Why are Securitization Issues Tranched?

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ABSTRACT

Securitizations usually involve creating multiple tranches of a single issue with different characteristics which are sold as separate securities. This paper provides the first systematic testing of theoretical explanations of the extent and nature of tranching using a proprietary and comprehensive database of over 5000 separate tranches of European securitizations raising a total of $1 trillion. We find increasing use of tranching through our sample period, and support for asymmetric information and market segmentation explanations for tranching. We also show that tranching can increase prices for the issue as a whole.

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Securitization has become established as an important way for financial institutions, and companies, to pool assets and sell them to investors. Within Europe, total issuance of such asset-backed securities (ABS) has been estimated at €255 billion in 2004, and has been growing rapidly in recent years. In the US the ABS market is even more developed, and represents almost 30% of the total corporate bond market.[2]

In securitizations, the assets themselves are typically financial obligations of third parties such as receivables, mortgages or loans, but they can also be cash flow-generating fixed assets such as aircraft or even whole businesses. At the beginning of the securitization process, a company (the "originator") decides to sell a certain group of its assets. This group of assets is pooled together and sold to an external legal entity - a special purpose vehicle (SPV). The SPV (the "issuer") buys the assets from the originator with funds raised from investors who purchase the ABS issued by the SPV and backed by that pool of assets. Under the guidance of ratings agencies, the profile of expected cash flows from securitised assets is often synthetically amended and transformed by an investment bank (the "arranger") into multiple tranches. These tranches usually have different risk, duration, and other characteristics, but they are backed by the same pool of assets.

Although tranching is now a standard practice when securitizations are undertaken, the factors that determine the extent and nature of tranching remain largely unknown. This paper provides the first systematic empirical analysis of tranching.[3] We employ a proprietary, and comprehensive, database – originally compiled by JP Morgan – of securitizations undertaken in Europe between 1987 and 2003. The sample consists of 1605 issues, and 5161 separate tranches. In total, the issues in our sample raised just over $1 trillion – this is very close to the totals for all European securitization

[2] European Securitization Forum Data Reports 2001-4; Bond Market Association for the US data (www.bondmarkets.com).

[3] We are not aware of any empirical paper devoted specifically to tranching. The institutional and legal background on securitizations can be found in Schwarcz (1993), one of many legal studies of the subject. The few existing empirical studies of securitizations include event-studies such as Thomas (1999, 2001) and Cuchra (2004), who aim to test the impact of securitizations on the prices of companies' debt and equity securities in the United States and Europe, respectively. Lockwood et. al. (1996) focuses on the wealth effects of securitizations for banks' investors.

issuance as reported by different sources.[4] We provide some interesting stylised facts about the cross-sectional differences in the extent of tranching according to underlying asset type, and the time-series trends in the way securitizations are structured. We also use this data to test the theoretical predictions regarding the motivation for pooling and tranching.

At first sight, the creation of tranches is difficult to explain from the standard Modigliani-Miller perspective, since structuring additional tranches incurs transactions costs and because the creation of multiple tranches may reduce ex-post trading liquidity as average tranche size decreases. However, as noted by Mitchell (2004) and further explored by DeMarzo (2005), there are three broad explanations: market incompleteness, asymmetric information, and market segmentation.[5] In this paper we lack information on transactions costs, and so focus on the predictions of the three sets of theories.

A number of theoretical models have been proposed explaining pooling and tranching under the assumption of asymmetric information. The basic intuition of many of the models (such as Boot and Thakor (1993), Riddiough (1997), and Plantin (2004)) is that tranching may add value in the presence of heterogeneous investors with differential private information and different abilities to screen investments. For instance, by creating an essentially riskless senior tranche – attractive to those with a low ability to screen the underlying assets – the issuer is able to create a separating equilibrium and focus the returns to information acquisition on the sophisticated investors who are attracted to the more junior tranches. Such benefits from tranching have to be compared with the potential detrimental impact on post-issue trading liquidity.

Similarly, DeMarzo and Duffie (1999) and DeMarzo (2005) develop models in which an informed issuer trades off an information-destruction effect from pooling assets against a risk-diversification effect, and show how tranching can be optimal for large enough pools of assets.

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[4] European Securitization Forum Data Report Autumn 2004.

[5] There is also a growing theoretical literature on the decision to securitise in the first place, with a focus on agency issues - see, for example, Cuchra (2002) for a model of securitizations in the spirit of incomplete contract theory, or Iacobucci and Winter (2005) for a review of different rationales from the issuer's perspective.

Pooling can also play a role in overcoming adverse selection problems faced by uninformed investors. Such adverse selection problems may be particularly acute given the existence of informed intermediaries who are able to purchase the high quality pools of assets, which they can then pool, repackage and sell. However, given their superior information, such intermediaries face a "lemons" problem that can result in illiquidity, and a price that declines as the quantity sold increases. In this model of informed financial intermediation, pooling and tranching play a key role in allowing intermediaries to re-cycle their capital and to enhance the returns to their private information.

The second group of theoretical explanations focuses on market incompleteness. For instance, tranches might be designed to exploit specific appetites of various investor clienteles in an environment characterised by imperfect arbitrage and missing markets. Early papers on market incompleteness include Duffie and Rahi (1995) which combines spanning with asymmetric information. This is appealing because, as others have stressed, both explanations could potentially coexist with respect to different tranches created within a single issue. For example, Riddiough (1997) notes that although the creation of a senior tranche could be driven by asymmetric information, multiple junior tranches might be created to suit particular tastes of investors in order to facilitate the placement of the information-sensitive tranches in the market. More recently, Gaur, Seshadri and Subrahmanyam (2004) model a market where all assets cannot be uniquely priced: attainable claims have unique prices, but prices of unattainable claims can only be bounded. In this setup, holders of unique assets can take advantage of market incompleteness by focusing on claims that augment market spanning. The authors show that the value of a new asset can be enhanced by 'stripping away' the maximal attainable portfolio – the senior, near-riskless tranche – for which market prices are readily available, and selling the rest (the junior tranches) at the arbitrage-free prices. This suggests that market incompleteness can imply similar security design solutions as informational asymmetry.

Evidence from other markets, and from the professional literature on structuring, suggests that market incompleteness might also justify tranching if a given market segment has limited capacity and no arbitrage opportunities exist. This would imply that an arranger, when trying to place a large issue, might face a downward sloping demand curve. Such market segmentation could be due to limits on arbitrage (see for example Shleifer and Vishny (1997)). Also, imperfect arbitrage has been documented in other financial markets (Froot and Dabora (1999), Richardson and Ofek (2001), Wurglar and Zhuravskaya (2001)). At a more informal level, market incompleteness may vary over time as investor sophistication increases.

We propose some tests of these alternative hypotheses regarding the determinants of tranching. We find evidence that the nature of tranching is developing over time in Europe, with a tendency towards more extensive tranching. This is consistent with European investors becoming more sophisticated over time, but European securitizations still remained in 2003 (the end of our sample period) significantly less tranched than equivalent US issues. We also find strong evidence that larger issues tend to be tranched more extensively. Indeed, the nature of this increased tranching is interesting: issuers can create additional tranches with distinct ratings, or they can tranche within a ratings class. We find a strong relationship between issue size and intra-rating-class tranching, which suggests that market segmentation and/or downward sloping demand curve effects may indeed be significant, and dominate, at least in our sample, the ex-post trading liquidity effects.

We also test whether asymmetric information provides an explanation for tranching. By constructing a measure of the informational-sensitivity of different asset types based on the variance of observed launch spreads, we find that information asymmetry has a significant impact on the number, and type, of observed tranches. However, and consistent with the theory, this effect is much stronger in relation to the creation of additional tranches with distinct ratings, rather than further tranches within a particular ratings-class.

Finally, we investigate the impact of tranching on pricing. We show how the calculated weighted average issue spreads on the pricing date relate to the way the issue is tranched. Clearly the tranching decision itself is endogenous – depending, for example, on the size of the issue, the type of assets, the extent of information asymmetry, etc. – and so we use the predictions from our econometric model of the tranching decision to investigate the relationship between structuring and pricing. We find that the overall issue prices are positively related to the predicted number of tranches. This suggests that structuring is allowing issuers to overcome and/or exploit market factors such as market segmentation, investor sophistication, diversification, and heterogeneous screening skills related to asymmetric information, to their advantage via tranching.

The remainder of the paper proceeds as follows. In the next section we describe the data and provide some stylised facts on the nature of securitizations and tranching. Section II focuses on possible market incompleteness explanations for tranching. In section III we develop our proxy for asymmetric information, and test whether this provides an explanation for the extent, and nature, of tranching. Section IV then considers the relationship between tranching and pricing. Section V concludes.

