Capital Market Imperfections and Investment:

Evidence From Firm-Level Panel Data

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Thesis submitted to the Board of the Faculty of Social Sciences, Sub-Faculty of Economics, of the University of Oxford in partial fulfilment of the requirements for the degree of Doctor of Philosophy

Linacre College, Oxford

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Abstract

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Recent work in macroeconomics argues that imperfections in capital markets may magnify business cycle fluctuations by propagating relatively modest shocks. This thesis investigates evidence for such a mechanism (also known as the "financial accelerator") by analysing two empirical models of investment in physical capital that test for the importance of capital market imperfections on firms' investment decisions. These models are, respectively, an error correction specification augmented with an additional cash flow term, and an Euler equation model explicitly derived from dynamic optimisation in the presence of symmetric, quadratic costs of adjustment. Chapters 4 and 5 use a large panel of individual Italian manufacturing firms to investigate the impact of capital market imperfections on investment expenditures. Regression results from a system Generalised Method of Moments (GMM) estimator appear to be consistent with the hypothesis that firms that are in a strong informational or liquidity position (large firms, group members, R&D performers) are less likely to face binding financing constraints than firms in a weak informational or liquidity position (small firms, independent firms, non-R&D performers). Investment regressions in Chapter 6, based on consolidated accounting data for three samples of UK, US and Italian companies, show that the sensitivity of investment spending to financial variables is greater in the UK and the US than in Italy. This finding is consistent with the suggestion that *outsider control* financial systems perform less well in channelling investment funds to firms with profitable investment opportunities than do *insider control* financial systems. Finally, the empirical analysis in Chapter 7, based on two samples of UK and US firms, provides some preliminary evidence that a less concentrated ownership structure and a high level of institutional ownership may increase the sensitivity of investment to the availability of low-cost internal funds.

To my wife and my family

Nec te caelestem, neque terrenum, neque mortalem, neque immortalem fecimus, o Adam, ut tui ipsius quasi arbitrarius honorariusque plastes et fictor in quam malueris tute formam effingas. Poteris in inferiora quae sunt bruta degenerare, poteris in superiora quae sunt divina, ex tui animi sententia regenerari.

Pico della Mirandola

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Chapter 1

Introduction

In recent years there has been a resurgence of interest in the determinants of firms' investment decisions. The empirical shortcomings of existing models, developed under the assumption of perfect capital markets, and the theoretical advances in the field of information economics have stimulated a growing literature on the effects of capital market imperfections on corporate investment.

Capital market imperfections add a new dimension to the traditional neoclassical investment theory, according to which firms undertake any investment project with positive net present value and the capital structure is irrelevant. Since these imperfections (transaction costs and, in particular, informational asymmetries) can prevent interest rates and securities prices from fully adjusting to allow firms to undertake all desired investment, the availability of internal finance may constrain investment directly. The existence of capital market imperfections leads therefore to a close relationship between internal finance and investment: holding investment opportunities constant, positive shocks to internal net worth will increase investment spending, either because firms are in a position to draw upon relatively inexpensive internal funds, or because additional collateral reduces costs of external finance.

Whether financial variables affect investment expenditures for a significant fraction of firms is the subject of econometric testing in this thesis. Two different econometric models of investment are used to test for the importance of capital market imperfections on firm's investment decisions. The first model is an error correction specification augmented with an

additional cash flow term to investigate the presence of liquidity constraints. Since with this type of model a significant cash flow effect may reflect information that influences expectations of future profitability rather than the impact of financial constraints, we also estimate an Euler equation model explicitly derived from a dynamic optimisation problem in the presence of symmetric, quadratic costs of adjustment. Under this assumed structure and the assumption of rational expectations, the Euler equation model has the advantage of controlling for all expectational influences on the investment decision, so that significant evidence of mis-specification associated with profit variables is more likely to reflect the effect of capital market imperfections on the firm's investment spending.

Chapters 2 and 3 constitute introductory chapters for the research that we present in Chapters 4, 5, 6 and 7, in which we consider a number of issues related to capital market imperfections and investment. In Chapter 2 we present a selective survey of the literature relating investment to financial market imperfections and we discuss the models and econometric issues that will be examined in the subsequent chapters. In Chapter 3 we discuss a taxonomy of financial systems and review the main characteristics of the systems of corporate financing and governance in Italy, the UK and the US.

