum standards.[49]

Equally emphasized by Oehmke (2014), strategic interactions between repo lenders represent a third important element for understanding the timing of liquidations.[50] For example, the creditor structure of a given borrower funded by repos against one single type of collateral asset may have a direct bearing on the respective lenders' decision to liquidate this very collateral asset upon debtor default. A higher number of creditors might be expected to soften the binding character of individual lenders' balance sheet constraints because each lender has a smaller exposure relative to the case where she funds the borrower entirely on her own. Hence, one can imagine a positive correlation between the number of creditors and the flexibility of individual lenders in choosing the moment of liquidation. According to Oehmke (2014), however, there is a trade-off involved in this situation. Lenders may still proceed to sell the collateral in an inefficient "rush to the exit" despite non-binding balance sheet constraints, if they fear their homologues will push down the market price permanently by selling the seized collateral before they themselves enter the market. In the presence of a downward sloping demand curve, all lenders might have an incentive to liquidate as soon as possible to secure a higher value for their repossessed share of collateral. The theoretical ability to postpone liquidation is of little use if the market price of the underlying collateral stagnates at low levels and never recovers. Under certain circumstances, the strategic interaction between multiple creditors secured with the same collateral asset can therefore considerably reduce each individual creditor's actual room for maneuver when it comes to the timing of liquidation.

Based on the theoretical considerations above, I formulate the following hypotheses. If repo lending banks failed during the crisis of 1873 because of losses deriving from the liquidation of collateral, then I would expect these liquidations to have happened at a time of severe market illiquidity when prices were already heavily depressed. In other words, losses from liquidations must have been substantial. If this was the case, then the context begs the question why lenders sold collateral at times so unfavorable to them. I would expect untimely liquidations to occur if either the legal regime required an instantaneous sale of collateral upon borrower default or strategic and balance sheet constraints became binding, or both. In Section 1.7 below I analyze the legal, financial and strategic constraints on collateral liquidation during the crisis of 1873 to shed light on these hypotheses.

1.2.3 The nature of banking crises and policy responses

Scholars of banking crises conventionally distinguish between two major channels to bank distress. On the one hand, the "illiquidity hypothesis" connects bank defaults to (self-fulfilling) panic runs on short-term debt in the

[49] One example might be the obligation to swap collateral securities for high quality liquid assets (HQLA) to satisfy the liquidity coverage ratio (LCR) as introduced by Basel III.

[50] For a different interpretation of strategic interactions to model the relationship between investor sophistication and fund flows, c.f. Schmidt et al. (2016).

absence of (deposit) insurance. These runs are ascribed to either a combination of liquidity shocks to creditors and their subsequent coordination failure triggered by so-called "sunspots" (Diamond and Dybvig, 1983)[51], or from an (anticipated) negative shock expected to affect banks' financial solidity paired with information asymmetries between credit institutions and their depositors (Gorton, 1988). According to this view, otherwise solvent banks fail because they do not possess sufficient liquid assets to stem deposit withdrawals as they happen. The "insolvency hypothesis", on the other hand, perceives bank distress as an outgrow of widespread losses on the asset side of banks' balance sheets, where targeted deposit runs respond to clearly observable signs of banks' individual weaknesses. Thus, this hypothesis states that banks fail because they are inherently weak, when "deeper causes", such as shocks to local, regional and national macroeconomic fundamentals, unveil bad and risky loan or investment decisions (Claessens and Kose, 2013).

It has been argued that the difference between illiquidity-induced and insolvency-induced bank distress has important consequences for policymakers. The illiquidity hypothesis contends that individual bank failures should not be predictable on the basis of bank-level and macroeconomic fundamentals measured just before the outbreak of the crisis: closures should be random or near random as panicking depositors are assumed to be unable to properly discriminate between healthy and unsound credit institutions (Calomiris and Mason, 1997). Hence, the illiquidity hypothesis allows for a straight-forward conclusion regarding the appropriateness of central banks' policy response. If liquidity shortages rather than underlying fundamentals trigger a banking crisis, then a central bank has a clear mandate to act as a lender of last resort (LLR) to coordinate expectations by supporting illiquid but solvent credit institutions to stem deposit withdrawals (Champ et al., 1996). In its simplest specification, the LLR is an ad-hoc or permanent institution which provides liquidity for the benefit of all financial intermediaries in the system under circumstances of a collective financial market liquidity crisis when regular funding markets cease to function.[52] Given their fundamental soundness, banks in distress should be able to pledge sufficient and good collateral to obtain the liquidity needed to meet depositors' demands. Liquidity assistance in this case might even help to avoid a run altogether if customers are convinced that the value of their investments remains protected by the LLR.

In contrast, under the insolvency hypothesis, bank failures are essentially non-random and can be predicted on the basis of underlying bank-level characteristics as well as macroeconomic fundamentals prior to the actual outbreak of a given banking crisis (Calomiris and Mason, 2003b). A second implication of the insolvency hypothesis concerns the policy response. Contrary to the case of solvent bank distress induced by liquidity shortages, banking sector crises that emerged because of fundamental bank weaknesses are difficult to counteract by a conventional lender of last resort alone.[53] If their financial situation makes it impossible for distressed

[51] Following Cass and Shell (1983), I define "sunspots" as unobservable random variables that cause depositors to simultaneously align their expectations about withdrawals by their peers and thus produce a self-fulfilling bank run.

[52] Please refer to Chapter II and Chapter III of this dissertation for a precise definition of the lender of last resort and a detailed discussion of its role, rationale and design.

[53] The "conventional" lender of last resort is viewed to provide unlimited liquidity to banks in distress, but demands high quality collateral and charges penalty rates in return. The accurateness of this interpretation of the "Bagehotian" approach is debatable, although it appears to represent the standard interpretation of the lender of last resort role in the late 19th century, c.f. Bignon et al. (2012). Please refer to the subsequent chapters of this dissertation for further discussion.

banks to provide good collateral and to credibly pledge to pay the required interest rate for liquidity assistance, traditional central bank interventions are at best unlikely to be powerful enough to prevent credit institutions' failure; in the worst case, liquidity assistance is superfluous altogether (Mishkin, 1992).

This endeavor to separate causes of bank distress into two clear-cut categories is problematic for several reasons. For example, Richardson (2007) shows that the illiquidity and insolvency hypotheses are complementary rather than mutually exclusive in the context of the Great Depression 1929-1933. More generally, in the light of recent contributions, an earlier controversy over which of these two approaches constitutes the more accurate explanation for historical banking crises increasingly fades. Instead of advocating a "one-explanation-fits-all" approach, scholars are taking a more micro-level perspective by testing which of the channels comes closer to explaining specific episodes within longer periods of banking distress. For example, Calomiris and Mason (2003b) conclude that, while earlier phases of crisis during the Great Depression can be accounted for by bank fundamentals, at least the final episode of distress in 1933 was largely driven by panic-induced illiquidity. Furthermore, illiquidity and insolvency are extremely difficult to disentangle in practice, even at the bank-level (Goodhart, 1999). Costly fire sales triggered by funding withdrawals following a liquidity shock may induce insolvency. In many cases, bank failures may require that both solvency and liquidity shocks occur (almost) simultaneously. As argued in the previous subsection, repos are most likely to lead to (lending) bank distress when market illiquidity (of the collateral), funding shocks (to the lender) and borrower default coincide. Similarly, due to contagion through interbank networks, insolvency at one bank can cause liquidity problems at others (Mitchener and Richardson, 2016). Finally, from a methodological point of view, work which focuses on whether bank failures can be predicted by weak fundamentals often discounts the explicit description of the mechanisms leading to bank distress. The danger of *ex post* rationalization looms large in these cases as panics can create focal points endogenously: certain characteristics appear as important predictors only contingent on a specific state of the world (Gorton and Ordoñez, 2014).

If the distinction between illiquidity and insolvency is inherently difficult, how can we make an informed judgment about the appropriate policy responses? First of all, there are still occasions when clear-cut cases can be made for LLR based on the presence of exogenous liquidity shocks (Carlson et al., 2015). Examples in the literature exploit natural disasters, such as plight infestations, as random shocks triggering liquidity distress clearly distinguishable from solvency concerns (Carlson et al., 2011; Bignon and Jobst, 2017).[54] The other extreme concerns bank distress that can unmistakably be linked to insolvency. In these cases, liquidity provision by a LLR is not effective in addressing the underlying cause of distress and, usually, it is also not possible at the standard conditions governing central bank credit (Bindseil, 2009).[55] Other forms of rescue packages, including government bail-outs and "life-boats", might be implemented in response, in particular if the banks experiencing distress bear systemic relevance (Hautcoeur et al., 2014; Ugolini, 2014). Third, both

[54] In Chapter III of this dissertation, and in a companion paper to Chapter III, I make a similar argument based on an exogenous shock deriving from an imminent threat of war in 1912, opposing Austria-Hungary and the Russian Empire.

[55] For example, the central bank will not be able to provide liquidity via its standard standing facilities if the financial intermediary is unable to pledge adequate collateral.

modern banking supervision and credible resolution regimes for banks might allow for a more accurate distinction between illiquidity and insolvency – and its enforcement (Tucker, 2014). Regular reporting and stress-testing exercises provide the central bank with the possibility to constantly fine-tune and update its assessments of individual institutions. The existence of a credible resolution authority, including contingency plans, can create a credible alternative to unwarranted bail-outs by the LLR, even for systemically important banks.

In practice, however, many crisis events blur the lines between illiquidity and insolvency. Any judgment about the solvency of credit institutions is necessarily probabilistic and always entails a residual tail risk that the assessment is misguided (Tucker, 2014).[56] Under these circumstances, an alternative rationale for or against LLR interventions is needed. One way to make a case for LLR under uncertainty about the underlying solvency of banks rests on the presence of significant negative externalities (Antinolfi et al., 2015). For example, negative liquidity spirals develop when many market participants are forced to sell their assets simultaneously in order to meet short term liabilities (Brunnermeier, 2009). On these occasions, liquidity provision, potentially also in exchange for substandard collateral, can mitigate the propagation of the shock and its impact on third parties.[57] From a normative perspective, these interventions should be grounded in a (social) cost-benefit analysis. Effective central bank risk management frameworks and tools to address potential moral hazard implications are paramount for the sustainability of these operations.[58]

During the crisis of 2007-08, the U.S. Federal Reserve took two specific measures to backstop financial distress in repo markets, both of which were explicitly motivated by concerns about negative externalities, rather than a distinction between illiquidity and insolvency. On the one hand, the Federal Reserve set up the Primary Dealer Credit Facility (PDCF) to channel liquidity to repo borrowers against all collateral eligible in the tri-party repo market. The FED argued that "the triparty repurchase agreement market is a critical, short-term funding market" and that the PDCF was needed to stabilize this market and "promote the orderly functioning of financial markets more generally".[59] On the other hand, the FED established the Asset Backed Commercial Paper (ABCP) Money Market Mutual Fund Liquidity Facility (AMLF). The facility was created to extend cash to banks and other financial institutions for the purpose of financing ABCP purchases from MMMFs, which in turn suffered from heavy funding withdrawals. To justify the establishment of this facility, the FED stated that:

> MMMFs hold trillions of dollars in funds on behalf of individuals, pension funds, municipalities, businesses, and others; without additional liquidity in the money markets, forced sales of ABCP could have depressed the price of ABCP and other short-term instruments, resulting in a cycle of losses to MMMFs and even higher levels of redemptions and a weakening of investor confidence in MMMFs and the financial markets.[60]

[56] Tucker (2014) argues that the amount of risk incurred in this regard should be decided by each society according to its preferences. Elected representatives may determine the acceptable level of risk-taking.

[57] Chapter II of this dissertation explores an example characterized by similar circumstances.

[58] These points are key elements discussed in Chapter II and Chapter III of this dissertation.

[59] c.f. https://www.federalreserve.gov/regreform/reform-pdcf.htm; last consulted on 8 December 2017.

[60] c.f. https://www.federalreserve.gov/regreform/reform-amlf.htm; last consulted on 8 December 2017.

The present chapter will assess the causes of bank failures during the Austro-Hungarian *Gründerkrach*. Its purpose is to produce the groundwork for an analysis of policy responses to the crisis. As I will show in Section 1.7 below, repo lender distress during the crisis of 1873 blurred the line between insolvency and illiquidity while also triggering negative externalities in the form of large-scale sales of repossessed collateral. This context thus posed a serious challenge for contemporary policy-makers which I explore in Chapter II of this dissertation.

1.3 Primary sources and data

The present chapter brings to bear a large array of new financial and archival data. This section discusses all sources which were systematically consulted with the aim of compiling new primary data bases for the purpose of this study. All graphs, figures and econometric work in my study rely on these novel data sources. Data which served as an *ad hoc* source for specific, minor aspects of interests will be duly referenced over the course of the study but their sources are not discussed explicitly in this section.

First, I compiled a bank-level panel data set which contains more than 130 variables covering background information, balance sheets as well as profits and loss statements for 300 individual banks operating on a joint-stock basis[61] in Austria-Hungary between 1868 and 1878. The data for the panel was retrieved from two independent primary sources: on the one hand, the official statistical yearbooks for Austria and Hungary compiled by the imperial statistical commissions for the two halves of the Empire; and a financial yearbook edited by a private publishing house, the so-called *Compass - Finanzielles Jahrbuch*, on the other hand. The annual reporting frequency for balance sheets and profits and loss statements determines the time index of the data set, while its panel component is given by the number of banks operating and reporting each year. All relevant volumes from the Austrian statistical yearbook series are available online.[62] The Hungarian statistical yearbook is available for consultation at Austria's National Library in Vienna. The present paper also benefited from free access to a large set of *Compass* volumes published since 1868. In particular, all relevant volumes between 1868 and 1878 have been digitized by the publishing house and were generously provided both online and on data storage media.[63]

For this paper, bank-level panel data was compiled in two steps. First, the statistical yearbooks served as the primary source because they feature balance sheets and profits and loss statements in table form which is extractable by OCR software, allowing for quick conversion into spreadsheet formats. The yearbook publications followed a standardization procedure to summarize the reported balance sheet positions and income statements into several, albeit still quite numerous main categories. Unfortunately, judging from the official publications alone, it is impossible to determine whether the standardized positions in the yearbooks consistently aggregate

[61] These banks include joint-stock banks stricto sensu (*Aktienbanken*), mortgage banks (*Hypothekarkreditanstalten*) and pawn banks (*Pfandleihanstalten*).

[62] c.f. http://www.literature.at/; last accessed on 8 December 2017.

[63] The *Compass* and many other historical publications are accessible on-line for a fee via the ZEDHIA portal, managed by the *Compass Verlag*, c.f. http://portal.zedhia.at/; last accessed on 8 December 2017.

the same balance sheet positions in the cross section as well as over time. Therefore, the second step, the compilation and cross-checking of financial and other descriptive bank-level information from the *Compass*, is crucial. Apart from the coverage of bank-level data for Hungary (which is not available in the Hungarian statistical yearbook until 1875), the most valuable contribution of the Compass is undoubtedly the reporting of frequently much more disaggregated balance sheets and income statements which can be compared to the standardized positions from the yearbooks for each individual bank and year. The possibility of comparisons enables the reader to reproduce the standardization procedure implemented by the yearbooks and check their consistency in the cross-section as well as over time. Therefore, information conveyed by the *Compass* is essential for both understanding the content of standardized variables and disaggregating financial variables in a more detailed manner.

The merits of the *Compass* extend well beyond its usefulness to correct and understand data from the statistical yearbooks. In particular, for many descriptive variables the *Compass* is complementary to the information published in the yearbooks which, to name only a few examples, contain no consistent data on banks' branches and omit information on the exact date when a bank started to operate or, where applicable, when precisely it closed down. The *Compass* plays an equally crucial role in the compilation of secondary data sets employed in this paper. Most noteworthy in this regard are the summaries of credit institutions' general and extraordinary shareholder assemblies which enable the reader to extract a wealth of additional information.[64] For a considerable number of financial intermediaries which closed down following the crash in May 1873, the summaries edited by the *Compass* also offers a descriptive account of the reasons for failure. This qualitative data proves useful for understanding the driving forces behind different types of bank failure.[65]

In principle, my panel data set covers the entire population of joint-stock banks, mortgage banks and pawn banks in business between 1868 and 1878. Some banks, however, do not report financial data at every call date (31 December of each year) throughout their lifespan. On the one hand, banks that were founded and closed in the same year never published a balance sheet because they simply did not manage to survive until the call date. This de-selection mechanism mainly applies to a few banks which opened for business in 1873, shortly before the *Gründerkrach* hit. On the other hand, a second group of banks displays missing balance sheet data for the call dates which, in most cases, represent the end of their first business year. Many banks did not report financial data until six months to one year after they became operative. Therefore, their first balance sheet only appears in the annual statistics of the year following their foundation.

For this chapter, selection into the panel data set is an issue only if the reason for missing financial data is correlated with the likelihood of a given bank to experience distress in the 12 months following the gap in the data. If banks did not report on their financial situation at the call dates preceding their demise because,

[64] Although not available for all banks, these summaries contain valuable information on business links between banks, foundations of banks from within the banking sector, mutual provision of banks' payment services on each other's behalf, correspondence networks, and joint participation in investment consortia or underwriting syndicates. In Chapter II of this dissertation I exploit the only source of information on business links that is systematically available: directorate interlocks between banks.

[65] Banks could either be liquidated, merged or enter bankruptcy proceedings, c.f. Section 1.4.

for example, they had an incentive to hide the state of their business from public scrutiny and/or they were unable to draw up a balance sheet for the sheer lack of systematic documentation, selection bias would have to be taken into account. Two remarks apply. First, it should be noted that if banks remain outside my sample because they are particularly weak or engage in unsound management practices, selection is likely to bias my estimates downwards: on average, I will have both less failures and less "wildcat" banks in my estimation sample than contained in the population of credit institution. Second, selection into the sample is only a problem for statistical inference if my sample is unrepresentative of the overall population.

In order to check for selection bias, I collected as much additional qualitative information on the banks absent from my sample as possible. First, I checked the descriptive reasons of failure in the *Compass* to see whether the causes, dates and types of bank closure of de-selected credit institutions were systematically different from the banks in my sample. Since this exercise is only possible to the extent that information is reported in the *Compass*, further work was needed. Therefore, I also looked at the reports of the arbitration panel at the Viennese stock exchange (VSE) as a second source. This panel dealt with all cases of defaults and non-payments of contracts on the stock exchange as long as they were recorded as official transactions in the books of the *Bourse*'s trading agents (the so called *Sensale*). Whenever a trader, broker or investment fund defaulted on a bank, and the trade had been officially registered, the bank presented its residual claim to the arbitration panel. Third, the official Viennese stock exchange committee issued a public statement on 18 July 1873[66], requesting all creditors who had not yet reached full settlement with their debtors to send in lists of outstanding receivables including the amounts and the names of the liable party. For this chapter, I systematically collected all the lists banks addressed to the stock exchange committee. Both the arbitration court reports and the list of debtors allow me to collect valuable information on the activities of banks not present in my balance sheet sample. Finally, I also transcribed the list of firms that received official trading spots inside the Viennese stock exchange. Overall, the data should enable me to provide an informed assessment of whether banks outside my sample failed due to systematically different reasons than the banks inside my data set. I exploit this information in the robustness checks contained in Section 1.6.[67]

Newspapers and specialized finance magazines helped satisfy diverse supplementary data needs. *Der Tresor*, a review on economic and financial statistics of the Austro-Hungarian Empire published on a weekly basis between 1872 and 1918, was drawn upon to assemble data on the monthly status of retail (deposit) funding and yield curves on retail deposits for a subsample of banks. All issues of *Der Tresor* can be accessed via the *Austrian Newspapers Online (ANNO)* platform hosted by Austria's National Library in Vienna.[68] This platform represents an invaluable source with over 19 million pages digitized from the period between 1568 and 1946. For any given weekday in 1873, there are about 30 different digitized newspapers available on the platform. *ANNO* also contains the entire set of issues of the *Wiener Zeitung*, a daily newspaper in existence since

[66]This communiqué was published in all major newspapers, e.g. *Wiener Zeitung*, 19 July 1873, p.245. See below for information on where to access these newspapers.

[67]For information on where to consult archival data on the operations of the Viennese stock exchange, c.f. below.

[68]To access the platform, c.f. http://anno.onb.ac.at/; last accessed on 8 November 2017.

1703. Apart from publishing a great range of valuable statistical information, the *Wiener Zeitung* functioned as the ministerial journal for new legislation and official statistics. Since many credit institutions also published the monthly status of their retail funding in the *Wiener Zeitung*, the latter constitutes a second source that allows for cross-checking and complementing data from *Der Tresor*. Several other newspapers were consulted on *ANNO* to assemble contextual information. Whenever drawn upon, these newspapers are duly referenced in the sections below.

In order to capture both the origins and the extent of the *Gründerboom* as well as the severity of the crash starting in early May 1873, this study created a new panel data set containing individual monthly stock market prices for all stocks and bonds, public and private, traded on the VSE between January 1867 and December 1874. In addition to the three conventional types of quotes reported (average, bid and ask), for each financial instrument the panel records the industry type of the issuing firm, the nominal amount of the stock or bond as well as its currency denomination and the actual amount already paid in on the quoted stock by the shareholders. The two sources feeding into the stock market panel data set are the daily official stock market reports of the VSE, called the *Coursblatt des Gremiums der k.k. Börse-Sensale*, on the one hand and the daily issues of the *Wiener Zeitung*, on the other hand. Both sources provide a complete set of stock market reports for the entire period under observation. Digitized photos of the daily publications of the *Coursblatt* were generously provided by the current market data service department of the Vienna stock exchange.[69] This department also hosts the entire VSE archives. The data from the *Wiener Zeitung* served as a valuable back-up whenever the quotes from the official VSE reports turned out to be illegible.

The *Coursblatt* also delivers direct systematic evidence for the existence of a dynamic repo market in Austria-Hungary. Albeit only for a small number of stocks, the *Coursblatt* provides daily interest costs for overnight repos which can be collected and converted into repo rates in order to generate a continuous picture of the market's evolution before and during the *Gründerkrach*. I collected these rates on a weekly basis between December 1868 and December 1874 and on a monthly basis between January 1868 and July 1914, together with the prices of stocks serving as collateral. The data is unique in that it likely summarizes the only systematically available information (apart from bank balance sheets of course) on the state of the Austro-Hungarian repo market during the *Gründerboom* conserved until the present day. The calculated rates serve as a barometer for the repo market in the Habsburg Empire. Although repo haircuts were not reported by the *Coursblatt*, they can be reconstructed for a sample of transactions from the debtors lists requested by the VSE (c.f. above). Some of the creditors submitted the whole transaction history of defaulted repo loans to the VSE committee following the communiqué of 18 July 1873. Most repos had a transaction history of several months because they were continuously rolled over at maturity.

Finally, additional qualitative and quantitative evidence was retrieved from the Viennese archives of the *Creditanstalt*. The *Creditanstalt* archives contain the only systematically preserved documents produced by

[69] Vienna Stock Exchange (VSE), *Market Data Services*, Wallnerstrasse 8, 1010 Vienna, Austria.

commercial banks in business while the *Gründerkrach* was still ravaging. Since the bank merged with and acquired some of the most important financial institutions operating in Austria during the second half of the 19th century, its archives inherited a wealth of historical documents issued by other commercial banks. This study engages with material drawn from the protocols of the *Creditanstalt's* and *Bodencreditanstalt's* directorate as well as supervisory council meetings to corroborate the econometric analysis and robustness checks with insights from qualitative case study evidence. Founded by the Viennese Rothschilds and shareholders of the *Crédit Foncier de France* in 1855 and 1864 respectively, the *Creditanstalt* and *Bodencreditanstalt* represented the two most prominent joint-stock banks in Vienna at the time. The *Creditanstalt* operated according to a universal banking model whereas the *Bodencreditanstalt*, at least on paper, constituted the largest private mortgage bank of the Empire. The *Creditanstalt* later gained particular fame for its spectacular crash in 1931. Located in UniCredit Bank Austria's headquarters in Vienna, the *Creditanstalt* archives are open to researchers upon appointment.[70]

1.4 Historical background

1.4.1 From *Gründerboom* to *Gründerkrach*

In 1867, the political and economic agenda of the so-called Austro-Hungarian Compromise calmed the constant interior tensions which had coined the Habsburg Empire for decades since the revolutionary turmoil of 1848/49. After the Empire's defeat against Prussia in 1866, the Compromise separated the monolithic monarchy into two sovereign political entities: Cisleithania (the Austrian crownlands) and Transleithania (the Hungarian lands of the Crown of Saint Stephen)[71]. As of 1 January 1868, Austria and Hungary received independent Parliaments and fiscal autonomy, while remaining united "in the person of the common monarch" (Eddie, 1989, p.814), the maintenance of a "common army, a common diplomacy and foreign representatives" (Flandreau, 2001, p.16). Although dualism brought long term interior political stability, the newly dualistic Empire did experience an early episode of crisis. The stock market crash of 1873, commonly known as the *Gründerkrach* in allusion to its origins in a start-up frenzy of joint-stock companies, abruptly ended the economic boom that had coined the first years of Austro-Hungarian dualism. The underlying causes of the strong, but with hindsight unsustainable financial sector expansion between 1868 and 1873 (often called *Gründerzeit*) are reminiscent of the work on drivers of speculative boom episodes in economic history[72].

The era of dualism began with a sequence of high-yielding harvests that boosted exports and railway profits, conveying an economic incentive to expand existing railway infrastructure (Gratz, 1949). The perspective of profitable railway expansion started the first of several waves of joint-stock company foundations, with the

[70] 8899/Historical Section Bank Austria - Member of UniCredit, *Creditanstalt historical archives*, Z114, Lassallestraße 1, 1020 Vienna, Austria.

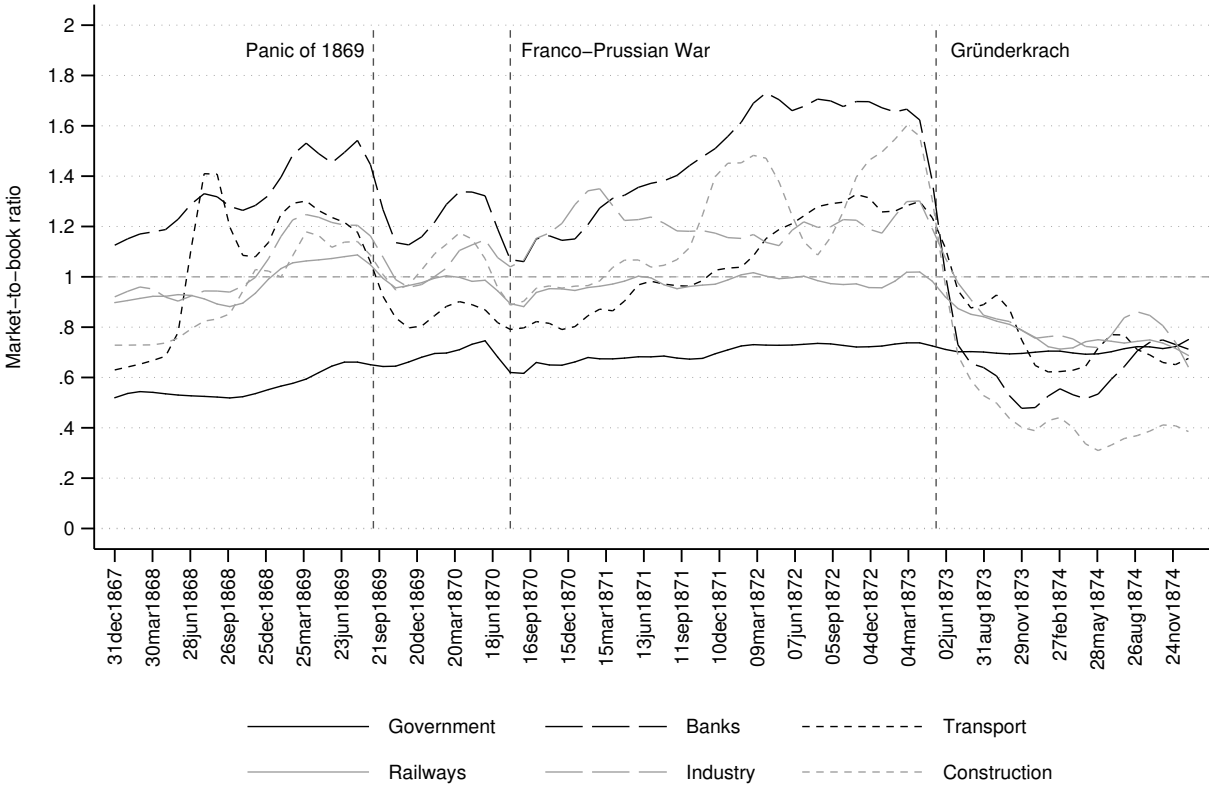
[71] This paper uses the terms Cisleithania and Austria, as well as Transleithania and Hungary interchangeably.

[72] For a general survey, c.f. Kindleberger (1978); Brunnermeier and Schnabel (2016).

following ones concentrating on industry and subsequently moving on to the construction as well as the banking sector (c.f. also Figure 1.1 below). At the same time, the first years after the Austro-Hungarian Compromise of 1867 heralded the high tide of liberal economic policy in the Habsburg Empire. During the *Gründerzeit*, every month a large number of new companies were converted into officially licensed joint-stock businesses, while almost no standardized supervisory framework was in place. Before 1867, charters for joint-stock firms were difficult and slow to obtain, ultimately depending on the consent of the Emperor (Brunnermeier and Schnabel, 2016). After the Compromise, applications for new businesses only needed to be submitted to the ministerial commission for associations (*Ministerielle Vereinscomission*) located at the Ministry of the Interior, which reviewed them. Due to the lack of any further normative legislation in this matter, the commission did apparently not follow any transparent, standardized procedure in examining these submissions. Contemporary Neuwirth (1874, p.30) described the regulation of joint-stock companies dismissively as "legislatory chaos" and the official parliamentary inquiry into the causes of the crisis cites the lack of supervision as well as the legal uncertainty surrounding the establishment of joint-stock companies as a major driver behind the unsustainable financial boom (Abgeordnetenhaus, 1874, p.45). Wirth (1876, p.38) blames the Austrian and Hungarian governments for abusing their authority by creating the false impression that businesses with an official license had been thoroughly analyzed and were safe enough to go public. According to the author, the practice of centralized licensing generally diluted market discipline and should have been abolished long before, following similar steps taken by other countries such as England, France and Belgium. The total number of joint-stock businesses from the banking, construction, industrial and transport sectors quoted in the Viennese stock exchange, the Empire's main *Bourse* where the large majority of Austrian and Hungarian companies' shares were traded, amounted to 39 in 1867; at the peak of the boom in 1873, 378 of these companies were officially listed (Leonhardt, 1876). Simultaneously, the number of membership tickets issued for traders on the Viennese stock market exploded despite ever increasing accession fees. Annual tickets increased from 867 in 1867 to 2941 in 1873, while the daily settlement of trades was maintained (Leonhardt, 1876). Unsurprisingly, overcrowding and chaos reigned on the stock exchange during the last months before the *Gründerkrach* (Baltzarek, 1973).

What enabled financial markets to soak up this steadily increasing supply of equity? Liquidity was abundant in the markets from the very beginning of dualism and even more so when the boom was already on its way. First, the Austro-Prussian War in 1866 had forced the Empire to inflict the burden of debt monetization on the central bank. The new state notes in circulation represented a permanent increase of the currency in circulation by more than 50% (Jobst and Kernbauer, 2016). The second major impulse arrived in 1871. French war reparations following the Franco-Prussian War in 1870 enabled the newly founded German Empire to redeem a large part of its sovereign debt, thus freeing German private capital in search for placement opportunities in the Habsburg lands (Wirth, 1876). Kindleberger (1978) also mentions that a considerable part of German debt had been held directly by Austrians who now reinvested their wealth in the newly stabilized and economically flourishing home country.

Figure 1.1: Mean market-to-book ratio of stocks traded in Vienna (12/1867 - 12/1874).



Source: own calculations; Compass, Coursblatt, and Wiener Zeitung

The *Gründerboom* continued until spring 1873. Stock market prices then started to decline consistently from the beginning of April 1873 onwards, when a number of recently founded joint-stock companies published their first annual financial statements showing profits far below expectations (Neuwirth, 1874). Kindleberger (1978) notes the disappointing sales on the first day of the Viennese World Exhibition on 1 May as an additional blow to investor sentiment. The Viennese Stock Exchange finally ground to complete halt on Black Friday, 9 May 1873: on this day, a famously empty list of stock price quotations heralded a protracted financial turmoil whose consequences in terms of sluggish growth would later trigger an academic debate about the existence of a "Long Depression" in the Habsburg lands (Good, 1978; Komlos, 1978). As Figure 1.1[73] shows, the *Gründerkrach* stands out as a particularly long-lived stock market meltdown, especially if contrasted to other major negative shocks during this period, such as the panic in autumn 1869 or the outbreak of the Franco-Prussian War in July 1870.

Finally, it should be noted that financial distress in 1873 was by no means limited to the Habsburg lands. The Austro-Hungarian stock market crash in early May 1873 constituted only one event in a series of panics and financial crises that struck in a wide variety of countries. Indeed, McCartney (1935, p.85) famously described the global financial turmoil of 1873 as the "first significant international crisis" – an acknowledgment of the strong

[73]Figure 1.1 shows end-of month quotes; par values are adjusted to account for not paid up capital and fluctuations in silver prices where necessary. The market-to-book ratio compares a security's current trading price to the nominal stock amount. Therefore, values above 1 mean that the stock is trading above par.

ties between financial centers at the time, which was later popularized in Kindleberger (1978) and Kindleberger (1990b). Yet, already contemporary observers expressed their fascination with the international dimension characterizing the crisis of 1873. For example, Wirth (1874a) discusses the causes and consequences of the crises of 1873 in Austria-Hungary, Germany, the United States, Italy, Russia, Sweden, the Netherlands, Egypt and South America (in this order).

Most authors agree that the initial impulse for the financial boom in Europe had its roots in Germany. The combination of the above mentioned French reparation payments, a relaxation of German banking laws and the unification of the German Reich provided the backdrop for the foundation of myriad new companies and bullish stock market developments (Burhop, 2004). Financial innovation, in particular the birth of so-called *crédit mobilier* banking houses with investment banking business models and risky short-term lending practices (c.f. Section 1.5 below), soon spread from Berlin to Vienna. While central and southern European markets responded strongly to the initial impulse, the late 1860s and early 1870s did not herald an equally strong financial boom phase in France or Britain. The French economy remained subdued mainly because part of the reparation payments were financed by tax increases (Baltzer, 2006), whereas British investors were still highly skeptical of too risky enterprises on the stock exchange following the boom and bust cycle in 1847 and the major financial panic caused by the demise of Overend, Gurney & Co in 1866 (Kindleberger, 1990a).

In the United States, economic and financial developments reflected a longer term trend of railway expansion, which had gone hand in hand with increasing settlement towards the West and emigration from Europe, but which intensified remarkably following the end of the Civil War in 1865 (Wirth, 1874a). Total railroad mileage more than doubled between 1865 and 1873 and a considerable fraction of this boom was financed by the influx of foreign, in particular European, capital (Wilkins, 1989): American agents sold railway bonds and priority obligations on British, German and Swiss stock exchanges to raise the funds for increasingly risky expansion and construction projects (Wirth, 1874a). Initially intrigued by the apparent success and pace of pioneering projects such as the first Pacifique line, investors began to demand higher returns as competition for funds and freights became fiercer over time (Mixon, 2008).

The chronology of crisis events in 1873 is well-established in the historiography. From a timing perspective, it is crucial to note that the Viennese crash in May represented the first crisis event in 1873. In fact, its role as the first financial turmoil of 1873 may provide another motivation to study the Austro-Hungarian *Gründerkrach*: a detailed understanding of the causes of financial distress in Austro-Hungarian markets might allow us to better grasp the exact nature of the links between the different panics of 1873 in a variety of countries. This question of contagion effects and networks in 1873 still remains very much under-researched today, relying mostly on anecdotal evidence from contemporary sources. Citing Bologna, Florence, Genoa and Torino as the cities most adversely affected, Wirth (1874a, p.682) suggests that northern Italy was among the first regions to see surges in the number of liquidations and bankruptcies in July 1873, following the Viennese stock market crash in May. German stock market indices show a declining trend starting in early 1873 (Baltzer, 2006), but bank failures and

generalized systemic distress did not occur before September of that year (Burhop, 2004). Close ties to a slowing German economy might explain why commerce in Nizhny Novgorod, Odessa and Moscow experienced severe difficulties during the summer months, while deteriorating profit margins and fundamentals for the riskiest U.S. railroads set the stage for the American panic in 1873 as informational asymmetries increased (Mixon, 2008). Kindleberger (1978, p.19; p.51) connects the gradual turn of American investor sentiment to developments in the German Reich and Austria-Hungary: he argues that foreign lending to the U.S. increasingly dried up, both because of domestic financial booms in central Europe and the subsequent stock market crash in Vienna, which contributed to the financial difficulties of highly leveraged U.S. banking houses active in the railway business. The actual financial panic in the United States was concentrated in New York. The start of the panic in New York is conventionally dated 20 September 1873, when the banking house Jay Cooke & Co suspended payments. Following heavy losses deriving from its involvement in the construction syndicate for the Northern Pacific railway line, depositors targeted Jay Cooke & Co in Philadelphia and New York. Given the house's splendid reputation as the government's banker, the runs on Jay Cooke & Co also triggered a more generalized panic. Finally, while French markets remained relatively calm throughout 1873, Wirth (1874a, p.666) also mentions a brief panic in London around 9 November 1873. In 1873, the Bank of England had subjected the British financial system to a record twenty-four changes in its main discount rate to counteract gold flows. Ultimately, the Bank hiked the rate to nine percent in November – a level previously only seen during severe panics–, not least to prevent Germans from drawing out the remaining sterling balances of the Franco-Prussian indemnity Kindleberger (1978, p.76).

1.4.2 Austro-Hungarian banking during the *Gründerkrach*

Although the general narrative on the Austro-Hungarian *Gründerkrach* is well documented, the fully-fledged banking crisis which ravaged the Empire from May 1873 onwards has not yet received much detailed, let alone separate attention by modern economic historians. This gap is surprising given that the Empire's joint-stock banking sector contracted severely in response to the *Gründerkrach*.[74]

In order to convey a brief summary view of the Austro-Hungarian banking system on the eve of the *Gründerkrach*, some general remarks and figures are warranted. The major legal foundations for the monarchy's financial system had been created long before the Compromise. Although the Compromise anchored the power of licensing and regulating credit institutions for the first time entirely at the national, that is, Austrian and Hungarian, level[75], the period after 1867 is best characterized as an expansion of already established forms of banking rather than the emergence of new legal types of financial intermediaries (Kövér, 1992). Banking inter-

[74]This chapter deals exclusively with the joint-stock banking sector. Savings banks and credit cooperatives are excluded because they were not affected by the crisis due to fundamentally different business models and regulation, both in comparison with joint-stock banks and across parts of the monarchy. Chapter III of this dissertation also uses data on cooperatives and savings banks, and explains the business models of these two sectors in detail. For private bankers, there is no systematic data record.

[75]Reichs-Gesetz-Blatt für das Kaiserthum Österreich, '4.Gesetz vom 24.Dezember 1867', *2.Stück, 4.Gesetz* (Gesetz wodurch das Ministerium der im Reichsrathe vertretenen Königreiche und Länder zur Vereinbarung eines Zoll- und Handelsbündnisses mit dem Ministerium der Länder der ungarischen Krone ermächtigt wird; Vienna, 1868).

mediaries in Austria-Hungary can be classified into four main categories according to their legal structures.[76] The broad category of joint-stock companies covers joint-stock banks in the narrow sense (*Aktienbanken*), pawn banks (*Pfandleihanstalten*) and all privately run as well as state-operated mortgage banks (*Bodenkreditanstalten* and *Landeshypothekenbanken*) which emitted equity or covered bonds for public subscription. Credit cooperatives (*Kreditgenossenschaften*) and savings banks (*Sparkassen*) constitute two further categories deriving from type-specific legislation. The fourth category, private banking houses, cannot be classified according to any particular modern form of incorporation. According to both the Cisleithanian Code of Commercial Law of 1862[77] and the Hungarian Law XVII of 1840[78], private banks corresponded to an open commercial partnership with full liability of all participating parties. To anticipate, private banquiers are not discussed in any more detail by the present chapter for two reasons. First, except for a small number of famous houses, the Rothschild family included, which pursued only a specialized and limited scope of business as main underwriters for government debt, the role and influence of Austro-Hungarian private banking houses in credit intermediation waned considerably in the second half of the 19$^{\text{th}}$ century. Kövér (1992, p.322) suggests that private bankers either vanished or incorporated larger joint-stock banks after the crisis of 1857, and even more so following the *Gründerkrach*. Second, so far no systematic financial records on their business activities have been uncovered. This lack of systematic evidence makes private banking houses a potentially interesting avenue for future research.

Joint-stock banks constituted the central pillar of the Austro-Hungarian banking system. The traditional view in the literature emphasizes that joint-stock banks followed a relatively cautious universal banking model (März, 1968).[79] The banks accompanied and organized the structural transformation of major parts of Austrian industry from smaller private enterprises to large listed companies, rarely also founding new industrial firms themselves (Good, 1984). Relationships with industries remained close even after firms had gone public, as the banks provided trade credits and helped the creation of cartels among their affiliated companies. Thus, until 1900, joint-stock banks catered almost exclusively to firms and rich individuals, financing themselves mainly via current account deposits and covered bonds. After 1900, the joint-stock banks started to vie more intensively for savings deposits, previously the domain of savings banks. This move was helped by the significant extension of the banks' branch networks (März, 1984). While Viennese banks dominated in the second half of the 19$^{\text{th}}$ century, institutions domiciled in Budapest and Prague expanded rapidly after 1900 (Michel, 1976). Although this traditional description is appropriate for most of the 19$^{\text{th}}$ century, I will substantially qualify this "benign account" of banks' business models for the period of the *Gründerzeit* below.

The second pillar of the Austrian banking system were savings banks. Initially designed to offer the poorer populace a safe way to deposit their savings and encourage industriousness and thrift, most deposits soon came from a reasonably well-off middle class. Unlike joint-stock banks, the savings banks had no share capital and were backed by dedicated associations (*Vereinssparkassen*), municipalities (*Gemeindesparkassen*) or counties

[76] The expansion of the postal saving system only followed in the 1880s, c.f. Good (1972, p.200).
[77] c.f. §85-§149 in Ministerium für Justiz und Handel (1894).
[78] c.f. XVIII. Gesetzesartikel §1-§53 in Orosz (1840).
[79] After the *Gründerkrach* of 1873, joint-stock had significantly scaled down their exposure to industry. The years after 1900, however, saw a strong return of the joint-stock banks to industrial financing, c.f. Rudolph (1976).

(*Bezirkssparkassen*). Cis- and Transleithania differed considerably in their regulation of savings banks. In Cisleithania, savings banks always had a clearly defined social and philanthropic scope.[80] Their "raison d'être" was to provide poorer classes of the population with the possibility of safe-keeping of their funds.[81] Founded either by municipalities or charity associations which provided the initial equity (no share capital, but reserve funds), savings banks were supposed to enable the lower strata of the society to capitalize on their savings, even on the basis of initially very small funds. The Cisleithanian legal provisions with regard to savings banks reflected these goals, suggesting a maximum ceiling for savings accounts per individual depositor as well as regressive interest rates (decreasing in the size of the deposits).[82] In order to protect depositors, the Austrian Regulation of 26 September 1844, which remained the basis for the foundation and regulation of savings banks throughout the entire period until 1918[83], also strictly defined the types of assets savings banks could hold, gearing the focus of their activities towards government bonds and well-known small local business enterprises. Any profits obtained by savings banks were earmarked for their reserve funds to strengthen the institutions' capital position.[84] Hence, in the Cisleithanian part of the Empire, a clear-cut division between profit-oriented joint-stock institutions and philanthropic savings banks is possible.

In Transleithania, a strict legal distinction between joint-stock companies and savings banks was absent. Hungary's savings banks operated as joint-stock, de facto profit-seeking companies since their very beginning in the 1840.[85] Thus, financial intermediaries bearing the label of "savings bank" in their name were not tied to special social responsibilities, nor were their business activities constrained by rules similar to those in vigor in Cisleithania. Although the neo-absolutist era following the revolutions of 1848/49 saw repeated attempts by the imperial government to impose an equivalent of the Austrian Regulation of 1844 on the Hungarian part of the Empire, the required changes to the statutes were mostly implemented on paper only (Gunszt, 1908). Nevertheless, between 1850 and 1867 the number of savings banks in Hungary stagnated because, following the Austrian legal provisions, new foundations were reserved to municipalities or charity associations and subject to the ultimate approval by the Emperor (Gunszt, 1908, p.18). After the Compromise, however, savings banks and joint-stock banks in Transleithania operated according to the same legal principles, officially published in the new Hungarian Code of Commercial Law of 1875. Hence, in contrast to their Cisleithanian counterparts, from 1868 until World War I Hungarian savings banks and joint-stock banks did not rely on fundamentally different forms of incorporation.

To be sure, the primary source of this study, the *Compass*, still categorized Hungarian financial intermediaries into "banks" and "savings banks". The *Compass* separated between the two groups on the basis of their size, location and business model. Savings banks acted in the provinces, soaking up and lending out funds to farmers

[80]Some authors argue that the non-profit, social character savings banks was increasingly lost in Austria towards the later part of the 19th century, c.f. Conrad et al. (1893, p.653).

[81]c.f. Conrad et al. (1893, p.786).

[82]c.f. Mischler and Ulbrich (1895, p.288).

[83]The Regulation was amended and complemented several times during this period (in 1853, 1855, 1872 and 1892) but it never lost its essential traits. For more details, c.f. Mischler and Ulbrich (1895, p.286-87).

[84]Reichs-Gesetz-Blatt für das Kaiserthum Österreich, 'Regulativ für die Bildung, Einrichtung und Ueberwachnung der Sparcassen', *72.Band, 123.Gesetz* (Vienna: K.u.k. Hof- und Staats-Aerarial-Druckerei, 1844).

[85]This point is emphasized by several authors, e.g. Gunszt (1908, p.12-13), Wirth (1896, p.142) and Kövér (2000, p.58).

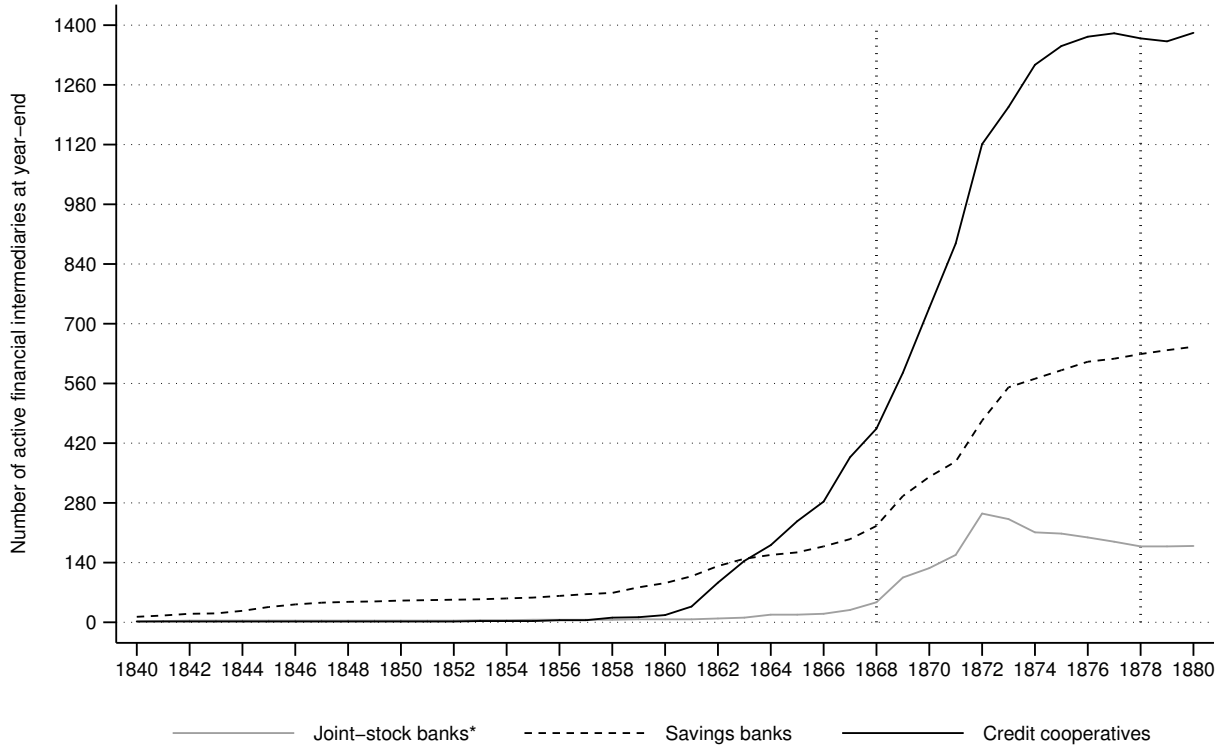
as well as small local enterprises, whereas joint-stock banks in the narrow sense remained concentrated around larger cities.[86] The *Compass* thus distinguished between small provincial banks, which *de facto* operated like Austrian savings banks in terms of the clientele they serviced and which even bore the name *Sparkasse* (or in Hungarian, *takarékpénztár*) on the one hand, and large joint-stock banks with big business customers from industry and manufacturing on the other hand. Hence, following this contemporary interpretation on the comparable categories of financial intermediaries in the Habsburg Empire, Hungarian savings banks, just like their Austrian homologues, do not enter this paper's econometric analysis, whereas Transleithanian joint-stock banks in the narrow sense are included in the data set.

The third pillar of the banking system consisted of credit cooperatives. Cooperatives were structured following the German example, frequently operated with a strictly limited geographical scope and specialized either in loans to farmers (*Raiffeisen* system) or small businesses (*Schulze-Delitzsch* system). The first cooperatives were formed in the 1850s but their number expanded massively in the years after 1900, reaching more than 8400 for the rural and 3800 for the urban cooperatives in 1913. While in theory credit cooperatives aimed at providing relatively cheap access to loans for their members, in several cases the concept was perverted and used by small numbers of persons, often related, to provide loans to non-members at usurious rates (Neurath, 1998). Due to the high number of cooperatives and often limited resources available to smaller cooperatives, no regular standardized statistics were collected as in the case of joint-stock banks and savings banks.

Figure 1.2 displays the long term evolution of the three well documented categories of the Austro-Hungarian banking sector between 1840 and 1880. It shows credit cooperatives mushrooming ever since the 1860s, when the number of savings banks also started to multiply on either side of the Leitha. In contrast, the joint-stock banking sectors of Hungary and Austria, which had remained almost inexistent until the Compromise of 1867, only started expanding very strongly in relative terms between 1868 and 1873. Whereas the Austro-Hungarian joint-stock banking sector contracted again in the immediate aftermath of the *Gründerkrach*, the other categories of credit institutions either merely stagnated or even increased in numbers. The number of institutions active in each category, however, masks the real balance of power which reigned among financial intermediaries in Austria-Hungary. During the *Gründerzeit*, the equity capital, defined as stock capital plus hedging reserves, of the Austrian joint-stock banking sector not only outgrew its Transleithanian homologue by many millions of Gulden, but also dwarfed the total own funds of all other types of financial intermediaries. Figure 1.3 shows that, as far as the expansion of the Austro-Hungarian banking sector is concerned, the period between 1868 and 1878 was largely driven by a boom and bust cycle in the (Austrian) joint-stock banking sector. Therefore, the remainder of this study focuses on explaining this rapid expansion and the subsequent wave of bank failures in the joint-stock banking sector.

[86] Towards the end of the dualistic period, Hungarian joint-stock banks also operated large branch networks penetrating the hinterland more and more, c.f. Jelić (2008, p.341).

Figure 1.2: Long-run evolution of the Austro-Hungarian banking sector (1840-1880)



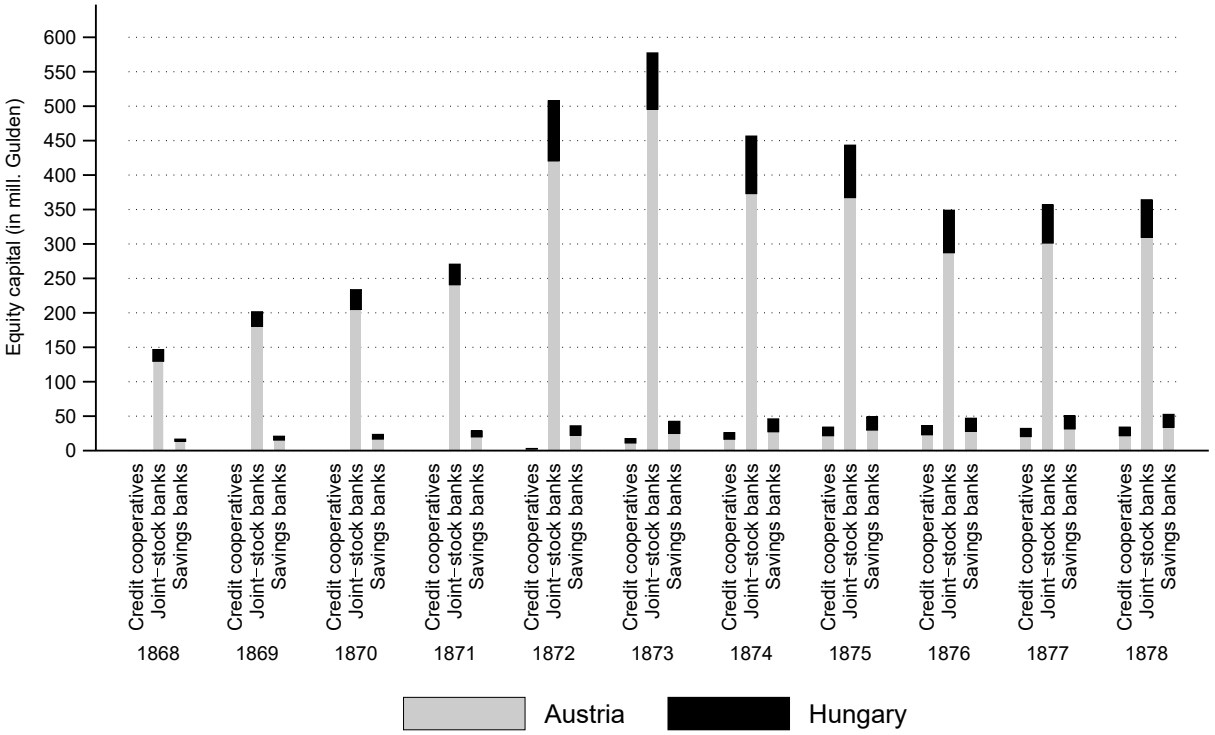
Source: Brazda (2001), Compass, Gyula (1885) and Oesterreichische Statistik

* Joint−stock banks: pawn, mortgage and joint−stock banks stricto sensu.

Figure 1.4 provides an overview of the distribution of terminal joint-stock bank closures across the three possible types of failures for the period from 1868 until 1878.[87] The relevant laws explicitly regulated the differences in the application of liquidations (*Liquidation*) and bankruptcies (*Concurs*), while treating mergers (*Fusion*) as a special case of bank liquidation (Ministerium für Justiz und Handel, 1894, p.90). In order for a liquidation to take place, the shareholders of a given credit institution first had to agree to hold an extraordinary general assembly (*außerordentliche Generalversammlung*), unless the liquidation was decided on the occasion of the main annual shareholder meeting. The proposal to convene the extraordinary assembly could be put forward by the supervisory board (*Aufsichtsrat*), the bank management (*Vorstand*) and any shareholder or group of shareholders who represented at least ten percent of total nominal capital. No matter who convened the assembly, the intended purpose of convocation always needed to be communicated to all participants prior to the meeting. During the extraordinary general assembly, the proposal to liquidate the bank was subsequently put to the vote, following an explanation of the proposing party why shareholders should proceed to liquidation. Liquidation had to receive a qualified majority of votes under the presence of a quorum, the exact details of which were specified in each bank's statutes. Once decided upon by the shareholders, the liquidation still needed to be approved by the regional representation of the Ministry of the Interior (the *politische Landesbehörden* mentioned before). For this purpose, the regional representation received a communiqué from the management board, stating the reasons for the intended dissolution of the firm. Upon ministerial approval, the bank's assets

[87] Since no bank failures were recorded in 1868 and 1869, these two years are not included in Figure 1.4.

Figure 1.3: Decomposition of banking sector equity* ** (1868-1878)



Source: Compass, Statistisches Jahrbuch and Österreichische Statistik

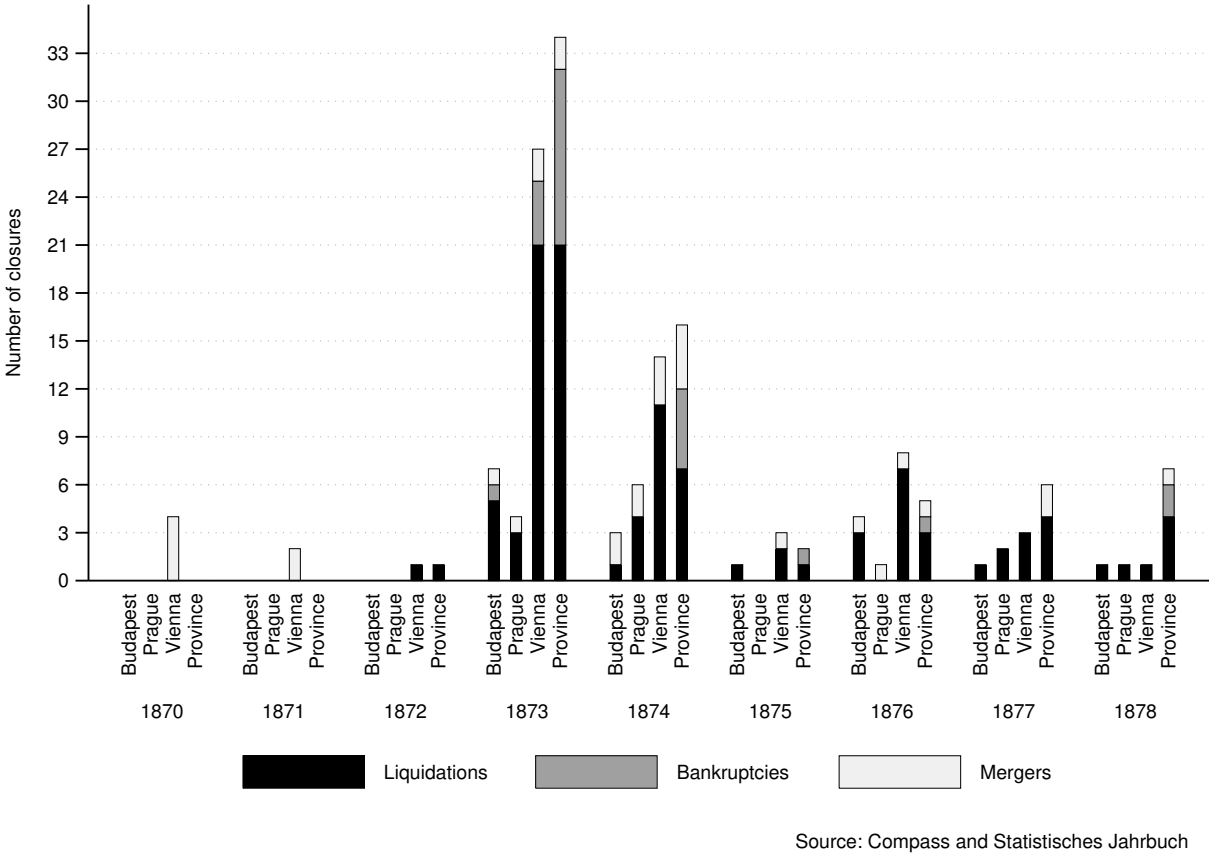
*Austrian savings banks did not emit share capital; thus, their own funds are fully represented by their reserve funds.
**Equity includes covered bonds of mortgage banks set up without share capital.

were liquidated, creditors repaid and shareholders received a payback of their initial contribution, the amount of which depended on how much equity had been lost (if any). The committee of people executing the liquidation of assets and the repayment of creditors was appointed by the shareholders on the basis of a proposal by the executive board. Thus, the liquidation of a joint-stock bank represented a more or less orderly, extra-judicial bank resolution controlled by the credit institution itself.

The only exception to this ordinary way of proceeding towards liquidation consisted of the case in which the management board of a given bank became aware that more than 50% of paid up capital had been lost during the current business year. For these particular circumstances, the Code of Commercial Law stipulated that the bank's management board would have the obligation to convene an "extraordinary assembly" on its own initiative, while also having to inform the *politische Landesbehörde* about the credit institution's financial situation. Moreover, in this special case, the Code of Commercial Law endowed the *politische Landesbehörde* with considerable discretionary authority, as the latter was given the right to force and implement the liquidation of the bank in question, even without the agreement of its shareholders.

Mergers of joint-stock banks represented *de jure* liquidation procedures during which shareholders of the target bank agreed to accept shares of an acquiring institution in return for their own holdings in a predetermined ratio. For a merger to take place, the *politische Landesbehörde* had to be notified and agree to the intended

Figure 1.4: Terminal bank closures in Budapest, Prague, Vienna and the Provinces (1870-1878)

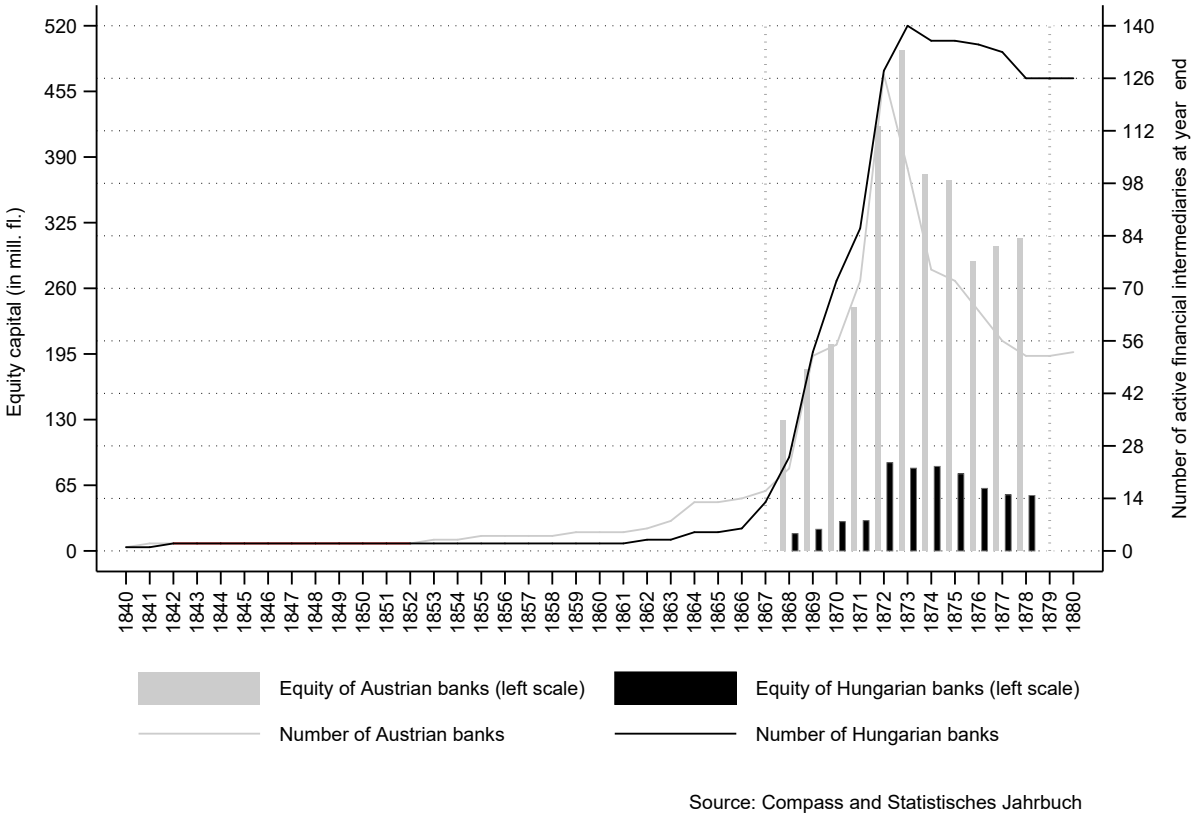


acquisition. After the exchange of shares, the acquired institution was deleted from the commercial register and the acquiring bank took over all assets and liabilities of its target. If two firms merged with the intention of creating an entirely new bank, the two founding institutions both formally liquidated, pooling assets and liabilities once the two types of old shares were replaced by one new set of stocks.

Finally, outright bankruptcy applied when a bank's total liabilities exceeded its total assets (Ministerium für Justiz und Handel, 1894; Orosz, 1840, p.189). By its very definition, bankruptcy signaled a state of affairs in which losses had outgrown the total amount of a given bank's equity. Whenever total liabilities exceeded total assets, the managing board was under the obligation to notify the local commercial court to open a bankruptcy procedure. Alternatively, creditors could report a bank's *de facto* suspension of payments to the local commercial court and demand the imposition of bankruptcy procedures upon verification of the financial situation of the denounced institution. The court then set a date for the convocation of the bank's creditors to decide upon the most effective way to liquidate the remaining assets. In most of the cases, bankruptcy thus followed a complete wipe-out of equity, meaning that shareholders had no residual claim on the remaining assets.

Starting in 1873, the impact of the *Gründerkrach* on the banking sector is clearly visible in Figure 1.4. Bank closures were clustered strongly in the Empire's major cities and the overwhelming majority of bank

Figure 1.5: Long-run evolution of the Austro-Hungarian joint-stock banking sector (1840-1880)



closures took the form of liquidations. As shown in Figure 1.5[88], by 1878 50% of all Austro-Hungarian credit institutions in operation at the end of 1872 had terminally suspended their activities (139 out of 270; 100 failures were registered in 1873 and 1874 alone) and more than 40% of the banking sector's total equity[89] had evaporated.

An interesting observation that can be made on the basis of the data depicted in Figure 1.5 is that the Austrian (Cisleithanian) banking sector contracted much more heavily during the crisis of 1873 than its Hungarian counterpart, whereas the expansion phase of the banking sector before 1873 looks relatively similar in the two parts of the Empire. One way to understand this different development is to take a broader perspective on the joint-stock business sector, including not only banks but also all other types of firms. Comparing end-of-year data in 1867 and 1872, Cisleithania's joint-stock business sector quadrupled in terms of numbers (from 149 to 703) and grew by 150% in terms of nominal paid-up capital (from 721 million to 1.798 billion *Florins*) (Leonhardt, 1879, p.902-905). In principle, this trend was no different in Transleithania, where the relative increase in joint-stock companies was even more pronounced than in Austria (Wirth, 1874b, p.23-24). Starting out with only 31 joint-stock businesses in 1867, Hungary was home to 149 joint-stock companies by the end of 1872, while the total paid-up capital of the Transleithanian joint-stock sector increased by more than 250% over this

[88]Figure 1.5 does not contain information on equity capital prior to 1868 because my panel data collection started in 1868. Aggregate numbers, however, are easy to reconstruct using the information in the *Compass*.

[89]I define equity as the sum of paid up capital and reserve funds. In the case of mortgage banks which did not issue stocks, I include covered bonds instead.

period (from 19.2 million to 68.1 million *Florins*).[90] However, Transleithania experienced most of this growth before 1870 (the number of joint-stock companies jumped from 31 in 1867 to 66 in 1868, to 118 in 1869 and stagnated at around 140 from 1870 onwards) while Cisleithania's joint stock businesses grew constantly at rates between 19% and 61% per annum until the crash in 1873 (the numbers of businesses are 149, 177, 285, 359, 475 and 703 for the period from 1867 to 1872). In other words, the founders' boom was less pronounced in Hungary after 1869 than it was in Austria, leading to fundamentally different joint-stock business sectors: whereas the entire joint-stock business sector in Hungary was basically identical to the joint-stock banking sector, in Austria the founders' boom entailed the creation of many new, non-bank joint-stock companies. Moreover, it should be noted that the expansion of the Hungarian joint-stock banking sector was mainly driven by Austrian banks which often joined forced in syndicates to open new banks in Hungary.[91] Kövér (2014) attributes these different trajectories in the expansion of the joint-stock business sector to the severity of the "small crash" of 1869 which had a stronger effect on the Hungarian real economy (measured in terms of the relative number of bankruptcies) than in Cisleithania and thus generated a growth drag for the ongoing boom between 1870 and 1872. Hence, one possible explanation for the different reaction of the Empire's banking sectors to the crisis of 1873 could be rooted in the business model of Austrian joint-stock banks. If Cisleithanian banks' fate was more tightly connected to the overall boom and bust cycle of the whole joint-stock sector in Cisleithania (which can be observed in Figure 1.1) because their business model translated into a stronger exposure to the evolution of shares traded on the stock exchange than the business model of their newly founded Hungarian homologues, then this exposure could perhaps explain the difference in survival performance observed in Figure 1.5. To be sure, for this chapter I mostly draw on the Hungarian banking sector to increase the sample of my control cases. However, a more detailed investigation into why the banking sector response to the *Gründerkrach* was so different in Austria and Hungary would certainly be an interesting question for future research.

What explains the wave of (Cisleithanian) bank failures during the *Gründerkrach*? Early studies by Steiner (1913) and Scheffer (1924) provide some of the most insightful contributions built on case studies of individual banks and their fate during the *Gründerkrach*. They highlight risky investment banking business, bad loans granted to stock market agents, fraud and large write-offs on securities portfolios as immediate causes of bank failures. März (1968, p.181) argues that losses on securities holdings, investments difficult to liquefy and dubious loans pushed banks to the brink of default. Matis (1971) generally rejects the explanatory power of economic theory and holds that banks failed following irrational speculative activities. Rohrer (1971, p.43–49) also emphasizes that banks engaged in the creation of companies without fundamental value and invested in securities which absorbed most of their capital, while neglecting traditional credit business. Kindleberger (1978,

[90] These numbers exclude Hungarian savings banks which were de facto set-up as joint-stock banks, in contrast to their Austrian homologues. Transleithanian savings banks were not treated as joint-stock companies by contemporary statistical publications, c.f. the discussion above. The number of Hungarian savings banks increased enormously from 54 in 1867 to 229 by the end of 1872, c.f. (Leonhardt, 1879, p.902-905).

[91] This tendency of Austrian banks to found Hungarian banks can be directly observed from the different issues of the *Compass* which often report the names of the founders/founding companies of a new bank alongside the publication of the first balance sheet. The fact that banks founded other banks, instead of creating branches, seems puzzling because financial institutions thereby effectively increased their own competition. However, as will be discussed below, the business model of joint-stock banks was very much focused on IPOs and riding the boom on the Viennese stock exchange, rather than engaging in traditional banking activities.

p.53) mentions that banks over-leveraged, "stretching credit to the limit" by using accommodation bills. Kövér (2000) backs the conjectures in März (1968) by looking at disaggregated financial data for several individual Hungarian joint-stock banks. More recently, the apparent correlation between the fate of real estate development and banking (c.f. Figure 1.1) has invited some to liken the *Gründerkrach* to a bursting real estate bubble which subsequently compromised the financial health of banks (Brunnermeier and Schnabel, 2016).

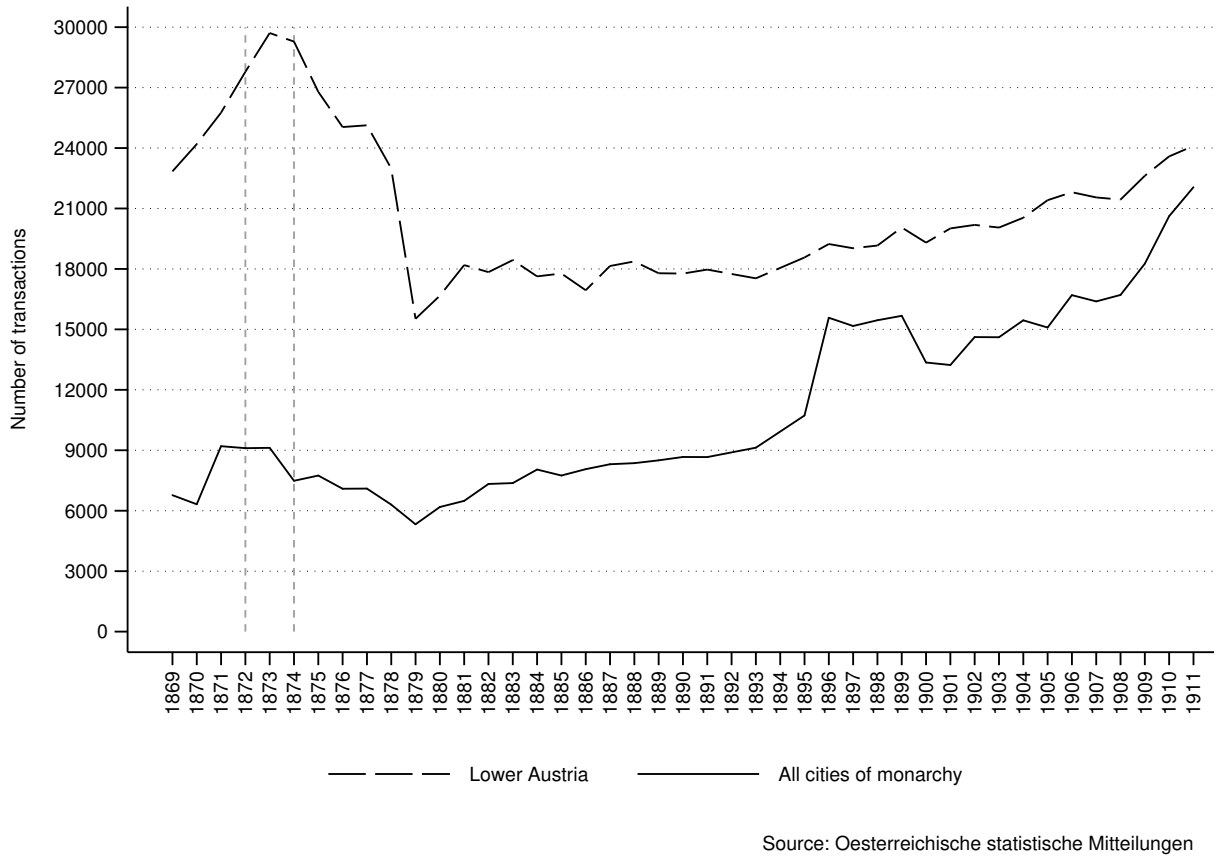
The real estate hypothesis is not without context: the construction of many representative buildings on the *Ringstrasse*, Vienna's famous boulevard encircling today's first district, loosely falls into this period; and so does of course the World Exposition of 1873 which triggered huge building projects in the *Prater*, the large leisure park in Vienna's second district. Although we lack detailed, disaggregated data on transactions and prices, the Imperial statistical commission published a summary overview of the changes in real estate ownership on an annual basis, both for Lower Austria (the Austrian crownland containing Vienna) and for all the cities in the Empire. These data can be plotted as a time series of transactions between 1869 and 1911 and they may be drawn upon to compute the mean real transaction prices for each of these years.[92] Figures 1.6 and 1.7 below plot these two series respectively. Total transactions (Figure 1.6) show an upward trend until 1873 and a clear collapse following the crisis year, reaching a trough in 1879. The absolute numbers may be deceiving: in relative terms, the absolute increase in transactions is higher in the aggregate numbers for cities than it is for Lower Austria. Figure 1.7 depicts the evolution of real average transaction prices. Real prices are computed using the consumer price index compiled by Mühlpeck et al. (1979). For both series available, the average real transaction prices suggest a stunning price boom during the years leading up to the *Gründerkrach*. On average, transaction prices tripled between 1871 and 1873, before collapsing back to 1871 levels in the aftermath of the crisis.[93]

Contemporaries Neuwirth (1874) and Wirth (1874b) both emphasize that the initial increase in construction activity after the Compromise responded to a lack of available housing in Vienna, where most of the new projects were concentrated (Matis, 1971). The housing scarcity of the late 1860s in turn was a product of vigorous migration to Vienna following the incipient economic boom and the job opportunities created by the preparation for the World Exhibition in 1873, the start of the Danube's stream regulation project and the construction of urban water conduits. While the initial increase in construction activity seemed justified by the lack of housing, contemporaries note that speculative behavior soon started to prevail. Neuwirth (1874) stresses that very little actual housing projects were started, let alone completed. Instead, firms involved in the real estate business purchased and and resold real estate taking advantages of rapidly increasing prices. Reflecting the general trend towards limited liability incorporation, construction companies founded on a joint-stock basis were perhaps the most prominent agents "riding the price bubble" in this context. In Vienna, the first joint-

[92] Although we can compute the mean average transaction price for 1868, the number of total transactions in 1868 contains executions and changes in ownership due to death. Therefore, absolute numbers in 1868 cannot be directly compared to the aggregate number of transactions in later years and are omitted from Figure 1.6.

[93] The average transaction price used in this chapter is only a crude measure of price developments around the Austro-Hungarian crisis of 1873. Ideally, one would like to compile a properly weighted, hedonic real estate price index to depict trends. However, unfortunately no real estate price index for Austria-Hungary, Austria or even Vienna is available for the time before 1970. Building on the original transaction certificates which have survived in Austrian court archives, the sampling and construction of a longer term real estate price index is in fact possible: in a post-doctoral project with Markus Lampe (WU Vienna), Clemens Jobst and Karin Wagner (both OeNB), I am currently working towards the construction of such an index for Vienna between 1870 and 1970.

Figure 1.6: Changes in real estate ownership: number of transactions (1869-1911)



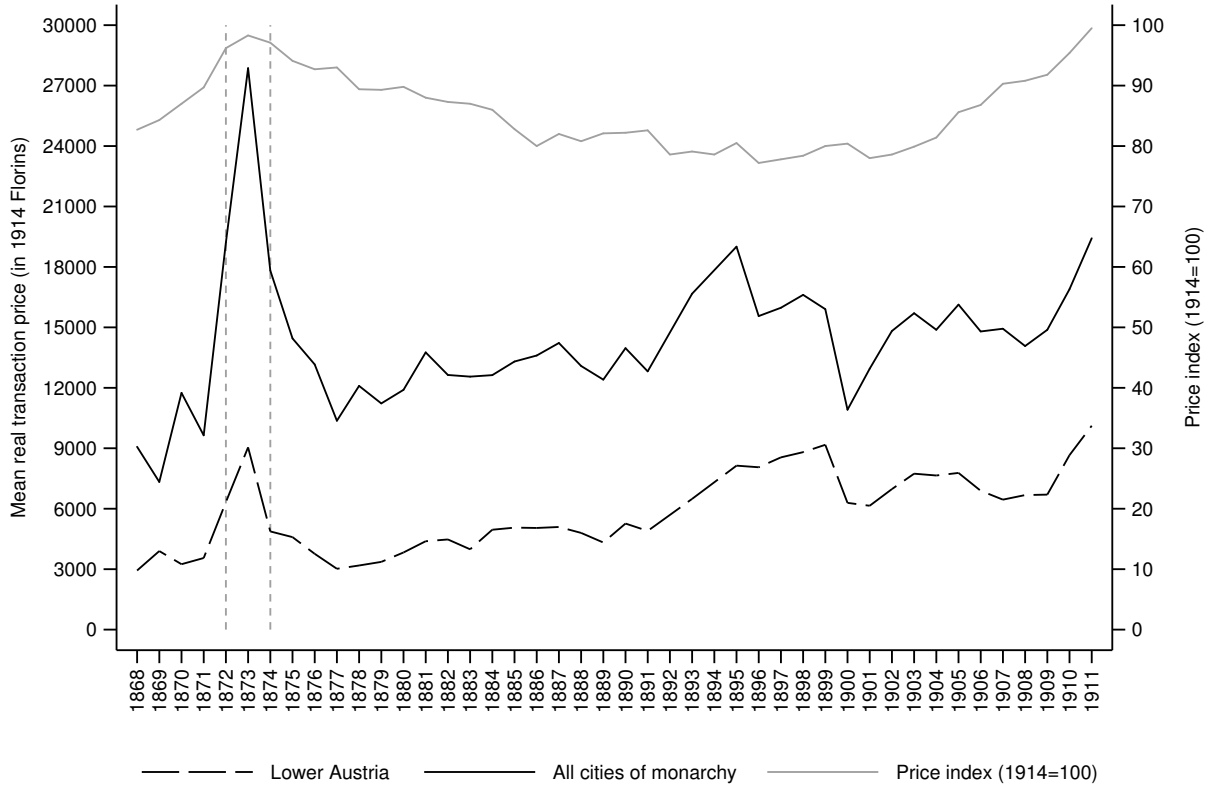
Source: Oesterreichische statistische Mitteilungen

stock construction company started business in 1869. By May 1873, 34 of these companies operated in Vienna alone and 66 charters for further construction firms had been approved by the Ministry. The dimension of planned construction activities was reflected in the number and extent of building permits granted to these companies: it covered roughly 100 square kilometers, or a quarter of the city's current territory.[94] Neuwirth (1874, p.29) suggests that, given the contemporary speed of construction, effectively building all the projects which had been officially licensed would have taken Viennese firms between 300 and 400 years. According to Wirth (1874b, p.98), the real estate development envisaged by the Viennese construction firms would have accommodated three times more inhabitants than Vienna did at the time.

Contemporary narratives suggest several connections between the real estate boom-and-bust cycle and bank distress during the Austro-Hungarian *Gründerkrach*. Neuwirth (1874, p.28) mentions that the firms funded their real estate purchases via their own equity capital (approximately 250 million fl. in nominal terms) plus an almost equal amount of debts collateralized by the plot of land in question. Wirth (1874b, p.99) confirms that real estate speculation consumed additional resources, beyond the companies' equity capital: real estate purchases were partly financed by loans payable in monthly installments. Construction firms hoped for ever rising prices that would allow for both the repayment of loans and a subsequent sale of the lots with considerable profit. Anecdotal evidence suggests that falling prices in 1873 led to loan defaults (Wirth, 1874b, p.101). Although

[94] In 1872, Vienna consisted of 11,400 houses and an annual average of 180 houses had been constructed over the preceding decade, c.f. Neuwirth (1874, p.29).

Figure 1.7: Changes in real estate ownership: real mean transaction prices (1868-1911)



Source: Oesterreichische statistische Mitteilungen, Muelpeck et al. (1979)

none of the contemporary sources explicitly comments on the identity of the lending side involved in this carry trade, more recent contributions have linked the bursting real estate boom to the banking sector's mortgage loan portfolios (Brunnermeier and Schnabel, 2016). Moreover, Wirth (1874b, p.99) states that some of the construction companies struggled to obtain full subscription and release the shares to the market: the stocks thus remained on the balance sheet of the investment banks organizing the IPOs, either in the form of collateral against short-term loans (c.f. Section 1.5 below) or as part of the banks' securities portfolio. Hence, this balance sheet exposure could have proven problematic for banks during the crisis of 1873: in the wake of the stock exchange crash, approximately half of the Viennese construction companies terminally closed and by October 1873 the firms listed on the Viennese stock exchange had lost almost 80% of their pre-crisis market value as measured in February 1873 (Schäffle, 1874, p.15).

Although there is considerable overlap in these earlier studies, there are several reasons why prior accounts prove unsatisfactory. First, these accounts lack an empirical analysis on the basis of bank-level data. Detailed insights on individual banks' business operations are essential for understanding the mechanisms leading to the failure of credit institutions, but the risk of selection bias looms large in these cases. In order to assess the causes of bank distress more systematically and shed light on the relative power of explanatory variables, it would be important to conduct *ceteris paribus* tests. Second, the secondary literature does not elaborate on the exact channels triggering bank distress. Considering the evidence in Figure 1.1, there is little doubt that the

substantial asset price declines could have had an impact on banks' securities portfolio. Yet, this observation only begs a set of further questions. In view of their rather traditional business models, why did banks hold risky securities in the first place? Given that asset price declines might be only temporary, why did banks close permanently? Furthermore – since the explanations above focused on asset-side difficulties –, how did banks' creditors react during the *Gründerkrach*? These are some of the most crucial open questions in the historiography which I tackle in this chapter.

Third, more specifically, quantitative and qualitative evidence indicate that the interplay between real estate development and banking distress through the mortgage loan channel was limited at best. Real estate lending boomed during the crisis rather than before. In the decade from 1868 to 1878, mortgage loans on Austro-Hungarian bank balance sheets continuously grew from 166 to 427 million *Florin*. The most pronounced year-on-year increase in aggregate mortgage loans took place between December 1872 and December 1873.[95] In addition, banks' board meeting minutes imply that real estate was *de facto* considered the only remaining credit-worthy collateral after the stock market had collapsed. Archival evidence from the *Creditanstalt* (CA), Austria's foremost joint-stock bank, shows that it almost exclusively accepted real estate – ranging from private houses to fabric grounds – as collateral during the high noon of the *Gründerkrach*, rather than shying away from it.[96] Indeed, not only private banks saw their mortgage portfolios soar during the crisis. In a report on its activities during the apex of the crash, the *Oesterreichische Nationalbank* (OeNB, Austria-Hungary's central bank) mentioned a "non-ordinary upswing" in its mortgage loan portfolio which had increased by roughly 24 million *Florin* between May 1873 and October 1874 (Pressburger, 1962, p.1220). This revealed preference for mortgage loans constitutes another important aspect which suggests that received wisdom on the origins of bank distress during the *Gründerkrach* may need to be reconsidered.

Finally, to some extent prior contributions discount agency on the part of the banking sector: it is depicted as a receiver rather than a catalyst of shocks. This view clashes with contemporary sources. In its final report on the causes of the crisis of 1873, the Austrian House of Representatives' economic committee emphasized credit institutions as key agents of the boom (Abgeordnetenhaus, 1874). The committee decried the banks' "almost exorbitant freedom, completely unfettered by the previous system of licensing, concerning the accumulation of the most heterogeneous and incompatible branches of banking business"[97]. The next section deciphers this statement based on contemporary reports and newly collected balance sheet data. It first reconstructs banks' business models during *Gründerzeit*. Second, based on this business model, it introduces a new explanation for the mass failures following May 1873.

[95] These numbers are computed on the basis of the balance sheet data I collected. For a description of my primary sources, c.f. Section 1.3.

[96] Executive committee meeting on 2 August 1873, CA archives 1873/DIR/8.

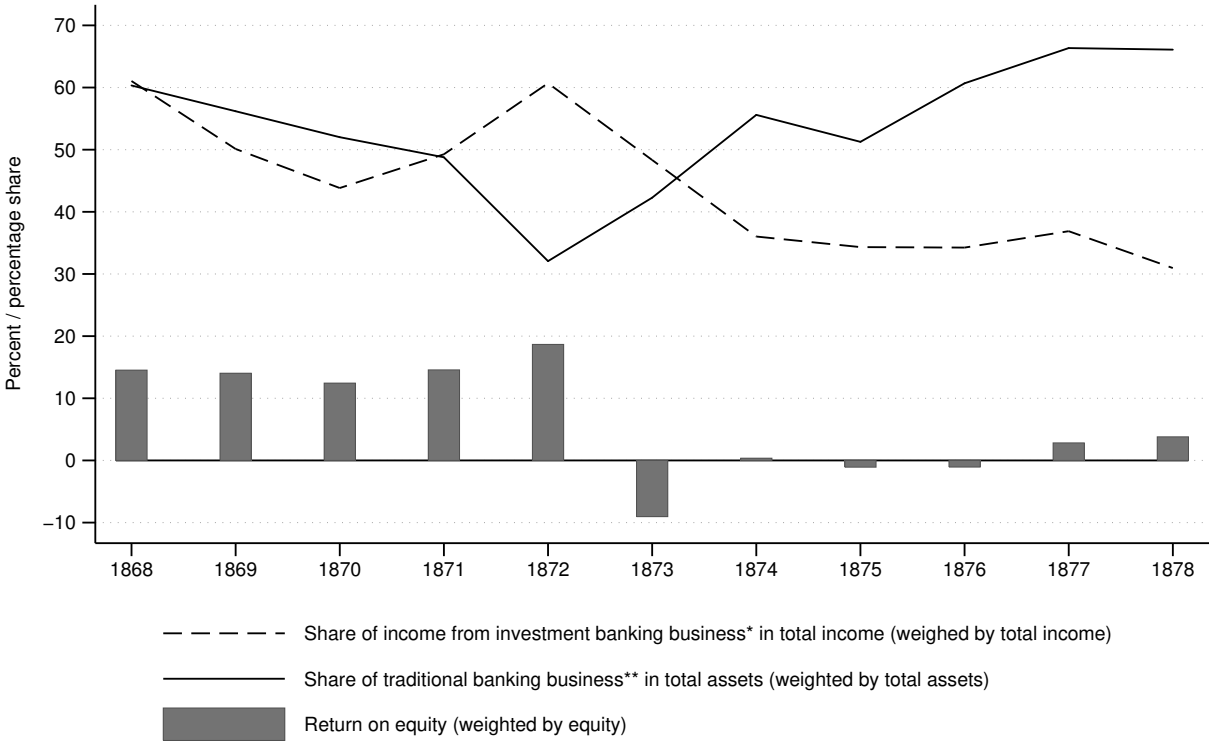
[97] Abgeordnetenhaus (1874, p.45)

1.5 *Gründerbanking* and the role of repos

1.5.1 Investment banking with information asymmetries

Between 1867 and 1873, an increasingly large majority of Austrian joint-stock banks operated according to a business model which placed classic investment banking at the core of their commercial activities[98]. This business model included proprietary trading, that is, the purchase and sale of securities for banks' own profit/account. Yet, for many credit institutions the single most important source of income during the *Gründerzeit* consisted in underwriting and introducing newly emitted securities on the stock exchange. Banks, either alone or together with their peers in so called investment syndicates and consortia, organized initial public offerings (IPO) on behalf of the founders of recently created joint-stock companies in a variety of different sectors (e.g. banks, construction, industry and infrastructure). The high profits credit institutions were able to generate in the first years of the boom led to an increasing reallocation of capital away from traditional banking business towards investment banking.