I. Data and Stylised Facts

A. Dataset

Our study is based on a comprehensive dataset of European securitization transactions from 1987 to 2003. The original database was compiled by JP Morgan Securitization Research Desk in London. We have cross-checked the database against the records of securitization transactions in Bloomberg and Thompson Financial. There are 1605 issues, comprising 5161 separate tranches, so on average there are 3.22 tranches per issue. Approximately 86% of all issues are floating rate issues. The dataset includes a wide range of structured finance transactions including residential mortgage-backed securities (RMBS), collateralised debt obligations (CDOs), credit card receivables and other ABS transactions.[6]

From the original dataset, as well as from our data gathering and cross-checking exercises, we have data on the characteristics of each tranche, including the date of the issue, the issuer, the originator, the price at issue (almost all floating rate issues are sold at par), the coupon, the launch spread measured against a given benchmark, the weighted average life until maturity, any call/put features, the rating (if rated) according to different rating agencies, plus a composite rating as reported to investors. We also have data on the type of assets being securitised (according to a European

[6] For comparative purposes, we also use a separate dataset from the same source of 768 issues with 4388 tranches issued in the US in the single year of 2003.

classification), the size per tranche, the country of origin of assets, the currency of issue, and other details. In addition, we have some category-specific information for certain types of assets, such as market-value/cash flow or balance sheet/arbitrage specification for the CDOs.

We also have pricing data for approximately 80% of the tranches. Out of the 1082 tranches for which we have no pricing data, 702 are parts of CDOs and 380 are from other types of securitizations. If we eliminate all issues for which we have no pricing data for at least one of the tranches per issue, then we are left with 2518 tranches from 824 issues, approximately one-half of the original set. Since we use the pricing data only in selected parts of our study, we do not dispose of the non-priced tranches up-front.

B. Types of securitization transactions

As can be seen from Table I we have 10 main transaction categories corresponding to the types of assets being securitised, with RMBS representing the largest share of all issues (~37%) followed by CDOs. In terms of tranches, our dataset contains 1901 RMBS securities, followed by 1730 CDOs – comprised of 790 'balance sheet' and 940 'arbitrage' CDOs – and 470 commercial mortgage backed securities (CMBS).

Securities backed by various types of consumer loans are characterised by the largest average tranche size relative to issue size – they are, therefore, tranched *least*, not only in nominal terms, but also less than other types in relative terms. CMBS, CDO, RMBS, and the whole business (WB) securitizations are tranched most relative to their size. Since asset type might be important both in terms of structuring as well as information asymmetry, we also create a summary classification assigning different types of assets into five main categories: 709 mortgage issues (2373 tranches), 132 corporate issues (346), 407 CDOs (1730), 242 consumer issues (488), 19 securitizations of government assets or those of government agencies (41), and 96 unclassified or 'other' issues (183 tranches).

Table II reports summary statistics on issue size. Securitizations of sovereign and public agency assets and obligations are largest overall across different types, with a mean issue size in excess of US$2 billion, followed by whole-business (corporate) securitizations, CDO, CMBS and RMBS. The average size of a tranche is $196 million, although there is significant cross-sectional variation. For instance, the two largest tranches in our sample are $6.8 billion each, being part of the same AAA-rated issue from Cyber-Val in 1997. The third largest is the $5 billion issue by the Spanish government to collateralize its nuclear payment obligations. Out of 38 tranches in the sample that are larger than $2 billion, 26 are CDO tranches. The bottom 10% of all tranches are $9.4 million or less in size and the top 10% are $520 million or more.

C. Tranching and ratings

Tranches in our dataset are rated by several credit rating agencies: 70% of all tranches are rated by Moody's, 65% are rated by S&P, and 55% are rated by Fitch. Almost 14% of all tranches are not rated by any of the agencies. The original database also features a 'composite' rating, drawing on the separate ratings of different agencies. This composite rating is reported in the following broad categories, without any refinements: AAA, AA, A, BBB, BB and B. In our sample 1831 securities are rated AAA, 622 are rated AA, 957 are rated A, 784 are rated BBB, and 240 are rated BB or less. There are only six securities rated single-B and only one security rated below B, according to the composite rating. From Cuchra (2004) we adopt another set of ratings - the 'extended Moody's ratings'. This has the advantage of preserving all refinements while incorporating ratings from other agencies for issues not rated by Moody's and hence being as comprehensive as the composite rating. For comparison, Ammer and Clinton (2004) use a composite credit rating constructed from Moody's and S&P's ratings using the average based on the standard mapping between their respective rating scales. Their dataset excludes securities that are rated below BBB3 or less than US$ 25 million in size. In comparison, 32% of tranches in our dataset are less than US$25 million.

Since tranching is often said to be about carving out a riskless tranche, we are interested in the relative size of senior tranches. As can be seen in Table III, transactions based on 'consumer' obligations (as per our general classification) other than mortgages are characterised by the largest AAA-tranches relative to the size of issue. This might in part be due to the low risk of the entire pool. However, consumer loans other than cards and auto loans also exhibit large senior tranches, relative to their issue size, despite being rather risky overall. On the other hand, AAA-rated tranches are relatively small in the case of corporate assets, such as whole-business securitizations and commercial property. The same picture emerges when we take into account all senior tranches, not just AAA-rated, since for some issues an AAA-rated tranche is never created. This picture is to a lesser degree reflected by the relative sizes of the most junior tranches.

Although there is no consistent relationship between the number of tranches and the size of issue, it is clear in the extremes: issues over $1 billion in size have, on average, over 5 tranches, issues of $100 million or less have barely 2 tranches. As shown in Table IV, the share of issues tranched into 1-4 securities varies significantly according to issue size, but there is a significantly greater number of single-tranche issues among very small transactions. Very large issues differ considerably in the extent of tranching: for example, 22% of all issues of $1 billion or more have only 1 or 2 tranches, although a similar proportion (24%) have 7 or more tranches.

D. Expected maturity, pre-payment and market characteristics

Among other characteristics differentiating tranches in securitization transactions, the expected maturity or 'life' is reported by practitioners to be important. This is because nominal maturity is typically meaningless in securitizations because of different prepayment schedules as well as embedded options (see Fabozzi (2001)). The 'weighted average life' or 'WAL' is a catch-all variable that is often reported in the prospectus with the corresponding prepayment assumptions (where applicable), any possible step-ups (of the coupon), and any embedded options, if present.

In our sample we know the expected life of each tranche for 968 issues, comprising 3257 tranches. For 2392 or 73% of all tranches in this sub-sample, there exists at least one tranche with an *identical* expected life in the same issue. Therefore, only 0.89 out of the average of 3.36 tranches per issue has a unique expected life in that issue. Expected life least differentiates CDO, CMBS and

RMBS tranches. Similarly, there is a significantly greater number of tranches than the number of unique rating groups observed per issue. In other words, some tranches have the same rating as other tranches, which is surprising given the typical assumption that tranches are differentiated by rating. Sovereign agency, whole-business and CDO issues are least differentiated by rating: e.g. only 69% of tranching in the whole-business securitizations is characterised by differentiated credit ratings. In our econometric models the distinction between the number of uniquely-rated tranches (which we refer to as *rating classes*) and the number of same-rated tranches (referred to as *market classes*) is often important.

Given the popularity of 'clientele effects' as a practitioner explanation for structuring, we are naturally interested in differentiation by target markets. 3231 of all our tranches are sold in one of the European 'public' markets, 1803 in the European 'private' market, and 127 are issued as public securities in the US backed by European assets. Most of the transactions in the dataset are classified as 'European' on the basis of the origin of assets, but 9 securities are classified as 'international', 119 securities are classified as 'European' and for 242 securities no country has been specified.[7] Overall, we have 27 countries represented, 14 of which have more than 20 observations. United Kingdom represents the greatest share with 460 securities, followed by Italy with 164, Spain with 101, France with 97, Netherlands with 75, US with 69, Germany with 61, and Portugal with 41. In terms of the currency of issue, we have 2933 securities denominated in Euro and 1209 denominated in British pounds – both of which have an identical average tranche size of $183 million – as well as 446 securities denominated in US dollars (average size of $273 million) and 118 originally denominated in French francs ($380 million); other currencies are represented by less than 100 securities each.

[7] There are also some assets in the dataset which come from non-European originators, but are placed in Europe.

II. Tranching, Sophistication and Market Incompleteness

A. Tranching and investors' sophistication

The first set of hypotheses we would like to test concerns markets' and investors' sophistication in relation to structuring. For example Plantin (2004), among others, predicts that increasing investor sophistication should be associated with more tranching and greater differentiation among the constituent parts. Plantin's model suggests that issuers in particular should be interested in tranching securities backed by high quality, information-sensitive assets to attract classes of sophisticated investors. Issuers might also want to tranche securities backed by assets that are not very information-sensitive if investors' sophistication is sufficiently high and if a sufficient number of sophisticated investors exist. This implies that tranching of less information-sensitive assets should be increasing with investors' sophistication. The author also shows that multiple tranches might be optimal in equilibrium with several different 'classes' of investors as long as there is a sufficient gradation in screening skills – the key measure of investors' sophistication.[8] Growth of securitizations in general has also been linked to market sophistication: for example, a recent study of ABS for the European Commission identifies improvements in the techniques of risk analysis and advances in information technology as the two most important drivers behind the growth of securitizations, whereas greater investor sophistication is among top 6 drivers identified by the study.[9]

We start with the most obvious measures of market development and sophistication – the number of securitizations per year, and the number of tranches per issue. Since our data covers virtually the entire history of securitizations in Europe, we would expect investors to develop greater sophistication in line with market development throughout time. The strong market development is confirmed by Figure I: there has been a steady increase in the number of securitization transactions (issues) year by year.