In Chapter 4 we investigate the importance of financial constraints on the investment decisions of Italian manufacturing firms. The Italian industrial system is characterised by a large number of small and medium-sized firms and arm's-length relationships between banks and firms. This is likely to result in important imperfections in the capital markets, as small firms may find it difficult to convey information to "distant" financial institutions, and may suffer from high idiosyncratic and default risk. The diffusion of family and group control among Italian firms may, however, reduce the importance of these imperfections. In fact, family control and membership in a business group can mitigate information and liquidity

problems by improving corporate control and by allowing the formation of an internal capital market that may replace the capital market allocation function of the external market.

The empirical analysis is based on an unbalanced panel of 710 individual firms, obtained by combining information from two different sources. The first source is the Centrale dei Bilanci database, which includes balance sheets of 1309 manufacturing companies over the period 1986 to 1996. The second source is a survey conducted in 1995 by Mediocredito Centrale. This survey is based on the responses of 4431 manufacturing companies to a questionnaire concerning the period 1992 to 1994, and provides additional information about the firms that is typically not available in their financial statements. This makes it possible to identify firms that are likely to face different degrees of capital market imperfections (small and large firms, independent and group firms) and to test whether their investment expenditures display a different sensitivity to the availability of internal finance.

In Chapter 5 we investigate the impact of capital market imperfections on investment in research and development (R&D) by Italian private firms. R&D investment represents a case in which the difference in cost between internal and external finance is likely to be particularly significant. Indeed, the nature of R&D investment precludes outsiders from making accurate appraisals of its value. Moreover, since a failing R&D project generally leaves few tangible assets of value, firms may face a greater cost premium for external finance when a project involves substantial R&D investment rather than investment in physical assets. Hence, imperfections in the capital markets provide an explanation of why firms can find it difficult to obtain adequate external financing for R&D, and innovative projects are primarily funded by current profits and accumulated funds. This underlies the view that a firm must possess some monopoly power, along with the associated monopoly profits, for it to carry on doing R&D.

As Italian balance sheets lack quantitative information on R&D expenditures, we collect company accounts data for a sample of 707 manufacturing firms that provide information on

innovative behaviour in the survey conducted by Mediocredito Centrale. Since the survey information is limited to the period 1992 to 1994, it is not possible to estimate R&D investment equations. In order to investigate the impact of financial variables on Italian firms' R&D investment, we then examine the relationship between fixed investment and internal finance over the period 1986-1996 for samples of R&D performing and non-R&D performing firms (based on the survey information for the period 1992 to 1994). The rationale for this exercise is the observation that, if there is a significant cost premium on external finance, firms in a strong liquidity position (and for whom, therefore, financial constraints are less likely to be binding) are more likely to undertake long-term commitments to R&D investment projects.

In Chapters 4 and 5 we take explicit account of firm heterogeneity to identify companies that are more likely to face different degrees of capital market imperfections. One problem of employing cross-sectional differences to test the different sensitivity of company investment to financial variables is that the sample split may be endogenous, that is, the regime the firm is in is partly a choice variable of the firm itself[1]. In Chapter 6 we address this issue by comparing the sensitivity of investment to the availability of internal finance for firms in three different countries: Italy, Britain, and the United States. Since the financial and institutional environment faced by firms in each country is quite different, and these differences are exogenous, different responses of investment to financial variables in the three countries offer a potentially compelling source of identification for the impact of capital market imperfections.

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[1] A different problem -that of interpreting differences between firms that display high or low sensitivity of investment to cash flow, raised by Kaplan and Zingales (1997)- is generally avoided in our results. We succeed in identifying sub-samples of firms where there is no evidence of excess sensitivity to cash flow (e.g. large firms, group members, R&D performers), and contrast these with sub-samples where we find significant cash flow effects.