Figure 1.8: Gründerbanking business model in Austria-Hungary (1868-1878)



Source: Compass and Statistisches Jahrbuch

*Investment banking business: underwriting & IPOs, proprietary trading and investment depots.
**Traditional banking business: bills discounting, goods commissioning & inventories, Lombard loans, bank and mortgage loans, real estate, exchange business.

Since Figure 1.8 relies on data from all banks active at the end of each year, it also includes banks which survived the crash of 1873. Yet, even the aggregated, weighted averages of the variables depicted in Figure 1.8

[98]Contemporaries refer to these activities as the *crédit mobilier* business, c.f. Kautsch (1871); Wirth (1876).

display some clear trends. *Gründerbanking* in Austria-Hungary was visibly profitable with a mean return on equity between 10-20% ever since 1868. There is little doubt, however, that 1872 represented an extraordinary year in which profits reached their absolute climax. In 1872, investment banking (underwriting and IPOs, proprietary trading and investment depots) accounted for 60% of total income while traditional banking activities (here defined as the discounting of bills, goods commissioning and inventories, lombard, bank, and mortgage loans, real estate and exchange business) plummeted to around 30% of total assets.

These trends warrant a closer look on investment banking practice prior to the crisis of 1873. IPOs on the Viennese Bourse were implemented according to a fixed offer price regime. Under this regime emission consortia determine an offer price *ex ante* and do not adjust prices afterwards once marketing has begun (Chambers, 2009). The total surplus generated by an IPO amounts to the difference between market value on the first of trading minus the fixed purchasing price paid to the founder. The total profit the investment bank receives from an IPO is equal to the difference between the price at which it can sell the shares to investors (offer price) and the fixed purchasing price paid to the founder. The offer price for a given issue is usually (well) below the quote on the first day of trading: this empirical phenomenon is called "IPO underpricing".[99] The jump in the price is commonly ascribed to a problem of asymmetric information, where the difference between offer price and first quote compensates investors for liquidity risk[100] (Ellul and Pagano, 2006) and uncertainty about the stock's intrinsic value prevailing before its actual trading starts (Chambers and Dimson, 2009).

To maximize expected profits from an IPO, the underwriter will attempt to reduce the difference between offer price and expected market value of the securities once trading has begun. For this purpose, the investment bank needs to credibly address investors' worries about the market liquidity and intrinsic value of the shares. One standard tool for reshaping the surplus distribution is "promotion". However, any attempt to talk up offer prices *ex ante* triggers a time inconsistency problem if underwriting banks do not or cannot credibly guarantee market prices *ex post*. In principle, investment banks care about this form of information asymmetry because their ability to benefit financially from introducing new shares strongly depends on their reputation – which in turn is based on having offered "good" issues to the market in the past. The profit margin underwriters are able to cash in depends at least partly on the current performance of the shares they introduced in the past. Therefore, investment banks have an incentive to deliver on their promotional commitments. This incentive should thus work to reduce the moral hazard problem. The difficulty remains that not all underwriters might have benign motives: some simply issue shares to reap windfall profits and disappear from the scene. Historically, infamous frauds on the London stock exchange constitute extreme examples.[101] For information asymmetries to become a problem, it suffices that reputational damages are not of concern for a small number of underwriters. If investors are uncertain about which type of underwriters they face, they will either demand a hefty premium

[99] For reviews of the literature on IPO underpricing, c.f. Ritter and Welch (2002) and Ljungqvist (2007).

[100] Liquidity risk in this context refers to "after-market" liquidity risk, i.e. the risk faced by the individual investor that she will be unable to buy or sell as desired because there are no liquid secondary markets for the securities in question. The less liquid the after-market is expected to be, and the less predictable its liquidity appears *ex ante*, the larger will be the effect of IPO underpricing, c.f. Ellul and Pagano (2006).

[101] See Flandreau (2017, p.85-89) for a recent survey.

on all IPOs, or, more likely, ration funds in favor of the best known names in the market.[102] Entering the market as a new underwriter is therefore inherently tricky: one needs to convince investors of the quality of securities on offer.

One way to bridge this informational gap consists of creating artificial demand. Underwriting banks may directly stabilize prices *ex post* by buying up or keeping shares on their own balance sheet. Another option, more specifically aimed at influencing the expected market liquidity of emitted shares, and thus their expected price, is to generously lend against the shares in question. Investment banks can promise to accept securities currently on offer and effectively accept the shares they previously introduced to the market as collateral in secured lending operations. This technique to boost after-market liquidity may be preferable to direct purchases. First, secured lending enables investment banks to earn additional income via the loan's interest rate. Second, it minimizes risk and increases flexibility: banks can keep the maturity of loans short, adjust haircuts when rolling over loans or place margin calls if the collateral value has depreciated. Third, consider the example of an investor speculating *à la hausse* who runs out of short-term liquidity to cover her trading positions. Depending on the size of the investor's holdings, an underwriting bank could have an interest in stepping in as buyer of last resort. Yet, in anticipation of increasing market prices, the investor may prefer to avoid a permanent liquidation of her holdings. Secured lending represents an attractive solution to a liquidity squeeze, which enables the investor to honor her commitments without having to renounce her upward bet.

An important side-effect of this liquidity-enhancing mechanism consists of its amplification effect on the degree of financial leverage incurred by banks and investors. On the one hand, underwriting banks holding large arsenals of securities may themselves become more and more inclined to pledge (re-hypothecate) these securities as collateral to other credit institutions in order to obtain the necessary liquidity for meeting their own obligations. Securities may thus become distributed in the whole financial system in quite opaque ways, with potential implications for systemic risk. Investors, on the other hand, are able to take advantage of lending facilities to leverage on their equity. As long as they can service interest costs and repay when loans are due, market participants can reinvest the cash obtained in order to buy up fresh securities which again may be pledged for renewed liquidity and so forth.

A priori, asymmetric information must have been a particularly pressing concern during the *Gründerzeit*. Many investment banks were new entrants to the market: a majority of banks had just been founded in the years preceding 1873 (c.f. Figure 1.5). Moreover, concerns about fundamental values and after-market liquidity should have been substantial. *Ceteris paribus*, the amount of new shares introduced each month probably caused the task of identifying sound investment projects to become very challenging. At the same time, expected after-market liquidity for each separate issue should have also fallen over time as more and more securities flooded the stock exchange. In fact, in the context of an ongoing financial boom episode, one would expect after-market liquidity to play a prevalent role. During these episodes, most investors buy into IPOs to

[102] Chapter II of this dissertation discusses the literature on information asymmetries in financial markets in more detail.

sell them again soon afterwards at a higher price. These investors have a tendency to disregard the stock's fundamentals and to attempt to ride the boom instead. In their study, Ellul and Pagano (2006) explicitly refer to these so called "flipper" investors in the context of IPO underpricing. Ellul and Pagano (2006, p.382) argue that flipper investors demand "compensation for the trading cost that they expect to incur, as well as for the associated uncertainty". In their view, "the correlation between IPO underpricing and after-market liquidity should therefore be stronger in markets where many initial investors are flippers" (Ibid.).

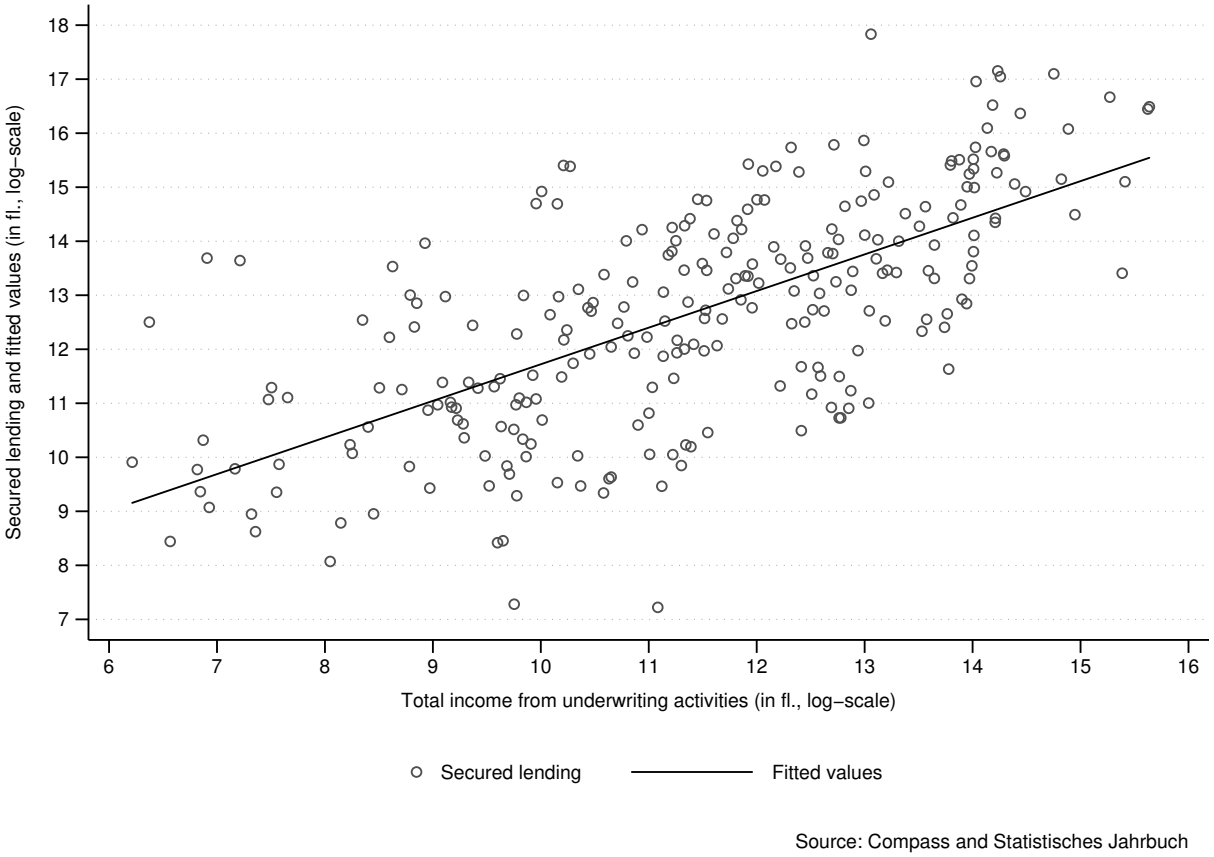
1.5.2 The role of repos

Perhaps unsurprisingly, the combination of investment banking and secured lending had indeed coined the entire period of the *Gründerboom* but certainly intensified during the last 15 months before the crash of 1873. Figure 1.9 plots banks' secured loan portfolio collateralized by traded securities against the income generated via underwriting activities each year from 1868 until 1878. The fitted line shows a clear positive correlation between these two variables, suggesting that banks employed secured lending operations as tools to boost profits deriving from underwriting business. Apart from adding a time dimension, the bar graphs in Figure 1.10 allow for a more detailed look into the nature of banks' secured lending portfolios. By 1872, total secured lending against traded securities had skyrocketed to previously unseen heights, after having almost doubled in size compared to the amounts outstanding 12 months before. This increase in loans was driven by one particular component of secured lending portfolios: repo loans[103]. Figure 1.10 shows that repos, which contemporaries knew as *Report*[104], *Prolongation* or *Kostgeschäft*, accounted for roughly 70% of the banking sector's total secured lending on the eve of the *Gründerkrach*. On aggregate, this amount represented approximately one fifth of total bank equity at the end of 1872. Certainly considerable, this sum is still likely to constitute a lower bound estimate of the size to which these lending facilities had grown just before 9 May 1873. By definition, bank balance sheets only convey a snapshot of credit institutions' financial situation at a specific point in time, namely at year-end, when short-term lending and investments were probably settled more intensively in order to facilitate the computation of annual profits. Moreover, the balance sheets of 1872 do not capture a possible further build-up in the last four months before the crash.

To reconstruct the purpose of repo loans in *Gründerbanking*, I resort to contemporary reports. Neuwirth (1874), Schäffle (1874), Weber (1874) and Wirth (1874b) are only some examples for authors who provide excellent descriptions of how repos were used in the years before 1873. Their accounts exhibit a level of detail not found in any of the secondary literature discussed above. First, banks lured founders into choosing them for their company's IPO by providing bridge-financing in the form of repos against the stocks of the newly created firm. These repos were granted even before the stocks serving as collateral were officially traded. Second, banks offered to lend temporarily against the stocks they introduced to the market to attract brokers and investors to

[103] Please refer to Section 1.7 below for a discussion of repos' maturities, rates, haircuts and legal framework during the *Gründerzeit*.
[104] Who ever wondered why "repo", rather than "repu", was chosen as the common acronym for "repurchase agreements" would be well advised to read about historical repo markets.

Figure 1.9: Underwriting and secured lending by Austro-Hungarian banks (pooled, 1868-1878)



buy into an IPO. Thus, buyers only necessitated equity worth a fraction of the stocks they wanted to purchase. Third, repos were also used by stock market brokers outside the narrow banking sector to extend credit to individual clients. Figure 1.11 summarizes the role of repos in *Gründerbanking*.

Contemporaries frequently commented on the role of repos during the *Gründerboom*. The above mentioned report compiled by the Austrian House of Representatives' economic committee, for example, could "hardly oppose the claim that by far the largest part of the capital banks had added to their vaults until the crisis was employed for speculation purposes, and above all invested in the lucrative, periodically excessively pursued *Kostgeschäft*".[105] Unsurprisingly, the role of *Kostgeschäft* in leveraged securities purchases particularly caught the attention of contemporaries. In a series of essays on the causes of the stock market crash published in the weekly magazine *Oesterreichischer Oekonomist*, Sommaruga (1873, p.260) stated that "one could place buy orders and purchase as many securities as one desired, and one could enter in a Kostgeschäft at will, one only needed to pledge the securities as collateral and pay the interest". Weber (1874, p.64) explicitly referred to repos as financial transactions employed to "buy securities at moderate prices, to borrow against these assets, and to purchase new ones for the loan amount thus received".

Intuitively, contemporaries also grasped the importance of the combination of investment banking and secured lending. Already two years before the Gründerkrach, economist Jakob Kautsch (1871, p.345) hinted at

[105] Abgeordnetenhaus (1874, p.33).

Figure 1.10: Secured lending and repos on Austro-Hungarian bank balance sheets (1868-1878)

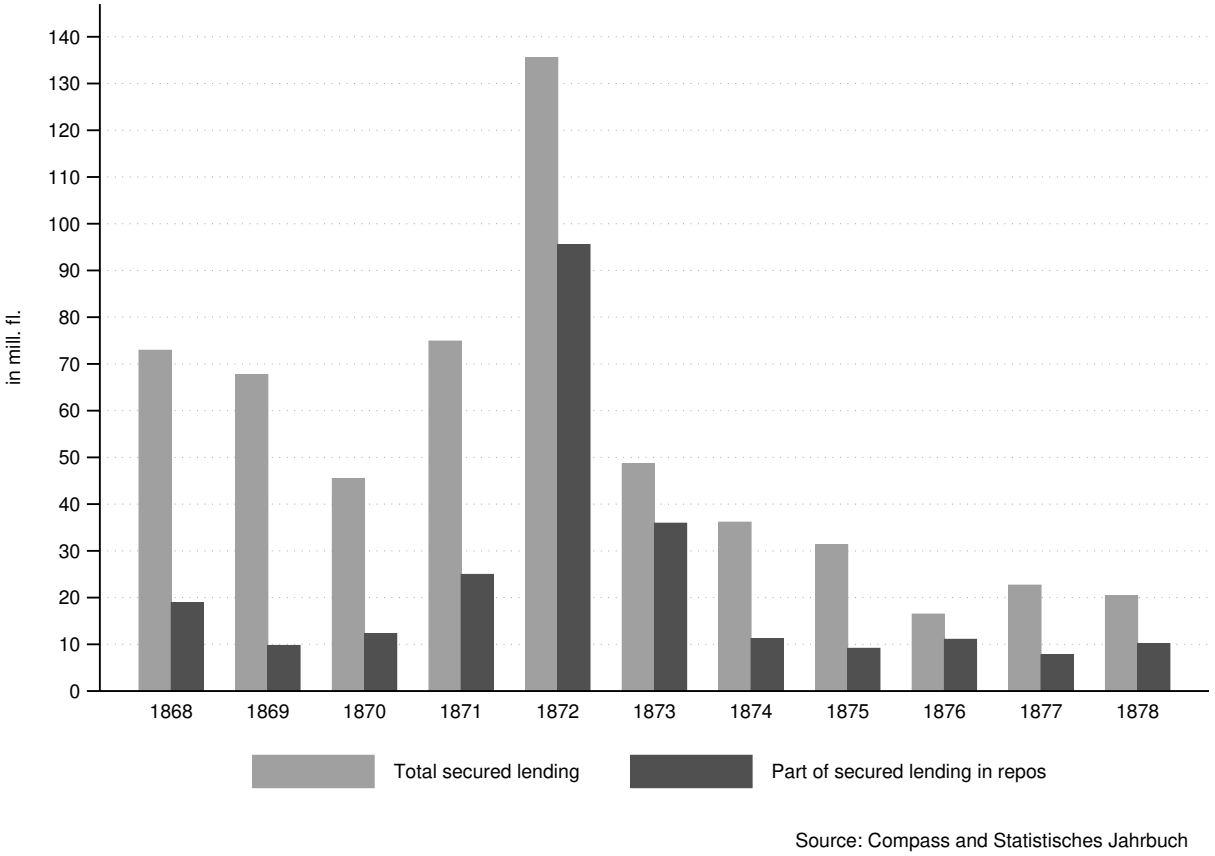
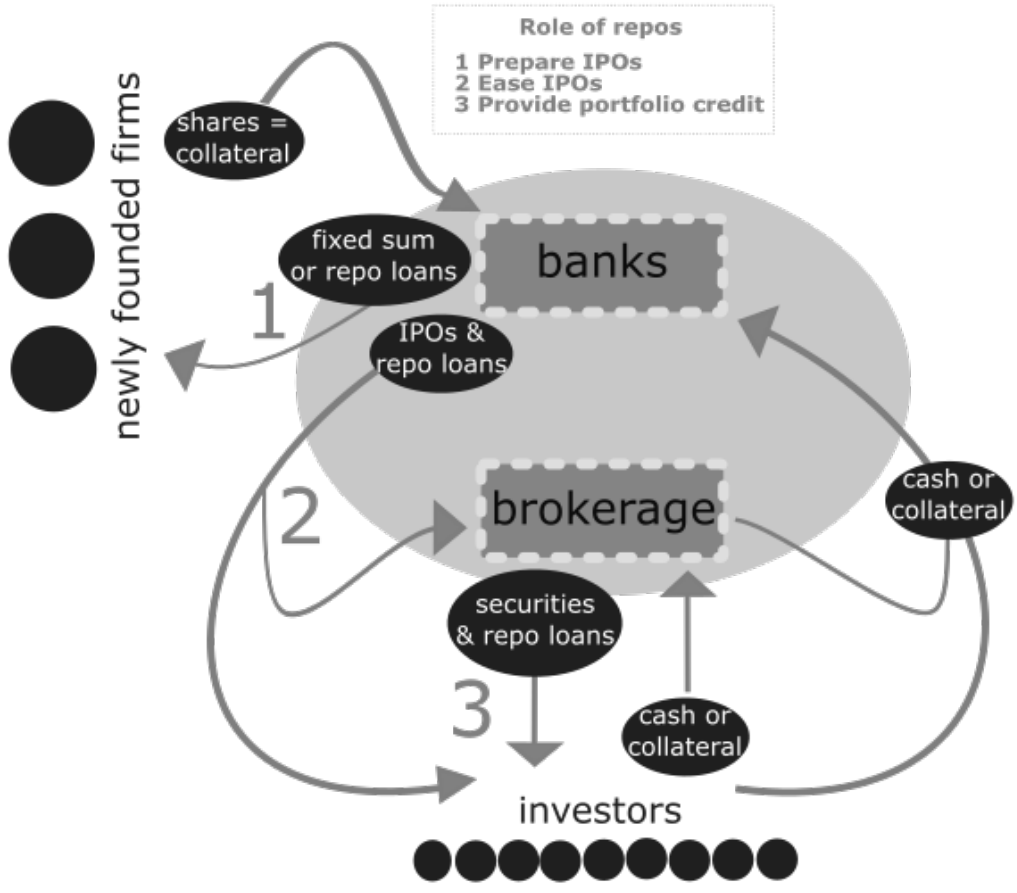


Figure 1.11: The role of repos in *Gründerbanking*



certain new tools investment banks used to push IPO offer prices:

> If – as this was the case over the last years – the participation of the public in the business of the stock exchange is very important, bankers will try to offer the shares of a just founded institution above their nominal price and, thanks to several artificial maneuvers on the *Bourse* [...], they will certainly reach this goal."

Whereas Kautsch's remarks remain somewhat vague, the banking chapter of the *Compass* later addressed this aspect rather unequivocally. Referring to the *Wiener Makler-Bank*, one of the most active *crédit mobilier* institutions during the *Gründerzeit*, Leonhardt (1875, p.143) explained:

> Of course, the enormous asset price increases of securities the bank patronized were only attainable because it lent against the securities in the most liberal ways, and manipulated the price by interfering itself as a buyer.

Wirth (1874b, p.139) sketched out this interplay of underwriting and secured lending even more intriguingly:

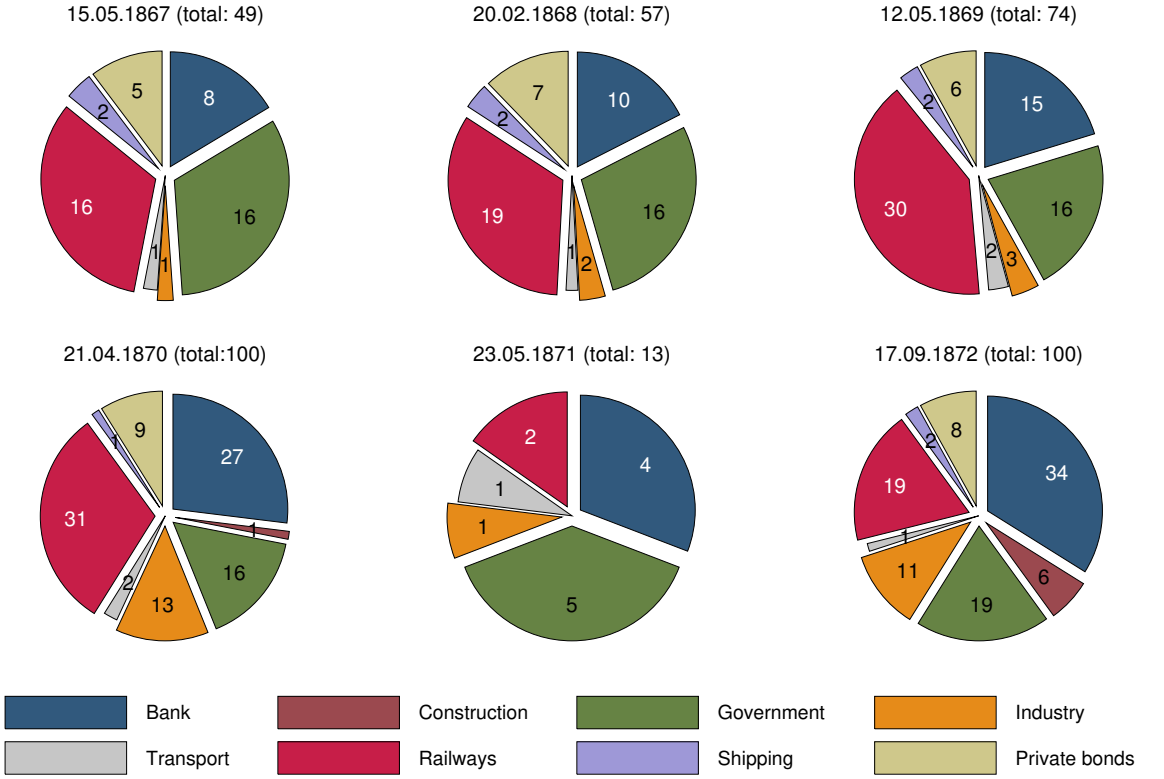
> All clients first assured themselves easy and cheap secured loans for a longer period of time and, thus, syndicate investors were on the safe side until the agio[106] allowed for a profitable sale of their merchandise. Joint-stock companies were founded and their barely printed shares presented as collateral in exchange for bank loans in order to avoid market forces. The temptation [for investors] to subscribe to or buy into an IPO therefore became irresistible, because one did not even have to invest one's own capital, search for capital or permanently hold the securities [...].

To grasp the diversity of shares that were repo'd by banks in the years leading up to the *Gründerkrach*, it suffices to take a deeper look at banks' trading books. The *Bodencreditanstalt* (BCA) was a large Austrian mortgage bank financed by domestic and international capital which had become particularly unfaithful to its original business focus during the *Gründerboom*. In contrast to similar documentation from other financial intermediaries, a tiny sample of this bank's trading books survived destruction because it was directly attached to the governing board's meeting minutes. The books were kept on a daily basis and allow for a more in depth perspective on the variety of shares banks had accepted as collateral in their repos. Figure 1.12 shows that the BCA's *Kostgeschäft* collateral alone encompassed up to 100 different securities on the eve of the *Gründerkrach*. For example, on 17 September 1872 the credit institution had repo'd about 30 distinct Austrian bank stocks, covering thus approximately a quarter of the entire Austrian banking sector at that time. Between May 1867 and September 1872, the bank's exposure to specific stocks ranged from tiny amounts of only 12.25 fl. to large sums up to 1.7 million fl.

To close this section, it is crucial to emphasize how the role of repos during the *Gründerboom* links back to bank distress. Arguably, the best way to do so is to let contemporary accounts speak for themselves. By 1871, the prominence of the symbiosis between IPO business and repo lending was so generally acknowledged that

[106] *Agio* is a term used to describe a positive difference between securities' actual market price and their par value. The price of an asset displaying an *agio* therefore exceeded the asset's nominal amount.

Figure 1.12: Bodencreditanstalt's repo collateral composition: number of distinct securities per sector



Source: own calculations; Creditanstalt archives: BCA board of directors minutes

some authors already referred to underwriting banks' secured short-term lending as a moral obligation these institutions had vis-à-vis investors. For example, Kautsch (1871, p.98) argued that:

> [d]ue to their participation in the stock market business, they [the investment banks] are, one may say, morally bound to support speculators in particular securities, especially during times of crisis, which may put them into very embarrassing situations.

Kautsch (1871) already hints at the problematic nature of large repo loan portfolios in case of a market turn. Yet, undoubtedly the real "smoking gun" for the empirical analysis in the next section is provided by Wirth (1874b). A year after the stock market crashed in May 1873, Wirth (1874b, p.139-141) described the dynamics during the *Gründerkrach* very clearly. He leaves no doubt about the crucial role for repo loans in banks' demise:

> Repos of securities were done systematically, just like the discounting of bills of exchange in normal times. Banks provided investors and brokers with millions and millions of Gulden for whatever purposes the latter pursued because financial intermediaries not only received collateral, including an additional margin of several percent due to the haircut applied, but also possessed another guarantee in form of the creditworthiness of their counterparties. [...] The clique of founders counted on the support by repo lenders, and above all investment banks amassed millions of collateral securities of dubious origin and value in order to gain huge dividends from repo loans. If any downturn was expected at all, nobody believed in a fall of asset prices greater than 10 or 20 percent, which seemed to be manageable. On the eve of the Krach, most of the banks' capital was employed in repos and precisely this caused the crisis to have such a fatal origin and evolution. The repo lenders immediately placed margin calls when prices started to fall; at first, these margin calls were met. Yet, the

> continuous erosion of prices was soon accompanied by the market illiquidity and worthlessness of collateral, in particular the shares of companies founded during the last years, and investors could not find anything to replace the repo loans banks had started to call in. The repo crisis became an epidemic, and there was no remedy for the market's illness. Repo lenders became sick, they could not come to the rescue of their clients anymore and needed support themselves; in particular the investment banks, which held repo portfolios ten times as high as their equity capital, intended to gain some room for maneuver by selling collateral into the market, but the securities offered could not be sold even at the very lowest prices. [...] Repo lenders suddenly became owners of securities, they never wanted to possess, and at prices which devoured the previously gained profits and parts of their equity at least momentarily.

1.6 Causes of bank failures

1.6.1 Baseline econometric set-up

In this section, I will proceed to an empirical test of the above-mentioned hypotheses on the causes of bank distress during the *Gründerkrach* of 1873. An econometric analysis is crucial to understand the relative importance of the different factors that could have caused bank distress. Without a regression framework that allows for *ceteris paribus* analysis, no definitive statement on the major drivers of bank failures can be made. Following contemporary accounts, I explore the importance of banks' repo exposure in the failure dynamics during the crisis of 1873 and I also test the hypothesis that exposure to real estate loans played a role in banks' demise. I employ a vector of covariates conventionally used in the context of bank failure regressions to check whether *Gründerkrach* specifics still bear additional explanatory power after other bank characteristics are controlled for in my model.

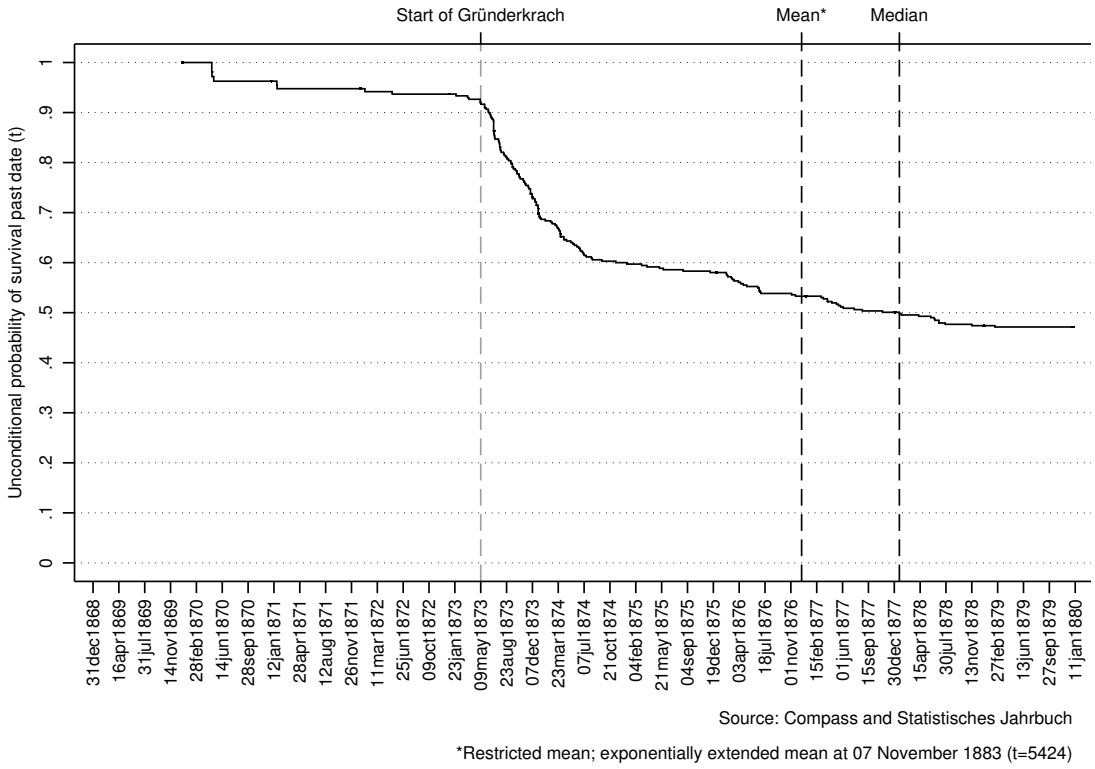
This chapter uses standard cross-sectional logit regressions as its baseline estimation procedure to shed light on the drivers of terminal bank closures during the *Gründerkrach*. I draw on bank-level characteristics measured at the end of 1872 to predict failure between May 1873 and December 1874. The motivation for choosing this approach is threefold. First, logit regressions constitute a parsimonious technique that fits the low, annual frequency of my data and the relatively low number of observation in my sample. My baseline sample contains 181 joint-stock banks, including 64 terminal closures. Second, there are good reasons to believe that multi-year panel estimators might suffer from simultaneity bias and feedback effects when applied to bank failure prediction models. A high probability of failure in a given year is likely to translate into a worse financial situation (e.g. via bank runs or forced fire sales), which in turn feeds back into a higher probability of failure for the coming 12 months. To be sure, I exploit both the panel nature of my data and my knowledge on the exact dates of bank failures in the subsection dealing with robustness checks below. Third, as shown in Figure 1.4 above, the bulk of bank failures during the *Gründerkrach* happened in 1873 and 1874. To restate this fact more precisely using day-by-day data on bank failures between 1868 and 1880, I employ non-parametric survival analysis tools. The Kaplan-Meier estimator of survivor functions only requires data on the number of banks at risk and the number

of failures at each point in time:[107]

$$\hat{S}(t) = \prod_{j|t_j \leq t} (\frac{n_j - d_j}{n_j}), \tag{1.1}$$

where n_j stands for the number of banks at risk and d_j represents the number of bank failures, both evaluated at time t_j.

Figure 1.13: Kaplan-Meier estimator of the survival probability of Austro-Hungarian bank (1868-1878)



The estimated survivor function in turn can be used to obtain the empirical cumulative hazard function and the empirical hazard rate. The empirical survivor function of Austro-Hungarian banks between 1868 and 1878 (c.f. Figure 1.13) confirms that bank distress during the *Gründerkrach* was concentrated in the months following May 1873. The corresponding hazard function is displayed in Figure 1.14.[108] Apart from informing baseline model selection, the non-parametric analysis also conveys a compact overview of the distribution of bank failures in the observation period spanned by this study's panel data. Overall, banks approximately had a 50% chance to survive the crisis of 1873, with the strongest decrease in survival probability occurring during the 12 months following Black Friday. On average, banks stayed in operation until the end of 1876 and half of the bank

[107]I implement the Kaplan-Meier estimator for the entire population of banks rather than only for my sample of 181 banks. While I only have complete balance sheet information for 181 banks, I can draw on information regarding failure dates for the entire sector, not just my sample. Hence, Figure 1.13 and Figure 1.14 below represent the survivor and hazard function for the entire Austro-Hungarian joint-stock banking sector.

[108]The hazard function is computed as follows: $h(t) = \lim_{\Delta t \to 0} \frac{P(t+\Delta t > T > t | T > t)}{\Delta t} = \frac{f(t)}{S(t)}$. In words, the hazard rate represents "the limiting probability that the failure event occurs in a given interval, conditional upon the subject having survived to the beginning of that interval" (Cleves et al., 2010, p.7).

population had disappeared by December 1877.

Figure 1.14: Non-parametric estimate for the hazard function of Austro-Hungarian banks

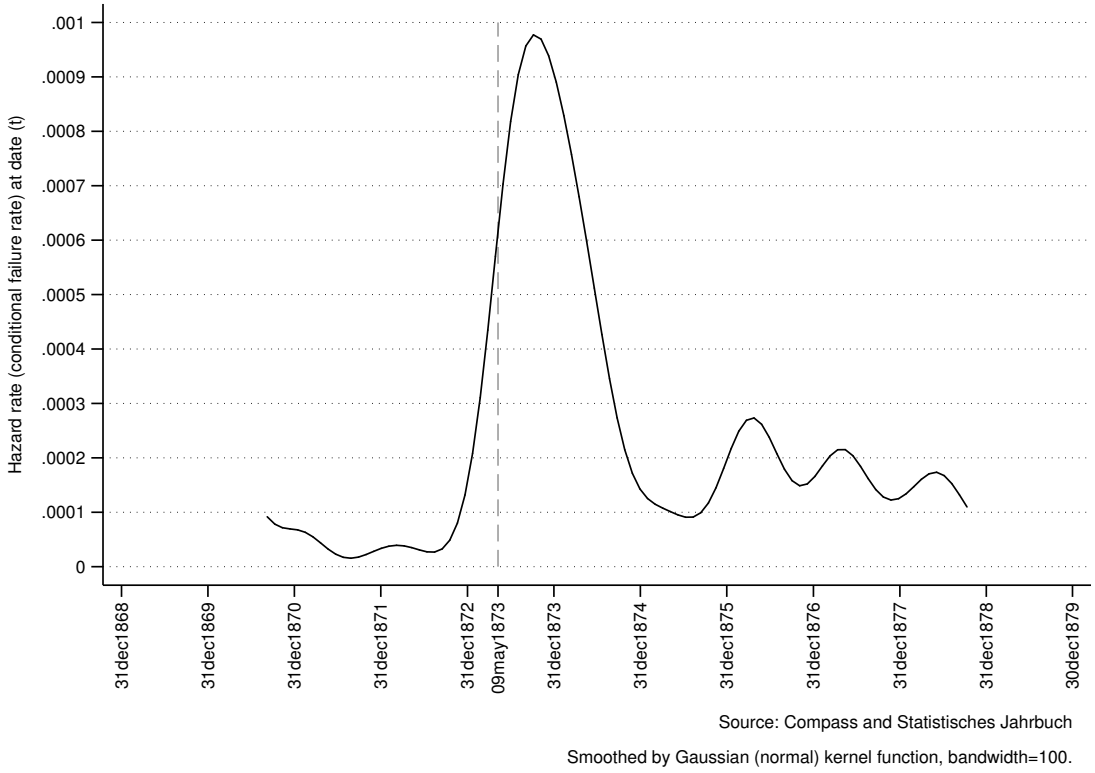


Figure 1.4 already highlighted that terminal bank closure in Austria-Hungary between 1868 and 1878 necessarily took one of three forms: liquidation, merger or bankruptcy. In this chapter, I pool all three types of bank closures when examining the drivers of bank distress during the Austro-Hungarian *Gründerkrach*. I provide qualitative evidence in Table 1.9 in the appendix to show that mergers and liquidations did not represent types of bank closures which were driven by underlying causes fundamentally different from those triggering outright bankruptcy.[109] Although the result of a voluntary decision taken by the qualified majority of shareholders, there are good reasons to believe that liquidations during the *Gründerkrach* were in fact simply one of several possible management reactions to bank distress. The general assembly's decision to liquidate mostly sprang from the desire to avoid outright bankruptcy due to further losses that would have been incurred if the bank stayed open for business. The advantage of a quick decision to liquidate in response to losses was at least twofold. First, liquidation allowed for more orderly asset sales because payments to creditors, that a given bank would have had to honor as a going concern, could be suspended. Second, in contrast to bankruptcy, liquidation enabled shareholders to retain the power over how and when bank assets would be sold.

This interpretation of liquidations as a response to distress rather than an unforced decision to suspend business for "benign" reasons is confirmed by the summaries of final general assemblies published in the *Compass*. Table 1.9 in the appendix of this chapter conveys a systematic summary of the available information on bank failures contained in the reports of the *Compass*. Out of the 70 liquidating banks, for which reports are

[109] Please refer to Section 1.7 for additional evidence that shows liquidations did not constitute "benign" closures.

available in the *Compass*, only 6 mentioned bad future business perspectives as one of their main motivations for liquidation. All others cited their dismal financial position, for example losses from defaulting loans as well as securities holdings and withdrawals of funding, as the main reason for liquidation. The summary in Table 1.9 also provides qualitative data on reasons for 8 out of the 18 mergers which took place following the *Gründerkrach*. In only one of these cases did the target institution apparently give up the independence of its business activities for merely "benign" reasons: the *Austro-Ottomanische Bank* merged into the *Imperial Ottoman Bank* on 30 June 1874 when the Ottoman Empire had founded the latter bank to take over the entire state-financing business. Since the introduction of Ottoman government bonds in central Europe had previously been its most important banking arm, the *Austro-Ottomanische Bank* saw its future business perspectives eroding and agreed to a take-over by the *Imperial Bank*. In all other cases, shareholders seemingly rescued their stakes in a stumbling bank by agreeing to merge with another more solid institution. The difference between the three forms of bank closure therefore appears to amount to a difference in the extent of losses rather than any kind of essential difference in the nature of the failure process. During the Austro-Hungarian *Gründerkrach*, mergers, liquidations and bankruptcies were located alongside a continuum of loss intensity; all three paths to closure constituted manifestations of bank distress. While bankruptcy by definition incarnated situations in which repayments on liabilities were suspended, liquidations and mergers constituted reactions to ongoing or anticipated losses with the aim of preemptively foreclosing bankruptcy as the worst case scenario.

In this chapter, I use the following cross-sectional logit model specification to predict the probability of bank failures in 1873 and 1874:

$$P(Y|\mathbf{F},\mathbf{S},\mathbf{G}) = H(\beta + \mathbf{\Gamma'F}_i + \mathbf{\Delta'S}_i + \mathbf{\Psi'G}_i) \tag{1.2}$$

$$\text{where } H(u = \beta + \mathbf{\Gamma'F}_i + \mathbf{\Delta'S}_i + \mathbf{\Psi'G}_i) = \tfrac{exp(u)}{1+exp(u)}$$

where Y is the dependent variable of my regressions, a dummy that takes the value of 1 if bank i failed during the *Gründerkrach* in 1873 or 1874; $\mathbf{F}$ is a vector of bank-level (financial) characteristics, $\mathbf{S}$ represents a vector of (banking-related) structural variables and $\mathbf{G}$ is a vector of *Gründerkrach* specific variables.

1.6.2 Variables and baseline results

The summary statistics for the variables contained in $\mathbf{F}$, $\mathbf{S}$ and $\mathbf{G}$ are displayed in Table 1.1 below. In my sample of 181 banks, 64 represent terminal failures. My dependent variable codes this information in the form of a binary covariate: banks which failed between May 1873 and December 1874 receive a value of 1; all other banks are coded as zeros. The bank failures which enter my sample and the banks which closed down but did not publish any balance sheet information are clearly indicated in Table 1.9 in the appendix.

I include six variables in vector **F**. This first group of regressors consists of a set of bank characteristics which emerge as particularly relevant predictors from previous work on the causes of bank distress in similar historical contexts.[110] The selected covariates respond to the need of controlling for more general bank-level weaknesses in order to single out the ceteris paribus impact of *Gründerkrach* specifics on the probability of failure. **F** contains the following control variables. The natural logarithm of banks' total assets is included to control for bank size. Previous work generally finds that the risk of failure decreases with bank size. The exact rationale for this negative relationship is seldom explicitly mentioned but bank size arguably covers a broad mix of relevant characteristics ranging from market power, solidity and risk bearing capacity, to a higher likelihood of diversification of investment as well as to an increased probability of receiving policy support by the government or the central bank due to systemic importance.

Bank age represents a second generic control variable which other contributions find to be negatively correlated with the probability of bank demise. Bank age proxies mainly for management experience and the extent to which credit institutions' internal processes are well-rehearsed. In addition, bank age may also speak to characteristics such as risk appetite if entry barriers to the banking sector are high and new institutions, offering competitive rates to attract clients, are pushed to seek risky and profitable investments to maintain a decent interest margin.

The share of illiquid assets in total assets represents one of two control variables that are intended to capture liquidity mismatches on bank balance sheets. Given its role as a potential balance sheet constraint, controlling for asset illiquidity is crucial. Illiquid assets are defined to include banks' participation in investment syndicates and consortia, investments in real estate and companies, mortgage loans, and other long-term loans. Intuitively, the share of illiquid assets in total assets should be positively correlated with the risk of failure.

The ratio of sight deposits and callable cash certificates to vault cash and bills held is the second variable which is included explicitly to control for illiquidity mismatches on bank balance sheets. *Ceteris paribus*, a higher ratio should be correlated with a heightened risk of bank closure. In order to control for the size of the available capital buffer relative to total bank assets, the present chapter draws on the leverage ratio which is defined as the ratio of banks' total assets to equity. I define equity as the sum of paid up capital and reserve funds. In the case of mortgage banks which did not issue stocks, I include covered bonds instead. Higher leverage ratios signal a lower relative equity buffer and, therefore, increased risk taking on the part of banks. One would expect higher leverage ratios to be positively related to the odds of bank distress. Sixth, credit institutions' overall profitability as proxied by the bank-level return on equity is taken into account. This study defines return on equity as the ratio of net profits after taxes to bank equity. A higher return on equity in a given year should allow banks to build up more contingency reserves to cover losses in bad times: high profitability increases the capacity of banks to build up reserve funds in addition to satisfying their shareholders' demands for dividend payments. Therefore, return on equity is expected to be negatively correlated to the probability

[110] For some examples of studies that served as an inspiration in this regard, c.f.Calomiris and Mason (1997), Wheelock and Wilson (2000), Calomiris and Mason (2003b), Carlson (2005), Carlson et al. (2011), Colvin et al. (2015), and Postel-Vinay (2016).

of failure.

Vector **S** contains two structural variables to control for existing local bank market structure/competition as well as city population. I include the natural logarithm of the number of banks in a given city at the end of 1872 and the natural logarithm of the city population for all the bank locations in my data set. The city population is taken from the closest population census (as published in the Austrian and Hungarian statistical yearbooks) to the crisis of 1873, which took place in 1869. From a theoretical point of view, the impact of these variables on bank survival is not clear-cut. A higher number of banks in a given city could mean increased competition and thus higher efficiency (reducing the probability of failure) and/or higher risk-taking (positively correlated with failure probability). The same considerations apply to city population: larger cities might be home to more financial institutions (other banks but also savings banks, cooperatives and private banks) increasing competition; yet, the presence of multiple financial intermediaries might also make contagion effects (between local institutions and from elsewhere) more likely.

In addition to these general bank-level and structural characteristics, I include four variables that reflect *Gründerkrach* specifics. First, I compute credit institutions' real estate loan share. Given the strong development of the construction sector reflected in Figure 1.1, banks' exposure to mortgage loans might be suspected to have played an instrumental role in bringing about financial distress. Although this connection has been established neither quantitatively nor qualitatively in the historiography, many Austrians would instinctively associate the *Gründerboom* with a real estate bubble which deflated rapidly following the stock market crash in May 1873. The real estate loan share is computed as the share of mortgage loans to total loans. Mortgage loans constitute an independent position on banks' balance sheets and the sum of total loans contains mortgage loans, discount loans, lombard loans and all other unsecured and secured loans. More extensive exposures to mortgage loans, that is, higher real estate loan shares, are expected to induce a higher risk of failure.

The second variable in **G** constitutes an alternative covariate intended to capture the real estate bubble narrative in Brunnermeier and Schnabel (2016). The ratio of real estate owned or repossessed to non-cash assets proxies for non-performing or defaulted mortgage loans and banks' direct investments in real restate. Non-cash assets are defined as total assets minus vault cash and bills held. The rationale for including this variable in addition to the mortgage loan share is simply to account for the more general exposure to real estate price fluctuations and capture potential losses on real estate loans which had already been incurred by the end of 1872. I expect a higher ratio to be correlated with a higher probability of failure.

Finally, banks' exposure to repo loans represents the third regressor of interest contained in **G**. For the purpose of measuring the intensity of exposure, this independent variable is defined as the ratio of a bank's repo portfolio to its equity. Specified in this way, credit institutions' repo exposure proxies for the extent of potential cuts into a bank's equity due to defaulting *Kostgeschäft* borrowers and subsequent damaging collateral liquidations. I chose this specification because contemporary reports such as Wirth (1874b) and Abgeordnetenhaus (1874) explicitly mention the high ratios of repos to equity as a reason for bank distress

during the *Gründerkrach*. To check whether an alternative, simpler specification changes my results, I also draw on a simple repo dummy that indicates whether a bank had balance sheet exposure to repos. One important point that should be noted with regard to my measures of repo balance sheet exposure concerns measurement error. When comparing my balance sheet data as recorded for year-end 1872 to the descriptive reasons of bank failures, I encountered several cases in which credit institutions did not list any repo loans on their balance sheet although they subsequently reported to have failed due to *Kostgeschäft* exposure (c.f. Table 1.9). Whether this divergence occurs because banks did not fully disclose repo loans or because banks only granted repo loans during the last months before May 1873 cannot be determined. Either way, it suggests that my sample of balance sheet data is likely to underestimate the impact of repo loans on the probability of failure.

Table 1.1: Summary statistics for cross-sectional logit regressions

Variable	Cat	Obs	Mean	Std. Dev.	Min	Max	P1	P5	P25	P50	P75	P95	P99
Bank failure dummy	**Y**	181	0.35	0.48	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00
Bank size (ln)	**F**	181	14.91	1.64	11.23	19.29	11.82	12.30	13.68	14.95	15.99	17.40	18.92
Bank age	**F**	181	4.61	4.17	1.00	33.00	1.00	2.00	2.00	4.00	5.00	10.00	32.0
Illiquid assets to total assets	**F**	181	0.46	0.32	0.00	1.00	0.00	0.00	0.18	0.50	0.77	0.92	1.00
Deposits to cash reserves	**F**	181	1.21	2.74	0.00	32.22	0.00	0.00	0.14	0.65	1.21	3.95	10.31
Leverage ratio	**F**	181	4.65	4.08	0.75	25.25	1.02	1.15	2.06	3.35	5.42	14.49	21.05
Return on equity	**F**	181	0.17	0.22	-0.74	1.09	-0.56	0.00	0.09	0.14	0.22	0.59	0.91
City population in 1869 (ln)	**S**	181	11.42	1.60	7.55	13.32	8.12	8.80	9.99	11.38	13.32	13.32	13.32
Number of banks in city (ln)	**S**	181	2.12	1.67	0.00	4.16	0.00	0.00	0.69	1.79	4.16	4.16	4.16
Mortgage loan share	**G**	181	0.09	0.24	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.79	1.00
Real estate to non-cash assets	**G**	181	0.02	0.06	0.00	0.46	0.00	0.00	0.00	0.00	0.01	0.13	0.32
Repos to equity	**G**	181	0.10	0.54	0.00	6.66	0.00	0.00	0.00	0.00	0.00	0.49	2.06
Repos dummy	**G**	181	0.17	0.37	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00

I report the results for my baseline maximum likelihood regressions in Table 1.2. Several general remarks apply. First, all the coefficients in Table 1.2 represent the marginal effects of a one standard deviation increase in the corresponding covariate and are thus directly comparable to each other. The only exception is the binary repo dummy: its coefficient represents the marginal effect of a discrete change from zero to one.[111] Second, because of the logit specification I use, positive marginal effects mean that an increase in the covariate trigger an increase in the probability of failure; and vice versa for negative marginal effects. Third, given the geographic clustering of bank failures in large cities (c.f. Figure 1.4 in Section 1.4), I cluster standard errors by default at the city-level for all my regressions. This decision somewhat decreases the statistical significance of the estimated coefficients in all the result tables reported, but it does not change my conclusions at all. Finally, I would like to emphasize that the results presented below merely represent a list of conditional correlations and should not be considered as causal effects.

In Table 1.2, I gradually add more regressors to show that my baseline results are highly stable in terms of the sign and significance of the marginal effects I obtain. Overall, the estimated marginal effects for vector **F** are consistent with results found in similar studies: bank age, asset illiquidity, the ratio of deposit to cash reserves, the leverage ratio, and the return on equity all yield the expected sign. In addition, as one might have expected, practically all variables are both economically and statistically significant predictors of bank distress during the *Gründerkrach*. Bank size is the only variable in **F** for which I estimate surprising results in some

[111] In order to allow for cross-chapter comparisons, I use standardized coefficients/marginal effects in all my regression result tables in this dissertation.

Table 1.2: Explaining bank failures in 1873 and 1874: baseline maximum likelihood estimates

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Bank size	0.02	0.08**	0.02	0.02	0.02	0.02	-0.12***	-0.11***	-0.13***	-0.12***	-0.13***	-0.12***
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)
Bank age		-0.38***	-0.36**	-0.40**	-0.45***	-0.44***	-0.41***	-0.42***	-0.37***	-0.42***	-0.39***	-0.42***
		(0.13)	(0.18)	(0.16)	(0.16)	(0.15)	(0.11)	(0.11)	(0.11)	(0.11)	(0.10)	(0.12)
Illiquid assets to total assets			0.11*	0.09	0.07	0.08*	0.09*	0.09*	0.12**	0.13***	0.15***	0.13***
			(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.04)
Deposits to cash reserves				0.19***	0.12***	0.14***	0.13**	0.13**	0.10***	0.07**	0.08**	0.07**
				(0.07)	(0.04)	(0.04)	(0.05)	(0.05)	(0.04)	(0.03)	(0.03)	(0.03)
Leverage ratio					0.09**	0.15***	0.20***	0.20***	0.24***	0.28***	0.27***	0.28***
					(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.06)
Return on equity						-0.10**	-0.10**	-0.10**	-0.13**	-0.14***	-0.15**	-0.14***
						(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.06)	(0.05)
City population							0.15***	0.19*	0.21*	0.21**	0.21**	0.20*
							(0.04)	(0.10)	(0.11)	(0.10)	(0.10)	(0.11)
Number of banks in city								-0.04	-0.02	-0.04	-0.05	-0.04
								(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Mortgage loan share									-0.18***	-0.18***	-0.18***	-0.18***
									(0.05)	(0.05)	(0.05)	(0.05)
Real estate to non-cash assets										0.09***	0.09***	0.09***
										(0.02)	(0.02)	(0.02)
Repos to equity											0.05**	
											(0.02)	
Repo dummy												0.01
												(0.11)
Observations	181	181	181	181	181	181	181	181	181	181	181	181
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Pseudo R-squared	0.00	0.14	0.17	0.20	0.22	0.24	0.27	0.27	0.33	0.35	0.36	0.35
Log pseudolikelihood	-117.36	-101.26	-97.68	-93.50	-91.51	-89.44	-85.62	-85.52	-79.17	-76.41	-75.72	-76.40
LR (Wald) chi2 statistic	0.56	10.36	22.57	29.01	36.87	32.29	36.64	35.53	119.32	115.05	180.67	127.01

Marginal effects for one standard deviation increase in covariate,
except for binary repo dummy, when discrete change from 0 to 1.
Clustered standard errors for marginal effects in parentheses
*** p<0.01, ** p<0.05, * p<0.1

of the specifications: apparently size did not impact the probability of survival during the crisis of 1873, unless city population is controlled for. Once city population is included, bank size receives both the expected sign and becomes a statistically and economically significant predictor. One explanation might be that bank size and city population are capturing similar characteristics (their correlation coefficient is 0.72). If both variables are included their effect points into opposite directions: in other words, the coefficient on bank size in columns (1) to (6) appears to show a compound effect of the two variables, suggesting that the inclusion of city population in **S** is important to disentangle these effects. In contrast, the number of banks in a given city does not emerge as a relevant predictor for bank distress during the *Gründerkrach*. Since bank age bears the largest marginal effect in my baseline specification, the coefficient merits some further comments. An increase of one standard deviation in the age of banks reduces the probability of failure by around 40%. This substantial economic effect is corroborated by descriptive data summarized in Figure 1.22 in the appendix. The graph provides a breakdown of banks' survival performance according to their year of foundation, testifying to the fact that younger bank generations were much more likely to suffer from the *Gründerkrach* than older ones. It suggests that younger banks engaged in particularly risky behavior during the boom, possibly in an attempt to compete for market share.

Turning to vector **G** and *Gründerkrach* specifics, I obtain the perhaps surprising result that an increase in the mortgage loan share at the bank-level had a significant mitigating effect on the probability of failure. The more banks specialized in mortgage loans, the less likely they were to fail. Although this result contradicts the idea that banks failed due to their exposure to real estate loans turning foul during the crisis of 1873,

my finding is very much consistent with the qualitative and quantitative evidence on mortgages I discussed in Section 1.4 above. While the marginal effect of an increase in the mortgage loan share appears to challenge real estate story, I interpret my results as qualifying the latter rather than rejecting it. The reason for my conclusion is the following. The second variable in **G**, the ratio of real estate to non-cash assets, actually exhibits the expected sign and represents a statistically and economically fairly important predictor of bank distress. In other words, my econometric analysis suggests that real estate exposure did matter during the *Gründerkrach* but the channel through which it affected bank distress was different from the one assumed in previous contributions. The collapse in real estate prices affected banks because of their direct holdings of real estate rather than their mortgage lending activities. To be sure, to some extent the distinction between these covariates blurs because real estate held by banks might have also reflected loans already gone bad.

Finally, I turn to the explanatory power of banks' repo exposure during the *Gründerkrach*. The ratio of repos to equity has the expected sign and is a statistically significant predictor of bank failure during the crisis of 1873. The economic size of the marginal effect matches the impact of the other very specific variable in my regression model, i.e. the ratio of real estate to non-cash assets. For every standard deviation increase in the repo to equity ratio, a bank becomes 5% more likely to fail. However, when I draw on the simpler dummy specification, I do not find any effect on bank survival. This finding suggests that the size of the repo portfolio relative to equity capital mattered. This result confirms that the repo to equity ratio does not simply proxy for overall risk appetite: the size of the exposure was important. Given the above-mentioned problem of measurement error and the fact that my repo variable represents a very specific covariate in comparison to the generic variables contained in vector **F** and **S**, I conclude that repo exposure indeed appears to have constituted a relevant, although certainly not the only factor explaining bank distress during the *Gründerkrach*. This conclusion is further bolstered by the substantial increase in the model's goodness of fit triggered by the inclusion of the bank-level exposure to repos: of all covariates included in my model, the repo to equity ratio induces the second highest increase in the LR statistic.

1.6.3 Robustness checks

Despite the fact that my results are consistent with findings in prior studies and theoretical expectations, the results presented in Table 1.2 only reflect correlations, not causal relationships. Discussions of causal identification in bank failure models are rare and authors often implicitly rely on the assumed exogeneity of shocks to banks' financial health. An instrumental variable approach may be a solution for one particular regressor, but it is difficult to implement if many variables are of simultaneous interest. In this subsection, my aim is to address two specific concerns.

The first concern is omitted variable bias. The logit regressions above might show a good fit but the marginal effects I obtain could be severely biased due to a wide variety of reasons. Although I made sure that reasonable

changes in the specification and functional form of the variables in **F**, **S** and **G** do not impact my results[112], there are many covariates so far excluded from my model which could affect the estimated marginal effects. In this chapter, I pay particular attention to two factors. On the one hand, Section 1.4 has shown that bank failures were very much concentrated in the major cities of the Empire. Although I address this geographical dimension by clustering standard errors accordingly and controlling for vector **S**, an arguably more convcincing approach would be to include actual city-fixed effects in my logit model. On the other hand, the same reasoning applies to the three bank types in my data set. Until now, I have not explored whether controlling for the different categories of joint-stock banks, i.e. joint-stock banks *stricto sensu*, mortgage banks and pawn banks, has an impact on the estimated marginal effects. Both the geographical location and the type of bank might be important sources of omitted variable bias if **F**, **S** and **G** are correlated with these non-financial characteristics. In one sense, financial characteristics were almost certainly correlated with a given bank's location: bank lending in the 19$^{\text{th}}$ century often remained very local, in particular if banks did not have branches as was the case for the large majority of credit institutions in my sample.[113]

The major obstacle to including city- and bank-type fixed effects in Model 1.2 is the limited size of my sample. My sample of 181 banks covers 73 different geographical locations. Hence, the inclusion of a full set of fixed effects is not viable from a degrees of freedom perspective. Yet, although I would not be able to include fixed effects in my cross-sectional logit models, I can draw on the particular nature of my data to exploit an alternative approach to the problem. Having collected a full panel data set with bank balance sheets covering the years from 1868 until 1878, I am able to exploit survival analysis techniques to address omitted variable bias in my baseline regressions. To be sure, there are good reasons why I do not simply run a panel logit or probit regression on my data. In cases of panel data sets with low time dimensions, any attempt to control for constant unobserved bank-level effects by adding $N-1$ dummies to the binary model results in inconsistent estimates of the unobserved effects and leads to severely biased coefficients on other explanatory variables. A time span of ten years as covered by the bank-level panel data set of this study is unlikely to fulfill the sufficiency requirements guaranteeing consistency and unbiasedness of coefficients. If one were to use a conditional fixed effects approach instead in order to eliminate unobservable characteristics at the bank-level, one would need observations on the dependent variable for each individual to vary between 0 and 1 at least once over the time period considered. For the bank-level panel data used this paper, this requirement would imply an exclusion of credit institutions, which do not fail during the observation period, from the sample. Equally, banks, which closed down in the year immediately following their foundation year, would be excluded from the estimation sample, simply because the dependent variable matched to their balance sheet characteristics never changes. As a corollary, the only control cases remaining in the study would be credit institutions that fail at later moments in time. Thus, the demanding prerequisites of conditional fixed effects logit models make them unattractive for this chapter's unbalanced bank-level data set; these prerequisites are even more generally unsuitable for bank

[112] I also proceeded to the elimination of outliers in the data by drawing on systematic identification strategies (DFBETA, likelihood displacement and LMAX).

[113] In an alternative specification of the logit model above I also include a branch dummy in my regression model. The dummy remains insignificant and does not significantly change the results displayed in Table 1.2 above.

failure prediction unless one is willing to accept losing all control information contained on non-failing banks' financial statements.

Survival analysis is an excellent econometric tool for handling data sets which would suffer from incidental parameter bias as well as collinearity problems when treated by fixed effects methods in logit or probit models. Its toolbox contains methods akin to fixed effects estimation which neither rely on the inclusion of individual dummies, nor require the same restrictive preconditions as conditional panel logits. Fixed effects estimation in survival analysis goes by the name of "baseline hazard stratification". Stratification on group variables amounts to allow for different baseline hazards across these groups and therefore represents a neat way of controlling for (time-varying) fixed effects in the panel data. In contrast to conventional fixed effects, stratification of the baseline hazard is not only able to control for time-invariant unobservables, but also captures the potentially time-varying intensity of these unobservables at a pre-defined group level. In the context of this chapter, stratification may be employed to capture differing failure dynamics in cities, at different moments in time; and it may be used to control for different hazard experiences across different bank types over time. All these granular dynamics are subsumed into a time-varying baseline hazard at the level of the groups for which stratification is implemented. To the best of my knowledge, I am the first to employ stratification techniques in the context of bank-level survival regressions.

From the range of available survival analysis techniques, this study employs semi-parametric methods. Choosing between semi-parametric and parametric modeling amounts to trading off a loss of efficiency against potentially wrong assumptions concerning the nature of the baseline hazard. If a reasonably clear assumption about the distribution of failure times in the data can be made, then parametric survival analysis is superior to semi-parametric analysis. While the latter only draws on the recorded failure times in the data to estimate the probability of failure for individuals at these particular moments in time, the specification of an underlying distribution of failure times enables parametric models to compute the probability of failure at every moment for the time span during which individuals are at risk. Hence, parametric methods harbor the advantage of estimating covariate coefficients much more precisely than semi-parametric survival analysis, as long as the correct underlying distribution of failure times is chosen. Judging from the multimodal form of the empirical hazard rate obtained on the basis of the Kaplan-Meier estimator (c.f. Figure 1.14 above), there is no obvious parametric model for the baseline hazard which could easily capture the failure dynamics in this study's panel data. Therefore, the risk of selecting a parametric model which does not adequately reflect the distributional properties of failure times of Austro-Hungarian banks looms large. Since a misguided assumption with regard to the distribution of failure times would bias the estimated coefficients on the covariates in the model, semi-parametric survival analysis constitutes the safest option for this study. In contrast to parametric models, semi-parametric survival analysis does not require any assumptions regarding the exact nature of the baseline hazard underlying a given data set.[114] Hence, I analyze the determinants of bank failure during the Austro-Hungarian

[114]Mathematically, the likelihood function is set up in a way that cancels out the baseline hazard in the process of calculating the coefficients on covariates.

Gründerkrach by drawing on semi-parametric Cox proportional hazard regressions. The really defining feature of Cox proportional hazard regression is the so called proportionality assumption. Cox regression models the individual hazards of the subjects in the data set as multiplicative replica of the baseline hazard and, therefore, of each other. There is a large array of graphical and formal statistical tests which can be drawn upon post estimation to check whether the data fits the proportionality constraint of Cox regressions. Hence, the proportionality requirement boils down to a testable empirical condition of the data. Adapted to the context of this chapter, the general hazard form of the Cox model is as follows:

$$h_{i,t_y}(t \mid \mathbf{F}_{i,y-1}, \mathbf{G}_{i,y-1}) = h_0(t)_{t_y} \cdot exp(\mathbf{\Gamma'}\mathbf{F}_{i,y-1} + \mathbf{\Delta'}\mathbf{G}_{i,y-1}) \tag{1.3}$$

where the first term, $h_0(t)_{t_y}$, stands for the baseline hazard faced by all banks on day t in year y and the second term, $exp(\mathbf{\Gamma'}\mathbf{F}_{i,y-1} + \mathbf{\Delta'}\mathbf{G}_{i,y-1})$, represents the two groups of (time-varying) covariates which shape the overall hazard rate experienced by a specific bank over time. I cannot include vector **S** anymore because it does not vary at the bank-level and I am using stratification techniques to control for city and bank-type fixed effects which are time-varying. In other words, stratification makes the controls in **S** redundant. As in my cross-sectional logit models, logic requires that I lag my explanatory variables: in practice, I estimate the hazard function of a given bank i on day t in year y by drawing on balance sheet information from the end of year $y-1$. The exponential function keeps the hazard rate from turning negative and $\mathbf{\Gamma'}$ and $\mathbf{\Delta'}$ constitute the vectors of coefficients to be estimated by the model.

Since I am employing baseline hazard stratification techniques on the city- and bank-type level, I need to adjust Model 1.3 as follows:

$$h_{i,t_y}(t \mid \mathbf{F}_{i,y-1}, \mathbf{G}_{i,y-1}) = h_0(t)_{t_y,c,b} \cdot exp(\mathbf{\Gamma'}\mathbf{F}_{i,y-1} + \mathbf{\Delta'}\mathbf{G}_{i,y-1}) \tag{1.4}$$

where the baseline hazard $h_0(t)_{t,c,b}$ is now allowed to vary for each city c and each bank type b in the sample. The stratifications of the baseline hazard according to bank type and city result in 384 different possible baseline hazards on day t of year y. Although part of these possible combinations are not brought to bear at any moment because cities only harbored a bank from a particular moment onwards or were home to one single bank only, stratification on this granular level places a very demanding, time-varying fixed effects control on the independent variables in the model.

Table 1.3 displays the summary statistics for my survival regressions. All independent variables in **F** and **G** are defined as before. However, in terms of repo exposure, I limit myself to the ratio of repos to equity to

allow for a more succinct summary of the results.[115] Time to failure now represents the dependent variable.[116] Banks enter the "survival contest" on 31 December 1868 or on the day on which they first published a balance sheet if they were founded after 31 December 1868. Survival analysis deals with delayed entry by assuming that late arrivals were not at risk before they entered the study. This certainly applies to credit institutions which did not yet exist; but this assumption also makes sense for the time span between the foundation date and the publication of the first financial statement because, as a matter of fact, banks did not fail during this period. The latest time at which a bank can fail in the survival setting of this subsection is 30 December 1879. Banks which managed to survive until after this date are right-censored. Right-censoring is the standard way of dealing with non-failing subjects in survival studies running for a pre-specified length of time. The ease of incorporating left- and right-censored observations into survival regressions yields a definitive advantage over conventional probit and logit models when using unbalanced panel data. Another benefit that can be reaped by applying survival techniques relates to the nature of the dependent variable. By using the exact time to failure, rather than a binary indicator of failure, I can draw on more variation on the left-hand side of the equation, exploiting the full set of information captured in my panel data set. Finally, since the survival setting follows banks between 1868 and 1879, it significantly expands the sample of this study. Model 1.4 is estimated on the basis of 300 individual banks, 100 of which close permanently during the time period under observation.

Table 1.3: Summary statistics for survival regressions

Variable	Cat	Obs	Mean	Std. Dev.	Min	Max	P1	P5	P25	P50	P75	P95	P99
Time to failure (in days)	**Y**	1542	2568.46	990.45	365.00	4017.00	365.00	730.00	1826.00	2556.00	3287.00	4017.00	4017.00
Bank size (ln)	**F**	1542	14.14	1.79	9.12	19.06	10.87	11.80	12.79	13.71	15.49	17.40	18.79
Bank age	**F**	1542	4.97	5.28	0.00	38.00	0.00	0.00	2.00	4.00	6.00	13.00	32.00
Illiquid assets to total assets	**F**	1542	0.32	0.28	0.00	1.00	0.00	0.00	0.08	0.25	0.52	0.87	0.95
Deposits to cash reserves	**F**	1542	1.08	3.18	0.00	65.90	0.00	0.00	0.22	0.59	0.99	3.11	10.19
Leverage ratio	**F**	1542	3.71	3.10	1.01	25.25	1.03	1.13	1.79	2.71	4.41	9.62	16.16
Return on equity	**F**	1542	0.08	0.15	-0.88	0.97	-0.50	-0.20	0.05	0.09	0.14	0.25	0.47
Mortgage loan share	**G**	1542	0.15	0.29	0.00	1.00	0.00	0.00	0.00	0.00	0.14	0.97	1.00
Real estate to non-cash assets	**G**	1542	0.05	0.12	0.00	0.96	0.00	0.00	0.00	0.00	0.04	0.31	0.64
Repos to equity	**G**	1542	0.04	0.26	0.00	6.66	0.00	0.00	0.00	0.00	0.00	0.17	0.81

Columns 1 to 4 in Table 1.4 summarize the results of the Cox regressions estimated for this section. In column 1, I display the results for a Cox proportional hazard regression without stratification/fixed effects, reflecting the reduced equation in Model 1.3; column 2 adds bank-type fixed effects, column 3 swaps bank-type stratification for city-level stratification and column 4 draws on both bank-type and city-level fixed effects. The Schoenfeld residual test cannot reject the null of hazard proportionality at any conventional confidence level in column 1, 3 and 4.[117] In the specification using only bank-type fixed effects, proportionality is rejected at the 10% level. All coefficients in Table 1.4 constitute marginal effects of a one standard deviation increase in the covariate. For Cox proportional hazard models, the marginal effect is conventionally computed for the relative hazard. Thus, the implicit question I ask is the following: by how much does the instantaneous rate of failure on any given day increase for an average bank if the covariate in question is raised by one standard deviation?

[115] In the survival regressions using bank-type and city fixed effects, the repo dummy actually emerges as a significant predictor. One explanation for this difference might be that the control group is much bigger than in the cross-sectional regressions, making exposure to repos itself a significant predictor too.

[116] Although Cox regression models are conventionally written in hazard form, they can be expressed in a time-to-failure metric too.

[117] Table 1.4 shows the p-values for the Schoenfeld residual test; the null hypothesis is hazard proportionality, which represents the essential requirement for Cox regressions to be valid.

Table 1.4: Explaining bank failures (1868-1879): survival regressions

VARIABLES	(1) Cox PH	(2) Cox PH	(3) Cox PH	(4) Cox PH	(5) Lognormal	(6) Gamma
Bank size	0.16	0.14	-0.52***	-0.51***	-743.28*	-651.37*
	(0.12)	(0.12)	(0.18)	(0.19)	(413.31)	(366.50)
Bank age	-0.94***	-0.97***	-0.78***	-0.83***	3,487.37***	3,178.72***
	(0.18)	(0.19)	(0.21)	(0.24)	(755.84)	(796.21)
Illiquid assets to total assets	0.64***	0.65***	0.51***	0.47***	-2,015.97***	-2,167.82***
	(0.14)	(0.14)	(0.15)	(0.16)	(538.46)	(594.10)
Deposits to cash reserves	0.09*	0.11*	0.03	0.11	-490.12	-201.53
	(0.06)	(0.06)	(0.06)	(0.16)	(345.97)	(167.50)
Leverage ratio	0.37***	0.39***	0.36***	0.36***	-1,011.95***	-1,022.76***
	(0.10)	(0.10)	(0.12)	(0.13)	(389.37)	(339.23)
Return on equity	-0.52***	-0.54***	-0.47***	-0.48***	1,667.83***	1,323.37***
	(0.08)	(0.08)	(0.10)	(0.11)	(456.64)	(380.93)
Mortgage loan share	-0.74***	-0.70**	-0.72***	-0.68**	2,089.75***	2,348.31***
	(0.17)	(0.30)	(0.18)	(0.34)	(521.71)	(669.60)
Real estate to non-cash assets	0.13	0.13	0.08	0.04	-40.56	-347.27
	(0.10)	(0.10)	(0.11)	(0.12)	(346.05)	(332.21)
Repos to equity	0.13***	0.13***	0.13**	0.13**	-501.25*	-392.46***
	(0.03)	(0.03)	(0.05)	(0.05)	(293.18)	(141.59)
Clustered SE	✓	✓	✓	✓	✓	✓
Bank type fixed effects	×	✓	×	✓	×	×
City fixed effects	×	×	✓	✓	×	×
Observations	1,542	1,542	1,542	1,542	1,542	1,542
Banks	300	300	300	300	300	300
Failures	100	100	100	100	100	100
Log-likelihood	-443.99	-413.81	-174.24	-150.39	-116.19	-109.27
LR (Wald) chi2 statistic	135.33	128.63	71.38	63.47	151.35	158.26
Schoenfeld residuals test	0.14	0.09	0.91	0.78	-	-

Marginal effects for one standard deviation increase in covariate.
For Cox PH models marginal effects are on relative hazard.
For parametric models marginal effects represent change in time to failure (in days).
Clustered standard errors for marginal effects in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Computing the marginal effect in this way allows for comparisons with the marginal effects obtained from my logit models above.

Overall, the baseline results in Table 1.2 are robust to the inclusion of fixed effects at the bank-type and city-level. In fact, a comparison of results in column 1 and 2 shows that differences in bank-types beyond those already captured in **F** did not matter for banks' survival experience: marginal effects are hardly changed. However, the use of Cox models and the inclusion of city-fixed effects triggers some changes in comparison to the maximum likelihood estimation results which are worth discussing. First, once city-level fixed effects are included, bank size receives the right sign and becomes both statistically and economically highly significant. This radical change suggests that the covariate capturing bank size in the baseline model is strongly correlated with location. This explanation is plausible as the largest banks of the Empire were concentrated in the main cities (Vienna, Budapest and Prague). Second, once the location of credit institutions is controlled for, the deposit to cash ratio loses both statistical and economic significance. This finding suggests that the ratio mostly captured differences in the intensity of funding withdrawals across various cities. Third, and most interestingly, the real estate to non-cash assets ratio is statistically indistinguishable from zero in all survival regressions. To be sure, the imprecision is not due to the inclusion of fixed effects as statistical insignificance also emerges from the simple Cox model results in column 1. I interpret this result in the following way: while

the variation in the real estate to non-cash assets ratio is enough to precisely predict failure in a binary setting, the covariate does not contain enough information to discriminate among different times to failure. Paired with the fact that mortgage lending is still estimated to have significantly reduced the risk of failure, the absence of any significant effects of bank-level real estate exposure in the Cox models further qualifies the "real estate" channel to bank distress during the *Gründerkrach*. Together, these results present a more serious challenge to the received wisdom on bank distress during the *Gründerkrach* than my baseline results. Finally, although the marginal effects of banks' repo exposure are a little less precisely estimated than in my baseline regressions, the size of the estimated effect actually increases relative to the logit results. The survival regressions thus confirm the important role of repos as a specific channel to bank distress.

Although there are good reasons to choose semi-parametric modeling over parametric survival techniques if the proportionality assumption holds (c.f. above), I also estimate two parametric accelerated-failure time models. The parametric models estimated in this chapter primarily serve the purpose of checking the robustness of my Cox models. In addition, parametric survival analysis allows for a nice representation of marginal effects in the form of increasing or decreasing days to failure. Based on the empirical hazard function displayed in Figure 1.14 above, I assume that bank failures during the *Gründerkrach* occur either according to a lognormal distribution or a more flexible two-parameter generalized gamma distribution. The results for these two models are displayed in column 5 and 6 in Table 1.4. All the signs on marginal effects are necessarily reversed in the parametric models: positive marginal effects increase the time to failure rather than the risk of failure. The results in columns 5 and 6 should be compared with column 1 only because the parametric models do not allow for fixed effects estimation. Overall, it is encouraging to see that all marginal effects obtained from the fully parametric models are consistent with the findings emerging from the corresponding Cox model. Moreover, the parametric estimation results enable me to put a precise number on the effect of repo exposure. Drawing on the more conservative gamma model, I find that a one standard deviation increase in the repo to equity ratio reduces the time to failure by more than year (392 days).

Having addressed omitted variable bias in depth, I now turn to the second major concern for identification: selection bias. As noted above, some banks did not publish their financial data for the year preceding failure in 1873 and 1874, which reduces my baseline sample to 181 banks. If there was a systematic relationship between the omission to publish financial statements and bank closure, selection bias should be taken into account in the interpretation of the econometric results in this study. To some extent, my survival regressions above alleviate these concerns because they are based on a much larger sample and yield qualitatively similar results. Yet, in order to systematically check for the presence of selection bias in my baseline sample, I first compare banks which failed and are contained in my sample to bank failures that remain outside my sample. I can proceed to these comparisons because the *Compass* provides some information even for banks that did not publish balance sheets. I conduct several statistical tests drawing on data shown in Table 1.9 in the appendix. First, I test for differences in the average dates of failure. In order to do so, I convert the failure dates into integer values starting with 9 May 1873 as day zero. When I compare the dates of the 64 failures in my baseline sample to the

dates of the 40 failures outside my sample, I cannot reject the null of mean equality (the corresponding p-value is 0.94). Moreover, more formal test of the equality of survivor functions of the two groups cannot reject the null of equality (c.f. Table 1.5). Second, I test whether the prevalent type of failure (liquidation, bankruptcy and merger) is systematically different for the two groups. For this purpose, I assign categorical values to the three types of failure and then test the equality of failure distributions across the three types using a two sample Kolmogorov-Smirnov test. This distributional test cannot reject the null of equality. In fact, the test suggests that the distribution of failure types is literally identical (p-value of 0.99).

Table 1.5: Tests for equality of survivor functions ($H0 = equality$)

In/out of sample	Events observed	Events expected
Failures outside sample	40	42.12
In sample failures	64	61.88
Total	104	104
1) Log-rank test: $Chi2(6) = 0.19,\ Pr > Chi2 = 0.66$		
2) Cox test: $LR\ Chi2(6) = 0.19,\ Pr > Chi2 = 0.66$		
3) Wilcoxon-Breslow-Gehan test: $Chi2(6) = 0.28,\ Pr > Chi2 = 0.59$		
4) Tarone-Ware test: $Chi2(6) = 0.03,\ Pr > Chi2 = 0.87$		
5) Peto-Peto-Prentice test: $Chi2(6) = 0.24,\ Pr > Chi2 = 0.62$		

Third, for 68 banks which failed between May 1873 and December 1874, the *Compass* provides descriptive reasons of failure (c.f. Table 1.9). Since 20 of these banks are not in my sample, I can test whether the causes of failure were systematically different across the two groups in the subsample for which I have information available. For this purpose, I classify descriptive reasons of failure into six categories: funding problems (incl. withdrawals), losses due to market liquidity, losses from investment banking (incl. repos), defaulting loans, contagion and other reasons.[118] Table 1.6 presents the results for this exercise. I find no statistical significant difference in the causes of failure, except for one category: investment banking (IB). Whereas roughly half of the banks outside my sample failed due to IB activities, more than 70% of the bank failures in my sample had losses from IB listed as a reason for closure. This result could suggest that my regression results, in particular the coefficient on repo exposure, are biased upwards relative to the population parameter.

Table 1.6: T-test for mean equality: reasons of bank failures (05/1873-12/1874)

In/out of sample	**Total/obs.**	**Funding**	**Market**	**IB**	**Loans**	**Contagion**	**Other**
Failures outside sample	27	2	1	9	3	3	9
In sample failures	88	11	8	34	14	9	12
Failures outside sample (mean)	20	0.10	0.05	0.45	0.15	0.15	0.45
In sample failures (mean)	48	0.23	0.17	0.71	0.29	0.19	0.25
t-statistic		-1.23	-1.29	-2.05**	-1.22	-0.36	1.63

*** p<0.01, ** p<0.05, * p<0.1; statistical significance based on p-values for the null of equal means.
Several reasons can be given for failure. Source: *Compass*

However, since I do not have any information on the descriptive reasons of failures for half of the banks which remain outside my sample, the tests in Table 1.6 remain inconclusive. In order to go beyond the data in the *Compass*, I examine several additional archival sources. I suspect that banks outside my sample really engaged in similar investment banking activities but did not report on them. The rationale for this hypothesis is that many of the banks which remain outside my baseline sample were founded in 1872 or 1873 and immediately closed after the crash, leaving little time to communicate extensive information on business activities to the *Compass*. As mentioned in Section 1.3, I collected several complementary data sets from the Viennese stock

[118] The category "other" contains mainly cases of fraud and instances when a bank was unable to go fully public after its foundation.

market archive for the purpose of investigating the presence of selection bias. First, I transcribed the list of firms that had received official trading spots inside the Viennese stock exchange for the year 1873. This list enables me to find out and test whether banks that failed but remained outside my sample were less active on the stock exchange than the credit institution which closed but published balance sheet data. Second, I looked at the reports of the arbitration panel at the Viennese stock exchange. Whenever a trader, broker or investment fund defaulted on a bank, and the trade had been officially registered, the bank presented its residual claim to this arbitration panel. I collected the claims presented by credit institutions which subsequently failed, again with the purpose of comparing banks inside to banks outside my sample. Third, the official Viennese stock exchange committee issued a public statement on 18 July 1873 requesting all creditors who had not yet reached full settlement with their debtors to send in lists of outstanding receivables including the amounts and the names of the liable party. I systematically collected all the lists banks addressed to the stock exchange committee to assemble material for a third test comparing failing banks inside my sample to their peers that did not publish financial data. Table 1.10 in the appendix summarizes the data I collected for all banks that failed between May 1873 and December 1874. Based on Table 1.10, I implement three mean equality tests comparing failing credit institutions in my baseline sample to banks outside my sample. The results are reported in Table 1.7. The tests suggest that there is no systematic, statistically relevant difference between the failing banks in and outside my baseline sample when it comes to the data from the VSE archives. This final set of tests therefore joins other statistical exercises above in suggesting that selection bias is not a serious concern for my empirical results. Banks which failed had very similar profiles, no matter whether they published financial balance sheets or not: they were equally likely to be an active trading institution on the stock exchange and to suffer from losses due to defaulting investors. Furthermore, they also show no differences in their propensity to accumulate residual claims on repo borrowers as shown in the debtors lists submitted to the VSE committee.

Table 1.7: T-test for mean equality: additional data from VSE archives

In/out of sample	**Obs.**	**VSE member**	**VSE arbitration panel**	**VSE debtors list**
Failures outside sample	40	6	3	5
In sample failures	64	16	10	12
Failures outside sample (mean)	40	0.15	0.08	0.13
In sample failures (mean)	64	0.25	0.16	0.19
t-statistic		-1.21	-1.22	-0.83

*** p<0.01, ** p<0.05, * p<0.1; statistical significance based on p-values for the null of equal means.
Source: *VSE archives*

1.7 Origins of a banking crisis

The previous section shows that bank-level exposure to repos constitues an important, very specific econometric determinant of bank distress during the *Gründerkrach* of 1873. Whereas the channels through which other significant predictors in **F** lead to bank distress are explored in many of the previous contributions on the causes of banking crises in economics and economic history, the mechanisms leading to repo lender distress are less well known. More generally, discussions of historical repo market crises and repo market microstructure

are largely absent from the literature. In this section, I thus explore these topics in more depth. Wirth (1874b, p.141) suggests that repo lenders had to repossess heavily depreciated collateral from defaulting borrowers, affecting their equity reserves *momentarily*. This description raises the question why and how losses ultimately materialized. To set the groundwork, I will explain the major characteristics of the repo market and depict its evolution during the crisis of 1873. In a second subsection, I briefly survey the legal background of repo lending in Austria-Hungary. Third, I will put the hypotheses formulated in Section 1.2 to the test: specifically, I ask whether and why lenders incurred losses by selling repossessed collateral; and I look at stock market conditions during the crisis of 1873.

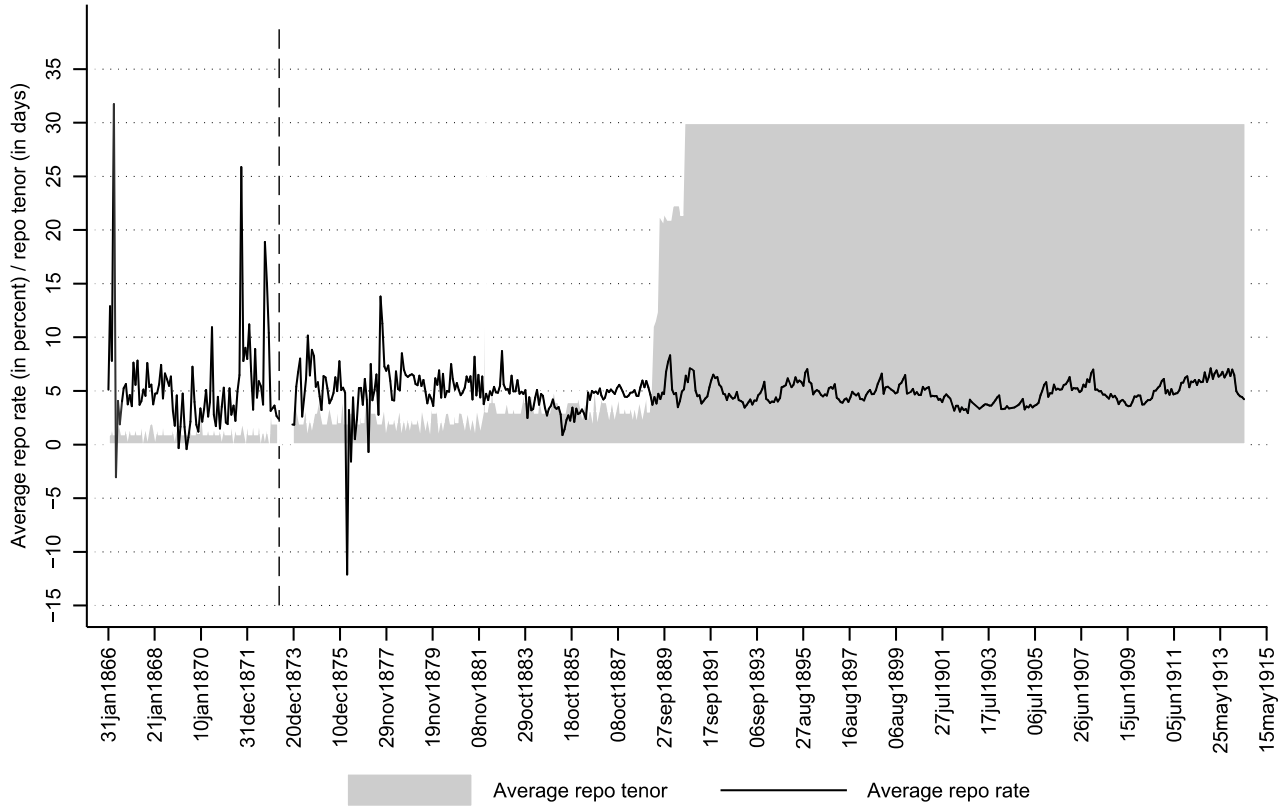
1.7.1 Repo market microstructure

How did the Austro-Hungarian *Kostgeschäft* market evolve before and during the *Gründerkrach*? Bank balance sheets only provide a snapshot of the size of the repo portfolio at year-end. By definition, these snapshots cannot deliver a continuous picture of the market and they do not convey any information on the riskiness and profitability of *Kostgeschäft*. Fortunately, repo interest rates can be obtained from the *Coursblatt des Gremiums der k.k. Börse-Sensale*. The *Coursblatt* daily published the average cost for an overnight repo on the Viennese *Bourse*, expressed as the difference between the sale and the repurchase price for 25 pieces of a given stock. The *Coursblatt* reported these repo costs (*Kostgeld*) averaged across counterparties for two railway stocks, the *Nordbahn* as well as the *Staatsbahn*, and two bank shares, the *Creditanstalt* and the *Anglo-Austrian Bank*. To compute repo rates, I follow the instructions in contemporary investor manuals (Haupt, 1874): I relate the price differential to the underlying collateral price, taking into account the repo tenor and the accumulated interests attached to the collateral:

$$repo\ rate = \frac{(Kostgeld + daily\ interest \cdot tenor)}{25 * (collateral\ price + accumulated\ interests)} \cdot \frac{100\% \cdot 360\ days}{tenor}$$

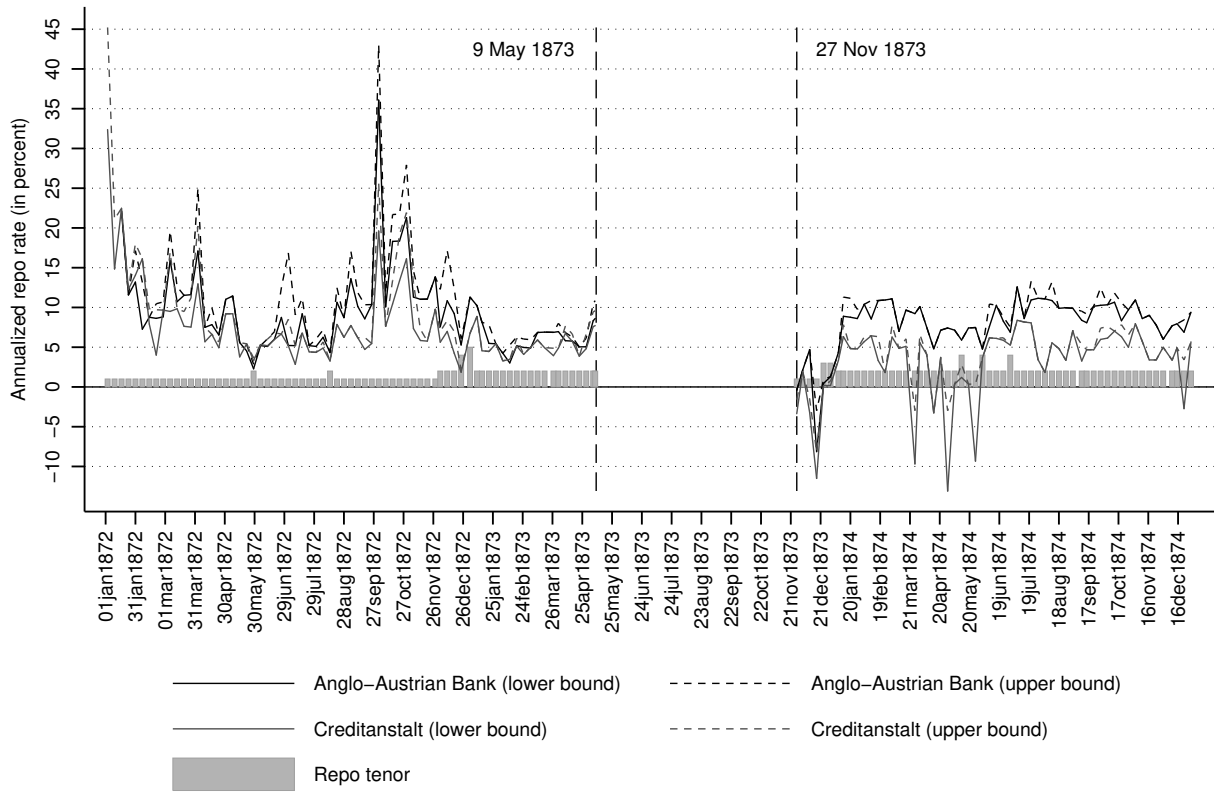
The totality of underlying repo transactions contributing to the average *Kostgeld* reported in the *Coursblatt* was contracted partly among brokers, partly between investors, brokers and banks. Consequently, the prices displayed in the *Coursblatt* constitute an imperfect measure of the interest rate paid on individual overnight repurchase agreements: the cost of repos most probably varied across different contracts depending on the default risk of the borrowing party. Furthermore, the stocks for which repo costs are quoted in the *Coursblatt* represent securities with particularly liquid markets: both the *Nordbahn* as well as the *Staatsbahn* were important railway lines benefiting from state guarantees on dividends, while the *Creditanstalt* and the *Anglo-Austrian Bank* represented the largest and fourth largest Austrian banks respectively in 1873. The interest rate attached to them is almost certainly an underestimation for the wider market conditions. The data thus reflects a lower-bound barometer for the volatility, profitability and riskiness of the repo market in the Habsburg Empire.