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[8] One of his findings is that the average sophistication of the successful bidder for a given tranche decreases with its seniority.

[9] 'Study on Asset-Backed Securities: Impact and Use of ABS on SME Finance', Final Report for the Enterprise and Industry Directorate-General of the European Commission, November 2004.

However, it is also clear from Figure I that as the number of securitization issues has increased, so has the extent of tranching. This increasing number of tranches per issue over time does not seem to be explained by a changing composition of issues, as can be seen from Table V. For example, the share of mortgages, one of the most ‘tranched’ categories, has fallen steadily throughout the period, but the average number of tranches per mortgage securitization has increased almost every year throughout the period. Therefore, one very simple proxy for investor sophistication, given the reasonably linear development of the market observed in Figure I, would to include a simple time trend in a model explaining the extent of tranching.

Before we proceed to our empirical models, however, we briefly compare US and European markets. It is widely reported that the US securitization market is more mature and more sophisticated than the European market. We would therefore expect to see the number of tranches per issue in the US market exceed that in Europe for the same types of assets. This is indeed what we find. We only have information on the US market for 2003, so we limit the comparison to this year. As can be seen from Table VI, the average number of tranches per issue is greater in the US than in European for all asset-types, with the exception of credit cards. For some asset types, the tranching averages in the US securitizations exceed those in Europe by as much as 100%, despite the fact that the average issue size in Europe (US$1127 million) is almost twice the size of the average US issue (US$ 659).

The aggregate market evidence, therefore, shows a rapid growth of the European securitization market since 1987, and this growth has been accompanied by increased tranching of issues. The extent of tranching, however, is still considerably less than that observed in the more developed US market, suggesting that investor sophistication has been increasing in Europe but has yet to converge with that of US investors.

To analyse the determinants of tranching more rigorously we initially run an ordered logit regression to explain the number of tranches per transaction with the year index, and several controls, for all 1605 issues in our dataset (in subsequent sections we introduce measures of market incompleteness, information asymmetry etc.). The advantage of the ordered logit methodology in this context is that it allows for purely normative ordering without any assumptions about the relative size of each ‘step’ between two consecutive, discrete realizations of the dependent variable. However, we also report equivalent results using OLS for comparison.

Our controls include a measure of the type of collateral. We are also interested in seeing if there is asset-specific innovation so we include interaction controls of the year index with type dummies (not reported). We also control for the size of issue and for the issue ‘life’: the size-weighted, average expected maturity of an issue across all tranches as explained in the previous section. This is important since these controls might be related to tranching by channels other than market sophistication, which we investigate further below. As noted earlier, our sample is reduced by approx. 1/3 when controlling for the weighted average life due to missing information on this variable.

Our results, presented in Table VII, show that the year index – the most simple proxy for investors’ sophistication – has a significant and positive effect on the number of tranches after controlling for the type of assets. It also remains significant and of similar magnitude after we conduct robustness checks by adding additional controls including the size of an issue. The year index remains significant, but weaker when we include the weighted average life of an issue. This would suggest that there are more longer-dated issues in recent years than before, and longer expected maturities make tranching more beneficial, perhaps because they add an extra dimension for splitting securities. Finally, in order to check that the results are not influenced by the quality of assets, we also control for the weighted average launch spread per issue (the weighted sum of launch spreads of each tranche). Although average issue spread has a positive and significant coefficient, the impact of the year index remains almost unchanged.

As an additional check on our results, we introduce two cross-sectional proxies for investors’ sophistication in specific markets. This has the advantage that we can simultaneously test different dimensions of sophistication. As a first proxy we include a dummy for European issues that are placed on the US market – we have 127 such tranches in our dataset. The dummy is significant at the 10% level, but becomes stronger and significant at 5% level when we drop controls for the expected life of the issue and the average launch spread. This is likely to be due to the fact that our sample of issues placed in the US is significantly reduced with those controls. Given these problems, we would like to test for an alternative, cross-sectional proxy of investor sophistication. As a second proxy, therefore, we use the level of sophistication of each market across Europe determined by the ranking of countries according to the overall number of securitization issues originated each state. We then regress the number of tranches on the set of all controls, the year index, and the country ranking. The coefficient on the country variable is strong and significant. Clearly, developed securitization markets with many originators and sophisticated investors are characterised by a substantially higher optimal number of tranches per issue than smaller, developing securitization markets. We note that although the year effect is now weaker, it remains significant at 10% level, but of the same magnitude as before.

This initial analysis of the determinants of tranching has demonstrated that the European market has been developing considerably in the last few years. Controlling for asset type, size, maturity and other factors, it remains the case that the extent of tranching has increased steadily, although it remains at levels below those observed in the US.

B. Market incompleteness and segmentation

According to information asymmetry theories, tranches should be differentiated by seniority. To offer an example, a CDO issue might be tranched into a senior AAA-rated tranche and a junior BB-rated tranche. If there is sufficient differentiation among investors, then the junior tranche might be tranched further into a BBB-rated tranche and a subordinated junior tranche, which might be B-rated or not rated at all. However, theories of tranching based on informational asymmetry might have difficulties explaining why a senior AAA-rated tranche would be tranched further into two *pari-pasu* AAA-rated tranches with different expected maturities or denominated in different currencies.

In general, our dataset strongly supports the hypothesis that tranches should be differentiated by rating: on average, there are 2.07 differently rated groups of tranches per issue.[10] However, since there are 3.22 tranches per issue overall, 36% of tranching is unrelated to the differentiation by

[10] Almost all issues in our sample have external or internal enhancement based on a first-loss 'equity' tranche retained by the issuer or, equivalently, external first-loss insurance from a mono-line insurer.

rating.[11] In Table VIII we show how such differentiation varies according to asset type. The results are not affected by single-tranche issues: if we eliminate all such issues (representing 24.6% of all issues) the average overall number of tranches rises to 3.94 per issue of which over 35% cannot be differentiated by rating. This simple evidence suggests that market segmentation, market incompleteness and liquidity factors might play an important role in tranching.

The incomplete markets argument for tranching is presented in a model by Gaur, Seshadri and Subrahmanyam (2004) who solve a value maximization problem for the price of securities sold in the market and backed by multiple originators' assets, for different levels of pooling and tranching. The optimal regions for tranching and pooling are dependent on the relative unit prices at which originators sell securities to the intermediary and are non-monotonic. In this context tranching could be particularly attractive at times of lower *market* liquidity associated with imperfect arbitrage and missing markets.

Similarly, the problem of market segmentation implies that splitting larger issues into several, more refined tranches should be particularly important for large issues, junior classes, and in difficult market conditions. By dividing the issue, the arranger could enlarge the investor base and avoid a detrimental effect of quantity on price. But these market incompleteness and market segmentation hypotheses alone would imply that optimal tranching consists of splitting each issue into a large number of tranches of different characteristics. This might not be optimal since tranching is costly due to high legal, regulatory, servicing and rating agency costs in the case of multiple groups of creditors with different cash flow rights – see for example Schwarcz (1994), who reports that securitizations are rarely cost effective for transactions of US$50-100 million or less.[12] Moreover, tranching is likely to be costly in terms of post-issue trading liquidity.

By combining these effects, tranching could represent a trade-off between: (i) the benefits of tapping different market segments while avoiding a downward sloping demand curve in each segment

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[11] In order to determine rating groups we use the extended Moody's ratings.

[12] 3.4% of the issues in our sample are less than US$50 million in size and 10.2% of the issues are less than US$100 million.

for large issues, and (ii) the ex-post liquidity and transaction costs of finely tranched transactions. Taken together, market segmentation and liquidity premium hypotheses jointly imply a positive relation between size of an issue and the number of tranches resulting in a relatively stable average size of a tranche. Small issues are expected to be tranched less in order to preserve post-issue liquidity, whereas large issues might be expected to be tranched more if they face segmented markets. Jointly, these theories predict a positive relationship between size and the number of tranches. We find evidence consistent with this explanation: the results of the ordered logit regressions in Table VII show that the number of tranches decreases as the issue size falls.

So far, this initial analysis of the tranching decision has looked mainly at the development of the securitization market over time, and the impact of issue size on the extent of tranching, controlling for asset types. In the next section we consider whether asymmetric information can explain the tranching decision, which leads us to analyse not only the extent but the nature of tranching.