The empirical analysis is based on company accounts covering the period 1986 to 1997 for the UK and US firms, and the period 1986 to 1996 for the Italian firms. A problem that usually arises when comparing UK and US firm-level data with Continental European company accounting data is that the latter are generally based on unconsolidated accounts for individual corporations (as is also the case in Chapters 4 and 5). Clearly there is the possibility that the investment spending by a legally independent subsidiary is constrained by the internal funds of the company group as a whole, rather than by the internal funds of the subsidiary itself, and that this will not be detected using unconsolidated data and investigating the sensitivity of the subsidiary's investment to its own internal finance. In this case the use of unconsolidated accounts would underestimate the impact of financial constraints on capital accumulation. Therefore, in order to make the data across countries more comparable, consolidated accounts for a selected sample of Italian corporate groups are obtained from the Centrale dei Bilanci database.

In Chapter 7 we present some preliminary results on the influence of ownership structure on the sensitivity of investment to internal finance. The structure of ownership affects the way in which companies are managed and controlled. The more concentrated the ownership, either the more closely managers' interests should coincide with those of shareholders, or the greater the incentive other large shareholders have to monitor the behaviour of managers. In either case there may be a reduction in the free-rider problems associated with management performance and funding distressed firms. In the case of dispersed ownership, agency cost theories suggest that a high dividend pay-out ratio, or a greater reliance on external sources of external finance, may substitute for direct monitoring of firms by large shareholders. Moreover, to the extent that institutional investors tend to be relatively passive shareholders, preferring exit rather than voice in the exercise of corporate control, the monitoring motive for dividend payments/debt can also be associated with high levels of institutional ownership.

Hence, if imperfections in the capital markets are important and there is a wedge between the cost of internal and external finance, agency cost models predict that a less concentrated ownership structure and/or a high level of institutional ownership may result in a greater sensitivity of investment spending to the availability of low-cost internal funds.

To investigate the impact of ownership structure on the link between investment and internal finance, we match company accounts data with detailed data on beneficial ownership for two samples of UK and US manufacturing companies. The resulting data sets allow us to test whether dispersed ownership and/or a high level of institutional ownership is associated with a greater sensitivity of investment to the availability of internal finance.

Chapter 8 summarises the main findings of our research, and suggests some directions in which this work could be usefully extended. In particular, whilst we have focused on testing the basic neoclassical investment model (in which value-maximising firms have access to external funds that are a perfect substitute for internal finance) against a financing constraints alternative (in which excess sensitivity to cash flow arises from a cost premium for external funds) we recognise that other departures from the neoclassical model may also generate this excess sensitivity to cash flow. In particular, managers may have objectives other than maximising shareholder value that could make investment sensitive to the availability of "free" cash flow. Distinguishing between these alternative explanations for the empirical relationship between investment and the availability of internal finance presents an important challenge for future research in this area.

Chapter 2

Financial Constraints and Corporate Investment: Theoretical Framework, Microeconomic Models of Investment and Econometric Issues

1. Introduction

This introductory chapter contains the theoretical and empirical framework for the description and analysis of the effect of financial constraints on company investment. In Section 2 we discuss the literature on investment and capital market imperfections and survey recent microeconometric research on investment that has used firm-level panel data. Section 3 presents a formal derivation of the empirical models of fixed investment that will be estimated in the following chapters. Section 4 discusses some econometric issues that arise in the specification and estimation of dynamic models of investment and explains the distinctive features of the estimators employed in the econometric analysis.

2. Theoretical aspects and literature overview

Recent theoretical research shows that capital market imperfections can cause credit to be rationed or prevent firms from obtaining funds through new equity issues, even though firms have investment opportunities with positive net present values. That is, projects that would increase the value of the firm and would be undertaken according to traditional neoclassical

theory might be constrained by financial market imperfections. In this section we initially explore how research based on the concept of asymmetric information in capital markets relates to the theory of investment. Afterwards we describe neoclassical models of investment incorporating capital market imperfections and summarise the approaches and the results of empirical studies using firm-level panel data.

2.1 Investment, net worth, and asymmetric information

Following the Modigliani-Miller theorem on the irrelevance of the capital structure[1] (1958, 1961) the separability of firms' investment and financing decisions became a standard assumption of investment theory. According to the traditional neoclassical theory with perfect information, firms undertake any investment project with a positive net present value, and the choice of financing mix is indeterminate[2]. That is, under perfect capital markets and no taxes[3],

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[1] Modigliani and Miller argued that in the absence of taxes and under perfect capital markets (all agents have equal information, transaction costs to vary the mix of stocks and bonds in the portfolio of investors are zero, and personal borrowing is a perfect substitute for corporate borrowing, that is, firms and individuals face the same interest rates), the market value of any company is independent of its capital structure. Firms should therefore be indifferent to financing their investment projects through debt or equity because "the average cost of capital to any firm is completely independent of its capital structure and is equal to the capitalisation rate of a pure equity stream of its class" (Modigliani and Miller, 1958).