Figure 1.15: Average repo rates on the Viennese Stock Exchange, monthly data (01/1868-07/1914)



Source: own calculations; Compass, Coursblatt des Gremiums der k.k. Börse−Sensale and Wiener Zeitung

Figure 1.16: Average repo rates on the Viennese Stock Exchange, weekly data (01/1872-12/1874)



Source: own calculations; Compass, Coursblatt des Gremiums der k.k. Börse−Sensale and Wiener Zeitung

Figure 1.15 displays the evolution of average repo rates and maturities (so called "tenors") for the long run and Figure 1.16 zooms into the period between 1872 and 1874 for two specific types of collateral, *Creditanstalt* and *Anglo-Austrian Bank* shares.[119] Several conclusions can be drawn from these two figures. First, the graphs plausibilize contemporaries' reports of high repo rates of up to 50% per annum throughout the last two years before the *Gründerkrach*. Both Neuwirth (1874) and Wirth (1874b) mention these exorbitantly high rates had become standard in the autumn of 1872.

Second, repo rates turned negative on various occasions. Although the mere existence of negative interest rates on repos seems puzzling at first sight, negative repo rates are not unknown in both historical and modern repo markets (Flandreau and Sicsic, 2003; Federal Reserve Bank of New York, 2004; Viaene, 2004). Negative repo rates can arise for two reasons. First, the lender might want to reap particular advantages connected to holding collateral securities at a specific point in time (e.g. due to a lottery, an upcoming shareholder assembly or additional subscription options) and thus be willing to pay for obtaining them temporarily. As highlighted by the Federal Reserve Bank of New York (2004, p.2; 4-5), negative rates occur in so-called "special collateral" repo transactions, where the lender's aim is to obtain specific securities rather than to earn interest on the money lent. In contrast to the cost of "general collateral" repos which are entered into by cash lenders to gain interest, "specials" rates can therefore turn negative. Second, negative interest rates may be a sign of particularly bearish markets. In order to prolong a downward bet, an investor might wish to obtain securities through a repo to honor maturing obligations to deliver. At the same time, she hopes to be able to repurchase the collateral at a lower price in the future when the repo loan is due to be paid back (Flandreau and Sicsic, 2003, p.201). In the Austro-Hungarian case, negative interest rates might reflect attempts by the *Creditanstalt* and the *Anglo-Austrian Bank* to stabilize their own stocks' prices on the market during phases of financial turmoil: the banks could have intervened to support their shares via repo transactions for a limited amount of time, paying interest to investors willing to swap their holdings temporarily for cash rather than liquidating them into the market. A second rationale for negative rates on *Anglo-Austrian Bank* shares may be that investors heavily speculated against these shares in 1874 when the bank was weakened by losses incurred through its daughter bank, the *Anglo-Hungarian Bank* (c.f. Table 1.9 below).

Third, with the average tenor fluctuating between one and two days between 1868 and 1874, the Austro-Hungarian repo market exhibited very low maturities which are comparable to those in modern day tri-party repo markets. Interestingly, Figure 1.15 also shows a clear negative correlation between repo tenors and rate volatility. After the Viennese stock exchange committee had voted to abolish the daily liquidation of stocks in favor of three liquidations per week in the aftermath of the crisis of 1873, rates started to flatten out – and this tendency was reinforced when the committee again raised the tenor to 20 and subsequently 30 days at the turn of the century.[120] From a long-run perspective, the *Gründerzeit* stands out as a period of high rate volatility

[119] For these two collateral types, a continuous time series of repo rates is available; rates on the other two collateral shares were sometimes not recorded on a weekly basis.

[120] In ongoing research beyond the scope of this dissertation, I work on the long-term evolution of the Austro-Hungarian repo market and the role of regulation in determining the volatility and the level of rates.

and very short average maturities. Finally, the *Gründerkrach* itself emerges as an exceptional episode in the history of the Austro-Hungarian repo market. Figures 1.15 and 1.16 show that the repo market on the Viennese *Bourse* completely froze between 9 May and 27 November 1873: for a period of seven months following Black Friday not a single repo quote was reported by the *Coursblatt*. The fact that the market ground to a halt even for some of the most liquid, well-established securities of the time testifies to the severity of the market freeze following 9 May 1873. I will elaborate on the causes of this collapse below.

Interest rates and tenors constitute only two of the three major loan-level characteristics of repo loans; the third feature is the haircut. Repo haircuts were not reported by the *Coursblatt*. However, following the stock market committee's communiqué of 18 July 1873, several creditors submitted transaction histories of defaulted repo loans to the VSE. These transaction histories enable me to reconstruct the haircuts for a sample of repo loans. I was only able to reconstruct haircuts for repo transactions for which the lender reported both, the purchasing price of collateral and the exact date on which the transaction was entered, to the VSE.[121] These two pieces of information allow me to compare the purchasing price to the market price of the collateral at the start date of the repo loan in order to compute the haircut. In this way, I collected a sample of 288 haircuts on repo loans granted between 1 January and 9 May 1873. Repo haircuts might depend on a variety of factors, including the liquidity of the underlying collateral, the solvency of the borrower, the risk aversion of the lender and the general market conditions at the time of loan approval. This range of potential drivers means that pooling haircuts across counterparties (lenders and borrowers) and collateral securities might not be informative. My main goal, however, is to compare the overall evolution of haircuts prior to the market collapse in 1873 to the developments in 2007-08.[122] I am primarily interested in knowing whether margins increased gradually in the period immediately before 9 May 1873 or, on the contrary, remained fairly stable. Gorton and Metrick (2012a, p.429) compute a repo-haircut index for the bilateral repo market in the U.S. as the equally weighted average haircut for different collateral classes. They show that this index increased from zero to over 25% in the months between September 2007 and Lehman Brothers' default in September 2008. In contrast, Copeland et al. (2014, p.2345) show that margins in the tri-party repo market did not move upwards until September 2008 when they started to climb as the market's size contracted precipitously.

In Figure 1.17 I plot both the actual transactions and the unweighted average of repo haircuts as recorded in my sample between 1 January and 9 May 1873. The underlying collateral classes fall into one of two categories: shares (banks, construction companies, transport companies including railways, shipping and local public transport, industrial firms) and lots (sovereign debt). The bulk of repos in my sample were done on bank shares (143), construction company stocks (70), and industrial firm shares (61), with transport companies (18) and sovereign lots (7) being only of minor importance. Since repos were terminable over night, I assume that transactions which lasted for more than one day were continuously rolled over by the lender. Figure 1.17 shows

[121] Many more outstanding repo debts were reported to the VSE committee but due to the absence of information on either date or purchasing price, I cannot compute the corresponding haircut.

[122] When talking about "comparisons" in this context, I do not mean to suggest that direct 1-to-1 comparisons between 1873 and 2007-08 are feasible, let alone sensible. Rather, I am interested in juxtaposing general market tendencies that should be relatively independent of the time period.

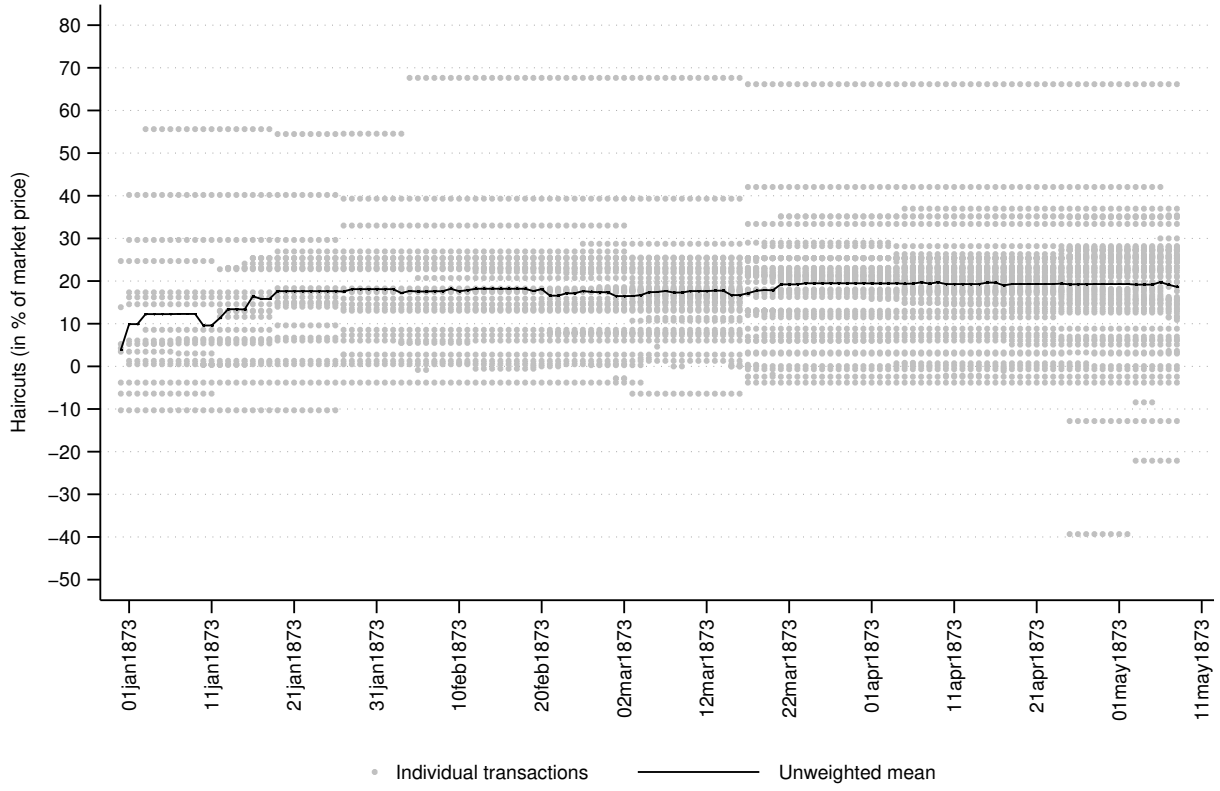
that after an initial increase in margins in January 1873, the average haircut remained remarkably stable until the market collapsed. Although the rise in January is substantial, due to a lack of data prior to 1 January 1873 I am unable to check whether this increase merely derives from an end-of-year effect or rather reflects an actual increase compared to previous levels observed in 1872. The data plotted in Figure 1.17 is remarkable for several reasons. First, it should be noted that the sample of 288 haircuts I collected from the VSE archives is almost certainly unrepresentative: it contains only repo loans which ended in default. Hence, these haircuts are likely to constitute an upper bound for the haircuts which actually prevailed in the market. Still, even these "lemon" loans benefited from extremely stable haircuts prior to the crisis. Second, it is interesting to see that repo lenders applied negative haircuts: at times, they purchased the collateral at a price above the prevailing market price. While negative haircuts are puzzling from a risk management perspective, this behavior fits into the *Gründerbanking* business model discussed in Section 1.4. If investment banks attempted to boost the attractiveness of particular shares or wished to extend generous support to certain investors, negative haircuts could have constituted a straightforward way to do so. The fact that the most generous negative haircuts in my sample were applied just before the market collapsed speaks to this interpretation and the "moral obligation" of investment banks vis-à-vis investors as mentioned by Kautsch (1871) (c.f. Section 1.4). Third, in conjunction with the low volatility and low levels of repo rates in early 1873 (c.f. Figure 1.16), the stability of haircuts between the end of January and 9 May 1873 indicates that the Austro-Hungarian repo market did not adjust gradually to a higher risk equilibrium in spring 1873: rather, the market collapsed precipitously on Black Friday. The stickiness of repo haircuts on the eve of the crisis could suggest that repo lenders never seriously contemplated the possibility of borrower default. At the very least, repo lenders did not anticipate a fall in collateral prices of more than 20% (which was the average haircut just before the market collapsed).

Overall, the repo market microstructure in 1873 was characterized by the combination of very short tenors, repo rates which were relatively low in terms of levels and volatility directly before the crisis but highly volatile otherwise, and stable haircuts. These features and the sudden collapse of the market in May 1873 therefore show several parallels to the evolution of U.S. tri-party repo markets during the recent crisis of 2007-08. Two further elements of the market microstructure hitherto not discussed in detail are the legal treatment of repo loans and the funding situation of repo lenders during the *Gründerzeit*. These two aspects are key for our understanding of the channels leading to bank distress during the crisis of 1873. I will turn to these points in the last two subsections of this chapter.

1.7.2 Legal provisions governing repos

Section 1.2 provided a theoretical checklist for an investigation into the potential connection between the evolution of the Austro-Hungarian overnight repo market and bank distress during the *Gründerkrach*. A legal definition of the *Kostgeschäft* and its economic implications in the Habsburg Empire of the 1870s represents the logical starting point. The study of relevant journals, such as the *Gerichtshalle* (literally, the "court room"; the

Figure 1.17: Repo haircuts for a sample of transactions from VSE archives (Jan 1873 - May 1873)



Source: own calculations; VSE archives and Coursblatt

most prominent weekly journal of judicature of the time), reveals that practitioners and scholars alike discussed the legal nature of repo transactions with increasing passion on the eve of the *Gründerkrach*, after their economic importance had grown during the boom years. While some dissenting voices argued for different interpretations and although there was no specialized law dealing explicitly with *Kostgeschäft*, the Austrian legal doctrine treated these 19$^{\text{th}}$ century repos as loan contracts regulated by the provisions for the so-called *pignus irregulare* (in German, *irreguläres Pfandrecht*; irregular lien).[123] Although technically the Kostgeschäft combined a sale with a subsequent repurchase of securities, its mainstream contemporary legal interpretation corresponded to that of a special sort of collateralized loan. This interpretation governed the Austrian repo market until 2003 when these loans were finally recognized as a financial transaction *sui generis* (Plattner, 2007, p.683).

Pignus irregulare, as opposed to *pignus regulare*, deals with collateral which cannot be – or simply by convention, is not – separated from the creditor's own assets once it has been handed over by the borrower in exchange for a cash loan. It provides the legal framework for loans secured by fungible collateral. In 19$^{\text{th}}$ century Austria-Hungary, legal custom considered securities sold in the first step of *Kostgeschäft* repo transactions to meet these criteria whereas normal, longer term lombard loans were classified into the category of regular lien. The reason for this difference is grounded in the fact that the *Kostgeschäft* had initially represented a credit transaction which was almost exclusively used on the stock market. The very short-term, mostly overnight

[123]For a discussion of this intepretation, c.f. Abeles (1871), Bezecny (1871), Ofner (1871, 1890) and Adler (1889).

maturity of the *Kostgeschäft* made it impracticable to legally treat these repos as traditional secured loans. Even though each single share acting as collateral could have been identified as it carried a unique serial number, *Kostgeschäft* collateral was perceived to commingle with the securities holdings of the lender.[124] Repo creditors could therefore re-sell or re-hypothecate *Kostgeschäft* collateral without running the risk of being accused of misappropriation as they would have been under the regime of *pignus regulare*. *Pignus regulare* did not only require the restitution of the very same collateral that was pledged, it also forbade any re-sale or re-hypothecation by the lender while the transaction was still ongoing. Abeles (1871) argues that these differences explain why *Kostgeschäft* loans were generally cheaper and entailed lower haircuts than conventional lombard loans, at least during the early years of dualism.

Although repo lenders benefited from the right to make use of the collateral at their discretion while the repo was still outstanding, the handling of collateral upon debtor default depended on the details of the underlying contract and the type of lender. Upon debtor default, the Code of Commercial Law (*Handelsgesetzbuch*, henceforth: HGB) of 1862 ruled out any type of compensatory acquisition of the collateral by non-bank lenders.[125] Non-bank lenders were obliged to sell collateral in order to match the outstanding debt claim in case of borrower default. Liquidation of the collateral was possible without a formal lawsuit but the provisions of §310 HGB had to be met. First, the credit contract had had to be set up in writing. Second, the local commercial court needed to approve of the sale of collateral upon borrower default and liquidation was only possible after the creditor had informed the debtor about the court's approval. Third, the court bore the monopoly power to set the date for the executive sale. Hence, since the decisive power upon borrower default resided with the court, the stipulations of §310 HGB may be interpreted as imposing a form of automatic stay on collateral in secured lending operations.

§311 HGB allowed for a circumvention of any interference by the local court in the liquidation process, and thus an exemption of automatic stay, as long as creditor and debtor mutually consented to do so in the written, initial credit contract. Under §311 HGB, the lender possessed the right to sell the collateral at discretion either publicly (i.e. upon public advance notice in official governmental journals) or privately if there was a market price for the pledged securities. Also, there was no exact rule for when this sale of collateral had to occur. In principle, the lack of precision was perceived to act in favor of both, lender and borrower, as it endowed the parties with the flexibility to maximize liquidation proceeds. Moreover, according to §311 HGB, the lender was only obliged to inform the debtor after she proceeded to the sale of collateral. In case the collateral liquidation resulted in a residual liability of the lender *vis-à-vis* the borrower, the excess proceeds were added to the borrower's bankruptcy assets; if, on the contrary, the liquidation ended with a residual claim on the borrower, this claim could be held against the remaining bankruptcy assets (Ministerium für Justiz und Handel, 1894, p.108).

[124] Bank balance sheets show that repos were categorized separately from the lender's own securities portfolio, at least as far as the banking sector is concerned.

[125] Compensatory acquisition of collateral was, and still is, forbidden by §1371 of the General Austrian Civil Code (*Allgemeines bürgerliches Gesetzbuch*, ABGB).

The focus of this paper, however, is on the banking sector. As ascertained by §312 HGB, lending banks benefited from certain legal privileges in the application of the HGB. §3 of the Law of 28 October 1865 granted banks the right to choose at will between the procedures of §310 and §311 HGB in response to debtor default.[126] This privilege to choose between the procedures in §310 and §311 HGB was not conditional on there being a written understanding between the bank and its debtor. Thus, these provisions did not leave much room for ambiguity whenever banks intervened as lenders in the *Kostgeschäft* market. If banks chose to opt for §311 HGB, repo collateral was exempt from automatic stay. Borrower default then resulted in the liquidation of pledged securities by the lenders, where the exact timing of the collateral sale was at the discretion of banks, or at least not legally fixed. Hence, in principle the legal context of the early 1870s allowed Austro-Hungarian credit institutions to benefit from a maximum of flexibility concerning the timing of collateral liquidation.

1.7.3 Repo lender distress during the *Gründerkrach*

I now turn to the question how this legal framework and the exemption from automatic stay for bank lenders played out during the *Gründerkrach*. As noted in Section 1.4, stock market prices started to decline from the beginning of April 1873 onwards when a number of joint-stock companies published disappointing results relative to the high expectations driven by the renewed boom in 1872 (Neuwirth, 1874, p.74). The decline in asset prices caught most investors on the wrong foot. Many had speculated *à la hausse* and could not honor time contracts after prices had started to fall. Every day, starting in mid-April 1873, contemporary newspapers listed dozens of individual investors and investment firms as insolvent and thus as expelled from the *Bourse* by the Viennese stock exchange's executive committee (Steiner, 1913).[127] *Prima facie*, falling collateral prices and increasing default risk should have signaled a need for *Kostgeschäft* lenders to increase haircuts for overnight roll-overs and place margin calls for repos with longer-term maturities. At the same time, one would expect that counterparties unable to meet these tighter requirements had their outstanding repo loans called in by creditors. However, as I have shown in Figures 1.16 and 1.17, neither repo rates nor haircuts moved much in the weeks before 9 May 1873. Again, this evolution of margins seems to be consistent with the *Gründerbanking* business model. *Ceteris paribus*, banks had no interest in pressurizing their borrowers, in particular if they believed that the downturn was temporary: increasing margins or calling in loans would have only raised the probability of collateral repossession given that most borrowers' financial position were far too leveraged and far too illiquid to honor all their commitments.

And yet, the fact that the Austro-Hungarian repo market collapsed precipitously on 9 May 1873 suggests that other features of the market remain to be explored. Contemporary sources provide helpful guidance in

[126] Reichs-Gesetz-Blatt für das Kaiserthum Österreich, '110.Verordnung vom 28.Oktober 1865', *30.Stück, 110.Verordnung* (Verordnung des Staatsministeriums und des Justizministeriums, über die, den Anstalten, welche Creditgeschäfte betreiben, zukommenden Ausnahmen von den allgemeinen Justizgesetzen), Vienna, 1865. c.f. http://alex.onb.ac.at/cgi-content/alex?aid=rgb&datum=18650004&seite=00000347; last accessed 12 December 2017.

[127] For some snapshots of the lists of insolvencies on the stock exchange, c.f. *Neue Freie Presse*, 'Börsen-Insolvenzen', 27.04.1873, p.11; *Neue Freie Presse*, 'Wiener Börse vom 29. April 1873', 30.04.1873, p.12; *Neue Freie Presse*, 'Wiener Börse vom 1. Mai 1873', 01.05.1873, p.4; *Neue Freie Presse*, 'Opfer der Börse', 03.05.1873, p.11; *Neue Freie Presse*, 'Wiener Börse vom 9.Mai', 09.05.1873, p.4.

this regard. In addition to banks' large exposure to repos, the report of the official parliamentary inquiry also mentioned that credit institutions had fostered:

> [t]he proliferation of activities akin to modern *crédit mobilier* institutions in all possible directions while relying on totally inadequate reserves for short-term liabilities. [Credit institutions' demise may be blamed on their] boundless investment of not only their own but also of borrowed capital in assets which were difficult to liquidate in times of need, instead of keeping their portfolio liquid as would have been appropriate given their liabilities structure.[128]

In order to finance the expansion of their underwriting business as well as their *Kostgeschäft* portfolio, investment banks drew on sight deposits and cash certificates (*Cassascheine*) with very short maturities. According to the final report of the Austrian House of Representatives' economic committee, cash certificates alone accounted for approximately 180 mill. *Florins* of Cisleithanian bank funding at the end of April 1873 (Abgeordnetenhaus, 1874, p.33). The fact that the Austrian part of the bank level data compiled for this study only sums up to 91 mill. *Florins* of cash certificates on 31 December 1872 testifies to empirical limitations induced by the annual frequency of balance sheets; however, it also suggests that the banking system's funding via *Cassascheine* still increased considerably during the last four months leading up to the *Gründerkrach*.[129] The correlation between the expansion of sight deposits and the high noon of investment banking did not only feature in reports on the causes of the crisis, it had also worried contemporary observers already several months before the *Gründerkrach*. There was no minimum reserve requirement, no guarantee scheme for retail deposits or cash certificates, and depositors had no legal entitlement whatsoever to be prioritized over other external funding providers in the case of bankruptcy or liquidation (Abgeordnetenhaus, 1874, p.33-34). On May 7, the *Neue Freie Presse*, alongside the *Wiener Zeitung* one of the most eminent Austrian daily newspapers, published an explicit warning:

> "We have pointed out repeatedly that the general public is indulged in an illusion concerning the nature and the laws governing cash certificates. [...] One should not ignore the fact that cash certificates are currently issued by so called banks whose solvency is questionable from one day to another."[130]

Some highly leveraged banks suffering directly from losses on their own securities holdings are known to have started to struggle with their deteriorating financial position as soon as 5 May. On this date, the supervisory council of the *Franco-Hungarian Bank*, a Budapest-based credit institution, itself an offspring of the Viennese *Franco-Austrian Bank*, felt the need to publicly call upon its shareholders for a further payment on its stocks – despite the fact that it had just recently decided in favor of the distribution of superdividends (Sommaruga, 1873, p.292). This bold move by the *Franco-Hungarian Bank*, which had participated in the foundation and IPOs of at least six of its Transleithanian homologues, triggered first concerns about certain banks' exposure

[128] Abgeordnetenhaus (1874, p.45).
[129] Figure 1.18 below corroborates these conjectures to the extent that it shows that certain banks, in particular those which failed in the aftermath of the Gründerkrach, exhibited very high deposit growth rates just before the crash.
[130] *Neue Freie Presse*, 'Das Recht der Cassenscheine', 07.05.1873, p.10.

to stock market developments. However, generalized public uncertainty surpassed a critical level when rumors solidified on 8 May that one of the largest stock market brokers and repo borrowers, the *Commissionshaus Petschek*, had defaulted on its repos loans.[131] Reacting to these events, depositors of Austro-Hungarian credit institutions initiated heavy funding withdrawals.

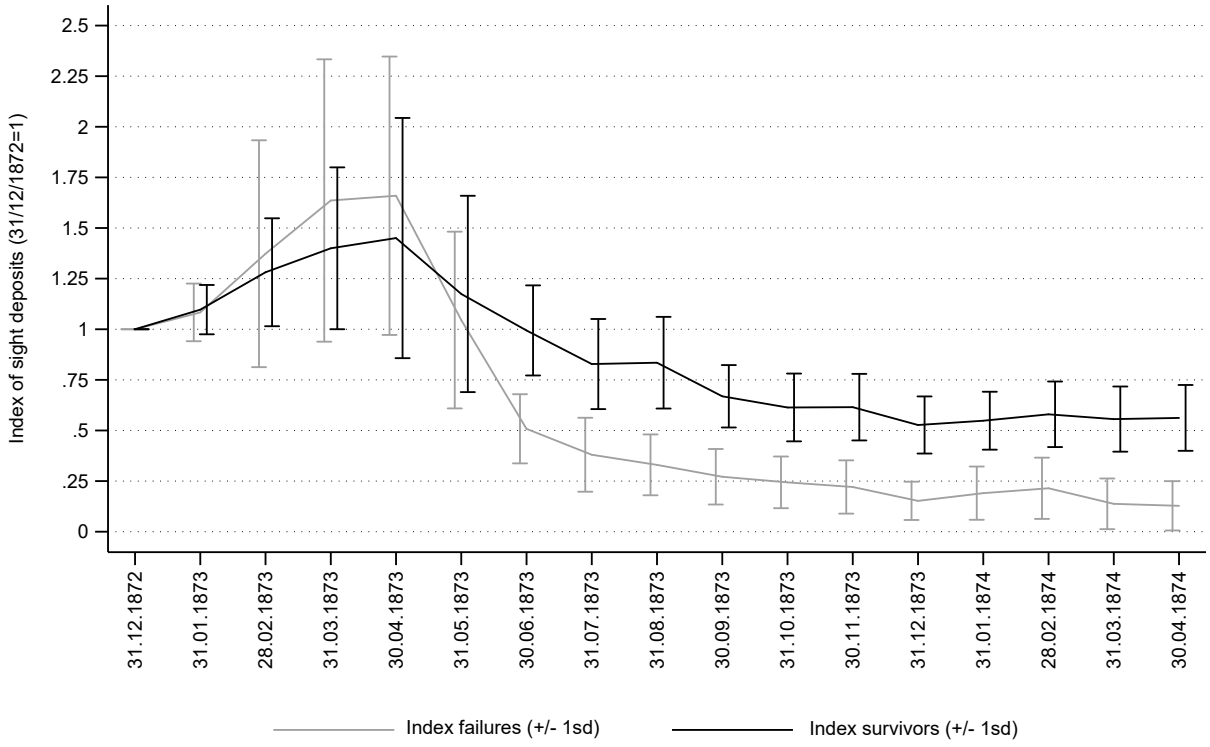
Figure 1.18 displays the mean monthly index (31/12/1873=1) of total callable deposits (retail deposits and cash certificates) for an available subsample of Austro-Hungarian banks between December 1872 and April 1874. Figure 1.18 is constructed on the basis of banks' voluntary data submissions to the press. The nature of this data is therefore problematic for any type of generalized statistical inference because the subsample varies in number and composition from call date to call date, depending on whether credit institutions published their financial data at the end of the month. The risk of selection bias looms large in this context. Specifically, one might expect financial intermediaries with particularly high withdrawal rates to stop publishing their data or to submit falsified accounts in order to avoid "adding fuel to the fire". Similarly, an *ex ante* selection into the sample may have occurred. For example, in the absence of deposit guarantee schemes, only very solid banks are likely to publish the outstanding amount of their retail deposits in the first place. Both behavioral patterns would make it impossible to gauge the dimension of occurring bank runs, let alone conducting any analysis on the groups of targeted banks, since they would imply a considerable upward bias in deposit growth rates. Nonetheless, contrary to what might be expected under the assumption of selection bias, the data allows for the construction of an almost black and white opposition between banks that failed during *Gründerkrach* and *ex post* survivors. I do not see financial intermediaries with particularly high withdrawal rates stop publishing their data, nor do only solid surviving banks publish the statements in the first place. Figure 1.18 shows that depositors were fairly confused about the financial health of their banks during the first month of the *Gründerkrach*: both banks that failed and banks which survived suffered from withdrawals. Table 1.8 disentangles the monthly changes in deposits from cumulative withdrawals for the collected sample of banks. While the cumulative mean equality tests confirm the picture from Figure 1.18, Table 1.8 shows that, when comparing ex post survivors and ex post failing banks, differences in the monthly changes in deposits were only statistically significant in June and July as well as in November and December 1873. Overall, 8 May 1873 heralded a period of severe funding pressures for the entire Austro-Hungarian banking system. However, whereas the stock market crash first led to runs on both ex post survivors and ex post failing banks, the sample of monthly deposits suggests that the months of June and July 1873 were characterized by more targeted runs on the specific group of banks which depositors had seemingly identified as particularly weak or exposed to the consequences of the financial market crisis. The re-intensification of targeted runs in November and December 1873 may be explained by the near-failure of the *Bodencreditanstalt* around this time.[132]

Banks' exposure to suddenly increasing funding liquidity risk represents the last piece to the puzzle of

[131] *Neue Freie Presse*, 'Wiener Börse vom 9.Mai', 09.05.1873, p.4.

[132] Chapter II will provide more details on the troubles of the BCA and how the government devised a rescue operation to save the bank. For examples of more detailed, bank-level graphs on deposit withdrawals, please refer to the appendix to the present chapter.

Figure 1.18: Monthly index of total deposits* of Austro-Hungarian banks (Dec 1872 - Apr 1874)



Source: own calculations; Tresor and Wiener Zeitung

*Total deposits equal the sum of retail deposits and cash certificates.

Table 1.8: Deposit withdrawals: mean equality tests (t-statistics)

Month	(1) Sample size	(1) Ex post survivors vs. ex post failures monthly changes	(2) Sample size	(2) Ex post survivors vs. ex post failures cumulative index
Jan 1873	17 vs 16	0.15	17 vs 16	0.15
Feb 1873	15 vs 13	-0.28	15 vs 13	-0.66
Mar 1873	15 vs 12	-0.90	14 vs 15	-1.14
Apr 1873	15 vs 15	-0.46	16 vs 18	-1.44
May 1873	16 vs 15	0.08	16 vs 15	-0.41
Jun 1873	14 vs 15	2.70**	27 vs 17	3.51***
Jul 1873	30 vs 14	3.11***	28 vs 17	3.27***
Aug 1873	31 vs 11	0.70	30 vs 18	3.61***
Sep 1873	30 vs 13	-0.14	27 vs 18	4.23***
Oct 1873	30 vs 12	-1.04	30 vs 18	3.83***
Nov 1873	29 vs 13	2.60**	28 vs 18	4.50***
Dec 1873	30 vs 9	1.76*	31 vs 19	4.28***

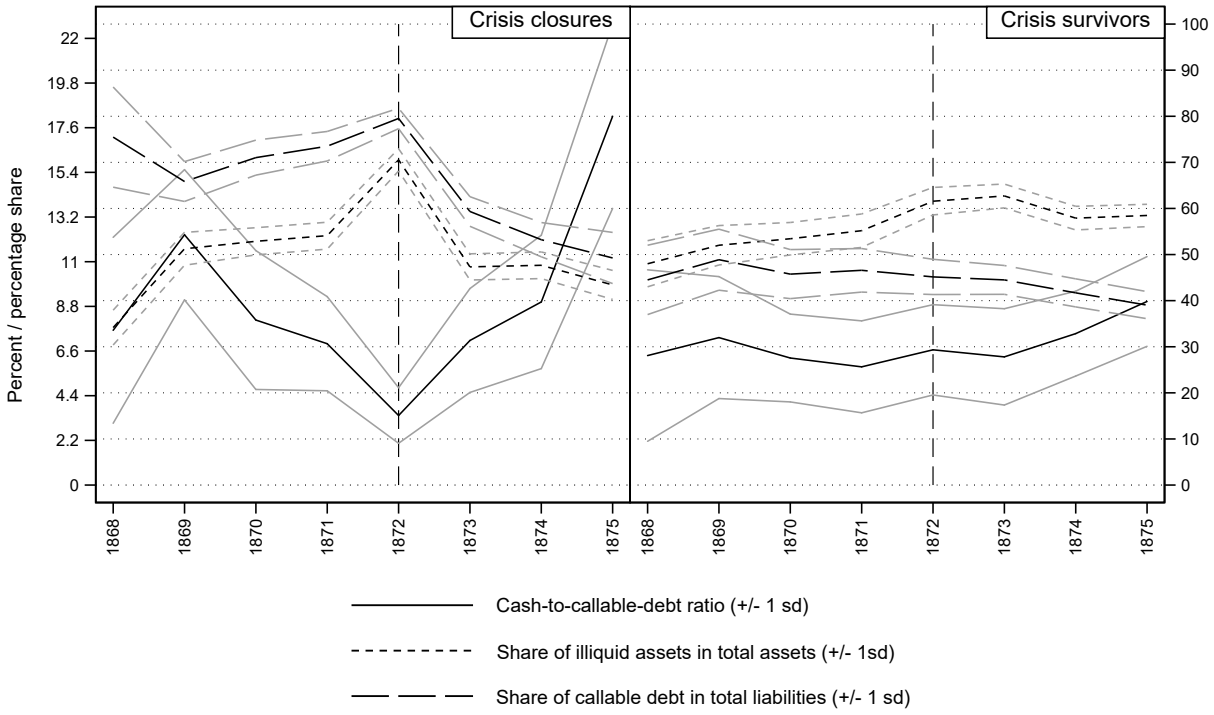
*** p<0.01, ** p<0.05, * p<0.1; statistical significance based on p-values for the null of equal means.
Source: *own calculations: Tresor & Wiener Zeitung*

the repo market freeze following 9 May 1873. Figure 1.19 shows several balance sheet indicators for Austro-Hungarian banks: banks that failed during the months following 9 May 1873 had higher callable debt ratios, while maintaining lower cash reserves and exhibiting a less liquid asset composition than *ex post* survivors. Reports on bank runs are abundant in the contemporary press but no runs were reported prior to the failure of prime broker *Petschek*.[133] Banks had to redeem on average between 30% (*ex post* survivors) and 70% (*ex post* failing banks) of their total deposits in the first two months of the Gründerkrach (c.f. Figure 1.18). The emergence of sudden funding pressures forced banks to call in outstanding repo loans as balance-sheet constraints became binding (Oehmke, 2014). Repo loans that remained unpaid triggered immediate collateral liquidations: the short tenors of repo loans and the exemption from automatic stay for bank lenders enabled credit institutions to rapidly pull back from the market. En masse liquidations of collateral reinforced the fall in asset prices (c.f. Figure 1.1) and triggered severe negative externalities for the broader financial market. Figure 1.20 plots the average bid-ask spread for private sector shares on the Viennese stock exchange. Bid-ask spreads measure the difference between offer and demand prices for securities traded on the stock exchange as a percentage of their offer prices. They serve as indicators for market liquidity: the higher the bid-ask spread, the lower the market liquidity of the asset in question. Between January 1871 and May 1873, the average bid-ask spread for all private sector shares traded on the Viennese *Bourse* stagnated at a long-term low of around 0.7%. In particular, there is no discernible upward trend in the months immediately preceding the *Gründerkrach*. Following 9 May 1873, however, large-scale liquidations of repossessed collateral drove an ever growing wedge between bid and ask prices. Figure 1.20 sheds light on the magnitude and persistence of the shock in May 1873 compared to the small crash in autumn 1869 and the onset of the Franco-Prussian War in July 1870. Whereas the latter two events had been accompanied by a relatively short-lived, though pronounced hike in market illiquidity, the crisis of 1873 saw the bid-ask spread soar to previously unattained levels which thereafter paralyzed the financial market for more than twelve consecutive months.

By trying to "gain room for maneuver" Wirth (1874b, p.141), banks not only suffered from idiosyncratic losses due to already depressed asset prices; they were also likely to push market prices even further down the demand curve. This in turn opened a trade-off very similar to the one discussed by Oehmke (2014). Credit institutions which kept benefiting from more "slack" in terms of collateral liquidation now faced a tough choice. They could either hold onto repossessed collateral and hope for merely temporary price effects; or, if anticipating a permanent depression of asset prices, they had the option to proceed to the liquidation of securities defaulted *Kostgeschäft* borrowers had pledged to them. The minutes from the *Bodencreditanstalt's* (BCA) supervisory board and board of directors meetings provide a micro-level illustration of how banks perceived this trade-off in practice. Justifying its policy stance during the first weeks of the crisis, the directorate reported to the supervisory board on 21 May 1873, not without a decent tone of self-praise:

[133]Some examples include *Morgen-Post*, 'Neuestes - Zur Börsenkrise', 12.05.1873, p.4; *Fremdenblatt*, 'Zur Börsenkrise', 15.05.1873, p.10; *Neue Freie Presse*, 'Von der Börse', 16.05.1873, p.4; *Deutsche Zeitung*, 'Die insolventen Banken', 17.05.1873, p.10; *Volksblatt für Stadt und Land*, 'Von der Börse', 21.05.1873, p.6; *Neue Fremdenblatt*, 'Neue Opfer der Börsenkrisis', 29.05.1873, p.3; *Illustriertes Wiener Extrablatt*, 'Wieder eine Bank-Kalamität', 30.05.1873, p.3; *Morgen-Post*, 'Die Katastrophe bei der Industrial-Bank', 30.05.1873, p.3.

Figure 1.19: Asset liquidity, callable debt and reserves of Austro-Hungarian banks (1868-1875)



Source: own calculations; Compass and Statistisches Jahrbuch

* For variable definitions, c.f. Section 6.

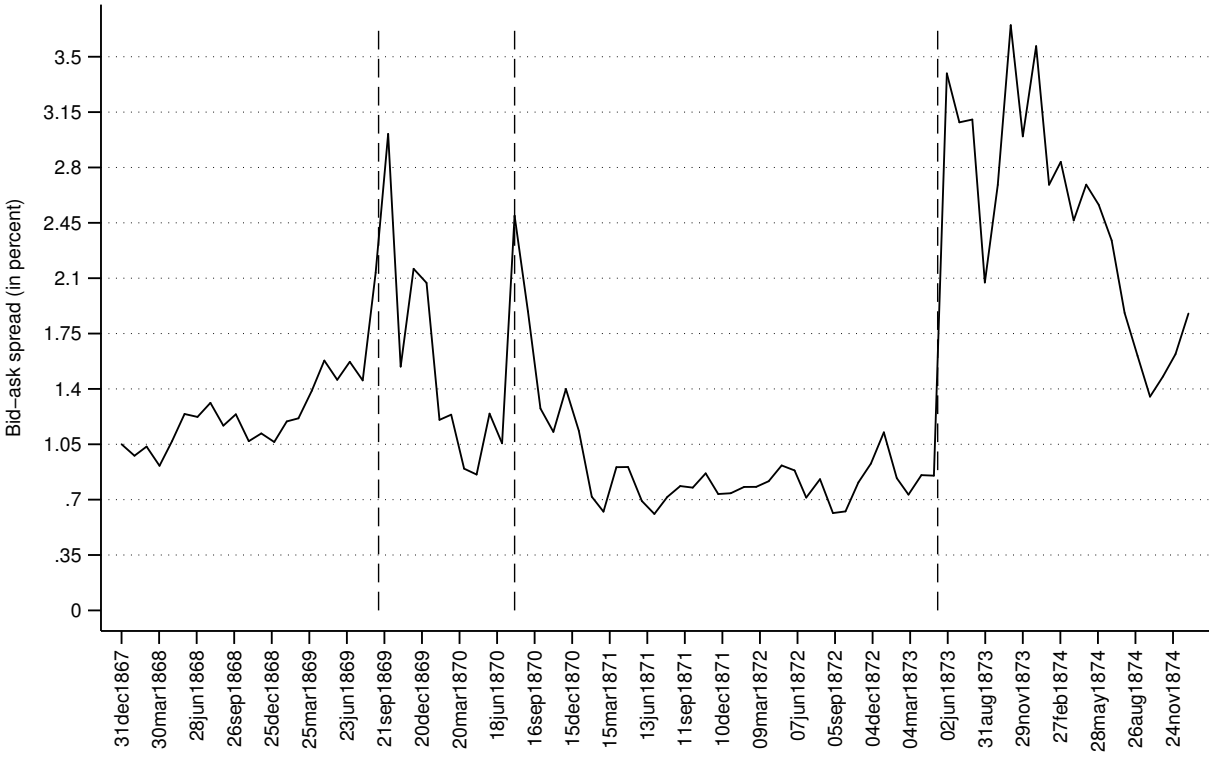
> The big credit institutions [were called upon to] cooperate during this [last] time and contributed their part to achieve the so necessary mitigation [of the panic] without further fostering rotten and bogus practices in order to revive and strengthen trust. For this reason, we did not implement a single collateral liquidation, although we certainly placed margin calls on our *Kostgeschäft* and trading account debtors; this way of proceeding was seemingly in our own interest, because we were able to avert otherwise inevitable damages due to canny and sober-minded waiting.[134]

In the long run these perseverance tactics did not turn out to be that canny after all. Five months later, on 8 October 1873, the BCA's managing director ruefully reported to the board of directors:

> [In May 1873], the losses amounted to a little bit more than one million *Florins* and seemed to be manageable in view of the bank's large reserves; yet, today the stock market reports already provides very strong evidence to what extent the situation has changed since then; had the collateral executions been implemented at an earlier time, they could have resulted in a more favorable position; however, this was not possible, because banks which implemented collateral liquidations were stigmatized by the public, and even officially asked to refrain from executions in the hope that the crisis would be alleviated by this measure. Since then the recovery that was hoped for has not occurred, because the acute emergency situation evolved into a sluggish crisis which led to much higher losses.[135]

[134] BCA's supervisory council meeting on 21 May 1873, Creditanstalt archives.
[135] BCA's board of directors meeting on 8 October 1873, Creditanstalt archives.

Figure 1.20: Bid-ask spread for private sector shares* traded in Vienna (12/1867-12/1874)



Source: own calculations; Compass, Coursblatt des Gremiums der k.k. Börse−Sensale and Wiener Zeitung

*Private sector shares: agriculture, banks, construction, transport, food, industry, insurance, shipping, trade and transport.
Monthly data; bid−ask spread calculated as percentage of ask price.

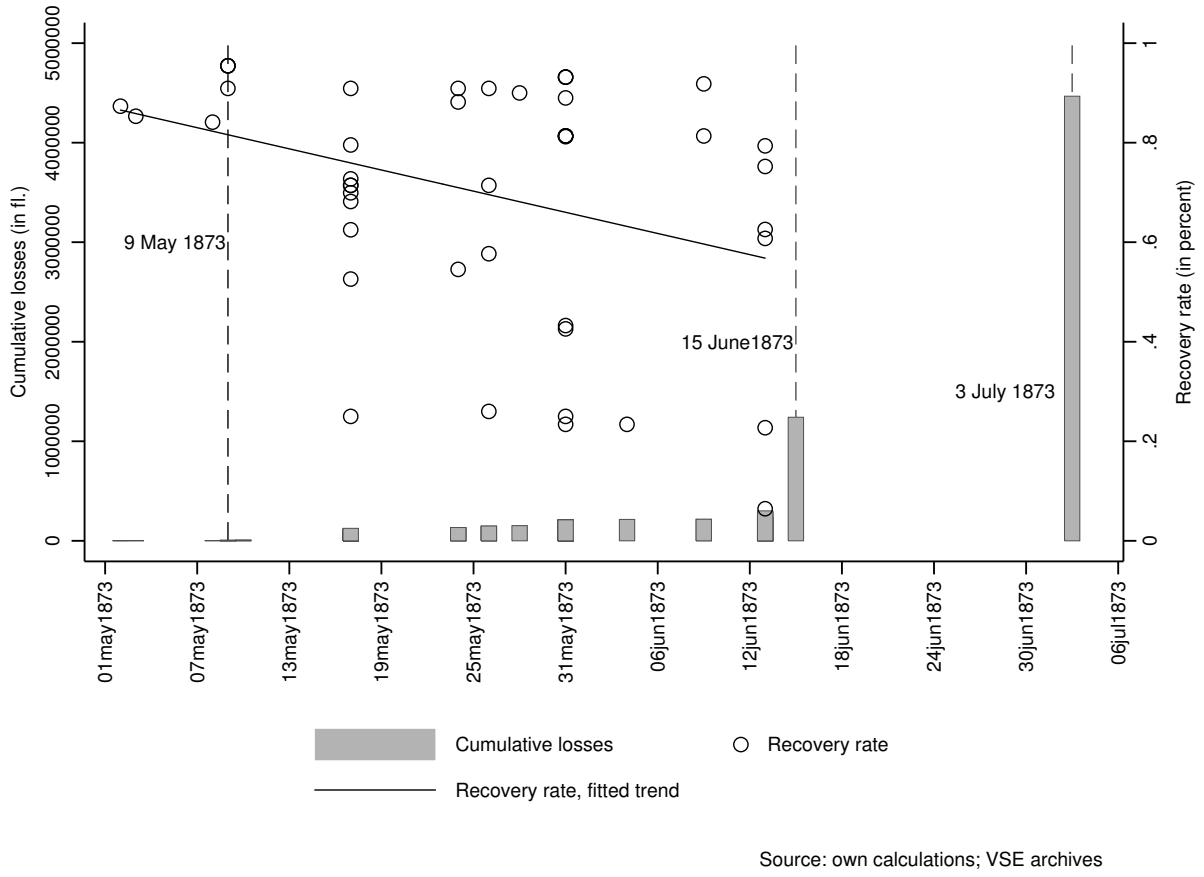
Although the BCA benefited from the luxury to be able to postpone collateral sales in May 1873[136], its directorate seems to have underestimated the consequences of other market participants' reaction. It simply did not reckon with a permanent price slump of repossessed collateral caused by exiting lenders and investors. The bank's stocks, hitherto fairly unimpressed by the turmoil in Austria-Hungary, suddenly came under pressure when international shareholders realized the dimension of previously unacknowledged losses in October 1873 and started to dump their stocks in Frankfurt and Berlin.[137] Due to its large exposure to worthless collateral from defaulting *Kostgeschäft* borrowers, the bank almost failed to honor its credit commitments in the autumn of 1873. Even though the BCA survived because it was the only credit institution bailed out by the Austrian government[138], its fate illustrates the possibility of strategic interactions forcing credit institutions to walk the tightrope between a "wait-and-see" strategy and a "rush to the exit". The second quote from the BCA archives also suggests that strategic trade-offs were further compounded by banks having higher order interests to avoid collateral liquidations. Credit institutions which got caught executing repossessed securities were apparently thought to signal their deteriorating financial situation to the market. Public "stigmatization" in response to these signals may have taken the form of targeted withdrawals, with potential negative feedback loops between funding pressure and asset liquidations.

[136]The BCA's main funding source were covered bonds, rather than sight deposits. This particular funding situation, together with latent bail-out expectations due to the tight business connections with the Austrian state, probably shielded the BCA from outright bank runs.

[137]BCA's board of directors meeting on 8 October 1873, Creditanstalt archives.

[138]Please refer to Chapter II of this dissertation for more details.

Figure 1.21: Chronology of failure: *Wiener Boersenverkehrsbank* (1 May - 3 July 1873)



Source: own calculations; VSE archives

Overall, the underlying microstructure of the Austro-Hungarian repo market played an important role in shaping its resilience to distress. The nature and motivation of repo lenders, their funding situation on the eve of the *Gründerkrach* and the very short repo maturities provide a rationale for the precipitous collapse of the market in 1873. I also argue that repo exposure subsequently drove banks distress: to honor their short-term liabilities, banks had to sell off rapidly depreciating repo collateral into a highly illiquid market. The sale of repossessed collateral triggered large losses. Yet, even if not sold outright, repossessed collateral had to be constantly written down, equally cutting into banks' equity. While the BCA's fate delivers the smoking gun for the "wait-and-see" channel to bank distress, it is also possible to reconstruct a "chronology of failure" for banks that sold off repossessed collateral. Although no systematic information is available, the debtors lists submitted to the VSE committee again prove a highly valuable source in this context. A small number of banks also provided the achieved price and date for repo collateral sales they had already undertaken by 18 July 1873. The rationale for sending in this data was to apply for the enforcement of residual claims resulting from recovery rates lower than 100%. The *Wiener Boersenverkehrsbank* was one such case. Its shareholders had voted in favor of winding down the bank on 3 July 1873 but the bank's own liquidation committee hoped to make good on some of the repo losses incurred in order to minimize the impact of the closure on shareholders. Figure 1.21 plots the time line leading up to the decision to liquidate the bank. It shows that the recovery rates achieved by the bank displayed a clear downward trend over time as asset prices and market liquidity eroded.[139] By 3 July

[139]No further recovery data was reported by the bank for the period between 15 June and 3 July 1873 but the cumulative losses

1873 the bank had accumulated almost 500,000 fl. of losses due to defaulting repos alone. Although the *Wiener Boersenverkehrsbank* had an equity buffer more than ten times as high, shareholders decided to close the bank's doors and liquidate the business. This example shows that bank closures during the *Gründerkrach* did not necessarily involve negative net worth and it also bolsters the conclusion drawn from Table 1.9: the motivation for credit institutions' *Liquidationen* was frequently not benign. Many shareholders decided to permanently close their banks to reap the benefits of an orderly sale of assets rather than having to engage in costly fire sales to honor their depositors' claims on an ongoing basis.

1.8 Conclusion

All financial crises are systemic events which affect the stability of many or most intermediaries in a given financial market following a fundamental re-evaluation of assets that back their short-term liabilities (Gorton and Ordoñez, 2014). Yet, financial crises also come in many different forms as well as degrees of severity, and are triggered by a large variety of causes. One important element that distinguishes financial crises from one another is the form of short-term debt which is targeted during the episode under consideration. Historically, banks issued mostly sight deposits. In our modern "securitized" banking systems (Gorton and Metrick, 2012a), MMMF shares and repurchase agreements (repos) represent two examples for instruments conventionally drawn upon. Moreover, the characteristics and microstructure of short-term debt markets differ substantially. They are populated by different agents on both the supply and the demand side, with varying degrees of sensitivity to distress and risk-bearing capacities. A detailed understanding of the instruments targeted by a run, and their underlying market features, is therefore crucial for formulating both real-time policy responses and *ex post* reforms.

So called "runs on repo" heralded the recent financial crisis of 2007-08. Lehman Brothers, a large US investment bank, was forced to suspend payments and face bankruptcy when its short-term repo funding suddenly dried up in autumn 2008 (Copeland et al., 2014). The U.S. tri-party repo market collapsed in the wake of increased counterparty risk, while the bilateral repo market was able to adjust gradually to the higher risk environment. Ten years on, our ability to explain these events is still limited while repo markets remain virtually untouched by the post-2008 financial market reforms (Skeel, 2011; Saguato, 2017). This lack of information is disconcerting not least because repo markets play a crucial role in financial systems: they generate market liquidity for many types of securities, they represent a major funding source for market-making broker dealers and they play a part in the smooth functioning of the general payment system (Baklanova et al., 2015).

In this chapter, I argued that analyzing historical repo market disruptions can be one innovative way forward to address the small sample bias and external validity concerns haunting the current state of the literature. Although economic historians point out that repo markets have existed for centuries (Flandreau and Sicsic,

until 3 July are available in the *Compass*.

2003; White, 2007), orthodox wisdom still holds that "repos as we know them were introduced to the U.S. financial market by the Federal Reserve in 1917" (Acharya and Öncü, 2011, p.323). I analyze the causes of bank distress during the Austro-Hungarian crisis of 1873 and showed that bank closures were tightly connected to the collapse of a vibrant market for repurchase agreements. This chapter situated repos in the wider context of banks' business models during the stock market boom leading up to the crisis of 1873. Repos played an essential role in the investment banking business conducted by Austro-Hungarian banks during the run-up to the crisis. Repurchase agreements allowed credit institutions to raise the attractiveness of IPOs to investors in the stock exchange by supporting the after-market liquidity of emitted shares through generous lending schemes (Ellul and Pagano, 2006). Using a novel, hand-collected bank-level panel data covering the period from 1868 until 1878, I show that repo exposure is a significant predictor of bank distress even after I control for a vector of financial variables conventionally drawn upon in studies on bank distress. In order to minimize omitted variable bias in my regression results, I also estimate several survival models implementing baseline hazard stratification. To the best of knowledge, I am the first to use this technique, which represents the survival analysis equivalent of fixed effects estimation, in the context of bank failure regressions. I also know of no other study analyzing a historical repo market crisis using microdata.

My study offers a detailed narrative approach to trace the channels leading to repo lender distress during the Austro-Hungarian *Gründerkrach* by tracking how a reversal of investor sentiment slowly snowballed into an outright "run on repo". Insights from the legal environment, financial constraints and strategic trade-offs between repo lenders show that distress likely occurred in the context of forced collateral liquidation following severe liquidity mismatches on banks' balance sheets. My findings corroborate work by Copeland et al. (2014) who emphasize the role of market microstructure in explaining the varying degrees of resilience to distress in different segments of the U.S. repo market. The Austro-Hungarian experience of 1873 suggests that repo markets with short maturities ("tenors") in which lenders themselves are susceptible to sudden funding withdrawals are prone to sudden break-downs of funding flows. My conclusions back recent policy proposals by Copeland et al. (2014), Oehmke (2014) and Begalle et al. (2016) who argue in favor of lengthening repo tenors and institutionalizing a last resort lending mechanism for these markets.

Overall, in view of the evidence marshaled in this chapter, the nature of bank distress in 1873 cannot be easily classified. Bank failures did not spring from a pure liquidity problem, nor did they derive from a simple solvency shock. Repo lender distress emerged from the combination of several different shocks weakening the financial situation of banks. First, the severe funding shock following 8 May 1873 constituted the bank-level liquidity component of the *Gründerkrach*. Second, repo borrowers defaulted on their loans when banks stopped rolling them over and called in the cash they had lent out. These loan defaults represent a classical example of bad bank-level fundamentals, reflecting the bank-level solvency component of financial distress in 1873. After all, although their business model might have provided a good rationale for these lending policies, banks had granted short-term, undiversified loans to highly leveraged and risky borrowers. The third component of bank distress relates to market liquidity: lenders were unable to sell repossessed collateral at sufficiently high prices

to avoid residual claims on borrowers. Since many banks were forced to liquidate collateral in securities markets that had already begun to implode before 8 May 1873, lenders incurred heavy losses. Unsurprisingly, the complex roots of bank distress in 1873 thus posed difficult questions for policy-makers who needed to decide whether and how to intervene. The following chapter of this dissertation is dedicated to an analysis of the policy response to the *Gründerkrach*.

1.9 Appendix

1.9.1 Descriptive reasons for failure

Table 1.9: Reasons for bank closures as recorded by the *Compass* (1870-1880)

Bank	Date of closure	Type of closure	Reasons for closure	Baseline sample
Oesterreichisch-niederlaendische Bank	02.05.1870	merger	losses due to stock market crisis of 1869; bad future business perspectives	
Allgemeine Agrar-Bank	02.05.1870	merger	losses due to stock market crisis of 1869; bad future business perspectives	
Wiener Bank	03.05.1870	merger	losses due to stock market crisis of 1869; bad future business perspectives	
Oesterreichische Disconto-Bank	10.05.1870	merger	losses due to stock market crisis of 1869; bad future business perspectives	
Generalbank für Industrie, Handel und Gewerbe	24.01.1871	merger	losses due to Franco-Prussian War; bad future business perspectives	
Oesterreichische Volksbank	25.01.1871	merger	losses due to Franco-Prussian War; bad future business perspectives	
Oesterreichische Centralbank	20.01.1872	liquidation	business partner went bankrupt; losses by branches; held own shares	
Laibacher Gewerbebank	11.05.1872	liquidation		
Pest-Ofener Gewerbebankverein	28.01.1873	merger		
Veszprimer Credit-Anstalt für Handel und Gewerbe	16.03.1873	merger		
Raaber Credit- und Pfandleih-Anstalt	21.03.1873	bankruptcy		
		***Gründerkrach* (05/1873-12/1874)**		
Szegediner Credit- und Pfandleih-Anstalt	10.05.1873	bankruptcy	fraud	Yes
Oedenburger Credit-Bank	25.05.1873	bankruptcy	losses from investment banking business	Yes
Oedenburger Handels- und Gewerbe-Bank	25.05.1873	bankruptcy	losses from investment banking business	Yes
Nieder-Oesterreichische Bank	31.05.1873	bankruptcy	withdrawal of funding; losses due to Kostgeschäft	Yes
Wiener Wechslerbank	09.06.1873	bankruptcy	stock market crash made it impossible to borrow money against securities or sell them; defaulting loans; withdrawal of funding	Yes
Oedenburger Allgemeine Bank	15.06.1873	liquidation		No
Allgemeine Gewerbebank	18.06.1873	bankruptcy	withdrawal of funding; losses on securities holdings; defaulting debtors	No
Allgemeine Credit- und Handelsbank in Pilsen	20.06.1873	liquidation	fraud; withdrawal of deposits; defaulting interbank loans; losses from securities holdings	Yes
Industrie- und Commercialbank fuer Ober-Oesterreich und Salzburg	25.06.1873	bankruptcy	losses due to failure of other credit institutions; defaulting loans; withdrawal of funding; unable to sell securities to satisfy liquidity needs	Yes
Wiener Maklerbank	30.06.1873	liquidation	losses from investment banking business; losses due to Kostgeschäft; collateral and securities cannot be sold due to market conditions	Yes
Werschetzer Handels- und Gewerbebank	01.07.1873	bankruptcy		No
Alföld er (niederungarische) Bau- und Hypothekar-Creditanstalt	01.07.1873	liquidation	capital was not paid up	No

Continued on next page

Table 1.9 – continued from previous page

Bank	Date of closure	Type of closure	Reasons for closure	Baseline sample
Munkacser Credit- und Pfandleihanstalt	01.07.1873	liquidation		No
Neusatzer Spar- und Credit-Anstalt	01.07.1873	liquidation		No
Credit-Institut für Handel und Gewerbe in Stuhlweissenberg	01.07.1873	liquidation		No
Budapester Spar- und Credit-Anstalt	01.07.1873	liquidation	capital was not paid up; bad future business perspectives	No
Oesterreichische Boersen- und Wechslerbank	02.07.1873	liquidation	losses due to failure of other credit institutions	Yes
Bank für den Wiener Börsenverkehr	03.07.1873	liquidation	losses due to commission business and Kostgeschäft; held own shares	Yes
Wiener Boden-Credit-Gesellschaft	04.07.1873	merger	losses due to failure of other credit institutions; defaulting loans	Yes
Wiener Commissionsbank	05.07.1873	bankruptcy	losses from investment banking business	No
Boersen-und Credit-Bank	05.07.1873	liquidation	losses due to Kostgeschäft; defaulting loans; withdrawal of funding	Yes
Boersen- und Arbitrage-Maklerbank	05.07.1873	liquidation	losses due to investment banking business and Kostgeschäft; defaulting loans	Yes
Ungarische Maklerbank	06.07.1873	liquidation	losses due to failure of other credit institutions	No
Oesterreichische Industrialbank	10.07.1873	liquidation	withdrawal of funding, losses from securities holdings and commission business; losses from Kostgeschäft	Yes
Schlesischer Bankverein	21.07.1873	liquidation	unable to sell any shares to the public	No
Westungarische Escomte- und Credit-Bank in Pressburg	22.07.1873	liquidation	defaulting debtors on the stock exchange	No
Credit-Bank in St. Poelten	25.07.1873	liquidation		No
Oesterreichischer Vorschuss-Cassen-Verein	26.07.1873	liquidation	losses due to failure of other credit institutions	No
Raten- und Renten-Bank	26.07.1873	liquidation	losses from investment banking business	Yes
Wiener Cassen-Verein	28.07.1873	liquidation	losses due to failure of other credit institutions; defaulting loans	Yes
Pester Volksbank	29.07.1873	liquidation	losses from Kostgeschäft	Yes
Bank fuer Handel und Gewerbe des Riesengebirges in Trautenau	01.08.1873	liquidation		No
Allgemeine Vorschussbank	11.08.1873	liquidation		No
Wiener Effectenbank	14.08.1873	liquidation	losses from investment banking business; large scale losses on securities holdings; defaulting loans	No
Wiener Agentur- und Credit-Bank	20.08.1873	liquidation	losses from investment banking business	No
Lemberger Bank	25.08.1873	liquidation	losses due to failure of other credit institutions	Yes
Temesvarer Gewerbebank	31.08.1873	bankruptcy	losses on repossessed collateral	Yes
Allgemeine Triesterbank	11.09.1873	liquidation		Yes
Bank in Stadt Steier	16.09.1873	liquidation		No
Temesvarer Commercial- und Hypotheken-Bank	16.09.1873	bankruptcy	withdrawal of funding precipated suspension of payments	No
Spar- und Lombard-Verein	20.09.1873	liquidation	losses due to failure of other credit institutions	Yes

Continued on next page

Table 1.9 – continued from previous page

Bank	Date of closure	Type of closure	Reasons for closure	Baseline sample
Pressburger allgemeine Credit-Bank	28.09.1873	liquidation	defaulting debtors on the stock exchange	Yes
Szegediner Escompte- und Spar-Anstalt	04.10.1873	liquidation		No
Allgemeine steierische Creditbank	05.10.1873	bankruptcy	defaulting loans; losses from Kostgeschäft	Yes
Triester Bodencredit- und Sparverein	13.10.1873	liquidation		No
Italisch-oesterreichische Bank	14.10.1873	merger	losses due to Kostgeschäft; losses due to connections with stock market; defaulting loans	Yes
Wiener Capitalisten-Vereins-Bank	18.10.1873	liquidation	forced liquidation by other bank holding majority of stocks; bad future business perspectives	Yes
Provinzialbank in Wien	30.10.1873	liquidation	unable to sell any shares to the public	No
Pester-Bank	02.11.1873	liquidation	losses due to Kostgeschäft; defaulting loans; losses due to failure of other credit institutions; losses from securities holdings; losses on discount loans	Yes
Oedenburger Escompte-Bank	06.11.1873	bankruptcy		Yes
Bürgerlicher Spar- und Credit-Verein	09.11.1873	liquidation		No
Prager Wechslerbank	10.11.1873	liquidation	liquidation of large securities holdings resulted in losses	Yes
Wiener Commerzial-Bank	20.11.1873	liquidation	losses from investment banking business; held own shares; attempts to merge failed; losses due to Kostgeschäft	Yes
Oesterreichisch-ungarische Escompte- und Creditbank	22.11.1873	liquidation	strong speculative orientation; withdrawal of funding; held own shares; losses from commission business	Yes
Crédit foncier fuer das Koenigreich Boehmen	29.11.1873	merger		Yes
Galizische Landesbank	29.11.1873	liquidation		Yes
Wiener Spar- und Credit-Bank	29.11.1873	liquidation	losses from Kostgeschäft; held own shares as Kostgeschäft collateral	Yes
Boehmische Hypothekar-Renten-Bank	06.12.1873	liquidation		No
Erste Raten-Bank in Prag	06.12.1873	liquidation		Yes
Pester Vereins-Bank	07.12.1873	liquidation	withdrawal of funding; liquidity shortage; bad future business perspectives	Yes
Allgemeine Escompte-Anstalt	17.12.1873	liquidation	losses due to failure of other credit institutions	No
Zwittauer Commercialbank	18.12.1873	liquidation		Yes
Universalbank	23.12.1873	liquidation	stocks not admitted to Viennese stock exchange; losses from securities holdings (consequence of insolvent debtors in Kostgeschäft)	Yes
Wiener Boersen-Bank	23.12.1873	liquidation	losses from brokerage, investment banking	Yes
Oesterreichischer Spar-Verein	30.12.1873	liquidation	withdrawals of deposits; unable to obtain sufficient price for collateral in order to meet deposit withdrawals; losses from securities holdings; defaulting loans	Yes
Mährische Pfandleih-Gesellschaft	30.12.1873	merger		Yes
Papaer Handels- und Gewerbe-Bank	31.12.1873	liquidation	defaulting loans	Yes
Südungarisches Boden-Credit-Institut in Szegedin	31.12.1873	liquidation		Yes
Trenchiner Credit-Anstalt	31.12.1873	liquidation		Yes

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Table 1.9 – continued from previous page

Bank	Date of closure	Type of closure	Reasons for closure	Baseline sample
Nordwestboehmische Vereins-Bank	04.01.1874	liquidation	losses from investment banking business and Kostgeschäft	Yes
Mährische Boden-Credit-Anstalt	04.01.1874	merger	losses due to failure of other credit institutions	Yes
Erste Banater Handels- und Gewerbebank in Temesvar	05.01.1874	liquidation		Yes
Szegediner Verkehrs-Bank	11.01.1874	liquidation		Yes
Westungarische Hypotheken-Bank in Oedenburg	29.01.1874	liquidation		Yes
Inneroesterreichische Boden-Credit-Anstalt	20.02.1874	liquidation	stocks not admitted to Viennese stock exchange	No
Boehmischer Sparverein	26.02.1874	liquidation	deposited collateral lost value and generated losses for bank; losses from securities holdings; defaulting loans	No
Carlsbader Bank	10.03.1874	liquidation	losses from investment banking business	Yes
Industrie- und Boden-Credit-Bank	16.03.1874	liquidation	losses from securities holdings; held own shares	Yes
Hód-Mezö-Vásárhelyer Oekonomie-, Gewerbe- und Handelsbank	19.03.1874	bankruptcy		Yes
Austro-Tuerkische Credit-Anstalt	24.03.1874	liquidation	unable to obtain sufficient price for collateral in order to meet deposit withdrawals; held own shares; losses from securities holdings; losses from investment banking activities	Yes
Boehmischer Bankverein	27.03.1874	liquidation		Yes
Leopoldstädter Bank	31.03.1874	liquidation	losses from securities holdings, Kostgeschäft and commission business; held own shares	No
Prager Wechselstuben-Gesellschaft	31.03.1874	liquidation		No
Wiener Credit-Bank	01.04.1874	liquidation		No
Franz- und Josefstäder Spar- und Credit-Verein	01.04.1874	merger		No
Saazer Bank	15.04.1874	liquidation	defaulting debtors on the stock exchange	Yes
Erstes Unter-Theiß-Credit-Institut in Török-Becse	15.04.1874	liquidation		Yes
Budweiser Bank	26.04.1874	liquidation	losses from securities holdings; losses from commission business	Yes
Oesterreichische allgemeine Bank	13.05.1874	liquidation	losses due to collateral repossession; withdrawal of deposits; held own shares; losses from securities holdings; losses due to Kostgeschäft; defaulting loans	Yes
Prager Boersen-Bank	21.05.1874	liquidation		No
Mariahilfer Spar- und Escompte-Gesellschaft	28.05.1874	liquidation	bad future business perspectives	No
Pester Wechselstuben Gesellschaft	07.06.1874	merger		No
Genossenschaftsbank von Julius Heinisch Leopold Loewy & Comp	15.06.1874	merger	defaulting loans	Yes
Mährische Hypotheken-Bank	20.06.1874	merger	losses from securities holdings	Yes
Oesterreichische Sparbank	22.06.1874	liquidation	losses due to Kostgeschäft and commission business; held own shares; losses from securities holdings	No
Austro-Ottomanische Bank	30.06.1874	merger	bad future business perspectives	No
Wiener Escompte- und Depositen-Casse	04.07.1874	merger		Yes

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Table 1.9 – continued from previous page

Bank	Date of closure	Type of closure	Reasons for closure	Baseline sample
Landwirtschaftliche Credit-Actienbank in Lissa a. d. Elbe	07.07.1874	bankruptcy	losses from securities holdings; losses from investment banking business	Yes
Credit-Anstalt in Kuttenberg	16.07.1874	bankruptcy	withdrawal of funding	Yes
Oesterreichische Interventions-Bank	06.08.1874	liquidation	losses from securities holdings and Kostgeschäft; held own shares as Kostgeschäft collateral; defaulting loans	Yes
Pester Pfandleih-Anstalt	10.08.1874	liquidation	losses from commissions business	No
Wiener Spar- und Credit-Casse fuer Gewerbe und Handel	18.09.1874	liquidation	losses due to Kostgeschäft	Yes
Actien-Gesellschaft für den Hypothekar-Credit	14.11.1874	liquidation		No
Oesterreichische Immobiliar-Credit-Anstalt	31.12.1874	liquidation		No
Later failures (01/1875-12/1880)				
Gratzer Bankverein	28.02.1875	liquidation	bank complained about high taxes compared to very low profits; losses from securities holdings	
Ofner allgemein bürgerliche Sparcassa	22.03.1875	liquidation	defaulting loans; bad future business perspectives	
Vorschuss-Escompte-Anstalt in Klattau	12.05.1875	bankruptcy		
K K privilegirte oesterreichische Vereinsbank	28.05.1875	merger	losses due to Kostgeschäft; losses from securities holdings; defaulting loans	
Wiener Wechselstuben-Gesellschaft	17.08.1875	liquidation	losses due to Kostgeschäft; losses from securities holdings	
Wiener Lombardverein	06.12.1875	liquidation		
Oesterreichische Hypothekar-Credit- und Vorschussbank	10.02.1876	liquidation	losses from securities holdings; defaulting loans	
Indo-Aegyptische Bank	12.02.1876	liquidation	bad future business perspectives	
Warnsdorfer Escompte-Gesellschaft	16.02.1876	bankruptcy		
Wiener Vororte-Bank	02.03.1876	liquidation	losses on real estate; held own shares	
Oesterreichische Hypothekar-Rentenbank	06.03.1876	liquidation	losses from securities holdings and investment banking activities; defaulting loans	
Disconto- und Wechsler-Gesellschaft	13.03.1876	liquidation	losses from securities holdings	
Allgemeine Pest-Leopoldstädter Sparcasse	31.03.1876	merger	fraud; withdrawal of funding; defaulting loans	
Ungarisches Beamten- Credit- und Versicherungs-Institut	09.04.1876	liquidation	withdrawal of funding	
Bruenner Bank	20.04.1876	merger		
Boehmische Handels- Gewerbe- und Realitäten-Bank	04.05.1876	merger		
Steinamangerer Escompte-Gesellschaft	18.06.1876	liquidation		
K K priv Wiener Handelsbank fuer den Producten- und Waarenverkehr	24.06.1876	liquidation		
Salzburger Bank	24.06.1876	liquidation	illiquid assets could not be sold; withdrawal of funding	
Franko-ungarische Bank	26.06.1876	liquidation	losses from securities holdings and investment banking business; defaulting loans	
Ober-ungarische Creditanstalt als Producten- Commissions- und Wechselgesellschaft	01.07.1876	liquidation		

Continued on next page

Table 1.9 – continued from previous page

Bank	Date of closure	Type of closure	Reasons for closure	Baseline sample
Ofen-Alt-Ofner Volksbank als Selbsthilfs-Verein	04.11.1876	liquidation		
Austro-Aegyptische Bank	20.11.1876	liquidation		
Ofner Commercial- und Gewerbebank	05.03.1877	liquidation	defaulting loans	
Oesterreichische Bank-Gesellschaft	14.03.1877	liquidation		
Erste ober-ungarische Gewerbe- und Creditbank	31.03.1877	merger		
Eperieser Spar- und Creditverein	31.03.1877	merger		
Neusohler Bankverein	18.04.1877	liquidation		
Allgemeine boehmische Bank	07.05.1877	liquidation		
Franco-Oesterreichische Bank	15.05.1877	liquidation	losses from consortial and underwriting business	
Oesterreichisch-orientalische Bank	24.05.1877	liquidation		
Teplitzer Bank	04.06.1877	liquidation	losses from securities holdings and investment banking business	
Länderbanken-Verein	19.07.1877	liquidation	losses from securities holdings; defaulting loans	
Triester Bank-Verein	21.08.1877	liquidation	losses from securities holdings and investment banking business	
Prager Bank-Verein	12.11.1877	liquidation	losses from syndicates	
Boehmische Volksbank	20.01.1878	liquidation		
Anglo-Hungarian Bank	28.01.1878	liquidation	losses from securities holdings and investment banking business	
Papaer Volksbank	09.04.1878	bankruptcy		
Wiener Hypotheken-Casse	29.05.1878	liquidation	defaulting loans	
Slavonische Commercial- und Escomptebank	01.06.1878	bankruptcy		
Komorner Handels- und Gewerbe-Creditanstalt	12.06.1878	liquidation		
Nord-ungarische Hypotheken- und Industriebank	01.07.1878	liquidation		
Bacser erste Handels- und Gewerbebank	01.07.1878	liquidation		
K K priv mährische Bank fuer Industrie und Handel	27.07.1878	merger		
Baranyaer Comitats Spar- und Creditbank	13.11.1878	liquidation	defaulting loans	
Mezöberenyer Volksbank	16.02.1879	liquidation		

1.9.2 Survival performance of different bank generations

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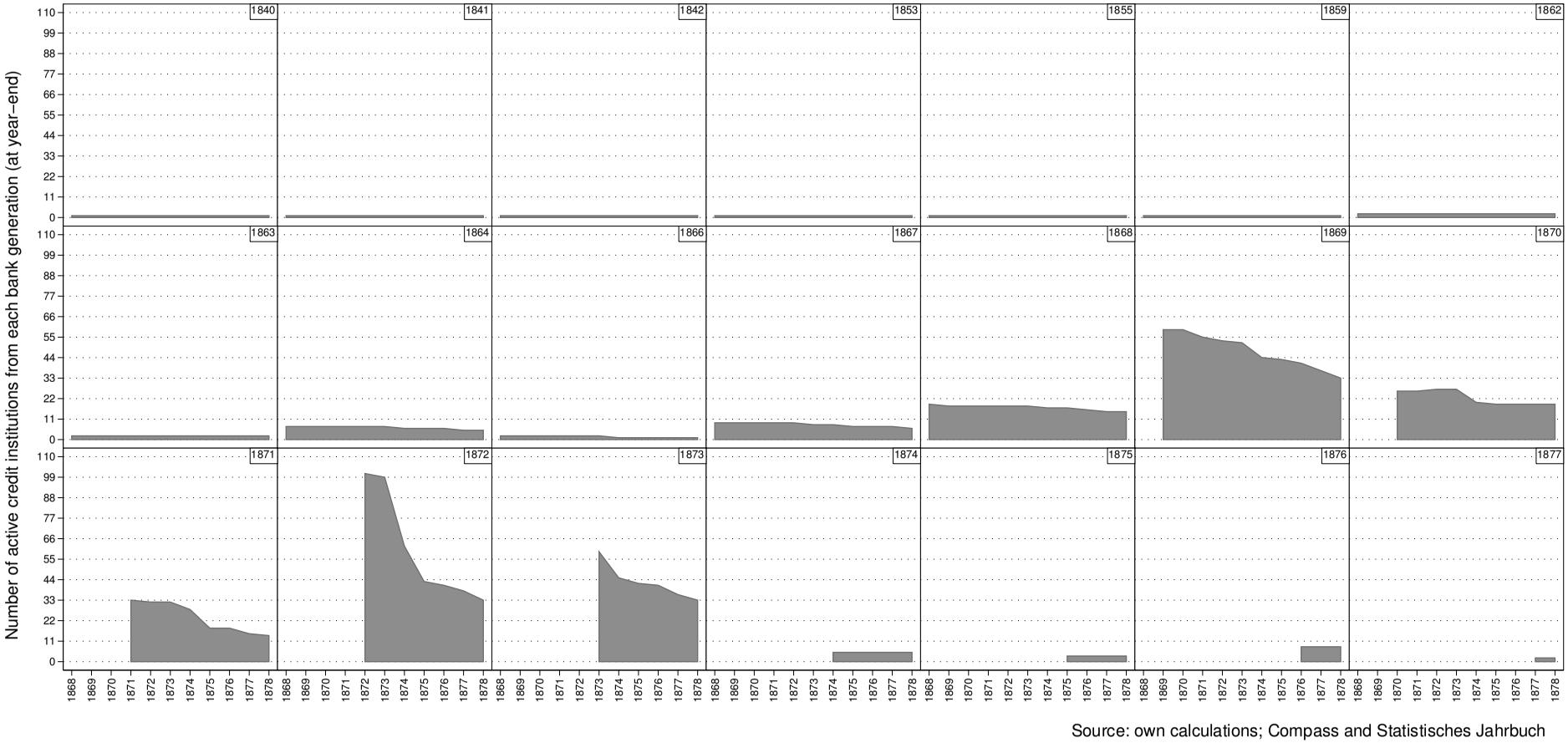
Figure 1.22: Survival performance of different bank generations (1868-1878)



Source: own calculations; Compass and Statistisches Jahrbuch

1.9.3 Comparing bank failures inside and outside baseline sample

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Table 1.10: Comparing bank failures inside and outside baseline sample: additional information (05/1873-12/1874)

Bank	VSE debtors list	VSE arbitration panel	VSE member	In sample
Szegediner Credit- und Pfandleih-Anstalt	No	No	No	Yes
Oedenburger Credit-Bank	No	No	No	Yes
Oedenburger Handels- und Gewerbe-Bank	No	No	No	Yes
Nieder-Oesterreichische Bank	No	No	No	Yes
Wiener Wechslerbank	No	Yes	Yes	Yes
Oedenburger Allgemeine Bank	No	No	No	No
Allgemeine Gewerbebank	No	No	Yes	No
Allgemeine Credit- und Handelsbank in Pilsen	No	No	No	Yes
Industrie- und Commercialbank fuer Ober-Oesterreich und Salzburg	No	No	No	Yes
Wiener Maklerbank	Yes	Yes	Yes	Yes
Werschetzer Handels- und Gewerbebank	No	No	No	No
Alföld er (niederungarische) Bau- und Hypothekar-Creditanstalt	No	No	No	No
Munkacser Credit- und Pfandleihanstalt	No	No	No	No
Neusatzer Spar- und Credit-Anstalt	No	No	No	No
Credit-Institut für Handel und Gewerbe in Stuhlweissenberg	No	No	No	No
Budapester Spar- und Credit-Anstalt	No	No	No	No
Oesterreichische Boersen- und Wechslerbank	Yes	No	Yes	Yes
Bank für den Wiener Börsenverkehr	Yes	Yes	No	Yes
Wiener Boden-Credit-Gesellschaft	No	No	No	Yes
Wiener Commissionsbank	No	No	Yes	No
Boersen-und Credit-Bank	No	No	Yes	Yes
Boersen- und Arbitrage-Maklerbank	No	Yes	No	Yes
Ungarische Maklerbank	No	No	No	No
Oesterreichische Industrialbank	No	No	Yes	Yes
Schlesischer Bankverein	Yes	Yes	No	No
Westungarische Escomte- und Credit-Bank in Pressburg	No	No	No	No
Credit-Bank in St. Poelten	No	No	No	No
Oesterreichischer Vorschuss-Cassen-Verein	No	No	No	No
Raten- und Renten-Bank	No	No	Yes	Yes
Wiener Cassen-Verein	No	No	No	Yes
Pester Volksbank	No	No	No	Yes
Bank fuer Handel und Gewerbe des Riesengebirges in Trautenau	No	No	No	No
Allgemeine Vorschussbank	No	No	No	No
Wiener Effectenbank	No	Yes	Yes	No
Wiener Agentur- und Credit-Bank	No	No	No	No
Lemberger Bank	No	No	No	Yes
Temesvarer Gewerbebank	No	No	No	Yes
Allgemeine Triesterbank	No	No	No	Yes
Bank in Stadt Steier	No	No	No	No
Temesvarer Commercial- und Hypotheken-Bank	No	No	No	No
Spar- und Lombard-Verein	No	No	No	Yes
Pressburger allgemeine Credit-Bank	No	No	No	Yes
Szegediner Escompte- und Spar-Anstalt	No	No	No	No
Allgemeine steierische Creditbank	No	No	No	Yes
Triester Bodencredit- und Sparverein	No	No	No	No
Italisch-oesterreichische Bank	Yes	Yes	Yes	Yes
Wiener Capitalisten-Vereins-Bank	Yes	Yes	Yes	Yes
Provinzialbank in Wien	No	No	No	No
Pester-Bank	No	No	No	Yes
Oedenburger Escompte-Bank	No	No	No	Yes
Bürgerlicher Spar- und Credit-Verein	No	No	No	No
Prager Wechslerbank	No	No	No	Yes
Wiener Commerzial-Bank	No	Yes	Yes	Yes
Oesterreichisch-ungarische Escompte- und Creditbank	No	Yes	Yes	Yes
Crédit foncier fuer das Koenigreich Boehmen	No	No	No	Yes
Galizische Landesbank	No	No	No	Yes
Wiener Spar- und Credit-Bank	No	Yes	No	Yes
Boehmische Hypothekar-Renten-Bank	No	No	No	No
Erste Raten-Bank in Prag	No	No	No	Yes
Pester Vereins-Bank	No	No	No	Yes
Allgemeine Escompte-Anstalt	No	No	No	No
Zwittauer Commercialbank	No	No	No	Yes
Universalbank	No	No	Yes	Yes
Wiener Boersen-Bank	No	Yes	Yes	Yes
Oesterreichischer Spar-Verein	Yes	No	No	Yes
Mährische Pfandleih-Gesellschaft	No	No	No	Yes
Papaer Handels- und Gewerbe-Bank	No	No	No	Yes
Südungarisches Boden-Credit-Institut in Szegedin	No	No	No	Yes
Trenchiner Credit-Anstalt	No	No	No	Yes
Nordwestboehmische Vereins-Bank	No	No	No	Yes
Mährische Boden-Credit-Anstalt	No	No	No	Yes
Erste Banater Handels- und Gewerbebank in Temesvar	No	No	No	Yes
Szegediner Verkehrs-Bank	No	No	No	Yes
Westungarische Hypotheken-Bank in Oedenburg	No	No	No	Yes
Inneroesterreichische Boden-Credit-Anstalt	No	No	No	No
Boehmischer Sparverein	No	No	No	No
Carlsbader Bank	No	No	No	Yes
Industrie- und Boden-Credit-Bank	Yes	No	Yes	Yes
Hód-Mezö-Vásárhelyer Oekonomie-, Gewerbe- und Handelsbank	No	No	No	Yes
Austro-Tuerkische Credit-Anstalt	Yes	No	Yes	Yes
Boehmischer Bankverein	No	No	No	Yes
Leopoldstädter Bank	Yes	No	Yes	No
Prager Wechselstuben-Gesellschaft	No	No	No	No
Wiener Credit-Bank	Yes	No	Yes	No
Franz- und Josefstäder Spar- und Credit-Verein	No	No	No	No
Saazer Bank	No	No	No	Yes
Erstes Unter-Theiß-Credit-Institut in Török-Becse	No	No	No	Yes
Budweiser Bank	No	No	No	Yes
Oesterreichische allgemeine Bank	Yes	No	Yes	Yes
Prager Boersen-Bank	No	No	No	No
Mariahilfer Spar- und Escompte-Gesellschaft	Yes	No	No	No
Pester Wechselstuben Gesellschaft	No	No	No	No
Genossenschaftsbank von Julius Heinisch Leopold Loewy	No	No	Yes	Yes
Mährische Hypotheken-Bank	No	No	No	Yes
Oesterreichische Sparbank	Yes	Yes	Yes	No
Austro-Ottomanische Bank	No	No	No	No
Wiener Escompte- und Depositen-Casse	Yes	No	No	Yes
Landwirtschaftliche Credit-Actienbank in Lissa a. d. Elbe	No	No	No	Yes
Credit-Anstalt in Kuttenberg	No	No	No	Yes
Oesterreichische Interventions-Bank	Yes	No	No	Yes
Pester Pfandleih-Anstalt	No	No	No	No
Wiener Spar- und Credit-Casse fuer Gewerbe und Handel	Yes	No	No	Yes
Actien-Gesellschaft für den Hypothekar-Credit	No	No	No	No
Oesterreichische Immobiliar-Credit-Anstalt	No	No	No	No

1.9.4 Bank-level data on deposit withdrawals

Table 1.11: List of banks in deposit withdrawal sample for Figure 1.23

Bank	Bank ID	Closure date
Anglo-Oesterreichische Bank	1	
K K privilegirte allgemeine oesterreichische Boden-Credit-Anstalt	6	
Allgemeine Depositen-Bank	9	
Nieder-Oesterreichische Escompte-Gesellschaft	10	
Oesterreichisch-ungarische Escompte- und Creditbank	11	22.11.1873
Allgemeine Gewerbebank	12	18.06.1873
Franco-Oesterreichische Bank	13	15.05.1877
Genossenschaftsbank von Julius Heinisch Leopold Loewy & Comp	14	15.06.1874
Industrie- und Boden-Credit-Bank	16	16.03.1874
Länderbanken-Verein	18	19.07.1877
Mariahilfer Spar- und Escompte-Gesellschaft	20	28.05.1874
Oesterreichische allgemeine Bank	21	13.05.1874
Oesterreichische Hypothekar- Credit- und Vorschussbank	25	10.02.1875
Oesterreichische Hypothekar-Rentenbank	27	06.03.1876
Oesterreichische Industrialbank	29	10.06.1873
Oesterreichische Interventions-Bank	30	06.08.1874
Oesterreichische Sparbank	32	22.06.1874
Oesterreichischer Spar-Verein	33	30.12.1873
Raten- und Renten-Bank	36	26.07.1873
Unionbank	39	
K K privilegirte allgemeine Verkehrsbank	41	
Wiener Commissionsbank	49	17.05.1873
K K priv Wiener Handelsbank fuer den Producten- und Waarenverkehr	53	24.06.1876
Wiener Maklerbank	56	30.06.1873
Wiener Vororte-Bank	58	02.03.1876
Wiener Wechslerbank	59	09.06.1873
Wiener Wechselstuben-Gesellschaft	60	17.08.1875
Nieder-Oesterreichische Bank	61	31.05.1873
Bank fuer Ober-Oesterreich und Salzburg	62	
Industrie- und Commercialbank fuer Ober-Oesterreich und Salzburg	63	25.06.1873
Salzburger Bank	64	24.06.1876
Marburger Escomptebank	70	
Carlsbader Bank	77	10.03.1874
Boehmischer Bankverein	87	27.03.1874
Boehmischer Sparverein	92	26.02.1874
Boehmische Unionsbank	93	
Prager Bank-Verein	101	12.11.1877
Prager Wechselstuben-Gesellschaft	103	31.03.1874
Prager Wechslerbank	104	10.11.1873
Galizische Bank fuer Handel und Industrie	120	
Galizische Landesbank	124	29.11.1873
Anglo-Hungarian Bank	165	28.01.1878
Ofner Commercial- und Gewerbebank	176	05.03.1877
Budapester Industriebank	178	
Franko-ungarische Bank	188	26.06.1876
Ungarische allgemeine Creditbank	193	
Erste ungarische Gewerbebank	196	
Allgemeiner Spar- und Creditverein für Gewerbetreibende	197	
Pester ungarische Commercialbank	203	
Pest-Ofner Handwerker-Bank	205	
Ungarische Escompte- und Wechsler-Bank	209	
Allgemeine ungarische Municipal-Creditanstalt	215	
Ungarisches Bodencredit-Institut	254	
Ungarische allgemeine Bodencredit-Aciten-Gesellschaft	255	
Pester erste vaterländische Sparcassa in Budapest	260	
Pester Bank	261	02.11.1873
Pester Pfandleih-Anstalt	265	10.08.1874
Pester Vereins-Bank	266	07.12.1872
Vereinigte Budapester hauptstädtische Sparcasse	296	
Pester vorstädtische Sparcasse	298	
Ungarische Landes-Central Sparcassa	299	
Spar- und Vorschuss Verein	300	30.12.1873
Ofen-Alt-Ofner Volksbank als Selbsthilfs-Verein	311	04.11.1876
Pester Volksbank	312	29.07.1873

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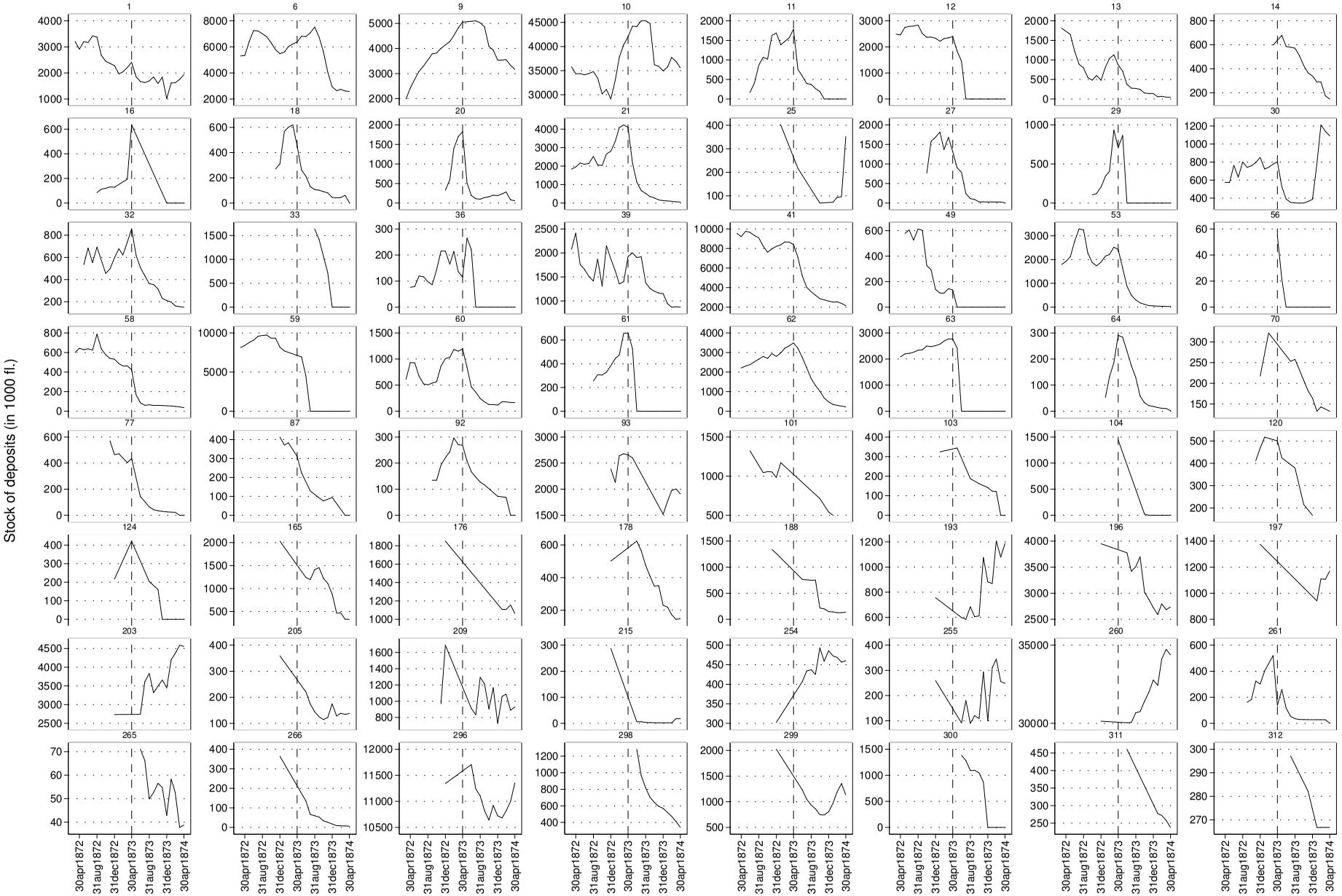
Figure 1.23: Bank-level data on deposit withdrawals (sample, April 1872 - April 1874)



Source: own calculations; Tresor and Wiener Zeitung

Chapter II

Haunting the Specter of Credit Rationing: Unconventional Last Resort Lending during the Austro-Hungarian Gründerkrach of 1873

2.1 Introduction

Chapter I of this dissertation shows that defaulting repo debtors played an important role in the demise of banks during the Austro-Hungarian *Gründerkrach* of 1873. Credit institutions granted large repo loans against securities that turned into highly illiquid and depreciated collateral after 9 May 1873. Banks that were forced to sell the collateral in response to heavy funding withdrawals had to write-off substantial portions of their repo portfolios and incurred heavy losses. As shown in Chapter I, repo lender distress emerged from the combination of several different shocks: bank-level liquidity and solvency problems paired with deteriorating market illiquidity. Chapter I thus raises the question whether and how policy could have mitigated bank distress during the crisis of 1873.[140]

The course of events in 2007-08 illustrated how negative liquidity spirals develop when many market participants are forced to sell their assets simultaneously in order to meet short term liabilities (Brunnermeier, 2009). The resulting asset price decline may affect unrelated parts of the banking sector, other third parties and, more globally, if the costs of credit intermediation rise (Bernanke, 1983), the real economy – all of which might not be directly exposed to the initial shock (Antinolfi et al., 2015). The possibility of negative externalities provide the rationale for a lender of last resort (LLR) that can provide the financial system with unlimited (or at least a very large amounts of) cash in exchange for illiquid collateral. The LLR allows illiquid debtors to honor liabilities targeted by the run and thus addresses creditors' fears that their debtors will face illiquidity-induced insolvency (Diamond and Dybvig, 1983). Hence, the LLR can stop the incipient run and avert fire sales with potentially severe macroeconomic consequences (Oehmke, 2014). As the monopoly issuers of currency, central banks are in a natural position to act as LLRs.