III. Tranching and Asymmetric Information

A. Information asymmetry, asset differentiation and tranching

One of the most important conclusions from the security design literature is that the optimum level of tranching is predicted to be higher for information-sensitive assets.[13] For example, the effect of tranching in the Boot and Thakor (1993) model is to reduce the variance of pricing per tranche. Since issuers' revenues are positively correlated with the information sensitivity of the junior tranches and tranching is costly, the issuers with highly information-sensitive assets should tranche more. If tranching is unable to establish the minimum threshold for the concentration of private information in a junior tranche, it might not be worth pursuing. Similarly, Riddiough's (1997) model implies that multiple-tranched issues should be typical of more information-sensitive assets since the latter offer

[13] This might be due to technical complexity of some assets, as in the case of elaborate prepayment models, or a significant impact of the private information factor on price. DeMarzo (2001), for example, links such information sensitivity with the type of assets being securitised – a critical determinant given the fact that structuring features are generally shared across different transactions of the same type.

greater benefits to compensate for higher transaction costs.

DeMarzo (2005) shows that a combination of pooling and tranching is optimal when private information is common to all assets, but information risks are idiosyncratic (asset-specific), since this combination best allows for the creation of a riskless tranche. He asserts that tranching should be particularly attractive when private information (screening ability) is pool-specific and characteristic of the type of the asset. This "may explain the tendency not to combine types of underlying assets (e.g. mortgages and corporate bonds), since for these different asset classes the private information is likely to be uncorrelated".[14] It follows that if types of assets are differentiated by the degree of information sensitivity, those where private information is important can benefit more from tranching. Also, since gains from tranching are enhanced if the pool has lower residual risk, issues with better collateral should be tranched more.

In order to test these hypotheses, we proxy the informational asymmetry of assets being securitised by ranking 10 categories of asset types according to the standard deviation of launch spreads *within* each type/rating group at the time of issue.[15] The variability in spreads has been linked to information asymmetry before: for example, Bernardo and Cornell (1997) conclude that significant variance in MBS spreads is related to private information. This approach implicitly assumes that price implications of any tranche characteristics beyond a given rating/type group can only be understood by sophisticated investors and are related to private information.

Since a simple standard deviation of launch spreads across all tranches of a given type might be related to the number of tranches by construction (because structuring an issue with a higher number of tranches might result in greater differentiation of tranches by price) we first calculate the standard deviation of spreads within each rating/type group, and then calculate the average standard deviation (across ratings classes) for each type of asset. We then rank the asset types from 1 (low standard deviation) to 10, as a broad measure of the relative asymmetric information.

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[14] Ibid. p. 19.

[15] As we explain in Section IV, we do not have pricing information for all tranches in our sample, and so the analysis of the variability of launch spreads is based on a substantial subset of the issues.

Table IX reports our findings: in general, it is clear that asset pools with corporate obligors, such as CMBS, CDOs or whole-business securitizations are characterized by a higher standard deviation of spreads than pools of consumer loans, such as credit cards or auto-loans. This might be expected because consumer loans are typically more numerous and homogeneous in any asset pool – and hence the individual variances might be better diversified away – than the industry- or company-specific corporate securitizations. We also note that mortgage-backed securities have relatively high variance vis-à-vis other assets, which might be due to pool-specific pre-payment risks, and that the launch spreads on CMBS have greater variability that those on RMBS for every rating group.

We now turn to testing the information asymmetry hypothesis by using the ordered logit and OLS models used in the previous section. We control for investor sophistication (proxied by the year index) and the log of issue size to proxy for the effects of post-issue liquidity and severity of market segmentation on the optimal number of tranches. The asset-type dummies are now replaced by our information asymmetry (IA) index taking values 1 (low IA) to 10 (high IA) across asset types. The results, presented in Table X (model I), strongly indicate that information asymmetry exhibits a positive and significant relation to the number of tranches, as predicted by the asymmetric information literature. This effect remains significant after we control for the weighted average life, as shown in model II. These results imply that a move by 3-4 asset categories towards the more information-sensitive end of the spectrum is associated with the optimal number of tranches per issue increasing by 1. Our conclusions are even more significant given that the construction of the information asymmetry index might be producing a bias *against* our results. This is because assets that are tranched more might have a lower variance of launch spreads per tranche, purely because of more refined tranching. This would imply that our measure would actually underestimate information asymmetry for the more finely tranched assets.

B. Asymmetric information and the quality of assets

Asymmetric information theories directly or indirectly predict that tranching should be particularly beneficial for better quality assets. For example, Plantin (2004) gives the example of the balance sheet- and arbitrage-type CDOs, which are driven by 'immunization' and 'sensitization', respectively: tranching should be particularly attractive for high quality assets in case of the former and when investors are sufficiently sophisticated in case of the latter. Boot and Thakor (1993) predict that issuers with better quality of collateral might tranche more despite the fact that low-quality issuers would also tranche in equilibrium. They show that with more than two types of issuers, those with the highest quality of collateral might split securities into 3 tranches ranked by seniority, if the gain is greater than the loss due to reduction in liquidity. However, market segmentation and liquidity hypotheses imply the opposite: segmentation should be less severe for better quality assets, *ceteris paribus*, as the market for high quality issues, such as AAA-rated bonds, is generally seen as very deep. In terms of placement, less effort might be required to sell better quality assets implying greater demand for equity and simpler structures of junior tranches; high quality assets might also be easier to place due to greater post-issue trading liquidity.

In order to test these hypotheses in model III of Table X we proxy the quality of assets in each issue by the weighted average composite rating index of an issue, where 6 is assigned to AAA tranches and 0 to the non-rated tranches. However, when we add this proxy for quality to our model, it turns out to be insignificant. This could indicate that forces operate in both directions, as explained above, rendering the overall effect null. Finally, Plantin (2004) predicts that less information-sensitive assets should be tranched when there are more sophisticated investors in the market and market sophistication overall is higher. This would imply interaction between the time dimension as measured by time index as a proxy for market sophistication and the type-ranking of assets. To test this prediction we interact year with type (not reported), but the coefficient is not significant.

C. Rating classes and same-rated market classes

One potential problem with information asymmetry models is that any *ex ante* information asymmetries might be eliminated by the rating process. Moreover, asymmetric information theories face difficulties explaining tranching within a given rating class, since it is not clear how such 'extra' tranches differentiate between sophisticated and unsophisticated investors. An alternative set of possible justifications for tranching is based on market incompleteness. As DeMarzo and Duffie (1999, p.95) point out: "The motivation for 'splitting' securities in this setting [with asymmetric information] is independent of motivations due to spanning or clientele effects." Under market incompleteness, tranching becomes a process by which new securities, not available before, are created.

To investigate these issues better, we next split tranches into two groups. First, for each issue we calculate the number of unique rating groups according to the Moody's extended rating, which is more precise than the composite rating because it includes all refinements. The result is the number of 'rating classes' uniquely defined by credit ratings. For example, an issue of 5 tranches with 2 AAA-rated tranches, 2 BB-rated tranches, and a single B-rated tranche will feature 3 rating classes. Non-rated issues are not considered to be a separate rating class.

The number of rating classes would be equal to the number of tranches if all tranches were differentiated by rating. However, some additional tranches (after the rating differentiation) are often created within the same rating class by differentiating the securities issued in terms of the currency, the weighted average life, the payment structure, or some other feature. It is commonly reported in the professional literature that they are created to meet "investors' needs". To capture these, we calculate the number of such extra 'market classes' equal to the difference between the overall number of tranches and the number of rating classes for each issue. Around 56% of issues have additional same-rated market classes: on average, there are 1.14 additional market classes per issue, although the maximum observed in the sample is 13.

Since the same-rated market classes are not differentiated by rating, but only by market characteristics, they are predicted to be related to clientele effects and designed to exploit market incompleteness or as a remedy for market segmentation controlling for the liquidity problem. It is more difficult to explain the existence of those market classes from the asymmetric information security design vantage point. On the other hand, it is clear that the rating classes should primarily be associated with the asymmetric information theories of tranching if the latter are correct. This division is not without precedent in theoretical literature. Riddiough (1997), for example, suggests that although two classes might be created to differentiate informed and uninformed investors, further tranching might be necessary to place an issue due to clientele effects.

The division between rating classes and same-rated market classes allows us to compare and contrast the potential effects of asymmetric information versus market segmentation, incompleteness and liquidity effects. To do this, we conduct the same regressions as before for rating classes and the same-rated market classes separately. The results are reported in regressions IV and V in Table X. It is clear that different effects influence these two sub-groups of tranches very differently. The coefficient on the information asymmetry index is over 70% greater (and almost twice as significant) for the number of rating classes as for the number of same-rated extra market classes. However, this pattern is reversed for the size factor – our proxy for liquidity and segmentation effects – where the coefficient on size is now over twice as high for the rating classes as for the same-rated market classes and almost twice as significant. This is as predicted by theory since the issue size is not predicted to be an important determinant of tranching by the asymmetric information literature.