[2] The Modigliani-Miller propositions on the irrelevance of financing decisions have been contrasted from the beginning by "static trade-off" theories of capital structure, in which the optimal debt ratio is determined by a trade-off of the costs and benefits of borrowing, and the firm is viewed as setting a target debt-to-value ratio and gradually moving towards it. The firm is portrayed as balancing the value of interest tax shields against various costs of debt overhang (Myers, 1977) and bankruptcy and financial distress (Kraus and Litzenberger, 1973, and DeAngelo and Masulis, 1980), and to substitute debt for equity, or equity for debt, until the value of the firm is maximised.

[3] Taxes can give rise to a reason for relatively costly external new equity finance under the "tax capitalisation view" of dividend taxation. Empirical evidence, however, casts doubt on the tax capitalisation view. For a further discussion of this issue and empirical evidence, see Poterba and Summers (1983) and Sinn (1991).

a firm's cost of capital is the same whether that capital is raised internally through retained earnings or externally through the issuance of debt or equity[4].

The main characteristics of the traditional neoclassical investment models may be summarised as in Figure 2.1 (page 15), portraying the demand for capital by a firm with net worth *W* and the supply of funds to the firm[5]. The quantity and cost of capital are, respectively, on the horizontal and the vertical axes. The supply curve, *S*, is depicted as a horizontal segment at r, the risk-adjusted market real rate of interest: the cost of capital does not depend on the capital structure. The first best desired capital stock, K^*, is determined by the intersection of the downward sloping demand curve *D* and the *S* curve at the interest rate r, that is, where the marginal product of capital equals the interest rate. All else being equal, an increase in investment opportunities or a decrease in the market interest rate increases the desired capital stock. In this framework, the availability of internal funds does not affect investment decisions: the firm insiders perceive the opportunity cost of internal funds to be the market interest rate, and they can borrow and lend at that interest rate in the capital market.

More recent theoretical work has suggested that the Modigliani-Miller theorem may not hold under imperfect information and that the state of the firm's balance sheet, or its "internal net worth", may affect firms' investment spending. If managers or insiders have better

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[4] The existence of transaction costs created by registration fees, underwriters' spreads, and other administrative costs for new issues of stocks or bonds may lead to a wedge between the cost of internal and external finance. Estimates presented in Securities and Exchange Commission (1974) show that in the US the transaction costs consume, on average, nearly 19% of the gross proceeds of small stock issues and about 14% of the proceeds of small debt issues. Thus transaction costs could have created a significant financing hierarchy for relatively small firms. However, the SEC data show that the transaction costs become less burdensome with increases in issue size. By employing firm size as a proxy for transaction costs (and controlling for characteristics that may vary with size, such as age and inside equity holdings), Oliner and Rudebusch (1992) do not find any statistical evidence supporting a role for transaction costs as a source of the financing hierarchy for business investment.

[5] For simplicity, investment is assumed to be fully reversible and the rate of depreciation and the expected rate of change in the price of capital goods are equal to zero.

information about the characteristics of the firm's return stream or investment opportunities than do potential investors, the cost of new security issues may increase relative to the cost faced by a firm not burdened by such information asymmetries - perhaps to the extent that they cannot raise funds at all. The plausibility and existence of a shadow price differential between internal finance (retained earnings) and external finance (debt and stock issues), as a consequence of information problems in the capital markets, has been investigated in a number of recent papers.