Yet, while central banks may be first-best candidates for the LLR role, they can also face constraints which obviate an elastic supply of liquidity during a crisis. Some of these constraints may be institutional or technical (Bindseil, 2009): access to central bank liquidity could be reserved to specific counterparties only, eligible collateral may be (too) narrowly defined or central bank cover ratios might inhibit a large increase in note issuance.[141] Historically, constraints also proved to be ideational: the Federal Reserve's policy reaction to the banking crises during the Great Depression in the 1930s has often been criticized on the account of wrong ideas (Friedman and Schwartz, 1963; Carlson and Wheelock, 2013).[142] Others still are driven by market characteristics. Microeconomic theory suggests that quantity rationing can be the result of asymmetric information problems in financial markets (Stiglitz and Weiss, 1981). Credit rationing by the central bank can have severe macroeconomic consequences if it leads to illiquidity-induced mass failures of banks during a financial crisis.

[140] By looking at the policy response to the crisis of 1873, at the most basic level this chapter addresses potential omitted variable bias concerns regarding the econometric analysis of bank distress in Chapter I.

[141] Historically, institutional constraints often took the form of ratios regulating the relationship of central bank note issuance to specie reserves. Cover ratios served to bolster public confidence in the value-storing capacity of central bank notes (Jobst and Rieder, 2016). In the case of the Bank of England, these rules were conventionally suspended in times of crises, c.f. Bignon et al. (2012).

[142] For a more detailed discussion, c.f. Section 2.2.

The historical experience of the Great Depression in the United States represents a particularly infamous case in point (Bernanke, 1983). Perhaps unsurprisingly, credit rationing, rather than free lending, was the standard response to financial crises in the early days of central banking (Bignon et al., 2012).

In this chapter, I show how institutional innovation helped address the specter of credit rationing during the Austro-Hungarian crisis of 1873. The Austrian central bank (*Oesterreichische Nationalbank*, OeNB)[143] initially rationed credit through its discount facility during the peak of the *Gründerkrach* in May 1873. Central bank credit rationing can be explained by a combination of constraints, both institutional and ideational, and information asymmetries faced by the Bank. As the crisis evolved, however, the central bank did produce several specific policy responses which were clearly motivated by considerations to avoid negative externalities. In particular, the central bank coordinated and participated in an unconventional lender of last resort mechanism to stem the crisis. Facing the central bank's limited willingness to provide direct liquidity support, market participants joined forces to preempt large-scale fire sales during the *Gründerkrach*. Bankers, brokers and investment firms founded so-called *Aushilfs-Comités* (AHCs, support committees) in all major cities of the Habsburg Empire. The OeNB agreed to grant direct refinancing lines to these committees in return for the joint guarantees of their members and the creation of equity funds to cover up losses from the committees' lending activities. On the basis of these guarantees, the central bank even allowed AHCs to rediscount substandard paper.

The LLR solution devised in response to the *Gründerkrach* differed in design from the classical direct Bagehot-style LLR in that it interposed another layer between the central bank's standing facility and liquidity recipients.[144] At the same time, the solution chosen in 1873 shared the principle of "wide eligibility" present in the classical LLR model because anybody could join an AHC and apply for a loan as long as a subscription to the equity fund was made. "Wide eligibility" and the explicit aim to stem a systemic problem rather than distress at individual institutions clearly distinguish the AHCs from so-called "life-boat operations" (Hautcoeur et al., 2014; Calomiris et al., 2016). The present chapter focuses on the non-standard policy response chosen in 1873. I first provide descriptive evidence that AHCs alleviated central bank credit rationing during the crisis of 1873. I then show that unconventional LLR effectively mitigated bank distress during the *Gründerkrach*. In order to tease out the causal effect of the non-standard LLR intervention on bank survival, I use a two-stage inverse-probability-weighted regression adjustment (IPWRA). Hence, my main identification assumption is that selection into the committees can be thought of as random conditional on a set of observables that predict selection into the committees in a first stage.

I argue that AHCs can be viewed as innovative solutions remedying the under-provision of a good particularly desirable in times of crises: central bank liquidity. They helped alleviate central bank credit rationing by

[143] As a delayed consequence of the Austro-Hungarian Compromise of 1867, the *Oesterreichische Nationalbank* was renamed *Oesterreichisch-ungarische Bank* or OeUB between 1878 and 1918; c.f. also Chapter III of this dissertation.

[144] Walter Bagehot (1873) is usually interpreted as having argued that central banks acting as LLR should lend freely, at high interest rates, and only in return for good collateral. For a discussion of these principles, please refer to the introduction of this dissertation.

addressing some of the trickiest aspects haunting LLR ever since the concept was first coined. First, on the most basic level, AHCs reduced risk management costs for the central bank by shifting borrower screening activities back to market participants. Second, AHCs tackled information asymmetries faced by the central bank in direct LLR. They made effective use of private information on liquidity recipients and had an inbuilt defense against moral hazard. *Aushilfs-Comités* constituted an ad-hoc alternative to direct LLR lending in the absence of an institutionalized central bank risk management and monitoring framework.[145] Third, the AHCs provided an indirect way of temporarily enlarging the pool of collateral eligible for last resort liquidity. Their joint guarantee structure, and their equity funds limited the amount of additional risk a similar enlargement would have triggered for the central bank in direct LLR, while also addressing the moral hazard implications of the enlargement.

Understanding which crisis management practices proved effective in the past is not only interesting in its own right. As several decades-worth of research on the Great Depression of the 1930s have shown, the past may harbor policy-relevant insights for today (Eichengreen, 2016). From this point of view, *Aushilfs-Comités* constitute a useful precedent for recent proposals to ensure LLR access to a wide range of market participants beyond the traditional banking system via market solutions or private-public partnerships (Acharya and Öncü, 2011). The structure and set-up of *Aushilfs-Comités* provided a straight-forward answer to the key questions of collateral financing, collateral liquidation and loss allocation which are conventionally cited in this regard (Begalle et al., 2016).

The remainder of this chapter is structured as follows. Section 2.2 discusses the related literature and the contributions of this chapter in more detail. Section 2.3 presents the data sources. Section 2.4 provides the historical background and explores the reasons behind central bank credit rationing in 1873. It also describes the policy responses adopted by the OeNB in 1873, focusing on the role of AHCs. Section 2.5 analyzes the role of *Aushilfs-Comité* membership in mitigating bank distress econometrically, including several robustness tests. Section 2.6 discusses the precise channels through which AHCs addressed credit rationing and liquidity squeezes at the bank-level. Section 2.7 concludes.

2.2 Relevant literature

The intricacies of last resort lending have generated an extensive set of contributions in both economics and economic history. This chapter is related to three strands in the previous literature: (1) the rationale and design of last resort lending; (2) the effectiveness of last resort lending; and (3), other prerequisites for and constraints on last resort lending. These three strands shall be briefly outlined here. Each discussion is followed by an explanation how this chapter contributes to our present knowledge of the matter.[146]

[145] Chapter III of this dissertation argues that such frameworks are crucial to check moral hazard deriving from LLR.
[146] Parts of this literature review have been published in Jobst and Rieder (2016).

2.2.1 Rationale and design of last resort lending

While the proximate and ultimate causes of the fragility leading to a financial crisis may differ and continue to be debated, all systemic financial crises share similar consequences that are most relevant for the question of last resort lending (Gorton and Metrick, 2013). In a systemic run, the affected intermediaries are by definition unable to fully meet the large-scale scramble for cash they are facing. In this sense, all intermediaries become insolvent, as they cannot honor their obligations without trying to sell assets (Gorton, 2012). If many credit institutions sell their assets simultaneously, however, fire sales will result, as asset values are depressed by "cash-in-the-market pricing".[147] The resulting price declines may have both direct and indirect spill-over effects which also extend to third parties. Creditors make losses if loan defaults force them to sell collateral at depreciated prices while declining asset prices have more general balance sheet effects. Ultimately, the cost of credit intermediation may rise substantially, transmitting the financial crisis to the real economy (Bernanke, 1983).

These negative externalities provide the rationale for a lender of last resort that can provide liquidity against illiquid collateral when no one else can. In doing so, the LLR can address creditors' doubts, stop the incipient run and avert fire sales that would have potentially severe macroeconomic consequences. In fact, some have argued that the mere existence of a credible LLR can prevent the emergence of a crisis in the first place.[148] To be able to fulfill this task, the LLR must be an institution that cannot become illiquid itself. As the monopoly issuers of currency, central banks are in a natural position to act as LLRs, although historically other institutions, such as associations of large banks or the government also served in this role (Gorton, 2012).

Since central banks can take and, historically, have taken a large number of different measures in reaction to financial crises, the terms "lender of last resort" and "emergency liquidity assistance" are unfortunately not always used consistently in the literature (Goodhart, 1999). Bindseil (2009) classifies the broad concept of "central bank financial crisis management" into three categories depending on who is at the receiving end of the liquidity support measures. First, "equal access measures" are addressed to all financial intermediaries with which the central bank normally operates and include measures like aggregate liquidity injections or the widening of the collateral set. Second, "individual access measures" are addressed to banks that are no longer eligible for help in standard equal access operations. Third, the central bank can organize a collective help effort by financial institutions that would be hurt most by the illiquidity or insolvency of the institution under stress. In the literature such measures are often referred to as "life-boat operations".[149] Interwoven with this first dimension is a second one which relates to the extent to which financial crisis management requires discretionary measures or (alternatively) whether it is already intrinsic to the normal operational framework of the central bank. While Freixas et al. (1999) restrict their review to cases of a "discretionary provision of liquidity to a financial institution (or the market as a whole)", others include the standard operational

[147] "Cash-in-the-market pricing" occurs when the total liquidity available in the market at a specific moment in time is (much) smaller than the total value of assets offered for sale (Allen and Gale, 2007).

[148] Consider e.g. the classical model by Diamond and Dybvig (1983), where the possibility of a sun-spot equilibrium involving deposit runs disappears as soon as a discount window is available and generally known to be so.

[149] For a historical case study and an excellent discussion thereof, c.f. Hautcoeur et al. (2014) and Ugolini (2014).

framework in the analysis as well (Bindseil, 2016). Consequently, a clarification regarding the definition used in this chapter seems appropriate: when referring to the concept of LLR in this chapter, I will subscribe to a definition that blends the idea of "wide eligibility" with the classical conception of a rules-based standing facility. The classical LLR as understood in this chapter is an ad-hoc or permanent institution which functions as an elastic source of liquidity for the benefit of all financial intermediaries in the system under circumstances of a collective financial market liquidity crisis, i.e. when regular funding markets seize to function.

By investigating the operation of a non-standard LLR solution during the Austro-Hungarian crisis of 1873, the present chapter makes two separate contributions to the literature. First, if carefully interpreted, *Aushilfs-Comités* might constitute a useful precedent for recent proposals to adapt the LLR to an evolving post-2007/08 regulatory environment.[150] How exactly LLR was operationalized differed historically and is likely to change as we go forward. Since the liquidity crisis of 2007-08, new legislation such as the U.S. Dodd-Frank Act has made it considerably more difficult for central banks to establish wide-eligibility LLR facilities in the future (Gorton and Metrick, 2013). Proposals for market solutions or private-public partnerships ensuring LLR access to a wide range of market participants beyond the traditional banking system proliferate (Acharya and Öncü, 2011). Begalle et al. (2016) cite three crucial questions which should be answered by the design of such a mechanism: (1) who liquidates collateral if need be and when? (2) How will collateral be financed until its liquidation? And, (3) how are losses going to be allocated? As will be discussed in Section 2.4, the structure and set-up of *Aushilfs-Comités* provided a straight-forward answer to all three questions.

Second, this chapter sheds light on how central banks addressed information asymmetry problems in the past. Microeconomic theory suggests that information asymmetries, and in particular adverse selection dynamics, can be core drivers of credit rationing in financial markets. In their seminal contribution, Stiglitz and Weiss (1981) show that credit rationing can be an equilibrium outcome in credit markets characterized by residual imperfect information, i.e. a lack of information persisting even after borrower screening. The loan interest rate impacts both the demand and the willingness to supply loans. For given collateral requirements, higher interest rates on average attract riskier borrowers because they perceive their probability of repaying the loan to be low in the first place. Therefore, there might be an equilibrium interest rate at which the lender rations credit: at this rate, she does not supply any further funds to borrowers even though there would be demand at higher rates because she fears adverse selection.[151]

Bester (1985) has shown that, if lenders can vary both interest rates and collateral requirements, there may be a separating equilibrium instead of credit rationing. In the case of central banks, however, credit rationing à la Stiglitz and Weiss (1981) seems more likely than in the case of standard commercial banks. Central banks cannot easily adjust collateral requirements "on the fly" for two reasons. First, there are legal/statutory limits determining the collateral and haircut acceptable for central bank credit which apply to all central bank

[150] There is a small but growing economic history literature on alternative LLR solutions, see e.g. Gorton and Tallman (2016).

[151] The same argument can be made fixing the interest rate while changing the collateral requirement. More recently, Arnold and Riley (2009) and Su and Zhang (2017) have challenged the possibility of rationing equilibria as described by Stiglitz and Weiss (1981).

counterparties equally. These rules are usually difficult to change and, by design, cannot be adapted to the individual borrower. Second, changing collateral requirements can induce moral hazard problems (c.f. Section 2.4). Hence, if the residual amount of imperfect information is large, a central bank might be induced to ration credit instead of supplying Bagehot-style "free lending" in a crisis.

In the 19th century, neither rating agencies nor banking supervision could be drawn upon to limit adverse selection. In order to engage in LLR activities, a central bank required an extensive in-house risk management framework which allowed for rapid processing and screening of large amounts of (financial) assets that were either used as collateral or purchased by the LLR. Most central bank operations involved the discounting of bills of exchange (c.f. Section 2.4). The quality of these financial instruments depended on the signatures they bore: all signatories that had "accepted" a bill were mutually liable for its payment in case the original debtor was unable to pay at maturity (Santarosa, 2015). Hence, central banks continuously monitored the quality of these names. For example, the Bank of England recorded all transactions entered into with a given counterparty either directly, by discounting the bills the latter had submitted, or indirectly, by discounting bills it had signed but which were submitted by other borrowers (Flandreau and Ugolini, 2011, 2013, 2014). Counterparty risk management frameworks reduced adverse selection problems: continuous monitoring of exposures to and payment histories of specific counterparties enabled central banks to form an opinion of borrower quality. However, these frameworks were far from perfect and their sophistication differed substantially from country to country. On the one hand, central banks could only obtain detailed information on the basis of transactions they themselves had entered with counterparties: whether or not these were good proxies for general borrower quality is difficult to ascertain. On the other hand, some central banks did not implement a harmonized counterparty risk management framework until late in the 19th century.[152] In 1873, *Aushilfs-Comités* constituted an ad-hoc solution partly designed to deal with these deficiencies in times of extreme market distress. Due to their institutional design, AHCs addressed informational asymmetries (c.f. Section 2.6). The evidence marshaled in Section 2.5 suggests that AHCs substantially alleviated the credit rationing problem.

Counterparty risk management alone, however, does not address the major potential cost associated with LLR: moral hazard. The existence of a LLR creates an insurance mechanism against liquidity shocks which may lead financial institutions to disregard liquidity risk management, which in turn makes both liquidity crises and recourse to the LLR facility more likely. Dealing with moral hazard requires a regulatory tool the LLR can draw upon to set incentives for proper liquidity management in normal times (Carlson et al., 2015). While Basel III regulatory tools such as the liquidity coverage ratio (LCR) or the net stable funding ratio (NSFR) were devised to respond to these concerns in the post-Lehman era, we do not know much about whether and how central banks dealt with moral hazard in the early days of LLR.[153] These unsolved questions about the past are important because the previous answers given in the literature continue to exercise a strong influence, rightly

[152] c.f. Section 2.4 of this chapter and Chapter III of this dissertation for details on the Austro-Hungarian case.

[153] The question how central banks checked moral hazard in the 19th century without explicit liquidity regulation is explored in detail in Chapter III of this dissertation.

or wrongly, on present discussions of LLR.[154] Investigating the specific design of the LLR solution chosen in 1873 sheds light on how a contemporary central bank dealt with moral hazard in practice. *Aushilfs-Comités* created an ad-hoc solution to this problem. To be eligible for a loan, members had to contribute to an equity fund covering all losses that would be incurred by the AHCs. These compulsory contributions made sure that members would be collectively penalized for imprudent risk management in normal times.[155] Section 2.4 shows that this penalty was not only a hypothetical possibility in the aftermath of the *Gründerkrach*.

2.2.2 Effectiveness of last resort lending

There is a large literature on the effectiveness of LLR operations in mitigating financial distress. Not surprisingly, the 2007-08 crisis has also sparked considerable new interest in this topic. Perhaps historically the most important single starting point for this ever growing literature in modern economic history and economics was the fierce criticism, marshaled by Friedman and Schwartz (1963), of Federal Reserve (FED) policies during the banking panics of the Great Depression 1929-1933. Friedman and Schwartz (1963) argued that the FED had, at best, neglected its role as a LLR and, at worst, contributed to harshening the effects of the liquidity crises during these years.[156] It took several decades worth of research following the publication of *A Monetary History of the United States* to cement the claims of a connection between policy inaction, banking crises and real effects during the Great Depression. Bernanke (1983) set the conceptual groundwork for understanding the channel between financial distress and the real economy by coining the idea that the main consequence of unaddressed bank distress consisted of rising costs of credit intermediation (CCI). More recently, Calomiris and Mason (2003a) provided convincing empirical evidence for this channel during the Great Depression.

There are several reasons why the earlier literature focused on the link between bank distress and real effects, rather than investigating the link between policy responses and the depth of the financial crisis more directly. First, since the FED's reaction to the Great Depression seemed to be one of general omission, the apparent absence of variation in the policy response geared empirical studies towards indirect assessments of this link. Contributions by Calomiris and Mason (1997), Calomiris and Mason (2003b), and Richardson (2007) all analyze the question whether and when liquidity provision would have been enough to prevent large scale bank failures during the Great Depression. Their assessments are based on the presumption that bank distress due to souring fundamentals, in contrast to panic-induced illiquidity following mass withdrawals of short-term funding, cannot be effectively addressed by the LLR.[157] These indirect assessments yielded mixed results. Richardson (2007)

[154] Perhaps most famously, authors have rationalized Walter Bagehot's (1873) dictum that the LLR should lend at "high rates" during crises as an attempt to disincentivize lax liquidity management by making emergency liquidity very costly (Crockett, 1996; Castiglionesi and Wagner, 2012). According to Stiglitz and Weiss (1981), however, lending at high rates should aggravate the problem rather than addressing it. Making emergency liquidity very costly during crises can increase the probability of adverse selection at the discount window and may motivate bad banks to gamble for survival.There are convincing, alternative explanations for "high rates", c.f. Martin (2009) and Bignon et al. (2012).

[155] AHCs could have fallen prey to moral hazard in teams, since the members could socialize their larger losses while only paying a fraction of them through the equity contributions. Below I show that OeNB supervision on the boards of AHCs likely limited this risk.

[156] For a more recent perspective, c.f. Carlson and Wheelock (2013).

[157] These assessments are related but not identical to the normative argument, which is sometimes made, that the LLR should never lend to insolvent but only to illiquid institutions. The problematic nature of this argument is evident in the difficulty of

shows that the illiquidity and insolvency hypotheses are complementary rather than mutually exclusive in the context of the Great Depression 1929-1933. Instead of advocating a "one-explanation-fits-all" approach, scholars have thus taken a more micro-level perspective by testing which of the channels comes closer to explaining specific episodes within longer periods of banking distress. Similarly, Calomiris and Mason (2003b) conclude that, while earlier phases of crisis during the Great Depression can be accounted for by bank fundamentals, at least the final episode of distress in 1933 was largely driven by panic-induced illiquidity.

Second, even assuming we had observable variation in the policy response to banking crises, attempts at identifying the link between policy responses and the intensity of financial distress are fraught with endogeneity concerns. Both omitted variable bias and simultaneity constitute serious obstacles for pinning down causality and its direction. Not only are the strength and dimension of the LLR's reaction a function of the intensity of distress experienced, but the extent of the policy intervention itself might be endogenous to various unobservable, time-variant characteristics at the bank-level. Over the last decade, these concerns motivated several authors to focus explicitly on empirical identification strategies. In order to tease out the causal effects of last resort lending, these contributions rely on an arguably exogenous variation in the policy response and/or build their case on an exogenous liquidity shock causing financial distress. Based on the premises of theoretical studies such as Gorton and Huang (2004) and Diamond and Rajan (2005), seminal empirical work by Richardson and Troost (2009) exploits border discontinuities around Federal Reserve districts to identify the mitigating effect of liquidity provision on bank distress during the Great Depression. While the Atlanta FED provided ample liquidity to banks situated in its district, the St. Louis FED followed a pro-cyclical real bills doctrine. Arguing that these policy differences were already in place before the banking panics of the Great Depression hit, Richardson and Troost (2009) are able to identify a large and significant mitigating effect of last resort lending. Subsequent work by Jalil (2014), using the same underlying empirical strategy but widening the scope of study, confirms these results.[158]

A related study by Carlson et al. (2011) has the merit of addressing endogeneity concerns deriving from previous central bank policies. The latter are often argued to be connected to past financial crises, through channels such as lax lending conditions and moral hazard. In April 1929, an exogenous shock emanating from a fruit-fly infestation in Florida triggered the propagation of bank distress via correspondent networks. The Federal Reserve Bank of Atlanta reacted to stop the contagion effect by providing last resort liquidity to affected banks. Carlson et al. (2011) draw on this shock, which was clearly unrelated to prior Federal Reserve policies, to study the counterfactual question how bank distress would have evolved in the absence of the LLR. Their results suggest that the bank failure rate would have been substantially higher, had more large correspondent banks failed – which, according Carlson et al. (2011), would have been the likely consequence in the absence of a LLR. More recently, a similar study by Bignon and Jobst (2017) combines both an exogenous liquidity shock and arguably exogenous variation in the access to the LLR facility. The authors exploit a wine blight

separating solvency from liquidity concerns, in particular in times of crisis, c.f. Goodhart (1999).

[158] Although Richardson and Troost (2009) and Jalil (2014) exploit border discontinuities, they do not test their hypothesis in a fully-fledged regression discontinuity framework.

in 19th century France and the fact that counterparties had differential access to central bank liquidity due to differences in the *Banque de France*'s local branch network density to show that LLR access had a strong mitigating effect on regional default rates.

To be sure, the econometric challenge of identifying a potential mitigating impact of LLR is not only limited to historical banking crises and policy interventions. Attempts to isolate the effect of liquidity provision during and beyond the crisis which erupted in 2007-08 face identical problems (Hamilton, 2009). Only few studies manage to go beyond aggregate time-series data to address endogeneity concerns. In this context, Duygan-Bump et al. (2013) provide one of the rare explicit attempts to tackle identification issues explicitly by disaggregating to the institution-level data. In their study of the impact of the FED's Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF), they draw on both time-series and cross-sectional variation in a difference-in-difference panel model. This data format allows the authors to address reverse causality concerns which complicate aggregate time-series analysis. Echoing the results of previously discussed papers, Duygan-Bump et al. (2013) also find a positive impact of LLR in terms of stabilizing money market mutual funds' (MMMFs) asset flows.

The present chapter makes two contributions to the literature discussed in this subsection. First, to the best of my knowledge, this chapter is the first to employ inverse-probability weighted regression adjustment (IPWRA) as an empirical strategy to tackle the challenges in identifying the effects of LLR on bank survival. This chapter uses IPWRA to address potential endogeneity concerns related to the selection of banks into *Aushilfs-Comités*. This selection problem is essentially equivalent to the omitted variable bias discussed above: the working assumption is that there is a correlation at the bank-level between particular bank characteristics and the probability of receiving liquidity support (or, equivalently, the action of selecting oneself into a AHC). Other contributions addressed this problem by relying on a source of exogenous variation in the access to the LLR (Richardson and Troost, 2009; Bignon and Jobst, 2017). This arguably first best approach is, however, only an option in rare cases. An alternative way to deal with endogeneity would be to directly model the selection process in a first stage regression by drawing on at least one predictor exogenous to the main regression explaining bank failures. In a second stage, IPWRA then runs the main regression of interest but penalizes observations by re-weighting them based on their predicted probability to select themselves into the treatment group. This empirical strategy could help to significantly expand the set of studies quantifying the role of LLR in mitigating bank distress.

Second, to the best of my knowledge, this study represents the first analysis of a 19th century LLR intervention using both disaggregated balance sheet data and a precisely matched treatment indicator at the level of individual financial institutions. Furthermore, this study is the first to test the effectiveness of a non-standard, multi-layered LLR mechanism empirically. While the studies discussed above all investigate the (implied) effect of conventional LLR standing facilities in mitigating bank distress, the present chapter contributes to this literature by exploring a non-standard LLR device which, *inter alia*, shifted potential losses back to market

participants and decentralized lending decisions. Prior contributions to the literature suggest unanimously that conventional LLR operations have a strong and positive impact on bank survival during liquidity crises.[159] While there were benefits to be reaped from setting up an unconventional LLR in the Austro-Hungarian case, e.g. in terms of addressing information asymmetry problems, it is not necessarily clear that the specific structure of *Aushilfs-Comités* had a positive effect on the effectiveness of LLR. For example, one could imagine that compulsory equity fund subscriptions deterred potential borrowers. Similarly, it is possible that the involvement of private institutions in LLR lending decisions led to discrimination against specific counterparties and thus decreased LLR access as well as success. The present chapter offers an empirical investigation to shed more light on these aspects.

2.2.3 Other prerequisites and constraints on last resort lending

When examining the historical beginnings of LLR, the conventional narrative emphasizes the idea that central banks had frequently been founded as private companies (Capie et al., 1994). According to this view, central banks initially viewed other credit institutions as direct competitors. Consequently, it is often argued, it took some time, and also fierce criticism by contemporaries, until central banks finally assumed their responsibility as Bagehot-type LLRs – a role, which evolved as the logical corollary of central bank's note-issuing monopoly only gradually.[160] More recently, Calomiris et al. (2016) reaffirm this evolutionary perspective on the LLR. They argue that for central banks to become fully-fledged LLRs, five pre-conditions needed to be met. First, central had to receive the right to issue bank notes which bear the privilege of legal tender. As discussed above, the ability to create sufficient liquidity in a crisis is a crucial element for LLRs to address financial panics. Second, the central bank had to have a clear mandate to guide its policy response to crises. In the case of the Bank of England, the recurring suspension of Peel's Act, which bound the Bank to specific cover requirements when issuing notes in normal times, is often interpreted as having constituted the starter's gun for "free lending" during 19$^{\text{th}}$ century financial crises. Third, Calomiris et al. (2016) argue central banks required the flexibility to adjust interest rates upwards during crises. Rising interest rates contributed to safeguard the credibility of their commitment to the Gold Standard over the medium term (Martin, 2009) and revived interbank markets (Bignon et al., 2012). This pre-requisite meant that usury ceilings needed to have been abolished prior to the establishment of a fully-fledged LLR. Fourth, in order to ensure the LLR would act in accordance with social objectives rather than maximizing its own profits during episodes of financial distress, windfall profits deriving from the application of high rates should be taxed by the government. Finally, there was a need for provisions to avoid unduly discrimination between applicants at the discount window, e.g. because the LLR wished to favor certain pre-existing business relations. Calomiris et al. (2016) see this requirement at least partly fulfilled by the establishment of lending standards and internal rating books at the Bank of England. The latter usually

[159] This unanimity should not be over-interpreted: there might be publication bias in favor of positive results, c.f. Christensen and Miguel (2016).

[160] For a recent paper challenging this point using contemporary data, c.f. Bartels et al. (2016) who show that central banks with private shareholders do not seem to differ in their financial behavior from purely public central banks.

assigned maximum credit limits to each counterparty which depended *inter alia* on the borrower's financial characteristics.[161]

Needless to say, there are many historical instances where a central bank was unable or unwilling to take on LLR responsibilities despite fulfilling all five criteria. On the eve of the Great Depression, the FED had arguably complied with most, if not all, of these pre-requisites (Meltzer, 2003). Still, in the case of some Federal Reserve banks, the prevalence of, with hindsight, fatal policy beliefs about the role of a central bank during banking crises (Richardson and Troost, 2009) and the existence of a stigma attached to discount borrowing (Gorton and Metrick, 2013; Rotemberg, 2013) translated into the absence of an effective LLR in several districts. Jobst and Rieder (2016) point to two additional constraints which historically curtailed a central bank's ability to act as a LLR. First, there is what might be termed a "confidence constraint". This constraint seems to be particularly relevant for central banks in the "periphery", with less established reputations for defending the value of their bank notes. Although central banks cannot become illiquid, the privilege to issue more legal tender does not always constitute a sufficient basis for acting as an effective LLR. Indeed, banknotes – the cash liabilities issued by the central bank – must themselves be accepted as a liquid and safe means of payment. If, on top of a run on banks engendering outflows of liquid reserves from the banking system, a run on the central bank occurs because the public loses its confidence in the value of banknotes and the central bank is compelled to convert large quantities of cash into specie (or foreign exchange), the central bank's ability to calm a panic by issuing currency is severely curtailed. Raising the discount rate might slow the external drain, but even this move relies on the medium-term credibility of the central bank.

Second, successful "free lending" requires that the counterparties in need of liquidity have sufficient assets at hand that can be sold to the central bank or pledged in collateralized borrowing. In principle, assets should suffice as long as the central bank stands ready to value them at their pre-panic prices. In the 19^{th} century setting, bills of exchange did not pose any complications, as they were always valued at 100% minus a deduction for the discount rate. In the case of securities used in collateralized lending, central banks could simply use the pre-panic prices to avoid pro-cyclical tightening of credit. In practice, however, the situation was often more complex because central banks were bound by their statutes and regulations. In collateralized lending operations, the central bank regulations combined mark-to-market pricing (like in the Eurosystem today) with significant haircuts and an often very small list of eligible assets. These stipulations and the narrow definition of "good collateral" constrained the amount of (collateralized) lending central banks could grant in "collateral crisis" when a large array of assets previously perceived as information-insensitive suddenly became the object of creditors' doubts (Gorton and Ordoñez, 2014).

Yet, central banks never simply surrendered to the prerequisites and constraints they faced when acting as LLR. They took a variety of alternative measures such as credit guarantees, securitization and asset pur-

[161] *Prima facie*, credit limits would appear to contradict the very tenet of "free lending" which characterizes a LLR. Chapter III of this dissertation discusses how these limits were operationalized on a daily basis by the OeNB and why the credit limit system can be viewed as consistent with a fully-fledged LLR.

chases (Bignon et al., 2012; Calomiris et al., 2016) which were consistent with Bagehot's dictum to provide "wide-eligibility" liquidity in response to systemic crises. This chapter contributes to the literature by showing how institutional innovation, the creation of *Aushilfs-Comités*, enabled the OeNB to partly circumvent the institutional constraints on "free lending" it faced in 1873.[162] Section 2.4 will describe these constraints and their consequences in 1873. AHCs constituted an attractive alternative to direct LLR lending in the presence of concerns about the "confidence constraint" and statutory limits on collateralized lending. As discussed in detail in Section 2.6, the AHCs' ability to lend against collateral that was not central bank eligible and their right to rediscount substandard paper with the OeNB suggest one possible channel which can explain why *Aushilfs-Comités* mitigated bank distress during the *Gründerkrach*.

2.3 Primary sources and data

In order to analyze the effectiveness of non-conventional last resort lending, the present chapter builds on the bank-level panel data set compiled for Chapter I of this dissertation. This bank-level panel data set contains more than 130 variables covering background information, balance sheets as well as profits and loss statements of banks operating on a joint-stock basis[163] in Austria-Hungary between 1868 and 1878. The data for the panel was retrieved from two independent primary sources: on the one hand, the official statistical yearbooks for Austria and Hungary compiled by the imperial statistical commissions for the two halves of the Empire; and a financial yearbook edited by a private publishing house, the so-called *Compass - Finanzielles Jahrbuch*, on the other hand. The panel data set containing the financial characteristics of individual banks represents the logical empirical backbone for the present chapter: we are interested in role of LLR lending in mitigating bank distress after explicitly controlling for bank-level characteristics. Hence, this chapter employs the same binary dependent variable for bank failures and the same set of control variables already drawn upon in Chapter I.[164] In addition to the covariates collected for Chapter I of this dissertation, the present chapter uses the *Compass - Finanzielles Jahrbuch* to compile the full matrix of directorate interlocks for all Austro-Hungarian banks at the end of 1872 to undertake robustness checks (c.f. Section 2.5.3). The *Compass* published the names of directors for all banks on an annual basis. I compile the cross-section for December 1872 and then match the names across banks to construct an undirected network of interlocks. The matching procedure yields a success rate of almost 100% because for each director, we do not only know family name and first name but also titles and nobility ranks where applicable.

For the purpose of constructing our regressor of interest, and to analyze the functioning of *Aushilfs-Comités*, this chapter draws on a variety of additional primary sources. First, and most importantly, this chapter relies on

[162] Founded in 1816, the OeNB had in fact used similar AHC mechanisms as soon as 1820 to channel liquidity to the market in times of crises (Jobst and Rieder, 2016).

[163] These banks include joint-stock banks stricto sensu (*Aktienbanken*), mortgage banks (*Hypothekarkreditanstalten*) and pawn banks (*Pfandleihanstalten*).

[164] For a more detailed description of the primary sources and archives drawn upon to compile the bank-level data, please refer to Chapter I.

a detailed reading of the general (daily) press to gather information on the location, subscribers, programme, design as well as the modalities of lending and financial information of *Aushilfs-Comités*. Starting with the creation of the first AHC in early June 1873, the press regularly reported on the location of the initiatives and provided rolling updates on the list of institutions as well as individuals participating in the equity funds (including their contributions). For the bigger AHCs, such as the ones located in Vienna and Budapest, more contextual information is available. For example, the Viennese AHC published its complete mission statement, including the modalities of its lending operations, the composition of its management board and several financial statements over the course of its operation. In order to filter relevant information rapidly this chapter used the *Austrian Newspapers Online (ANNO)* platform provided by the Austrian National Library in Vienna.[165] Besides its easy and free accessibility and the possibility to conduct complex full-text searches, the platform is outstanding with regard to its geographical coverage: far from featuring only Viennese newspapers, ANNO also covers the Austro-Hungarian provinces including notably Bohemia, Galicia, Tyrol but also the Hungarian lands. The geographic dispersion of digitized newspapers allows for an exact tracking of the foundation and members of relatively small local *Aushilfs-Comités*. Among the most relevant newspapers for this chapter were *Die Presse*, *Neue Freie Presse*, *Wiener Zeitung*, *Deutsche Zeitung*, *Der Tresor*, *Wiener Extrablatt* and *Pester Lloyd*. Thanks to summaries of the overall contributions to the committees published in the *Compass*, I can verify the numbers obtained from individual newspaper publications.

Apart from the general press, several further sources were consulted for this chapter. First, additional information on the operation and design of *Aushilfs-Comités* is drawn from summary reports on the crisis, both official ones, most notably the Parliamentary Enquiry of 1874 (Abgeordnetenhaus, 1874), and semi-official as well as personal ones from contemporary observers. Wilhelm Ritter von Lucam (1876), general secretary of the OeNB published a detailed quantitative account of the central bank's policy actions between 1862 and 1876, including an analysis of the Bank's actions during the crisis of 1873. Joseph Neuwirth (1874), journalist and MP to the lower chamber of the Austrian Parliament (*Reichsrat*), and Max Wirth (1874b), journalist and Vienna correspondent of *The Economist*, both wrote detailed books on the *Gründerkrach* in the direct aftermath of 1873. These sources were invaluable in terms of narrowing down the search within newspapers and for providing a general overview of how the AHCs worked in practice, how they related to the OeNB and how they were perceived by contemporaries.

Second, the central bank archives constituted a further primary source that contains much more detailed and descriptive data on the thought process which policy-makers were following when co-founding the Viennese *Aushilfs-Comité*. The AHC in Vienna was undoubtedly the biggest of its kind and hence not necessarily representative with regard to the exact local implementation of AHCs elsewhere. However, the OeNB archives convey a detailed picture of how the central bank initially became involved in the mechanism, how its management thought about and dealt with the question of credit risk and moral hazard in this context and which measures it developed to assure itself of a professional implementation. The OeNB archives were equally valuable for

[165] For further details, c.f. Chapter I of this dissertation.

researching the other policy responses to the crisis of 1873 (c.f. Section 2.4). For this chapter in particular, the protocols of directorate and supervisory board meetings between 1873 and 1878 were consulted in detail. The central bank archives are located in the OeNB's headquarters in Vienna and are open to researchers upon appointment.[166]

Third, descriptive evidence for the market perspective on AHCs was retrieved from the Viennese archives of the *Creditanstalt*.[167] For this study in particular, the protocols of directorate and supervisory board meetings of the *Creditanstalt* and the *Bodencreditanstalt* served as valuable resources. Both credit institutions were founding members of the Viennese AHC. Fourth, one part of Section 2.4 below briefly explains how a "lifeboat" operation was devised to avoid a default of the *Bodencreditanstalt* in November 1873. Although a detailed account of this episode is beyond the scope of this chapter, I draw on archival evidence from the Austrian state archives (*Oesterreichisches Staatsarchiv*, OESTA). In particular, this chapter employs meeting minutes, files and records which originated in the Austrian Ministry of Finance's (*k.k. Finanzministerium, Präsidium*) section dealing with banks and credit institutions (*Faszikel 8.2: Banken und Kreditinstitute, Karton Nr.2.853-2.855*). The relevant department of OESTA is located in Vienna and open to all researchers.[168]

Finally, this chapter makes use of data on central bank lending rates and compares them with the prevailing market rates at the time to yield precise judgments on the existence and timing of credit rationing by the central bank. Data on the OeNB discount rates can be obtained from the *Compass - Finanzielles Jahrbuch* discussed in Chapter I. The data series on comparable market rates comes from the the daily official stock market reports of the Viennese Stock Exchange (VSE), the *Coursblatt des Gremiums der k.k. Börse-Sensale*. The market rate is quoted daily and constitutes the rate charged for the discounting of prime bills in the Viennese market with a maximum maturity of 90 days. Therefore, the underlying bills' characteristics coincide with the requirements for submitting to the OeNB disount window (a maximum maturity of 90 days plus at least two reputable signatures). The *Coursblatt* is available on a daily basis in the archives of the VSE and has been digitized for most years of the 19$^{\text{th}}$ century. The VSE, however, does not operate its archives on an official footing. In order to gain access, researchers need to contact the market data services section.[169]

2.4 The policy response in 1873

This section will provide the historical background and descriptive evidence summarizing the OeNB's policy response to the crisis of 1873. It directly builds on the historical background section in Chapter I. The first subsection will discuss the most well known policy reaction to the *Gründerkrach*, the suspension of the Bank Act

[166]Oesterreichische Nationalbank (OeNB), 'Dokumentationsmanagement und Kommunikationsservice, Bankhistorisches Archiv', *Direktoriumsprotokolle* and *Verwaltungsratsprotokolle* (Rotenhausgasse 4, 1090 Wien, Austria).
[167]For further details on the *Creditanstalt* archives, c.f. Chapter I of this dissertation.
[168]Oesterreichisches Staatsarchiv, 'Allgemeines Verwaltungsarchiv, Finanz- und Hofkammerarchiv', *k.k. Finanzministerium, Präsidium* (Nottendorfergasse 2, 1030 Vienna, Austria).
[169]Vienna Stock Exchange (VSE), 'Market Data Services', *Board meeting minutes and records* (Wallnerstrasse 8, 1010 Vienna, Austria).

of 1862. The suspension is well documented in contemporary reports and the secondary literature. Therefore, the first subsection may be regarded as a summary of previous findings, although it provides new details on the motivation for suspension from protocols in the OeNB archives and frames the decision in a new light, i.e. from the perspective of the "confidence constraint" discussed above. The first subsection will also provide an overview of the likely reasons for OeNB credit rationing at the peak of the *Gründerkrach*. The second and third subsections will deal with two further central bank policy responses. Neither operation has been treated in detail in previous research: first, the OeNB widened the pool of collateral eligible for its lombard facility in May 1873; second, the central bank participated in the floating of a "lifeboat" for the ailing *Bodencreditanstalt* in late October 1873. Since these policy responses are at best briefly mentioned in the secondary literature, this chapter relies on primary archival material to sketch out their major characteristics. An in-depth discussion of their effectiveness and consequences is beyond the scope of this chapter but forms the object of my ongoing research in separate research papers. The last subsection conveys a detailed description of the *Aushilfs-Comités'* programme and functioning. It discusses the Viennese *Aushilfs-Comité* which served as proto-type for regional AHCs. The Viennese AHC has left several useful traces of its activities in archives and the general as well as specialized press. The subsection then investigates the creation of regional AHCs.

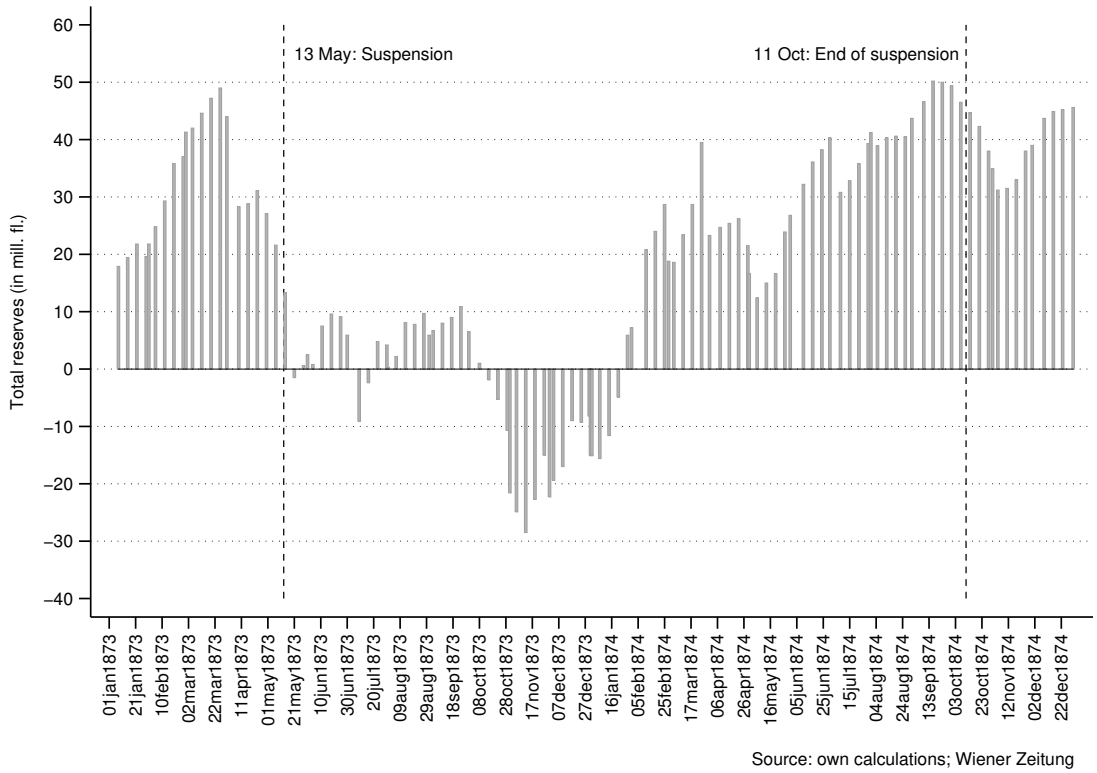
For a better understanding, a (very) brief description of the Bank's lending facilities is in order before delving into the details of the policy response to the crisis of 1873.[170] Financial institutions in Austria-Hungary could obtain central bank funding through two lending facilities, a discount and a lombard (advances) facility. Both types of operations were organized as standing facilities. In other words, the central bank defined the general lending conditions (most importantly what constituted eligible assets and the setting of the interest rate), but the actual transactions were initiated by the prospective borrower, not the central bank itself. In an advance, the OeNB granted a loan against some pledged collateral, typically securities, at a set interest rate. Loans had a maximum maturity of three months. The loan amount was calculated as the market price of the pledged securities minus a pre-defined haircut which depended on the underlying collateral class. The Bank regularly published the list of collateral eligible for credit at the lombard facility. In discount operations, the Bank bought a bill of exchange with a short initial or remaining maturity at a discount to its nominal value (the discount rate). Unlike in secured contracts, where in the case of nonpayment the Bank could resort to selling the posted collateral, the reimbursement of a bill depended solely on the ability of the Bank's counterparties to honor their contracts at maturity. Hence, it was crucial that the safety of the bill was supported by the legal provision of joint liability (Santarosa, 2015). Joint liability stipulated that every owner who resold a given bill (e.g. by using it to pay for a debt or by selling it to a bank) had to endorse it by adding his/her signature to the bill. Endorsement served as an acknowledgment of liability: if the original debtor on whom the bill was initially drawn were to default, the endorsers were still liable for payment to the ultimate purchaser/owner at the bill's maturity. Joint liability thus significantly increased the safety of the bill for the final discounter, in our case the OeNB.

[170] Please refer to Chapter III of this dissertation for a more detailed discussion.

2.4.1 Suspension of the Bank Act of 1862 and central bank credit rationing

Following the suspension of convertibility and the subsequent strong depreciation of the currency during the tumultuous revolutionary years of 1848 and 1849, the Imperial government devised plans for new statutory rules governing the OeNB's cover of banknotes by precious metals. After 1862, the Austrian National Bank was therefore operating a system modeled on the British Peel Act[171]: as recorded in paragraph 14 of the Bank's statutes, the government limited the amount of banknotes to fl. 200 million without silver coverage, while every *Florin* issued beyond the fl. 200 million ceiling had to be covered by reserves in specie (Jobst and Kernbauer, 2016). The rationale for this provision was to safeguard the currency's silver parity by limiting the OeNB's note issuance at a time when Austria-Hungary was on a (non-convertible) silver standard. From the perspective of the "confidence constraint", the measure aimed at increasing and maintaining public trust in the value-storing capacity of banknotes. It was meant to reduce the incentive for the public to drain metal reserves from the central bank in times of crisis, when specie was arguably most needed by the latter in order to expand its liquidity supply to the market.

Figure 2.24: Evolution of "free" OeNB reserves according to paragraph 14 of the Bank Act (1873-1874)



Ironically, however, the flipside of these new rules was of course that they limited the OeNB's capacity to expand lending in the case of a financial crisis. On the eve of the *Gründerkrach*, statutory reserves fell rapidly in March 1873 and started to dwindle down to dangerous levels from late April 1873 onwards (c.f. Figure 2.24). When the stock market crashed on 9 May, market participants were well informed about the reserve

[171] For a recent discussion of this Act and how it constrained liquidity provision of the Bank of England during 19th century crises, c.f. Anson et al. (2017).

situation of the Bank because the latter published the relevant data on a weekly basis in the major Viennese newspaper of the time, the *Wiener Zeitung*. Neuwirth (1874) reports that representatives of the financial sector demanded a suspension of the Bank Act as soon as 10 May in order to enable the central bank to expand its loan supply without running the risk of violating its statutes. They repeatedly voiced these demands in the ad-hoc crisis meetings in the offices of the stock exchange and in official gatherings with the Finance Minister which took place during the weekend following Black Friday (Pressburger, 1962; Jobst and Kernbauer, 2016). In an almost immediate reaction to the stock market crash, the Austrian and Hungarian governments gave in to these demands and jointly agreed to suspend the OeNB's reserve requirement on 13 May in order to decouple the central bank's credit supply from any formal reserve rule.[172][173]

Nevertheless, despite the legal possibility to lend freely, the central bank policy response to the crisis initially stayed very tentative.[174] The cover ratio was effectively overshot in only 18 out of the 74 weeks of suspension, which was upheld until October 1874. Furthermore, the amount by which the statutory limit of note issuance was exceeded remained negligible throughout. The all-time high of excess supply amounted to fl. 28.5 million and was reached on 11 November 1873 (c.f. Figure 2.24). Although a definite judgment is inherently difficult because there is no possibility to quantify the financial system's liquidity needs, this sum appears to be negligible compared to an aggregate equity base of the joint-stock banking sector of fl. 575 million (c.f. Chapter I). "Free lending" according to the traditional LLR model would have required the central bank to grant unlimited access to its standing facilities (discount window and advances), at a given interest rate set by the Governing Board and against eligible collateral. Bignon et al. (2012) propose a simple test for the absence of credit rationing which can be applied to the Austro-Hungarian case of 1873. Under the null hypothesis of free lending, the central bank's "interest rate (for any given quality) ought to always be above, or equal to, the market rate (for the same quality)" (Bignon et al., 2012, p.590). The market rate can only be higher than the Bank's discount rate in the presence of credit rationing; under free lending, an initially higher market rate would decrease immediately due to funding liquidity arbitrage. As shown in Figure 2.25, the OeNB rationed credit at the peak of the *Gründerkrach* by refusing to lend on eligible bills, as the rates paid on prime bills in Vienna repeatedly exceeded official rates by up to 300 basis points during the first weeks after 9 May. Importantly, this rationing happened despite the fact that cover requirements had been suspended on 13 May.

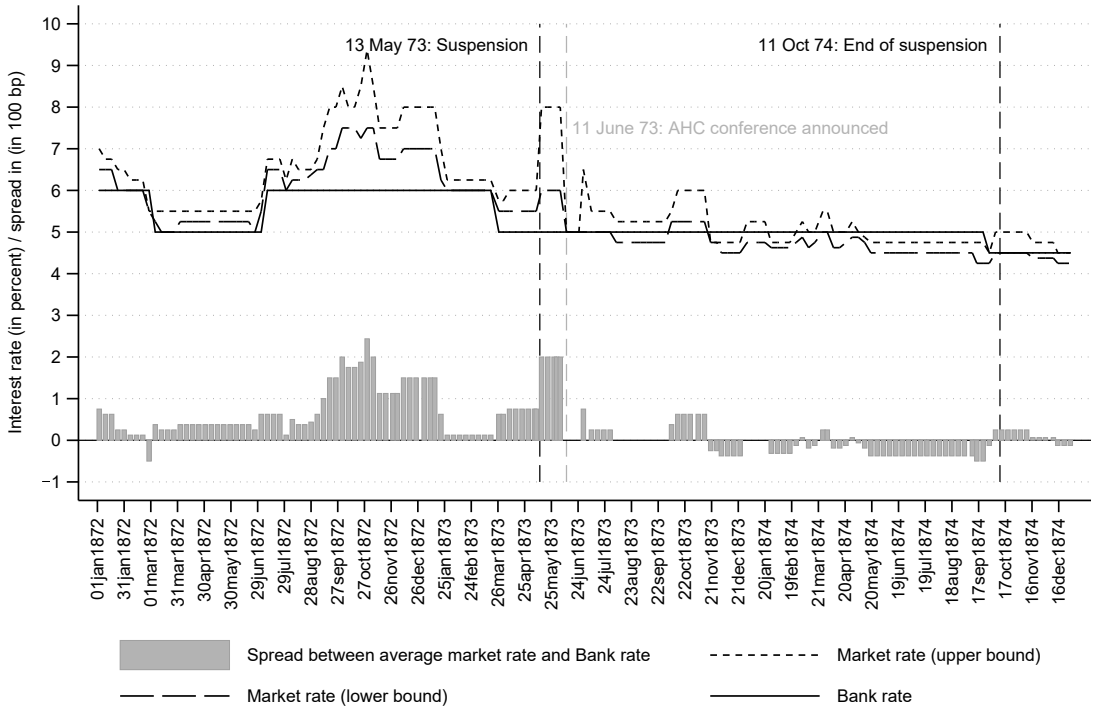
Why did the OeNB ration central bank credit during the crisis of 1873? After all, the central bank fulfilled the most important prerequisites mentioned by Calomiris et al. (2016): OeNB banknotes were legal tender, the suspension of the Bank Act provided a clear mandate to act, and the central bank had the ability to set interest rates at its discretion. In fact, the OeNB's institutional and ideational foundations provide several plausible reasons that can explain why the Bank did not assume a policy of "free lending" in 1873. The first one might

[172]Strictly speaking, the government did not suspend the entire Bank Act of 1862 but only paragraph 14 which contained the reserve requirements. In this chapter, I stick to the term "suspension of the Bank Act" to emphasize the analogy with the British Peel Act, which, of course, was also never fully suspended.

[173]Between 9 May and 13 May, the OeNB also conducted several purchase and re-sell operations involving gold and silver specie in order to provide liquidity to the market without depleting its reserves, c.f. supervisory board meeting on 13 May 1873, OeNB archives 1873/2546/15.

[174]For a detailed contemporary summary of the OeNB's operation during the suspension, c.f. Lucam (1876).

Figure 2.25: Official Bank discount rate and prime market discount rates (1872-1874)



Source: own calculations; Compass, Coursblatt des Gremiums der k.k. Boerse−Sensale and Wiener Zeitung

be ascribed to the realm of ideas governing OeNB decisions at the time, in combination with a fear of violating the "confidence constraint". The most striking feature of the period following 13 May 1873 is the puzzling skepticism of the OeNB and the governments vis-à-vis "free lending". Recurring references and discussions in the minutes of the OeNB's Governing Board meetings suggest that its policy decisions were haunted by the fear that the cover ratio could soon be fully reinstated. The Governing Board argued that any too sudden reinstatement could catch the OeNB on the wrong foot, if it were to overextend credit during the episode of suspension and could lead to the loss of the Nationalbank's note-issuing privilege (Pressburger, 1962).

Prima facie, it is difficult to understand why the OeNB took this threat so seriously, given that the governments had themselves taken the initiative to suspend the Bank Act. Discussions perpetuated in the minutes of the OeNB's Governing Board meetings suggest that the Bank's caution reflected a general consensus on the importance of rules to guard the stability of the currency. To be sure, initially the members of the Bank's supervisory board had opposed a suspension in an inter-locution with the Austrian Minister of Finance and had only reluctantly taken note of the governments' decision in a meeting on 13 May. In the same supervisory board meeting, directly following the suspension, the Bank governor remarked that the OeNB had always regarded the Bank Act as a panacea which needed to be defended; he stressed that the Bank would not be misled by a panic and would never forget its primary objective was to safeguard the value of the *Florin*.[175] In fact, as is evident from the protocols of directorate meetings, the OeNB always kept a close eye on its reserve situation throughout the entire period of suspension. Routinely at the beginning of each meeting, the OeNB's secretary general

[175]Supervisory board meeting on 13 May 1873, OeNB archives 1873/2546/15.

would present the current status of reserves and detail by how much the ceiling stipulated by paragraph 14 was exceeded. As the convertibility of the *Florin* into silver had remained suspended since the war with Prussia in 1866, adherence to the statutory cover requirements remained the only formal safeguard in place for the value of the Austrian currency. Lifting the cover requirements thus represented a potentially far-reaching intervention that put the public's confidence in the *Florin* to a test, especially if its purpose were to lend against rapidly depreciating collateral. As discussed in Section 2.6 below, depreciation had indeed intensified remarkably upon suspension: in a matter of days, the *Florin* had lost 3% of its value following 13 May 1873. In this context, it does not seem surprising that, when writing an account of central bank policy during the period from 1861 to 1875, the OeNB's secretary general actually prided himself on the fact that the Bank had always behaved as if convertibility had been in place (Lucam, 1876). These policy concerns appear to have been shared by the Minister of Finance, who, when he informed the central bank's governor about the decision to suspend on 13 May, advised the Bank not to abuse its newly gained freedom:

> By informing your Excellency [of the decision to suspend the Bank Act], I have to emphasize explicitly that, by taking this exceptional measure, which is of course only limited to the period of highest necessity, the government's intention is merely to prevent the loss of confidence in solvent and creditworthy circles and to avoid even worse calamities. I will firmly expect that the esteemed Bank will only use its newly gained rights to the extent to which it is necessary in order to prevent worse consequences.[176]

Overall, it appears that one explanation for OeNB credit rationing was the Bank's fear that an expansion of the note supply without any additional guarantees would endanger the stability of the currency. Put in more modern terms, the Bank sacrificed financial stability to maintain the integrity of the currency.[177]

The second reason for relatively weak transgressions of the reserve requirements despite the suspension was more technical. It combines supply-side as well as demand-side constraints on central bank credit. On the eve of the *Gründerkrach*, the OeNB's eligibility requirements for collateral were narrowly defined (c.f. next subsection).[178] The lion's share of pledgeable securities on the banking sector's balance sheet in May 1873 was composed of equity shares of recently founded companies.[179] These shares were ineligible for central bank credit via the lombard facility. The fact that most securities held by the banking sector were not central bank creditworthy might also explain why the increases in the lines of credit the OeNB governing board had granted to its branches were not drawn upon (Lucam, 1876): rightly or wrongly so, the central bank management interpreted the absence of strong demand for central bank credit as evidence (1) that it had done enough to address the liquidity crisis and (2) that the market had received all the support needed.

[176] Memorandum to the Supervisory Board signed by Finance Minister de Pretis on 13 May 1873, supervisory board meeting on 15 May 1873, OeNB archives 1873/2547/15.

[177] Historically, the OeNB usually rationed credit until the government proceeded to the suspension of note convertibility into specie or the introduction of foreign exchange controls. While halting the banking panic, these measures triggered sharp depreciations of the currency, c.f. Jobst and Rieder (2016).

[178] The list of assets eligible at the lombard facility was regularly published by the OeNB and can be consulted in the annual publications of the *Compass - Finanzielles Jahrbuch*. The list also grew substantially over time to include all types of public debt, railway debentures and covered bonds. However, it never included but a fraction of shares traded on the Empire's stock exchanges.

[179] For an explanation why banks ended up with rapidly depreciating collateral on their balance sheets, c.f. Chapter I of this dissertation.

In a published statement summarizing its actions during the period of suspension, the Bank argued:

> In accordance with the spirit of the the Imperial decree [to suspend the Bank Act], the OeNB kept in mind, as in duty bound, that the exceptional and temporary rights needed to be employed with the greatest possible caution; but one could not say that the Bank did not make ample or sufficient use of its delegated power, because she rather provided larger sums than were actually demanded.[180]

Although the Bank enlarged the pool of eligible collateral (c.f. next subsection), it did not consider the option to include more equity shares of newly founded companies. The OeNB management thought (and probably rightly so) that the moral hazard implications of this move would outweigh its short term benefits.[181] Without any additional guarantees or penalties for banks that had amassed these equity shares, the OeNB would have simply endorsed the dubious practices detailed in Chapter I of this dissertation.

Third, the existence of information asymmetries, in combination with the Bank's character as a private institution, constitutes another plausible reason for why the OeNB did not engage in "free lending" despite the suspension on 13 May. The Bank was owned by private shareholders whose main concern should have been the amount of dividends received. *Ceteris paribus*, a large expansion of central bank credit, possibly even against substandard collateral, would have increased the risk of losses for the Bank. To understand this point, consider the following. Preempting adverse selection, and thus ultimately also losses, would have required detailed information on and monitoring of counterparties: the quality of signatures on the bills depended on how often they were used, i.e. on how leveraged the counterparties (both discounter and acceptors of the bill) already were. Discount lending, however, was still very much decentralized in 1873: each OeNB branch was home to a college of so-called censors (*Zensoren*) who decided whether to accept or reject a bill submitted to the discount window.[182] Although the censors screened bills to ascertain minimum standards regarding the number of reputable signatures and the remaining days maturity, the Bank did not yet have an institutionalized monitoring framework for its counterparties in place in 1873. The absence of a harmonized risk management framework meant that the Bank's clerks and censors were only imperfectly able to monitor the OeNB's exposure vis-à-vis specific counterparties. The lack of such a framework therefore generated informational asymmetries between the data available to the Bank and the actual quality of signatures on the bills. A large increase in the amount of credit supplied to counterparties whose prior leverage the Bank could not fully assess in real time thus entailed taking on substantial new risk. From this point of view, rationing credit only to the very best counterparties might have been a rational response.

Finally, at least in theory, the decentralized nature of lending activities in conjunction with the absence of an overarching, harmonized lending framework also allowed considerable room for discrimination against specific

[180] *Die priv. österreichische National während der teilweisen Suspension des Paragraphen 14 der Bankstatuten*, as cited in Lucam (1876, p.87).

[181] Bank directorate meeting on 17 May 1873, OeNB archives 1873/II/5.

[182] *Zensoren* were chosen among reputable individuals from the local business community and were centrally appointed by the Bank's board in Vienna. The Bank did not pay censors for their services but the latter could simultaneously exercise a remunerated position in a local firm: even a managing position in a local commercial bank was no exclusion criterion. Censors could not, however, vote on bills submitted by their own firm.

counterparties. How exactly this discrimination would have looked like is unclear, but it could have further added fuel to the incentive to ration credit due to informational asymmetries. Overall, the consequences of credit rationing during the high noon of the *Gründerkrach* were at least two-fold. First, perhaps unsurprisingly, the *Florin's* silver value remained remarkably stable throughout the crisis period, in particular if compared to the course of events in 1848[183]: despite the crisis, the depreciation to par always fluctuated around 7.5% between January and December 1873 (c.f. also Figure 2.33 in Section 2.6). Second, as discussed in Chapter I, a large number of banks failed during the weeks following 9 May 1873. Ascribing causality to credit rationing is however naturally difficult in this context. In order to test whether LLR could have helped mitigate bank distress during *Gründerkrach*, this chapter will look at the effect of non-standard last resort lending in the form of *Aushilfs-Comités* which were set up in early June 1873.

2.4.2 Widening the pool of eligible assets

Before looking at *Aushilfs-Comités* in more depth, I will briefly describe two other policy reactions the OeNB took to address distress in the financial sector. The first of these two, the widening of the set of eligible collateral for the lombard facility, can be considered as an "equal access measure" (Bindseil, 2009). The second, the floating of a "lifeboat", was specifically aimed at rescuing the *Bodencreditanstalt*: the "lifeboat" provided liquidity to an institution whose financial situation and pledgeable collateral did not satisfy the requirements of standard equal access facilities. The rescue operation is discussed in the next subsection.

Four days after the suspension, on 17 May, the governing board met to discuss additional demands from market participants. The most pressing one, first mentioned during an ad-hoc board meeting on 15 May, was a call to enlarge the pool of collateral eligible for the Bank's lombard facility (Pressburger, 1962). Due to the Bank's statutes, the room for maneuver in this regard was fairly limited: the Bank was allowed to accept all forms of domestic public debt (national and subnational), its own covered bonds, the covered bonds issued by domestic mortgage banks and publicly traded, fully paid-up equity shares and priority obligations of industrial companies (including railways) situated in either part of the Empire (Leonhardt, 1872). Yet, statutory eligibility did not translate into an automatic inclusion in the list of collateral effectively accepted by the central bank. Therefore, the list of eligible collateral was shorter than the number of securities with statutory eligibility.

The OeNB revised its collateral pool periodically. It published the list of effectively admissible collateral at least once per year and whenever changes were made to this list during the year these alterations were immediately released for publication in the general press.[184] Furthermore, the exception confirmed the rule: due to a fairly lenient interpretation of its statutes the Bank had taken in response to a smaller crisis in autumn 1869, equity shares of several joint-stock banks in Brno, Budapest, Graz, Trieste and Vienna also enjoyed the

[183] In 1848, the silver value of the currency depreciated strongly after the suspension of convertibility, c.f. Jobst and Rieder (2016).
[184] The pool of central bank eligible assets was published on a regular basis alongside the minimum haircuts for each asset class. This information is available in the annual *Compass* publications between 1868 and 1914.

status of eligible collateral.[185] Ever since admitting these bank shares, however, the board had tried to find the right moment to phase out their eligibility again. Hence, the Bank was determined not to admit any additional bank shares in the future and the directorate reaffirmed this stance on the occasion of the meeting on 17 May (Pressburger, 1962). In terms of the haircuts charged on collateral submitted for lombard loans, the OeNB displayed a high degree of risk aversion – although for some types of collateral its lending standards are comparable to those of modern day central banks.[186] It charged a *minimum* haircut of 40% on equity shares of banks and industrial companies and a *minimum* haircut of 30% on all other securities, including government bonds.

The meeting minutes allow for a detailed reconstruction of the directorate's deliberations on 17 May 1873.[187] The Bank's secretary general raised four specific points when starting the discussion on a possible enlargement of the pool of central bank eligible collateral for the lombard facility: first, there would be a need to identify those securities which in principle fulfilled the statutory requirements for eligible collateral but had not yet been included in the pool; second, there was a more general question how to appropriately price collateral given that most trading on the Vienna Stock exchange had come to halt on 9 May; third, the secretary general raised the question whether the prevailing system of haircuts should be maintained, and finally, he also suggested that the directorate could consider an interest rate increase for the lombard facility given that higher demand might be expected following the widening of the collateral pool. The secretary general then immediately pleaded in favor of a rate increase to "avoid demands for Bank credit that exceed the amount really needed".[188] In order to preempt an "egoistic interpretation of this measure" by the wider public, he argued that any commercial benefits the Bank were to reap from a lombard rate increase should be transferred to a special reserve fund rather than paid out to its (private) shareholders.[189]

After briefly considering the creation of a subcommittee to ponder the first and second aspect in detail, the directorate finally decided to proceed to an immediate inspection of the official stock exchange list. Ultimately, the directorate admitted three recently issued Hungarian government debt titles as well as 12 additional railway securities (a mix of shares and so-called *Prioritätsobligationen*, i.e. preferred shares). The limited scope of the enlargement might have disappointed market expectations; however, a decision to widen the collateral set beyond the Bank's statutes would have likely had severe moral hazard implications. The inclusion of more collateral issued by banks, real estate companies and industrial companies during the run up to the *Gründerkrach* would have implicitly validated the boom and its unsound fundamentals.[190] By accepting specific securities into the

[185]The group of eligible bank shares included the *Creditanstalt*, *Niederösterreichische Escompte-Gesellschaft*, *Triester Commerzialbank*, *Pester ungarische Commerzialbank*, *Mährische Escompte-Bank*, *Steiermärkische Escompte-Bank*, *Ofner Commerzial- und Gewerbebank*, *Pester Gewerbebank*; c.f. Leonhardt (1872, p.268).

[186]In 2017, the European Central Bank (ECB) charges valuation haircuts between 0.5 and 29% for public debt, depending on the residual maturity, credit rating and the type of security; for corporate debt titles and securities issued by financial institutions, the haircuts range between 1.0 and 38%, c.f. ECB (2016).

[187]Bank directorate meeting on 17 May 1873, OeNB archives 1873/II/5.

[188]Ibid. Note that this argument for a rate hike is very much in line with the rationale for "high rates" put forward in Bignon et al. (2012).

[189]Ibid. This proposal suggests the Bank was well aware of the privilege and responsibility it bore relative to other financial market participants: it had to walk a delicate tight rope between its role as a LLR and satisfying its shareholders.

[190]Well aware of these implications, the Bank's secretary general argued that simply lending against or buying up all types of securities would ultimately be equivalent to an artificial control of prices on the stock exchange; he argued that by doing so, the

pool of central bank eligible collateral, a central bank (at least partly) endogenously creates additional "good", i.e. information-insensitive, collateral (Gorton and Ordoñez, 2014): the inclusion of securities in the pool of eligible collateral creates a last resort buyer for eligible securities and therefore inclusion is likely to increase their market liquidity. Central bank eligibility may also generate a yield premium, although liquidity and solvency are notoriously difficult to distinguish – not only during episodes of financial distress. Regarding the remaining questions, the Bank directorate opted for the status quo: it decided to leave the pricing of non-traded collateral at the discretion of the lending committees, while keeping both the framework of haircuts and the interest rate unchanged.[191] In principle, these decisions reflect some willingness to abide by Bagehot's (1873) dictum that, during crises, a central bank should lend freely on collateral considered to be "good" in normal times. Instead of pro-cyclically tightening collateral requirements, the Bank continued to lend against collateral just as before 9 May. Both the pre-selection of securities into the pool of eligible collateral and the routinely high haircuts may have limited the additional credit risk faced by the central bank. In the general conclusion to this dissertation, I will briefly come back to the OeUB's decision to widen the pool of collateral eligible for lombard loans to present a related future research project.

Using weekly data, Figure 2.26 summarizes the evolution of both arms of central bank credit (discounts and advances, i.e. lombard loans) between 1872 and 1874. Figure 2.26 reports both levels in million *Florin* and an index that depicts the evolution of lending relative to 1 January 1873. Two observations can be made. First, although the stock of lombard loans on the OeNB's balance sheet almost doubled following the suspension on 13 May, this increase occurred from very low levels. Overall, however, the evolution of credit granted via the Bank's lombard facility shows a clear reaction to the crisis. Second, in contrast to the lombard facility but in line with the qualitative evidence discussed in the previous subsection, the lending activity at the OeNB's discount window remained at best subdued throughout the *Gründerkrach*. The index does not show a pronounced deviation from the longer run trend between January 1872 and December 1875.

2.4.3 Floating a "lifeboat"

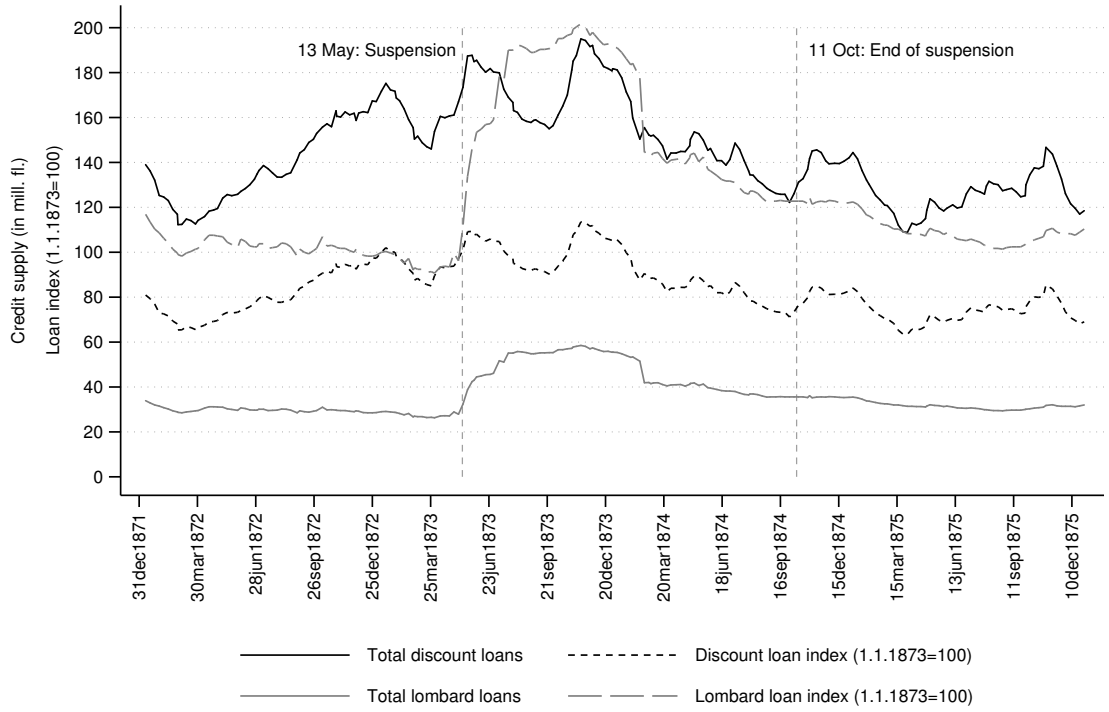
As shown in Figure 2.26, the stock of discount loans does not peak following 9 May, but reaches its maximum in early November of 1873. The peak in discounts in the last quarter of 1873 is directly related to another policy response which was jointly implemented by the government and the OeNB. In late autumn 1873, it became known that the *Bodencreditanstalt* was struggling to honor its liabilities. Lacking enough liquidity and pledgeable collateral to sort out its predicament by itself, the bank faced bankruptcy procedures.[192] As briefly mentioned in Chapter I of this dissertation, the BCA had suffered losses from its large speculative investments

OeNB would tarnish Austria's credit reputation abroad while possibly even contributing to worsen the crisis, c.f. Pressburger (1962, p.1150-1151).

[191] Bank directorate meeting on 17 May 1873, OeNB archives 1873/II/5. It is interesting to note that these provisions are similar to those for the Troubled Asset Relief Programme (TARP) during the recent crisis of 2007-08, c.f. https://www.treasury.gov/initiatives/financial-stability/TARP-Programs/Pages/default.aspx#; last accessed on 12 December 2017.

[192] Governing board meeting on 25 October 1873, BCA archives 1873/VR/X.

Figure 2.26: Total central bank credit in discounts and lombard loans (1872-1875)



Source: own calculations; Lucam (1876) and Wiener Zeitung

in *Kostgeschäft* and from customers for whom it had managed trading accounts on the stock exchange. Given that the public had always viewed the *Bodencreditanstalt* as one of the safest credit institutions in the Empire, the rumors surrounding the imminent failure of the BCA triggered a renewed loss of confidence in the banking sector which now started to affect even the most reputed institutions. Funding withdrawals from large Viennese banks, many of which had weathered the *Gründerkrach* relatively unscathed until this point, intensified. For example, the *Niederoesterreichische Escompte-Gesellschaft* and the *Allgemeine Depositenbank*, both of which had actually seen their retail funding increase after 9 May due to a flight to safety, lost almost 20% of their deposits between 30 September and 30 November 1873.[193] To pay out depositors, these banks had recourse to the OeNB's discount window, driving down the OeNB statutory reserves to their lowest level since the beginning of the crisis (c.f. Figure 2.24).

In order to stop the incipient panic, the OeNB, jointly with the Austrian government and several other large banks, devised a rescue plan for the *Bodencreditanstalt* that would allow the BCA to continue its operations while forcing it to restructure significantly. The rationale for keeping the BCA operative instead of opening standard bankruptcy procedures was linked to an implicit judgment by the authorities that the bank exhibited systemic importance. It should be noted that there is a thin line between a financial institution's "systemic importance" and its characterization as "too big to fail (TBTF)" because both terms are usually applied to motivate the rescue of large financial intermediaries. Financial commentators often use these terms interchangeably to explain why a government bailout was extended to a particularly large financial institution. One way of distinguishing

[193] As mentioned in Chapter I, data on monthly deposit stocks can be collected from the general press.

between bailouts motivated by "systemicness" and government rescues driven by TBTF considerations could be to look at the underlying causes of the bank's financial distress. On the one hand, "pure systemicness" may be an extreme case that could be considered to apply only if an exogenous (solvency) shock affects a large financial institution crucial for the stability of the financial system. As discussed by Ugolini (2014), "systemicness" is a concept that is directly proportional to the negative externalities engendered by an eventual failure ("destructive potential") and inversely proportional to the financial system's capability of finding substitutes for the failing institution ("replaceability"). To justify a "lifeboat" operation, Ugolini (2014) argues, two preconditions need to be met: first, it has to be shown that ordinary LLR would not be enough to prevent the default of the affected bank from generating large negative externalities on the payments system; second, the "lifeboat" needs to be designed in a way that offsets the negative distributional effects from the good banks to the failing institution that it entails.

On the other hand, if a large bank enters into highly risky business *because* it expects to be eventually bailed out by the government should investments turn bad, the moral hazard component involved may point to TBTF motivations rather than pure "systemicness" concerns (Gorton and Tallman, 2016). The BCA's pre-crisis behavior certainly points to particularly risky practices from the point of view of a mortgage bank business model. Hence, it seems plausible that the "lifeboat" floated to rescue the BCA was at least partly triggered by TBTF considerations. However, a detailed discussion of the motivations for the "lifeboat" and the BCA's investment strategies before the crisis is beyond the scope of this chapter, as is a complete description of the "lifeboat's" design. Both form part of an ongoing research project based on extensive qualitative evidence from the BCA's, the OeNB's and the official state archives. I will come back to my ongoing research on the BCA lifeboat operation in the general conclusion to this dissertation.

Ex post, the BCA turned out to be solvent. The rescue operation lasted for several years until its completion in 1875, but the BCA repaid all the loans in full. By providing tailored bridge financing to an institution unable to tap into its standing facilities, the OeNB, jointly with the government and other credit institution, bought the *Bodencreditanstalt* enough time to return to its original mortgage banking business model.

2.4.4 The *Aushilfs-Comités*: unconventional last resort lending

While all three policy decisions discussed above followed a rationale which suggests the OeNB cared about the negative externalities of liquidity distress during the *Gründerkrach*, none of them directly addressed the persistent problem of credit rationing at the discount window after 9 May. Early attempts of market participants, immediately following Black Friday, to create a consortium of banks with the purpose of stemming negative asset price spirals had no impact.[194] No further initiatives were taken until early June 1873 when the failure of the

[194]Contemporary observer Neuwirth (1874, p.255) derided this first consortium as having represented a "completely negligible episode in a great drama": he argued that the consortium had played no role whatsoever as it operated with a fund of only 16 million fl. when the stock exchange investments of individual banks had comparable dimensions and asset price declines alone had opened a funding gap of 300 million fl.

Wiener Wechslerbank on 10 June led stock prices to a new low (Pressburger, 1962, p.1149). The bank's default constituted a substantial blow to the banking sector for two reasons. First, the bankruptcy translated into an immediate suspension of payments on the bank's substantial retail deposits, triggering new runs elsewhere. Second, the *Wechslerbank* had founded 11 other banks in literally all parts of the Empire, all of which had entrusted large sums to their mother institution and thus faced heavy losses too (Neuwirth, 1874, p.120-121).[195]

This renewed turmoil called for action. On 11 June, the Austrian Finance Minister announced a conference for 13 June with all major Viennese banking houses, including the central bank (Neuwirth, 1874, p.122). His declared purpose was to find a solution to the ongoing distress in the market, yet without getting the government directly involved in the endeavor.[196] In his opening statement on 13 June, the Minister of Finance therefore emphasized that he believed it to be "the duty of all credit institutions to jointly discuss the means which could be employed to counteract the frictions in the money market, the gradual erosion of asset prices, and the increasing loss of market confidence" (Pressburger, 1962, p.1150). The discussions, which lasted for several days, culminated in the creation of the so-called Viennese *Aushilfs-Comité* on 17 June. Its founding members were the OeNB, the *Anglo-Oesterreichische Bank*, the *Bodencreditanstalt*, the *Creditanstalt*, the *Allgemeine Depositenbank*, the *Niederösterreichische Eskompte-Gesellschaft*, the *Franko-österreichische Bank*, the Viennese Rothschilds, the *Union-Bank*, and the *Wiener Handelsbank für den Produkten- und Warenverkehr*. Representatives from these institutions also formed the board of the Viennese *Aushilfs-Comité*. The AHC published its programme, which had been written by the OeNB's secretary general Lucam, in all major Viennese newspapers on 18 June 1873.[197] In its first sentences, the programme explained the rationale for (unconventional) LLR by emphasizing the negative externalities of the reigning liquidity crisis:

> The events of the last weeks did not only cause material damages to our economy, they also threaten many not directly involved parties with the disruption of their usual solid businesses. In addition, as always in similar circumstances, unjustified rumors surface frequently, which are easily believed and artificially stimulate panics able to cause a much bigger moral danger.[198]

In order to address these externalities, the AHC would provide credit to commerce, industry, trade and the money market by discounting commercial bills, granting loans secured by goods as well as special loans against other types of collateral and, finally, by alleviating the tensions on the stock market.[199] "In this sense and within these limits", the Viennese *Aushilfs-Comité* declared to be willing to provide support "wherever the maintenance of fundamentally sound circumstances are at stake, and wherever individual interests appear to be well justified by the higher interest of the common good".[200] The AHC's institutional design regulated its day-

[195]The *Wiener Wechslerbank* had founded four banks in Vienna, two banks in Budapest, three banks in Bohemia, one bank in Trieste and one bank in Lviv, c.f. Leonhardt (1872).

[196]In a letter to provincial governors on 26 June 1873, Finance Minister de Pretis looked back at the government's role arguing that "[t]he royal and imperial government considered it to be its duty to not intervene in the economic process which is currently ongoing, even if it proves to be painful for wide circles of the economy, because, from experience, economic crises are only delayed and worsened, rather than stopped by artificial intervention. [...] Also in this matter [the creation of AHCs], the participation of the government can only be a moral one." Memorandum to provincial governors signed by Finance Minister de Pretis on 26 June 1873, as cited in Pressburger (1962, p.1155).

[197]This programme is printed in original language and full length in the appendix to the present chapter.

[198]*Neue Freie Presse*, 'Aufruf des Aushilfs-Comités', 18.06.1873, 1873 p.9.

[199]Ibid.

[200]*Neue Freie Presse*, 'Aufruf des Aushilfs-Comités', 18.06.1873, 1873 p.9.

to-day business operations as well as its relationship with the central bank, while also dealing with the questions of membership, how to cope with potential losses and how to raise funds in the first place. Since the AHC did not have its own physical headquarter, applications for loans from the AHC had to made in a decentralized way before they were considered by the AHC's board which met regularly in the headquarters of the *Creditanstalt*. Applications for discount loans had to be submitted to the *Niederösterreichische Eskompte-Gesellschaft* or the *Allgemeine Depositenbank*; applications for advances on goods were accepted by the *Wiener Handelsbank für den Produkten- und Warenverkehr*, and all other loan applications had to be submitted to the *Creditanstalt*.