This distinction between the two classes has important implications for our proxy for the quality of assets – the weighted average rating – which is now strongly significant in both cases, but in opposite directions. This seems to confirm that higher quality assets are tranched more to the extent that tranching is associated with remedying the problem of asymmetric information, as predicted by the asymmetric information literature. At the same time, some additional tranches (the same-rated market classes) are typically created in the case of poor quality assets, when the latter might be more difficult to place. Moreover, the year index as a proxy for investors' sophistication is now significant for the rating classes only; it does not have a significant impact on the number of the same-rated market classes per issue. Finally, longer expected life is associated with a larger number of the same-rated market classes, perhaps because it facilitates the creation of the same-rated market classes only distinguished by expected life. However, a long expected life of an issue might pose problems for seniority-tranching by making it difficult to create an AAA-rated tranche necessary to appeal to unsophisticated investors. This is supported by the fact that although AAA-rated tranches represent 77% of all tranches with expected maturity of less than 2 years, they represent only 26% of tranches with life longer than 7 years.

We also investigate the impact of market conditions by including controls for the three leading bond market characteristics: the level of interest rate (proxied by the corresponding 10-year government bond), the slope of the yield curve (proxied by the 10-year minus 2-year swap differential) and the 'curve' - the interaction variable of weighted average expected life per issue and the slope of the yield curve since the yield curve might be expected to have a different impact on issues of different maturities. We expect the number of the same-rated market classes to be higher in severe bond market conditions when more effort might be needed to cater for investors' specific tastes or for exploring market niches, especially when placing the junior tranches of each issue. Our results (equations VI and VII) broadly confirm this view. Although the interest rate is not significant, a steep yield curve, associated with rising interest rates in the future (and hence falling bond prices), is related to a greater number of the same-rated market classes being carved out, as expected, but a lower number of rating classes. Also, the coefficient on the interaction variable of life and the slope, another proxy for market conditions, is negative and very significant for the same-rated market classes.

In order to explore the distinction between the rating classes and the same-rated market classes further, we test the impact of additional factors, which might have a different effect on the two groups of tranches. For example, we would expect the asset type characteristics to have a dominant impact upon the number of rating classes per issue and the market conditions to primarily influence the number of the same-rated market classes per issue. To test the former, we now replace the info-asymmetry index with individual dummies for all asset types (regressions VIII-IX using OLS, X-XI with ordered logit). The impact of asset dummies turns out to be much stronger on the number of rating classes than on the number of the same-rated market classes, as expected. Whereas a dummy on *each* asset type is significant at the 1% level for the number of rating classes, only the CDO dummy (out of 10 different asset types) has a strong and significant impact on the number of same-rated market classes. This result underlines the difference in the impact of the information-asymmetry asset type index on the rating classes and the same-rated market classes as reported earlier. It also provides an important robustness check by showing that our results are not dependent on any single group of assets such as the CDOs.

The analysis so far has focussed on the factors that can explain the extent and nature of tranching. Clearly, tranching itself is a means to an ends, the ultimate objective being a higher price for the issue as a whole. In the next section we shift the focus of attention to the impact of tranching on pricing for the subset of issues for which we have complete pricing information.

IV. Tranching and pricing

The analysis so far has identified that the tranching decision is driven by a number of considerations, such as market liquidity, the existence of investor clienteles, market sophistication, the extent of information asymmetry, etc. But the ultimate objective of tranching is likely to be to obtain a better price for the originator for the *issue* as a whole. In this section we investigate the relationship between the predictions of the tranching model developed in the previous section, and the launch price for the *issue*. We measure the average launch spread of the entire issue from spreads on individual tranches weighted by their respective sizes. However, our data on launch spreads is much less comprehensive. We lack the spreads for a large number of tranches, and eliminate from our sample all issues where the pricing data is incomplete. Since we are estimating a pricing model, it is important to control for other determinants of spreads (as we discuss below) and when these control variables are not available we also eliminate the issue. We also remove all issues that contain fixed-rate tranches because they might require a different pricing model. Finally, we remove all issues with one or more tranches denominated in currencies other than euro, US dollar, or pound sterling and exclude all issues with a non-European country of origin of assets.[16] Consequently, our original sample of 1605 issues is reduced by around one-half to 785 issues for which we have reliable pricing data.

Before analysing the impact of tranching, we start by regressing the issue weighted average launch spread on the size of the issue and a set of controls. We adopt a simple pricing model that uses a similar set of controls to those typically used in the reduced form models from the existing literature on bond pricing.[17] Our market controls include the interest rate level (proxied by the government 10-year benchmark bond), the slope of the yield curve (proxied by the difference between the 10-year and the 2-year government bond), as well as the implied volatility of interest rates at the time of issue and the issue weighted average expected life (weighted average of WALs across tranches), both of which are important due to embedded options. We also include the total number of lead managers (arrangers), which might be related to the placement effort. Our regressions also include dummies for all asset types, each composite rating category, year and the month of issue.

As can be seen from Table XI (model I), the issue size has a negative impact on launch spread – i.e. a positive impact on the implicit price obtained by the originator for its securitised assets. Issue size might be serving as a proxy for various factors, such as post-issue trading liquidity, or the reputation of the originator. However, the models reported in Table X have also shown that issue size is a major determinant of the number of tranches, so the negative coefficient may be misleading. Only once we introduce the predicted number of tranches per issue can we observe whether the issue size has an independent impact on pricing.

Beyond size, other pricing factors exhibit estimated coefficients of expected sign and magnitude – in line with those from earlier bond pricing models – although the coefficients on the interest rate level and the number of lead managers per issue are almost never significant. The coefficient on the proxy for the shape of the yield curve has the expected negative sign and is always significant. Similarly, the market volatility proxy (implied volatility) is associated with the expected

[16] These issues constitute less than 10% of all issues and they are typically priced against benchmarks other than LIBOR or EURIBOR.

[17] See e.g. Campbell and Taskler (2003).

positive and significant effect on spreads. Finally, a higher weighted average rating per issue and an AAA rating of the most senior tranche are both associated, as expected, with a lower spread.

In order to test the effect of tranching on pricing, we need to control for the endogeneity of the tranching decision. We use a two-step procedure whereby we predict the total number of tranches per issue using our tranching model outlined in the previous section including all individual asset types (to proxy for the asymmetry of information and any other potential, type-specific characteristics), the year index (to capture differences in investors' sophistication and market development), and the issue size (to capture tranching due to market segmentation, incompleteness and liquidity effects). We then include the predicted number of tranches alongside the issue size and the set of controls. For comparative purposes, we estimate the first stage model by both OLS (model II) and ordered logit (model III).

The predicted total number of tranches is highly significant as well as being consistently strong and negative (any differences in results between the two first-stage estimation methods for tranching are small). This implies a strong, positive relationship between the predicted number of tranches and price and confirms that arrangers are tranching the issues to obtain a better price. This provides some additional indirect support for the form of the tranching model estimated in the previous section.

When the predicted number of tranches is included in the model, the coefficient on (issue) size becomes positive and significant. That is, controlling for the impact of issue size (and other determinants) on tranching, the remaining impact of size is to reduce overall issue prices. These results can be interpreted as indicating that (i) there is a downward sloping demand curve, with bond markets having a limited capacity at any given time for any particular type of issue, but (ii) tranching – which is positively related to issue size – is at least partly successful in remedying the problem of market segmentation.

Finally, we explore whether the results change when we distinguish between the two dimensions of structuring – the number of ratings classes and same-rated market classes per issue – identified in the previous section. We take the predictions from estimating separate ordered logit models and then add them up to get the composite predicted total for the issue. The predicted composite number of tranches per issue might be more precise than the total number of tranches where both groups are jointly predicted. The coefficient on the number of tranches is now even more significant (regression IV) and more negative than before. Other variables have similar coefficients as before, although the impact of the issue size variable is noticeably larger (and more significant).

All the results in the section confirm the importance of tranching on pricing. Clearly the tranching decision is endogenous, but when we instrument the number of tranches in various ways using the models developed in the previous section we find a consistent and significant positive impact of the predicted number of tranches on the overall price of the issue.

V. Conclusions

Securitizations have become established as an important source of finance for financial institutions and companies alike. Tranching is the process by which securitization issues are structured, by creating different securities with different risk, duration or other characteristics backed by the same pool of assets. Although such structured financings have become an increasingly important technique, there has been little academic research on the subject beyond pure theory. This paper represents the first attempt to shed empirical light on the key factors that determine the tranching decision using a comprehensive database of European securitizations.

We have tested several key hypotheses regarding tranching derived from the security design literature. We find strong support for the theoretical prediction that greater sophistication of investors and progressive market development should be associated with more tranching. The extent of tranching within the European market has increased steadily in recent year, although it remains at levels below those observed in the US. Theory also predicts that tranching may be a response to asymmetric information. We construct an index to proxy the extent of information asymmetry for different asset class, and find that a greater degree of asymmetric information is indeed associated with a higher optimal number of tranches issued in any given deal. We also show that different explanations of tranching are responsible for the creation of different types of tranches in the same deal. Alongside tranching driven by information asymmetry we delineate tranching driven by market conditions such as market segmentation, incompleteness and post-issuance liquidity, and show the factors associated with each of those groups.

Finally, we investigate the effect of tranching on the pricing of issues at launch. Our results indicate a consistent and significant positive relationship between the predictions of our tranching model and the prices of securities issued in any given transaction. This suggests that structuring is allowing issuers to exploit, or overcome, various factors – such as market incompleteness, greater investor sophistication, and heterogeneous screening skills related to asymmetric information – to their advantage via tranching.