The fundamental insight on the effects of asymmetric information comes from Akerlof's (1970) analysis of the "lemons" problem, in which the sellers of a product have more information about its quality than do buyers. Akerlof showed that information asymmetries can hamper the functioning of markets and, in extreme situations, bring about a complete breakdown of trading. In capital markets, the asymmetry of information concerns the quality of firms' investment projects and managers' behaviour. Myers and Majluf (1984) analyse the case in which outside investors are less well informed than current firm insiders about the value of the firm's assets and investment opportunities. Because outside investors cannot distinguish between good and bad ("lemon") investment projects, they will require a higher return from good projects to cover the losses incurred from inadvertently funding bad ones. As a result of asymmetric information, managers/insiders can issue new stocks only at a premium, and equity backing good projects are undervalued. Undervaluation of new equity issues may then be so severe that new investors capture more than the net present value of the new project, resulting in a net loss to existing shareholders. In this case the project will be rejected, even if the net present value is positive. Underinvestment can be avoided if the firm can finance the new project using a security that is not undervalued by the market, like internal funds and/or riskless debt. Myers (1984) refers to this as a "pecking order" theory of financing,

i.e., that capital structure will be driven by firms' desire to finance new investments, first internally, then with low-risk debt, and with equity only as a last resort.

In the presence of imperfect information, banks and financial intermediaries should be in a better position than individual investors to gauge the value of firms' existing assets and investment opportunities. Since they are specialised in gathering information on risky ventures, financial intermediaries are expected to face lower information costs to selecting and monitoring investment projects. Along with the tax advantage of debt with respect to equity, this explains why firms generally prefer financing through debt, and choose new equity only when their ability to issue low-risk debt is exhausted.

However, even if financial intermediaries can reduce adverse selection problems[6], the cost of debt might not be completely exempt from information costs. Especially in cases in which universal banking is not developed and firms and banks are rigidly separated, the relationship between the quantity and shadow price of credit is likely to vary across firms according to information asymmetries. If lenders cannot exactly distinguish "good" firms from "bad" firms, they may charge interest rates based on the average quality of the firms, to cover the risk of funding bad ones. In this case, firms that are successfully able to conceal high-default risks from lenders would be subsidised by low default-risk borrowers. Therefore, firms with profitable investments would pay a premium that in part reflects the lender's uncertainty about the prospect of repayment. In the most extreme case, asymmetric information can lead to "credit rationing" to some categories of borrowers in competitive equilibrium (Stiglitz and Weiss, 1981); in other words, there could exist a threshold of the performance or collateral

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[6] The type of asymmetric information problem stemming from the fact that suppliers of funds do not have the information to know which firms have which projects, is said to be a *selection* problem or a problem of *ex ante* asymmetric information, since the asymmetry exists before the parties involved enter into an agreement with one another.

indicator used by lenders, below which external funds are not available irrespective of the cost the firm would be ready to pay[7].

A greater cost of debt[8] can also be the result of conflicts of interest between equity-holders and various fixed-payment claimants ("agency costs" of debt). Under asymmetric information, managers/shareholders may have a moral hazard opportunity to exploit creditors by substituting riskier assets for safer ones[9] (possibly undertaking negative present value investments). Indeed, if an investment yields returns well above the face value of debt, shareholders capture most of the gain. On the other hand, if the investment fails lenders bear most of the consequences, because of limited liability of equityholders on the firm's debt. Thus, managers may benefit from investing in highly risky projects, even if they are value-decreasing, since the gain in equity value captured at the expense of lenders more than offsets the loss in equity value from the poor investment. However, if debtholders anticipate managers' behaviour, they would protect themselves by demanding either interest rate premiums or bond covenants that restrict the firm's future use of debt. Because of this under-

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[7] De Meza and Webb (1987) contrast the traditional underinvestment results implicit in the study by Stiglitz and Weiss (1981) on credit rationing resulting from asymmetric information. They show that under plausible assumptions, the inability of lenders to discover all the relevant characteristics of borrowers leads to overinvestment, that is, investment in excess of the socially efficient level. The crucial difference between the Stiglitz-Weiss model and the De Meza-Webb model is that in the former all projects have the same expected return but the dispersion of returns is different, whereas in the latter the expected returns differ between projects.

[8] Regardless of asymmetric information problems, the cost of debt is supposed to increase with the extent of borrowing, as a consequence of higher odds of incurring costs of financial distress. Several studies (Feldstein, Green and Sheshinski, 1978; Auerbach, 1979; Gordon, 1982, etc.) have found that the capacity to use debt may be limited, in the sense that the required rates of return on debt and equity increase with leverage.