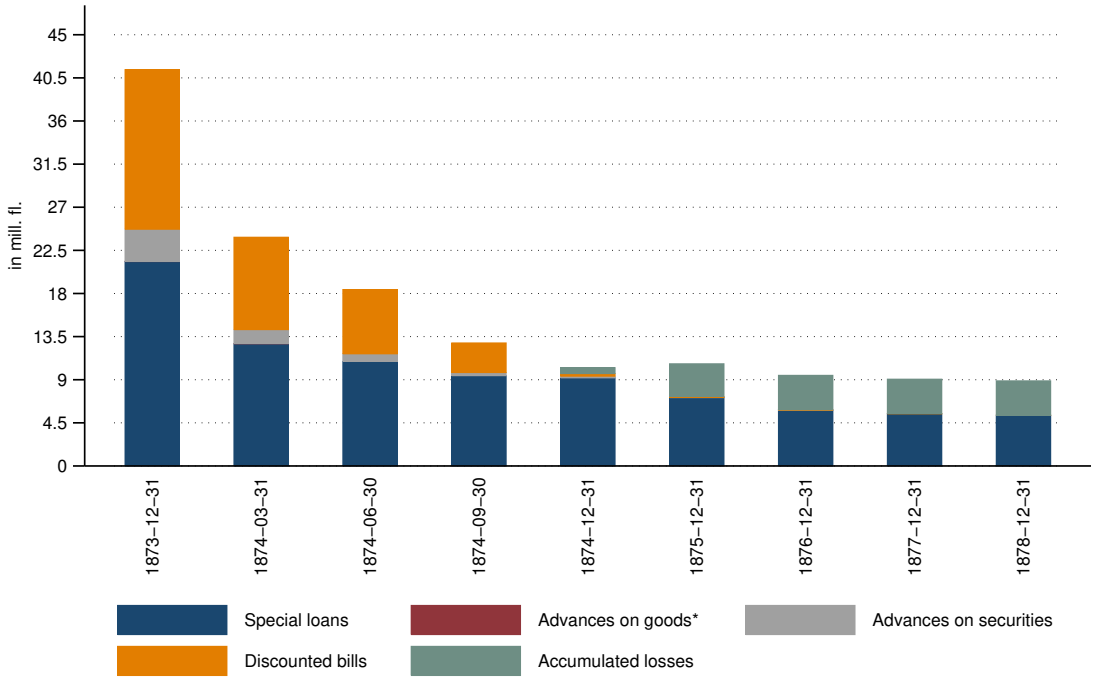
To start its lending operation, the AHC needed a stable source of funding, an operating fund (*Betriebsfonds*). In this regard, the founding members opted for a two-pronged solution. First, the founding credit institutions, except for the central bank, were called upon to make outright cash contributions.[201] Second, the AHC could raise virtually unlimited funds by tapping into the OeNB's standing facilities in one of three ways: (1) it could rediscount any bill with only two signatures as long the bill was accepted by two AHC members, or alternatively, one AHC member plus another suitable firm of high repute, and under the conditions that the bill had a remaining maturity of less than three months; (2) it was allowed to submit bills with a remaining maturity of more than three months, up to a maximum amount equal to the OeNB's reserves not invested in securities[202], if these bills were accepted either by the *Niederösterreichische Eskompte-Gesellschaft* or the *Allgemeine Depositenbank*; and (3) it had the possibility to submit bills with any two reputable signatures if they were submitted for the purpose of refinancing advances on goods granted by the *Wiener Handelsbank für den Produkten- und Warenverkehr*.[203] Furthermore, the OeNB made clear that, under point (1), it would also accept pure financial bills (*Geldbeschaffungswechsel*), without any underlying real transaction. All rediscounts were done at the prevailing Bank rate. In a memorandum summarizing its actions during the period of suspension, the OeNB mentioned that the stock of AHC rediscounts on its balance sheet had reached 2.8 million fl. by 30 June 1873, peaked at 34.6 million fl. on 31 October 1873 and still amounted 7.7 million fl. in early October 1874.[204] Contemporary observer Neuwirth (1874) did not neglect to underline the crucial role the OeNB played by refinancing the AHC:

> Without the OeNB, even this Aushilfs-Comité would have not been able to achieve anything at all and its entire operations and existence would have just been as problematic as those of the first lending consortium.[205]

Figure 2.27 captures both the distribution of emergency support measures across different loan categories and the total amount of outstanding assets between year-end 1873 and December 1878. The AHC's total assets stood at approximately 41 million Gulden at the end of 1873 and then decreased gradually over time. Of course, the data from 1873 only conveys a snapshot in time. It does not capture the total turnover during

[201] Governing board meeting on 17 June 1873, CA archives 1873/VR/26.
[202] In June 1873, this amount was approximately 12 million fl.
[203] Board of directors meeting on 17 June 1873, OeNB archives I4b/DR/1873/6.
[204] *Die priv. österreichische National während der teilweisen Suspension des Paragraphen 14 der Bankstatuten*, as cited in Lucam (1876, p.82).
[205] Neuwirth (1874, p.262).

Figure 2.27: Annual balance sheets of the Viennese *Aushilfs-Comité* (1873-1878)



Source: Neue Freie Presse and Compass

*Amounts are too small to appear on graph (30451 Gulden on 31 December 1873 and 15200 Gulden on 31 March 1874, zero afterwards).

the first months of the crisis, nor does it show the values at which loan stocks peaked. In January 1874, the Viennese AHC published a first report detailing the dimensions of its operations during the first seven months. According to this report, the total sum of loans granted between 17 June 1873 and 31 December 1873 amounted to 89 million fl., split relatively evenly between special loans (32 million fl., including purchased securities with a value of 970,000 fl.), discounted bills (35 million fl.) and advances (22 million fl. of advances on securities and merely 82,000 fl. of advances on goods) (Neuwirth, 1874, p.261-262). A second report published at the end of 1874 mentioned an additional increase in the total amount granted by 12 million fl., all of which were attributable to an increase in the bills discounted.[206] Throughout the entire period of its existence, the Viennese *Aushilfs-Comité* mainly invested in the category of special loans which also constituted the only class of assets, apart from losses, still remaining on the balance sheet at the end of 1878.[207] The Viennese *Aushilfs-Comité* was operative until the end of 1875, when its board decided to concentrate exclusively on winding down the portfolio.

The questions of membership and loss absorption were intertwined.[208] In principle, any firm or person – even if located outside Vienna – could join the AHC by pledging a contribution to its equity fund (*Sicherstellungsfonds*). Contributions were not fixed to a specific amount but 20% of the sum pledged had to be paid down upon starting membership. If need be, members would be called upon to pay in their contributions fully.

[206] c.f. *Wiener Zeitung*, 'Geschäftsbericht des Wiener Aushilfs-Comité per 31.Dezember 1874', 02.03.1875, p.788.
[207] For the years 1874 until 1877, a sectoral breakdown of this special loans category is available, c.f. Figure 2.29 below.
[208] The following information can be drawn directly from the AHC's programme, c.f. *Neue Freie Presse*, 'Aufruf des Aushilfs-Comités', 18.06.1873, 1873 p.9.

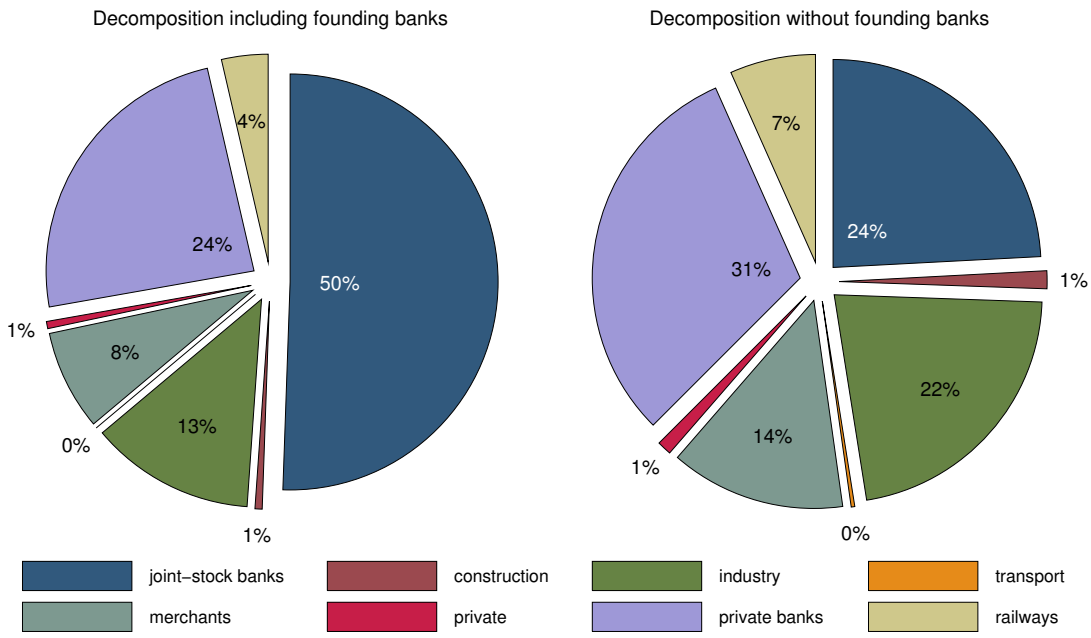
In case losses were to be incurred, the shortfall would be distributed among the AHC members in proportion to their initial contributions. Hence, the fund was the first line of defense against losses deriving from the AHC's lending activities. Despite the fact that the contributions were used as additional operative funds, their main rationale consisted in the creation of a capital buffer to enable safe refinancing. In fact, the OeNB had made the set-up of an equity fund a pre-condition for AHC access to its standing facilities (Neuwirth, 1874, p.129). The equity fund ultimately provided a buffer that would significantly reduce the likelihood of defaults on OeNB refinancing.

Since the individual contributions were published in the general press, it is possible to reconstruct an accurate picture of the membership of the Viennese *Aushilfs-Comité* (c.f. Figure 2.28 below). Equity fund contributions, and thus membership of the Viennese AHC, hold a few surprises. First, far from holding themselves harmless, the OeNB and other founding members also took a stake in the equity fund. The founding members opened the contributions to the equity reserve in the following way: (1) OeNB: one million fl., (2) *Anglo-Oesterreichische Bank*: 300,000 fl., (3) *Bodencreditanstalt*: 250,000 fl., (4) *Creditanstalt*: 500,000 fl., (5) *Allgemeine Depositenbank*: 100,000 fl., (6) *Niederösterreichische Eskompte-Gesellschaft*: 250,000 fl., (7) *Franko-österreichische Bank*: 150,000 fl., (8) Viennese Rothschilds: 500,000 fl., (9) *Union-Bank*: 250,000 fl., and (10) *Wiener Handelsbank für den Produkten- und Warenverkehr*: 100,000 fl.[209] Unfortunately, the sources do not provide a detailed rationale for why the OeNB made such a substantial contribution. The governing board meeting minutes of the *Creditanstalt* merely suggest the OeNB's participation in the equity fund was the price the Bank had to pay for chairing the AHC via its secretary general; another argument for the contribution, made by a director of the *Creditanstalt*, was simply that the OeNB had the biggest portfolio of discounted bills.[210] The second notable feature of Viennese AHC membership was that joint-stock banks did not dominate entirely. As Figure 2.28 shows, equity fund contributions came from a wide variety of sectors. One caveat is that contributions by private banks, merchants and industry are often difficult to separate based only on the name published in the newspapers as most bankiers ran these types of businesses simultaneously and in a complementary way. Similarly, private individuals as well as private banking houses often had some stake in the joint-stock sector (both industry and finance) and frequently sat on the boards of these companies.[211]

Since no dividend payments were made on equity fund contributions, there was no overt economic incentive to donate to the *Aushilfs-Comité*. Hence, the fact that banks, firms and private businessmen still stepped forward to contribute more or less generously to the fund raises a puzzling question concerning the motives behind their donations. One reason to add resources to the fund's equity may have consisted in potential reputational benefits: the list of contributors was published in all major contemporary newspapers, alongside the amount of their donation. Undoubtedly, stumbling banks could have used these payments to send misleading signals of solvency to their creditors. However, this rationale does not explain why some deeply troubled banks like the *Oesterreichischer Spar-Verein* (c.f. list of failed banks in the appendix to Chapter I of this dissertation)

[209] *Neue Freie Presse*, 'Aufruf des Aushilfs-Comités', 18.06.1873, 1873 p.9.
[210] Governing board meeting on 17 June 1873, CA archives 1873/VR/26.
[211] A full list of individual contributors to equity reserve is printed in the appendix to the present chapter.

Figure 2.28: Equity fund contributions and Viennese *Aushilfs-Comité* membership



Source: Compass, Deutsche Zeitung

*The entire equity fund amounted to 8.4 million fl. and the Viennese AHC counted 94 members: 22 joint–stock banks, 2 construction firms, 23 industrial companies, 13 merchants, 13 private individuals, 17 private banks, 3 railway companies and 1 other transport company.

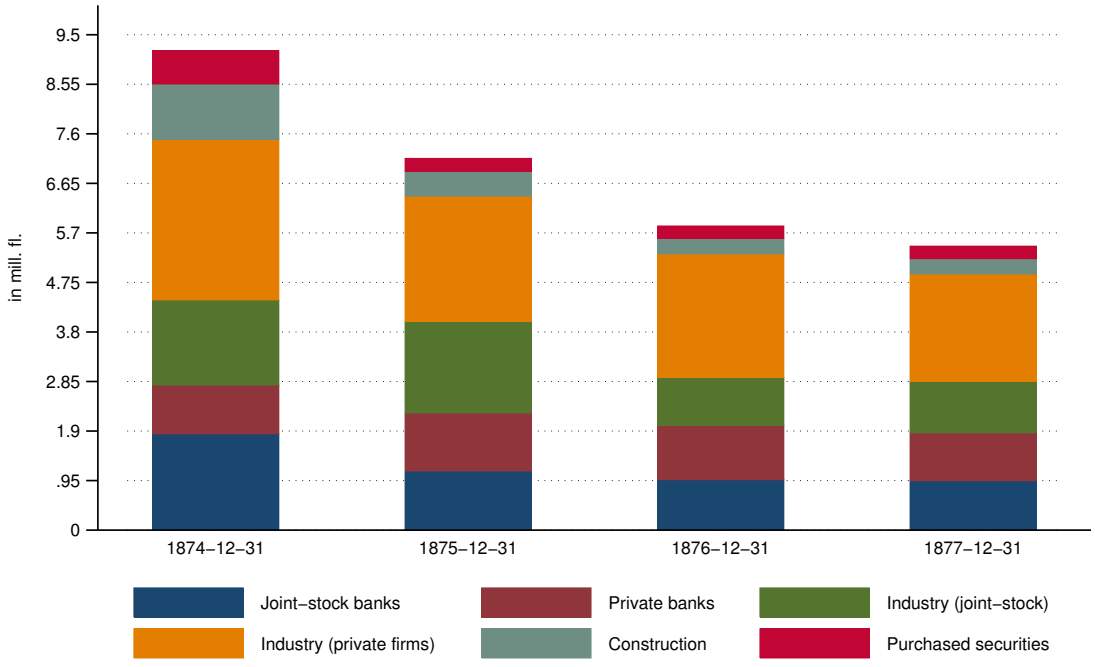
contributed while other similarly weak credit institutions did not.

A second plausible reason for donating to the equity reserve could have simply been that contributors also constituted the main debtors of the AHC. In this scenario, contributors mutualized the burden of potential losses and, in return for participating in the equity reserve, they could place demands for assistance. Risk mutualization funds that operated in this precise manner were common in the 19$^{\text{th}}$ century. For example, White (2007) and Riva and White (2011) report that brokers on the Paris *Bourse* operated a mutual guarantee scheme to manage counterparty risk and preempt systemic liquidity crises.[212] More recently, Jaremski (2017) argues that clearinghouse associations of banks in 19$^{\text{th}}$ century America were the closest substitute for a LLR prior to the creation of the Federal Reserve in 1914. As in the French case, these associations only provided emergency liquidity to credit institutions which had previously joined their ranks.

To obtain a first impression of the link between contributions to the equity fund and the receipt of loans, one might look at the aggregate data published by the *Aushilfs-Comité*.[213]. Thanks to data published in the *Compass*, it is possible to reconstruct the composition of the Viennese AHC's special loan portfolio on an annual basis between 1874 and 1877 (c.f. Figure 2.29). Unfortunately, neither the sectoral decomposition for other loan types, nor the decomposition of special loans for 1873 are available. Nevertheless, on the basis of these admittedly imperfect data, one can compare the relative sizes of sectoral contributions to the equity fund in

[212]Unlike the AHC, which constituted an *ad hoc* solution for a crisis, White (2007) and Riva and White (2011) analyze insurance funds set up before any crisis occurred.
[213]Unfortunately, disaggregated loan-level data has not been preserved.

Figure 2.29: Sectoral decomposition of special loans granted by the Viennese *Aushilfs-Comité* (1874-1877)



Source: Compass

*Purchases securities were classified under the rubrique of special loans, but there is no data on the sectoral decomposition of these purchases.

Figure 2.28 to the sectoral composition of special loans granted by the AHC. The data do not show a perfect match but, when the sums paid in by the ten founding members are accounted for (right pie chart in Figure 2.28), and taking into consideration the possibility of classification errors in Figure 2.28, they are at least suggestive of a connection between AHC membership and AHC lending. An alternative, more convincing "smoking gun" is found in the qualitative sources. In a letter to provincial governors on 26 June 1873, Finance Minister Pretis clearly stated that the core idea of the AHC was for the "healthy elements from all business areas to come together, in order to vouch for each other and thereby enable justified credit accommodation"[214].

The establishment of an AHC in Vienna was only the start of an institutional framework that would be exported to all major regions of the Empire during the weeks following 17 June. The impetus for this regional expansion derived from the aforementioned memorandum to the provincial governors signed by Finance Minister Pretis on 26 June 1873:

> The [Viennese] committee stands ready to expand its operations to the other parts of the Empire too, where, be it for specific locations or specific subsectors, similar associations are formed which are willing to create an equity fund appropriate to the circumstances and which are willing to guarantee, based on the mutual liability of its members, that the the financing received via the local [i.e. Viennese] committee, directly from the OeNB or via the OeNB's branches, will only be dedicated to effectively threatened, real business interests.[215]

[214] Memorandum to provincial governors signed by Finance Minister de Pretis on 26 June 1873, as cited in Pressburger (1962, p.1155).
[215] Ibid.

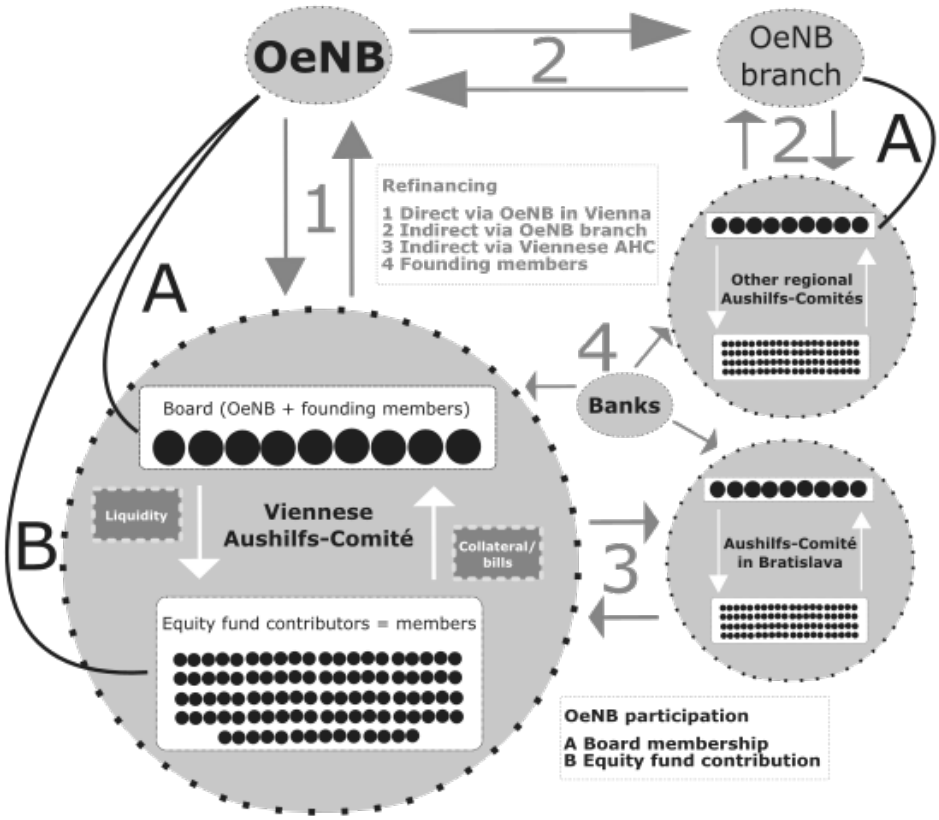
Following this general statement, the memorandum contained a proposal for how exactly the set-up of local *Aushilfs-Comités* should proceed. First and foremost, interested credit institutions and private firms in a given city or county would have to raise an equity reserve. The amounts subscribed to this fund and the names of contributors would have to be published and sent to Vienna. Second, based on the size of the equity fund, the local AHC would receive a refinancing quota. In order to rediscount bills for the purpose of refinancing operations, each of the local members would have to accept the bills in order to create a common liability for repayment. For practical reasons, the common liability could also be bestowed on a given bill by a single credit institution, provided the latter had previously been authorized by all others to do so. Third, the modalities for the refinancing of regional AHCs would depend on the location of the latter. AHCs headquartered in a city with a local OeNB branch would be rediscounting directly with this branch and its head clerk would represent the OeNB in the committee. AHCs located in cities without OeNB branches, however, would have to refinance their operations by submitting their bills to the Viennese *Aushilfs-Comité*. In the subsequent weeks, AHCs were founded according to these guidelines in all major cities of the Empire: Brno, Bratislava, Prague, Budapest, Trieste, and Zagreb. The OeNB had branches in all of these cities, except Bratislava, where the local committee could therefore tap into OeNB funds only indirectly via the Viennese AHC. Unlike their Viennese counterpart, other AHCs did unfortunately not publish any detailed documentation of their operations. To the best of my knowledge, subscriptions to the regional AHC equity funds constitute the only consistent source of information available in the sources on AHCs outside Vienna.

Figure 2.30 summarizes the overall institutional framework and functioning of *Aushilfs-Comités* during the *Gründerkrach*. *Aushilfs-Comités* created a coordination mechanism for market players explicitly intended to prevent the negative externalities of liquidity crises from affecting third parties. The AHC was an attempt to address one of the most consequential collective action problems associated with banking panics: negative asset price spirals. The AHCs complied with the three effectiveness criteria for public-private LLR solutions proposed by Begalle et al. (2016) (c.f. Section 2.2). First, their programme regulated the liquidation of collateral: decisions on collateral liquidation were taken by the management boards of AHCs, which were controlled by participating institutions under OeNB oversight. Second, the question of refinancing operations was solved by the right of AHCs to have recourse to the OeNB's standing facilities at any time, in return for certain guarantees by AHC members and contingent on the creation of an equity fund. Third, the equity funds of AHCs constituted a clear answer to the question of the allocation of losses resulting from their activity.

2.5 The effectiveness of unconventional last resort lending

Figure 2.25 in subsection 2.4.1 above shows that credit rationing was a particularly acute problem during the weeks following Black Friday, despite the suspension of the Bank Act. The graph also displays a correlation that is suggestive of a link between the inaugural conferences, the eventual set-up of *Aushilfs-Comités* and the fall of

Figure 2.30: *Aushilfs-Comités*: stylized institutional framework



the substantial positive spread between market and Bank rates. The problem of central bank credit rationing seems to have decreased permanently after the creation of AHCs. Qualitative evidence from commercial bank archives equally hints at a positive impact of AHCs immediately following the start of their operations. On 11 May 1873, the *Creditanstalt's* governing board had designated an internal executive committee with full powers to deal with crisis matters that required quicker action than the slow moving decision-making process of the board would allow for.[216] Over the coming weeks, this special committee reported back to the governing board on several occasions to account for its actions.[217] These regular reports repeatedly stressed the fact that the *Creditanstalt* had received many demands for liquidity support. Yet, the special committee emphasized that it had always based its decisions to help on the feedback effect the granting or refusal of loans would have on its its own position.[218] Hence, the *Creditanstalt's* actions seem to confirm the presence of a persistent liquidity squeeze in the market, while also highlighting the rationale for a LLR that is not primarily guided by its own business interests. Most interestingly, however, the internal committee's report on July 1 stated that "it had not been called upon by any new requests [...] during the last week, which is probably the result of the positive influence

[216]Governing board meeting on 11 May 1873, CA archives/VR/19.

[217]Governing board meetings on 13 May 1873, CA archives/VR/20; on 20 May 1873, CA archives/VR/21; on 27 May 1873, CA archives/VR/22; on 29 May 1873, CA archives/VR/23; on 4 June 1873, CA archives/VR/24; and on 17 June 1873, CA archives/VR/26.

[218]For example, c.f. governing board meeting on 20 May 1873, CA archives/VR/21: "The committee was also able to help in several cases, but its decision to extend support mainly depended on an assessment of the positive feedback effect the help provided would have on our own position."

of the existence of the [Viennese] *Aushilfs-Comité*".[219] There is little doubt that contemporaries considered the *Aushilfs-Comités* a clear success story. After ascribing the low amount of advances on goods granted to the characteristics of commerce in Austria, Neuwirth (1874) stated:

> [There can] be no doubt of the fact that the remaining points emphasized in the [AHC's] programme were fulfilled in a noticeably beneficial way for commerce and industry and that the cooperation of the Viennese Aushilfs-Comité with the individual committees formed in the provinces prevented both calamities of a bigger dimension and many insolvencies.[220]

In order to investigate whether contemporary accounts of AHC success can be attributed to more than a mere correlation of events, this chapter will use disaggregated bank-level data to estimate the effectiveness of AHC liquidity provision in mitigating bank distress. Testing whether unconventional LLR had a measurable positive effect on bank survival effectively amounts to asking whether the end of central bank credit rationing can be plausibly attributed to the creation of AHCs. Based on the assumption that a contribution to the equity fund of an AHC constituted a necessary precondition for borrowing from the committee, I will use an indicator variable for contributors from the banking sector as my treatment variable. The causal interpretation of this treatment variable is seriously compromised if selection into the contributor pool is non-random. In the following, I will thus tackle this identification problem explicitly.

2.5.1 Identification strategy and empirical set-up

Estimating the impact of AHC membership on bank survival using simple maximum likelihood methods is unlikely to tease out the underlying causal effect of the treatment variable. Potential bias derives from the fact that the assignment of treatment is not likely to be random in the specific context of this study. The decision to select into AHC membership, i.e. to contribute to the local AHC equity fund, was probably a function of the (financial) characteristics of a given bank. Some of these characteristics, in turn, were most certainly correlated with a bank's probability of failure. For example, one might hypothesize that the weakest, most illiquid or exposed banks would join AHCs. These credit institutions would have had arguably much to gain from participation: they could refinance using substandard collateral and perhaps mutualize some of the losses they would have otherwise incurred on their own. Likewise, one may expect banks with a large stake in the stability of their local financial market to participate in AHCs in order to avoid a general meltdown which would ultimately affect their own balance sheets. In contrast, banks that did not exhibit any exposure to repos or were not prone to contagion had probably less incentive to join an AHC. They would have only had to lose from a participation due to the mutualization of losses. Omitting these bank-level characteristics in the estimation of treatment effects would induce severe omitted variable bias.

[219] Governing board meeting on 1 July 1873, CA archives/VR/28.
[220] c.f. Neuwirth (1874, p.261).

This chapter addresses the problem of selection into the AHCs by drawing on a two-stage inverse-probability weighted regression (IPWRA) adjustment. Three identification assumptions must hold in order to make IPWRA a convincing strategy for teasing out the causal effect of AHC membership. The first, main identification assumption is commonly called "unconfoundedness". Unconfoundedness holds if the treatment can be considered as randomly assigned conditional on a set of observable characteristics which predict treatment in a first stage. Applied to the AHC case, this assumption can be illustrated as follows. One can imagine the decision to select into an AHC as being endogenous at the extremes of the distribution of banks (i.e. for very weak and very strong banks), but not otherwise. In contrast, the decision of banks occupying the middle-ground between these two extremes is not predictable *ex ante*. This random element of AHC membership could be rationalized by the fact that some credit institutions were not fully certain about their exposure and vulnerability to contagion effects. Moral suasion of peers to join or not to join the committees could have worked as an additional randomization factor. A bank that was perceived as too weak and dangerous might have been prevented from joining, whereas a really strong bank might have been persuaded into joining. To set up a valid equation for selection into treatment, one requires pre-treatment observables to predict treatment assignment: unconfoundedness does not hold if the observables used to estimate selection into treatment are themselves affected by the treatment. Similar to other endogeneity problems, unconfoundedness cannot be directly assessed. In Subsection 2.5.3, I conduct a series of Placebo tests to check the sensitivity and plausibility of my results.

The second condition which has to hold for IPWRA to be valid is known as "overlap" or "common support". Overlap refers to the similarity of the covariate distributions for the treatment and control subpopulations. Overlap is ascertained if each unit in the defined population has a non-zero probability of being treated and a non-zero probability of not being treated. The probability of treatment as a function of observables is usually called the "propensity score" (PS). The propensity score constitutes the predicted probability of treatment from the first stage regression which models the selection process into AHCs. Depending on whether a study is interested in estimating the average treatment effect (ATE) or the average treatment effect on the treated (ATET), the overlap assumption can be significantly relaxed. In the context of this study, the ATE represents the expected change in the probability of failure due to treatment for a randomly selected bank from the underlying sample. The ATET constitutes the average change in the probability of failure due to treatment for banks that were actually AHC members. The focus of this study is mostly on the ATET: we are interested in finding the effect of unconventional last resort lending on those banks' probability of failure which actually chose to join AHCs. For the estimation of ATET, the overlap assumption can be relaxed to $PS < 1$. The probability of being treated can be zero for non-treated banks because one averages only over the treated subpopulation to compute ATET. Sufficient "overlap" is usually verified in two ways: first, by plotting the predicted probabilities of treatment for the treatment and control groups against each other (graphical inspection); and second, by computing the standardized differences between covariates in the treated and non-treated subsamples.[221] Conventionally,

[221] The standardized differences are computed by $\frac{(\bar{X}_{1i}-\bar{X}_{0i})}{\sqrt{S^2{}_{1i}+S^2{}_{0i}}}$, where $\bar{X}_i$ stands for the mean of the covariate in question (for treatment and control groups) and S_i represents its estimated standard deviation.

normalized differences above 0.25 are considered as problematic.

The third crucial assumption for the identification of a causal effect using IPWRA is the stable unit treatment value assumption (SUTVA): one unit's treatment status should have no effect on another unit's outcome. Banking systems are inherently interconnected both via direct balance sheet links and contagion effects that work through creditors' beliefs (e.g. bank runs). Hence, *a priori* it seems unrealistic to claim that AHC membership of a given bank did not have an effect on the credit institutions it interacted with in 1873. It is important to realize, however, that the direction of bias deriving from a violation of SUTVA in the context of this chapter is unclear. On the one hand, a violation of SUTVA could bias the coefficients on AHC membership upwards if credit institutions that were members maintained primarily links to banks which also adhered to *Aushilfs-Comités* and vice versa. In this case, the coefficient on AHC membership might be blown up as it really measures the effect of a bank's own membership status in conjunction to the membership status of its closest business partners. On the other hand, a violation of SUTVA could also bias the coefficient on unconventional LLR downwards. A negative bias could occur if the AHC membership of a given bank entailed positive externalities for credit institutions which did not adhere to any *Aushilfs-Comité* but still benefited from a financially stabilized business partner. Equally, a bank which had signed up for unconventional LLR support might still have been impacted by the negative treatment status of the banks with whom it entertained business relations. Thus, the direction of the bias deriving from a violation of SUTVA depends on the relative size of these opposite effects. In the robustness checks for my results (Subsection 2.5.3), I use data on interbank networks to minimize the potential bias deriving from violations of SUTVA.

If unconfoundedness, overlap and SUTVA hold, the remaining challenge is to construct a valid first stage model. The validity of the first stage depends on the existence of explanatory variables that can be plausibly excluded from the second stage, i.e. the main bank failure prediction model already used in Chapter I. The general description of AHCs in Subsection 2.4.4 and the discussion of selection into AHC at the beginning of this subsection provide some guidance for appropriate covariates. In addition to the full vector of relevant financial characteristics used in Chapter I of this dissertation, the equation modeling selection into AHCs will include the following four variables. First, the model includes a dummy variable for the presence of an OeNB branch in a given city. The rationale for drawing on this indicator variable derives from the overall institutional framework of AHCs depicted in Figure 2.30. Although it was possible for banks to set up *Aushilfs-Comités* even in cities without OeNB presence, the existence of a local OeNB branch prior to the start of the *Gründerkrach* should have increased the probability of AHC creation in a given location: OeNB presence likely facilitated the refinancing of local AHCs and decreased communication costs as well as delays. Therefore, the coefficient on the indicator variable for the presence of an OeNB branch in the city of a given bank's headquarter is also hypothesized to bear a positive sign. The second variable of interest is the natural logarithm of the distance of a given bank to Vienna or Budapest, whichever city was closer. Once OeNB presence in a bank's location is accounted for, closeness to the Austrian and Hungarian capital might have incentivized AHC creation and participation for similar reasons as the existence of an OeNB branch. In 1873, the OeNB was still fully headquartered in Vienna

but Budapest constituted by far the second largest OeNB office. This variable is expected to have a negative sign: the further away from the capital a given bank was located, the lower its probability of selecting into an AHC should have been. The third additional covariate measures a given bank's local market share. The local market share is approximated by the share of a credit institution's total assets in the sum of all banks' total assets in a specific location. As discussed above, a high market share could have pushed even sound banks into AHC membership if their balance sheet was vulnerable to local financial disruptions. Finally, the fourth new variable in the selection equation is the natural logarithm of the number of banks present in the city in which a particular credit institution was headquartered. The inclusion of this variable is motivated by two considerations. One the one hand, controlling for a credit institution's market share alone might be problematic because there were several locations with only one bank; in these cases, a high market share might only reflect the low number of banks in a given city. On the other hand, a bank placed in a city with many other credit institutions might have been more likely to become an AHC member: the importance of credit institutions in the creation of the Viennese AHC suggests that the chance of an *Aushilfs-Comité* being created in the first place was probably higher in more banked locations.

One big advantage of employing IPWRA, rather than only regression adjustment or simple inverse probability weighting, is that both the outcome equation and the treatment equation can be explicitly modeled. Yet, perhaps the most important benefit of using an IPWRA estimator consists in the IPWRA method's double-robust property (Scharfstein et al., 1999; Lunceford and Davidian, 2004). This property allows for either the second stage or the first stage model to be misspecified without affecting the consistency of the estimated treatment effects. In other words, as long as the outcome model is correctly specified, uncertainty about the correct selection model is not critical for consistency and vice versa. Relative to other econometric methods aiming to obtain point estimates corrected for potential selection bias (e.g. Heckman-type models), the doubly robust property can thus be a distinct advantage of IPWRA. Compared to Heckman-type selection correction methods, the IPWRA also differs in that it represents an explicit attempt to rebalance the covariate distributions before estimating treatment effects. Whereas the first stage essentially requires identical conditions to be met in both techniques, the second stage in Heckman-type approaches consists of the inclusion of an error correction term in the unbalanced outcome regression. Hence, compared to the standard Heckman correction, the IPWRA approach allows for a statistical test of the covariate balance achieved after the first stage-based re-weighting procedure and thus provides more transparency with regard to the effectiveness of the method in dealing with selection bias. In comparison to more recent approaches using information on the selection on observables as a guide for evaluating the effect of selection on unobservables on estimated outcomes (c.f. Altonji et al. (2005)), the IPWRA has both disadvantages and advantages. IPWRA requires that some variables included in the selection stage can be plausibly excluded from the outcome regression. Therefore, IPWRA builds on a requirement/assumption that is analogous to instrumental variable estimation procedures. The approach in Altonji et al. (2005) does not require this assumption: rather than reestimating the outcome model after re-weighting or the inclusion of a correction term, Altonji et al. (2005) provide a strategy to estimate the size of the

selection bias in the outcome model, based on an assumption regarding the relative sizes of the selection on the unobservables and the selection on the observables. Alternatively, Altonji et al. (2005) also propose a method to compute the hypothetical severity of selection on unobservables needed to completely offset the estimated treatment effect. Instead of a corrected point estimate, the approach in Altonji et al. (2005) thus generates a lower and upper bound for the marginal effects to judge whether some part of the treatment effect is "real" once the likely impact of selection bias is quantified. Although this approach could be adopted in the present chapter, there are also potential downsides which suggest that IPWRA might be preferable in the context of this study. As Altonji et al. (2005, p.182) themselves argue, their approach might be less convincing if the number of observable covariates is small, if observables do not have strong explanatory power and if covariates are unlikely to constitute a randomly selected sample of all variables relevant for the outcome of interest. In particular the last assumption appears to be tenuous in the context of the present study: the list of observable regressors is determined by the nature of my sources which clearly focus on financial statements and discount other potentially relevant predictors of bank distress.

In practical terms, IPWRA proceeds in three steps. First, one fits the treatment model to obtain the propensity score, i.e. the predicted probability of receiving treatment. The PS is then used to compute the inverse probability weights: observations on AHC members will be weighted by $\frac{1}{PS_i}$ so that banks which exhibited a high probability of selecting into AHC membership and which have effectively become AHC members are penalized; vice versa, observations on credit institutions that have not selected into AHCs are weighted by $\frac{1}{(1-PS_i)}$, which thus penalizes banks which had a low probability of selecting into AHCs in the first place. In other words, the weighting process aims at re-balancing the sample by giving more importance to banks which are on the random portion of the continuous spectrum between the extremes of quasi-deterministic selection into and de-selection from *Aushilfs-Comités*. In the third stage, the outcome model is estimated on the re-weighted sample, separately for those banks which received treatment and for those which did not. Finally, the predicted probabilities of survival resulting from the two outcome models regressions on the re-weighted samples serve as the basis for computing ATE and ATET in the standard way.

The outcome model is identical to the baseline logit equation employed in Chapter I of this dissertation. The outcome model uses bank-level characteristics measured at the end of 1872 to predict failure over the following 24 months until December 1874. As highlighted in Chapter I of this dissertation, terminal bank closure in Austria-Hungary between 1868 and 1878 necessarily took one of three forms: liquidation, merger or bankruptcy. This chapter pools all three types of bank closures when examining the effectiveness of LLR operations during the Austro-Hungarian *Gründerkrach*. The qualitative evidence presented in Chapter I strongly suggests that mergers and liquidations did not represent types of bank closures which were driven by underlying causes fundamentally different from those triggering outright bankruptcy.[222] The sample is also identical: it contains 181 joint-stock banks including 64 credit institutions that closed permanently during the *Gründerkrach*. The first stage model of the IPWRA technique includes all covariates from the outcome model plus the four

[222]For a more detailed discussion of the different failure types, please refer to Chapter I of this dissertation.

selection variables described above. For a given bank, the equation models the probability of selecting into AHC membership. The selection model is estimated by maximum likelihood (cross-sectional logit regression). Model 2.5 summarizes the first stage:

$$P(Y_1|\mathbf{F},\mathbf{S}) = G(\alpha + \mathbf{\Gamma'F}_i + \mathbf{\Delta'S}_i) \tag{2.5}$$

$$\text{where } G(z = \alpha + \mathbf{\Gamma'F}_i + \mathbf{\Delta'S}_i) = \tfrac{exp(z)}{1+exp(z)}$$

where Y_1 is the dependent variable of the first stage, AHC membership, i.e. a dummy that takes the value of 1 if the bank in question selected into an AHC; $\mathbf{F}$ is a vector of bank-level (financial) characteristics and $\mathbf{S}$ is the vector of selection variables discussed above. I use the predicted probabilities of treatment (propensity score) from Model 2.5 to compute the inverse probability weights.

$$P(Y_2|\mathbf{F}) = H(\beta + \mathbf{\Gamma'F}_i) \tag{2.6}$$

$$\text{where } H(u = \beta + \mathbf{\Gamma'F}_i) = \tfrac{exp(u)}{1+exp(u)}$$

where Y_2 is the dependent variable of the second stage, a dummy that takes the value of 1 if the bank failed during the *Gründerkrach*; as before, $\mathbf{F}$ is a vector of bank-level (financial) characteristics. I estimate Model 2.6 separately for treated and non-treated banks and apply the corresponding weights computed on the basis of Model 2.5. I then compute the average predicted probability of failure resulting from the estimation of Model 2.6 for treated and non-treated groups. The latter constitutes the potential outcome mean. The ATE constitutes the simple difference between the average predicted probabilities of failure for non-treated and treated banks. The ATET is obtained by restricting the calculations of the means to treated banks only.

Table 2.12 presents the summary statistics for all variables entering Model 2.5 and Model 2.6. *Bank failure dummy* is the outcome variable of interest: it records whether a given bank failed in 1873 or 1874. *AHC member* is the treatment variable of interest: it constitutes the dependent variable in the first stage selection equation. As discussed in Chapter I of this dissertation, the variables summarized by $\mathbf{F}$ are financial characteristics and bank weaknesses which emerge as particularly relevant predictors from previous work on the causes of bank distress in similar historical contexts. $\mathbf{F}$ also includes *Gründerkrach*-specific covariates such as the repo exposure of banks.

Table 2.12: Summary statistics

Variable	Cat	Obs	Mean	Std. Dev.	Min	Max	P1	P5	P25	P50	P75	P95	P99
Bank failure dummy	$\mathbf{Y_2}$	181	0.35	0.48	0.00	1.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00
AHC member	$\mathbf{Y_1}$	181	0.23	0.42	0.00	1.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00
Repos to equity	**F**	181	0.10	0.54	0.00	6.66	0.00	0.00	0.00	0.00	0.00	0.49	2.06
Illiquid assets to total assets	**F**	181	0.46	0.32	0.00	1.00	0.00	0.00	0.18	0.50	0.77	0.92	1.00
Mortgage loan share	**F**	181	0.09	0.24	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.79	1.00
Deposits to cash reserves	**F**	181	1.21	2.74	0.00	32.22	0.00	0.00	0.14	0.65	1.21	3.95	10.31
Bank age	**F**	181	4.61	4.17	1.00	33.00	1.00	2.00	2.00	4.00	5.00	10.00	32.0
Leverage ratio	**F**	181	4.65	4.08	0.75	25.25	1.02	1.15	2.06	3.35	5.42	14.49	21.05
Return on equity	**F**	181	0.17	0.22	-0.74	1.09	-0.56	0.00	0.09	0.14	0.22	0.59	0.91
Real estate to non-cash assets	**F**	181	0.02	0.06	0.00	0.46	0.00	0.00	0.00	0.00	0.01	0.13	0.32
Bank size (ln)	**F**	181	14.91	1.64	11.23	19.29	11.82	12.30	13.68	14.95	15.99	17.40	18.92
OeNB branch in city	**S**	181	0.62	0.49	0.00	1.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
Distance to capitals (ln)	**S**	181	1.76	4.71	-5.30	6.30	-5.03	-5.30	-5.30	4.93	5.53	5.88	6.11
Local market share	**S**	181	0.40	0.43	0.00	1.00	0.00	0.00	0.02	0.17	1.00	1.00	1.00
Number of banks in city (ln)	**S**	181	2.12	1.67	0.00	4.16	0.00	0.00	0.69	1.79	4.16	4.16	4.16
Share of AHC links in interlocks*	**C**	181	0.26	0.33	0.00	1.00	0.00	0.00	0.00	0.00	0.50	1.00	1.00

* This variable is discussed in the section dealing with robustness checks below.

2.5.2 Results

All coefficients reported in this subsection represent the marginal effects of one standard deviation increase in the corresponding independent variable. Treatment effects and coefficients on dummies always represent the impact of a discrete change in the variable from 0 to 1. Due to the standardization of covariates, marginal effects in Table 2.13 and Table 2.14 below are directly comparable with each other and across tables. In order to put the results from the two-stage IPWRA model into perspective, this subsection first reports the marginal effects one obtains when simply estimating a non-balanced failure prediction model to compute the effect of unconventional LLR. Table 2.13 summarizes these results, both without and with the other bank-level controls in **F**. As in Chapter I, standard errors are clustered on the city-level to control for correlated error terms within a given city. The results in Table 2.13 suggest that becoming an AHC member reduced the bank-level probability of failure by between 25% and 27%. Since the results derive from a logit regression, the reported marginal effect of unconventional LLR results when all other covariates are evaluated at the mean. In all three maximum likelihood specifications (corresponding to the three columns in Table 2.13, i.e. (1) no controls, no clustering; (2) no controls but clustering; (3) controls and clustering) the marginal effect of unconventional LLR is a highly significant predictor of bank failure.

As discussed above, there are good reasons to believe that the marginal effect of AHC membership is biased if obtained on the basis of simple maximum likelihood estimation. The estimation of treatment effects using IPWRA allows us to address this problem. The key results of the two-stage IPWRA procedure are displayed in Table 2.14 and Table 2.15. Table 2.14 highlights the results for two different variants of the first stage regressions and three different variants for the outcome regressions. Let us first consider the selection stage. Column 1A displays the first stage regression results for a selection model that only includes vector **S**, and Column 2A=3A summarizes the first stage for the full selection model containing both **F** and **S**. First stage results suggest that three out of four variables from **S**, and in particular OeNB presence, are decent predictors of selection into AHCs. The signs of the coefficients are intuitive in the simple selection model including only **S**, and they

Table 2.13: Baseline maximum likelihood estimates

VARIABLES	(1) Failure in 1873/1874	(2) Failure in 1873/1874	(3) Failure in 1873/1874
AHC member	-0.27***	-0.27***	-0.25***
	(0.07)	(0.07)	(0.08)
Repos to equity			0.12***
			(0.04)
Illiquid assets to total assets			0.15***
			(0.05)
Mortgage loan share			-0.19***
			(0.05)
Deposits to cash reserves			0.11*
			(0.06)
Bank age			-0.35***
			(0.12)
Leverage ratio			0.17***
			(0.05)
Return on equity			-0.14**
			(0.07)
Real estate to non-cash assets			0.11***
			(0.03)
Bank size			0.06
			(0.05)
Observations	181	181	181
Clustered SE	No	Yes	Yes
Model	Logit	Logit	Logit
Pseudo R-squared	0.047	0.047	0.353
Log pseudolikelihood	-112.04	-112.04	-76.11
LR (Wald) chi2 statistic	11.09	17.55	122.79

Marginal effects for one standard deviation increase in covariate,
except for binary AHC membership, when discrete change from 0 to 1.
Clustered standard errors for marginal effects in parentheses
*** p<0.01, ** p<0.05, * p<0.1

remain so for OeNB presence and the distance variable once **F** is added. The overall fit and adequacy of the first stage regressions can be assessed in two ways. First, Table 2.15 shows the standardized differences in the covariate distribution of treated versus untreated banks before and after the re-weighting process for the average treatment effect (ATE) and the average treatment effect on the treated (ATET). Column 1A, 1B and 1C in Table 2.15 report the pre- and post-IPWRA standardized differences for the simple first stage (only **S**), whereas columns 2A=3A, 2B=3B and 2C=3C in Table 2.15 show the same information for the full selection model. The standardized differences are considerably reduced due to the IPWRA procedure in both cases. Variables with particularly high standardized differences (all covariates from vector **S**, but also bank size, bank age and real estate exposure) are well balanced after the re-weighting procedure. The mere fact that the variables in vector **S** are highly imbalanced before the adjustment suggests that they played a role in the selection process. An over-identification test can be used to test the overall balance achieved after IPWRA. As reported in Table 2.15, the tests cannot reject the null of covariate balance at any conventional confidence levels. Second, one can compute the predicted probabilities of treatment (propensity scores) for both actually treated and untreated banks to check whether there is sufficient overlap for stage one. Figure 2.31 plots overlap resulting from the full selection model (i.e. first stage including **S** and **F**). Figure 2.31 allows for two conclusions concerning overlap. On the one hand, it shows how necessary the IPWRA procedure is to correct for selection given the strong clustering of control group banks at one extreme of the distribution. On the other hand, it suggests that

Table 2.14: Two-stage inverse-probability-weighted regression adjustment (IPWRA)

VARIABLES	(1A) First stage	(1B) ATE	(1C) ATET	(2A=3A) First stage	(2B) ATE	(2C) ATET	(3B) ATE	(3C) ATET
AHC Member		-0.38***	-0.50***		-0.30***	-0.42**	-0.17*	-0.31***
		(0.05)	(0.08)		(0.09)	(0.21)	(0.10)	(0.07)
Repos to equity				-0.03				
				(0.02)				
Illiquid assets to total assets				-0.04				
				(0.03)				
Mortgage loan share				-0.03				
				(0.03)				
Deposits to cash reserves				-0.01				
				(0.04)				
Bank age				0.06				
				(0.05)				
Leverage ratio				-0.04				
				(0.03)				
Return on equity				0.04*				
				(0.02)				
Real estate to non-cash assets				0.02				
				(0.02)				
Bank size				0.09*				
				(0.05)				
OeNB branch	0.21***			0.11*				
	(0.06)			(0.06)				
Distance to capitals	-0.03			-0.09*				
	(0.04)			(0.05)				
Local market share	0.02			-0.09*				
	(0.05)			(0.05)				
Number of banks	0.08			-0.09				
	(0.08)			(0.08)				
Observations	181	181	181	181	181	181	181	181
Treated	41	91.4	89.4	41	84.6	91.8	84.6	91.8
Non-treated	140	88.6	91.6	140	96.4	89.2	96.4	89.2
Second stage incl. **F**	-	No	No	-	No	No	Yes	Yes
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Model	Logit	Logit	Logit	Logit	Logit	Logit	Logit	Logit
Pseudo R-squared	0.25	-	-	0.42	-	-	-	-
Log pseudolikelihood	-73.15	-	-	-56.57	-	-	-	-
LR (Wald) chi2 statistic	23.66	-	-	44.91	-	-	-	-

Marginal effects for one standard deviation increase in covariate,
except for binary AHC membership, when discrete change from 0 to 1.
Robust standard errors for marginal effects in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.15: Standardized differences in covariates before and after IPWRA

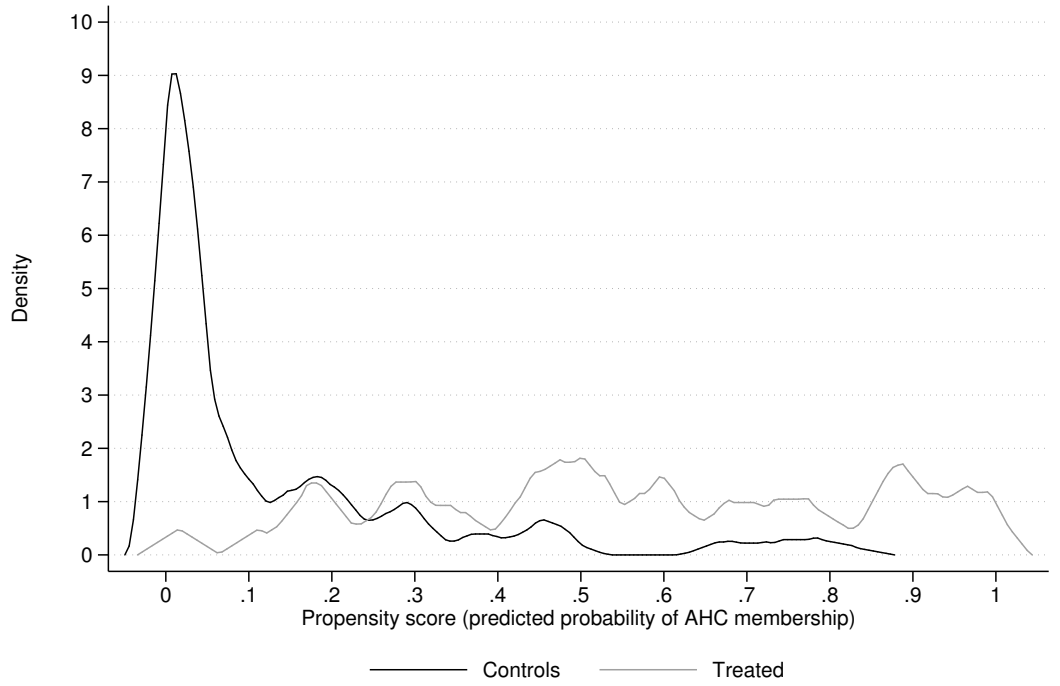
VARIABLES	(1A) St.Diff. < IPWRA	(1B) ATE > IPWRA	(1C) ATET > IPWRA	(2A=3A) St.Diff. < IPWRA	(2B=3B) ATE > IPWRA	(2C=3C) ATET > IPWRA
Repos to equity				0.04	-0.4	-0.07
Illiquid assets to total assets				0.16	0.26	-0.08
Mortgage loan share				-0.03	-0.15	-0.25
Deposits to cash reserves				-0.08	0.00	-0.26
Bank age				0.62	0.24	-0.05
Leverage ratio				-0.06	0.01	0.06
Return on equity				0.21	0.11	-0.03
Real estate to non-cash assets				0.30	-0.08	-0.05
Bank size				1.25	0.46	0.20
OeNB branch	1.22	-0.10	-0.00	1.22	-0.04	0.01
Distance to capitals	-1.23	0.02	0.09	-1.23	-0.09	-0.08
Local market share	-1.18	0.19	0.05	-1.18	0.11	-0.08
Number of banks	1.40	-0.12	-0.07	1.40	-0.01	0.11
OID-Test ($H0$ = balance; p-value)	-	0.26	0.12	-	0.99	0.88

the overlap condition is barely sufficiently fulfilled for a correct estimation of ATE. Fortunately, however, the re-balancing procedure achieves sufficient overlap for proceeding with the estimation of ATET. Together, these two insights deriving from the first stage regressions are encouraging.

Turning to the second stage, i.e. ATE and ATET estimation, the results of interest are displayed in columns 1B, 1C, and 2B to 3C of Table 2.14. Columns 1B and 1C report treatment effects after re-balancing using only **S**, columns 2B and 2C show results for re-balancing using both **S** and **F**, and columns 3B and 3C draws on the same first stage as 2B and 2C but includes the control vector **F** in the outcome models estimated for the computation of ATE and ATET. Compared to the simple maximum likelihood estimation results in Table 2.13, the estimated ATET of AHC membership is larger, and remains statistically and economically highly significant in all specifications. The preferred specification 3C suggests that unconventional LLR support reduced the probability of failure by 31% for banks which actually became AHC members. The same fully mounted model for ATE (3B) shows a smaller treatment effect of 17%. The difference between ATET and ATE partly derives from the definition of the two treatment effects, but ATE estimation is also less precise due to the somewhat imperfect overlap achieved.

In conclusion, the IPWRA results strongly suggest that a non-conventional LLR mechanism was effective in mitigating bank distress during the *Gründerkrach*. These results also hint at the presence of a downward bias in the maximum likelihood estimates which might be an indication that particularly strong banks selected into AHCs. Overall, the econometric evidence appears to back the conjectures of contemporary observers who stressed the effectiveness of last resort lending channeled via *Aushilfs-Comités*.

Figure 2.31: Overlap plot for propensity scores from first stage regression (first stage incl. **F**)



Source: own calculations and Compass

2.5.3 Robustness

This subsection presents several robustness checks to the results discussed above. First, I conduct a set of Placebo tests to ascertain that the effect of AHC membership on bank survival cannot be simply attributed to spurious correlations. Second, I replicate the IPWRA estimation procedure above by drawing on duration analysis techniques to check whether the results hold in more sophisticated survival regression settings. Third, I address potential bias deriving from challenges to SUTVA.

I implement two sets of Placebo tests: first, I exploit the longer panel dimension of my bank-level dataset (1868-1879) to check whether AHC membership still exercises a significant and large effect on bank survival for banks that failed after December 1875. As mentioned in Section 2.4.4 above, *Aushilfs-Comités* were operative until the end of 1875 and then concentrated exclusively on winding down their operations. In concrete terms, I am testing whether AHC membership influenced bank survival between January 1876 and December 1879. The expected outcome of these first Placebo regressions is statistical and economic insignificance: unconventional LLR should have not affected banks' survival performance post December 1875. The second set of Placebo tests serves to investigate whether AHC membership mattered for bank survival before 17 June 1873 when the unconventional LLR mechanism first became operative. AHC membership should not have positively influenced bank survival prior to the AHCs' creation. The time window on failures considered for this second Placebo test stretches from December 1872 until May 1873.

The results for these tests are reported in Table 2.16 and Table 2.17. Columns 1 to 3 of Table 2.16 display a first set of results for the Placebo tests on the post-1875 period obtained from simple logit regressions. Column 1 and 2 only use a single regressor, AHC membership, and differ merely in the use of clustered standard errors. Column 3 also includes the entire second stage control vector, **F**. These results are thus directly comparable to the ones presented in Table 2.13 above. In all three logit regressions, unconventional LLR bears the wrong, positive sign. The coefficients are considerably smaller than those obtained in Table 2.13 and in two out of three cases the effects are also statistically insignificant. Columns 1 and 2 of Table 2.17 replicate the two-stage IPWRA analysis for the Placebo tests on the post-1875 period. The first stage is identical to the one discussed in the previous section (c.f. column 2A=3A in Table 2.14).[223] In Table 2.17, column 1 displays the ATE and column 2 shows the ATET obtained from the Placebo regressions. Both treatment effects are very small and statistically insignificant. The first set of Placebo tests thus confirms that AHC membership did not mitigate bank distress once the *Aushilfs-Comités* stopped operating.

The results for the second set of Placebo tests are displayed in column 4 and 5 of Table 2.16. Given that my data set only records five bank failures before June 1873, I use a penalized maximum likelihood estimator (PMLE), drawing on the so-called "Firth logit" approach (Firth, 1993). Employing a standard maximum likelihood estimator to estimate the occurrence of rare events leads to substantial underestimation of the event probabilities and biased standard errors (King and Zeng, 2001). Without the control vector **F**, the results show a substantial negative impact of AHC membership, which, however, is statistically not different from zero. Once **F** is included (c.f. column 5 in Table 2.16), the coefficient changes sign and its impact becomes both statistically and economically insignificant. Two-stage IPWRA regressions cannot be implemented as Placebo tests on pre-June 1873 failures because the small number of closing banks does not generate enough statistical power (the second stage likelihood does not converge). Nevertheless, the PMLE results further strengthen the main conclusions drawn in the previous section. Placebo tests strongly suggest that the mitigating effect of unconventional LLR on bank distress during the *Gründerkrach* is not simply an artifact of spurious correlations.

In order to test the robustness of results obtained through IPWRA estimations using logit regressions in both first and second stages, I also run the IPWRA procedure drawing on more demanding survival analysis techniques in the second stage. This robustness check is primarily intended to investigate whether results are sensitive to changes in the functional form of the second stage. Based on the failure distributions discussed in Chapter I of this dissertation, I use two alternative parametric survival models for this purpose: one assumes the underlying failure process is gamma distributed, and the other model draws on a standard lognormal distribution. As before, the first stage is again estimated by maximum likelihood (logit). First stage results are thus identical to the fully-fledged ones (containing the selection variables and **F**) reported in Table 2.14. The second stage builds on bank survival/failure data between December 1872 and December 1879.[224] All banks

[223] Due to the low number of failures in the post-1875 period (altogether 29), the second stage of the IPWRA does not converge when **F** is included in the second stage. The results reported are thus comparable only to the same specifications in Table 2.14, i.e. columns 2B and 2C.

[224] The lack of statistical power does not allow for two-stage survival regressions considering only failures in 1873 and 1874.

Table 2.16: Placebo (PM)ML estimates

VARIABLES	(1) Failure after 12/1875	(2) Failure after 12/1875	(3) Failure after 12/1875	(4) Failure before 6/1873	(5) Failure before 6/1873
AHC member	0.08	0.08**	0.02	-1.21	0.04
	(0.07)	(0.03)	(0.04)	(1.49)	(1.83)
Repos to equity			-0.13		0.56*
			(0.13)		(0.33)
Illiquid assets to total assets			-0.02		1.56
			(0.03)		(1.19)
Mortgage loan share			-0.01		-0.50
			(0.03)		(0.62)
Deposits to cash reserves			0.00		0.26
			(0.01)		(0.23)
Bank age			-0.04*		0.54
			(0.02)		(0.36)
Leverage ratio			-0.07**		1.42**
			(0.03)		(0.65)
Return on equity			0.04**		-1.17
			(0.01)		(0.90)
Real estate to non-cash assets			0.00		0.72
			(0.02)		(0.47)
Bank size			0.06**		-0.78
			(0.03)		(0.85)
Observations	181	181	181	181	181
Clustered SE	No	Yes	Yes	No	No
Model	Logit	Logit	Logit	PMLE	PMLE
Pseudo R-squared	0.01	0.01	0.06	-	-
(P-)Log pseudolikelihood	-79.00	-79.00	-74.79	-21.61	-1.56
LR (Wald) chi2 statistic	1.30	4.13	41.42	0.67	14.17

Marginal effects for one standard deviation increase in covariate,
except for binary AHC membership, when discrete change from 0 to 1.
Clustered standard errors for marginal effects in parentheses
*** p<0.01, ** p<0.05, * p<0.1

surviving beyond the latter date are automatically censored. Since I am able to include control vector **F** in the second stage, the treatment effects obtained are comparable to the baseline results in columns 3B and 3C of Table 2.14.

To be sure, the sign and size of ATE and ATET are expected to be different to the baseline results because of the nature of survival models. Rather than constituting marginal effects on survival probability, the treatment impact reported in column 3 to 6 of Table 2.17 represent the increase in the time to failure (measured in months) resulting from AHC membership. As might be expected, all treatment effects are positive and economically significant. This result corresponds to intuition because LLR support should prolong the "life" of a given bank: depending on the treatment effect considered, AHC membership generates an additional lifetime of between six and eleven months. The estimated coefficients do not change substantively when we alter our assumptions about the underlying distribution. It should be noted, however, that the ATE is very imprecisely estimated while the ATET is statistically significant at conventional levels. One explanation for why survival models lead to less precisely estimated coefficients than the baseline IPWRA regressions could be the difference in the time horizons considered. In the duration models, the effect of AHC membership on bank survival is estimated using the entire period from December 1872 until December 1879. In contrast, the baseline regressions only consider the determinants of bank failures in 1873 and 1874. As is evident from the first set of Placebo tests discussed above, AHC membership is a negligible factor in the survival dynamics post-1875. We would therefore expect treatment effects obtained from survival regressions to be less precisely estimated due to the longer underlying time horizon. Moreover, the survival set-up is very demanding because it requires explanatory variables to

Table 2.17: Placebo IPWRA regressions and survival IPWRA models

VARIABLES	(1) Failure after 12/1875 ATE	(2) Failure after 12/1875 ATET	(3) Failure before 12/1879 ATE	(4) Failure before 12/1879 ATET	(5) Failure before 12/1879 ATE	(6) Failure before 12/1879 ATET
AHC Member	-0.03	0.02	6.47	10.04**	6.54	11.22*
	(0.06)	(0.13)	(6.39)	(5.11)	(6.88)	(6.24)
Observations	181	181	181	181	181	181
Treated	84.6	91.8	84.6	91.8	84.6	91.8
Non-treated	96.4	89.2	96.4	89.2	96.4	89.2
Second stage incl. **F**	No	No	Yes	Yes	Yes	Yes
Second stage model	Logit	Logit	Gamma	Gamma	Log-normal	Log-normal
First stage model	2A=3A in Table 2.14	2A=3A in Table 2.14	2A=3A in Table2.14	2A=3A in Table 2.14	2A=3A in Table 2.14	2A=3A in Table 2.14

Columns (1) and (2): marginal effects on probability of failure for discrete change from 0 to 1.
Columns (3) to (6): marginal effects on time to failure for discrete change from 0 to 1.
Robust standard errors for marginal effects in parentheses
*** p<0.01, ** p<0.05, * p<0.1

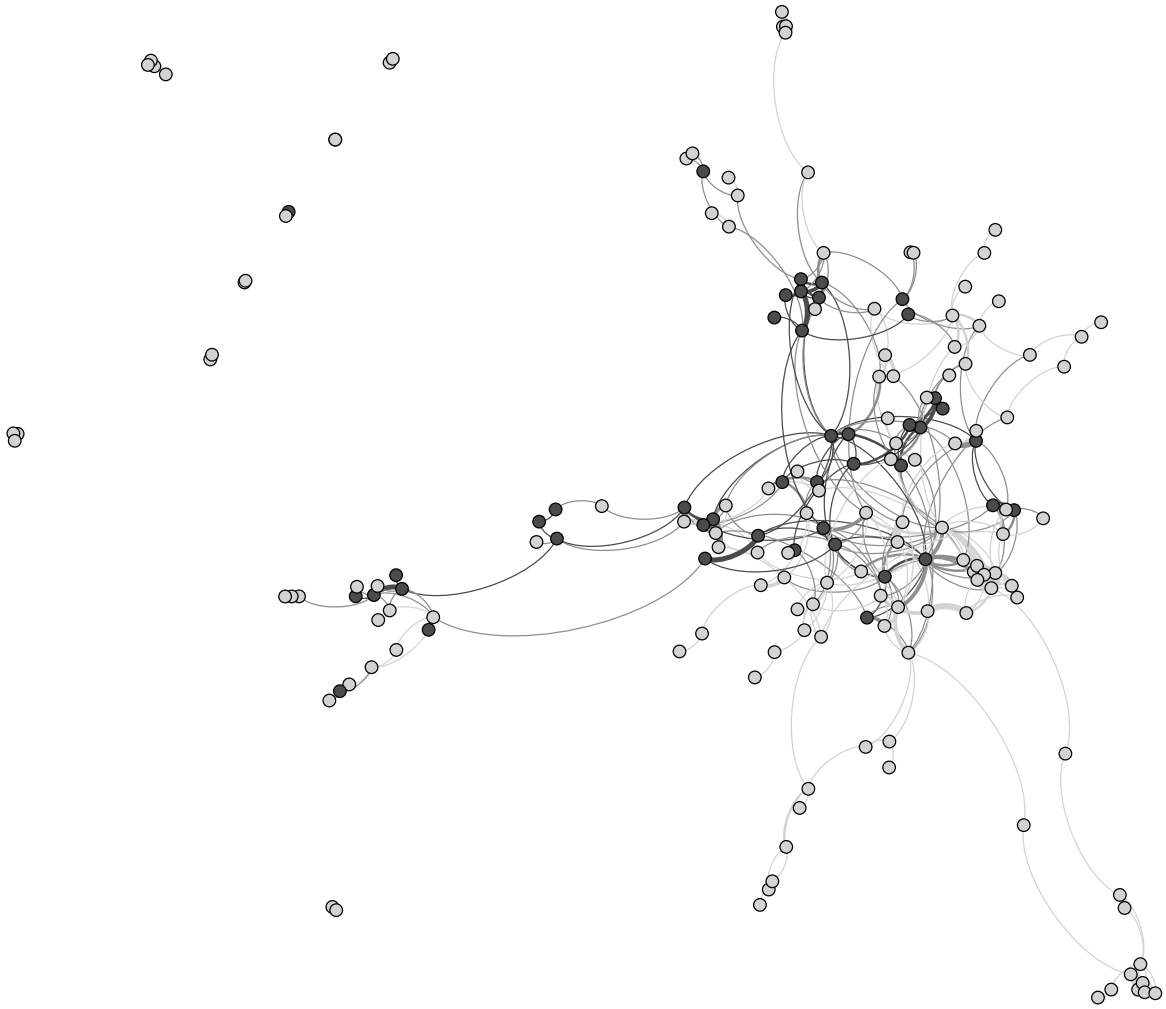
not only discriminate between the binary outcomes of survival and failure but to predict the expected time to failure (in terms of months). In the presence of small samples, such as the one employed in this chapter, comparatively less precise estimation results should thus be expected. Once these two aspects are taken into account, the survival analysis-based treatment effects estimation performs surprisingly well in replicating the baseline results.

The final robustness check conducted in this paper addresses violations of SUTVA. In order to minimize potential bias resulting from a violation of SUTVA, at the very least one would like to control for the AHC membership status of a given bank's business relations. As discussed above, we cannot determine the direction of bias on the computed AHC treatment effects on the basis of theoretical considerations only. Depending on the relative size of opposite bias effects, treatment effects might be either over- or under-estimated (and in the best of worlds, they might effectively cancel out). Unfortunately, disaggregated data on the intensity of financial links (e.g. interbank loans or deposits) are not available for the period of interest. It has been argued, however, that directorate interlocks can serve as proxies for the intensity of business links between banks in the absence of information on exact balance sheet connections between financial institutions (Colvin et al., 2015). Therefore, I followed several steps to construct a control variable that addresses basic concerns about the violation of SUTVA. First, I collected an extensive network data set on all directorate interlocks of Austro-Hungarian banks at the end of 1872. In essence, this data set takes the form of a $m \times m$ matrix which is filled with an indicator taking the value of 1 if there is an interlock between any two banks. The relevant information for this purpose is obtained from the *Compass* (c.f. Section 2.3 above). In a second step, I feed information on AHC membership into the data set of interlocks. The output of these two steps can be illustrated by a network graph in the form of Figure 2.32. Each node represents an individual bank: black nodes stand for banks that were AHC members and grey nodes constitute non-members. Links between nodes are weighted: more interlocks between any given pair of two banks results in thicker connection lines. Figure 2.32 suggests that directorate interlocks were indeed an important feature of Austro-Hungarian banking during the *Gründerkrach*.[225] *Prima facie*, Figure 2.32 could be cautiously interpreted as graphical evidence for positive bias in our treatment effects: in most cases, AHC member banks were effectively connected to financial institutions that also received unconventional

[225]A detailed discussion of network properties is beyond the scope of this study. For future research projects, I plan to collect a panel data set on directorate interlocks to enable dynamic network analysis.

LLR support.

Figure 2.32: Network of directorate interlocks of Austro-Hungarian banks (31/12/1872; AHC member banks in black)



Source: Compass

The third step consists of constructing a control variable that captures how strongly a given bank's business links (i.e. other banks) were involved in AHCs. I use the simplest possible specification by computing the share of interlocks with AHC members in the total number of interlocks of a given bank. In other words, the computed variable reflects the percentage of interlocks a given credit institution entertained with AHC members. In order to alleviate concerns about a potential violation of SUTVA, I include this variable in the outcome models for ATE and ATET. Since the variable is obviously endogenous to treatment, it should not be included in the first stage model. The summary statistics for the share of AHC links in total interlocks (henceforth **C**) is displayed in Table 3.24 above. A simple mean equality test of **C** for AHC members versus non-members confirms the conclusion drawn from Figure 2.32: the null of equality is strongly rejected (t-statistic of -5.92). On average, 50% of directorate interlocks of AHC members can be attributed to other AHC participants; the corresponding number for non-members is only 19%. The regression results are reported in Table 2.18. In terms of specification, the IPWRA regression results in Table 2.18 are directly comparable to columns 2B and 2C in Table 2.14. Whereas the ATET is practically unaffected by the inclusion of the additional covariate, the inclusion of **C** literally brings the ATE down to zero, both in terms of economic and statistical

Table 2.18: IPWRA regressions incl. SUTVA correction

VARIABLES	(1) ATE	(2) ATET
AHC Member	0.00	-0.39**
	(0.98)	(0.16)
Observations	181	181
Treated	84.6	91.8
Non-treated	96.4	89.2
Second stage incl. **F**	No	No
Second stage incl. **C**	Yes	Yes
Second stage model	Logit	Logit
First stage model	2A=3A in Table 2.14	2A=3A in Table 2.14

Marginal effects on probability of failure for discrete change from 0 to 1.
Robust standard errors for marginal effects in parentheses
*** p<0.01, ** p<0.05, * p<0.1

significance. These findings allow for the following conclusions. First, for a randomly selected bank, the effect of AHC membership was effectively zero once we control for how many of its business partners participated in an AHC. The stark difference between the ATE results in column 2B of Table 2.14 and column 1 in Table 2.18 is interesting in its own right: it seems to suggest that, for a randomly selected bank, the benefits of the unconventional LLR mechanism worked mainly through the stabilization of credit institutions with whom the bank was tightly connected. In other words, for the average bank it was vastly more important to see business partners become AHC members than to participate itself. Second, for banks that were actually treated, AHC membership reduced the probability of failure substantially even after one accounts for the share of business partners that also participated in AHCs: these banks would have been considerably worse off, had they not joined an *Aushilfs-Comité*.

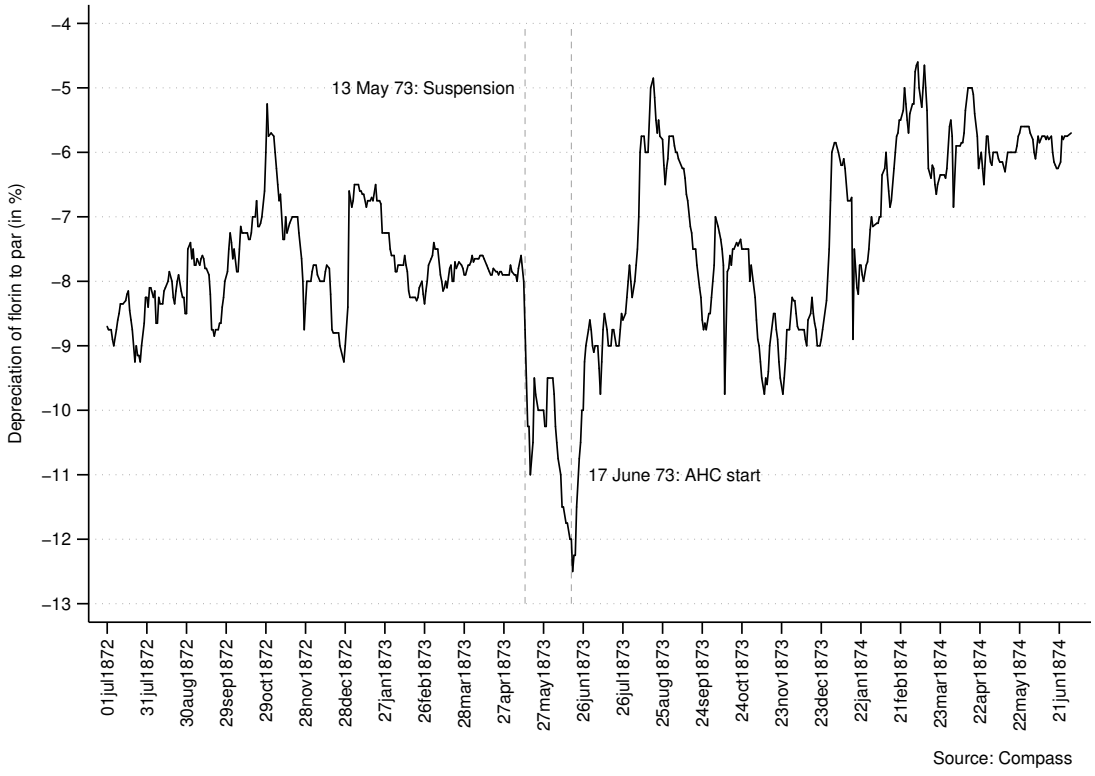
2.6 Addressing credit rationing: channels

How did AHCs address the specter of credit rationing and through which channels did *Aushilfs-Comités* mitigate bank distress? From the central bank's point of view, four aspects made liquidity provision via AHCs an attractive alternative to the policy of credit rationing. First, the creation of equity funds by each and every AHC meant that the OeNB would have to shoulder a smaller part of potential losses than in the case of traditional LLR lending. When lending directly via the standing facilities, loan defaults affected the profitability of the central bank.[226] The equity funds essentially drove a wedge between defaults on AHC lending and their refinancing through the OeNB: losses could only have a direct impact on the central bank if the entire buffer were exhausted. For the OeNB, the existence of equity buffers significantly reduced the expected loss given default on LLR lending, while increasing the central bank's prospective lending opportunities. The reduction in the expected losses given default should have decreased the OeNB board's fears of hitting the "confidence constraint". Although it did not directly provide for higher metal reserves, the equity fund assured that the

[226]Losses from lending via the standing facilities could be incurred in one of two ways: (1) if discounted bills remained unpaid at maturity after the full cascade of signatures was exhausted or (2) if debtors defaulted on their lombard loans and the liquidation of pledged collateral yielded less than the original loan amount, despite the safety margin provided by the haircuts.

increased note supply would be backed by high quality assets absorbing potential losses. This reasoning is corroborated by the data displayed in Figure 2.33. Figure 2.33 shows the depreciation of the *Florin* relative to par between July 1872 and July 1874, using daily quotes.[227] The graph shows that the *Florin* depreciated rapidly after the Bank Act was suspended on 13 May 1873. The public confidence in the currency waned, suggesting that the concerns of OeNB directors discussed in Section 2.4 above were not unfounded. Yet, Figure 2.33 testifies to an equally rapid and persistent recovery after 17 June 1873, when the AHCs first became operative. Thus, the evolution of the currency relative to par suggests a plausible channel leading to the end of credit rationing: the returning public confidence in the *Florin* following the creation of AHCs alleviated the "confidence constraint" Bank directors had been wary to stretch any further.

Figure 2.33: The *Florin's* depreciation to par (7/1872-7/1874)



A second, related point concerns the decentralization of lending decisions from the central bank to AHC boards. This decentralization represented a *de facto* externalization of risk management activities from the OeNB to the AHCs. In crisis times, lending via the standing facilities can be highly resource intensive. For example, disaggregated data from the Bank of England's discount ledgers suggest that Bank staff had to screen roughly eight bills per minute during the crisis of 1847 (Anson et al., 2017). Abnormally high demand at the discount window can increase operative costs if it is necessary to pay staff overtime or employ additional clerks.[228] In addition, new employees might be less productive than those already employed if they need to

[227] Since the Empire was on a non-convertible silver standard since 1862, the currency remained mostly below par until its stabilization in terms of a gold parity in the early 1890s, c.f. Jobst (2009).

[228] If staff is taken from other departments rather than newly employed, the Bank might still incur costs in the form of opportunity costs.

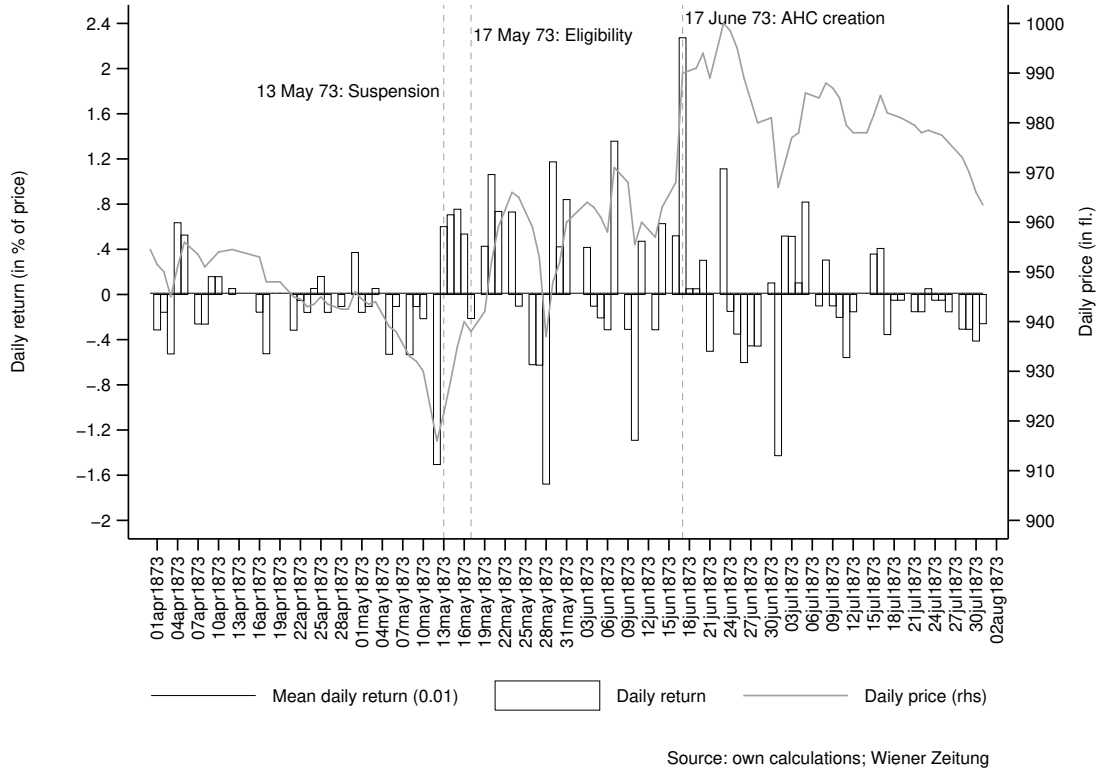
undergo instruction first. Hence, a non-rationing LLR could experience rising operative costs per bill discounted during periods of high demand. The externalization of lending activities to AHCs may therefore have contributed to a reduction (or at least a stabilization) of the costs associated with borrower screening and monitoring incurred by the central bank. Given the absence of a convincing counterfactual, it is of course difficult to evaluate the impact of these dynamics. Potentially relevant descriptive statistics are summarized in Table 2.20. While operative costs in 1873 did increase in absolute terms relative to the pre-crisis years, the increase appears to be part of a general upward trend at the time. As displayed in Table 2.20, relative cost measures such as operative costs per bill discounted and operative costs per 100 fl. discounted are both well below average in 1873, with the latter at its second lowest level of the period between 1863 and 1885. It should be noted, however, that since there is no break-down of operative costs according to subcategories such as risk management, rent and maintenance, it remains unclear whether the evolution of total operative costs is an accurate proxy for our purpose. For example, the substantial increase in operative costs following 1878 paired with a fall in the operative costs per bill after 1880 strongly suggests that structural changes, such as the conversion of the OeNB into the *Oesterreich-Ungarische Bank* (OeUB) in 1878 and the concomitant expansion of the Bank's branch network (Jobst and Kernbauer, 2016), played an important role. Thus, the most plausible piece of evidence for a positive impact of the externalization of risk management remains the absence of a surge in the costs per bill in 1873.

From a principal-agent perspective, both the reduction of expected losses given default and the externalization of risk management should have also reduced the incentive of OeNB shareholders to back credit rationing practices. Indeed, AHCs should have been an attractive solution for the OeNB's private shareholders. Figure 2.34 presents some suggestive evidence for this proposition: on 17 June, the day on which the Viennese AHC published its programme and opened its doors for business, the OeNB's share price showed the by far highest positive daily return (+2.25%, compared to the main daily return of 0.01% during this period) during the first months of the crisis.[229] Furthermore, Table 2.20 in the appendix shows that while non-performing loans (NPL) at the discount window peaked in 1873, the respective share of NPL in total bills discounted and in the total amount discounted by the OeNB remained negligible and in fact comparable to several other non-crisis years.

Connected to the externalization of risk management is a third element which made AHCs an attractive institutional arrangement to channel LLR funding in the presence of the informational asymmetries described above. The fact that lending decisions were decentralized did not only shift screening and monitoring costs to the AHCs; it also allowed the LLR structure to exploit market players' private information on each other's creditworthiness. From the perspective of the OeNB, the decentralization of lending decisions should have reduced the risk of adverse selection. It is well known that counterparties might apply for central bank funding to "gamble for survival": when negative (insider) information leads lenders in the market to cut its funding sources, a counterparty might still be able to refinance via a less up-to-date central bank in order to overcome a liquidity squeeze. If Bank rate functions as a ceiling for prevailing market rates, central bank refinancing is

[229]The daily return in Figure 2.34 is calculated as the day-to-day change in prices divided by the prevailing share price.

Figure 2.34: Daily returns and prices for OeNB shares (4/1873-7/1873)



necessarily costlier than market finance - hence the expression "gambling for survival". In 1873, however, the OeNB's main refinancing rate was mostly below market rates (c.f. Figure 2.25 above). Therefore, in theory, adverse selection could have been a particularly pressing problem for the OeNB during the *Gründerkrach*.[230] The creation of AHCs, whose boards and lending decisions were controlled by market participants themselves, should have helped to limit lending to "lemons". Private sector board members could have had the benefit to base lending decisions on private information *a priori* unavailable to the central bank. Of course, private information also risked being abused in the context of AHCs, potentially leading to the rise of clientelism in liquidity provisions. But in this regard, OeNB presence on AHC boards served an additional rationale besides the more general oversight condition linked to refinancing: OeNB presence thwarted incentives for AHCs to engage in dodgy relationship lending. Neuwirth (1874) suggests that the role of the OeNB was crucial for the success of the Viennese AHC:

[230]Of course, the acuteness of the adverse selection problem would have ultimately depended on how successfully the Bank's credit rationing approach discriminated against low quality borrowers.

> Thanks to influence which the OeNB's general secretary had secured for himself in the AHC with his energetic, continuous engagement since the beginning, the AHC did not become just another investment fund; its interventions were restricted to the purpose of providing support to trade and industry, and to prevent that the loss of confidence and the absolute lack of credit on the stock exchange would affect other sectors of the national economy.[231]

Figure 2.27 presented above seems to suggest that the Viennese AHC was ultimately only moderately successful in separating wheat from chaff: it incurred losses which consumed half of its equity reserve. However, in the absence of an adequate counterfactual, it would be careless to make any too definitive statement: we simply do not know how high the losses deriving from LLR lending would have been in the absence of AHCs.

The fourth aspect worthy of discussion is the AHCs' treatment of moral hazard. Moral hazard is a generic term which summarizes the negative consequences of *de facto* liquidity insurance provided by a LLR. Moral hazard is present when the existence or expectation of this insurance – once it has been activated or promised – leads market participants to act irresponsibly in the future. In the case of 1873, moral hazard could have derived from the creation of *Aushilfs-Comités* if their set-up triggered clear expectations that similar arrangements would be taken in future crises and if their creation led to essentially costless liquidity insurance for market participants. Had these two conditions been met, it would have arguably been rational for market participants to downsize costly liquidity buffers in the years following the *Gründerkrach*.[232] Without an appropriate empirical strategy, there is little hope of disentangling the medium to long-term effects of AHCs on the banking sector's attitude towards liquidity management. Yet, one might argue from first principles that the creation of AHCs in 1873 did not entail a promise to create similar unconventional LLR mechanisms in future crises. On the one hand, the AHCs of 1873 were *ad hoc* responses, and they were entirely wound down after 1875. On the other hand, the failure of a similar mechanism (the bank consortium) to gain momentum earlier in the crisis suggests that the conditions for creating effective LLR lending structures via AHCs are complex and may only be met when a critical mass of actors is immediately concerned (as it was the case following the demise of the *Wiener Wechslerbank*). Therefore, simply relying on the *ad hoc* creation of AHCs in future crises could be a dangerous gamble. Most importantly, however, the liquidity insurance provided by *Aushilfs-Comités* was far from costless. By construction, the guarantee structure and the creation of equity funds meant that a significant share of any losses incurred by AHCs would ultimately have had to be borne by the members themselves. Hence, even under the assumption of an implicit promise to create AHCs again in future crises, neglecting proper liquidity management in normal times could strike back in periods of distress. Low liquidity buffers make market participants susceptible to become members of AHCs; membership, however, comes at the risk of having to bear losses from the *Aushilfs-Comité's* lending activities. In 1873, the Viennese AHC set a clear precedent in this regard as operations generated losses which had to be shouldered by its members.

From the point of view of market participants, the AHCs provided three crucial services that mitigated liquidity distress during the *Gründerkrach*. First and foremost, they allowed liquidity provision in a crisis

[231] Pressburger (1962, p.1154).

[232] Liquidity buffers are costly because investments in short-maturity, liquid assets usually generate less interest than longer-term, illiquid investments.

context that would have otherwise been marked by severe credit rationing on the part of the central bank. The creation of AHCs, however, went beyond simply substituting for a non-functioning standard LLR mechanism. As noted above, the *Aushilfs-Comités* also enabled the central bank to buy bills that were considered to be substandard according to its statutes. The willingness of the OeNB to discount bills with maturities longer than 90 days[233] and to accept bills bearing less than the standard number of signatures was contingent on the guarantee of AHC members as well as the construction of an equity fund. Therefore, the creation of *Aushilfs-Comités* not only raised an almost shut discount window, it also enlarged the pool of securities eligible at the OeNB's discount facility. To be sure, these softened requirements only applied to AHC refinancing via the OeNB. Since *Aushilfs-Comités* were not only allowed to discount bills but could also lend against any collateral they deemed appropriate, the two-layered structure of unconventional LLR provided for a significant enlargement of the pool of collateral eligible for liquidity support. Evidence on the operations of the Viennese AHC suggest that members took advantage of this fact: as shown in Figure 2.27, the category of "special loans" accounted for 50% of the AHC's balance sheet. Crucially, this enlargement did not come at the automatic price of moral hazard because at the AHC-level decision-makers had to weigh up the benefits of wider collateral eligibility against the potential cost of increased risk thus incurred: in the end, too risky lending practices would fall back on AHC members by diminishing the equity fund.

2.7 Conclusion

Facing credit rationing from the central bank, market participants joined forces to stop large-scale fire sales during the Austro-Hungarian *Gründerkrach* of 1873. Bankers, brokers and investment firms founded so-called *Aushilfs-Comités* (AHCs) in all major cities of the Habsburg Empire. These committees could access direct refinancing lines at the central bank to rediscount substandard paper in return for the joint guarantees of their members and the creation of loss absorption funds. The present chapter showed that this non-conventional, innovative lender of last resort (LLR) mechanism provided a solution to credit rationing by the central bank. AHCs directly addressed the institutional as well as ideational constraints that prevented the central bank from "lending freely" during the crisis, and it responded to problems of asymmetric information at the root of central bank credit rationing.

This chapter showed that unconventional LLR effectively mitigated bank distress during the Austro-Hungarian *Gründerkrach* of 1873. In order to address the potential bias deriving from banks' self-selection into *Aushilfs-Comités*, this chapter used a two-stage inverse-probability-weighted regression adjustment (double-robust IPWRA). The estimated average treatment effects suggest that *Aushilfs-Comité* membership reduced the bank-level probability of failure by between 30 and 40% for those credit institutions which took part in the mechanism. Hence, unconventional LLR does not only emerge as a statistically highly significant variable reducing bank

[233] Pressburger (1962, p.1153) suggests that the creation of AHCs allowed the Bank to discount bills with remaining maturities between four and six months.

distress during the *Gründerkrach* – its effect was also large from an economic point of view. These results are robust to a set of Placebo tests and different specifications, including treatment effect estimation on the basis of duration models. Moreover, there is evidence that the creation of AHCs impacted banks' chances to survive the *Gründerkrach* by generating positive externalities: for a randomly selected bank, the sizable effect of AHC membership becomes negligible once the share of its business partners on LLR support is controlled for.

Since the liquidity crisis of 2007-08, new legislation such as the U.S. Dodd-Frank Act has made it considerably more difficult for central banks to establish even wide-eligibility LLR facilities in the future. Proposals for market solutions or private-public partnerships ensuring LLR access to a wide range of market participants beyond the traditional banking system proliferate, but it is yet unclear how these mechanisms would operate in detail. Studying historical solutions such as the "symbiotic" relationship between the Austrian central bank and *Aushilfs-Comités* in 1873 may provide some useful insights in this respect. *Aushilfs-Comités* represented an attempt to minimize the central bank's counterparty risk via members' mutual guarantee and the creation of equity funds to shoulder losses; at the same time, they put the central bank into a position to channel credit to borrowers with potentially above-average default risk using collateral beyond its statutory requirements. Moreover, by leaving the business of rating submitted bills and collateral to the guaranteeing members, the Austrian central bank appears to have found a clever way to access private information and to shift some of the additional risk management costs back to the market. The design of the committees also addressed the moral hazard problem involved in traditional LLR operations. On the one hand, their equity subscriptions to the AHCs made members directly liable for their excesses to the extent that any losses for the central bank had to be covered by these reserves. On the other hand, the AHCs preempted a free-rider problem by lending only to market actors who had contributed to the equity fund.