REFERENCES

Ammer, J. and N. Clinton (2004): ‘Good News is No News: The Impact of Credit Rating Changes on the Pricing of Asset-Backed Securities’, International Finance Discussion Papers # 809, Federal Reserve Board, NY.

Bernardo, A. and B. Cornell (1997): 'The valuation of complex derivatives by major investment firms', *Journal of Finance* 52, 785-798.

Boot, A., and A. Thakor (1993): ‘Security Design’, *Journal of Finance*, 48, 1349-1378.

Campbell, J., G. Taskler (2003): ‘Equity Volatility and Corporate Bond Yields’, *Journal of Finance*, 2321-2349.

Cuchra, M. Firla-, (2002): ‘Financial contracting at the Boundary of a Firm’, working paper, Department of Economics, Oxford University, UK.

Cuchra, M. Firla-, (2004): ‘Explaining Launch Spreads in European Securitizations’, working paper, Department of Economics, Oxford University.

DeMarzo, P. (2001): ‘The Pooling and Tranching of Securities: A Model of Informed Intermediation’, working paper.

DeMarzo, P. (2005): ‘The Pooling and Tranching of Securities: A Model of Informed Intermediation’, *Review of Financial Studies* 18, 1-36.

DeMarzo P., and D. Duffie (1999): 'A liquidity-based model of security design', Econometrica 67, 65-99.

Duffie, G. R., (1998): ‘The relation between treasury yields and corporate bond yield spreads’, *Journal of Finance* 53, 2225-2241.

Duffie, D. and R. Rahi (1995): 'Financial innovation and security design', Journal of Economic Theory 65, 1-42.

Fabozzi, F. (ed.) (2001), The Handbook of Mortgage-Backed Securities, McGraw-Hill Education.

Fabozzi, F. and L. Goodman (2001): ‘Investing in Collateralized Debt Obligations’, Frank J. Fabozzi Associates.

Froot, K. A., and E. Dabora (1999): 'How are stock prices affected by the location of trade?' Journal of Financial Economics 53, 182-216.

Gaur, V., S. Seshadri, and M. Subrahmanyam (2004): 'Market incompleteness and super value additivity: implications for securitization", EFA 2004 Meetings Paper No. 2714.

Iacobucci, E., and R. Winter, (2005), ‘Asset Securitization and Asymmetric Information’, Journal of Legal Studies 34, 161-206.

Lockwood, L., Rutherford, R. and Herrera, M. (1996), ‘Wealth effects of asset securitization’, Journal of Banking and Finance 20, 151-164.

Mitchell, J. (2004), ‘Financial intermediation theory and the source of value in structured finance markets’, National Bank of Belgium, www.bis.org/publ/cgfs23mitchell.pdf

Oldfield, G. (2000), ‘Making markets for structured mortgage derivatives’, Journal of Financial Economics 57, 445-471.

Plantin, G. (2004): ‘Tranching’, working paper, http://ssrn.com/abstract=650839.

Richardson, M. and E. Ofek (2001): 'DotComMania: The Rise and Fall of Internet Stock Prices', NYU Stern Department of Finance Working Paper, No. FIN-01-037.

Riddiough, T. (1997): 'Optimal design and governance of asset-backed securities', Journal of Financial Intermediation 6, 121-152.

Schwarcz, S. (1993): Structured Finance: A Guide to the Principles of Asset Securitization, 2nd ed. NY: Practicing Law Institute.

Schwarcz, S. (1994): ‘The Alchemy of Asset Securitization’, Stanford Journal of Law, Business and Finance, 1:133-54.

Shleifer, A. and R. Vishny, (1997), ‘The limits of arbitrage’, Journal of Finance 52, 35-56.

Thomas, H. (1999), ‘A preliminary look at gains from asset securitization’, Journal of International Financial Markets, Institutions and Money 9, 321-333.

Thomas, H. (2001), ‘Effects of asset securitization on seller claimants’, Journal of Financial Intermediation 10, 306-330.

Wurgler, J. and E. Zhuravskaya (2001): 'Does arbitrage flatten demand curves for stocks?', Yale SOM Working Paper No. ICF - 99-12.

Table I: Issues by Type and Number of Tranches per Issue

Classification by type is according to the European classification of securitizations: 'CDO' are collateralised debt obligations; 'CMBS' are commercial mortgages; 'WB' are whole-business securitizations; 'RMBS' are residential mortgages, 'Equip' are securitizations of equipment assets, 'Cons' are securitizations of consumer assets other than auto-loans, credit cards or mortgages; 'SA' are securitizations by government or public agencies' assets or obligations; 'Auto' are auto-loans; 'Cards' are credit-card securitizations.

	Issues with the given number of tranches as percentage of all issues per asset type										
tranches per issue	CDO	CMBS	WB	RMBS	Equip	Cons	SA	Auto	Other	Cards	Total
1	16.0%	15.0%	21.6%	20.5%	24.4%	25.0%	36.8%	27.8%	53.8%	58.1%	24.6%
2	9.8%	13.3%	15.7%	26.5%	41.5%	30.0%	36.8%	55.7%	25.5%	17.6%	22.6%
3	18.9%	17.7%	19.6%	19.6%	14.6%	33.8%	10.5%	13.9%	9.0%	20.3%	18.6%
4	16.5%	12.4%	21.6%	13.4%	12.2%	7.5%	5.3%	1.3%	6.9%	2.7%	12.3%
5	13.5%	13.3%	3.9%	10.2%	7.3%	3.8%	10.5%	1.3%	2.1%	1.4%	9.0%
6	8.6%	10.6%	7.8%	3.9%					1.4%		4.9%
7	5.2%	10.6%	3.9%	2.0%					1.4%		3.1%
8	3.9%	1.8%	2.0%	0.8%							1.5%
9	2.9%	1.8%		0.2%							0.9%
10+	4.7%	3.5%	3.9%	2.9%							2.6%
Mean tranches per issue	4.25	4.16	3.51	3.19	2.37	2.35	2.16	1.94	1.88	1.73	3.22
Std. dev.	2.65	2.41	2.36	2.32	1.20	1.06	1.30	0.82	1.28	1.02	2.33
Total Issues	407	113	51	596	41	80	19	79	145	74	1605
Total Tranches	1730	470	179	1901	98	188	41	153	273	128	5161

Table II: Distribution of Transaction Sizes by Type

The nominal value of each tranche in the currency of issue is converted into US dollars at the closing exchange rate on the date of issue, as reported by Datastream. See Table I for explanation of the classification.

	Asset Type										
	SA	WB	CDO	RMBS	CMBS	Cards	Equip	Auto	Cons	Other	Total
Issues											
- mean size ($m)	2029	828	727	659	594	571	420	405	377	362	630
- std. dev. ($m)	1842	785	1277	849	722	223	331	302	317	508	923
- skewness	1.07	1.37	5.41	4.05	4.35	0.41	1.43	1.56	2.72	5.77	5.55
Tranches											
- mean size ($m)	940	236	171	207	143	330	177	209	160	193	196
- median ($m)	891	180	32	60	56	331	70	130	85	98	53
- std dev ($m)	613	222	497	337	223	288	228	272	221	365	
- skewness	0.29	2.19	6.73	3.84	3.89	0.62	1.69	2.12	3.31	8.91	6.13

Table III: Tranching and Ratings

See Table I for explanation of the classification. *Excluding all issues with no tranches rated. **Bottom-rated tranches excluded tranches classified at the same time as top-rated: e.g. in the case of all single-tranche issues. Rating is the composite rating of all ratings assigned by rating agencies to the particular tranche. Top tranches include all tranches with the highest rating in the issue (can be multiple); bottom tranches include all tranches with the lowest rating in the issue (can be multiple) but exclude single-tranche cases).

	Asset Type										
	Cards	Auto	SA	Equip	RMBS	CMBS	Other	Cons	WB	CDO	Total
% of all issues with at least 1 AAA-rated tranche	95%	87%	47%	83%	80%	74%	57%	68%	37%	66%	73%
average size of all top-rated tranches % of the issue*	96%	96%	99%	90%	90%	72%	91%	90%	73%	55%	81%
average size of the bottom-rated tranche % of the issue**	6%	5%	8%	11%	5%	11%	15%	8%	18%	21%	12%
average issue rating (AAA=6) weighted by tranche size	5.7	5.3	5.1	4.9	4.8	4.8	4.7	4.5	4	3.2	4.4
most senior tranches #	80	93	39	59	990	183	188	101	105	664	2502
most junior tranches #	30	51	1	26	502	111	51	54	44	415	1285
average # of most senior tranches per issue	1.08	1.18	2.05	1.44	1.66	1.62	1.30	1.26	2.06	1.63	1.56
mean size of AAA-rated tranches (where present) % of the issue	89%	80%	42%	64%	53%	43%	69%	69%	30%	35%	52%
mean size of BBB and below tranches % of the issue	15%	45%	-	28%	22%	13%	43%	37%	28%	23%	23%

Table IV: Issues by Size and the Number of tranches

Size of each tranche is calculated in US$ by converting the size of each tranche in the currency of issue at the exchange rate from the date of issue; issue size is the sum of all tranches of a given issue in the dataset.