[9] This type of asymmetric information problem is said to be a *hidden action* problem or a problem of *ex post* asymmetric information, since the asymmetry occurs after the parties involved enter into an agreement with one another. The problem differs from the selection problem in that the suppliers of funds cannot observe the investment choice made by firms after the funds have been made available to them, rather than facing the selection problem of being unable to distinguish between different types of firms.

pricing of new debt issues, stockholders would finally bear the cost of the incentive to invest in value decreasing projects created by debt. This result, known as the "asset substitution effect", represents the agency cost of debt[10].

Jensen and Meckling (1976) also consider the potential conflict of interest that may arise between managers and shareholders. If managers hold less than 100% of the residual claim, they may have an incentive to use firm resources in the form of perquisites or other wasteful activities. Such activities can be monitored at a cost, and ultimately the insiders will bear the cost in terms of a reduced price that prospective shareholders are willing to pay for a stake in the firm. Clearly, the incentive to invest sub-optimally is reduced the larger is the fraction of the firm's equity owned by the managers[11].

Imperfections in capital markets add a new dimension to the traditional neoclassical investment model. To predict investment spending it is necessary to know not only the firm's desired path of capital accumulation in the absence of financial constraints, but also whether all desired investment can be financed from low-cost internal sources. Because capital market imperfections can prevent interest rates and securities prices from fully adjusting to allow firms to undertake all desired investment, the availability of internal net worth may constrain investment directly. If we had a sufficient statistic summarising the firm's investment opportunities, we could test whether financial market imperfections affect capital accumulation by adding to empirical models of investment a term that proxies for internal net worth. If financial frictions are unimportant, internal and external financing are perfect substitutes, and information about changes in net worth should be irrelevant for the investment

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[10] See Jensen and Meckling (1976), and Smith and Warner (1979) among the others.

[11] Jensen (1986) points out that a way to mitigate the loss from the conflict between the manager and the shareholders consists in increasing the fraction of the firm financed by debt. Since debt commits the firm to pay out cash, it reduces the amount of "free" cash available to managers to engage in wasteful activities.

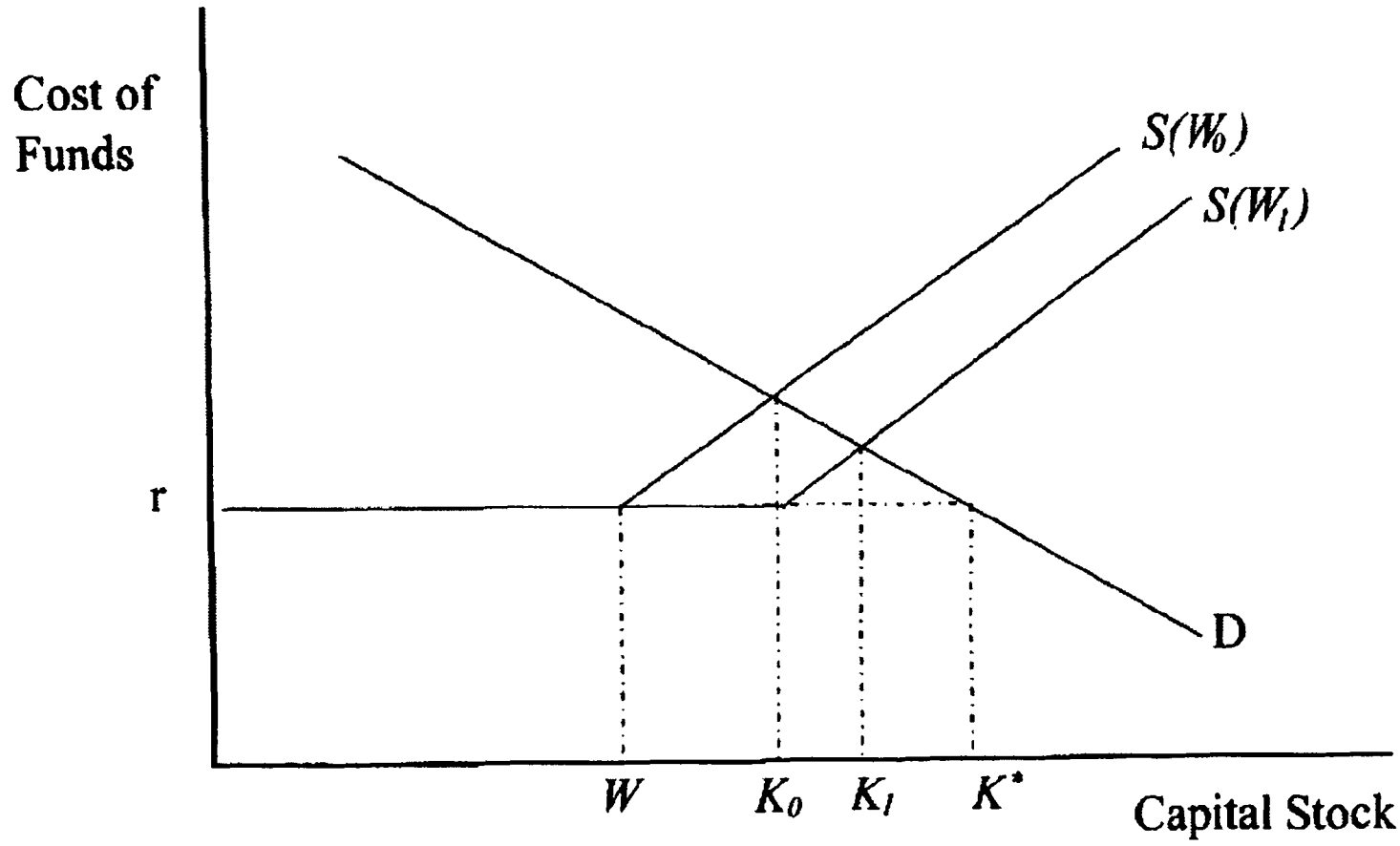
decision after controlling for investment opportunities. On the contrary, if financing constraints are binding, a change in net worth should have a direct effect on investment, holding investment opportunities constant.