Overall, the Austro-Hungarian experiment of 1873 shows why it might at times be fruitful to think beyond the narrow confines of the conventional Bagehotian LLR case in which liquidity is channeled through the central bank's standing facilities. Central banks, past and present, often face constraints when engaging in wide-eligibility liquidity provision during a financial crisis. Avoiding the specter of credit rationing requires innovative solutions that address both, problems of asymmetric information and institutional constraints on central bank lending.

2.8 Appendix

2.8.1 Programme of the Viennese *Aushilfs-Comité*

Die Ereignisse der letzten Wochen stifteten nicht nur auf unserem wirtschaftlichem Gebiete materiellen Schaden, sondern bedrohen auch viele unmittelbar gar nicht Beteiligte mit einer Störung ihres gewohnten soliden Geschäftsbetriebes. Dazu tauchen, wie immer in ähnlichen Fällen, oft ganz unbegründete Gerüchte auf, welche nur zu leicht Glauben finden und in der künstlich erregten Furcht eine viel größere moralische Gefahr hervorzutufen im Stande wären. Es schien uns unter solchen Umständen zweckmäßig, Maßregeln zu ergreifen, welche geeignet sind, nach Maß unserer Mittel, dem Gewerbe, der Industrie, dem Handel und dem Geldmarkte überhaupt die augenblicklich dringend nötige Hilfe zu bieten, um dadurch jene ruhige Besonnenheit zu kräftigen, die jedem Sturme männlich die Stirne bietet. Von diesem Gedanken gemeinsamer Bürgerpflicht geleitet und für diese Zwecke haben wir ein Wiener Aushilfskomitee gebildet. Das Wiener Aushilfskomitee behält sich vor, sich im Falle des Bedarfes noch durch andere Institute und Privatfirmen verschiedener Geschäftszweige zu verstärken. Das Wiener Aushilfskomitee wird während der Dauer der ausnahmsweisen Verhältnisse:

1. durch die Niederosterreichische Eskompte-Gesellschaft und die Allgemeine Depositenbank Wechsel eskontieren, 2. durch die Wiener Handelsbank Innerhalb der biefür festzusetzenden Grenzen Waren belehnen, 3. durch die Creditanstalt für Handel und Gewerbe gegen anderweitige Sicherheiten außerordentliche Kredite erteilen, 4. dem Effektenmarkte durch zweckmäßige Mittel eine tunliche Erleichterung gewähren.

In diesem Sinne und in diesen Grenzen wird das Wiener Aushilfskomitee seine Mitwirkung dort eintreten lassen, wo es sich um die Aufrechthaltung gesunder Zustände handelt, wo das Interesse des einzelnen in dem höheren Interesse des ganzen seine wohlberechtigte Begründung findet. Zur Ausführung dieser Aufgabe wird von dem Wiener Aushilfskomitee im Einvernehmen mit der priv. österreichlschen Nationalbank ein den vorbezeichneten Zwecken entsprechender Betriebsfonds gebildet werden. Die Verwaltung dieses Fonds, an welcher die priv. österreichische Nationalbank als Mitglied des Komitees teilnimmt, erfolgt nach den von diesem Komitee festzusetzenden Grundsätzen und unter dessen Überwachung. Wir haben uns gleichzeitig dafür entschieden, durch freiwillige Beteiligung hiesiger Firmen, ohne Unterschied des Geschäftes, einen Sicherstellungsfonds zu bilden, der bestimmt ist, etwaige Verluste zu decken. Jede Firma, welche sich an der Bildung dieses Sicherstellungsfonds beteiligt, übernimmt nach Verhältnis und bis zur Höhe des bezeichneten Betrages die Mithaftung für den aus der Geschäftsführung des Wiener Aushilfskomitees sich etwa ergebenden Gesamtverlust. Die beitretenden Firmen, welche öffentlich bekanntgemacht werden, verpflichten sich, von den durch sie gezeichneten Beiträgen zu diesem Sicherstellungsfonds bei Abgabe ihrer Erklärung vorläufig 20 Perzent für Rechnung des Wiener Aushilfskomitees bei der k. k. priv. österreichischen Creditanstalt für Handel und Gewerbe bar zu erlegen. Die zu diesem Sicherstellungsfonds eingezahlten Beträge werden gleichfalls zu den Geschäften des Wiener Aushilfskomitees verwendet. Nach Auflösung des Wiener Aushilfs-komitees wird eine Versammlung aller jener Firmen, welche zur Bildung dieses Sicherstellungsfonds beigetragen haben, über die Verwendung jenes Betrages entscheiden, der nach Abzug etwaiger Auslagen oder Verluste von den Geschäftserträgnissen erübrigt. Die Beiträge zu diesem Sicherstellungsfonds eröffnen: die Anglo-Oesterreichische Bank mit 300.000 fl, die k. k. priv. allgemeine österreichische Bodenkreditanstalt mit 250.000 fl, die k. k. priv. österreichiscbe Creditanstalt für Handel und Gewerbe mit 500.000 fl, die Allgemeine Depositenbank mit 100.000 fl, die Niederoesterreichische Eskompte-Gesellschaft mit 250.000 fl, die Franko-österreichische Bank mit 150.000 fl, die priv. österreichische Nationalbank mit 1,000.000 fl, S. M. v. Rothschild mit 500.000 fl, die Unionbank mit 250.000 fl, die k. k. priv. Wiener Handelsbank für den Produkten- und Warenverkehr mit 100.000 fl. Indem wir die geehrten Firmen Wiens einladen, sich an der Bildung dieses Sicherstellungsfonds recht zahlreich zu beteiligen, glauben wir im Interesse des gemeinnützigen Zweckes um so sicherer auf günstigen Erfolg rechnen zu dürfen, als ein namhafter Sicherstellungsfonds wesentlich dazu beitragen wird, die Aufgabe des Wiener Aushilfskomitees zu fördern und zu erleichtern. Die Erklärung für Beiträge zu dem Sicherstellungsfonds wolle unter Ausfüllung und Fertigung des nachstehenden Schreibens umgehend unter Adresse der k. k. priv. österreichischen Creditanstalt für Handel und Gewerbe an das Wiener Aushilfskomitee geleitet werden. Formulare solcher Beitrittserklärungen können auch bei der Creditanstalt für Handel und Gewerbe entgegengenommen werden.

Wien, am 17.Juni 1873

2.8.2 Equity reserve contributions to the Viennese *Aushilfs-Comité*

Table 2.19: Viennese AHC members

Counterparty name	Source	Date	Page	Type	Contribution (in fl.)
A. u. E. Bleyer	Deutsche Zeitung	22-06-1873	10	private	1000
Allgemeine Depositen-Bank	Deutsche Zeitung	22-06-1873	10	bank	100000
Anglo-Oesterreichische Bank	Deutsche Zeitung	22-06-1873	10	bank	300000
Austro-Tuerkische Credit-Anstalt	Deutsche Zeitung	22-06-1873	10	bank	100000
Brevilliers und Comp.	Deutsche Zeitung	22-06-1873	10	industry	50000
Eduard Wiener	Deutsche Zeitung	22-06-1873	10	private bank	100000
Ephrussi und Comp.	Deutsche Zeitung	22-06-1873	10	private bank	50000
F.E. Mayrhofer	Deutsche Zeitung	22-06-1873	10	private	30000
Friedrich Schey	Deutsche Zeitung	22-06-1873	10	private bank	150000
Franco-Oesterreichische Bank	Deutsche Zeitung	22-06-1873	10	bank	150000
Franz Freiherr Mayr von Melnhof	Deutsche Zeitung	22-06-1873	10	industry	100000
Franz Leitenberger	Deutsche Zeitung	22-06-1873	10	industry	50000
Franz Rucker	Deutsche Zeitung	22-06-1873	10	merchant	1000
Gebr. Gutmann	Deutsche Zeitung	22-06-1873	10	industry	50000
Gebr. Sigmund und Max Reitzes	Deutsche Zeitung	22-06-1873	10	private bank	50000
Herm. Todesco's Söhne	Deutsche Zeitung	22-06-1873	10	merchant	200000
J. Scharmitzers Neffe	Deutsche Zeitung	22-06-1873	10	merchant	50000
Joach. Fanto und Sohn	Deutsche Zeitung	22-06-1873	10	merchant	2000
Johann Gögl	Deutsche Zeitung	22-06-1873	10	merchant	30000
Johann Liebieg und Comp.	Deutsche Zeitung	22-06-1873	10	industry	200000
Jos. Oesterreicher	Deutsche Zeitung	22-06-1873	10	industry	2000
Joseph M. Pfeiffer	Deutsche Zeitung	22-06-1873	10	industry	50000
K K priv oesterr. Credit-Anstalt	Deutsche Zeitung	22-06-1873	10	bank	500000
K K priv Wiener Handelsbank	Deutsche Zeitung	22-06-1873	10	bank	100000
K K priv. Kaiser Ferdinands-Nordbahn	Deutsche Zeitung	22-06-1873	10	railways	100000
K K privilegirte allgemeine oesterreichische Boden-Credit-Anstalt	Deutsche Zeitung	22-06-1873	10	bank	250000
K K privilegirte allgemeine Verkehrsbank	Deutsche Zeitung	22-06-1873	10	bank	100000

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Table 2.19 – continued from previous page

Counterparty name	Source	Date	Page	Type	Contribution (in fl.)
K K privilegirte oesterreichische Staatseisenbahngesellschaft	Deutsche Zeitung	22-06-1873	10	railways	100000
K K privilegirte oesterreichische Vereinsbank	Deutsche Zeitung	22-06-1873	10	bank	150000
Karl Stummer	Deutsche Zeitung	22-06-1873	10	industry	50000
L. und H. Stern	Deutsche Zeitung	22-06-1873	10	private bank	30000
Länderbanken-Verein	Deutsche Zeitung	22-06-1873	10	bank	100000
Ludwig Ladenburg	Deutsche Zeitung	22-06-1873	10	private bank	50000
Mährische Pfandleih-Gesellschaft	Deutsche Zeitung	22-06-1873	10	bank	50000
Max Springer	Deutsche Zeitung	22-06-1873	10	private bank	200000
Moriz Königswarter	Deutsche Zeitung	22-06-1873	10	private bank	200000
Moriz Wodianer	Deutsche Zeitung	22-06-1873	10	private bank	200000
Nieder-Oesterreichische Escompte-Gesellschaft	Deutsche Zeitung	22-06-1873	10	bank	250000
Oesterreichische allgemeine Bank	Deutsche Zeitung	22-06-1873	10	bank	100000
Oesterreichische Bank-Gesellschaft	Deutsche Zeitung	22-06-1873	10	bank	200000
Oesterreichische Hypothekar-Credit- und Vorschussbank	Deutsche Zeitung	22-06-1873	10	bank	50000
Philipp Gomperz	Deutsche Zeitung	22-06-1873	10	industry	50000
Philipp Haas und Söhne	Deutsche Zeitung	22-06-1873	10	industry	50000
Privilegirte oesterreichische Nationalbank	Deutsche Zeitung	22-06-1873	10	bank	1000000
S. Auspitz	Deutsche Zeitung	22-06-1873	10	private bank	50000
S.M. von Rothschild	Deutsche Zeitung	22-06-1873	10	private bank	500000
Schenk und Bruckner	Deutsche Zeitung	22-06-1873	10	private	5000
Schoeller und Comp.	Deutsche Zeitung	22-06-1873	10	industry	100000
Seidel und Prossinagg	Deutsche Zeitung	22-06-1873	10	private	2000
Sim. G. Sina	Deutsche Zeitung	22-06-1873	10	private bank	200000
Unionbank	Deutsche Zeitung	22-06-1873	10	bank	250000
Lieben und Comp.	Deutsche Zeitung	22-06-1873	10	merchant	50000
Wiener Bank-Verein	Deutsche Zeitung	22-06-1873	10	bank	100000
Wiener Wechselstuben-Gesellschaft	Deutsche Zeitung	22-06-1873	10	bank	100000
Wollheim und Weisweiller	Deutsche Zeitung	22-06-1873	10	private bank	50000
Baiersdorf und Biach	Deutsche Zeitung	01-07-1873	10	industry	10000

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Table 2.19 – continued from previous page

Counterparty name	Source	Date	Page	Type	Contribution (in fl.)
Dutschka und Comp.	Deutsche Zeitung	01-07-1873	10	private bank	30000
E. Schuster	Deutsche Zeitung	01-07-1873	10	private	1000
Eduard Simon	Deutsche Zeitung	01-07-1873	10	private bank	30000
Em. Biach und Comp.	Deutsche Zeitung	01-07-1873	10	industry	6000
F. Grünbaum's Söhne	Deutsche Zeitung	01-07-1873	10	merchant	2000
Ferd. Figdor	Deutsche Zeitung	01-07-1873	10	merchant	50000
Genossenschaftsbank J. Heinisch Leopold Loewy	Deutsche Zeitung	01-07-1873	10	bank	10000
Glücksmann und Stutetsky	Deutsche Zeitung	01-07-1873	10	merchant	5000
Hackl und Pollak	Deutsche Zeitung	01-07-1873	10	industry	1000
Heinrich Hirsch und Comp.	Deutsche Zeitung	01-07-1873	10	industry	1000
J.M. Miller und Comp.	Deutsche Zeitung	01-07-1873	10	merchant	75000
Israel Hilferding	Deutsche Zeitung	01-07-1873	10	industry	2500
Jonas Fröhlich's Söhne	Deutsche Zeitung	01-07-1873	10	industry	1000
Josef Wertheimer	Deutsche Zeitung	01-07-1873	10	private	1000
K K priv. oesterreischische Südbahngesellschaft	Deutsche Zeitung	01-07-1873	10	railways	100000
Lippmann's Söhne	Deutsche Zeitung	01-07-1873	10	merchant	50000
M. Gerstle und Comp.	Deutsche Zeitung	01-07-1873	10	construction	10000
M. Thorsch's Söhne	Deutsche Zeitung	01-07-1873	10	private bank	30000
Neue Wiener Tramway-Gesellschaft	Deutsche Zeitung	01-07-1873	10	transport	10000
Oesterreichischer Spar-Verein	Deutsche Zeitung	01-07-1873	10	bank	50000
Real-Credit-Bank	Deutsche Zeitung	01-07-1873	10	bank	30000
Reyer und Schlick	Deutsche Zeitung	01-07-1873	10	merchant	100000
Rosenberg und Weintraub	Deutsche Zeitung	01-07-1873	10	private	500
S. F. Goldberger und Söhne	Deutsche Zeitung	01-07-1873	10	industry	25000
S. Hoffmann und Comp.	Deutsche Zeitung	01-07-1873	10	industry	2000
Wertheimer und Jonas	Deutsche Zeitung	01-07-1873	10	private	1000
Wiener Baugesellschaft	Deutsche Zeitung	01-07-1873	10	construction	50000
S. und A. Schlesinger	Deutsche Zeitung	17-07-1873	8	private	500
A. Popper Söhne und Latzko	Deutsche Zeitung	17-07-1873	8	merchant	5000

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Table 2.19 – continued from previous page

Counterparty name	Source	Date	Page	Type	Contribution (in fl.)
Kestler u. Kary	Deutsche Zeitung	17-07-1873	8	private	2000
Jakob Lenobel	Deutsche Zeitung	17-07-1873	8	private	1000
Leopold Rebenwurzl	Deutsche Zeitung	17-07-1873	8	private	500
Gebrüder Klein	Deutsche Zeitung	17-07-1873	8	industry	100000
Moriz Kohn	Deutsche Zeitung	17-07-1873	8	private	500
Innerberger Hauptgewerks-gsellschaft	Deutsche Zeitung	17-07-1873	8	industry	50000
Disconto-Commanditgesellschaft	Deutsche Zeitung	17-07-1873	8	private bank	2000
F. Schmitt	Deutsche Zeitung	17-07-1873	8	industry	50000
Wetzler u. Abeles	Deutsche Zeitung	17-07-1873	8	industry	5000

2.8.3 OeNB operations (1863-1885)

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Table 2.20: OeNB operations (1863-1885): total revenues, operative costs and discount window statistics incl. non-performing loans (NPL)

Year	(1) Total revenues (in mill. fl.)	(2) Op. costs (in mill fl.)	(3) Cost share of revenues	(4) Bills discounted (# bills)	(5) Op. costs per bill (in fl.)	(6) Discounts (in mill fl.)	(7) Costs per 100 fl. discounted	(8) Number of NPLs	(9) Share of NPLs (# bills)	(10) Amount of NPLs (in fl.)	(11) Share of NPLs (amount discounted)
1863	10.99	0.84	7.64%	193,350	4.34	366.94	0.23	9	0.00%	10,100	0.00%
1864	11.39	0.92	8.11%	220,868	4.18	479.95	0.19	23	0.01%	25,553	0.01%
1865	10.93	0.89	8.16%	199,674	4.47	471.14	0.19	18	0.01%	7,518	0.00%
1866	10.97	1.06	9.67%	186,495	5.69	378.51	0.28	21	0.01%	21,618	0.01%
1867	9.10	0.89	9.75%	157,315	5.64	296.70	0.30	1	0.00%	1,000	0.00%
1868	9.15	0.91	9.90%	219,421	4.13	435.43	0.21	0	0.00%	0	0.00%
1869	9.57	1.02	10.70%	237,987	4.30	461.85	0.22	30	0.01%	147,100	0.03%
1870	11.03	1.02	9.25%	248,978	4.10	509.64	0.20	39	0.02%	19,562	0.00%
1871	11.61	1.07	9.24%	291,646	3.68	639.40	0.17	0	0.00%	0	0.00%
1872	12.91	1.15	8.89%	333,713	3.44	755.41	0.15	22	0.01%	24,600	0.00%
1873	13.89	1.40	10.11%	391,677	3.58	877.27	0.16	278	0.07%	554,837	0.06%
1874	12.05	1.40	11.64%	330,172	4.25	722.77	0.19	19	0.01%	30,063	0.00%
1875	10.30	1.42	13.75%	363,659	3.89	679.62	0.21	74	0.02%	215,191	0.03%
1876	9.76	1.49	15.27%	358,753	4.16	640.53	0.23	82	0.02%	140,062	0.02%
1877	9.85	1.42	14.42%	360,020	3.95	646.33	0.22	75	0.02%	75,360	0.01%
1878	9.60	1.48	15.45%	373,366	3.97	625.43	0.24	58	0.02%	66,623	0.01%
1879	8.67	1.70	19.58%	368,597	4.60	574.04	0.30	38	0.01%	36,126	0.01%
1880	8.38	1.58	18.84%	413,729	3.82	658.76	0.24	4	0.00%	9,320	0.00%
1881	8.72	1.64	18.81%	514,346	3.19	780.39	0.21	21	0.00%	15,285	0.00%
1882	9.56	1.62	17.00%	567,033	2.86	817.64	0.20	32	0.01%	16,662	0.00%
1883	9.46	1.70	17.95%	611,688	2.78	871.03	0.19	30	0.00%	31,095	0.00%
1884	9.41	1.65	17.54%	688,114	2.40	863.10	0.19	49	0.01%	281,782	0.03%
1885	8.62	1.68	19.53%	625,822	2.69	720.97	0.23	10	0.00%	7,584	0.00%
Mean	10.26	1.30	13.10%	358,975	3.92	620.56	0.22	41	0.01%	75,524	0.01%

Source: own calculations; Lucam (1876) and Leonhardt (1886)

Chapter III

Managing Moral Hazard in Last Resort Lending: Credit Limits as "Contingent Rules" at the Austro-Hungarian Bank

3.1 Introduction

Chapter II of this dissertation analyzed the lender of last resort (LLR) in (in)action. It studied the unpromising beginnings of the Austro-Hungarian central bank as a LLR: the Bank initially rationed credit during the *Gründerkrach* of 1873. I showed that ideational and institutional constraints, as well as asymmetric information problems were some of the root causes of credit rationing in 1873. Chapter II of this dissertation then explored how ad-hoc institutional innovation in the form of so-called *Aushilfs-Comités* helped address the specter of credit rationing and mitigated bank distress.

However, no matter how successful it is in calming financial distress and independently of the concrete form it takes, the provision of LLR always comes at an important cost. A central bank which engages in "free lending", that is, which supplies an elastic amount of liquidity during crises, provides financial institutions with an insurance against liquidity shocks. While mitigating potential negative externalities and real effects of such shocks, insurance is known to invite moral hazard: anticipating central bank support in the case of a liquidity shortfall, banks have less incentives to hold sufficient but costly amounts of liquid assets. In addition, when push comes to shove, the central bank might find it difficult to distinguish between insolvent and illiquid financial institutions. This difficulty in turn provides an incentive for banks to draw on central bank liquidity support to gamble for survival. As a result, moral hazard can trigger large social costs. On the one hand, it undermines financial stability and thereby increases the probability of future crises. On the other, bank failures which result from gambling behavior need to be shouldered by the central bank (and ultimately tax payers) or – if the central bank has protected itself by requesting collateral – by junior debtors and shareholders. Consequently, moral hazard is a central issue in the literature on last resort lending.

While *Aushilfs-Comités* were designed in a way to minimize negative behavioral incentives for liquidity recipients, Chapter II only provided limited insight into how moral hazard was checked inter-temporally. If the creation of *Aushilfs-Comités* with OeNB support had become the general expectation in every crisis, credit institutions might have "banked" on this expectation. As argued in Chapter II, the very nature of AHCs as ad-hoc committees might have limited the rise of pernicious incentives. Yet, their ad-hoc nature also explains why more structural attempts at limiting moral hazard remained absent at the time: with a central bank hesitant to assume the role as ultimate liquidity provider in a crisis, there was no fully-fledged institutionalized LLR concerned with moral hazard.

Over time, however, the OeNB evolved into an institution up to the task. One key element for the phasing out of credit rationing was a change in the statutory rules governing the metallic cover of the notes in circulation (Jobst and Rieder, 2016). As explained in Chapter II of this dissertation, between 1862 and 1888 the Bank operated under a rule inspired by Peel's Act with a fixed fiduciary quota and a 100% cover of all notes issued in excess of the quota. Exceeding the limit required an act of legislation to suspend the corresponding paragraph of the Bank's statutes, which only happened during the crisis of 1873. Crucially, after 1888 the Bank was allowed

to exceed the quota subject to a 5% tax. The new regulation ensured that note issuance not covered by metallic reserves did not rise too much above the fixed quota in normal times, while giving the Bank the possibility to accommodate sudden increases in the demand for cash without requiring explicit government blessing (Jobst and Kernbauer, 2016, p.136-138). This change in the statutes thus *de facto* "normalized" or "institutionalized" transgressions of the cover ratio. It defined publicly known rules which made free lending in a crisis possible – without requiring a regime change whose effectiveness would ultimately hinge on the public confidence in the currency.[234]

If the Austrian central bank gradually adopted free lending practices towards the end of 19$^{\text{th}}$ century, this very evolution begs an obvious question: in the absence of explicit liquidity regulation, how, if at all, did the Bank address moral hazard deriving from the presence of its fully institutionalized LLR role? The purpose of the present chapter is to answer this question.

Prior work on central bank practice and theoretical contributions suggest several mechanisms to mitigate moral hazard. Most of the previous contributions focused on ways to increase the (expected) cost of accessing the lender of last resort, either by requiring banks to pay a "penalty rate" (e.g. Crockett (1996)) or by introducing an element of uncertainty whether the LLR facility will be available in a crisis ("constructive ambiguity", e.g. Freixas (2000); Naqvi (2015)). This chapter explores a third mechanism: incentive systems. Ex-ante monitoring, combined with sanctions, can allow the central bank to prevent its counterparties from engaging in riskier behavior following the availability of last resort lending. Monitoring can also help the central bank to better dose LLR support when actually needed. In this chapter, I look at the lending framework of the Austro-Hungarian Bank (*Oesterreichisch-ungarische Bank* or OeUB) as operated around 1910. By then, the Austro-Hungarian Bank – following the Bank of England and other continental central banks after the 1860s – had phased out its earlier practice of credit rationing, thus paving the way for "Bagehot-type"[235] free lending. This regime change meant that the banking system could henceforth rely on the (explicit or implicit) promise of the central bank to provide liquidity in case of need. Hence, this regime shift also increased the risk of moral hazard.

I argue that the Austro-Hungarian Bank used a system of so called "credit limits" as an instrument to address moral hazard concerns. For every counterparty, the Bank set an individual maximum amount that the counterparty could borrow. *Prima facie*, the mere existence of credit limits might be interpreted as evidence that the earlier practice of credit rationing was still prevalent. The concept seems to fundamentally contradict the tenet of free lending. I show, however, that while credit limits were enforced during normal times, they were flexibly raised in the event of a well-understood exogenous liquidity shock. In this way, the Austro-Hungarian Bank abode by the principle of free lending while having a tool at hand to prevent the building up of excess risk in normal times. I thus argue that managing moral hazard deriving from the provision of LLR facilities

[234] Another key element of the transition to a fully-fledged LLR is the very focus of this chapter: the setting-up of a sophisticated counterparty risk framework with a credit limits system at its core; c.f. Section 3.3 below for the historical context of this change.

[235] Walter Bagehot (1873) advocated that central banks acting as LLR should lend freely, at high interest rates, and in return for good collateral. These principles are generally derived from various passages in Bagehot's major work, *Lombard Street*.

required an operationalization of credit limits as "contingent rules".

Preventing the build-up of excess risk in normal times requires two elements. First, the central bank has to be able to monitor risk taking. I document the sophisticated system put in place by the Austro-Hungarian Bank. This system included the compilation of hard information like balance sheets and profit and loss statements by local branch offices as well as soft information obtained through local discount committees, regular visits by inspectors and an elaborate book-keeping system that allowed clerks to extract information from the bills submitted to the central bank. Second, the central bank has to be able to sanction banks that take excessive risks. Here I argue that the power of the Austro-Hungarian Bank to do so stemmed from the possibility to lower or cancel the credit limits it had accorded to its counterparties. *Ceteris paribus*, banks had an interest in obtaining a high credit limit. During normal times a higher limit facilitated liquidity management as banks could hold (interest earning) eligible bills instead of (unremunerated) cash, whereas in the event of stress, a higher limit offered more breathing space before the central bank would have to be asked for an increase in the limit. In addition, I show that the central bank's willingness to increase the limit during a period of distress was conditional on a positive initial credit assessment. Even though the OeUB had no formal regulatory powers, the attractiveness of the central bank's discount window thus endowed the OeUB with some (informal) power to influence the banks' liquidity management by increasing or decreasing the banks' normal credit limit.

To the best of my knowledge, this chapter provides the first economic interpretation and empirical analysis of a central bank's credit limit framework. A number of recent contributions have looked at the structure and determinants of actual discount lending for several late 19^{th} central banks (see Section 3.2 below). Actual lending, however, is the outcome of both the central bank's willingness to lend (credit limit) and the counterparties' demand for borrowing. To understand the role of credit limits as a proto-regulatory tool, direct evidence on credit limits is needed. I give a detailed presentation of the credit limit framework based on internal manuals of the Bank. I collected a new dataset of more than 4000 individual assessments of credit limits made by the Austro-Hungarian Bank over the years 1909–1913 including both normal periods and the panic of 1912. Next, I combine these assessments with balance sheet data of financial institutions to uncover the relevant criteria in credit assessments. To understand the role of credit limits both in normal operations and during periods of crisis, I exploit both quantitative and qualitative evidence given in the minutes of the OeUB board of directors.

The present chapter is organized as follows. Section 3.2 places this contribution into the context of the conceptual and historical literature on the lender of last resort as well as the literature on central bank operations. Based on extensive archival evidence, Section 3.3 describes the information management and credit limit framework of the Austro-Hungarian Bank in detail. At the end of this section I formulate the hypotheses and requirements for my interpretation of credit limits as "contingent rules". I also draw on a simple theoretical framework to inform my empirical strategy. Section 3.4 summarizes my qualitative and quantitative data sources. Section 3.5 provides an empirical investigation of the determinants and operationalization of credit limits in normal times. I first look at descriptive statistics regarding the credit limit setting process. Second, I

run regressions of credit limits on bank fundamentals providing suggestive evidence that the Austro-Hungarian Bank effectively adjusted credit limits as a function of the leverage and liquidity situation of its counterparties. This behavior is consistent with a standard textbook theoretical framework on the design of incentive systems to deal with moral hazard. I also find that banks could exceed their limits temporarily in normal times as long as transgressions were reversed quickly. In Section 3.6 I look at the banking panic of 1912 to illustrate how the Bank handled credit limits during periods of financial stress. Bank officials perceived the crisis of 1912 as largely driven by exogenous non-financial factors because large deposit withdrawals were the direct consequence of a fear of an imminent war with Russia. As a result, the OeUB's directors increased credit limits rapidly and generously. Econometric evidence confirms that the (exogenous) liquidity shock induced the central bank to tolerate transgressions and increase limits. However, I show that while all banks survived the panic, banks considered as fundamentally weak and which were already in a bad shape before the panic, were treated differently: the latter were forced to raise capital, divest assets or change management - and they saw their credit limits substantially reduced after the panic abated. Section 3.7 concludes.

Overall, I argue that the OeUB's monitoring of leverage and liquidity indicators when setting credit limits in normal times, paired with the Bank's differential treatment of counterparties during periods of distress, served a well-defined purpose: these techniques were designed to limit the risk of moral hazard deriving from the Austro-Hungarian Bank's commitment to act as a LLR in the event of a crisis. To be sure, the present chapter does not assess whether this policy was effective in practice. To do so would require the development of a counterfactual scenario of banks' liquidity management in the absence of the LLR as well as some idea about the optimal precautionary amount of liquidity banks should hold. Both aspects are far from straightforward and outside the scope of this study but would be worthwhile to analyze in future research.

3.2 Related literature

There is a large number of measures central banks can take and historically have taken in reaction to financial crises.[236] As a result, the terms lender of last resort and emergency liquidity assistance are not always used consistently in the literature (Freixas et al., 1999). Bindseil (2009) classifies the broad concept of "central bank financial crisis management" into three categories. First, "equal access measures" are addressed to all counterparties the central bank normally operates with and include measures like aggregate liquidity injections or the widening of the collateral set. Equal access measures are usually connected to a central bank's standard policy framework, in particular its standing facilities. All eligible counterparties can obtain liquidity via these facilities as long as they fulfill the minimum borrowing standards – for example, a particular credit rating and sufficient collateral quality. At the very least, equal access measures require the central bank to maintain access to its standard lending facilities at pre-crisis standards during periods of distress. Walter Bagehot's classic

[236] In this literature review, my main aim is to set the scene for this chapter, i.e. to provide an introduction to and overview of moral hazard in the LLR literature. For an explanation of the general rationale for a LLR, c.f. Chapter II of this dissertation; alternatively, c.f. Gorton (2012) and Gorton and Metrick (2013).

account of LLR practice mostly referred to the standard framework of the Bank of England. He argued that the key rule for the Bank of England was to continue free lending against collateral considered eligible before the crisis, i.e., in short, to keep standard operating procedures in place (Bagehot, 1873).

Second, "individual access measures" are addressed to banks that are no longer eligible for help in standard equal access operations. For example, the European Central Bank's emergency liquidity assistance (ELA) programme represents a possibility to channel liquidity support that is conceptually outside of the Eurosystem's normal monetary policy operations. The Federal Reserve's bridge loan to Bear Stearns in 2008 could be considered an example of individual liquidity assistance that facilitated the ailing securities firm's acquisition by JPMorgan Chase. Third, the central bank can organize a collective help effort by financial institutions that would be hurt most by the illiquidity or insolvency of the institution under stress. In the literature, such measures are often referred to as "life-boat operations". Life-boat operations might be used by authorities looking to gain time to allow for an orderly resolution of the bank in trouble. Alternatively, they might also serve the institution concerned to bridge a temporary period of severe distress and reorganize its business (plan) in a way to reassure long-term viability. Historical examples of life-boat operations include the rescue of the Austrian *Bodencreditanstalt* in 1873[237], the attempt to stabilize the French *Comptoir d'Escompte* in 1889 and the Baring crisis of 1890 (Pressburger, 1962; Hautcoeur et al., 2014; Ugolini, 2014; White, 2016). More recently, the so-called "secondary banking crisis" of 1973 led the Bank of England to coordinate several life-boat operations (Bank of England Quarterly Bulletin, 1978).

In this chapter, I focus on lending of last resort via equal access measures. Consequently, I refer to lending of last resort to describe the actions of a central bank which functions as an elastic source of liquidity for the benefit of all financial intermediaries in the system during a liquidity crisis, when regular funding markets seize to function. In my empirical analysis of the operations of the Austro-Hungarian Bank I will mainly focus on the LLR content of the standard operating framework that provides equal access to counterparties (c.f. Section 3.3 below). When discussing the Bank's policy during the crisis of 1912, I will also discuss a number of decisions on individual institutions, which, however, were part of the broader rules-based lending framework (c.f. Section 3.6).

Although there are many aspects of LLR lending that would merit attention in a literature review, here I focus on techniques employed to limit moral hazard problems conventionally associated with the development of LLR functions. I chose this focus because it is most relevant for my interpretation of the OeUB's operational framework, and the individual credit limits it accorded to counterparties in particular. As will become clear below, I believe that the question of how moral hazard was tackled historically is inextricably linked to central bank risk management and supervision of counterparties by the LLR. Similar to the term LLR itself, the idea of moral hazard is omnipresent in the literature on central bank policy responses to financial crises, and yet, it is not always clear what exactly authors have in mind when evoking this concept. In this chapter, I follow

[237] As mentioned in Chapter II of this dissertation, this rescue operation forms the object of my ongoing research.

Freixas et al. (1999) in defining moral hazard broadly, as a negative externality triggered by the creation of an insurance mechanism which in turn impacts the behavior of rational agents. The existence of a LLR creates an insurance mechanism against liquidity shocks. Insurance in turn triggers a decline in the incentives for counterparties eligible for LLR support to take preventative actions mitigating the risk they are being insured against. Following the creation of insurance, the probability that a liquidity crisis occurs might therefore increase because financial institutions have an incentive to exchange costly cash reserves[238] for interest-bearing but central bank-eligible assets.

Carlson et al. (2015) recently argued that insurance against exogenous, aggregate liquidity shocks, which are independent of banks' financial situation, do not trigger moral hazard concerns. I tend to agree with this statement. By definition, exogenous shocks cannot be anticipated and do not result from behavioral incentives related to the existence of an insurance mechanism. Examples of exogenous liquidity shocks are abundant. Historically, such shocks were triggered by events as diverse as fruit-fly infestations (Carlson et al., 2011), grape phylloxera (Bignon and Jobst, 2017) or war threats (c.f. Section 3.6 below). Yet, if the LLR takes the form of an equal access standing facility which continues to accommodate market demand during crises as long as collateral requirements are met, then moral hazard still results from the incentives the availability of the standing facility generates in normal times. Moral hazard in the LLR context arises from the expectation of individual emergency liquidity assistance. If individual institutions can always count on a liquidity backstop by the LLR, central bank liquidity provision is likely to be rife with moral hazard even if it was designed to respond to aggregate liquidity shocks. Moral hazard would manifest itself as a decline in the standard and extent of liquidity risk management of individual banks in normal times, in response to an expected insurance against idiosyncratic liquidity pressures via the standing facility.[239]

Prima facie, my interpretation of moral hazard in the LLR context excludes default risk considerations. One might argue that the creation of a credible LLR is unrelated to incentives for counterparties to lower credit risk management standards or to default more often on central bank loans. Certainly, capital injections and, more generally, bailouts as well as too-big-to fail considerations could have effects on the default risk and the quality of credit risk management as implemented by counterparties. Equal access measures, in contrast, should be mainly linked to liquidity risk. The creation of liquidity insurance is likely to decrease eligible counterparties' reliance on liquid reserves, but there seems to be no *a priori* reason why it should lead to lower credit risk management standards.

This study does acknowledge, however, that there might be occasions on which individual emergency liquidity support cannot be meaningfully separated from a bail-out. It is difficult to distinguish solvency problems from liquidity distress, especially when the LLR is very time-constrained as during a crisis (Goodhart, 1999). Furthermore, there are situations in which illiquidity may trigger insolvency, and vice versa (Morris and Shin,

[238] Cash reserves are costly because they bear an opportunity cost: vault cash could be invested in interest-bearing assets.

[239] While it has proven difficult to identify moral hazard effects empirically, there is evidence suggesting that the creation of LLRs reduces liquidity risk experienced by eligible counterparties, c.f. Bernstein et al. (2010).

2016). Hence, moral hazard related to credit risk management might also arise from the creation of liquidity insurance if eligible counterparties correctly anticipate the central bank's difficulty to differentiate between these two sources of financial distress.

Since implicit or explicit liquidity insurance can lead to a decline in the quality of liquidity risk management, and possibly also lower credit risk management standards, there is a clear rationale for policies addressing the negative externalities of LLR creation. Indeed, historically, central banks have tried to counteract moral hazard in several ways. The recommendation by Bagehot (1873) to use "high rates" in LLR operations is often interpreted as an attempt to provide an incentive for banks to engage in proper liquidity risk management in normal times (Crockett, 1996).[240] Making liquidity during crises very costly could force banks to reconsider proper liquidity management in normal times. This rationalization, however, has been challenged along several lines, in particular because high interest rates might just encourage failing institutions to gamble for survival (Stiglitz and Weiss, 1981). Besides triggering adverse selection problems, "penalty rates" have been associated with aggravating affected banks' difficulties and sending negative signals to the market, thereby further worsening already existing liquidity strains (Freixas et al., 1999).[241] Another concept frequently associated with the control of moral hazard is "constructive ambiguity". According to this idea, the central bank should not pre-commit to intervening as a LLR to incentivize market participants to engage in proper risk management (Freixas, 2000). In addition to the fact that Bagehot (1873) himself argued in favor of full, pre-announced transparency with regard to Bank policy in crisis situations, "constructive ambiguity" also suffers from an inherent time-inconsistency problem. Although it might seem beneficial to deny willingness to provide a liquidity safety net *ex ante*, the central bank is nevertheless likely to find it optimal to intervene *ex post*.[242] Time-inconsistency might arise from political pressures to intervene but it might also be motivated by self-interest if the central bank is heavily exposed to the financial system.[243] Most importantly, however, introducing an element of ambiguity with regard to the availability of LLR obviates its original rationale: if LLR cannot be counted on, panics are unlikely to be preempted.[244] Other tools employed to limit moral hazard, in particular related to credit risk, include the use of public-private partnership structures, in which the central bank takes on a coordination and refinancing role but requires banks to provide an equity fund to absorb potential losses and/or pledge mutual liability (Freixas et al., 2000). Chapter II of this dissertation explores the effectiveness of such an unconventional LLR mechanism in mitigating bank distress during the Austro-Hungarian crisis of 1873.

More recently, however, the bulk of the literature stressed the importance of supervision and monitoring to reign in moral hazard induced by LLR operations. To understand this argument, some historical background

[240] See Castiglionesi and Wagner (2012) for an extensive critique of this view.

[241] A classical account and rationalization of high or "penalty" rates can be found in Humphrey and Keleher (1984). For modern interpretations of "high rates", c.f. Martin (2009) and Bignon et al. (2012).

[242] For the classical reference for time-inconsistency in economic policy-making, c.f. Kydland and Prescott (1977).

[243] Self-interested motives for time inconsistent behavior might have been particularly prevalent in the past when central banks still functioned as private institutions answerable to their shareholders. Evidence on this front is mixed, c.f. Bartels et al. (2016) and Calomiris et al. (2016).

[244] For example, one of the major motivations for establishing the Federal Reserve in 1913 was to create a source of elastic currency to preempt and mitigate banking panics. Yet, the "stigma" attached to the discount window and ambiguous policy stances meant that banking panics during the Great Depression were widespread and difficult to contain. c.f. Gorton and Metrick (2013).

on the development of the LLR function is necessary. The conventional story links the transformation of the Bank of England into the first modern central bank, including the adoption of lender of last resort policies, to the development of an anonymous dealing with its day-to-day counterparties on the London money market. Capie (2002, p.310) famously describes the Bank's discount window as "made of frosted glass and raised just a few inches". According to this view, the operation of the Bank's prime standing facility did not require knowledge of who was on the other side of the window; only the quality of the bills submitted for discount was of interest for the central bank (Goodhart, 1988; Capie, 2002). Lending exclusively against good collateral may have also partly done away with the moral hazard problem. Pushed to the extreme, this doctrine could mean that banks without good collateral assets would have simply not received any liquidity support, regardless of their financial situation. From this perspective, changes in the incentive structure for proper liquidity and credit risk management are really only of secondary importance, as long as collateral management is appropriate.

In several seminal contributions, Flandreau and Ugolini (2013, 2014) challenge this conventional account. They show that the Bank's counterparties were really part of an exclusive club, the membership of which was subject to a number of conditions. Any new discounter had to be introduced by a reputable agent well known to the Bank (often a Bank director or an eminent merchant bank); moreover, the Bank took out guarantees on discounters' assets, and requested its counterparties to make deposits. Flandreau and Ugolini (2013) argue that the identity of counterparties was crucial for lending via the discount window. The very nature of bills of exchange meant that the names of acceptors and discounters were written on the bill submitted, thus providing the Bank with instantaneous information on whom it was transacting with. Although the authors suggest that the customers' character might not have been equally paramount for the Bank's lombard facility (the 19$^{\text{th}}$ century pendant of modern collateralized lending facilities), they hypothesize that the haircuts applied for these "advances" could have well been customized too.

By the mid-19$^{\text{th}}$ century, the Bank of England had put in place an extensive bookkeeping and monitoring system which recorded every single discount transaction in a twofold manner (Anson et al., 2017). Discounters usually submitted bills in so called "parcels" containing several bills at once. Every day, these parcels or "packets" were first recorded in the "daily discount ledger" for each discounter and regardless of whether the discount was eventually granted or refused. Subsequently, the parcels were unpacked into individual bills in the separate "customer with and upon ledgers" where they were classified under the name of their discounter and acceptor alongside with several other characteristics (place of origin, maturity, amount etc.). Together, these ledgers enabled the Bank to monitor its exposure towards individual acceptors and discounters. The records should have also enabled the Bank to monitor whether certain market participants overextended credit, although this "market monitoring" was of course only possible to the extent that the bills drawn effectively ended up with Bank.

Flandreau and Ugolini (2013) suggest that the Bank made use of its bookkeeping system within a wider a cascade of monitoring and screening layers to check the potential rise of moral hazard implications resulting

from the Bank's discount window operations. The submitted bills' acceptors were monitored by the discounters and the Bank in turn kept an eye on both discounters and acceptors by drawing on the information recorded in its ledgers. According to the authors, enforcement of this cascade worked because counterparties feared exclusion from the club of discounters. Remaining in the club was a valuable asset because the Bank of England had the effective crisis lending monopoly as the only institution not affected by runs in a system-wide liquidity crisis[245]. In other words, Flandreau and Ugolini (2013, p.151) argue "the Bank did limit moral hazard exactly by not lending anonymously". Recently, Avaro and Bignon (2017) provided empirical evidence for the operation of similar mechanisms in the context of the Banque de France. They show that the actual level of discounts accorded to specific counterparties was correlated with several financial characteristics proxying for the counterparties' risk taking behavior. However, actual lending is the result of both demand for and supply of central bank liquidity. Hence, it is difficult to determine to what extent these results are driven by the Banque de France's system of counterparty risk management, rather than a self-selection of counterparties demanding loans via the discount window.[246]

This study concurs with recent work in the belief that moral hazard in the LLR context is a structural problem which cannot be easily dealt with on the spot by drawing on one-off measures such as penalty rates. Moral hazard should, on the contrary, be addressed through a wider supervisory system that is in operation inter-temporally, during both normal and crisis times. Thus, I build my argument on the contribution by Flandreau and Ugolini (2013). However, I argue that it remains to be explained how the focus on counterparty risk management contributed to counteract incentives to neglect proper liquidity and credit risk management in practice. As explained above, these negative incentives are, at least as defined in this study, the main moral hazard implication of LLR policies. The forms of supervision described by Flandreau and Ugolini (2013) were certainly paramount in keeping the Bank of England's exposure and credit risk low at all times, even during and in the aftermath of crisis; but it remains to be explicated how they address the problem of moral hazard, i.e. laxer liquidity (and credit) risk controls displayed by counterparties benefiting from access to LLR.

The main contention of this study is to argue that establishing this connection requires moving another crucial aspect of 19$^{\text{th}}$ century central bank's operational framework into the spotlight. The missing link to understanding how moral hazard was tackled in mid-19$^{\text{th}}$ century LLR operations may be found in an in-depth discussion of so-called individual "credit limits". Central banks on either side of the Channel routinely administered such credit limits for all their eligible counterparties.[247] So far, the literature has rationalized the existence of these credit limits as a device to preempt discriminatory treatment of some borrowers and limit favoritism during crises (Calomiris et al., 2016). Credit limits set up during normal times are considered

[245]This argument needs to be qualified in the sense that runs on the Bank could occur in the form of heavy withdrawals of gold reserves in case the public lost confidence in the value-storing capacity of Sterling. Also, the Bank could run into difficulties when expanding its lending in a way that risked violating the reserve requirements stipulated in the Bank charter (Peel's Act). In practice, the reserve requirement was usually suspended during crises to avoid hampering the Bank in its liquidity provision operations.

[246]As will become clear below, I address this problem by focusing on a dependent variable largely determined on the supply-side: credit limits.

[247]Similar evidence is available for Japan, although the literature here points to the existence of binary central bank access rights (i.e. receiving a transaction account) rather than continuous credit limits, c.f. Okazaki (2007).

to have functioned as a disciplining constraint for the central bank, ascertaining "inter-temporal bureaucratic consistency" (Calomiris et al., 2016, p.53). In the case of the Bank of England, these limits were defined for each eligible counterparty in the so-called "rating books". Calomiris et al. (2016) argue that the credit limits functioned as the basis for "risk assessments on which lending during crises would be based". In line with Flandreau and Ugolini (2013), Calomiris et al. (2016, p.54) also suggest that the Bank "would have doubtless stopped lending had any of its limits (to individual discounters or acceptors) been reached" during periods of distress.

In this study, I offer another, possibly complementary, interpretation of the individual credit limit system entertained by central banks during the 19^{th} century. Based on new, unique archival evidence documenting the Austro-Hungarian Bank's use and management of credit limits, the present chapter suggests that these ceilings worked as an early form of liquidity and capital regulation imposed on central bank counterparties in normal times. Individual credit limits and their constant updates functioned as a mechanism to contain moral hazard that would have otherwise derived from the (expectation of) idiosyncratic liquidity assistance.

This interpretation mirrors recent arguments put forth by Carlson et al. (2015). The authors suggest that LLR policies on the one hand, and liquidity and capital regulation on the other hand, are best seen as complementary. LLR policies are best equipped to deal with aggregate liquidity shocks which arise exogenously and therefore do not entail moral hazard. Liquidity and capital regulation, in contrast, are best thought of as mechanisms that preempt the necessity of individual liquidity assistance, which, as discussed above, can be problematic from a moral hazard perspective. Even if idiosyncratic liquidity strains cannot be completely forestalled, regulatory liquidity and equity buffers are useful because they allow buying time: the affected counterparty remains in a position to continue payments for some time while the LLR, jointly with other competent authorities, can decide whether individual liquidity assistance is warranted or whether resolution represents the better approach. Importantly, Carlson et al. (2015) suggest that the LLR, rather than the regulatory buffers, should be the first line of defense in the event of an aggregate liquidity shock. On these occasions, the LLR should be lending freely against good collateral. I observe this behavior in Austria-Hungary: instead of rationing credit when individual limits were reached in aggregate liquidity crises, the Austro-Hungarian Bank temporarily suspended them. In normal times, however, whenever counterparties seemed to amass too much leverage, or started to cut back on their reserves of liquid assets, suffered from equity losses or engaged in improper management practices, the Bank reacted promptly by reducing discounters' credit limits or erasing them completely.

This dichotomy, between crises on the one hand and normal times on the other hand, in the Bank's attitude towards credit limit transgressions is key to the interpretation of the credit limits framework proposed in this chapter. Had the OeUB effectively stopped lending during panics when the limits were reached as suggested by Calomiris et al. (2016), one would have little reason to believe that credit limits served any other purpose than the Bank's own counterparty risk management. Given that the Bank actually lifted the limits in the presence of

aggregate liquidity shocks, however, one may interpret the credit limits framework as "contingent rules" which were only enforced during normal times. As I will discuss in more detail in the next section, a second aspect in favor of this interpretation is that obtaining a credit limit did not exempt counterparties from abiding by the strict rules for collateral acceptable at the discount window.[248] The granting of a certain quantitative credit limit did not mean the counterparty could simply discount any paper it wanted as long as it did not transgress this limit. While the precise screening of the quality of bills submitted to the discount window limited limited with counterparty risk, credit limits served another purpose.

The Bank used individual credit limits to steer the liquidity and capital buffers of its counterparties. The credit limit system was designed to preempt the necessity of individual liquidity assistance and thereby curtailed the build-up of moral hazard in normal times. Outside panic windows, counterparties could rightfully claim the share of central bank refinancing which corresponded to their financial and reputational characteristics, according to the Bank's assessment[249] Overall, based on my evidence, I argue that credit limits served as tools for the central bank to enforce proto-regulation in liquidity and capital matters. Far from conflicting with the idea of free lending in aggregate liquidity crises, credit limits were flexibilized in response to these shocks. At the same time, they minimized moral hazard deriving from the possibility of individual recourse to the discount window outside systemic crisis windows.

I will provide detailed evidence for this interpretation of the credit limit system maintained by the OeUB in the following sections. In Section 3.3, I marshal qualitative descriptive evidence to explain how the system was operated in practice. In Section 3.5, I discuss the characteristics of the system in normal times on the basis of descriptive statistics. Using more formal econometric analysis, I also investigate the determinants of credit limits at the counterparty-level. In Section 3.5.4, I document how the Bank dealt with credit limit transgressions in normal times. 3.6 shows how the OeUB handled credit limits in the presence of liquidity shocks.

3.3 Individual credit limits at the Austro-Hungarian Bank

3.3.1 Business organization of the Austro-Hungarian Bank

The Austrian National Bank (*Oesterreichische Nationalbank*) was established in 1816 as a privately owned stock company and enjoyed the note-issuing monopoly for the entire territory of the Austro-Hungarian Monarchy. To reflect the bi-national structure of the Empire, the Bank was renamed Austro-Hungarian Bank (*Oesterreichisch-ungarische Bank, Osztrák-magyar bank*) in 1878 and received two head offices (*Hauptanstalten*) in Vienna and Budapest, headed by two directorates (*Direktionen*). The directorates were composed of

[248] Interestingly, there were no credit limits for the lombard facility. In Section 3.3 below I provide an attempt to explain this omission.

[249] This chapter does acknowledge that the assessments might have been biased in favor of certain discounters. At this stage, I have not yet formally tested whether some forms of bias based on firms' relationship with the Bank or status, nobility etc. played a role in the determination of credit limits – but I am in possession of the necessary data and plan to do so in the future.

Austrian and Hungarian nationals respectively and were responsible for establishing the size and allocation of central bank credit at the level of the branch offices situated in the Austrian and the Hungarian half of the monarchy respectively.[250] The key decision powers, however, resided with the Governing Council, placed at the central level and above the two directorates. The General Council was composed of the governor, the two chairmen of the Vienna and Budapest directorates acting as vice governors, and additional members from each of the two directorates as well as members elected directly by the shareholder assembly. The responsibilities of the General Council comprised notably the setting of the policy interest rates, the definition of terms and conditions in central bank operations, the management of the bank's reserve assets and the establishment of branch offices (Jobst and Kernbauer, 2016, p.119–120). To understand the Bank's lending policy thus requires looking at both the central level, responsible for the overarching guidelines and the level of the two directorates, where the actual lending decisions were taken.

The two directorates had the exclusive right to determine the amounts of discounts granted in each half of the Empire. For this purpose they decided upon the credit limits up to which individual firms and private persons could access the discount window (c.f. below). Directorates also conducted high-level monitoring of the use of credit by each counterparty and, more generally, kept an eye on the liquidity situation and demand for credit in the different Austro-Hungarian regions. Finally, the directorates were also responsible for appointing the so-called discount censors (*Zensoren*) for each of the Bank's branches. Censors were usually chosen among highly reputable individuals from the local business community. The Bank did not pay censors for their services but the latter could simultaneously exercise a remunerated position in a local firm: even a managing position in a local commercial bank was no exclusion criterion[251]. By 1900, the Bank entertained an extensive network of branches distributed over the entire territory of the Empire (Jobst, 2010) and the number of censors varied from branch to branch.

The entirety of censors appointed to one branch formed the so called local college of censors (*Zensorenkollegium*). Besides its function as a local advisory body for the branch management body (composed of Bank clerks), the college, which was headed by the managing director of the branch, had the task to review the individual credit limits of all counterparties that were Bank customers at the respective branch location. The suggested alterations were subsequently submitted to the responsible directorate for approval (Jobst, 2010, p.126-127). The so-called committee of censors (also discount committee, *Zensurkomitee*) was composed of only a few members of the local college (usually three) who participated in the committee on a rotating basis. These committees, again led by the head of the branch office, were effectively responsible for screening, accepting or rejecting the individual bills submitted to the respective Bank location. The granting of a discount loan needed a simple majority of votes; in case of a tie, the head of the branch, who possessed a general veto (*Superzensur*), had the final word. Discount committee members also reviewed the decisions regarding bills submitted to those

[250]Note that "nationality" here refers to citizenship of the Austrian and the Hungarian part of the monarchy. The dualistic nature of the bank reflected the constitutional structure of Austria-Hungary, not national affiliations. Both parts of the Empire were themselves multinational states.

[251]Censors could not, however, vote on bills submitted by their own firm.

contract offices (so-called OeUB affiliates) which did not harbor their own committee and were subordinated to the respective branch. Contract offices were commercial banks or firms that operated a discount facility on behalf of the Bank in places where no branch was located.[252]

3.3.2 The Bank's standing facilities

Financial institutions in Austria-Hungary could obtain central bank funding through two lending facilities, a discount and a lombard (advances) facility. Both types of operations were organized as standing facilities, where the central bank defined the general lending conditions (most importantly what constituted eligible assets and the setting of the interest rate), while actual operations were initiated by the central bank's counterparties, not the central bank itself. Lending conditions were made public.[253] By design, standing facilities can accommodate sudden increases in liquidity demand without requiring the central bank to take any explicit measure. Whether the standing facilities can actually fulfill this role depends crucially on the central bank not restricting access to the standing facility during a crisis.[254] Restrictions were possible in principle as the Bank's statutes and regulations explicitly allowed it to refuse the granting of an advance or the discounting of a paper without giving reasons.

In an advance, the Austro-Hungarian Bank granted a loan against some pledged collateral, typically securities, at a set interest rate, the so-called lombard rate.[255] The lombard rate was set typically at 1 percentage point above the discount rate. Government bonds benefited from a preferential rate set at a half percentage point below the standard lombard rate. Conditions in lombard lending were straightforward. Loans had a maximum maturity of three months. The maximum amount of the loan was calculated as the market price of the pledged securities minus a haircut. If during the term of the operation the price of the pledged securities dropped below a specified threshold, the borrower had to provide additional collateral or else repay the loan. As a result and to protect themselves against margin calls loans were typically overcollateralized, i.e. counterparties deposited securities with a higher total market value than required to secure their outstanding loans.[256] In 1912 the list of eligible securities included government and subsovereign bonds, covered bonds secured by mortgages and municipal loans as well as bonds and shares of selected railroads and shipping companies. Haircuts were set at relatively high levels compared to today, mostly at 25% or 30% of market value. The decision to admit a security to the lombard facility and the setting of the hair-cut was taken by the Governing Council. It seems, however, that inclusion in the list was almost automatic around 1900[257], as soon as the security obtained a

[252] While the first contract offices set up in 1878 were endowed with discount committees, the Bank soon changed course and had the committee of the responsible branch office take responsibility. The reasons were probably the desire to keep the deliberations of the committees under the supervision of a Bank official as well as the relatively low volumes discounted through the intermediation of contract offices. In fact, contract offices primarily served to cash bills submitted for discount in Vienna, Budapest or some branch office (Jobst, 2010, p.129-130).

[253] See e.g. the detailed explanations published in the financial yearbook *Compass*, which were based on official information from the Austro-Hungarian Bank.

[254] In addition, the facility has to be free of "stigma", meaning that counterparties feel it is safe to access the facility if they need to without incurring huge reputational costs.

[255] Advances could also be granted against eligible bills and gold.

[256] The Austro-Hungarian Bank also provided securities depository services.

[257] This automatic inclusion differs from earlier OeUB practice, e.g. during the crisis of 1873, when eligible collateral was still very

stock exchange listing. As a result the universe of eligible securities included almost all fixed-income securities quoted in the Austrian stock market. The Bank regularly published a list of eligible securities and haircuts as well as any changes therein.

In discount operations, the Bank bought a bill of exchange with a short initial or remaining maturity at a discount to its nominal value (the discount rate). Unlike in secured contracts, where in the case of nonpayment the Bank could resort to selling the posted collateral, the reimbursement of a bill depended solely on the ability of the Bank's counterparties to honor their contracts at maturity. However, the safety of the bill was supported by the specific legal provision of joint liability (Santarosa, 2015). Joint liability stipulated that every owner who resold a given bill (e.g. by using it to pay for a debt or by selling it to a bank) had to endorse it by adding his/her signature to the bill. Endorsement served as an acknowledgment of liability: if the original debtor on whom the bill was initially drawn were to default, the endorsers were still liable for payment to the ultimate purchase/owner at the bill's maturity. Joint liability thus significantly increased the safety of the bill for the final discounter, in this case the Austro-Hungarian Bank.

In contrast to advances, the discounting of bills essentially amounted to granting unsecured loans which required the Bank to operate a risk control framework. The first pillar of the Bank's risk control system in discount operations was to screen the bills submitted with regard to certain minimum standards. The discount committees in each branch examined and checked the individual bills presented for discounting against formal criteria and decided on the admission on a case-by-case basis. First, there was a minimum number of endorsers that needed to be met. As a rule a bill had to be signed by three, but in any case by at least by two, persons known to be solvent.[258]

The second main objective was to understand the transaction underlying the bill of exchange. Apart from its formal correctness, one important aspect was the time to payment (maturity) of the submitted bill. Although the maximum maturity for bills to be eligible was 90 days, the Bank had a strong preference for shorter maturities, in particular because the central bank itself wanted to keep liquid reserves at high levels after it had more formally started to adhere to the Gold Standard in the late 1890s. The Bank's preference for liquid bills also explains why certain types of paper, in particular so called accommodation or finance bills (*Geldbeschaffungswechsel* or *Finanzwechsel*), were less welcome at the discount window. Given the guarantees of at least three involved parties, these bills did not bear a higher credit risk per se.[259] However, they tended to show higher maturities and higher amounts while not being based on an underlying real transaction (e.g. the sale of goods) that would generate an automatic cash flow at maturity. The probability that an accommodation bill needed to be rolled over at maturity was thus much higher than in the case of a trade acceptance. The importance the Bank attached to the detailed screening procedure of bills is reflected in the regular assessment

narrowly defined; c.f. Chapter II of this dissertation.

[258] See Article 60 of the Bank's statutes from 1878, 1887, 1899 and 1911.

[259] In fact, any three counterparties could in principle create bills at will by simply drawing on each other and endorsing each other's bills. These circular bills were known as *Reitwechsel*, alluding to the idea that counterparties were "riding" on each other's credit standing. These circular constructions were particularly frowned upon: contemporaries interpreted them as a negative signal about the quality of counterparties involved, which were seemingly unable to borrow outside their narrow circle of business partners.

of branch managements by inspectors from the central headquarters who reported back their evaluations to the head offices in Vienna and Budapest.

The second pillar of risk control concerned the evaluation of the quality of the endorsers on the bill presented for discount. Here, the operational framework had to strike a balance between leaving the necessary discretion to the local bank officers while keeping the overall risk under control. Accordingly, the bank drew up lists of persons and companies who were deemed eligible for discounts and defined a maximum amount up to which the counterparty could access the Bank's discount window.[260][261] The OeUB monitored its direct and indirect exposures to discounters and acceptors relative to these maximum amounts which were known to Bank staff as credit limits. To explain how how this second pillar of risk control worked in detail and practice, I dedicate the next subsection to an in-depth description.

Before diving into the operational details of credit limits, however, a more general observation should be emphasized. The system of credit limits was only applied to the discount facility of the Bank. To the best of my knowledge, the Bank did not monitor its lombard (advances) exposures in a way that comes anywhere close to the sophistication of the provisions for discounts. I argue that this stark contrast may derive from the fundamentally different nature of the collateral[262] submitted to the two standing facilities. The safety of lombard loans boils down to the characteristics of the assets used as collateral. For literally all securities admitted to the Bank's pool of lombard eligible assets, these characteristics were directly observable and widely known. All eligible collateral assets were traded on the stock exchanges in Vienna, Budapest or Prague and contemporary financial yearbooks provided extensive information on these securities.[263] Undoubtedly, the Bank may have topped up this publicly available data with additional private information. In the case of lombard loans, maintaining the *known* quality of the pool of eligible assets, in combination with fairly hefty haircuts, may have been sufficient to minimize the repercussions of counterparty default.[264]

On the face of it, this focus on collateral quality should also apply to the discounting of bills. There is, however, a crucial difference in the way the quality of collateral is observed at the discount window. While information on the quality of eligible collateral was widely known in the context of advances, for the bills market this information had to be generated by the central bank. The latter had to determine the quality of the signatures that backed each individual bill by monitoring the parties involved in the underlying transaction (discounter and acceptors). It is for this purpose, that the Bank established lists of counterparties authorized to discount and accept bills, including their credit history as well as other relevant behavioral and financial

[260]Discounting was, however, extended even beyond this large group of counterparties with individual limits as any potential borrower could apply for discount loans on a case-by-case basis (*Zensurkredit*).

[261]While in principle a large number of counterparties enjoyed access to central bank refinancing, financial institutions *de facto* accounted for an overwhelming share in Austria, c.f. Figures 3.35 and 3.36 in Section 3.5 below. In Hungary, the milling industry played an important role, but financial institutions seem to have dominated discounting there as well (Kövér and Pogány, 2002, p.185).

[262]To be precise, discounts technically constitute an outright purchase/sale rather than a collateralized loan.

[263]The *Compass - Finanzielles Jahrbuch* is probably the most comprehensive source for this type of security-level data and can be consulted for every year since 1868.

[264]Fire-sale conditions that depress asset prices in the market might constitute an exception to this observation. Central banks, however, are also exceptionally well placed to engage in hold-out tactics in such conditions as they are not, in theory, subject to liquidity pressures.

characteristics. What is more, the Bank did not only generate information on the quality of the bills by screening the names on the bills; as I will explain below, the individual credit limits for discounts also endowed the Bank with the ability to influence this very quality.

3.3.3 Individual credit limits

The following description of the OeUB's credit limits system is based on unique archival material from the central bank archives. In particular, I draw on an extensive manual the Bank had compiled to inform its clerks on the expected conduct of business. The manual contains detailed information on the day-to-day operation of all of the Bank's business areas. Since my focus is on the credit limits framework, I am interested in the manual's sections relevant to the OeUB's discount business. I elaborate on my sources in Section 3.4 below.

To place the following description in its historical context, it is worthwhile noting that the credit limits system did not feature in the OeUB's risk control framework when the Bank was founded in 1816. Credit limits were only systematically introduced in 1878 when the OeNB officially became the Austro-Hungarian Bank. Before 1878, the Bank seems to have collected information on its counterparties in a much less systematic way, although Leonhardt (1886, p.24) suggests that the Bank had established credit limits in some places already earlier in the 1870s. This important institutional change in the credit risk management framework of the OeUB had three main reasons. First, centralized control over the lending activities at the Bank's branches had proven problematic over the last decade. In his semi-official account of the Bank's policy between 1862 and 1876, the Bank's secretary general Lucam (1876, p.44-45) openly complained that the decision of the colleges of censors had been difficult to influence and that the quality of bills discounted was not uniform across locations. Given that the renewal of its note issuing privilege in 1878 required the Bank to open a series of new branches in the entire Empire, the renegotiation of the Bank's charter with the two governments in Austria and Hungary provided a fitting occasion to revamp the lending standards.

Second, while before 1878 the local colleges of censors had the sole power to decide upon the acceptance or rejection of a bill at the discount window, after 1878, the branch directors, who were official Bank clerks, obtained both the presidency over the colleges and a veto right (Leonhardt, 1886, p.23-24). In order to guarantee that branch directors would not behave arbitrarily but instead followed harmonized rules in their considerations, an overarching framework valid in all parts of the Empire was necessary.[265] Finally, the Austro-Hungarian Bank also had to fulfill the delicate mission of providing fair and equal access to central bank services for all firms and nationalities present in the Empire. Rightly or wrongly, the Bank had often been accused of discriminating against particular nationalities or ethnic minorities. Officially renamed the Austro-Hungarian Bank in 1878, the Bank faced even more explicit pressure to address this issue and took the opportunity to create a framework that would hopefully allow forestalling complaints about discriminatory treatment in the future. Hence, the

[265]Note that this rationale for the introduction of the credit limits system is close to the argument in Calomiris et al. (2016) discussed in Section 3.2 above.

OeUB also set up the credit limits system in order to establish an objective basis for its credit transactions with each and every counterparty, no matter where the latter was located.

General framework: setting credit limits

Before presenting the individual bills for their evaluation to the discount committee, the head of the branch checked the paper against the formal criteria (number of signatures and maximum maturity), prepared information on the credit history of the counterparties with the Bank and verified whether the signatures on the bill pertained to persons or firms excluded from the discount window (e.g. due to improper management practices). Crucially, the head of the committee also had to check the total current liabilities of signatories with the central bank, as recorded in the Bank's/branch office's credit ledges, against the individual credit limit assigned to the parties involved. These credit limits figured in the so-called credit list (*Kreditliste*) of the Bank, which centralized the relevant information obtained from all branch offices. The numbers involved were significant. In 1895, the last year for which such summary information was published, the Bank had assessed and fixed individual credit limits for more than 152,000 counterparties (Mecenseffý, 1896, tables 11–12).

The individual credit limits for each counterparty represented the basis for most discount transactions of the Bank[266]. The limits (in the Bank jargon, so called *Personalkredite*) determined the maximum amount up to which the firms and persons located in the different bank districts (corresponding to the branch offices) were allowed to tap into the discount facility of the Bank. More precisely, the credit limits put a ceiling on the Bank's exposure vis-à-vis the counterparty on any single day. The limits did not represent the average or the sum of central bank credit available over a certain period of time; rather they had to be checked against the running exposure of the Bank to the counterparty in question, as determined by the sum of discounted bills still outstanding[267] at the end of a given day minus the amount pending on previously discounted bills maturing during this day. It is important to note that the credit limit of any given counterparty functioned as a ceiling for the sum of both, the total amount the counterparty directly discounted "with" the Bank and the total amount of bills discounted "upon" the counterparty, due to its signature figuring on a bill submitted by a third counterparty to the Bank.

Hence, transgressions of limits could happen due to one of two reasons (or both simultaneously): heavy active recourse to the discount window by the counterparty itself and/or the discounting by a third party of paper the counterparty had accepted.[268] In addition to the *Personalkredite*, the directorate also determined a second list containing the names of firms which did not receive proper individual credit limits, but possessed

[266]The credit limits did not regulate so called *Zensurkredite* briefly mentioned above. For more information on *Zensurkredite*, c.f. also below.

[267]This sum included the bills previously discounted that had not yet matured and bills discounted on the current day.

[268]In this context, it should be mentioned that the discounting, by a third party, of paper accepted by the counterparty in question did not necessarily have to take place in the same bank district but could also occur at another branch office. To keep track of developments elsewhere, branch offices were in close contact with each other. The Bank jargon distinguishes here between *Platzwechsel* (bills payable in the location where they are submitted for discount) and *Rimessen* (bills payable in a location different from the place of discount).

sufficient security to be allowed to apply for discounts on a case-by-case basis. In the Bank's jargon, firms on this second list could apply for the aforementioned *Zensurkredite*, as opposed to *Personalkredite*, as long as the total amount of these loans did not transgress a certain sum set aside by the branch for their purpose.

The colleges of censors regularly (at least annually) revised the individual credit limits based on public and private information. The branch offices then sent the proposed changes to its local list - annotated by the head of the local branch - to the Vienna and Budapest directorates for a final revision and approval. In return, each branch office once received the entire credit list (and subsequently the annual updates thereof) containing all counterparties with individual *Personalkredite* located in both, the Austrian and Hungarian Bank districts. The lists were at all times held by the head of the branch and they were never fully disclosed to the local discount committees. Since the college of censors revised the limits of local firms on an annual basis, however, the censors must have had at least a fairly encompassing view of the credit ceilings in their own bank district.[269] Particular attention was paid to counterparties with especially high ceilings. The exact amount of credit limits for firms which benefited from ceilings above 2 million *Crowns* were not displayed in the credit lists posted to the branches. Instead, the list only mentioned *über K 2.000/m* ("limit above 2 million K") in the row corresponding to these counterparties whose actual limits were communicated confidentially only to the head of the branch office in charge.

For full clarity, I would like to close these general remarks by again referring to the actual credit ledgers, the so called *Kreditkonten*, maintained by the Bank. The present chapter briefly referred to these *Kreditkonten* above: they constituted the accounts used by the branches to keep track of a counterparty's current *Belastung* as compared to the assigned credit limit. As per the manual, the individual counterparties' credit accounts, the so called *Kreditkonten*, had to be updated every day. *Kreditkonten* represented the Austro-Hungarian equivalent of "customer with and upon ledgers" kept by the Bank of England. These accounts were updated daily to reflect the counterparty's transaction with the Bank and served, at least in the case of Austria-Hungary, as a valuable reference for the committee of censors. To keep track of their exposure to counterparties in their district and compare it to the maximum permissible amount of the firm's *Personalkredit* or *Zensurkredit*, branch offices calculated what the Bank called the counterparty's *Belastung* from the *Kreditkonten*. The *Belastung* represented the total amount discounted with the Bank plus the sum discounted upon the counterparty. The branches equally computed the so called *Obligo* for each firm, which amounted to the *Belastung* plus all the submitted bills which bore the counterparty's signature but were not charged on the latter's account. A bill that bore a counterparty's signature may have not been charged to the counterparty's account if the bill had more than two admissible signatures. A bill with only two signatures would always show up on both accounts because the Bank required at least two liable parties for each transaction.[270] In the case of more than two

[269] The practice is described in the manual. To the best of my knowledge, the lists have not survived.

[270] The only exception to this rule consisted of firms which had been granted the right to a so-called *Singularbelastung*. In practice, this right meant that the branch office would only charge one account, namely the one of the counterparty having received the privilege, with the amount discounted. The *Singularbelastung* probably made discounting easier for the privileged counterparty because the credit limit of the second signature on the bill did not act as a constraint on the submission. *Singularbelastung* privileges were not disclosed to the colleges of censors and could only be proposed to the central directorates by the branch offices.

signatures, however, the head of the branch office had full discretion with regard to which two accounts, of all the counterparties enlisted on the paper, the bill would be charged onto; whence the difference between *Belastung* and *Obligo*. For checks of compliance with the credit limits the Bank used the former number. The reasons provided for changes in individual credit limits (c.f. Section 3.4) suggest that the *Obligo* played some role in motivating alterations during the annual limit adequacy assessment.

Operational details

For a full picture of the day-to-day operationalization of the individual credit limit system by the Bank some further details are of interest. The organizational structure of the list was meticulously regulated.[271] The centralized credit list was organized in a strictly alphabetically manner according to the name of the firm/person rather than their domicile. The list separated counterparties into three groups: (1) private persons and unincorporated firms, (2) credit institutions including banks, savings banks and credit cooperatives, and (3) merchant, transport and industrial enterprises incorporated as joint-stock firms. Firms protocoled in the official commercial register (*Handelsregister*) had their name copied one-to-one from this record; unprotocoled firms' and persons' names were listed in full length. Titles of nobility and academic grades were reported if applicable, as were further professional characteristics: the list provided the domicile of the counterparty and the type of its trade or business (c.f. Section 3.4). The individual entries also indicated whether the firm functioned as an affiliate of the Bank and whether anyone involved in the firm currently acted as a censor in one of the Bank's branches. Finally, the centralized list contained information on the wealth (for private persons) or equity and reserves (for incorporated firms) of the counterparty in question, together with its most recent *Belastung*, and, naturally, the amount of the *Personalkredit* assigned to the counterparty.

As briefly mentioned above, the college of censors at each branch office had to revise and amend the credit lists at least once every year. Changes to the lists could occur due to any one of the following reasons[272]: (1) the introduction of a new counterparty[273]; (2) the increase of an existing limit; (3) the decrease of an existing limit; (4) the elimination of a counterparty from the list[274]; (5) the amalgamation or separation of counterparties due to mergers or dissolution of an existing firm or partnership; (6) the renaming of a counterparty; and (7) the change in the form of incorporation of a counterparty. Once these changes were established and the proposals for the altered limits had been agreed upon by the college of censors, the list was passed on the head of the branch who could add further counterparties or suggest a different credit limit than the one proposed by the college of censors. Afterwards, the modifications were sent to the responsible directorate in Vienna or Budapest.

[271] Again, these lists did not survive in the Bank's archives. Information on the structure of the list is drawn from the manual.
[272] These reasons are not to be confused with the justifications provided when a counterparty was downgraded or eliminated from the list. These justifications are discussed in more detail below.
[273] A new introduction meant the counterparty in question was assigned a *Personalkredit* for the first time.
[274] Practically, this meant the downgrading of a counterparty to a *Zensurkredit* - unless, of course, the elimination from the list resulted from a permanent closure of business.

The branches had to submit their annual revisions to the directorate at different times throughout the year so that the directorate did not have to consider them all at once. The meeting minutes from the directorates in the years between 1908 to 1913 suggest that the directorates usually took note of up to six lists sent in by branches at each meeting.[275] This arrangement did not preclude the possibility for branches of sending in additional lists throughout the year to correct or complement the regular ones, although directorate meeting minutes for the period from 1908 and 1913 suggest that these additional subannual postings were relatively rare. Before being submitted to the directors' meeting the lists were edited a last time by clerks of the head office. The directors then took the final decision. Thus, the actual deliberation and screening happened mostly at the local level where the information on counterparties was concentrated and generated.

The manual emphasizes that changes to the limits should not be proposed on the basis of a counterparty's *Belastung* or *Obligo* at the time of the annual or subannual revisions. Limits should be revised independently of a counterparty's current and previous recourse to the discount window. Rather, the college's main focus of attention should be placed on the solvency, liquidity and general business situation of the counterparty, together with its management's character. If the college itself remained divided with regard to a proposed credit limit, or if the limit proposed by the college was considered as too high by the head of the branch office, the latter had to communicate his own dissenting limit proposals and their rationale to the responsible directorate. Generally, when sending the revised credit lists to the respective directorates, the branch offices were also under the obligation to attach the balance sheets, and where applicable the statutes, of all incorporated companies, such as joint-stock firms or credit cooperatives. While the lists submitted by the branches did not bear specific explanations as to why a certain counterparty should be introduced to the credit list or receive a higher credit limit, reductions in the limits and eliminations from the list always included a justification or comment explaining the proposal (c.f. Section 3.4 and Section 3.5 below).

The manual explicitly states that the assignment of an individual credit limit to a counterparty never entailed a corresponding right of the counterparty to be granted discounts in all circumstances, and much less a right to always receive the full amount stated in the limit. Equally, limits could be subject to downward revisions at any moment if the college of censors or the head of a branch office deemed it appropriate. In the case of a downward revision of the limit assigned to a counterparty, however, the manual required that the corresponding reduction of the actual exposure to the counterparty be implemented gradually and carefully in order to grant enough time for the person/firm to adjust to the new circumstances.

Further operational details included the following aspects. First, each counterparty could only receive discount loans from one branch office, namely the office responsible for the Bank district in which it was domiciled. Second, the assigned credit limit was generally ordered to not exceed the liquid assets of the counterparty in question. The manual states that the limit could in fact be considerably less than the liquid reserves maintained by the counterparty, in particular if it was known that the person/firm also discounted

[275] Directorate meetings took place monthly except for the summer period, when there was usually a break of two months in July and August.

heavily with other institutions. Third, the public partner (*öffentlicher Gesellschafter*) of a company with an assigned Personalkredit could not hope to receive a separate, private credit limit for discounts as her assets were already implicitly pledged to guarantee for the firm's liabilities with the Bank. In a similar vein, two or more firms with the same proprietors were only eligible for one cumulative credit limit; and this same general idea also applied to husband and wife.[276] Fourth, as a general rule, only loans that surpassed the maximum amount for *Zensurkredite* needed to be recorded and monitored against the credit limits. If a counterparty without an assigned credit limit, but deemed creditworthy, exceptionally obtained a loan higher than the amount reserved for *Zensurkredite*, it was usually proposed to receive a *Personalkredit* and screened for this purpose.[277] Fifth, persons who did not engage in any commercial business were excluded from receiving a *Personalkredit* because they would not have been expected to be in a position to offer bills eligible for discount with the Bank. A list of examples of counterparties that would usually not be considered for discount limits, and are explicitly cited in the manual, included women, privatiers, lawyers, notaries, clergymen, medical doctors, and engineers. Other parties excluded from the possibility of receiving a *Personalkredit* were official stock exchange brokers, commercial brokers more generally, the military, minors, people under tutelage or parties subject to ongoing bankruptcy procedures.

Finally, the Bank established additional rules for its dealings with proper legal entities, which included, *inter alia*, most of the financial sector (e.g. joint-stock banks, credit cooperatives and savings banks). To start with, it would not grant *Personalkredite* to a legal person without having reviewed the entity's most recent balance sheets. The financial statement was screened for capital adequacy (paid-up capital plus all non-earmarked reserve funds), asset liquidity (amount of liquefiable assets) and asset structure (details about the quality of aggregate positions such as loans, bonds, own securities). The screening took place when the firm was first proposed for a credit limit and it was subsequently repeated every year on the occasion of the publication of the firm's annual balance sheets.

Where no published statement was available, or whenever the available statements did not contain the necessary detail, the Bank would proceed to checking the firm's books *in situ*. In addition to these "hard facts", the Bank placed particular emphasis on the trustworthiness of the counterparty's management staff akin to a modern "fit and proper" review (experience, legal record and credit history). From cooperatives more specifically, the Bank also demanded an up-to-date list of their members. Furthermore, the Austrian Bank directorate in Vienna communicated its desire to see cooperatives' financial statements published in a journal called *Die Genossenschaft* (German for "the cooperative") on a monthly basis. For this reason, the Viennese directorate regularly sent out copies of the journal to all of the Bank's Austrian branches. Savings banks, in contrast, were only allowed to tap into the Bank's discount facilities if their statutes, or the local competent authority (Ministry of the Interior or its delegated local representations, i.e. ethnarchies), explicitly granted

[276] The Bank followed similar principles when judging the adequacy of signatures on submitted bills. For example, the signatures of very close family members were regarded skeptically because the acceptor(s) might have only agreed to sign the bill as a favor, without entering a real underlying transaction.

[277] Proposals for new credit limit assignments thus motivated were submitted as addenda (*Nachträge*) to the last list of changes submitted by the branch in charge.

them the right to do so in the first place. In case a savings bank's statutes limited its entitlement to discount loans to a specific amount, the Bank paid attention to keep the institution's *Belastung* below this limit.

3.3.4 Credit limits as "contingent rules"

Hypotheses

The description above, which is based entirely on Bank-internal documents, leaves no doubt that the credit limit system was originally created as the second pillar of the OeUB's counterparty risk framework. From the point of view of the central bank, counterparty risk, i.e. the risk that one, several or all of the signatures on the discounted bills default on the central bank at maturity, is best minimized by making sure that the counterparties are highly solvent. The higher the absolute amount of wealth (or net worth, i.e. equity, in the case of incorporated firms) of the counterparties the Bank is dealing with, the lower will be both the probability of default at maturity and the probability of low recovery rates upon default. This reasoning leads straight to a first hypothesis concerning the determination of credit limits: due to the essential role of wealth in reducing counterparty risk, one would expect that the OeUB considered wealth/equity as an important factor when setting the levels of a given counterparty's credit limit. Since we already know that the OeUB's manual explicitly mentioned solvency as one of the key element to be considered, this hypothesis only remains to be empirically tested.

Yet, the main argument defended in this chapter is that the Bank also employed credit limits to achieve a second aim, which was clearly distinct from pure counterparty risk management. I argue that the OeUB operationalized credit limits in a way to contain moral hazard deriving from its implicit promise to stand ready as a LLR in case of a liquidity crisis. I assert that, in normal times, the Bank used credit limits as an incentive system to enforce minimum standards for liquidity (and potentially also capital) adequacy upon its acceptors and discounters. The Bank threatened to reduce - and often effectively reduced - a firm's borrowing limits at the discount window and, *in extremis*, excluded the firm altogether, if it had become concerned with the liquidity position or leverage ratios of the counterparty in question. As long as it was credible, this threat in turn provided an incentive for counterparties to abide by best practice risk management because, ceteris paribus, for liquidity management purposes a higher central bank credit limit was more desirable than a lower one. This argument leads me to formulate my second hypothesis: if the interpretation put forward in this chapter is correct, liquidity ratios, and potentially also leverage ratios, should be significant predictors of credit limits.

My third hypothesis represents a more precise restatement of the second one. Of all counterparties the OeUB assessed for credit limits, financial institutions were by far those most prone to engage in moral hazard following the creation of a LLR facility. By definition, financial intermediaries generate profit by implementing

maturity transformations: they collect short-term liabilities and invest in longer term assets. Therefore, if gone unchecked, the availability of LLR provides a clear incentive for credit institutions to downsize liquidity buffers in exchange for more interest-yielding assets. At the same time, of all counterparties, financial institutions were also the firms most vulnerable to liquidity shocks: non-financial institutions are unlikely to face the same intensity of liquidity pressures at short-notice which financial firms have to confront in panics due to mass withdrawals of callable liabilities. This fact explains why maintaining adequate liquidity buffers is relatively more important for financial institutions than for non-financial firms. Hence, my third hypothesis: if credit limits were operationalized as tools to counteract moral hazard, then liquidity considerations should have played a much bigger role in the OeUB's credit limit assessments of banks than in the assessments of non-financial institutions.

There would be an obvious pitfall in the argument if I solely based my interpretation on empirical tests of the three hypotheses formulated so far: even if I were able to marshal evidence in favor of these three hypotheses, the evidence would still be consistent with an interpretation of credit limits as a pure counterparty risk management tool. As mentioned previously, the OeUB's manual stated that solvency, liquidity, management quality and turnover should all be considered when assessing credit limits. For example, one could easily come up with good reasons why a more solid liquidity position decreases counterparty risk for the central bank: on the one hand, a high amount of liquid assets makes timely payment of matured bills more likely; on the other hand, it also reduces the probability of illiquidity-induced insolvency in case the counterparty suffers from large funding withdrawals. Since both the liquidity and the solvency situation of discounters and acceptors determined the quality of bills discounted and signed by them, the central bank could have simply relied on the credit limit system to endogenously generate higher quality collateral for its discount facility.

A convincing "identification strategy" for my argument would have to rely on additional information about how the credit limits system was operationalized in times of crises. The reasoning goes as follows. If the credit limits system was merely targeting counterparty risk, then one would expect the OeUB to have enforced the limits regardless of the state of the world counterparties faced. Most importantly, one would expect the OeUB to have enforced limits even during crises. Enforcement during panics would have certainly been inconsistent with the tenet of "free lending" implicit in LLR; but it would have been consistent with counterparty risk management. By reverse conclusion, if, on the contrary, one observed the OeUB increasing or even temporarily suspending limits during a liquidity crisis, this reaction would be consistent with "free lending" but inconsistent with counterparty risk management. From a pure risk management perspective, increasing limits during a liquidity crisis would have unnecessarily increased the overall exposure of the Bank, without any concomitant increase at all in the the quality of the counterparties. In other words, increasing limits would have been an irrational reaction had the Bank operated a credit limits system only for the purpose of counterparty risk management. This line of reasoning leads to my fourth hypothesis: if the OeUB operated credit limits exclusively as a counterparty risk management tool, then one should expect the OeUB to refrain from increasing *Personalkredite* during a liquidity crisis.

My interpretation of credit limits as incentive setting tools to check moral hazard requires a rejection of the fourth hypothesis. Yet, a simple rejection of this hypothesis is not enough. If the OeUB indiscriminately increased all limits in a crisis, then it would have certainly acted consistently with "free lending" but it would have also endorsed imprudent behavior by some counterparties prior to the crisis. Hence, finding the OeUB implementing an indiscriminate increase of all credit limits in a liquidity crisis would also be inconsistent with my interpretation of *Personalkredite*: this behavior by the central bank would increase moral hazard rather than addressing it. To be sure, I argue that an interpretation of credit limits as micro-prudential incentive-setting tools to check moral hazard does require an increase in limits in crises. However, if the central bank is concerned about moral hazard, it should only increase limits for counterparties which it perceives to experience liquidity distress due to an exogenous shock. In other words, counterparties that suffer from withdrawals because of bad fundamentals prior to a crisis should not equally benefit from LLR: they should be penalized for imprudent behavior in normal times by seeing their demands for credit limit transgressions or increases rejected. Alternatively, if such a rejection were to lead to large losses for the counterparties' creditors (e.g. due to the necessity of starting "fire sales" of remaining assets to honor liabilities), the penalty should be enforced once acute liquidity distress has abated. Hence, the fifth hypothesis reads as follows: if the OeUB operated credit limits as an incentive system to contain moral hazard, one would expect that the Bank increased limits for counterparties it perceived to be suffering from liquidity distress unrelated to fundamentals, in line with the tenet of "free lending". The OeUB should have operated credit limits as "contingent rules": enforced in normal times, credit limits should have been lifted in times of crisis when the OeUB perceived distress to be exogenous to counterparty fundamentals. Finally, one would also expect the OeUB to have penalized imprudent behavior in normal times by refusing to increase credit limits for counterparties suffering from liquidity distress due to unsound fundamentals.

In the remainder of this chapter, I set out to test these hypotheses (c.f. Sections 3.5 and 3.6). To reiterate an important point: this chapter is not arguing that or testing whether the credit limits system was successful in checking moral hazard. Its aim is merely to illustrate how the system was operated by the OeUB and which elements the Bank itself perceived important to achieve the system's purpose.

Theoretical framework

The interpretation put forward above is consistent with a standard theoretical framework in which a principal designs incentives in a way to counteract moral hazard by her agent. My starting point is a state of the world where the central bank has taken up the role as a credible LLR, but there are no legally binding regulatory capital or liquidity requirements for banks. Hence, in this state of the world, there is lots of potential for moral hazard - here broadly interpreted as a threat to financial stability. The central bank would like to achieve financial stability, but it cannot do so by itself: it needs commercial banks to do the work to "achieve" financial stability (or equivalently, minimize moral hazard): banks need to make the risk management effort consistent

with financial stability. In other words, the level of financial stability the central bank can achieve depends on the effort the banks make (i.e. the extent and quality of risk management of banks): $F = f(x)$ – where F is financial stability and x is the effort made by banks. The cost the central bank has to incur in order to achieve financial stability derives from the loans it offers to provide to banks. In the absence of legally-binding regulatory frameworks, the central bank needs to offer loans in order to be able to create an opportunity for interaction with commercial banks and induce effort. In order to make lending feasible, the central bank has to set up a monitoring system (credit limits) and the maintenance of this system is costly. The monitoring costs depend on the amount of financial stability the central bank wants to achieve $s(F)$. Hence the central bank maximizes $f(x) - s(f(x))$.

Commercial banks derive a positive utility from the credit lines they obtain from the central bank. Credit limit accounts with the central bank are useful because they allow banks to quickly obtain cash when they idiosyncratically need more liquid reserves. *Ceteris paribus*, from the point of view of banks, having a higher limit is more desirable than a smaller one because it facilitates liquidity management. Yet, in order to obtain a credit limit or to maintain the credit limit they have been attributed, banks have to make an effort: they have to abide by some capital and liquidity threshold the central bank deems appropriate for the limit level. Hence, banks maximize their utility by maximizing $s(f(x)) - c(x)$, where c is the (globally concave) cost function describing the price of effort for the banks.

The central bank cannot force the banks to subject themselves to supervision, so it has to make sure it sets the benefits of having credit limits high enough to fulfill the following participation constraint from the point of view of the banks: $P : s(f(x)) - c(x) \geqslant \bar{u}$, where $\bar{u}$ is the utility the banks derive from operating without a central bank credit limit. Hence, the central bank has to maximize $f(x) - s(f(x))$ subject to the constraint P. Therefore, it proceeds by maximizing $f(x) - c(x) - \bar{u}$. Setting the marginal product of the effort to its marginal cost, the central bank finds an optimal amount of effort, x^*, it would like banks to make. Now the central bank has to design the benefits for banks deriving from the credit limits system in a way that the latter effectively implement x^*. In other words, the central bank has to make sure the following incentive compatibility constraint is met: $s(f(x^*)) - c(x^*) \geqslant s(f(x)) - c(x)$ for all other levels of effort the banks show.

How can this be achieved? The central bank has to make the benefits generated by the credit limits a function of the effort x: it remunerates effort by its marginal product to financial stability at the optimal level of effort and it also provides a lump sum payment to make sure the participation constraint is met. Assuming a simple linear function, one may write this relationship as $s(x) = rx + k$, where r is the remuneration for r and k is the lump sum. Under these circumstances, the banks choose x to maximize $rx + k - c(x)$ which means the banks choose x to equalize the marginal cost of effort to the remuneration they obtain. Since the remuneration is equal to the marginal contribution to financial stability (marginal product) at its optimal level, the banks will choose x^* – the central bank obtains its desired level of effort to achieve its financial stability goal.

For the Austro-Hungarian Bank, I observe the credit limits accorded to counterparties, $s(x)$, and the liquidity and capital management quality of banks, i.e. the effort made x. Hence, in my empirical analysis below I can effectively estimate the remuneration coefficients r and the lump sum k (i.e. the regression constant). This simple theoretical framework yields a clear prediction that reflects hypothesis 2 and 3 discussed above: my proxies for effort and the constant should be highly significant predictors of credit limits in a setting where the central bank uses credit limits to enforce minimum capital and liquidity standards.