	Issue Size			
tranches	**<US$100m**	**US$100-500m**	**US$500-1000m**	**>US$1000m**
1	79 (46%)	216 (25%)	69 (21%)	31 (13%)
2	38 (22%)	232 (27%)	71 (21%)	22 (9%)
3	30 (18%)	176 (21%)	61 (18%)	31 (13%)
4	14 (8%)	93 (11%)	52 (16%)	38 (16%)
5	5 (3%)	59 (7%)	42 (13%)	38 (16%)
6	3 (2%)	33 (4%)	19 (6%)	23 (10%)
7+	2 (1%)	47 (5%)	21 (6%)	58 (24%)
Mean	2.09	2.89	3.28	5.07
Total	171	858	335	241

Table V: Issues, Tranches and Collateral Types Across Time

The average size of a tranche is reported in millions of US dollars (converted into US dollars at the current exchange rate if denominated in another currency).

	Year of Issue																
	87	**88**	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**
Average size of a tranche	185	181	328	258	171	158	153	149	123	311	299	178	168	137	145	149	286
Number of issues per year	8	17	12	17	26	12	17	34	44	54	84	102	159	177	252	261	329
Agency (%)													1	2	3	1	1
CDO (%)				6					20	12	17	10	17	23	34	32	39
Consumer (%)				29	19	50	29	15	12	31	20	24	20	12	12	15	9
Corporate (%)						8	6	15	7	7	5	6	10	11	8	9	8
Mortgage (%)	100	100	100	65	81	42	65	70	59	43	46	47	42	42	35	40	41
Other (%)									2	7	12	13	10	10	8	3	2

Table VI: Tranching in Europe and the United States, 2003

See Table I for explanation of the classification. This table compares the 2003 securitization from our European sample, with a similar sample of US securitizations for 2003. The US classification differs slightly from that employed in our European sample. 'HOMEQ' are home equity loans and other mortgages; 'STUDL' are student loans. In the US sample there are no separate categories representing CMBS, whole-business or sovereign/agency securitizations.

	Panel A: European securitizations during 2003										
	CDO	CMBS	WB	RMBS	EQUIP	CONS	SA	AUTO	OTHER	CARDS	TOTAL
Number of issues	129	24	13	110	5	6	3	9	20	10	329
Mean tranches per issue	4.10	4.5	2.92	4.53	2.8	3.17	3.67	2.56	1.55	2.5	3.93
	Panel B: US securitizations during 2003										
	CDO			HOMEQ	EQUIP	STUDL		AUTO	OTHER	CARDS	TOTAL
Number of issues	135			384	16	31		92	33	95	786
Mean tranches per issue	5.8			6.88	5.56	6.03		4.74	2.64	1.72	5.58

Table VII: Initial Determinants of Tranching

Dependent variable in all regressions is the number of tranches per issue. Each observation represents a single issue. Independent variables: *log of issue size* is the log of the sum of sizes of all tranches expressed millions of US$ converted from the issue currency at the FX rate at the date of issue; *year index* is the year of issue; *issue life* is the weighted average (by size) of component tranches' expected maturities in years since launch; *average launch spread* is the weighted average spread of component tranches per issue at launch over LIBOR; *US public* is a dummy =1 if an issue is placed on the US public market (there are no issues placed in the US private market); *issues per country* is the total number of all securitization issues per country. Dummy variables for each asset type are included; see Table I for the classification. The dummy for securitizations of sovereign and public agencies' assets is omitted. The OLS regression includes a constant. Z-statistics in ordered logit regressions and t-statistics in the OLS regression, calculated from the Huber-White robust errors, are reported in brackets. Pseudo R^2 is reported for ordered logit regressions; adjusted R^2 is reported for the OLS regression.

	I	II	III	IV	V	VI	VII
	ologit	OLS	ologit	ologit	ologit	ologit	Ologit
constant	-	**-4.81**	-	-	-	-	-
		(-8.35)					
year index	**0.17**	**0.12**	**0.09**	**0.08**	**0.08**	**0.17**	0.07
(sophistication proxy I)	(11.32)	(7.92)	(3.00)	(2.72)	(2.65)	(11.18)	(1.70)
auto	***1.05***	***1.01***	***1.18***	***1.24***	***1.22***	***1.03***	**1.38**
	(2.30)	(2.01)	(2.41)	(2.53)	(2.48)	(2.26)	(2.72)
cards	0.25	0.46	0.40	0.45	0.43	0.24	0.45
	(0.54)	(0.92)	(0.50)	(0.90)	(0.85)	(0.51)	(0.81)
cdo	**3.05**	**3.06**	**4.60**	**4.53**	**4.51**	**3.03**	**4.86**
	(7.09)	(6.61)	(9.49)	(9.32)	(9.28)	(7.05)	(8.22)
cmbs	**3.06**	**2.97**	**4.39**	**4.29**	**4.28**	**3.04**	**3.44**
	(6.81)	(6.08)	(8.84)	(8.61)	(8.58)	(6.78)	(6.46)
consumer	**1.75**	**1.51**	**2.40**	**2.45**	**2.42**	**1.72**	**2.42**
	(3.84)	(2.99)	(4.78)	(4.86)	(4.80)	(3.79)	(4.58)
equipment	**1.64**	**1.45**	***1.29***	***1.29***	***1.26***	**1.62**	***1.30***
	(3.28)	(2.66)	(2.22)	(2.21)	(2.17)	(3.24)	(2.17)
other	0.79	***1.17***	**1.66**	**1.46**	**1.43**	0.77	**1.27**
	(1.76)	(2.42)	(3.35)	(2.91)	(2.85)	(1.71)	(2.42)
rmbs	**2.25**	**2.14**	**2.77**	**2.81**	**2.76**	**2.21**	**2.61**
	(5.35)	(4.66)	(6.16)	(6.23)	(6.11)	(5.24)	(5.64)
whole business	**2.06**	**2.00**	**3.64**	**3.22**	**3.21**	**2.05**	**2.53**
	(4.25)	(3.78)	(6.66)	(5.70)	(5.68)	(4.23)	(4.24)
log of issue size	**0.64**	**0.72**	**0.96**	**1.04**	**1.01**	**0.63**	**1.10**
	(12.52)	(14.78)	(12.71)	(12.90)	(12.53)	(12.21)	(11.23)
issue life			**-0.08**	**-0.09**	**-0.09**		**-0.10**
			(-5.40)	(-5.57)	(-5.50)		(-5.60)
average launch spread				**0.004**	**0.004**		**0.006**
				(2.91)	(2.84)		(3.32)
US public					0.88	***1.23***	
(sophistication proxy II)					(1.70)	(2.43)	
issues per country							**0.001**
(sophistication proxy III)							(6.56)
issue type	all	all	all	all	all	all	All
pseudo-R^2 / adj. R^2	10.9	29.7	13.8	14.0	14.1	11.0	13.5
no. of observations	1605	1605	968	968	968	1605	729

Table VIII: Tranches, Ratings and Expected Maturities

% of tranches per issue differentiated by rating = average number of identically rated groups of tranches per issue divided by the number of tranches per issue in a given asset category. % of tranches per issue differentiated by expected life = average number of groups of tranches per issue with the same expected life divided by the number of tranches per issue in a given asset category. See Table I for explanation of the classification.

	Asset Type										
	SA	WB	CDO	CMBS	RMBS	Equip	Other	Cons	Auto	Cards	**Total**
% of tranches per issue differentiated by rating	51%	56%	57%	71%	64%	69%	76%	78%	82%	93%	**64%**
% of tranches per issue differentiated by expected life	98%	81%	53%	61%	75%	80%	88%	83%	87%	77%	**71%**

Table IX : Types of Asset and the Information Asymmetry Index

The table reports a mean launch spread (in basis points) for each type of asset by composite rating. B and CCC rated categories are not reported. Standard deviations of the launch spreads within each asset type and rating category are shown in brackets. Mean st. dev. shows the average standard deviation of launch spreads for each type for collateral, i.e. the mean across different rating categories. The ranking of the mean st. dev. by asset type is used to create the information asymmetry (IA) index. See Table I for explanation of the classification. The 'CORP' category includes all types of securities backed by corporate collateral except for CDOs and CMBS; the 'CON' category includes all types of securities backed by consumers' collateral except for RMBS.