In the case of asymmetric information, in which outside investors cannot monitor perfectly the allocation of funds by the firm insider, the supply-of-funds curve $S(W)$ represented in Figure 2.1 has two components. The first is a horizontal segment at r, up to the firm's net worth W. In this range, where investment can be financed either from internal funds or by issuing risk-free debt, no agency costs arise and lenders do not require any premium on external funds. For levels of external finance greater than net worth W, uncollateralised lending requires that lenders be compensated for the risk of investing in a bad project. As a consequence of the "lemons" premium demanded by potential new investors, the shadow cost to the firm insiders of uncollateralised external financing exceeds that of internal financing. This is reflected in the upward-sloping S schedule after W. The slope of the S curve reflects the information costs in uncollateralised financing. The higher (lower) the marginal information costs, the steeper (flatter) the upward-sloping portion of S. In the extreme case of "credit rationing", the cost of external funds is infinitely high, and S schedule becomes vertical at W. In the presence of information asymmetries and costly monitoring of managers' behaviour, the equilibrium capital stock determined by the intersection of the D and S curves at K_0 is less than K^*, the first-best desired capital stock in a frictionless setting, that is, there is underinvestment relative to the setting with no information costs.

Figure 2.1 also shows how, for firms facing high information costs, the availability of internal net worth enhances their ability to invest. Holding constant both information costs and investment opportunities, when net worth increases from W_0 to W_1, the supply-of-funds curve shifts from $S(W_0)$ to $S(W_1)$, and the equilibrium capital stock increases from K_0 to K_1. Note that for firms with sufficient internal net worth or (i.e. $W \geq K^*$) facing negligible information

costs, an increase in internal finance, independent of changes in investment opportunities, does not affect the equilibrium capital stock.

Figure 2.1



2.2 Models of investment and tests of capital market imperfections

Empirical evidence linking changes in net worth to investment dates back at least to Meyer and Kuh (1957), who stated that "the investment decision is subject to a multiplicity of influences..." but that, at business cycle frequencies, there is a "clear tendency for liquidity and financial considerations to dominate the investment decision in the short run...". A problem with the older empirical literature on investment is that changes in net worth may serve as a proxy for unobserved determinants of investment, particularly the stream of expected future profits from a new investment, so that the estimated effect of changes in net worth may be exaggerated. Relating back to the earlier discussion, the basic issue is that an increase in the availability of internal net worth may be associated with an outward shift in the firm's investment opportunities, which could result in an increase in investment even in the absence

of capital market imperfections. The key problem in these investment models consists in formulating satisfactory proxies for investment opportunities, i.e., determining the position of the demand curve *D*.