3.4 Data

In this section, I briefly summarize my data sources. I draw on both qualitative as well as quantitative archival data and I construct several novel data sets from primary sources. I first discuss the source for the main credit limit data set. Second, I explain the data collected on credit limit transgressions during normal and crisis times. The third subsection lists other qualitative sources employed in this chapter. Finally, I elaborate on the balance sheet data of financial intermediaries used in the econometric sections of this study.

3.4.1 Decisions on credit limits

The administration and monitoring of credit limits by the OeUB produced several types of Bank-internal documents, some of which are kept in the historical archives of the *Oesterreichische Nationalbank*, the successor institution of the Austro-Hungarian Bank and Austria's current central bank. Unfortunately, the full credit lists containing the population cross-section of all credit limits at certain points in time have not survived. However, documents on the annual (re-)assessments of credit limits and the routine monitoring by the directors in Vienna and Budapest were both classified with the meeting minutes of the directorates and can thus be consulted. As explained in Section 3.3, all regional branch offices submitted a hand-written form with suggested changes in their credit lists to the Vienna and Budapest directorates for approval at least once per year. I collected all credit assessments that were submitted by the OeUB's Austrian branches to the Viennese directorate between 1909 and 1913 inclusive. Although I refer to "Austria" or "Austrian" for simplicity, it should be noted that this study really collect data for all Austrian crownlands, i.e. the entirety of Cisleithania: Bohemia, Bukovina, Carniola, Corinthia, Dalmatia, Galicia, Gorizia and Gradisca, Istria, Moravia, Lower Austria, Salzburg, Silesia, Styria, Trieste, Tyrol, Upper Austria, and Vorarlberg.[278]

Altogether, the forms submitted to the Viennese directorate include a total of 4273 assessments of individual credit limits between 1909 and 1913. As some counterparties were assessed several times during the five year period, the data contain information for approximately 3400 unique counterparties. The data set obtained on the basis of this archival research is an annual cross-sectional sample of credit limits of all counterparties that

[278]The protocol for the 128$^{\text{th}}$ meeting of the Viennese directorate in 1913 is missing in the Bank archives. This exercise could be done for the Budapest directorate too, and I plan to collect these data in the future.

happened to be re-assessed by the branches during thr observation period. For a subsample of this data set (all banks and savings banks), I also exploit two particularly useful features of the assessment forms to construct a panel data set. First, each time a credit limit (re-)assessment was made, the old limit was also reported on the form. Second, the mere fact that a counterparty was not assessed in a given year also provides relevant information: it tells us that the old limit remained in vigor. Therefore, as long as a counterparty appeared once in the reassessment forms submitted by the branches, I was able to infer the relevant information for all five years from 1909 until 1913.

The forms submitted to the directors contain the following information on counterparties and credit limits. First, of course, the name of the assessed counterparty is listed. Sometimes, but not systematically, the names are reported in both local language and German. Second, the forms always contained a description of the business or occupation of a given counterparty. The third piece of information available concerns the counterparty's domicile. In order to be covered by a certain OeUB branch, the firm or person had to be domiciled in the bank district attributed to the branch.[279] For some counterparties several locations are listed, reflecting the sites of their branches and affiliates. Fourth, as briefly mentioned above, the forms showed the current (or old, in case suggested changes were accepted by the directorate) credit limit. The forms report credit limits in thousand *Crowns*. If the counterparty was assessed for the first time or had her *Personalkredit* revoked at a previous round, the limit was reported as zero. Fifth, every time a counterparty was (re-)assessed, the branch communicated its proposal for the new credit limit. Suggestions on the level of a particular counterparty's credit limit could be put forward by the local discount committee at the OeUB branch, the director of the branch, or the responsible clerk (*Referent*) at the Viennese head office. Thus, in case the different parties disagreed, the forms contained up to three distinct credit limit proposals. Just as in the case of current credit limits, the proposed limit could be zero. The sixth element on the submitted forms represented the credit limit as decided upon by the directors, i.e. the new credit henceforth in force (which, again, could be zero). Finally, when credit limits were lowered or left at zero despite a positive proposal, the forms usually provided a justification for why the decision was taken to the negative.

I collected the raw data from the forms and then proceeded to clean and harmonize the information obtained. In particular, proper names were corrected for slight changes in spelling. I also classified business activities into 25 categories based on the categories used in the official Austrian statistics at the time.[280]. Most importantly, however, for my research question was the harmonization of the handwritten remarks, added to the assessments by the directorates, explaining their final decision. Most of these remarks are negative in the sense that they represent a justification for why no limit was granted, why a given limit would not be raised despite a recommendation of the local college of censors to do so or why a limit was lowered.

[279] Bank districts differed in size, and economic as well as demographic composition. The geographic areas attributed to specific bank districts changed over time as more branches, and thus districts, were created over time. For an early summary, c.f. Leonhardt (1886).

[280] For details on the harmonization and categories used, c.f. the appendix to this chapter, in particular Tables 3.37 and 3.38.

While not standardized, the comments refer to a relatively small number of recurring arguments. In order to allow a statistical analysis I coded the comments distinguishing between 20 different arguments. Comments often drew on several of these arguments to explain a decision taken. The justifications and their relative frequency in the period 1909–1913 are discussed in detail in Section 3.5 below.

3.4.2 Reports on transgressions of credit limits

In order to understand whether and to what extent credit limits were binding in normal times, I would ideally like to compare the levels of individual limits to the actual amount of central bank credit received by a given counterparty. Unfortunately, to the best of my knowledge, the discount ledgers of the OeUB and its branches have not survived in the archives of the central bank. Therefore, unlike in the case of the Bank of England, I cannot reconstruct the running exposure of the Bank vis-à-vis particular borrowers. In order to be able to infer some conclusions about the possibility, consequences and length of credit limit transgressions, I thus focus on another primary source that is available. On the occasion of each OeUB directorate meeting in Vienna, the Bank's management discussed transgressions of credit limits by those counterparties which had received a *Personalkredit* above 2 million *Crowns* and benefited from *Singularbelastung* rights. In fact, the branch offices had to report the *Belastung* of these high limit firms to their corresponding directorate on a weekly basis (on the 7^{th}, 15^{th}, 23^{th} and 30^{th} of each month). In other words, counterparties with limits above 2 million *Crowns* that also benefited from *Singularbelastung* rights were directly monitored by the responsible directorate.

The close monitoring of these firms by the directorates allowed me to collect data on their credit limit transgressions between March 1906 and November 1911, that is, in normal times. The protocols of the monthly directorate meetings in Vienna included the amount (in *Crowns*) of transgressions for the four preceding weeks. Since there were usually no directorate meetings during the summer, the first protocol after August of a given year usually contained the transgressions for July and August. Counterparties were only mentioned in the protocols when they had effectively violated their assigned limit. Therefore, if a limit transgression for firm f was reported for week w but not for $w+1$, I can conclude that the firm's *Belastung* had again decreased below the limit in $w+1$. Consequently, the available information enabled me to construct a weekly panel data set of limit transgressions. A counterparty enters with a value of zero whenever no transgression was reported, and is assigned the reported amount of the transgression otherwise. I discuss and analyze this data in more detail in the last part of Section 3.5 below.

To obtain additional information on how the OeUB dealt with limit transgressions during periods of financial distress, I examined the OeUB protocols minutes during the crisis episode of 1912. In the months from October 1912 until January 1913, the Viennese directorate extensively discussed transgressions of limits and/or increases in the limits for individual counterparties at almost every meeting.

3.4.3 Other qualitative evidence

I also exploit the wealth of qualitative data available in the central bank archives in several other ways. First, as already mentioned in Section 3.3 above, I draw on a Bank-internal manual for clerks that was used by the OeUB to communicate minimum expectations to its employees on how to conduct business in the different lending and depositing arms of the central bank. This manual is entitled *Dienstunterricht für die Beamten der Oesterreichisch-ungarischen Bank*. It was printed by the in-house publishing division of the OeUB and appeared in several editions. For this chapter, I have drawn extensively on the 1907 edition in order to describe the OeUB's credit limit system in the previous section. Second, I employ qualitative evidence from the directorate meeting protocols to inform my discussion of the OeUB's policy reaction to the crisis of 1912. The debates and decisions by the Viennese directorate allow for a first-hand reconstruction of how the Bank perceived the crisis, including what it judged to be its cause, and how it reacted to distress in the panic-stricken regions. While I am also able to marshal quantitative evidence on this aspect, the meeting minutes constitute an invaluable source to understand how the OeUB asssumed the role as a LLR in autumn 1912. Most importantly, the protocols allow me to understand in detail how the Bank managed and flexibilized its credit limits system during the panic.

The contemporary general press constitutes another precious primary source I use in this chapter. I draw on the wealth of newspapers available on the so-called "ANNO - AustriaN Newspapers Online" platform provided by the Austrian National Library in Vienna.[281] ANNO contains more than 19 million digitized pages from the period between 1568 and 1946. The platform allows free access to up to more than 50 different digitized newspapers for any given weekday in 1912. Besides its easy and free accessibility and the possibility to conduct complex full-text searches, the platform covers newspapers from the entire area of the Empire, ranging from Bukovina in the East to Vorarlberg in the West. I primarily draw on ANNO to identify the location and timing of runs on banks in the autumn of 1912. In principle, I follow a methodology similar to Jalil (2015) who used newspapers to construct a new series for banking Panics in the United States between 1825 and 1929. Since my purpose is not to distinguish between individual bank runs and more general panics and because I do not rely on the reports to construct a disciplined time series, I do not follow a strict rule for identifying a "panic" vs a "run". I rather searched for obvious references (*Panik*, *Runs*, *Einlegeransturm*, *Spareinlagen*, *Krise*) in order to get a sense of the geographic dispersion of runs and the underlying reasons mentioned for the withdrawals of deposits. I make use of the information collected in Section 3.6. Among the most relevant newspapers for this study were *Neue Freie Presse*, *Pester Lloyd*, *Reichspost*, *Salzburger Volksblatt*, *Linzer Tagblatt*, *Czernowitzer Allgemeine Zeitung*, *Bukowinaer Post* and *Prager Tagblatt*.

[281] The platform is freely accessible via the following link: http://anno.onb.ac.at/.

3.4.4 Balance sheet data and other quantitative evidence

For my econometric analyses, I match balance sheet data from Austrian credit institutions with my data set on credit limits. In this section, I provide a brief overview of the Austrian banking system and present the sources I use in order to compile the relevant data sets. These sources partly overlap with the data used in Chapter I and Chapter II of this dissertation. However, due to the inclusion of additional types of financial intermediaries not discussed previously in this dissertation, a brief summary is in order.

Traditionally, Austria's banking system was composed of several sectors with different business models.[282] As discussed in Chapter I of this dissertation, the central pillar of the Austrian banking system were joint-stock banks. I collect balance sheet data for joint-stock banks from the official Austrian statistics (*Oesterreichische Statistik*) published by the Imperial statistical commission (*k.k. statistische Zentralkommission*). Bank balance sheets were published annually by the commission starting in 1882. For this study, I compiled a panel data set covering the years 1908 until 1913 inclusive. Since the number of reporting banks increased throughout the years from 82 in 1907 to 106 in 1913, the panel is slightly unbalanced.

The second pillar of the Austrian banking system were savings banks. Initially designed to offer the poorer populace a safe way to deposit their savings and encourage industriousness and thrift, most deposits soon came from a reasonably well-off middle class. Unlike joint-stock banks, the savings banks had no share capital and were backed by dedicated associations (*Vereinssparkassen*), municipalities (*Gemeindesparkassen*) or counties (*Bezirkssparkassen*). In the Austrian half of the Empire, savings banks operated exclusively on a not for profit basis. In order to protect depositors, legislation regulated the types of assets savings banks were allowed to invest in. Quantitatively most important were mortgage loans, loans to municipalities as well as securities, mostly bonds, issued by the public sector and covered bonds. In 1900 savings banks held roughly 70% of all savings deposits in Austria. Partly in reaction to increasing competition by joint-stock banks and the rising cooperative sector, partly reflecting national conflicts in the monarchy, after 1900 savings banks started to organize themselves in nationally-labeled associations and founded banks to serve as central institution of their associated savings banks. The most notable cases were the *Centralbank der deutschen Sparkassen* and the *Ústřední banka českých spořitelen* (central bank of the German and the Czech savings banks respectively). In addition to representing their members interests, the central institutions served to redistribute liquidity among member banks by taking deposits and rediscounting bills as well as taking over operations, which were too large for the small members banks, notably issuing covered bonds backed by municipal loans (Fritz and Hoffmann, 1969). In addition, however, the banks also vied for individual deposits and operated branch offices outside the regions where their member banks were situated. *Ústřední banka* was notably active in Galicia and the Bukowina, maintaining offices in Lviv, Krakow and Czernivtsi (Compass 1912). Savings banks balance sheet

[282] Banking legislation and policy was in the respective domain of the governments and parliaments of Austria and Hungary. As a result, the Hungarian banking sector differed in a number of important respects from its Austrian counterpart. As the article focuses on the 1912 panic in Austria, the Hungarian banking sector is not discussed in detail here. For an overview, see Kövér (1991).

data also come from the official Austrian statistics. For the same reasons as for banks, the data set is a slightly unbalanced panel for the years 1908 to 1913.

The third pillar of the banking system consisted of credit cooperatives. Cooperatives were structured following the German example, frequently operated with a strictly limited geographical scope and specialized either in loans to farmers (*Raiffeisen* system) or small businesses (*Schulze-Delitzsch* system). The first cooperatives were formed in the 1850s but their number expanded massively in the years after 1900, reaching more than 8400 for the rural and 3800 for the urban cooperatives in 1913. While in theory credit cooperatives aimed at providing relatively cheap access to loans for their members, in several cases the concept was perverted and used by small numbers of persons, often related, to provide loans to non-members at usurious rates (Neurath, 1998). Due to the high number of cooperatives and often limited resources available to smaller cooperatives, no regular standardized statistics were collected as in the case of joint-stock banks and savings banks. As a result, I had to resort to another strategy and source to compile balance sheet data for credit cooperatives. Using an annually published financial yearbook, the *Compass - Finanzielles Jahrbuch*, I hand-collected balance sheet data only for those credit cooperatives which appear in my credit limit data set. In other words, I obtained a cross-section of balance sheet data for different years that I match with the credit limit data. I always looked for balance sheet information published as close as possible prior to the date of the credit limit record. Only when I was not able to find a matching record in the *Compass*, I matched the limits data with balance sheet information from the last available official survey of credit cooperatives published in 1902 by the Imperial statistical commission.

I end this survey of my data sets by briefly mentioning the remaining primary sources I draw upon in this chapter to provide quantitative insights. First, I use a weekly magazine, the *Tresor*, and a daily newspaper, the *Wiener Zeitung*, to collect weekly data on OeUB lending operations, note issuance and interest rates. Both are available on the ANNO platform mentioned above. Second, in addition to these two publications, I also use daily official stock market reports of the Viennese Stock Exchange (VSE), the *Coursblatt des Gremiums der k.k. Börse-Sensale* to compile a data series on market interest rates for prime bills. This information is illustrated graphically in Section 3.6. Finally, in order to calculate distances between the locations of individual credit institutions and the Russian border, I draw on a shape file of the Austro-Hungarian Empire originally created by Rumpler and Seger (2010). This information is relevant for my econometric analysis of credit limit transgressions in times of distress (Section 3.6).

3.5 Business as usual: credit limits as regulatory tool in normal times

3.5.1 Credit limits: composition of counterparties and descriptive assessments

The framework for discounting bills as set out in Section 3.3 required the Bank not only to check the counterparties submitting bills at the discount window but also all other signatures featuring on a bill. As a result, the Bank had to assess a large number of firms. In 1895, the last year for which aggregate statistics are available, the Bank had accorded *Personalkredite* to a total of more than 152,000 firms (Mecenseffý, 1896, p. 230-231). This number should not be read as the maximum of potential firms featuring on bills, however, as the Bank also accorded loans on a case by case basis (*Zensurkredite*). In the main financial and commercial cities like Vienna, Budapest, Prague, Trieste and Brno the threshold above which an individual assessment was required, was set at a higher level than in the other branch offices and amounted to 10,000 crowns.[283] In other words, many firms domiciled in these cities regularly featured on bills discounted by the OeUB but are not included in the 152,000 quoted above. The distribution of limits is very much skewed to the right. In 1895, more than three quarters of all accorded limits were lower than 10,000 crowns and 95% lower than 20,000.

Within this universe my sample covers all assessments of firms with a credit limit at 20,000 crowns and above.[284] As explained in Section 3.4, my main source, the lists of limits submitted by the branch offices to the Vienna board, do not give a full list of all limits in force at a given date but report only the limits of those counterparties that the branch proposed to change in a given year. Based on the reported changes, however, I can construct a cross sectional sample of limits known to have been in force at any given date.[285] Using this technique yields a sample of 2,221 counterparties with credit assessments at 20,000 crowns and above for 31 December 1911. This cross-section is shown in Table 3.21. Of these counterparties, 23 were joint stock banks, 69 savings banks, 155 credit cooperatives and 77 private bankers, discounters and other types of unregulated financial agents.

Non-financial firms (1,897) accounted for more than 85% of counterparties. All sectors were represented, ranging from agriculture and mining to industry and services, with textile industries and wholesale and retail trade making up the largest groups by numbers.[286] The fact that many non-financial companies can be found among the firms assessed does not imply that all or even most of these firms actively sought refinancing at the

[283]The crown was introduced in 1900. The numbers in Mecenseffý (1896) are given in florin, where 2 crown = 1 florin.

[284]There are two possible explanations why changes to limits below 20,000 crowns were not discussed and decided in the board meetings. Either these limits were considered too low and were decided by individual directors or members of staff, or alternatively, by 1909 the threshold for *Zensurkredite* had been increased to 20,000 so that no *Personalkredite* below 20,000 existed.

[285]The cross section thus obtained covers a sub-set of the cross section of all limits in place. The composition of the sub-set might deviate from the composition of the full sample if the limits of some categories of firms are less often changed than others, meaning that these categories appear dis-proportionally less often in the list of changes. Increasing the number of years for which changes are recorded reduces the bias. A comparison of the sampled distribution of values of limits for 1911 and 1895, for which the full distribution of limits is available, however, shows no notable differences.

[286]Categories follow the classification used in contemporary official Austrian statistics, see appendix 3.8.1 below.

Table 3.21: Cross-section of credit limits in force at the end of 1911

Business	Number of limits	20 - 50 ths.K in %	50 - 100 ths. K in %	100 - 500 ths. K in %	above 500 ths. K in %
Agriculture and mining	234	66	22	11	1
Basic metals	6	50	0	17	33
Stone, clay and glass	66	56	27	14	3
Metal working	62	27	18	44	11
Machinebuilding	48	50	19	21	10
Wood	50	56	20	18	6
Rubber	5	0	20	40	40
Leather	28	57	32	7	4
Textiles	263	32	22	34	12
Wearing apparel	33	61	24	15	0
Paper	25	12	32	48	8
Food and beverages	194	42	27	24	7
Accomodation, food service	9	89	11	0	0
Chemicals	67	42	28	19	10
Construction	63	51	38	10	2
Printing	11	27	36	36	0
Electricity supply	3	33	0	0	67
Wholesale and retail trade	576	53	26	16	5
Finance and insurance	342	31	23	32	15
Trade and shipping agents	53	53	26	17	4
Transportation	9	22	33	22	22
Free professions	35	86	14	0	0
Wealthy individuals	39	41	28	28	3
Total	2,221	46	25	22	7

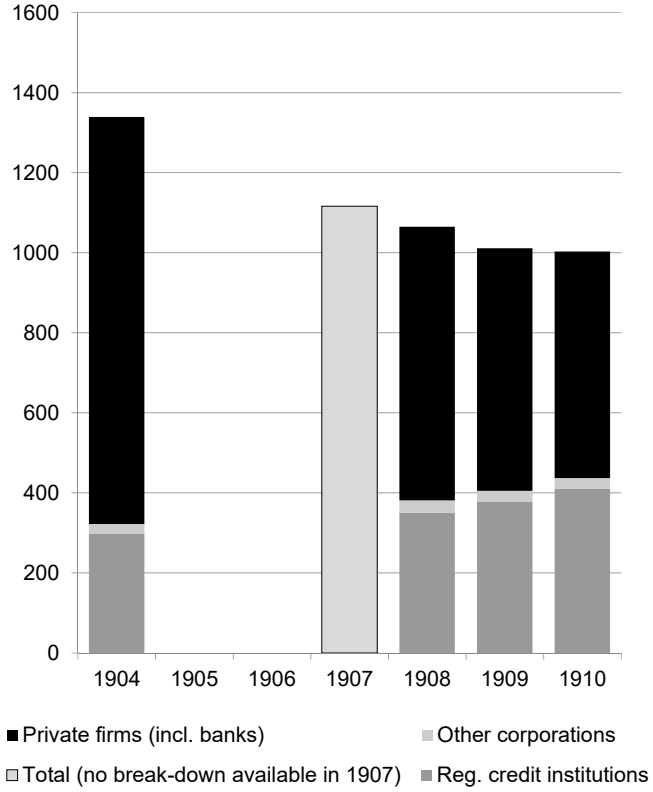
Source: OeUB directorate protocols (Vienna; 1909-1913)

central bank. Rather, many firms only featured on the bills submitted to the Bank by financial institutions. Aggregate statistics on discount window counterparties, collected routinely by the Viennese directorate and available in the Bank's archives for 1904, 1908, 1909 and 1910, suggest that financial institutions effectively received the lion share of discount lending. As the data are classified according to corporate form (joint-stock banks, other joint-stock corporations, savings banks, credit cooperatives and private firms) rather than activity (financial vs. non-financial), Figures 3.35 and 3.36 do not allow to fully assess the relative importance of financial vs. non-financial firms. However, between 1904 and 1910 the number of joint-stock banks, savings banks and credit cooperatives discounting bills at the OeUB was clearly increasing, while the number of private firms, among which there were probably many discounters and private banking houses, declined. Volumes show the dominating role of regulated financial institutions at the discount window, which submitted between 90 and 95% of bills in this period. Of the remaining 5 to 10% private banks surely accounted for a significant share. Direct credit to non-financial firms was thus *de facto* irrelevant, at least by 1904, and probably already earlier. By the end of the 19^{th} century, the OeUB had clearly become the Bank of banks. Non-financial firms served as guarantors ("acceptors") and ultimate payers of bills submitted by financial institutions.

3.5.2 Credit limits: reasons given for changes in limits

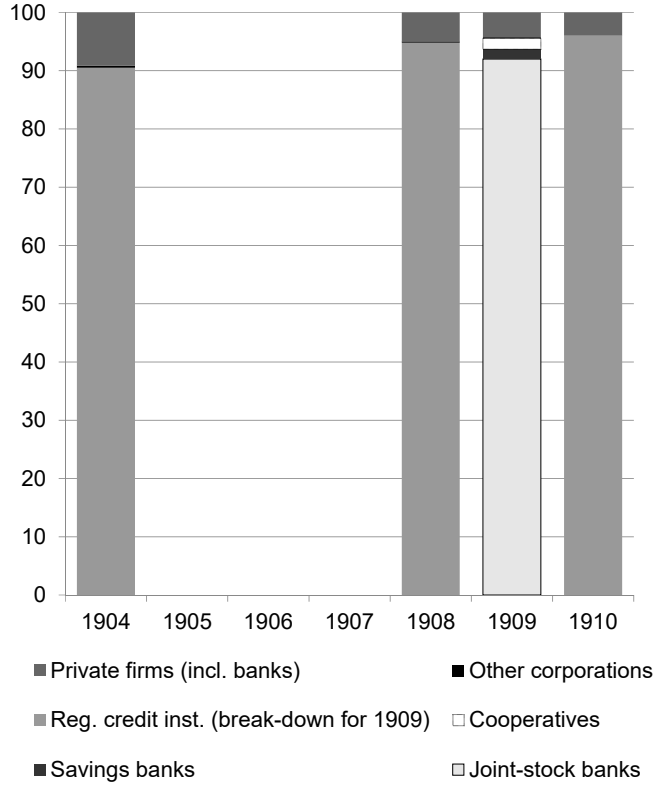
I now turn to the reasons given for decisions on (changes in) credit limits. Written comments on the directors' reasoning are available for 2,106 or roughly half of the 4,278 assessments in my sample. I coded the

Figure 3.35: Numbers of discounters at the OeUB (Austrian crownlands, 1904-1910)



Source: OeUB directorate protocols (Vienna; 1904-1910)

Figure 3.36: Shares of discounters at the OeUB in total discount volume (Austrian crownlands, 1904-1910)



Source: OeUB directorate protocols (Vienna; 1904-1910)

arguments the OeUB used to motivate changes in credit limits into 20 categories. Table 3.22 shows the observed frequency of the arguments in the decisions taken between 1909 and 1913. Table 3.22 also distinguishes the reasons given according to whether the argument was used in a decision that led to the canceling, the lowering, the maintaining or the increase of an existing limit or the first-time granting of a limit. As can be seen in the bottom row, written arguments can be typically found when it came to justifying the cancellation, the lowering or the maintaining of a credit limit. In more than 95% of these decisions the reasons were documented. This observation holds much less true for increases in limits and when a counterparty was attributed a limit for the first time. In these cases, arguments were only noted down in 12% of all cases and mostly when the directors wanted to justify why their final decision differed from the initial proposal made by the local college of censors.

Table 3.22: Reasons given in the assessments of credit limits and decisions taken (1909-1913)

	Reason	**Canceled**	**Lowered**	**Unchanged**	**Increased**	**New**	**Total**
1	Bankrupt	54	0	0	0	0	54
2	Dissolved	211	0	11	0	0	222
3	Illness, death	202	0	1	0	0	203
4	Change location/name	104	0	4	1	18	127
5	Equity	213	145	63	10	22	453
6	Change in owner	63	7	2	0	0	72
7	Withdrawal of partner	20	51	1	0	0	72
8	Change legal form	68	0	1	0	0	69
9	Leverage	24	9	26	3	10	72
10	Asset liquidity	10	17	41	8	17	93
11	Refinancing risk	48	42	83	2	11	186
12	Volume of business	18	18	6	2	4	48
13	Limit adequate	1	2	13	6	6	28
14	Management quality	14	7	11	3	0	35
15	Experience	0	2	5	0	12	19
16	Payment history	10	3	1	1	0	15
17	Risky loan portfolio	3	3	3	1	0	10
18	Absent from discount	289	0	11	0	0	300
19	OeUB rules	4	0	10	0	2	16
20	Quality bill portfolio	1	1	4	1	2	9
	Total decisions	1290	253	346	1039	1350	4278
	Decisions where reason was given	1269	234	307	126	170	2106

Several reasons can be given for decisions on credit limits.
Hence, sum of columns can be larger than total number of changes as given in the last row.
Source: OeUB directorate protocols (Vienna; 1909-1913)

Arguments can be broadly grouped under five headings. A first set of arguments refers to cases in which firms disappeared, which obviously led to the canceling of the firm's credit limit.[287] The most spectacular reason for the disappearing of a firm was its insolvency (1).[288] In reality, bankruptcies were relatively rare and firms were much more often dissolved voluntarily (2) or due to the death or a serious illness of its owner (3). Another reason for the disappearance of a firm was a relocation to a different bank district, which typically entailed a reassessment and attribution of a new limit in the new district (4).

[287] Most of the cases in which firms disappeared are classified under "Limit canceled" in Table 3.22. A handful, however, are also classified under "Limit unchanged". These are cases when a firm, which did not have a credit limit to begin with, applied for or was considered for a credit limit, but then was unexpectedly dissolved. As a result the initial credit limit remained at zero and was classified as "limit unchanged".

[288] Whenever a firm was officially declared insolvent and entered bankruptcy, the OeUB eliminated it from its credit lists. However, if the firm managed to reach a settlement with its creditors and reopened for business at a later point, the OeUB reconsidered its *Personalkredit* – although the counterparty was likely to receive a lower limit than before insolvency.

Turning to economic factors, which are key for the argument of this chapter, equity or wealth represent by far the most often cited reasons by the OeUB (5). A high level of equity is ultimately the best guarantee that the Bank will be repaid on the bills it held. Equity shows up both directly and indirectly in the arguments put forward by the central bank. Most of the firms in the sample were organized as sole proprietorships or partnerships with unlimited liability of the managing partners. The identity and economic situation of the owners was thus a key variable in assessing a firm's credit standing and the Bank looked therefore paid close attention to the entire private wealth of the owners, including private real estate holdings as well as the consequences of divorces and inheritances on the wealth of the firm's owner. The Bank also disliked if the financial status was not fully transparent or if a firm's owner was simultaneously liable as partner/owner of another firm. In these cases, all firms with a single owner typically received one single and joint credit limit. As full liability of the owners was the key underpinning of the credit assessment of most firms, any modifications to the ownership structure of a firm were closely monitored, including changes in ownership (6) as well as the withdrawal or death of a partner (7). All these events typically led to a downward adjustment in the credit limit.[289] A similar logic applies to changes in the corporate form to the extent that liability was affected. The transformation of a firm from a partnership to a joint-stock or a limited-liability company typically triggered a reassessment, often leading to the cancellation of a credit limit (8). For limited-liability institutions like joint-stock banks, savings banks and cooperatives, the sum of paid-up capital and retained earnings thus represented particularly relevant variables.

In addition to equity, the Bank also looked at a number of other aspects of a firm's balance sheet. The first element was the ratio of equity to the balance sheet total, i.e. leverage (9), where directors often voiced their concern that firms had high debts, operated beyond their means (i.e. were running a too large balance sheet relative to equity) or had mortgaged their real estate assets (which was perceived as a sign for a low level of equity relative to the balance sheet total). On the asset side, the Bank's directors looked at the (il-)liquidity of a firm's investments. In this context, the OeUB's main concern was that investments could not be realized quickly enough in case of need (10). The corresponding aspect on the liability side is funding risk, i.e. the importance of short-run liabilities that might out turn difficult to roll over, particularly in a period of increased financial stress (11). The comments frequently mention large current account liabilities, a high volume of bills issued or endorsed and the excessive reliance on rediscount credit both with the Bank and other rediscounting institutions. I also classified arguments on the volume of business and ongoing losses (12) in this overarching category, although they are not immediately reflected in the a firm's balance sheet. Both losses and reduced turnover potentially reduce available cash-flows and undermine the equity position of the firm over the medium term. In other cases, the arguments are more general and refer to the overall quality of the balance sheet. These arguments mostly accompanied statements arguing that the the existing limit was considered "adequate" or should be adjusted (13).

[289] If, in the case of a change in ownership or the withdrawal of a partner, a reduction in equity is explicitly mentioned, the argument is both coded as (6) or (7) and (5).

A fourth group of arguments refers to the quality of the firms' management. I include the following comments under this header: statements on the character and (lack of) personal qualities of the firm's owner, (lavish) lifestyle, the (speculative) nature of undertakings, (improper) business practices or the payment of excessively high dividends (14), the (lack of) experience (15), a (deficient) payment history (16) or (excessive) risk taking in the granting of loans (17).[290] Overall, the comments in this group are relatively rare when compared to statements on the firms' balance sheet and equity position.

In a fifth and last group I subsume arguments related to rules governing the use of the OeUB's discount window. The most frequent argument here concerned firms that had not appeared in the Bank's discount portfolio for several years – be it as discounter, payer or acceptor – and which, as a result, typically saw their *Personalkredit* canceled (18). To be sure, this cancellation did not imply losing access to the OeUB discount facility altogether: the counterparty could always use its *ad hoc Zensurkredit* and apply for a new credit limit whenever the *Zensurkredit* became sufficient. Much less frequent were statements on firms' which did not behave in line with the explicit and implicit rules at the discount window (19). In a handful of cases, discounters or acceptors did not feature in the official trade register as required or the information in the register did not conform with the details given when the firm applied for the credit limit. On a few occasions firms submitted bills which violated the criteria established by the Bank, e.g. by issuing accommodation bills. Category (20) includes cases when the directors complained about the low quality of bills submitted to the Bank.

To sum up, while many different arguments were made in the process of assessing credit limits, Table 3.22 shows that almost half of all decisions – notably the canceling of limits – were due to the voluntary dissolution of firms, the death of their owners or a partner as well as the moving of the firm to a different banking districts. All these reasons were not directly related to the economic situation of the firm.[291] Among the economic reasons narrowly speaking, wealth (equity) ranks first. If changes in ownership and corporate form, which impact the availability and identity of personally liable owners, are included, the relative prominence of equity increases even more. Next rank concerns about the firms' refinancing risk, asset liquidity and leverage. Individually, each of these arguments is voiced about as often as all arguments on management taken together.

The directors' emphasis on wealth or net worth is well in line with the interpretation of credit limits as risk management tool and thus provides support for the first hypothesis put forward at the end of Section 3.3. The second result of the descriptive exercise, i.e. the high importance attributed to liquidity – both on the asset and liability side of the balance sheet – suggests that my second hypothesis on the Bank's use of the credit limits to enforce some minimum standard for liquidity adequacy could be correct as well. In the next step, I thus check whether the third hypothesis is also borne out by the data: did the Bank differentiate between financial and non-financial firms? As argued in Section 3.3, moral hazard in liquidity provision first and foremost concerned financial institutions, which were also the most important (in fact almost exclusive) borrowers at the discount

[290] Comments under (17) could arguably also be classified as a statement on the possibility of future losses and thus the future equity position of the counterparty.

[291] Even though it can be argued that the voluntary dissolution of firms could have had an economic rationale; c.f. my arguments on *Liquidationen* in Chapter I of this dissertation.

window. Table 3.23 shows the frequency of arguments distinguished according to whether the firm assessed was non-financial or financial, where I further distinguish between joint stock banks, savings banks and cooperatives on the one hand and unregulated private banks on the other. In line with the groups suggested above, and to make the results easier to read, I aggregated voluntary dissolutions, death of the owner and relocation of the firm into one group. The same has been done for the arguments relating to the ownership structure (change in ownership or legal form, withdrawal of partner) and to the quality of the management (including experience, risk taking and payment moral). The arguments central to my story including equity, liquidity and leverage are all analyzed separately. The remaining categories, which only appear in a handful of cases, are not included in the table below.

Table 3.23: Justifications given in the assessment of credit limits by counterparty type (1909-1913)

	Non-financial	Private banks	Regulated FIs	Total	Non-financial	Regulated FIs	t-value
	(Number of observations)				(in %)		(equality of means)
Dissolved, relocated, death	505	25	10	540	28.8	4.4	7.91***
Bankrupt	52	1	1	54	3.0	0.4	2.19**
Owners, partners, legal form	202	7	4	213	11.5	1.8	4.50***
Equity	413	18	22	453	23.5	9.9	4.67***
Leverage	37	2	33	72	2.1	14.8	-9.89***
Asset liquidity	55	1	37	93	3.1	16.6	-9.17***
Refinancing risk	67	57	62	186	3.8	27.8	-14.35***
Management	38	5	30	73	2.2	13.5	-8.88***
Volume of business	46	0	2	48	2.6	0.9	1.57
Absence	278	9	13	300	15.8	5.8	3.99***
Total decision	3520	188	570	4278	-	-	-
Decisions where reason was given	1754	129	223	2106	100	100	-

Several reasons can be given for decisions on credit limits. Thus, sum of columns can be larger than total number of changes as given in the last column.

Source: OeUB directorate protocols (Vienna; 1909-1913)

Table 3.23 shows that there were clear differences between the assessments of non-financial and regulated financial firms. Obviously, as regulated financial firms operated under limited-liability regimes, arguments concerning ownership appear significantly more often for non-financial firms. Perhaps less evident, but very much in line with my hypothesis about the different treatment of financial and non-financial firms, wealth featured significantly more prominently in decisions on limits of non-financial firms than for financial institutions. For the latter, and again in line with my hypotheses, leverage and liquidity, both on the asset and the liability side, are much more prevalent. Together, leverage and liquidity were named in about 60% of all decisions concerning banks, while being only mentioned in 9% of decisions on NFIs. Reversely, 35% of assessments of NFIs mentioned wealth or changes in owners or partners, while only 12% of FIs' assessments did so. Interestingly, management quality also mattered more for financial firms. For turnover, no significant difference can be found.

3.5.3 Explaining credit limits of financial institutions: econometric evidence

In the previous subsection I showed descriptively that both liquidity and leverage concerns motivated the majority of changes in the credit limits of financial institutions. The fact that considerations with regard to the liquidity of institutions emerge as the most important factor in the descriptive evidence bolster my hypotheses and interpretation of credit limits. Credit limits appear to have generated leverage for the OeUB to enforce a

form of proto-regulation on counterparties appearing at the discount window. By enforcing these capital and, most importantly, liquidity standards, the Bank effectively counteracted the build-up of moral hazard in normal times which could have otherwise derived from its willingness to stand ready for free lending policies as a lender of last resort during liquidity crises.

In this subsection, I proceed to examine this relationship more formally in regression analysis. For this purpose, I match the credit limits collected for regulated financial institutions with their corresponding balance sheet data. There are two reasons why I focus my analysis on financial institutions. First, for most non-financial firms as well as for private banking houses no balance sheet information is available. Second, as shown in the previous section, borrowing at the OeUB was almost exclusively done by regulated banking institutions. If the OeUB intended to check moral hazard, liquidity management should have constituted the Bank's biggest concern.

Therefore, my aim is to analyze whether the descriptive justifications, which the OeUB provided when reassessing credit limits, are actually borne out in the institution-level data. In other words, I would like to find out whether the empirical evidence confirms that the Bank showed enough "teeth" to turn its concerns about counterparty liquidity (and leverage) into a a quasi-binding regulatory framework. In order to do so, I estimate three regression models.

The first model seeks to explain the level of credit limits assigned to a specific financial institution. I use my pooled cross-section of credit limits for cooperatives, banks and savings banks and regress these data on a list of financial variables reflecting, *inter alia*, size, age, leverage and liquidity of the individual institution. I assume that the OeUB always used the latest available balance sheet data when taking decisions on credit limits. To be sure, the OeUB is likely to have benefited from additional private information on its counterparties. Since this information is not available to us, I need to resort to publicly available data. Therefore, whenever data availability is not a constraint, I draw on financial information from year $y-1$ to explain the level of credit limits in year y. This strategy works perfectly for banks and savings banks. In contrast, balance sheet data for credit cooperatives is not always available for all institutions in every relevant year. Consequently, I always employed the next closest balance sheet publication available in the sources. I did not, however, use balance sheet data published in the years after the credit decision was taken. Taking the lagged dependent variable structure of my regressions seriously is not only important to proxy as accurately as possible the information available to the OeUB, but also to limit reverse causality issues that could bias my results. Under the assumption that the Bank's attempt to enforce liquidity and leverage standards was effective, the decision to lower the credit limit of a particular institution, due to e.g. a highly illiquid asset structure, should have triggered corrective measures by the institution concerned. This feedback of credit limit decisions on financial variables would introduce simultaneity bias into regressions.

Simultaneity is of course not the only endogeneity concern I face in my cross-sectional regressions. Omitted variable bias might be a problem that I cannot directly tackle in my setting: I would need instrumental variables

for all my regressors of interest to claim full causality. Hence, formally I think of my results reported below as (robust) conditional correlations. There are, however, two additional points that are worthwhile mentioning in this context. First, as will be clear from the results tables below, the fact that my cross-sectional specifications explain a large portion of the variation in the credit limits provides another, albeit not fully convincing, line of defense against potential omitted variable bias. Second, in my second and third model (c.f. Model 3.8 and Model 3.9 further below), in which I attempt to explain the levels and changes in credit limits in a panel setting, I employ both a fixed effects and a random effects estimator to tackle omitted variable bias more explicitly. To anticipate, my most important result, i.e. the importance of the liquidity situation of a financial institution in determining credit limits or changes therein, is robust to these specifications.

More formally, the cross-sectional model I estimate is specified as follows:

$$C_i = \alpha + \beta SIZE_i + \gamma AGE_i + \delta LEV_i + \phi LIQ_i \ (+\mathbf{\Lambda}'\mathbf{X}_i) + \varepsilon_i \tag{3.7}$$

where C_i is the level of the credit limit of institution i, $SIZE_i$ stands for total assets, AGE_i represents the years since the foundation of institution i, and LEV_i is the leverage ratio (the ratio of total assets to paid-up equity plus ordinary reserves). For LIQ_i, I try four alternative definitions: first, the ratio of (rediscountable) bills to total assets; second, the ratio of bills to total deposits; third, the ratio of bills and cash to total deposits; and fourth, a measure of asset illiquidity that is computed as the share of mortgage loans, (secured) advances, and real estate owned in total assets. I consider the four independent variables $SIZE_i$, AGE_i, LEV_i, and LIQ_i to constitute my baseline set of regressors.

$\mathbf{\Lambda}'\mathbf{X}_i$ is a vector of additional control variables that I include in my regressions to account for institutional type (a dummy for banks and savings banks) and to test for the robustness to the inclusion of other variables. $\mathbf{\Lambda}'\mathbf{X}_i$ includes the following variables. First, it contains the ratio of rediscounts to total assets to proxy for the extent to which the intermediary in question relies on short-term credit from other institutions. I include this variable because the Bank sometimes mentions the "use of multiple sources of credit" (*mehrseitige Kreditbenützung*) as a justification for reducing (or not increasing) credit limits. Although at first sight the rationale behind this argument appears to be similar to the one captured in the leverage ratio, its use might also reflect liquidity concerns that I do not capture fully with LIQ_i: a high share of short-term liabilities that are not deposits might add to liquidity concerns. Another variable I include in $\mathbf{\Lambda}'\mathbf{X}_i$ is the return on equity, i.e. a measure for bank profitability that I consider mainly as another proxy for effective management (c.f., however, below for a reason why it might not be a good proxy for this purpose). I also consider whether or not an institution operates as an affiliate for the OeUB and I create a dummy variable to reflect this aspect. The summary statistics for all variables discussed in this paragraph are displayed in Table 3.24. Finally, I also check the robustness of my cross-sectional regressions against the inclusion of region and year fixed effects. Since I run the cross-sectional regressions with some logarithmized variables, I also report the summary statistics for the

transformed variables where applicable. I transform the variables C_i, $SIZE_i$ and AGE_i, that is, the variables measured in units that lead to large positive values, because specification tests (so-called link tests) and scatter plots show a (much) better fit.

Table 3.24: Cross sectional regressions: summary statistics* of variables in levels/logarithmized variables

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P25	P50	P75	P99
Credit limit (in 1000 K)	423	219.67	326.09	0.00	2,000	0.00	40.00	100.00	260.00	1,500.00
Credit limit (in 1000 K, natural log)	423	4.74	1.15	3.00	7.60	3.00	3.91	4.61	5.70	7.31
Size (total assets, in 1000 K)	423	5,306.46	6,277.87	65.48	45,663.30	209.75	1,223.16	2,972.96	6,786.52	31,152.95
Size (total assets, in 1000 K, natural log)	423	14.89	1.15	11.09	17.64	12.25	14.02	14.91	15.73	17.25
Age (in years)	423	26.91	13.4	1.00	57.00	2.00	15.00	28.00	38.00	52.00
Age (in years, natural log)	423	3.09	0.75	0.00	4.04	0.69	2.71	3.33	3.64	3.95
Leverage (total assets to equity)	423	17.35	32.27	1.33	563.02	2.48	6.11	11.70	20.05	112.65
Liquidity 1 (bills to total assets)	394	0.37	0.30	0.00	0.98	0.00	0.12	0.27	0.58	0.98
Liquidity 2 (bills to total deposits)	394	0.90	1.63	0.00	12.77	0.00	0.14	0.35	1.07	9.43
Liquidity 3 (bills and cash to total deposits)	423	0.87	1.64	0.00	13.07	0.00	0.13	0.32	1.04	8.58
Illiquidity (mortgages, advances and real estate to total assets)	423	0.37	0.30	0.00	0.95	0.00	0.03	0.41	0.63	0.93
Refinancing (rediscounts to total assets)	291	0.09	0.14	0.00	0.62	0.00	0.01	0.02	0.11	0.58
Profitability (return on equity)	403	0.14	1.91	-1.00	37.37	-1.00	0.05	0.09	0.16	1.37
OeUB affiliate dummy	423	0.12	0.32	0.00	1.00	0.00	0.00	0.00	0.00	1.00
Bank dummy	423	0.07	0.26	0.00	1.00	0.00	0.00	0.00	0.00	1.00
Savings bank dummy	423	0.33	0.47	0.00	1.00	0.00	0.00	0.00	1.00	1.00

*Sample for baseline regression displayed in column (6) in Table 3.25.

My priors with regard to the sign of the independent variables are the following. I hypothesize $SIZE_i$ to have a positive sign because ceteris paribus bigger institutions are expected to have higher credit limits. I also anticipate AGE_i to bear a positive sign because an institution's age is likely to be positively correlated with a more established reputation and potentially also a more reliable management. LEV_i, in contrast, should go with a negative sign as higher leverage ratios would reflect a riskier institution. The sign of LIQ_i should vary depending on the definition: while $LIQ1_i$, $LIQ2_i$ and $LIQ3_i$ should be positively correlated with an institution's credit limit, whereas the ratio of illiquid assets to total assets is hypothesized to bear a negative sign. A higher ratio of rediscounts to assets should be negatively correlated with the level of credit limits. The sign on profitability may be either positive or negative since a higher return on equity ratio may be achieved by higher profits and/or lowering capital ratios. Finally, using credit cooperatives as my baseline category, I expect both the bank and the savings bank dummy to be positive reflecting the fact that the latter institutions are usually an order of magnitude bigger and provide financial services for a larger territory (including branches in the case of banks) than the former. Although some of this variation may be captured by $SIZE_i$, non-linearities in the size of institutions depending on their type might be better captured with type dummies. Also, it is likely that there are further characteristics associated with institutional type I cannot capture with other variables. For example, the available information on sometimes tiny credit cooperatives is likely to be much scarcer (as is indeed suggested by my sources) than for larger and established banks or savings banks. Furthermore, their different business models (c.f. above) might make the OeUB consider these institutions differently when setting credit limits. In order to check for potential systematic differences in the coefficients for the different institutional types, I also run my regressions separately for credit cooperatives on the one hand and banks and savings banks on the other hand.

Table 3.25: Cross-sectional regressions: explaining levels of credit limits (baseline)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Size	1.08***	1.09***	1.13***	1.19***	1.18***	1.17***	1.20***	0.98***	0.94***	0.92***	0.95***
	(0.04)	(0.04)	(0.04)	(0.06)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Age		-0.03	-0.05	0.01	0.05	0.05	0.02	0.22***	0.24***	0.22***	0.19***
		(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.04)	(0.04)	(0.04)
Leverage ratio			-0.15	-0.12	-0.11	-0.11	-0.10	-0.06	-0.06	-0.07	-0.08
			(0.10)	(0.09)	(0.09)	(0.09)	(0.09)	(0.07)	(0.07)	(0.07)	(0.08)
Liquidity 1				0.10**				0.21***			
				(0.05)				(0.05)			
Liquidity 2					0.15***				0.12***		
					(0.04)				(0.03)		
Liquidity 3						0.16***				0.11***	
						(0.04)				(0.03)	
Illiquidity							-0.18***				-0.20***
							(0.05)				(0.05)
Bank dummy								1.63***	1.50***	1.50***	1.39***
								(0.15)	(0.15)	(0.15)	(0.16)
Savings bank dummy								0.45***	0.30***	0.31***	0.48***
								(0.10)	(0.09)	(0.09)	(0.09)
Constant	4.81***	4.81***	4.82***	4.83***	4.83***	4.81***	4.84***	4.52***	4.58***	4.57***	4.56***
	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.06)	(0.05)	(0.05)
Observations	489	471	440	400	394	423	435	400	394	423	435
R-squared	0.57	0.57	0.59	0.60	0.61	0.60	0.60	0.68	0.68	0.67	0.67
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses; coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.
*** p<0.01, ** p<0.05, * p<0.1

I report the results on my first set of baseline regressions in Table 3.25. In column 1-4 I progressively add more regressors from the set of main independent variables to the regression. In column 4-7 I change my definition of LIQ_i as described above. Columns 8-11 report the results for the same specification as columns 4-7 with the exception that I include institutional type dummies. All continuous variable coefficients are directly comparable: they represent the increase in the natural logarithm of the credit limit triggered by a one standard deviation increase in the (natural logarithm of the) regressor. The results in Table 3.25 can be summarized as follows. As might be expected for regressions explaining the levels of credit limits, size is estimated to be a highly statistically and economically significant explanatory variable in all baseline regressions: my specification means that a one standard deviation increase in the log of $SIZE_i$ leads to an increase in the log of the credit limit by 0.92 to 1.20. Since my specification is nonlinear, the economic meaning of this coefficient varies depending on the value of $SIZE_i$ one considers. Evaluated at the mean value of $SIZE_i$, i.e. 5.3 mill. *Crowns*, the marginal effect of 1.20 amounts to an increase in the credit limit of approximately 29,500 *Crowns*. The same logic applies to AGE_i although this regressor is not statistically different from zero in specifications without institutional dummies and economically much less significant than $SIZE_i$. Using the highest coefficient obtained for AGE_i (0.24) I compute a marginal effect evaluated at the mean of AGE_i of roughly 2,000 *Crowns*. Maybe surprisingly, the leverage ratio, LEV_i, does not emerge as an important predictor in my baseline regressions although it bears the anticipated sign. LIQ_i, in turn, is estimated very precisely, no matter which definition I choose. The sign of the coefficient is intuitive and its size ranges between 0.1 and 0.21, the latter of which would translate into a marginal effect of roughly 30,000 *Crowns*.[292] Finally, the institutional type dummies stand out as highly statistically and economically significant predictors. Overall, the baseline regressions also do a very good job in capturing the cross-sectional variation in the levels of credit limits (R-squared between 0.57 and 0.68 depending on the specification).

Based on the results in Table 3.25, it seems worthwhile digging a little deeper to explore potential systematic differences in the estimated coefficients due to different institutional types included in the baseline sample. I motivate this decision by the large observed changes in the coefficients on AGE_i, but also on the basis of the seemingly high importance of type dummies. I therefore estimate Model 3.7 separately for savings banks and banks on the one hand, and credit cooperatives on the other hand. This strategy will also be helpful for direct comparisons with Models 3.8 and 3.9, which, due to limited data availability for cooperatives, use panel data for savings banks and banks only to analyze levels of and changes in credit limits. In order to simplify the results tables, I choose "Liquidity 3" as my main definition of LIQ_i for all regressions henceforth. I select "Liquidity 3" to err on the conservative side, because it bears the lowest coefficient in my baseline models including institutional type dummies. To be sure, this decision biases the coefficients on LIQ_i reported in Table 3.26 and 3.28 downwards.

[292]Since LIQ_i is not logarithmized, the marginal effect in *Crowns* needs to be computed by exponentiating the difference induced in the dependent variable, evaluated at its mean.

Table 3.26: Cross-sectional regressions: explaining levels of credit limits (different samples and additional controls)

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Size	1.47***	1.49***	1.41***	1.37***	1.21***	1.37***	1.37***	0.77***	0.74***	0.92***	0.95***	0.98***	1.06***
	(0.08)	(0.08)	(0.09)	(0.08)	(0.08)	(0.10)	(0.10)	(0.06)	(0.06)	(0.06)	(0.07)	(0.07)	(0.14)
Age		-0.05	-0.08**	0.11*	0.24***	0.20***	0.21***		0.09	0.16***	0.22***	0.27***	0.26***
		(0.04)	(0.04)	(0.06)	(0.06)	(0.06)	(0.06)		(0.06)	(0.05)	(0.05)	(0.06)	(0.08)
Leverage ratio			-0.11	-0.05	-0.00	0.02	0.01			-0.97***	-0.94***	-0.91***	-0.99*
			(0.09)	(0.07)	(0.04)	(0.04)	(0.05)			(0.24)	(0.23)	(0.26)	(0.58)
Liquidity 3				0.45***	0.21**	0.16**	0.15**				0.06*	0.04	0.11**
				(0.14)	(0.09)	(0.08)	(0.07)				(0.03)	(0.04)	(0.05)
Bank dummy					1.04***	1.14***	1.10***						
					(0.18)	(0.20)	(0.22)						
Refinancing							-0.32						-0.14**
							(0.31)						(0.07)
Profitability							0.17						1.37
							(0.38)						(1.21)
OeUB affiliate dummy							-0.01						0.94***
							(0.10)						(0.36)
Constant	4.79***	4.77***	4.84***	4.95***	4.78***	4.41***	4.20***	4.58***	4.55***	4.43***	4.42***	4.95***	4.70***
	(0.07)	(0.07)	(0.08)	(0.08)	(0.07)	(0.25)	(0.27)	(0.05)	(0.06)	(0.06)	(0.06)	(0.18)	(0.33)
Observations	174	174	174	168	168	168	166	315	297	266	255	255	116
R-squared	0.62	0.62	0.64	0.69	0.75	0.80	0.81	0.37	0.37	0.45	0.47	0.52	0.63
Robust SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Region FE	No	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Sample	B/SB	B/SB	B/SB	B/SB	B/SB	B/SB	B/SB	Coop	Coop	Coop	Coop	Coop	Coop

Robust standard errors in parentheses; coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.
*** p<0.01, ** p<0.05, * p<0.1

Table 3.26 reports the results for the baseline regressions on the two separate samples. Columns 1-5 report baseline regression results for banks and savings banks while columns 8-11 summarize the corresponding coefficients for credit cooperatives. In column 6 and 12, I reestimate the full baseline specification, again separately for banks and savings banks versus credit cooperatives, but include both year fixed effects and regional fixed effects. Finally, in column 7 and 13 I add three further control variables mentioned above on top of year and region fixed effects. Starting from the full specifications in columns 5 and 11, the results for the separate sample regressions allow for a fairly clear statement concerning the existence of systematic differences across the two samples. Whereas liquidity seems to be the driving financial variable in the determination of credit limits for banks and savings banks, the leverage ratio appears to dominate the scene for credit cooperatives. This statement is robust to the inclusion of additional controls and the inclusion of time and geographic fixed effects. Furthermore, this conclusion does not only emerge from the estimated coefficients, but also from the relative importance of these variables in capturing the variance in the levels of credit limits. When employing the banks and savings banks (credit cooperatives) sample, the inclusion of LIQ_i (LEV_i) induces a 5pp (8pp) increase in the R-squared; LEV_i (LIQ_i), in contrast, only contributes with 2pp to this measure.

My findings are consistent with the interpretation that the OeUB considered capitalization as a more important factor for smaller counterparties.[293] Rather than fearing an over-reliance on central bank liquidity, the OeUB appears to have judged counterparty default risk as the most relevant problem related to its lending to

[293]c.f. above for a descriptive discussion of how the justification for changes in credit limits differed across counterparty types.

credit cooperatives. At the same time, the Bank saw liquidity as the main concern for large counterparties such as banks and savings banks which accounted for the lion share of OeUB discounts. The OeUB's focus on the liquidity management of these institutions is not surprising. As I have argued above, the Bank effectively used credit limits to enforce appropriate liquidity standards on its counterparties. The OeUB drew on its credit limit system to counteract the build up of moral hazard in normal times which could have otherwise derived from its readiness to lend freely in liquidity crises.

Two more aspects are worthwhile mentioning. First, when I estimate Model 3.7, the banks and savings banks sample achieves a much better fit than my sample for credit cooperatives. Although the lower underlying data quality for credit cooperatives constitutes a possible explanation for this difference, I am not able to make any definitive statement regarding this point. Second, given the high economic and statistical significance of the bank dummy in the column 5, 6 and 7 in Table 3.26, one might be tempted to ask whether a further break-down into subsamples, i.e. banks vs. savings banks, would be useful. I am generally sympathetic to this idea and I might follow up on this point at a later stage once I have collected more credit limit data. I cannot, however, operationalize a further separation at this point because I only have 30 banks in my credit limit cross-section which makes meaningful econometric analysis questionable.[294]

As briefly mentioned above, my cross-sectional results face some obvious identification concerns, most importantly, from omitted variable bias. I now address these concerns more explicitly in a panel setting. Although literally all of the banks and savings banks only appear once in my cross-sectional data set on credit limits, I can exploit the structure of the data recorded by the OeUB for each reassessment to construct a panel data set. First, every time a counterparty was (re-)assessed, the rating books also reported the old limit. Second, as long as a counterparty was assessed once between 1909 and 1913, I can exploit the fact that the absence of reassessments for this counterparty in the other years constitutes valuable information too. This statement is true because no information in this context simply implies the OeUB kept the credit limit at its previous level. Having constructed a panel data set on credit limits, I am able to match this data with my balance sheet panel data set for banks and savings banks. Equation 3.8 represents the new model using panel data. I estimate equation 3.8 first using a "naive" fixed effects specification that controls for constant unobserved heterogeneity at the institution-level. Second, I also estimate equation 3.8 drawing on the system GMM estimator (augmented Arellano-Bond estimator) to account for the dynamics involved in the model. Since I cannot assume that my independent variables are strictly exogenous, all of them feed into my "GMM-style" instrument set (except the year dummies).

$$C_{i,t} = \alpha + \tau C_{i,t-1} + \beta SIZE_{i,t-1} + \delta LEV_{i,t-1} + \phi LIQ_{i,t-1} \ (+\mathbf{\Lambda}'\mathbf{X}_{i,t-1}) + \eta_i + \kappa_t + \varepsilon_{i,t} \tag{3.8}$$

[294] A third aspect that could be mentioned for completeness is that when I estimate Model 3.8 I end up with less observations than displayed in the summary statistics and less observations than I have for estimating Model 3.9 below. The reason for this difference is that I attempt to make the first set of panel regression results directly comparable to the cross-sectional results. Hence, I again use the natural logarithm of the credit limit as my dependent variable which leads to the elimination from the sample of all observations with zero limits at a specific point in time.

where all main regressors are defined as above but vary over time, η_i is an institution-level fixed effect, κ_t is a year-fixed effect and $\varepsilon_{i,t}$ is now a time-varying error. The equation also includes the lagged dependent variable. I exclude $AGE_{i,t-1}$ from the specification because in the panel setting this variable would merely capture an increasing linear time trend. The bank fixed effects, however, will capture most of the variation in age across institutions. The summary statistics relevant for Model 3.8 are reported in Table 3.27.

Table 3.27: Panel regressions: summary statistics of variables in levels

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P25	P50	P75	P99
Credit limit (in 1000 K)	597	294.64	400.27	0.00	2,000.00	0.00	0.00	150.00	400.00	2,000.00
Credit limit (in 1000 K, natural log)	445	5.46	1.09	3.00	7.60	3.00	4.61	5.52	6.21	7.60
Change in credit limit (in 1000 K)	597	36.11	131.61	-200.00	1,000.00	0.00	0.00	0.00	0.00	800.00
Size (total assets, in 1000K)	597	8,750.47	8,136.60	385.54	47,150.85	563.33	3,087.52	5,754.71	12,532.19	43,114.96
Size (total assets, in 1000K, natural log)	597	15.58	0.93	12.86	17.67	13.24	14.94	15.57	16.34	17.58
Leverage ratio (total assets to equity)	494	28.97	44.02	1.33	563.02	2.11	13.78	20.11	26.59	244.55
Liquidity 3 (bills and cash to total deposits)	587	0.39	1.54	0.00	29.9	0.00	0.07	0.13	0.25	4.82
Refinancing (rediscounts to total assets)	597	0.02	0.05	0.00	0.63	0.00	0.00	0.01	0.02	0.20
Profitability (return on equity)	493	0.04	1.31	-28.73	0.97	-0.23	0.04	0.07	0.12	0.82
OeUB affiliate dummy	597	0.22	0.41	0.00	1.00	0.00	0.00	0.00	0.00	1.00

The estimation results for Model 3.8 are summarized in Table 3.28. Columns 1-4 summarize the results deriving from the fixed effect estimator. Column 5 re-estimates the full specification in column 4 using a random effects estimator. Since the Hausman specification test strongly rejects the null that differences in the coefficients across column 4 and 5 are not systematic (chi-squared statistic of 103.55), the fixed effects estimator is my model of choice. In column 6 I therefore add further controls to my fixed model from column 4 to test its robustness. All coefficients are standardized and are directly comparable to the cross-sectional results above. Although the results reported in Table 3.28 are somewhat weaker than in the cross sectional specifications, they show that the conclusion regarding liquidity as an important driver of credit limits assigned to banks and savings banks continues to hold also in a fixed effects setting. The cross-sectional specification using year and regional fixed effects as well as additional controls reported column 7 of Table 3.26 yields a coefficient on "Liquidity 3" of 0.15. The comparable panel specification in column 6 of Table 3.28 shows a coefficient of 0.13. Evaluated at the mean of $C_{i,t}$ (5.46), this coefficient means that a standard deviation increase in the liquidity ratio is associated with an increase in the credit limit by approximately 20,000 *Crowns*. The results obtained when using a system GMM estimator are reported in Table 3.29. In comparison to the naive estimation results, the coefficient on "Liquidity 3" falls to 0.07 but it remains a significant predictor of the level of credit limits. In addition, in contrast to earlier results, the system GMM estimates suggest that the leverage ratio also played an important role in determining bank-level credit limits.

Having tested the robustness of my cross-sectional level results in a panel context, I now turn to the final set of regression models I estimate. I am interested in whether financial variables can also help explain changes in credit limits, rather than merely their levels. Equation 3.9 represents my attempt to model the dynamics

Table 3.28: Fixed effects panel regressions: explaining levels of credit limits

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Lagged credit limit	0.42***	0.42***	0.42***	0.91***	0.42***	0.35***
	(0.09)	(0.09)	(0.09)	(0.02)	(0.09)	(0.06)
Size		0.08	0.08	0.09***	0.07	0.23*
		(0.10)	(0.10)	(0.02)	(0.11)	(0.12)
Leverage ratio			-0.19	-0.28***	-0.20	-0.31
			(0.12)	(0.10)	(0.12)	(0.34)
Liquidity 3				0.04***	0.03*	0.13***
				(0.01)	(0.01)	(0.04)
Refinancing						-0.08***
						(0.02)
Profitability						-0.01
						(0.02)
OeUB affiliate dummy						0.00
						(0.04)
Constant	3.16***	3.19***	3.18***	0.55***	3.18***	3.57***
	(0.46)	(0.48)	(0.48)	(0.14)	(0.48)	(0.30)
Observations	391	391	390	389	389	337
R-squared	0.91	0.92	0.93	0.95	0.93	0.91
Number of panels	106	106	106	105	105	105
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
B/SB FE	Yes	Yes	Yes	No	Yes	Yes
B/SB RE	No	No	No	Yes	No	No

Robust standard errors in parentheses.

Coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

Table 3.29: System GMM panel regressions: explaining levels of credit limits

VARIABLES	(1)	(2)	(3)	(4)	(5)
Lagged credit limit	0.98***	0.96***	0.95***	0.93***	0.89***
	(0.02)	(0.02)	(0.03)	(0.03)	(0.04)
Size		0.05	0.06*	0.06	0.09
		(0.04)	(0.04)	(0.04)	(0.05)
Leverage ratio			-0.12	-0.16*	-0.26***
			(0.09)	(0.09)	(0.10)
Liquidity 3				0.04***	0.07**
				(0.01)	(0.03)
Refinancing					-0.01**
					(0.00)
Profitability					0.01
					(0.01)
OeUB affiliate dummy					-0.06
					(0.04)
Constant	0.15	0.00	0.00	0.42**	0.62***
	(0.13)	(0.00)	(0.00)	(0.19)	(0.23)
Observations	391	391	390	389	337
Wald chi2	180.75	183.41	186.74	148.13	193.96
Number of panels	106	106	106	105	105
Robust SE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses.
Coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.
*** p<0.01, ** p<0.05, * p<0.1

involved in the assessment of credit limits:

$$\begin{aligned} DC_{i,t} = \alpha + \tau DC_{i,t-1} + \beta_1 SIZE_{i,t-1} + \delta_1 LEV_{i,t-1} + \phi_1 LIQ_{i,t-1} \ (+\mathbf{\Lambda_1}' \mathbf{X}_{i,t-1}) \\ + \beta_2 {SIZE^2}_{i,t-1} + \delta_2 {LEV^2}_{i,t-1} + \phi_2 {LIQ^2}_{i,t-1} \ (+\mathbf{\Lambda_2}' \mathbf{X^2}_{i,t-1}) + \eta_i + \kappa_t + \varepsilon_{i,t} \end{aligned} \tag{3.9}$$

where $DC_{i,t}$ is the change in the credit limit from year $t-1$ to t, and all other variables are defined as before. The major difference with regard to Model 3.8 is that equation 3.9 includes the squared values of independent variables alongside their levels. My reasoning behind this specification is the following. I do not regress changes in credit limits on changes in the independent variables because there is no economic rationale for why simple (lagged) changes in the regressors should be linearly correlated with changes in credit limits. The OeUB is likely to have had rough threshold values, i.e. levels, it considered as appropriate liquidity and leverage ratios for certain levels of credit limits and the type as well as size of the counterparties it assessed. I believe this thinking is implicit in modern banking supervision too. A banking supervisor would not request an increase in the capital buffer simply because the buffer level has changed, in particular if the buffer level still meets the legal requirements. Rather, she would make her assessment of the adequacy of the actually maintained buffer contingent on the current level of the buffer relative to the legal requirement or regulatory expectation. Consequently, whether an increase or decrease in the level, i.e. a change, in the liquidity or leverage ratios triggers a change in the credit limit depends on the previous level of liquidity or leverage ratios. These considerations are exactly what I am trying to capture in equation 3.9. The quadratic form of the model allows me to make the size of the marginal effect of changes in the level of the financial variables contingent on the actual level of the regressors. For example, given the size of the counterparty, and given bank as well as year fixed effects, the higher the level of the liquidity ratio, the less important an additional increase in the ratio should be for motivating changes in credit limits (and vice versa).

The results for the regressions explaining the changes in credit limits are reported in Table 3.30 and 3.31. The organization of columns correspond to the structure in Table 3.28. Since the Hausman specification test again strongly rejects the null that differences in the coefficients across column 4 and 5 in Table 3.30 are not systematic (chi-squared statistic of 38.38), the fixed effects estimation results in column 4 remain my preferred specification. Column 6 in Table 3.30 adds further controls as above. Columns 1 to 5 in Table 3.31 provide the analogous results for the system GMM estimator. Not surprisingly, the estimated coefficients in both Table 3.30 and 3.31 are substantially larger than in my previous regressions because the dependent variable now represents the absolute change in credit limits, rather than the natural logarithm of their levels.[295] In contrast to my regressions results in Tables 3.28 and 3.29, however, I find that none of my explanatory variables, except the lagged change in credit limits, is a significant predictor of changes in credit limits once the full vector of controls is employed. Some specifications suggest that liquidity and leverage mattered but the full specification points to the absence of any effect on the changes in credit limits. Nevertheless, the signs on the coefficients are still

[295] Of course, the reason why I cannot meaningfully take logs of the changes in credit limits is that this transformation would eliminate all reductions in limits and observations without changes from my regressions.

Table 3.30: Fixed effects panel regressions: explaining changes in credit limits

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Lagged change in credit limit	-0.33***	-0.34***	-0.34***	-0.17***	-0.33***	-0.32***
	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)
Size		-603.54	-638.96	-507.25***	-937.38	-952.06
		(651.27)	(658.57)	(160.07)	(698.51)	(731.38)
Leverage ratio			-116.80*	-116.67***	-127.96**	-97.74
			(59.32)	(41.40)	(63.71)	(111.12)
Liquidity 3				54.31	236.82*	176.12
				(35.47)	(133.72)	(123.40)
Refinancing						-3.70
						(18.37)
Profitability						-20.93
						(58.32)
Size (squared)		565.84	597.63	535.74***	942.14	980.49
		(695.98)	(702.31)	(165.10)	(757.05)	(789.25)
Leverage ratio (squared)			1,659.89**	2,015.20***	1,814.02**	1,563.18
			(671.58)	(638.30)	(723.44)	(1,207.58)
Liquidity 3 (squared)				-89.36	-356.93*	-130.31
				(65.07)	(187.59)	(266.06)
Refinancing (squared)						-35.16
						(42.22)
Profitability (squared)						-23.17
						(57.95)
OeUB affiliate dummy						-40.21*
						(24.04)
Constant	-10.69	-15.25	46.83	46.22	60.36	77.15
	(27.18)	(34.37)	(40.72)	(31.57)	(38.03)	(50.97)
Observations	479	479	478	473	473	473
R-squared	0.12	0.12	0.13	0.12	0.14	0.15
Number of panels	124	124	124	123	123	123
Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
B/SB FE	Yes	Yes	Yes	Yes	No	Yes
B/SB RE	No	No	No	No	Yes	No

Robust standard errors in parentheses.

Coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

Table 3.31: System GMM panel regressions: explaining changes in credit limits

VARIABLES	(1)	(2)	(3)	(4)	(5)
Lagged change in credit limit	-0.03**	-0.05	-0.08**	-0.13***	-0.14***
	(0.01)	(0.04)	(0.03)	(0.03)	(0.03)
Size		68.19	-152.21	-140.03	-184.38
		(178.26)	(229.39)	(274.90)	(217.02)
Leverage ratio			-110.10*	-27.26	30.37
			(61.70)	(53.32)	(51.44)
Liquidity 3				51.91	34.08
				(33.75)	(39.42)
Refinancing					3.21
					(15.58)
Profitability					-43.06
					(31.92)
Size (squared)		-49.53	173.20	165.28	209.41
		(182.61)	(233.66)	(281.40)	(222.34)
Leverage ratio (squared)			1,837.54**	757.63	175.28
			(813.04)	(771.25)	(770.46)
Liquidity 3 (squared)				-81.96	66.34
				(62.31)	(160.29)
Refinancing (squared)					-36.93
					(40.47)
Profitability (squared)					-46.33
					(32.12)
OeUB affiliate dummy					-8.72
					(16.70)
Constant	38.69***	0.11	130.23***	90.45**	62.35**
	(5.63)	(6.01)	(38.46)	(36.51)	(30.51)
Observations	479	479	478	473	473
R-squared	0.12	0.13		0.14	0.15
Number of panels	124	124	124	123	123
Robust SE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses.
Coefficients on continuous variables represent effect of 1 std.dev. increase in regressor.
*** p<0.01, ** p<0.05, * p<0.1

intuitive. In order to better understand the estimated coefficients as well as the total marginal effects, consider the following example. Since the coefficients in Table 3.30 and 3.31 are again standardized, an evaluation of the marginal effects at the mean of "Liquidity 3" (a ratio of 0.39) effectively means that the marginal effect of the quadratic term is zero. Hence, an increase in the liquidity ratio of an institution already exhibiting a liquidity ratio above average would tend to have a smaller marginal effect on the credit limit than a bank with a low initial liquidity ratio (and vice versa). Evaluated at the mean and keeping all other variables constant, an increase of one standard deviation in the liquidity ratio triggers an increase of roughly 34,000 *Crowns* (using the coefficient from column 5 in Table 3.31). One plausible explanation for the weak results in Table 3.30 and Table 3.31 might be that the model is misspecified. The inclusion of quadratic terms is only one possible way to model the relationship between levels in the explanatory variables and changes in credit limits. For future versions of this chapter, I plan to draw on multinomial regressions that would perhaps allow to better take into account the discontinuous nature of changes in credit limits (which are bunched around certain specific values) as described above in Table 3.21.

Overall, the bulk of the econometric evidence marshaled in this subsection shows that liquidity and capital indeed played an important role in the OeUB's determination of counterparty credit limits. These results bolster the interpretation of credit limits as a leverage tool used by the OeUB to enforce a form of proto-regulation on counterparties appearing at the discount window.

3.5.4 Transgressions of credit limits in normal times

Having identified the determinants of the levels and changes in credit limits, I now turn to the question of their enforcement. Here, two situations can be distinguished. In the first, the Bank tolerates a transgression of the limit, in the second, the Bank explicitly raises the credit limit in response to a counterparty's request. Small transgressions were tolerated in principle as long as it was clear that they would be temporary. Larger and longer-term transgressions, however, required a formal increase in the credit limit and were authorized only after a thorough cost-benefit analysis by the central bank. This section focuses on the first type of these events: temporary transgressions in normal times which did not trigger a reassessment of the underlying credit limit. I am mainly interested in understanding whether credit limits were binding, because enforcement is a necessary condition for my interpretation of credit limits as microprudential regulatory tools. Understanding how long transgressions were allowed to last in normal times, and whether and how they were addressed by the central bank is thus crucial for this study.

In principle, as the Bank made clear in the manual addressed to its clerks and the discount committees, transgressions of credit limits should be avoided under all circumstances. In practice, however, some flexibility was in order. The extent of utilization of a credit limit was not under the full control of the counterparty, as a counterparty's limit was not only affected by its own discounting but also by a third counterparty discounting

a bill carrying the counterparty's name. In addition, a bill carrying the counterparty's name could not only be discounted at the branch office, where the counterparty was domiciled, but also at any other branch office in the monarchy. These loans would only show up at the home branch office after some delay, making it *de facto* impossible for the branch to perfectly enforce the limit in practice.

Instead, the credit limits framework left room for some discretion at the local level as long as the Bank's safety and its aim of promoting "real, healthy" business could be maintained. The Bank manual emphasized that the branch offices' and their heads' compliance with the rules of the credit system had to be in line not only with the written provisions but also with the broader spirit of the framework. As the manual put it, "the head of the branch office must not believe that a merely mechanistic, literal implementation of the written provisions and the neglect of non-written implicit rules are sufficient to live up to his tasks". The manual provides some concrete examples for when strict abidance by the rules would be considered undesirable. First, bills should not be refused just because their discount would lead to a small transgression of the limit.[296] Second, according to the manual, it would not be advisable to refuse a relatively small submission by a counterparty, whose line of credit is currently exhausted, if the firm's credit account shows that several previously discounted bills are close to maturity, bringing the amount borrowed back below the limit in due course. The third example the manual explicitly mentions relates to the submission of firms located in another bank district. These submissions should not be categorically refused by a branch office simply because of their "external" nature. In particular, there would not be an *a priori* reason for rejecting these submissions, if the bills offered for discount reflected a real transaction (e.g. a sale of goods), had previously been accepted by reputable counterparties and happened to be submitted "externally" only due to a one-off business in a location outside the home bank district. Other negative examples of actions not to be followed by the clerks include the expansion of credit merely on the grounds of increasing the Bank's earning assets without due consideration of the quality of bills, and the imprecise screening of submitted bills merely on the basis of a previously impeccable credit history with the Bank.

That some leeway was granted in the implementation of the credit limits is particularly well documented for the cases of counterparties with the highest limits, those above 2 million *Crowns*. As already mentioned in Section 3.4, counterparties with limits above 2 million *Crowns* were monitored directly by the directors in Vienna and Budapest.[297] Indeed, every single board meeting in the period of observation had an agenda item entitled *Kreditbelastung der mit Krediten über K 2000/m bemessenen Firmen* ("Borrowing by firms with credit limits in excess of 2 million *Crowns*"). Under this point of the agenda, the secretary-general or the central inspector first briefly reported on the current level of borrowing in general and then specifically noted any transgressions by high limit counterparties. These quantitative reports given in the board meetings allow us to trace transgressions on the individual bank level. Transgressions were recorded for four monthly call dates,

[296] The manual gives the example of the case of a bill amounting to 10,800 *Crowns* when the remaining credit within the limit would only allow for 10,100 *Crowns* more.

[297] All other limits were controlled and enforced directly at the branch level. Unfortunately, I do not have systematic information concerning enforcement of these limits.

namely the 7th, the 15th, the 23rd and the last day of each month. I collected all reports for the years 1906 to 1911. During this period a group of 24 banks in total had exceeded their credit limit at least at one of the call dates.

In compiling this data, my goal was fourfold. First, I wanted to understand to what extent credit limit transgressions were concentrated or correlated in normal times. If particularly strong correlations of transgressions were to be observed, one could interpret this as evidence for the presence of common liquidity shocks hitting the banks in the sample. In other words, looking at correlations provides a simple test for whether the periods I declared as "normal times" are actually free from aggregate liquidity shocks. Second, I was interested in the actual levels of the transgressions: were these minor transgressions of a few thousand *Crowns* or do they seem substantial? Unfortunately, my analytical capacity is somewhat hampered by data availability in this regard: I cannot assess the transgressions relative to the actual credit limit because I do not have the information on the exact level for counterparties assigned an amount above 2 million *Crowns*. Third, I aimed at finding out the average duration of credit limit transgressions. Although I have no benchmark for what may be an acceptable "duration", I can at least derive two pieces of valuable information from this average calculation. On the one hand, this exercise provides a number I can subsequently compare to tolerations of transgressions in times of distress (c.f Section 3.6). On the other hand, it allows me to test whether transgressions lasted longer in some cities than others, providing some feeling for whether the directorate was able to enforce a relatively homogeneous policy in terms of tolerating transgressions at its different branches. A fourth aspect I would like to work on for future versions of this chapter goes beyond the descriptive and non-parametric analysis I conduct here. I would like to examine econometrically whether I can explain the duration of transgressions of individual counterparties by drawing on variables such as measures of aggregate liquidity demand (e.g. the spread between Bank and market rate, or the level of current account holdings at the central bank), measures of individual liquidity demand and covariates capturing the unwillingness of the Austro-Hungarian Bank to accept transgressions (e.g. computing the number of call dates a bank is already in excess of its limits, or coding comments made in the directorate meetings suggesting that banks have been urged to reduce their borrowing). Since I have not fully coded this data yet, I leave the econometric analysis of credit limit transgressions for a later stage.

Before diving into the actual analysis and description of the data, it seems important to briefly discuss representativeness and the possible implications of a lack thereof. After all, the data available to us comes from the biggest counterparties the OeUB assessed in the period of observation – all of which happen to be financial institutions. The main question is, of course, whether data on credit limit transgressions by these counterparties allow for valid inferences on the duration and dimension of transgressions in general. My intuition is that this is not the case. The nature of big counterparties is likely to cause an upward bias in both the duration and the extent of transgressions one would observe for other firms in normal times: the large banks and firms which were directly monitored by the directorates in Vienna and Budapest probably received more lenient treatments, simply because they played a pivotal role in their local economy and/or financial market. Forcing them to

de-leverage quickly could have important negative consequences, also for third parties. In Section 3.6, I show that similar considerations were indeed key to the OeUB's reasoning during the panic of 1912. Therefore, I consider the non-parametric results presented in the following paragraphs as upper bound estimates.

Figure 3.37: Transgressions of credit limits by counterparties with limits above 2 mill. *Crowns* (1906-1911; each line represents one bank)

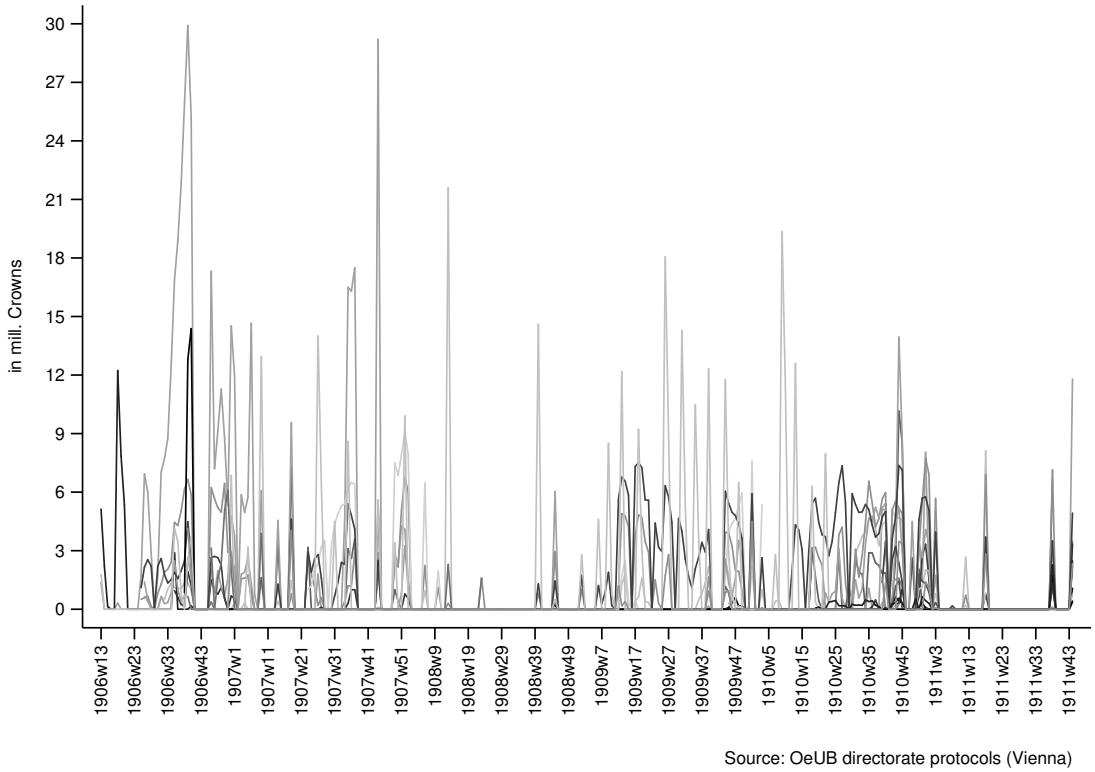
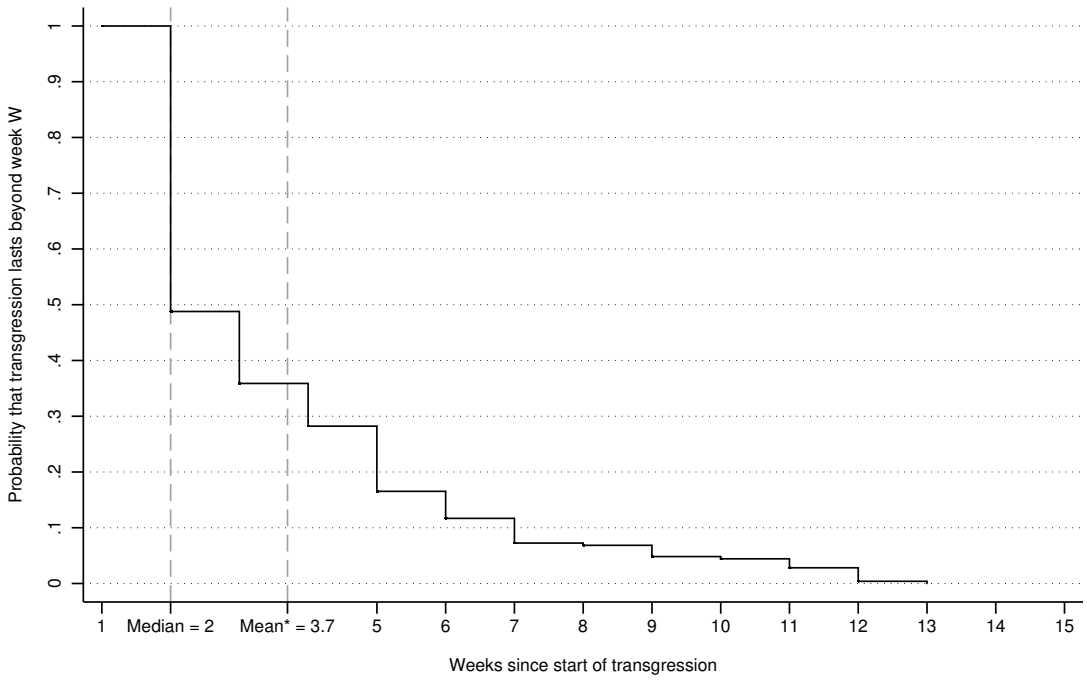


Table 3.39 in the appendix summarizes the correlation matrix for the credit limit transgressions of the 24 banks in my sample. Although some individual banks exhibit high correlations in their transgression dynamics, overall there seems to be enough variation in the correlation coefficients to claim that the years between 1906 and 1911 did not exhibit strong aggregate shocks that triggered many simultaneous, similarly timed, credit limit transgressions. This conclusion is confirmed by Figure 3.37. While there were prolonged periods in 1908 and 1911 during which no single transgression occurred, transgressions happened without any clear pattern outside these two time windows. As can be seen in Figure 3.37, however, transgressions were relatively frequent and could be very sizable. Great Viennese banks (*Wiener Bank-Verein*, *Wiener Giro- und Cassen-Verein* and *Anglo-Oesterreichische Bank*) dominated absolute transgression numbers. The *Anglo-Oesterreichische Bank* incurred the five highest breaches in my sample, with an enormous maximum transgression of approximately 30 mill. *Crowns*. Yet, putting these numbers into context relativizes the first impression. In comparison to the bank's total assets (660 mill. *Crowns*), its total discount portfolio (140 mill. *Crowns*) and its paid-up capital (100 mill. *Crowns*), the transgression sounds more reasonable – and, as I explained above, I do not know how high the credit institution's assigned limit actually was.

More importantly, although transgressions reached at times seemingly high levels, they were typically very short-lived as the spikes in Figure 3.37 suggest. In order to gain an idea about the average duration of credit

limit violations, I estimate a simple non-parametric survival curve based on the Kaplan-Meier estimator. For this purpose, I use the data in the following way. I define the moment when a given bank's transgression reverts to zero after a breach has occurred as my "failure" or "event" indicator. Hence, in my setting, each bank fails multiple times: it "dies" whenever it reverts back to zero after a credit limit transgression. To be precise, my subjects of study are not the banks themselves but the individual transgressions and their "failure", i.e. their end. This setting allows me to discard real time for analysis time: I can pool transgressions and check how long they are estimated to last once they have started. Figure 3.38 summarizes the results in one graph. More than half of the transgressions end directly in the second week following the breach: starting at $w = 0$, a median of 2 is associated with a fall in the probability that the transgressions continues beyond $w = 2$ of more than 50%. Figure 3.38 also suggests that banks benefited from an unofficial "close season" of around one week before they were expected to revert back and abide by their credit limit: after one week of transgression, the probability that the transgression would continue beyond $w = 1$ was literally 100%. In the years from 1906 to 1911, the average duration of transgressions amounted to 3.7 weeks. The difference between the median and the mean testifies to the fact that the estimated average is heavily influenced by a few very long transgressions. The latter were committed in particular by a large joint-stock banks located in Prague, the *Ústřední banka českých spořitelen*. Since this bank became subject to close scrutiny by the OeUB during the crisis of 1912, I leave a more detailed discussion of this case to Section 3.6.

Figure 3.38: Duration of credit limit transgressions: non-parametric Kaplan-Meier estimator



Source: OeUB directorate protocols (Vienna)

*Mean calculated by restricting to longest follow−up time

Transgressions of credit limits by banks with *Personalkredite* above 2 mill. *Crowns* were not merely passively reported on during the directorate meetings – they also formed the subject of discussions and deliberations on

how the Bank was supposed to react. When banks continued to exceed their limits for several call dates or when a number of banks at the same time accumulated large excess positions, the OeUB reacted by issuing warnings that borrowing amounts should be brought back within the credit limit as soon as possible. The minutes of the board meetings then typically contained a comment that "the necessary steps had been taken" with regard to the transgressions. As mentioned above, I intend to test econometrically whether these warnings accelerated the decrease of a given counterparty's *Belastung* in future versions of this study. Since I observe multiple transgressions per bank, I will be able to test the effect of OeUB warnings in semi-parametric and parametric survival regressions including bank-fixed effects (stratification on the bank-level) once I have collected the relevant data. For the moment, I propose to test the effectiveness of OeUB policy reactions to transgressions indirectly. If, as I show in Table 3.39, transgressions were not systematically correlated, and under the hypothesis that limits were not enforced, i.e. assuming there were *no* standardized/homogeneous interventions (or only ineffective interventions) by the OeUB to bring exposures back below the limits, there is no *a priori* reason why the duration of transgressions should have been similar in different bank districts/locations. In contrast, the similarity of transgression dynamics in different locations would be suggestive evidence for some form of homogeneous disciplining force. I report the results of several tests for the equality of "survivor" functions across the seven locations in my sample in Table 3.32. None of the five standard tests I compute can reject the null of equality at the 5% confidence level and four out of five tests are unable to reject the null at any of the conventional confidence levels. In the absence of more formal econometric results, one should interpret these results with a grain of salt but I cautiously consider them to hint at the existence of effective OeUB enforcement.

Table 3.32: Tests for equality of survivor functions ($H0 = equality$)

City	Events observed	Events expected
Bielsko-Biała	5	5.49
Brno	11	11.01
Graz	16	21.38
Hradec Králové	9	9.8
Lviv	13	13.36
Prague	115	124.08
Vienna	79	62.87
Total	248	248
1) Log-rank test: $Chi2(6) = 11.37,\ Pr > Chi2 = 0.08$		
2) Cox test: $LR\ Chi2(6) = 6.38,\ Pr > Chi2 = 0.38$		
3) Wilcoxon-Breslow-Gehan test: $Chi2(6) = 7.91,\ Pr > Chi2 = 0.24$		
4) Tarone-Ware test: $Chi2(6) = 10.12,\ Pr > Chi2 = 0.12$		
5) Peto-Peto-Prentice test: $Chi2(6) = 10.12,\ Pr > Chi2 = 0.12$		

To conclude, in this subsection I have provided suggestive evidence that, while the Bank allowed counterparties to temporarily exceed their limits, such transgressions were expected to be short-lived and brought down quickly. In cases where transgressions persisted, the Bank issued warnings and could, *in extremis*, refuse the discounting of selected bills, a right which was explicitly granted in its statutes.

3.6 The operation of credit limits during a liquidity crisis: the banking panic of 1912

The previous sections analyzed the operation of the OeUB's credit limits system during normal times. I showed that both the levels and changes in the limits were driven by considerations related to a given counterparty's liquidity and leverage situation. Furthermore, I explained that credit limits were binding in principle, although short temporary transgressions were tolerated. Thus, contingent on a state of the world without generalized liquidity distress, credit limits functioned as effective preventative checks for the emergence of moral hazard. I now turn to an investigation of credit limits in a crisis context. As argued in Section 3.3 above, the OeUB's crisis policy is key to my interpretation of credit limits.