rating	Asset Type										***Broad categories***	
	CDO	CMBS	WB	RMBS	Equip	Cons	SA	Auto	Cards	Other	*CORP*	*CON*
AAA	45 (48)	51 (34)	57 (23)	28 (17)	35 (15)	32 (13)	19 (10)	29 (12)	22 (12)	51 (38)	*47* *(25)*	*28* *(13)*
AA	74 (40)	73 (37)	74 (-)	53 (25)	59 (37)	66 (28)	44 (35)	42 (4)	-	78 (34)	*61* *(25)*	*63* *(27)*
A	135 (75)	109 (51)	113 (30)	80 (33)	74 (27)	77 (27)	44 (36)	64 (24)	58 (18)	132 (53)	*103* *(32)*	*68* *(25)*
BBB	247 (130)	207 (65)	250 (63)	162 (58)	197 (116)	167 (59)	-	152 (33)	145 (51)	260 (103)	*258* *(83)*	*154* *(52)*
BB	481 (203)	424 (171)	586 (64)	367 (103)	170 (184)	400 (-)	-	-	-	527 (156)	*516* *(181)*	*400* *(-)*
NR	250 (331)	169 (154)	163 (110)	85 (98)	96 (68)	38 (13)	-	88 (46)	-	204 (137)	*111* *(76)*	*66* *(43)*
mean st. dev.	123	63	54	37	46	26	22	21	22	55	***70***	***32***
IA index	**10**	**9**	**7**	**5**	**6**	**4**	**3**	**1**	**2**	**8**		

Table X : Tranching, Asymmetric Information and Market Incompleteness

The dependent variable in regressions I, II and III is the number of tranches per issue; the dependent variable in regressions IV, VI, VIII and X is the number 'rating' classes per issue as distinguished by the 'Moody's +' composite rating index; the dependent variable in regressions V, VII, IX, and XI is the number of 'market' classes – the additional tranches beyond the 'rating' classes differentiated from the latter by characteristics other than rating. Independent variables: the *info-asymmetry index* is derived from Table IX; *log of issue size* is the log of the sum of sizes of all tranches expressed in millions of US$ converted from the issue currency at the exchange rate at the date of issue; *year index* is the year of issue =1 if 1987 and =16 if 2003; *issue life* is the weighted average (by size) life of component tranches' expected maturities at launch (in years); *average rating* is the weighted average of component tranches' composite ratings where AAA=6 and not rated issues NR=0; *irate* is the yield on the government 10-year benchmark security on the date of issue; *swap diff* is the difference between the 10-year and 2-year swap rate on the date of issue; *curve* is equal to *swap diff * issue life* on the date of issue. When asset type dummies are included, the SA dummy is omitted. OLS regressions include a constant. Z-statistics in ordered logit regressions and t-statistics in the OLS regressions, calculated from the Huber-White robust errors, are reported in brackets. Pseudo R^2 is reported for ordered logit regressions; adjusted R^2 is reported for the OLS regressions.

	all	all	all	rating	market	rating	market	rating	market	rating	market
dependent variable	tranches	tranches	tranches	classes	classes	classes	classes	classes	classes	classes	classes
model number	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
estimation method	ologit	ologit	ologit	ologit	ologit	ologit	ologit	OLS	OLS	ologit	ologit
info-asymmetry index	**0.203**	**0.358**	**0.347**	**0.342**	**0.218**	**0.313**	**0.217**	-	-	-	-
	(11.42)	(14.26)	(13.29)	(12.65)	(7.53)	(10.94)	(6.79)				
log of issue size	**0.668**	**0.957**	**0.972**	**0.488**	**1.016**	**0.567**	**1.000**	**0.279**	**0.815**	**0.624**	**0.927**
	(13.50)	(13.38)	(13.43)	(7.26)	(12.31)	(7.56)	(11.09)	(6.89)	(13.05)	(7.69)	(9.71)
year index	**0.150**	**0.087**	**0.088**	**0.154**	-0.057	**0.170**	-0.051	**0.115**	-0.022	**0.196**	-0.028
	(10.05)	(3.00)	(3.04)	(5.17)	(1.71)	(3.06)	(0.79)	(3.79)	(0.49)	(3.47)	(0.43)
issue life		**-0.083**	**-0.085**	**-0.103**	-0.019	**-0.128**	**0.048**	**-0.051**	**0.056**	**-0.107**	***0.048***
		(6.06)	(6.19)	(7.23)	(1.26)	(6.82)	(2.57)	(-5.28)	(3.72)	(5.08)	(2.44)
average rating			-0.101	**0.242**	**-0.399**	0.062	**-0.405**	-0.013	**-0.301**	**-0.125**	**-0.425**
			(1.54)	(3.03)	(6.07)	(0.72)	(5.16)	(0.30)	(4.51)	(1.34)	(4.84)
irate						-0.025	0.095	0.113	0.122	-0.011	0.100
						(0.19)	(0.66)	(0.16)	(1.12)	(0.08)	(0.67)
swap diff (10y-2y)						**-0.562**	**0.949**	**-0.242**	**0.918**	**-0.482**	**0.942**
						(3.62)	(5.52)	(2.87)	(7.07)	(3.03)	(5.36)
curve (life*swap diff)						0.030	**-0.172**	0.005	**-0.152**	0.012	**-0.184**
						(1.20)	(6.09)	(0.40)	(7.38)	(0.44)	(6.23)
auto								**0.949**	0.375	**3.037**	-0.307
								(3.55)	(0.91)	(4.62)	(0.57)
cards								**1.115**	0.167	**3.367**	-1.343
								(3.98)	(0.39)	(4.91)	(1.81)
cdo								**2.692**	**1.632**	**6.251**	**1.813**
								(10.86)	(4.27)	(9.58)	(3.81)
cmbs								**2.645**	***1.028***	**6.256**	***1.056***
								(10.24)	(2.58)	(9.31)	(2.14)
consumer								**1.678**	0.271	**4.455**	-0.773
								(6.02)	(0.63)	(6.57)	(1.24)
equipment								**0.960**	0.418	**2.968**	-0.474
								(3.05)	(0.86)	(4.08)	(0.66)
other								**1.078**	0.639	**2.988**	0.164
								(4.20)	(1.61)	(4.59)	(1.70)
rmbs								**1.640**	***0.874***	**4.328**	0.744
								(6.97)	(2.41)	(6.96)	(1.70)
whole business								**1.426**	***1.122***	**3.861**	***1.239***
								(4.93)	(2.52)	(5.45)	(2.24)
pseudo-R^2, adj. R^2 (OLS)	0.08	0.10	0.10	0.09	0.10	0.10	0.11	0.33	0.31	0.15	0.13
no. of observations	1605	1605	968	968	968	838	838	838	838	838	838

Table XI : Tranching and Pricing

The dependent variable is the weighted average launch yield spread per issue (in bps) above LIBOR. All issues are floating rate. Each observation represents a single issue consisting of several tranches. Independent variables include: *predicted tranches* is the predicted number of tranches from the 1st stage regression as specified in the text; *issue size* is the issue size in US$ converted from the issue currency at the FX rate at the date of issue; *irate* is the yield on a 10-year government benchmark in the currency of issue on the day of issue; *swap diff* is the difference between a 10-year and a 2-year swap yield in the currency of issue on the day of issue; *cap vol* is the implied volatility of a 5-year interest rate cap in the currency of issue on the day of issue; *issue life* is the expected weighted average life of the entire issue (weighted by tranche size) in years as per assumed prepayment paths per tranche (where relevant); *lead tot* is the total number of lead and co-lead managers (arrangers) for each transaction. See Table I for explanation of the classification. All regressions include a constant (not reported). All tranches in issues for which at least one pricing factor/control is not specified for at least one tranche are omitted. t-statistics are reported in brackets.

	I	II	III	IV
1st stage model	-	OLS	ologit	ologit
predicted variable	-	all tranches	all tranches	rating & market classes estimated separately
predicted tranches (from 1st stage regression)	-	**-22.016** (-9.20)	**-19.699** (-8.76)	**-26.482** (-11.03)
issue size	**-0.006** (-3.84)	**0.012** (4.64)	**0.011** (4.39)	**0.019** (6.87)
irate $_{10y}$	3.094 (0.82)	2.890 (0.81)	3.674 (1.02)	3.904 (1.11)
swap diff (10y-2y)	**-7.695** (-2.35)	**-12.326** (-3.92)	**-11.755** (-3.73)	**-11.548** (-3.78)
cap vol $_{5y\ i/r\ cap}$	**0.958** (2.20)	0.618 (1.49)	**0.908** (2.18)	**1.152** (2.84)
issue life $_{log\ (WAL)}$	-3.841 (-1.36)	**-11.840** (-4.22)	**-12.140** (-4.27)	**-12.607** (-4.62)
lead tot	-0.375 (0.27)	-0.154 (-0.12)	0.060 (0.05)	-0.014 (-0.01)
issue rating index	**-13.775** (-7.00)	**-20.036** (-10.09)	**-18.510** (-9.49)	**-23.33** (-11.55)
AAA tranche (d)	**-37.115** (-6.53)	**-26.097** (-4.73)	**-27.657** (-5.01)	**-22.13** (-4.06)
9 asset type dummies	yes	yes	yes	yes
8 year dummies	yes	yes	yes	yes
3 quarter dummies	yes	yes	yes	yes
adjusted R^2	47.8	53.0	52.6	55.0
# of observations (issues)	785	785	785	785

Figure I: Development of Tranching in Europe Since 1987