Prima facie, the tenet of Bagehotian "free lending" appears to be in direct contradiction to the enforcement of binding credit limits. As I show below, however, credit limit transgressions during a liquidity crisis were fully tolerated by the OeUB, leading to a *de facto* suspension of the limits in periods of distress. Contingent on a state of the world characterized by a general liquidity squeeze, and consistent with Bagehotian"free lending", credit limits became non-binding. Hence, the interpretation of the credit limits system as a system of "contingent rules". To illustrate this mechanism, I draw on a case study: the "forgotten" banking panic that erupted in the fall of 1912 (Jobst and Rieder, 2016). I argue that this event is well suited to analyze the operation of credit limits as "contingent rules". Since the board of the OeUB perceived the panic as an exogenously driven liquidity crisis, the panic of 1912 provided a clear rationale for triggering the emergency clause to temporarily suspend the credit limits.[298] After conveying a brief overview of the events in question, this section focuses on the OeUB's reaction to the crisis and the reasoning behind its policy reponses, as discussed and explained by its directors and board members.

3.6.1 Historical background

Between October and December 1912 the Austro-Hungarian Monarchy experienced a series of depositor runs mostly concentrated in but not restricted to the Northeastern provinces of Galicia and Bukowina. The runs were triggered by depositors panicking due to an imminent war with Russia, trying to convert their deposits into banknotes and hard cash.[299] The backdrop of the crisis was the unresolved political situation in the Balkans, on the southeastern border of the Austro-Hungarian Empire. The second half of the 19th century had seen the gradual emergence of new nation-states on the European territory of the Ottoman Empire. By

[298] As I analyze the behavior of the OeUB, it is not necessary for the argument that the crisis was truly exogenous: it is sufficient that the Bank perceived the crisis to be exogenous. However, as shown in a companion paper, deposit losses were unrelated to financial institutions' fundamentals: runs were directly caused by fears of an imminent war.

[299] At the time, the crisis was widely commented upon, but later treatments in the literature have relegated the events to a footnote, at best. Among contemporary economists, Dub (1914) and Neurath (1998) provide somewhat longer treatments. In the later literature, the crisis is briefly mentioned in Michel (1976) and März (1984), but no analysis is provided. In Jobst and Rieder (2016), we thus argue that the crisis of 1912 is a "forgotten" panic.

1912, Ottoman holdings had been reduced to a strip of lands ranging from the Adriatic to the Black Sea and separating Greece in the South from Montenegro, Serbia, Bulgaria and Austrian annexed Bosnia-Hercegovina to the North. The ambitions of the regional nation-states to further increase their territories at the expense of the Ottoman Empire created tensions between the Great Powers who entertained different views on the future of the Ottoman Empire, not only in the Balkans but also in Northern Africa and Asia. Russia strove for an access to the Mediterranean Sea and supported Bulgaria and Serbia. In the meantime, Austria-Hungary, home to a significant slavic population in Bosnia, Vojvodina and other parts of the Empire, saw these pan-Slavic policies as a threat to its delicate political balance. As a result, Austria had an interest in continued Ottoman rule to keep Serbian ambitions at bay.

In late 1912, Bulgaria, Greece, Serbia and Montenegro, who under Russian sponsorship had formed the Balkan League earlier in the year, seized the opportunity for an attack. Montenegro declared war on 8 October, Bulgaria, Greece and Serbia followed on 17 October. Quite to the surprise of contemporary observers, the allies enjoyed rapid victory and succeeded in driving the Ottomans out of almost all of their remaining possessions in Europe.[300] A first armistice was signed on 3 December. In the meantime the success of the allies risked to escalate beyond the Balkans and provoke an international crisis. The occupation of Albanian territory by Greek and Serbian forces alarmed Austria-Hungary and Italy who wanted to prevent Serbia from gaining access to the Mediterranean Sea, while Russia supported Serbian expansion. In this context, Russia moved troops closer to the Austro-Hungarian border in late November. While all great powers strove to keep the conflict at the regional level, the speed of events and the number of conflict partners in the region meant that the probability of Austria-Hungary and Russia getting dragged into a war was not insignificant, at least until mid-December, when the risk of an armed conflict subsided somewhat with the convocation of an international peace conference in London on 16 December.[301]

The possibility of war with Serbia, Russia or both raised significant fears among the Austrian public in the autumn of 1912. In case of war with Russia, the region most likely to become immediately affected was Galicia, a province to the north-east of the Austrian part of the Austro-Hungarian Empire. Galicia shared a long and open border with Russia. Suspicion was that in the case of a Russian attack, Austrian forces would retreat towards the fortified cities of Lviv (ger. *Lemberg*, pol. *Lwów*) and Przemyśl and concentrate on a move towards Warsaw, capital of Russian Poland, thereby leaving significant parts of Galicia exposed to Russian occupation. One reaction of the population was to withdraw money from the banks en masse. Already on 7 October, i.e. the day before the official declaration of war by Montenegro, the press reported that a general fear of war had led a significant number of depositors of the Municipal Savings Bank of the city of Krakow (ger. *Krakau*, pol.

[300] *Tresor*, 1912, p.417.

[301] This conference was attended by the ambassadors of Great Britain, France, Germany, Austria-Hungary, Russia and Italy as well as by delegates from the Balkan League and the Ottoman Empire and led to the conclusion of the Treaty of London on 30 May 1913. The treaty provided for the ceding of all former Ottoman territories west of the line between Enos on the Aegean Sea and Midia on the Black Sea to the Balkan League, except Albania, whose borders were to be settled by the Great Powers. After much discussion, the establishment of the Principality of Albania was agreed upon on 29 July 1913. However, as the Treaty of London had not addressed the delineation of borders between the members of the Balkan League, a new war broke out on 29 June among the former allies, pitting Bulgaria against Greece, Serbia and Montenegro, which were soon joined by Romania and the Ottoman Empire. The Second Balkan War ended on 10 August 1913 with a Bulgarian defeat.

Kraków), the second-largest city in Galicia, to demand the repayment of their deposits.[302] Within a few days similar runs targeted notably the Second Savings Bank in Krakow, the District Savings Bank, as well as the Galician Savings Bank in Lviv, which lost 2 million *Crowns* within two days.[303] The runs soon came to spread to the entire province of Galicia.[304] Over the following weeks, the runs apparently subsided, but returned with a vengeance when political tensions intensified in late November. Again, savings banks in Lviv, Krakow, Premyśl as well as other cities in Galicia faced heavy deposit withdrawals.[305] According to press reports, starting on 24 November the Bukovina Savings Bank in Chernivtsi (ger. *Czernowitz*, rom. *Cernăuți*) lost deposits at a daily rate of about 300,000 *Crowns*. It was reported that at times so many people assembled in front of the Bank that police had to intervene to keep order.[306] By the second week of December the Bank had lost a quarter of its total deposits.[307] Runs were also reported for regions not immediately threatened in the case of hostilities with Russia, ranging from Bohemia and Moravia, notably Děčín (ger. *Tetschen*), Levoča (ger. *Leutschau*), Ostrava (ger. *Mährisch Ostrau*) and Šluknov (ger. *Schluckenau*), Hungary (in the Csanad district as well as the towns of Csongrád, Prešov (ger. *Eperies*, hun. *Eperjes*) and Törökkanizsa (ser. Novi Kneževac) as well as Upper Austria.

The scale of the runs had a direct impact on the balance sheet of the Austro-Hungarian Bank. From early October, when the first runs had occurred, to the end of December 1912, banknotes in circulation rose from 2.4 billion *Crowns* to 2.8 billion *Crowns* or by roughly 15%. Over the same period, discounts and advances increased from 1.2 to 1.7 billion *Crowns* or by over 40%. Even though part of the increase was due to the typical December peak, currency in circulation was 300 million *Crowns* above the previous year on 23 December and still exhibited a surplus of 275 million *Crowns* on 31 December. The Bank also saw heavy demand for coins, both gold and divisional silver money, occasionally even nickel coins were found to be preferred to banknotes.[308] Ultimately, the pressure on bank deposits seems to have subsided in late December. While newspapers still reported runs almost daily in early December, none were featured after 15 December 1912.[309] By the end of the year some institutions even saw a slow return of depositors.

Contemporaries cited several reasons for the runs. Apparently, the main concern was not the stability of the savings banks themselves. Rather people believed rumors that the Austrian authorities would confiscate the savings banks' assets, notably their cash holdings (Neurath, 1998, p.303), in the case of war. This rumor explains the rather peculiar choice of arguments in the official announcements issued by provincial governors of the affected regions. Instead of stating that banks had sufficient cash holdings to pay out all deposits if need be, officials argued instead that the deposits had been invested in illiquid mortgage and municipal loans and

[302] *Salzburger Volksblatt*, 8 October 1912, p.4; *Tagespost*, 9 October 1912, p.3.
[303] *Reichspost*, 15 October 1912, p.7.
[304] *Neue Freie Presse*, 16 October 1912, p.17; *Pester Lloyd*, 16 October 1912, p.11.
[305] *Pester Lloyd*, 28 November 1912, p.9
[306] *Czernowitzer Allgemeine Zeitung*, 24 November 1912, p.4-5; 26 November 1912, p.3; 27 November 1912, p.3; 28 November 1912, p.4; *Pester Lloyd*, 27 November 1912, p.5.
[307] *Bukowinaer Post*, 10 December 1912, p.3.
[308] Bank general council meeting, 19 December 1912, OeNB archives 1912/I-4.
[309] The last reported run occurred in Csanád, today *Cenad*, in western Romania, c.f. *Czernowitzer Allgemeine Zeitung*, 15 December 1912 p.8.

could therefore not be taken away easily by the government.[310] Other rumors often lacked common sense: for example, concerns were voiced that the government would declare paper money worthless in the event of war – which arguably constitutes the last move a government would ever think of in this context.[311] While those latter fears were obviously unfounded, there were also rational choices behind some deposit withdrawals. For example, large estate holders and their families, who decided to move out of the threatened border region, as well as soldiers who were mobilized in late November, withdrew deposits to take some ready cash with them (Neurath, 1998, p.304).

3.6.2 The reaction of the Austro-Hungarian Bank: assessment of events and policy response

The first meeting of the General Council after the beginning of the runs took place on 25 October 1912. The secretary general reported that since the last meeting "events have taken place that will have a strong impact on the economic conditions in both parts of the monarchy".[312] Although he mentioned reactions on the stock markets, he mainly emphasized "unrest among depositors and concerns about the stability of [banks'] asset values".[313] Furthermore, the secretary general concluded that "for the moment, some calm seems to have returned, but recent observations give already a strong clue on the disturbances that could arise given the known illiquidity of saving banks in the case of greater complications [...]".[314] At the end of October 1912, the Bank already noted a strong increase in the demand for its advances (i.e. lombard facility), which had effectively doubled relative to the same period in the preceding year.

The protocols of the General Council meeting on 28 November reflect the continuously mounting tensions. As usual, the secretary general provided his view of the economic situation faced by the OeUB. He argued that the general public was now holding unusually high amounts of banknotes, a development which he judged to be "causally linked to the worries about the political situation".[315] The protocol also mentioned reports on significant withdrawals of saving deposits from all parts of the economic area. Since financial institutions were increasing their cash holdings to be able to withstand possible runs in the future, the OeUB's General Council called for a preparation, together with both directorates, for possible complications. On 19 December, the situation of the banking sector was repeatedly discussed by the General Council of the OeUB. The secretary general compared the developments to "a contagious disease", affecting even the most stable banking institutions and leading to the withdrawal of a significant amount of cash from circulation (i.e. liquidity hoarding). Under these circumstances, the secretary general stated, "banks had no other choice than to obtain funds for further

[310] In addition, the government argued that private property was inviolable and protected by international law even in the case of foreign occupation. For reports on public announcements see *Mährisches Tagblatt*, 16 October 1912, p.1; *Pester Lloyd*, 16 October 1912, p.11; *Tagespost*, 17 October 1912, p.11.
[311] *Prager Tagblatt*, 3 December 1912, p.8.
[312] Bank general council meeting, 25 October 1912, OeNB archives 1912/I-4b.
[313] Ibid.
[314] Ibid.
[315] Bank general council meeting, 28 November 1912, OeNB archives 1912/I-4b.

repayments from the bank of issue, as a last resort".[316]

Table 3.33: Changes of credit limits during the panic of 1912 (excerpt)

City	Bank	Initial limit in 1000 K*	Increase in 1000 K	Increase in %*
Brody	Bezirkssparkasse	100	100	100
Brno	Maehrische Escomptebank	-	1000	-
Kolomea	Staedtische Sparkasse	600	100	17
Hradec Králové	Zálozni úverní ústav	-	1000	-
Lviv	Galizische Sparkasse	2000	4000	200
Lviv	Kreditverein Dnister	200	100	50
Lviv	Galizische Aktien-Genossenschafts-Bank	1000	500	50
Lviv	Galizische Bodencredit-Bank	600	400	67
Lviv	Landeskreditverband Sojna	300	100	33
Lviv	Verband der Landwirte	300	100	33
Lviv	Galizische Landesbank	20000	13000	65
Lviv	Agrar-Hypothekenbank	400	100	25
Lviv	Verband der ruth. Genossenschaften	200	200	100
Nowy Sacz	Vorschuss-Kasse	250	250	100
Prague	Centralbank der dt. Sparkassen	-	2500	-
Prague	Landw. Creditbank fuer Boehmen	-	1500	-
Stanislau	Gemeindesparkasse	1000	500	50

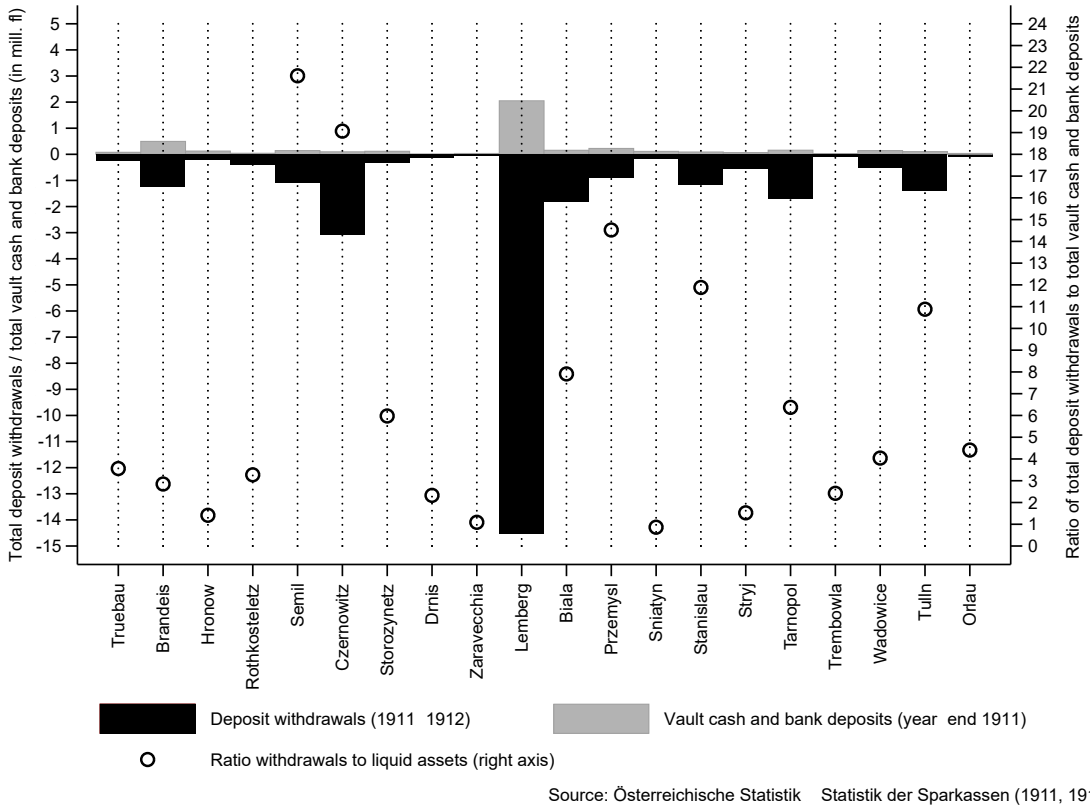
*Missing values occur whenever data on the initial credit limit is not available in the primary sources.

At no point was there a debate whether the Bank should accommodate the increased demand for liquidity by lending freely - this approach was generally accepted by the members of the General Council. When the runs started in October 1912, the affected banks could first tap into the ordinary credit lines, in form of the individual *Personalkredite* that had been accorded to them. This first stage of liquidity provision required no particular action on the side of the Austro-Hungarian Bank: the discount facility accommodated demand automatically as long as submitted bills were of sufficient quality. As reported in the meeting of the Viennese directorate on 29 October 1912, however, these ordinary credit lines were rapidly exhausted and the credit institutions targeted by runs asked for additional funds.[317] While loans covered by the limits were at the discretion of the local branch officers, credit beyond the limits required approval or at least the notification of the head office. As speed was crucial, the Bank management sometimes did not wait for the next meeting of the directorate (whose members were normally responsible for changes in credit limits, c.f. Section 3.3 above) and increased the limits *ex praesidio* asking (and receiving) the directors' approval *ex post*. As can be seen in Table 3.33, increases of credit limits could be substantial: in many cases they amounted to 50% or 100% of the initial level. In the case of the Galician Savings bank in Lviv the discount limit was even increased three-fold from 2 to 6 million *Crowns*.

In addition to these case-by-case extensions of credit limits, the Viennese directorate agreed on a general, but rules-based loosening of limits on 3 December 1912. To this end, the directors reestablished a set of measures which had already been taken during a similar phase of bank runs in March 1909 that had also been caused by fears of war. The measures allowed the heads of OeUB branches to discount bills over and above the credit limit as long as the bills carried the signature of at least one safe endorser and if the additional loans were covered

[316]In German, this iconic line reads "in letzter Linie bei der Notenbank", c.f. Bank general council meeting, 19 December 1912, OeNB archives 1912/I-4b.
[317]Bank directorate meeting in Vienna, 29 October 1912, OeNB archives 1912/I-4b.

Figure 3.39: Total deposit withdrawals and liquid assets (savings banks with highest withdrawal rates, 1911-1912)



by pledged securities up to 90% of their market value.[318] If the counterparty did not dispose of enough eligible bills, the Austro-Hungarian Bank could grant advances subject to the haircuts and lombard rates in place.[319] Therefore, while lifting the credit limits that were usually in place, these measures did not soften the credit standards. Together, the case-by-case increases and the general relaxation of credit limits provide suggestive evidence that limits did not serve to restrict credit when liquidity was most needed during moments of distress, while enabling the OeUB to steer counterparty risk-taking in normal times.

The necessity, the extent and the apparently successful nature of the OeUB's LLR intervention is best illustrated by a series of figures. Figure 3.39 suggests just how desperate the situation was for credit institutions in the border regions. It shows both the absolute amount withdrawn by depositors and the sum of highly liquid assets (at the end of 1911) of the 20 Austrian savings banks which experienced the highest year-on-year loss of deposits from 1911 to 1912. Figure 3.39 shows that it was highly unlikely that the majority of these savings banks could have withstood the runs in 1912 by relying on their own liquid reserves only. Without an institution ready to provide liquidity in exchange for eligible collateral, these banks would have probably defaulted in the autumn of 1912. The fact that none of them did suggests that the OeUB stepped in directly via its branches in the regions, or at least indirectly by refinancing the savings banks' central institutions.

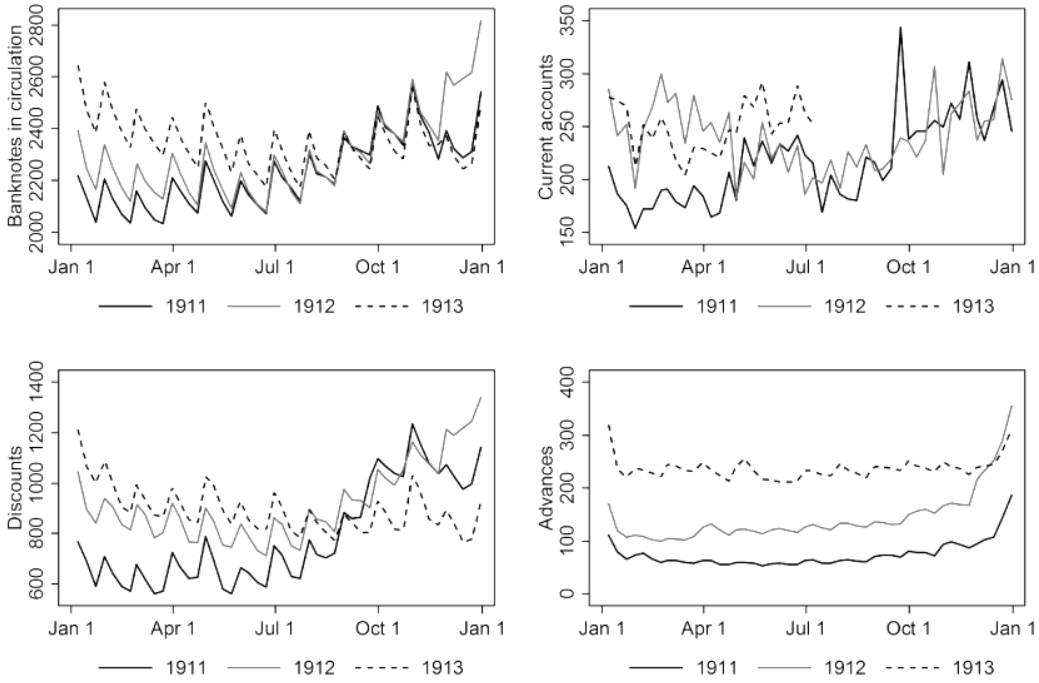
Figure 3.40 depicts the impact of the runs on the OeUB's lending arms. Both currency in circulation

[318] Compared to conventional advances, these "augmented" discount loans were attractive because the OeUB's discount rate was always 50 to 100 basis points below the lombard rate.

[319] Bank directorate meeting in Vienna, 3 December 1912, OeNB archives 1912/I-4b; circular 67 dated 20 March 1909 summarizes the extraordinary measures taken in 1909, which were again drawn upon in 1912.

and central bank borrowing exhibited strong intra-month and seasonal movements. Although the 1912 panic coincided with the routine increase in circulation, discount lending and advances in the last quarter of each year, the extension of extraordinary accommodation is well visible when comparing the evolution of the three balance sheet items in normal years (1911 and 1913) with the evolution in 1912 (in red). Most of the increase occurred in November and it is particularly marked for banknotes and advances, while current account holdings moved little, testifying to the fact that the panic mainly affected retail depositors, not the interbank market. At the end of the year banknotes in circulation were 15% above the level observed a year earlier and a year later. The dashed line tracks the evolution of the balance sheet for 1913 and shows that both borrowing and circulation had reverted to more normal levels by the end of the second quarter of 1913.

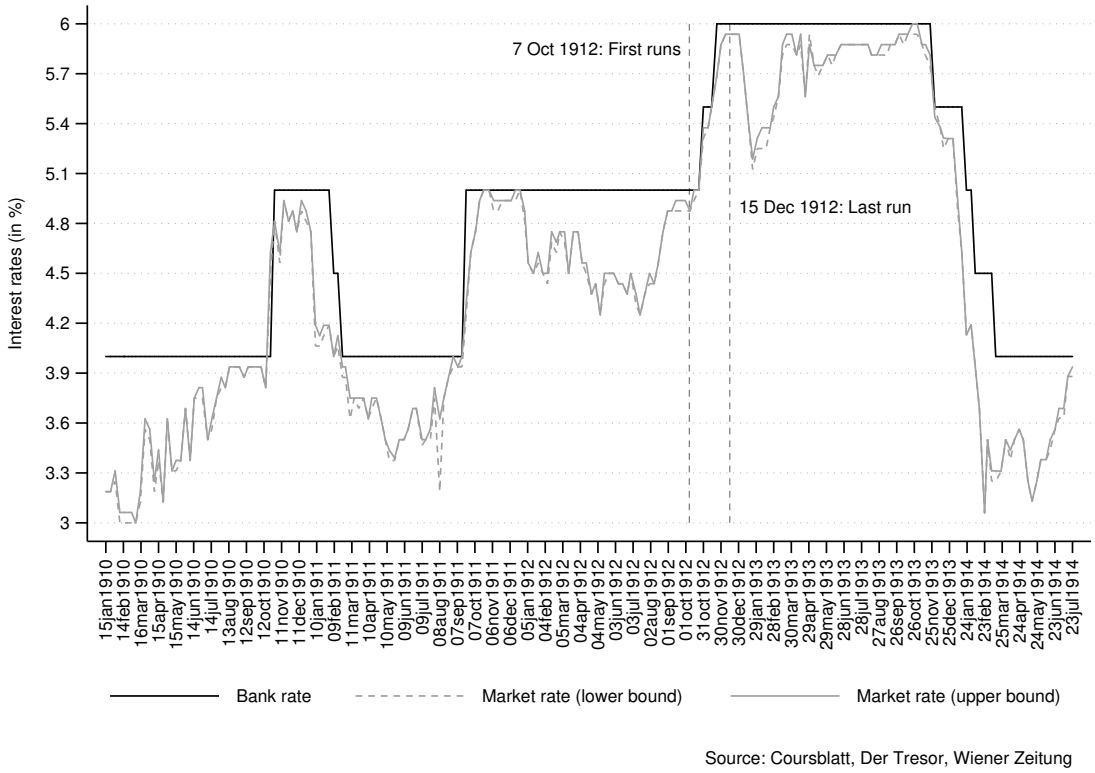
Figure 3.40: OeUB lending via standing facilities, note issuance and current account deposits (1910-1913, in *Crowns*)



Source: Wiener Zeitung

Bignon et al. (2012) propose a more formal test for the absence of credit rationing by the central bank. They argue that a positive spread between the central bank's main refinancing rate and the prevailing market rates for the same type of collateral suggests a "free lending" policy. Credit rationing in a crisis, in contrast, would manifest itself by a market rate which exceeds the corresponding Bank rate. In Figure 3.41, I perform this test graphically. Market rates peaked during the panic window in 1912, but at no instance did they exceed the OeUB's discount rate. Therefore, the OeUB appears to have satisfied all demands for borrowing at the discount window at the prevailing rate and given collateral/bill requirements. In other words, the OeUB lent freely to alleviate distress stemming from the liquidity squeeze in autumn 1912.

Figure 3.41: "Topping the Market": official Bank discount rate and prime market discount rates (1910-1914)



Source: Coursblatt, Der Tresor, Wiener Zeitung

3.6.3 Carrots and sticks: distinguishing between counterparties

Did the OeUB grant credit limit increases and tolerate transgressions indiscriminately during the panic of 1912? In principle, the origin of the 1912 crisis – a clearly external event unrelated to pre-crisis policies of financial intermediaries – limited moral hazard to begin with. Yet, banks' financial situation differed in terms of their volume of liquid reserves at beginning of the runs. Banks with higher reserves were better able to withstand a run *ex ante*. Similarly, banks that were perceived as fundamentally weak by creditors already prior to the crisis likely suffered more withdrawals during the runs. Indiscriminate free lending by the OeUB during the run would have thus meant endorsing risky liquidity management strategies, as well as lax credit standards, *ex post* and therefore encouraging imprudent behavior in the future. When the crisis of 1912 hit, the Bank certainly lent generously. However, a transgression of the credit limit sometimes implied different forms of penalization, depending on the financial situation of the counterparty prior to the exogenous liquidity crisis. As a general rule, the OeUB made clear that help was temporary. Increases in discount limits were typically granted for three months only. Whereas the Bank stood ready to prolong the extraordinary credit lines if need be – it did so when some of them came up for renewal in January 1913 –, counterparties were nevertheless under pressure to scale down central bank borrowing as quickly as possible.

Evidence from the meetings of directors in Vienna suggests that the OeUB fine-tuned its pressure depending on whether it perceived the counterparty making sufficient efforts to reestablish market funding. The prolongation of extraordinary credit extensions to the *Galizische Aktien-Genossenschafts-Bank* in Lviv is a case in

point. When the Lviv branch of the OeUB commented on the request of prolongation in February 1913, it observed that (1) the condition of the bank was improving slowly due to consolidation efforts, and that (2) external conditions nevertheless remained challenging: deposits had not yet returned to the provincial cooperatives because confidence only solidified gradually. In the eyes of OeUB directors, this combination of own efforts and continuing difficulties in obtaining deposit funding (which, however, were seemingly outside control of the counterparty) therefore justified the renewal of the temporary credit extension.[320]

In cases where the solvency of a counterparty was in doubt, additional discount loans above the original limits could only be granted if the quality of the remaining endorsers on the bill was exceptionally good. For example, although the *Zálozni úverní ústav*, a bank located in northeastern Bohemia, had breached its credit limits during the crisis, further submissions were considered "perfectly legitimate". The OeUB's reasoning was that bills consisted almost exclusively of trade bills endorsed by clients of industrial companies, which had themselves been assessed in the credit lists. As a result most of the bills could have been discounted even without the endorsement of the *Zálozni úverní ústav*: these bills thus constituted safe invstments even if the *Zálozni úverní ústav* were to face difficulties in honoring its debts.[321] In a reverse example concerning the *Kasa zaliczkowa* in Nowy Sacz (ger. *Neu-Sandec*), the responsible branch inspector argued for a gradual reduction, citing the "[limited] quality of the cooperative's discount portfolio", when the temporary increase in the credit limit of Kasa zaliczkowa in Neu-Sandec came up for renewal.[322] Hence, once credit lines were exhausted and the bills portfolio of a given institution did not exhibit exceptional safety, it became difficult to apply for additional central bank credit, even in the event of a crisis. One way to circumvent the problem of insufficient portfolio quality to justify a transgression of limits consisted of interposing additional good endorsements on the bills. When several Galician savings banks had exhausted their direct credit lines in December 1912, the OeUB encouraged them to discount their remaining bills at the *Galizische Landesbank*, which then could rediscount the same bills at the central bank. Thanks to this procedure, the Bank received the additional guarantee of the *Landesbank*, which was considered a very good risk. Furthermore, in order to allow the *Landesbank* to rediscount additional bills, the Austro-Hungarian Bank offered to raise the *Landesbank's* credit limit of 20 million before the crisis by as much as 50 million.[323] An alternative way to obtain an increase in the credit limit despite relatively low liquidity and/or credit standards was to pledge additional collateral. Raising credit limits typically involved an updated assessment of the quality of the counterparty as well as its assets and liabilities – in addition to the usual assessment of the bills submitted. As a result of these assessments, an increase in the credit limit could be granted unconditionally or conditional on the pledging of additional securities, as evidenced by the extraordinary measures taken in 1909 and 1912. In 1912, for example, the *First Croatian Savings Bank* in Zagreb received an increase in its credit allowance of 3 million *Crowns* after agreeing to pledge lombard-eligible securities worth the same amount as additional collateral.[324]

[320] Bank directorate meeting in Vienna, 25 February 1913, OeNB archives 1913/I-4b.
[321] Bank directorate meeting in Vienna, 4 February 1913, OeNB archives 1913/I-4b.
[322] Ibid.
[323] Bank directorate meeting in Vienna, 3 December 1912, OeNB archives 1912/I-4b.
[324] Bank directorate meeting in Budapest, 27 November 1912, OeNB archives 1912/I-4b.

A different case is provided by the OeUB's treatment of the *Ústřední banka českých spořitelen*. The *Ústřední banka* was one of the largest joint-stock banks located in the Empire industrial heart, Prague. It served as the central institution of Bohemian savings banks, refinancing the latter but also recycling their deposits to invest in riskier projects from which the savings banks were banned. In the course of its regular ex-ante monitoring, the Austro-Hungarian Bank had already issued a warning to the *Ústřední banka* on 23 September 1912, i.e. well before the start of the run.[325] Arguing that the bank had overstretched itself by its large business expansion into Galicia and Bukovina, the Austro-Hungarian Bank had turned down *Ústřední banka's* request for an increase in its credit limit on 24 September.[326] When the start of the crisis in late October revealed the weak position of the bank, the OeUB directors actually argued that *Ústřední banka's* (normal time) credit limits should be lowered. Given the ongoing run, however, an immediate adjustment was out of question. Due to the bank's important position in Bohemia and elsewhere, the OeUB directors deemed that a refusal to grant additional refinancing lines would have "led to a catastrophe", putting the bank's customers at risk.[327] Yet, in stark contrast to their treatment of the *Galizische Aktien-Genossenschafts-Bank* discussed above, the increasing gap between normal and actual central bank refinancing levels was not seriously addressed by *Ústřední banka's* management. OeUB officials thus thought it was appropriate to increase pressure on *Ústřední banka* to get its house in order. Apparently, the central bank became more restrictive, refusing a certain percentage (*quotenmäßige Aufteilung*) of the bills submitted by *Ústřední banka*, while still granting sufficient credit to the bank to enable it to continue operations and to protect the bank's customers (*ohne Gefährdung ihrer Kunden*).[328] At the same time, future access to central bank refinancing was made conditional on changes in *Ústřední banka's* business model. The directors' strategy seems to have worked, as the OeUB was able to lower *Ústřední banka's* credit limit by December 1912.[329] In February 1913, the directorate meeting minutes reported that the management of *Ústřední banka* had been changed and that a program to restructure the bank was already on its way.[330]

To be sure, the *Ústřední banka* was just one in case in point. Similar policies applied to several other banks.[331] Once the panic had abated, the OeUB could gradually return to enforcing its standard rules. However, as reported in the directors' meeting of 23 September 1913, four banks in Bohemia continued to be in the focus of the Bank's attention, suggesting that the central bank was determined to follow up on the credit institutions' lax lending and liquidity standards. This group included the already mentioned *Ústrední banka*, the *Böhmische Industrial-Bank*, the *Prager Credit Bank* and the *Zálozni úverní ústav* in Hradec Králové (ger. *Königgrätz*). In all cases the OeUB ultimately restricted the credit limits once it had become possible to do so without triggering negative externalities for third parties.[332] With the exception of *Ústrední banka*, all other banks were allowed to keep the *Singulargenehmigung* (c.f. Section 3.3), but the censoring of the bills had been tightened so that

[325] Bank directorate meeting in Vienna, 24 September 1912, OeNB archives 1912/I-4b.
[326] Ibid.
[327] Bank directorate meeting in Vienna, 19 November 1912, OeNB archives 1912/I-4b.
[328] Bank directorate meeting in Vienna, 3 December 1912, OeNB archives 1912/I-4b.
[329] Ibid.
[330] Bank directorate meeting in Vienna, 4 February 1913, OeNB archives 1913/I-4b.
[331] Bank directorate meeting in Vienna, 3 December 1912, OeNB archives 1912/I-4b.
[332] At least in the case of the *Ústrední banka*, the decrease was substantial, from 15 to 8 million *Crowns*. For the other three banks a comparison is not possible as the old credit limits are not given.

discounting required at least one other prime signature.

3.6.4 Tolerating transgressions in response to liquidity shocks: econometric evidence

I now analyze econometrically whether one can link the occurrence of an exogenous liquidity shock affecting the border regions with Russia to a policy of toleration, on behalf of the OeUB, of transgressions and increases in credit limits for affected institutions. For this purpose I estimate two binary response models. In the first model, my dependent variable is a dummy that equals one if the OeUB directorate protocols explicitly mentioned a credit institution's temporal transgression of its assigned credit limit and the governing body in Vienna decided to tolerate this transgression during the crisis of 1912. In my second model, the dummy is defined more broadly. It does not only record tolerations of transgressions but also turns on if an institution's credit limit was raised on or after 1 October 1912. Hence, the dummy records all increases in limits despite the fact that these increases were not explicitly mentioned in the directorate protocols but only documented in the lists submitted by the branches.

In order to find out whether the exogenous liquidity shock that occurred following an imminent war with Russia led the OeUB to implement a policy of toleration towards transgressions, I construct an independent variable that reflects an institution's direct exposure to the shock in the following way. First, I geocoded the location of each credit institution in the combined banks and savings banks data set. I then calculated the distance from each bank location to the nearest border segment with Russia. The distance is computed in kilometers and represents my measure for the intensity of a credit institution's exposure to the liquidity shock. In principle, the further away from the border a bank was located, the less affected it should have been by the shock. Naturally, there are several reasons why a simple linear measure of distance might not be a good proxy for the intensity of exposure: for example, one could imagine that, rather than representing a linear function of distance, exposure is likely to have mattered only in a small radius of distance from the border. In order to make sure that my estimation results are not driven by specification issues, I therefore use three different variations of the exposure variable: the simple linear distance, the natural logarithm of the distance to the border, and the inverse of the distance to the border. Finally, I also construct a fourth measure of exposure. I create an indicator variable that takes the value of 1 for all banks and savings banks situated in Galicia or Bukovina and for all banks which operated branches in either of these two regions. The rationale for computing this fourth variant is to account for banks which were flagged as unexposed based on a simple distance measure to their headquarter in, e.g. Vienna or Prague, but which suffered liquidity strains due to the exposure of their branches in the affected regions.

I estimate Model 3.10 below using a penalized maximum likelihood estimator (PMLE), drawing on the so-called "Firth logit" approach (Firth, 1993). The reason I cannot draw on a normal logit/maximum likelihood

estimator is that I only have a small number of positive observations (i.e. number of tolerations and increases in the credit limits) in order to estimate the binary response models. Drawing on a standard maximum likelihood estimator to estimate the occurrence of "rare events" can lead to substantial underestimation of the event probabilities and biased standard errors (King and Zeng, 2001). I estimate the following cross-sectional logit model:

$$P(T_i = 1|S_i, \mathbf{Y}_i) = F(\beta_0 + \gamma S_i + \mathbf{\Lambda'Y}_i) \tag{3.10}$$

$$\text{where } F(\beta_0 + \gamma S_i + \mathbf{\Lambda'Y}_i) = F(z) = \frac{exp(z)}{1+exp(z)}$$

where T_i represents the dependent variables explained above, S_i constitutes my measure of exposure to the liquidity shock in its various specifications, and $\mathbf{Y}_i$ is a vector of control variables which includes all my previously used financial variables in lagged form except AGE_i, which I add contemporaneously. The rationale for including these variables is based on the narrative evidence discussed in the previous subsection. Bank fundamentals should be important regressors if the OeUB made limit increases conditional on banks' liquidity and credit management standard prior to the shock. Endogeneity concerns constitute another reason to include bank characteristics: if Galician and Bukovinian banks were particularly weak, then my shock variable might be correlated with bank fundamentals. I estimate Model 3.10 for the cross-section of tolerations (and increases in credit limits, depending on the specification) occurring in 1912. Therefore, $\mathbf{Y}_i$ draws on data from 1911. As for the panel regressions, I only use data for savings and banks to estimate equation 3.10 because I do not have the full cross-section of data for credit cooperatives. Including credit cooperatives whose transgressions are tolerated or whose limits were increased only would lead to the addition of another treatment group without a corresponding control group. Table 3.34 presents the relevant summary statistics.

Table 3.34: PMLE regressions: summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max	P1	P25	P50	P75	P99
Toleration dummy	714	0.01	0.12	0.00	1.00	0.00	0.00	0.00	0.00	1.00
Toleration & increase dummy	714	0.03	0.18	0.00	1.00	0.00	0.00	0.00	0.00	1.00
Size (total assets, in 1000K, natural log)	714	15.39	1.42	11.68	20.88	12.3	14.46	15.26	16.17	19.68
Age (in years, natural log)	714	3.15	0.84	0.00	4.53	0.69	2.71	3.43	3.76	4.39
Leverage ratio (total assets to equity)	714	55.73	546.12	1.33	1,419.50	3.00	16.24	20.62	29.57	248.00
Liquidity 3 (bills and cash to total deposits)	714	0.24	0.98	0.00	19.58	0.00	0.01	0.04	0.15	3.55
Refinancing (rediscounts to total assets)	714	0.01	0.03	0.00	0.33	0.00	0.00	0.00	0.01	0.16
Profitability (return on equity)	714	0.07	0.18	-1.47	1.00	-0.29	-0.01	0.04	0.10	0.86
Distance to Russian border (in km)	714	409.92	196.78	3.45	1,002.30	12.52	294.34	429.65	550.03	875.95
Distance to Russian border (in km, natural log)	714	5.80	0.83	1.24	6.91	2.53	5.68	6.06	6.31	6.78
Distance to Russian border (in km, inverse)	714	0.01	0.02	0.00	0.29	0.00	0.00	0.00	0.00	0.08
Exposure to war threat dummy	714	0.11	0.31	0.00	1.00	0.00	0.00	0.00	0.00	1.00

The results for the two binary response models are summarized in Table 3.35 and Table 3.36 below. In both tables, the results show a strong effect of the shock variable that bears the intuitive sign in all four specifications. In Table 3.35, the coefficients on my continuous proxies for the liquidity shock indicate that a standard deviation increase in the predictor triggers a large corresponding decrease (or increase, depending on the variant of the

Table 3.35: Firth logit estimates (PMLE): explaining tolerations of transgressions during the crisis of 1912

VARIABLES	(1)	(2)	(3)	(4)	(5)
Distance to Russian border (linear)		-1.92***			
		(0.53)			
Distance to Russian border (natural log)			-0.81***		
			(0.20)		
Distance to Russian border (inverse)				0.36***	
				(0.12)	
Exposure to war threat dummy					3.05***
					(0.82)
Size	0.93***	1.26***	1.14***	1.07***	0.71**
	(0.30)	(0.35)	(0.32)	(0.31)	(0.31)
Age	-0.78***	-0.66**	-0.78***	-0.79***	-0.49
	(0.28)	(0.29)	(0.29)	(0.30)	(0.35)
Leverage ratio	0.10*	0.12**	0.12**	0.12**	0.14**
	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)
Liquidity 3	0.23	-0.11	0.03	0.19	-0.01
	(0.18)	(0.20)	(0.19)	(0.18)	(0.20)
Refinancing	-0.02	-0.33	-0.24	-0.39	-0.82
	(0.35)	(0.39)	(0.37)	(0.59)	(0.93)
Profitability	-0.85	-1.82*	-1.38	-1.13	-1.41
	(1.15)	(1.06)	(0.98)	(1.09)	(0.96)
Observations	714	714	714	714	714
Log-likelihood	-36.75	-26.42	-28.82	-31.58	-29.13
Chi-squared statistic	24.29	23.87	31.23	31.02	33.82
Number of tolerations	10	10	10	10	10

Standard errors in parentheses

Coefficients on continuous variables represent marginal effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

regressor I employ) in the probability of tolerations: the marginal effects range between a 36% increase at the lower end and a doubling of the initial probability (marginal effect of 1.92) at the higher end. The exposure dummy yields an even stronger effect than the continuous variables: a credit institution that was situated in Galicia or Bukovina or had opened a branch in these regions was three times more likely to have a transgression of its credit limits tolerated than a bank not characterized by these features.

When I employ a more broadly defined dependent variable and include tolerations of transgressions as well as increases in limits in my set of positive events, the coefficients on my regressors of interest decrease substantially in size but still remain economically large and statistically significant. The substantial difference in the size of the coefficients suggests that instances of transgressions mentioned in the protocols of the OeUB directorate meetings were cases that merited special attention as a corollary of the liquidity shock. While there is a more general pattern linking overall credit limit increases to liquidity stress close to the Russian border, the even stronger association between tolerated transgressions and my shock variables demonstrates that the OeUB had a very clear idea which institutions were particularly concerned. My estimation results therefore confirm an interpretation credit limits as "contingent rules" which can be flexibly lifted and adjusted in case of exogenous liquidity shocks. To conclude this subsection, it is worth noting that the regression coefficients on the shock

Table 3.36: Firth logit estimates (PMLE): explaining tolerations and increases of credit limits during the crisis of 1912

VARIABLES	(1)	(2)	(3)	(4)	(5)
Distance to Russian border (linear)		-0.82***			
		(0.26)			
Distance to Russian border (natural log)			-0.50***		
			(0.16)		
Distance to Russian border (inverse)				0.26**	
				(0.11)	
Exposure to war threat dummy					1.89***
					(0.56)
Size	0.67***	0.75***	0.76***	0.72***	0.58**
	(0.23)	(0.23)	(0.23)	(0.23)	(0.23)
Age	-0.66***	-0.55**	-0.62**	-0.65***	-0.51**
	(0.23)	(0.25)	(0.25)	(0.24)	(0.26)
Leverage ratio	0.06	0.05	0.06	0.06	0.07
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Liquidity 3	0.17	-0.02	0.02	0.13	-0.03
	(0.17)	(0.19)	(0.18)	(0.17)	(0.19)
Refinancing	-0.15	-0.47	-0.41	-0.41	-0.82
	(0.34)	(0.52)	(0.47)	(0.48)	(0.71)
Profitability	-0.32	-0.23	-0.23	-0.20	-0.28
	(0.92)	(1.27)	(1.18)	(1.09)	(1.13)
Observations	714	714	714	714	714
Log-likelihood	-84.06	-77.04	-77.45	-80.00	-78.27
Chi-squared statistic	22.32	29.44	30.03	27.89	33.03
Number of tolerations & increases	23	23	23	23	23

Standard errors in parentheses

Coefficients on continuous variables represent marginal effect of 1 std.dev. increase in regressor.

*** p<0.01, ** p<0.05, * p<0.1

variables presented in Table 3.35 and 3.36 constitute ceteris paribus results. This point is essential for two reasons. First, the fact that I control for the balance sheet characteristics of the credit institutions in my sample should allow for a clean separation of liquidity shock on the hand and bank-level fundamentals on the other hand. This strategy should help minimizing omitted variable concerns. Even if banks and savings banks in Galicia as well as Bukovina were highly prone to tap into last resort liquidity due to financial characteristics endogenous to the distance from the border, these characteristics are controlled for in my regressions. Second, it is important to emphasize what sort of conclusions the results back up and which ones they do not. The results in Table 3.35 and 3.36 mean that, all financial characteristics equal, a bank's exposure to a liquidity shock unrelated to fundamentals was likely to be met with leniency by the OeUB. Clearly, however, my results do not support the statement that exposure to an exogenous liquidity shock alone was necessarily enough for a bank to receive mild treatment in case of limit transgressions, let alone that the link between liquidity shock and toleration of transgressions was automatic. The case of *Ústrední banka ceských sporitelen*, which I discussed in some detail above, illustrates this point only too well.

3.7 Conclusion

Moral hazard is omnipresent in the literature on the lender of last resort (LLR). If an elastic supply of liquidity by the central bank can always be expected by the financial sector in the event of crises, then this *de facto* liquidity insurance is likely to generate incentives for eligible counterparties which negatively impact the resilience of the financial system. Given that liquidity is costly, financial intermediaries might "bank" on the LLR and thus hold lower liquid reserves in normal times. This behaviour can subsequently increase the risk of a liquidity crisis, i.e. the very event the LLR was created to address. At the very least, it makes LLR-eligible counterparties more vulnerable to liquidity shocks. Furthermore, since central banks find it generally difficult to clearly distinguish between illiquid and insolvent banks, the creation of a LLR can also decrease lending standards in the banking sector. Imprudent banks might find it optimal to gamble for survival in a crisis, while engaging in riskier but more profitable business in normal times.

Traditional accounts in the literature argue that, at least historically, central banks responded to moral hazard concerns by charging "penalty" rates during crises or maintaining some degree of uncertainty regarding their willingness to intervene as LLR ("constructive ambiguity"). Recent contributions shifted the academic focus on the counterparty risk management frameworks maintained by central banks in the past, stating that these systems helped check the build-up of moral hazard. Yet, how exactly these frameworks targeted at reducing credit risk for the central bank could thwart moral hazard (i.e. distortions in the behavior of central bank counterparties) in practice remained to be understood.

In this study, I focused on one specific component of these counterparty risk frameworks: counterparty credit limits for discount window customers. I argued that credit limits as operationalized by the Austro-Hungarian

Bank (OeUB) after 1878 played a crucial role in addressing moral hazard deriving from the creation of a credible LLR. My main argument was that credit limits constituted the backbone of an early form of microprudential regulation. Credit limits empowered the Austro-Hungarian Bank to enforce minimum liquidity and capital standards for its counterparties at the discount window. Drawing on extensive qualitative as well quantitative archival evidence, I documented, both descriptively and econometrically, how the credit limits system of the Austro-Hungarian Bank worked in practice. While the size of the credit limits the Bank attributed to non-financial counterparties were primarily a function of their solvency, liquidity considerations drove credit limits for banks and savings banks in the Austro-Hungarian Empire. *Ceteris paribus*, more generous access to the rediscounting facility was granted to institutions displaying a higher standard of liquidity management. Since the limits were routinely enforced in normal times and because, all else being equal, obtaining higher credit lines was desirable for banks, credit limits represented a tool the OeUB could draw upon to steer incentives of its counterparties at the micro-level.

In the event of liquidity distress which the Bank perceived as exogenous, however, the OeUB generously tolerated limit transgressions, increased limits and even proceeded to a general, but rules-based and temporary suspension of the credit limits system. I showed that an exogenous liquidity shock can explain the increases in limits and tolerations of transgressions at the bank-level during the panic of 1912. Yet, the Bank did not simply relax limits for all credit institutions: it differentiated between banks depending on their fundamentals prior to the crisis. Hence, in some cases, where solvency and pre-crisis risk management was deemed inappropriate by the OeUB's directors, the central bank refused to provide additional liquidity during the panic and even sharply reduced credit limits after the runs had abated. Whenever moral hazard concerns were present, the Bank took care not to endorse lax liquidity and credit risk management. What this chapter did not assess is whether such policy was or could have been effective. To do so would require the development of a counterfactual scenario of banks' liquidity management in the absence of the LLR as well as some idea about the optimal precautionary amount of liquidity banks should hold. Both aspects are far from straightforward but would be worthwhile to analyze in future research.

In modern economies, microprudential regulation is effectively used as a device to address the suboptimal incentive structure triggered by the creation of a LLR. It forces banks to abide by certain minimum standards even in normal times. For example, the liquidity coverage ratio (LCR) introduced by Basel III requires banks to hold an amount of high-quality liquid assets (HQLA) sufficient to cope with a thirty day stress scenario affecting their funding situation. Since this minimum standard has to be met in normal times, it counteracts moral hazard deriving from expected LLR interventions in times of crisis. The evidence I marshaled in this chapter suggests that the historical roots of liquidity regulation may run much deeper than previously thought.

3.8 Appendix

3.8.1 Cleaning of credit limit data and classification in economic sectors

The information for the credit limit data set stem from hand-written forms submitted to the Viennese head office. In order to organize the data in a panel format - with the same counterparty being assessed in several years - and to use them for statistical analysis the following steps where taken:

- **Proper names.** To be able to follow the same counterparty over time slight variations in the spelling of proper names were harmonized, if there was sufficient evidence that names referred to the same counterparty. Such evidence could be location, occupation or economic sector as well as information on limits accorded, as a new proposal always contained information on the previous limit as well.

  If in a location the same name appears in a later year within a different economic sector, these names are treated as two separate counterparties. The reason is that identical names can refer to different persons and that their treatment as one unit would bias the panel estimations.

- **Occupations and economic sectors.** Occupations or the business done were classified in line with the 25 categories used in the 1902 firm census ("Betriebszählung").[333] The firm census distinguished 325 types of trades and industry ("Gewerbearten") aggregated into 25 categories ("Gewerbeklassen"). To these two further categories were added referring to activities that did not form part of the firm census: (1) Free professions, including doctors, lawyers and notaries and (2) a residual category of wealthy individuals, including mainly owners of real estate but also holders of large security portfolios or participations in companies that are not specified in more detail. Within the residual category can also be found a handful of functionaries and company directors, who received a personal credit limit independently of the firm they headed. This was possible in the case of firms with limited liability; otherwise the personal credit could not be separated from the credit of the firm. The categories are given in table 3.37 below.

  If several activities were listed, the first one was taken, assuming that it was the most important one, and a dummy variable was added indicating that a firm was active in several economic sectors. In most cases entries in the credit limit forms could be assigned to one of the categories with reasonable confidence. Some ambivalence is present in the case of mills ("Mühlen"), which denoted both grinding mills as well as water mills used as power source in various industries, including wood, metal and textiles. Identification is not helped by the fact that specifications of the mill often refer to technology (e.g. "Walzmühle" or "Dampfmühle") and not to the in- or output ("Sägemühle" or "Getreidemühle"). In most cases, however, ambiguity could be resolved using information on additional business lines of the firm. E.g. in the case

[333] The results of the 1902 firm census were published in volume 75, issues 1–11 of the official Austrian statistics (*Oesterreichische Statistik*) edited by the Imperial statistical commission (*k.k. statistische Zentralkommission*). The categorization is detailed in issue 1, published in 1908.

of "Mill, grain trade" it can be assumed that mill refers to a grain mill. In those few cases where no additional information was available, mills were classified in the category "Food and beverages".

- **Regulated financial institutions.** Among firms in the category "Finance and insurance" a further distinction is made among joint-stock banks, savings banks and cooperatives and other banking institutions (Other financial institutions like insurances are quantitatively irrelevant). As set out in section 3.4.4 above, this distinction follows the legal norms governing the financial institutions' activities and is line with the classification of these institutions in official statistics. Institutions are therefore attributed to the four groups depending on whether they appear in the official statistics for banks, savings banks or credit cooperatives. All other institutions are classified among "unregulated financial institutions".

- **Discounting.** In a number of cases discounting, banking or money operations are listed in addition to other industrial or commercial activities of the counterparty. In these cases the counterparty is classified according to the industrial or commercial activity, assuming that the counterparty is not primarily a bank and discounting directly related to its main (non-banking) activity (e.g. "Wood trade, discounting" is classified as "Wholesale and retail trade" and not "Finance and insurance"). Instead, to capture banking activities an additional dummy variable "discounting" was added, which is set 1 for all firms/individuals providing financial services in addition to their other activities. It should be noted that these decisions only impact Table 3.21 but leave all other results unchanged as regressions include regulated financial institutions only, which are well defined as explained above.

3.8.2 Classification of arguments: decisions on credit limits

c.f. next page

Table 3.37: Economic sectors according to 1902 business census

Number*	Economic sector	Original name in 1902 census
	Production	*Erzeugungsgewerbe*
1	Agriculture and mining	Urproduktion
2	Basic metals	Hüttenbetrieb
3	Stone, clay and glass	Industrie mit Steinen, Erden, Ton und Glas
4	Metal working	Metallverarbeitung
5	Machinebuilding	Erzeugung von Maschinen, Apparaten, Instrumenten und Transportmitteln
6	Wood	Industrie in Holz, Flecht, Dreh- und Schnittwaren
7	Rubber	Erzeugung von Waren aus Kautschuk, Guttapercha und Zelluloid
8	Leather	Industrie in Leder, Häuten Borsten, Haaren, Federn und ähnlichen Materialien
9	Textiles	Textilindustrie
11	Wearing apparel	Bekleidungs- und Putzwarenindustrie
12	Paper	Papierindustrie
13	Food and beverages	Industrie in Nahrungs- und Genussmittel
14	Accomodation, food service	Gast- und Schankgewerbe
15	Chemicals	Chemische Industrie
16	Construction	Baugewerbe
17	Printing	Graphische Gewerbe
18	Electricity supply	Zentralanlagen für Kraftlieferung, Beheizung und Beleuchtung
	Trade and transportation	*Handels- und Verkehrsgewerbe*
20	Wholesale and retail trade	Warenhandel mit fester Betriebsstätte
22	Finance and insurance	Geld-, Kredit- und Versicherungswesen
23	Trade and shipping agents	Hilfsgewerbe des Handels
24	Transportation	Verkehrsgewerbe
	*Additional categories**	
30	Free professions	Freie Berufe
31	Wealthy individuals	Sonstige Einzelpersonen

** Refers to the numbering used in the 1902 census. The two categories added here (free professions, wealthy individuals) were numbered 30 and 31.*

Source: Österreichische Statistik 35(1) 1908.

Table 3.38: Examples for arguments used in limit decisions

	Category	Examples
1	Bankrupt	wegen Konkurs/Insolvenz/Konkurseröffnung
2	Dissolved	Geschäftsauflösung, Liquidierung, Stillegung des Betriebs, Firmalöschung, handelsgerichtliche Löschung, Firmalöschung wird unter ... neu bemessen/neu beantragt, Firmalöschung infolge Übersiedelung, Löschung und Umwandlung in eine GesmbH/Sparkasse
3	Illness, death	infolge Ablebens, Todesfall, gestorben, Selbstmord, geisteskrank
4	Change in location/name	Änderung des Firmenwortlauts, Übersiedelung/Domizilwechsel/Verlegung des Sitzes, bisher bei anderer Bankanstalt/unter anderem Namen bemessen gewesen, neubemessen unter geänderter Firma
5	Equity	dem Vermögen/Eigenkapital/Reserven entsprechend, schache Fundierung, anderseitiger niedriger Vermögensschätzung, rückgängige Verhältnisse, Vermögensverminderung durch Ableben/Austritt eines Gesellschafters, Verluste erlitten (aus einem bestimmten Geschäft), Vermögensrückgang infolge großer Konjunktur-/Spekulationsverluste, bevorstehende Verluste, unklare/komplizierte Vermögensverhältnisse, als Mitglied einer Gesellschaft unbeschränkt haftpflichtig, haftend für..., hat sein Vermögen übertragen, Kapitalerhöhung abzuwarten, Vermögensrückgang aufgrund von Erbteilung, Unklarheit hinsichtlich der Haftung der Gemeinde, hat große Spielverluste, geringe Mitgliederzahl (bei einer Genossenschaft)
6	Change in ownership	Geschäftsverkauf, Änderung des Inhabers, Übergang an..., fusioniert/vereinigt mit..., neuer Firmeninhaber
7	Withdrawal of a partner	Austritt/Rücktritt eines Gesellschafters, Ableben eines Gesellschafters
8	Change in corporate form	Umwandlung in Aktiengesellschaft/Gesellschaft mit beschränkte Haftung/Sparkasse, Umwandlung in eine Filiale, Übergang in den Staatsbetrieb
9	Leverage	hohe Schuldenlasten, hohe Verbindlichkeiten, ungünstiges/angespanntes Verhältnis zwischen eigenen und fremden Mitteln, starke Belastung mit fremden Geldern, Realbesitz/Immobilienbesitz hoch belastet, hohe Hypotheken, Vermögen für den Umfang des Geschäfts unzureichend, arbeiten stark über den eigenen Mitteln, arbeiten über ihre Kräfte, überschuldet, zu schwach fundiert, unverhältnismäßig starke Kreditanspannung
10	Asset liquidity	Vermögen immobil, unzureichende Mobilität, mobile Mittel knapp/unzureichend, stark illiquide Forderungen, Vermögen in Bauspekulation gebunden, Vermögen in Realitäten investiert, Betriebsmittel gering/fehlen, bewegt sich schwer, bei einem Konkurs beteiligt dessen Liquidierung Jahre dauern kann, hohe Einzelkredite, schwere Realisierbarkeit der Anlagen, mehr als die Hälfte der Effekten belehnt
11	Refinancing risk	andauernde/hohe/zunehmende mehrseitige/vielseitige Kreditbenützung, hohe Wechselverbindlichkeiten, hohe Giroverbindlichkeiten, Vorkommen von Geldbeschaffungswechseln, große und vielseitige Verpflichtungen, hohe Akzeptverbindlichkeiten/Akzeptobligo, starke anderwärtige Reeskomptebenützung, starkes anderwärtiges Vorkommen
12	Volume of business	dem Geschäftsumfang/den Geschäften entsprechend, macht kein Diskontgeschäft, Geschäft rückgängig, Umfang der Geschäfte stark reduziert, ungünstiger Wirtschaftserfolg, arbeitet seit Jahren mit Verlust, andauernde/fortgesetzte große Betriebsverluste
13	Limit adequate	angemessen, dem Kredit entsprechend, genügend für den Bedarf, ohnehin hoch bemessen
14	Management quality	Geschäft auf stark spekulativer Basis, wegen zu großer Spekulationen, befasst sich mit Spekulationen, verschwenderische Lebensweise, kostspieliger Haushalt, Spielverluste, hat moralisch gelitten, hohe Dividende, Charakter nicht einwandfrei, Geschäftsbetrieb nicht rationell, wird nicht mit der nötigen Umsicht geführt, flüchtig geworden, wegen Wucher verurteilt, Gewährung von Krediten an Beamte, Vermittlung bei unsoliden Ausgleichen, vom Verband gerügt, nicht immer vorsichtige Kreditgewährung, wegen Schulden unter Privatkuratel gestellt, lassen ihre offenen Buchforderungen belehnen, sehr unfähige Geschäftsführung, Gefälligkeitsgiri, Ordnungswidrigkeiten in der Leitung, ungünstiger Revisionsbericht, nicht vertrauenserweckend
15	Experience	wegen Kürze des Bestands, Geschäftsunerfahrenheit, weitere Entwicklung abzuwarten, für den Anfang genügend, wegen Übergangs an junge noch nicht bewährte Gesellschafter, Anfänger, erste Bilanz abzuwarten
16	Payment history	lösen ihre Wechsel unter Wert ein, Mangel der Rückzahlungen, Zahlungsschwierigkeiten, Zahlungsstockung, Zahlungsverlegenheiten, schleppende Zahlungsweise, jahrelange Prolongationen
17	Risky loan portfolio	hohe Einzelkredite, dubiose Forderungen, leichte Kreditgewährung, wegen hohem Engagement bei einzelner Firma, vielseitige starke Engagements
18	Absence	wegen Nichtvorkommens, kommt nicht vor, stellt keine Kreditansprüche
19	OeUB rules	Firma mit Statut nicht übereinstimmend, Firma nicht protokolliert, unzukömmliche Deklaration im Eskomptegeschäft, Inverkehrssetzung gefälschter Akzepte, Vorkommen von Geldbeschaffungswechseln, setzt Kellerwechsel in Verkehr, zu starke Inanspruchnahme des Kredits
20	Quality of bills submitted	strenge Zensur, Portefeuille nicht erstklassig/einwandfrei, schwaches Escomptematerial, Flankierung des Wechselmaterials lässt zu wünschen übrig, kein Einblick in die Qualität des Wechselmaterials

3.8.3 Correlation matrix for credit limit transgressions

Table 3.39: Correlation matrix for credit limit transgressions (1906-1911)

	bank 1	bank 2	bank 3	bank 4	bank 5	bank 6	bank 7	bank 8	bank 9	bank 10	bank 11	bank 12	bank 13	bank 14	bank 15	bank 16	bank 17	bank 18	bank 19	bank 20	bank 21	bank 22	bank 23	bank 24
bank 1	1																							
bank 2	.339	1																						
bank 3	.531	.151	1																					
bank 4	.239	.081	.625	1																				
bank 5	.163	.081	.667	.686	1																			
bank 6	.449	.164	.397	.447	.25	1																		
bank 7	-.008	-.002	-.017	-.024	-.022	-.039	1																	
bank 8	.229	.467	-.011	-.015	-.014	0	-.012	1																
bank 9	.314	.489	.286	.453	.308	.619	-.036	.14	1															
bank 10	.026	.114	.126	.035	.396	.188	-.013	-.008	.144	1														
bank 11	.08	.12	-.04	-.055	.047	-.027	-.043	.045	.216	.022	1													
bank 12	.18	.118	.468	.504	.56	.237	-.024	-.015	.29	.374	-.056	1												
bank 13	.239	.68	.276	.17	.44	.157	-.003	.538	.446	.467	.119	.298	1											
bank 14	.028	-.01	.169	.202	.072	.514	-.013	-.008	.22	-.009	-.029	.061	-.008	1										
bank 15	-.016	-.021	-.007	-.01	-.01	-.021	-.008	-.005	-.003	-.005	-.019	-.01	-.014	-.005	1									
bank 16	-.016	.123	.153	-.01	.454	.096	-.008	-.005	.072	.855	-.019	.445	.557	-.005	-.003	1								
bank 17	.411	.339	.297	.396	.176	.628	-.034	.123	.651	.095	.126	.379	.257	.065	-.024	-.009	1							
bank 18	.16	.065	.085	.159	.018	.248	-.009	-.006	.155	.366	-.021	.035	-.008	-.006	-.004	-.004	.265	1						
bank 19	.402	.202	.25	.28	.242	.517	-.057	.054	.623	.153	.143	.224	.197	.088	.007	.095	.422	.114	1					
bank 20	-.024	.458	-.008	-.015	-.004	.062	-.004	.229	.227	.01	-.027	-.006	.369	-.008	-.005	.016	.116	-.006	.082	1				
bank 21	.03	.075	-.042	-.058	-.042	-.018	-.003	.076	.049	-.013	.115	-.059	.052	-.031	.029	-.02	.016	-.022	.213	.049	1			
bank 22	.153	.082	.506	.569	.83	.323	-.027	-.017	.328	.555	-.063	.587	.506	.014	-.012	.657	.207	.01	.294	-.003	-.066	1		
bank 23	-.012	.211	-.02	-.028	-.026	-.058	-.022	.048	.199	-.015	-.051	-.028	.178	-.015	-.009	-.009	.105	-.011	-.055	-.014	.14	-.032	1	
bank 24	.399	.353	.325	.196	.171	.408	-.03	.114	.34	.194	.058	.203	.34	.232	-.014	.202	.378	.034	.377	.373	.136	.197	.016	1

Source: OeUB directorate protocols (Vienna; 1906-1911)

General conclusion

For decades, central banks' role as a lender of last resort (LLR) was considered a relic of the past with limited policy relevance. In hardly any other area of economic policy-making, history and modernism remained so far, and for so long, removed from each other. Starting in the 1980s, the literature on central bank operations became increasingly monopolized by discussions about central bank independence and inflation-targeting. Only the recent crisis of 2007-08 reinvigorated the research and debate on LLR. However, renewed academic interest has also shown that we still lack a firm grip on some of the most fundamental challenges haunting LLR ever since the concept was first coined. Three questions stand out in this regard – and they lie at the core of this dissertation.

First, how can central banks acting as LLR distinguish illiquid from insolvent financial institutions (if at all), and is this distinction necessary for successful LLR? Authors have suggested that making this distinction became a nearly impossible task during the crisis of 2007-08. In practice, the distinction between solvency and illiquidity frequently blurred: although many banks' net worth would have turned negative under distressed fire-sale conditions, the same credit institutions could still be regarded viable as a going concern under the assumption that liquidity-induced default would be prevented by the LLR. Moreover, not only did insolvency and illiquidity prove difficult to disentangle, but the distinction neither appears to have motivated central banks' LLR policies during the crisis of 2007-08. Central banks lent to institutions on the brink of default to preempt negative externalities for the financial system and the wider economy. These observations raise the question whether central banks' approach during the recent crisis can be or needs to be reconciled with the standard view that only illiquid institutions should receive LLR support. After all, providing liquidity support to insolvent institutions might be costly, both in monetary terms if loans are not repaid, and in terms of setting negative incentives, e.g. by increasing *de facto* bail-out expectations in the future.

Second, how should LLR be designed in order to be effective? The difficult distinction between insolvent and illiquid credit institutions is the focal point of information asymmetries between the central bank and its counterparties in LLR operations. Asymmetric information problems in turn can be one reason for quantity rationing of credit. However, central banks can also face other constraints which obviate an elastic supply of liquidity during crises. Some of these constraints may be ideational, institutional or technical. Credit rationing by the central bank can have severe macroeconomic consequences if it leads to illiquidity-induced mass failures

of banks. In this context, it is worthwhile noting that some central banks saw their emergency powers curtailed in the aftermath of the recent crisis. For example, the U.S. Dodd-Frank Act prohibits the U.S. Federal Reserve from engaging in emergency lending to insolvent borrowers and only allows for programs and facilities with wide eligibility that have been approved by the Secretary of the Treasury. If these legislative changes impose new institutional constraints on the FED's LLR function and, if so, how these constraints may be addressed in case of an emergency, remains an open question. More generally, the question how to best tackle the different constraints which can obviate an elastic supply of liquidity during crises remains to be fully addressed in the literature.

No matter how successful it is in calming financial distress and independently of the concrete form it takes, the LLR always comes at a cost. A central bank which engages in free lending during crises provides financial institutions with an insurance against liquidity shocks. Insurance in turn invites moral hazard: it leads to a decline in the incentives for counterparties eligible for LLR support to take preventative actions to mitigate the risk they are being insured against. Moral hazard may generate large social costs. It undermines financial stability and thereby increases the probability of future crises. Moreover, if the LLR struggles to distinguish between illiquid and insolvent institutions, defaults on LLR loans need to be shouldered either by the central bank (and ultimately tax payers) or by junior debtors and shareholders. A third fundamental question thus resurfaced following the crisis of 2007-08: what are convincing techniques to tackle moral hazard deriving from the provision of LLR support?

Although these three themes are at times presented as novel or unexplored, students of economic history will be aware that central banks have historically dealt with related challenges over and over again. Indeed, it is difficult to escape the conclusion recently reached by Grossman and Rockoff (2015): economists appear to be always "fighting the last war" when it comes to the design of LLR. Too rarely do we look beyond the commonplaces captured in Bagehot's three principles for LLR. Too often have we reinvented central bank practice already standard more than 100 years ago. The aim of this dissertation is to contribute to a better understanding of the three challenges raised above. For this purpose, I chose an *angle d'attaque* different from the majority of the recent literature on LLR: I focused on the role, design and effectiveness of historical central bank policy responses to financial crises. Central banks forged their role as LLR gradually over time, sometimes by committing momentous errors, and in other moments, by resolving challenging situations with innovative solutions. Even the most unpromising beginnings in history harbor lessons that should not be forgotten or discarded by the modern day central banker. Looking back at why and how central banks lost or won past struggles can be informative in the preparation for, or more optimistically, the prevention of the next war – rather than the last. My point is not to argue that history simply repeats itself and thus policy lessons from the past can be applied to modern day financial markets without the necessary "grain of salt". Rather, the starting point of this dissertation was the observation that our current views on LLR are so much shaped by condensed interpretations of past writings that we have lost track of the wealth of information the past itself still harbors.

More precisely, in this dissertation I analyzed the three themes discussed above through the lens of the path taken by the Austro-Hungarian central bank (*Oesterreichische Nationalbank*, OeNB) between 1868 and 1914. From the perspective of the literature on historical LLR operations, there are three major reasons why the *Oesterreichische Nationalbank* is an enticing object of study. First, the OeNB's adoption of LLR functions, and its crisis management practices more generally, are very much under-researched in economic history. Second, the OeNB's role as a LLR is not only under-researched, it is also a highly relevant case that deserves to be added to the existing empirical literature on historical last resort lending. This literature is strongly dominated by studies on England and the United States, while past financial crisis management on the European continent largely remains to be explored. The peculiar structure of the dominating money and financial markets in London, the very much decentralized institutional set-up of the U.S. Federal Reserve or the parallel existence of a variety of regulators and safety nets partly limit the external validity of conclusions based on these specific historical settings. By moving the focal point to a hitherto neglected central European case, my dissertation fills a gap in the international literature on the LLR. Third, the Austro-Hungarian record is exceptional with regard to the quality and coverage of qualitative, and above all quantitative sources on both the financial market side and central bank operations. The Austro-Hungarian case is unique in that precise quantitative data on both sides of the market are available to the researcher. In contrast, data limitations mostly meant that prior research on England, France and the United States could only focus on one of the two sides in detail. My dissertation builds on a vast array of new (panel) data sets which I compiled from archives and other primary sources. *Inter alia*, I collected several bank-level balance sheet data sets, bank-level information on LLR support, stock market data on the level of individual company shares and information on central bank supervisory operations as applied to individual counterparties. All graphs, tables and econometric analyses in the present dissertation are based on these novel data sets

My findings can be summarized as follows. Chapter I sets the groundwork for this dissertation: it examines the causes of bank distress during the Austro-Hungarian *Gründerkrach* (founders' crash) of 1873. The *Gründerkrach* stands out as the most severe financial crisis which hit the Habsburg Empire during the 50 years of Austro-Hungarian dualism. The fully-fledged banking crisis which ravaged Habsburg Empire in 1873 is surprisingly under-researched in modern economic history and represents a good starting point for this thesis: as so often in similar contexts, I argue that the nature of bank distress in 1873 cannot be easily classified into the conventional illiquidity versus insolvency setting. In Chapter I, I show that bank closures during the *Gründerkrach* were tightly connected to the collapse of a vibrant market for repurchase agreements (also called "repos") in Vienna. Repo loans were an essential part of banks' investment banking business model at the time: in order to boost the attractiveness of initial public offerings (IPOs), banks granted repo loans against equity shares they themselves had introduced to the market – with mostly brokers and stock market investors on the borrower side. I show that repos served the purpose of addressing concerns about after-market liquidity known to be important in IPO underpricing. In this context, bank failures did not spring from a pure liquidity problem, nor did they derive from a simple solvency shock. Repo lender distress emerged from the combination of several different

shocks weakening the financial situation of banks. First, a severe funding shock constituted the bank-level liquidity component of the *Gründerkrach*. Second, to honor their own short-term debts, banks stopped rolling over repo loans and called in the cash they had lent out. Many highly leveraged repo borrowers defaulted on their loans. These loan defaults represent a classical example of bad bank-level fundamentals, reflecting the bank-level solvency component of financial distress in 1873. After all, although their business model might have provided a good rationale for these lending policies, banks had granted short-term, undiversified loans to highly leveraged and risky borrowers. The third component of bank distress relates to market liquidity: lenders were unable to sell repossessed collateral at sufficiently high prices to avoid residual claims on borrowers. Since many banks were forced to liquidate collateral in securities markets that had already begun to implode before, they incurred heavy losses. To the best of my knowledge, Chapter I is the first study to examine a historical repo market crisis and its consequences using microdata. I empirically investigate the impact of repo lending on banks' probability of failure during the *Gründerkrach* of 1873. I estimate several cross-sectional and panel regressions, using binary response as well as semi-parametric survival models. To the best of my knowledge, I am the first to employ stratification techniques to address omitted variable bias in the context of bank-level survival regressions.

Unsurprisingly, the complex roots of bank distress in 1873 posed difficult questions for policy-makers who needed to decide whether and how to intervene. In Chapter II, I show that the Austrian central bank initially rationed credit through its discount facility during the peak of the *Gründerkrach* in May 1873. As the crisis evolved, however, the central bank did produce several specific policy responses that were primarily motivated by considerations to avoid negative externalities. However, it required an innovative and unconventional LLR solution to enable and convince the Bank to intervene effectively in a crisis in which the risk of lending to *de facto* insolvent banks loomed large. In particular, the central bank coordinated and participated in an unconventional lender of last resort mechanism to stem the liquidity crisis. Facing the central bank's limited willingness to provide direct liquidity support, market participants joined forces to preempt large-scale fire sales during the *Gründerkrach*. Bankers, brokers and investment firms founded so-called *Aushilfs-Comités* (AHCs, support committees) in all major cities of the Habsburg Empire. The OeNB agreed to grant direct refinancing lines to these committees in return for the joint guarantees of their members and the creation of equity funds to cover up losses from the committees' lending activities. On the basis of these guarantees, the central bank even allowed rediscounts of substandard paper by the AHCs. I explore unique bank-level information on treatment by the unconventional LLR mechanism. Drawing on inverse probability weighted regression adjustment (IPWRA) to tease out the causal effect of liquidity support, I show that this unconventional LLR was effective in mitigating bank distress. By addressing institutional constraints and adverse selection problems inhibiting "free lending", this mechanism worked as a remedy for the under-provision of a good particularly desirable in times of crises: central bank liquidity. To the best of my knowledge, Chapter II represents the first analysis of a 19^{th} century LLR intervention using both disaggregated balance sheet data and a precisely matched treatment indicator at the level of individual financial institutions. Chapter II is also the first study to employ inverse-probability

weighted regression adjustment (IPWRA) as an empirical strategy to tackle the challenges in identifying the effects of LLR on bank survival.

While *Aushilfs-Comités* were designed in a way to minimize negative behavioral incentives for liquidity recipients, Chapter II only provided limited insight into how the problem of moral hazard was checked inter-temporally. If the creation of *Aushilfs-Comités* with OeNB support had become the general expectation in every crisis, credit institutions might have "banked" on this expectation. As argued in Chapter II, the very nature of AHCs as ad-hoc committees might have limited the rise of pernicious incentives. Yet, their ad-hoc nature also explains why more structural attempts at limiting moral hazard remained absent at the time: with a central bank hesitant to assume the role as ultimate liquidity provider in a crisis, there was no fully-fledged institutionalized LLR concerned with moral hazard. Over time, however, the Austrian central bank evolved into an institution up to the task. Since the Bank gradually adopted free lending practices towards the end of 19^{th} century, this very evolution begs an obvious question: in the absence of explicit liquidity regulation, how, if at all, did the Bank address moral hazard deriving from the presence of its fully institutionalized LLR role? The purpose of the present chapter is to answer this question. In Chapter III, I provided a new explanation for how central banks dealt with moral hazard historically. I focused on one specific component of central banks' counterparty risk frameworks: credit limits for discount window customers. I argued that credit limits as operationalized by the Austro-Hungarian Bank (OeUB) after 1878 constituted the backbone of an early form of microprudential regulation that was designed to check moral hazard in normal times. Credit limits empowered the Austro-Hungarian Bank to enforce minimum liquidity and capital standards for its counterparties at the discount window. Rather than contradicting the tenet of free lending in times of distress, credit limits functioned as "contingent rules": enforced in normal times, limits were increased or lifted during liquidity crises perceived as exogenous. Moreover, even during crises, the Bank did not simply relax limits for all credit institutions: it differentiated between banks depending on their fundamentals prior to the crisis. In modern economies, microprudential regulation is effectively used as a device to address the suboptimal incentive structure triggered by the creation of a LLR. It forces banks to abide by certain minimum standards even in normal times. For example, the liquidity coverage ratio (LCR) introduced by Basel III requires banks to hold an amount of high-quality liquid assets (HQLA) sufficient to cope with a thirty day stress scenario affecting their funding situation. Since this minimum standard has to be met in normal times, it counteracts moral hazard deriving from expected LLR interventions in times of crisis. The evidence I marshaled in Chapter III suggests that the historical roots of liquidity regulation may run much deeper than previously thought. To the best of my knowledge, Chapter III provides the first economic interpretation and empirical analysis of the credit limit frameworks employed by central banks in the past.

To close this general conclusion, I would like to briefly summarize four ongoing and future research projects which derive directly from my work for this doctoral thesis. The first ongoing project explores the long-term evolution of the Austro-Hungarian repo market during the 50 years of dualism between 1868 and 1918. In Chapter I of this dissertation, I argued that the microstructure of the Vienna-based repo market contributed

to the sudden and prolonged break-down of funding flows during the *Gründerkrach* of 1873. More precisely, I argued *inter alia* that the combination of short repo tenors and lenders who were themselves subject to sudden funding withdrawals constituted an important factor that helps explain the precipitous collapse of funding flows following 9 May 1873. In Chapter I, my argument relied mainly on descriptive evidence, both qualitative and quantitative, which I employed to reconstruct the channels leading to the market freeze of 1873 and subsequent repo lender distress. My aim in future research is to base this line of argument on a more solid econometric and historical footing by exploring the long-term co-evolution of average repo rates and maturities. Figure 1.15 in Chapter I already provided a concise overview of the evolution of average repo rates and repo loan maturities between 1866 an 1914. The negative correlation between the level and, in particular, the volatility of repo rates on the one hand and the average tenor on the other is enticing. First, it raises interesting questions about the motivation behind the stock exchange committee's decision to regulate the minimum maturities of repo contracts. The precise timing of the, at times, sweeping changes in minimum maturities between 1866 and 1914 calls for an explanation and more knowledge about the historical context at hand. Thanks to the extensive written records of the committee's deliberations available in the VSE archives, I should be able to find out the necessary detail about these changes. Second, it should be noted that the average repo rate depicted in Figure 1.15 is composed of an increasing number of individual rates reported in the *Coursblatt*: over time, the stock exchange committee gradually introduced more reference collateral securities for which it regularly reported the repo rates. The most interesting corollary of this increased number of reference collateral is that the stock exchange committee implemented changes in minimum maturities for repos in several steps, affecting only some portion of the securities at a time. This setting should therefore enable me to exploit the existence of a control group of repo rates to estimate the effect of changes in the minimum tenor on rate volatility and rate levels in a panel difference-in-difference model. Finally, a further piece of information consists of the fact that the central bank's lombard rate slowly becomes a ceiling for the repo rates in the open market over time, particularly after 1900. This relationship was completely absent during the *Gründerboom* when market rates where frequently above official rates and did not respond at all to changes in the costs of OeUB lombard loans. Furthermore, a graphical inspection of the relationship between individual reference rates and the OeUB's lombard rate suggests that the open market rates on some reference securities followed the lombard more closely than others. This difference appears to be related to the collateral security's eligibility for central bank lombard loans. Since the eligibility of reference securities changed over time and because the changes for individual securities did not coincide with each other, I am again able to exploit the existence of a control group that would allow me to check whether central bank eligibility caused open market rates to gradually conform to the OeUB's lombard rate over time.

My second ongoing research project explores an idea similar to the one just explained. In Chapter II of this dissertation I explained that the OeUB decided to widen the pool of lombard-eligible collateral during the crisis of 1873. Even though the enlargement remained limited in reach, the question whether this policy decision exercised a positive effect on newly eligible collateral is an interesting one. Recent work suggests a scarcity of safe

assets in the global economy (Caballero et al., 2017) and stresses the (positive) effects of the production of new safe assets on output (Caballero et al., 2016). Asking to what extent central bank eligibility can endogenously create "safe assets" is an important avenue for future research. In ongoing research beyond the scope of this dissertation, I therefore investigate whether the inclusion into the pool of eligible collateral came with certain advantages in terms of market liquidity and the prices of chosen securities. For this purpose, I employ a so-called "synthetic control method" (Abadie et al., 2010). Since there were few securities which exhibited statutory eligibility but remained without effective eligibility after the decision to enlarge the pool on 17 May 1873, it is difficult to construct an appropriate control group for treated (i.e. newly admitted) securities. Financial instruments have highly idiosyncratic characteristics and therefore any single one cannot be easily compared with other securities. Hence, I construct a "synthetic" control case that matches all observable characteristics of a given treated security as close possible. Preliminary results suggest that the OeNB's decision to include a given security into its pool of effectively eligible collateral led to a marked increase in its market liquidity, as measured by the bid-ask spread on the security.

The third research project I am currently exploring further is an in-depth investigation into the rescue operation of the *Bodencreditanstalt* (BCA) in 1873. I sketched out the floating of this "lifeboat" in Chapter II of the present dissertation. The operation raises interesting questions about the design of the package and the distribution of costs as well as liabilities involved in rescuing a systemically important institution. Since the BCA was a truly international bank at the time, with half of the board of governors physically located in Paris and the other half in Vienna, I draw on archival evidence located both in Austria (Austrian state archives and *Creditanstalt* archives) and in France (*Archives nationales du monde du travail*) to reconstruct the rescue operation on the basis of official ministerial documents and internal communications between the two seats of the board. I also draw on my network data set based on directorate interlocks (c.f. Chapter II above) to gauge the systemic character of the BCA and the consequences its disorderly default would have had for the wider interbank network at the time. In the following, I briefly summarize my preliminary findings on the design of this operation.

In addition to incipient runs on large Viennese banks, the announcement of troubles at the BCA triggered particularly acute concerns about the future of the credit institutions the *Bodencreditanstalt* had founded during the boom years. Most importantly, the BCA was the founder and main creditor of the *Wiener Bankverein*, another large Viennese bank of high repute. As the investment banking arm of the BCA, the *Bankverein* had been struggling since the start of the crisis but managed to muddle through the summer. It was believed it would run into severe difficulties if suddenly pressed to replace structural BCA funding (Schäffle, 1874; Steiner, 1913). Moreover, the BCA represented one of Austria's main connections to financial centers abroad. Half of the members of the bank's governing board were Frenchmen, as were a considerable fraction the BCA's shareholders; in addition, part of its stocks was held in Frankfurt and Berlin.[334] Finally, one issue of covered bonds the credit institution had emitted was ultimately secured by imperial domain assets (the so-called *Staats-*

[334]Governing board meeting on 8 October 1873, BCA archives 1873/VR/X.

domänenpfandbriefe). Hence, foreign investors, particularly in Paris, where these covered bonds were actively traded, regarded those financial instruments as a form of public debt (Steiner, 1913). Fear of direct contagion effects deriving from the looming bankruptcy of the *Bodencreditanstalt* and the risk of negative feedback effects on the remains of its already tarnished reputation for servicing sovereign debt (the Empire's last sovereign default had occurred in 1866) pushed the Austrian government to initiate an intervention.[335]

The "lifeboat" floated to the BCA had several layers which are either vaguely summarized and misrepresented or altogether absent from the literature on the *Gründerkrach*.[336] It constituted a complicated attempt to make an example of the BCA and prevent the government or the OeNB from incurring any losses. Fortunately, primary sources allow for a detailed reconstruction of the rescue operation. The rescue of the *Bodencreditanstalt* was implemented in the following way. The Ministry of Finance asked four banks (*Creditanstalt*, *Niederoesterreichische Escompte-Gesellschaft*, *Bankhaus Wodianer* and the Viennese Rothschilds) to issue bills to the Austrian state's central cash office (*Staats-Zentral-Kasse*). In return, the banks became official creditors of the government. The Ministry of Finance accepted these bills and subsequently rediscounted them with the OeNB which provided the *Staats-Zentral-Kasse* with the liquidity for providing the BCA with emergency loans. The OeNB stood ready to prolong or increase rediscounts in case this were to become necessary. In return for the receipt of the loans from the central cash office, the BCA issued acceptances to the latter.[337] The emergency loans were guaranteed in several ways: first, the Ministry of Finance was given an unlimited senior claim on the BCA's assets including all assets in which the bank's equity capital (9.6 million fl.) was invested; second, the BCA board members had to set up a guarantee fund of 9 million fl. for which they were privately liable and which constituted the second line of defense against losses from the emergency loans.[338] Third, the BCA's shareholders would be called upon to fully pay in their shares (by 1873, they had only paid in 40%, i.e. 80 fl. on each 200 fl. stock). Fourth, the Ministry asked the four banks which had furnished the initial bills, plus the the OeNB, to set up a subsidiary guarantee fund of 2 million fl. that would be used as a last resort to cover losses. Any remaining losses would be borne by the government.

While settling the question of credit risk, the multi-layered structure of the "lifeboat" was only the start of the operation from the BCA's point of view. The bank was subjected to a full regime of conditionality, deleveraging and restructuring. First, the BCA's governor was replaced by an official from the Ministry of Finance. Second, its business was immediately restricted to areas that the government thought to be in harmony with the bank's nature as a mortgage credit institution emitting covered bonds.[339] An external committee, composed of members from the four credit institutions mentioned above, including the OeNB and a delegate from the BCA's

[335]Protocol of the meeting on 30 October 1873, at the Ministry of Finance, presided by His Excellency the Finance Minister Pretis, GZ5566/FM/24 November 1873.

[336]The only informative references to the rescue operation consist of a few sentences found in Steiner (1913) and Pressburger (1962).

[337]All the information in the preceding sentences is drawn from the Protocol of the meeting on 30 October 1873, at the Ministry of Finance, presided by His Excellency the Finance Minister Pretis and other meeting protocols classified under GZ5566/FM/24 November 1873 as well as a response letter by the BCA to the Ministry of Finance, GZ5421/FM/5 November 1873.

[338]Governing board meetings on 28, 29, 30 and 31 October 1873, BCA archives 1873/VR/X.

[339]Protocol of the meeting on 30 October 1873, at the Ministry of Finance, presided by His Excellency the Finance Minister Pretis, GZ5566/FM/24 November 1873.

governing board decided upon the course of the bank's future business engagements, under authorization from the Ministry of Finance. The BCA's governing board was bound by the deliberations of this committee and thus relegated to a simple executive role without proper decision-making power. Third, the BCA was completely separated from the *Wiener Bankverein* and the latter was not allowed to enter in any new business until the *Bodencreditanstalt's* financial situation was solid again.[340]

A final, fourth research project which directly derives from my dissertation relates to Chapter III. My interpretation of credit limits at the Austro-Hungarian Bank raises an important question: even if credit limits worked as a form of proto-regulation implemented to limit moral hazard related to the provision of LLR services in Austria-Hungary, it remains unclear to what extent my interpretation bears external validity for the wider population of 19th century central banks. This question regarding the applicability and external validity of the interpretation put forward in Chapter III constitutes the object of a fourth research project I would like to pursue in the future. Although I do know that both the Banque de France and the Bank of England set up a system of credit limits similar to the one I described above as early as the 1800s[341], it remains to be seen whether these systems were also operationalized as "contingent rules" to check moral hazard deriving from the creation of a LLR. The vast array of archival evidence on past central bank operations held by the Banque de France and the Bank of England would enable me to pursue this project in-depth. Most importantly, in the case of the Bank of England, I can thoroughly examine to what extent credit limits were binding and how the Bank dealt with transgressions over time: the existence of discount ledgers, which recorded all outstanding loans granted to specific counterparties on a day-to-day basis, would provide me with a unique source to analyze these questions.

Overall, while working on the present dissertation certainly strengthened my personal interest in economic history and enabled me to define several new projects for my research agenda as a (hopefully) future academic, I can only hope that this thesis also represents a rewarding and fruitful study for other researchers.

[340] Initially, the Ministry of Finance even called for a liquidation of the *Wiener Bankverein*, c.f. Protocol of the meeting on 30 October 1873, at the Ministry of Finance, presided by His Excellency the Finance Minister Pretis, GZ5566/FM/24 November 1873.
[341] c.f. Prunaux (2009, p.4-12) for the Banque de France and Calomiris et al. (2016, p.53) as well as Anson et al. (2017, p.23) for the Bank of England.

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