Exploiting cross-sectional variation in panel data, recent empirical work has presented important new evidence on the role of the financial accelerator in explaining business cycle fluctuations. The financial accelerator relies on the notion that capital market imperfections can amplify and propagate underlying shocks to the economy. In the presence of such a propagation mechanism, a contractionary shock reduces net worth and collateral values, worsening the terms of credit for borrowers who have difficulty signalling the true value of new projects. As credit conditions deteriorate, capital accumulation contracts, exacerbating and prolonging the downturn[12]. Under these conditions, fixed investment spending will vary with the availability of internal funds, not just with the availability of positive net present value projects.

For empirical researchers, the critical problem with developing an estimable investment equation is relating unobservable expectations to observable variables. A prominent solution is the *q* theory of investment -introduced by Keynes (1936) and revitalised and elaborated by Brainard and Tobin (1968) and Tobin (1969)- that uses information from asset prices in financial markets to address the problem of unobservable expectations. In this theory, a forward-looking firm faced with costs in adjusting its capital stock acts to maximise the present value of future net receipts *R*, given by:

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[12] Financial elements play an important role in Minsky's (1974) and Greenwald and Stiglitz's (1993) explanation of the business cycle. Bernanke (1983) and Calomiris (1993) suggest that capital market imperfections were contributing factors in the Great Depression. Gertler and Gilchrist (1994) and Kashyap, Lamont, and Stein (1994) suggest that some of the impact of monetary policy works through a financial propagation mechanism where internal finance plays a central role. Carpenter, Fazzari, and Petersen (1994) suggest that financing constraints link the procyclical movements of inventory investment and cash flow.

$$(2.1)\quad V_{it} = E\left[\sum_{s=0}^{\infty} \gamma_{t+s} R_{i,t+s} \middle| \Omega_{it}\right]$$

where $$R_{it} = p_t\left[F(K_{it}, L_{it}) - C(I_{it}, K_{it})\right] - w_t L_{it} - p_t^I I_{it}$$

and $$\gamma_{t+s} = \prod_{j=1}^{s} \frac{1}{1+r_{t+j}}, \qquad for\ s = 1,2,\ldots,\infty \quad and \quad \gamma_t = 1$$

subject to the capital accumulation constraint:

$$(2.2)\quad K_{it} = (1-\delta)K_{i,t-1} + I_{it}$$

where i and t denote the firm and time period, respectively; $E[.|\Omega_{it}]$ denotes the expectation conditional on information available to firm i at time t; r_{t+j} is the nominal discount rate between period $t+j$-1 and period $t+j$; γ_{t+s} is the discount factor between period t and period $t+s$; p_t is the price of output; K_{it} is the capital stock; L_{it} is a vector of variable factor inputs; w_t is a vector of prices of these variable factors; $p_tF(K_{it},L_{it},)$ is the revenue function, that is, the production function $F(K_{it},L_{it})$ multiplied by the product price; I_{it} is investment; p_t^I is the price of capital goods; $p_t^I I_{it}$ is the purchase cost of investment goods; $C(I_{it},K_{it},)$ is the cost-of-adjustment function, increasing and strictly convex in I_{it} and decreasing in K_{it}; and δ is the constant rate of depreciation. For simplicity it is assumed that there are no taxes and no debt finance, and the firm is a price taker in all markets.

The first-order conditions for maximising (2.1) with respect to L_{it}, I_{it} and K_{it} yield:

$$(2.3a)\quad w_t = (\partial R / \partial L)_{it}$$

$$(2.4a)\quad \lambda_{it} = -(\partial R / \partial I)_{it}$$

$$(2.5a)\quad \lambda_{it} = \left(\partial R / \partial K\right)_{it} + (1-\delta)E\left[\gamma_{t+1}\lambda_{i,t+1}\middle|\Omega_{it}\right] = \left(\partial V / \partial K\right)_{it} = \frac{\left(\partial V_{it} / \partial K_{i,t-1}\right)}{1-\delta}$$

where λ_{it} is the Lagrange multiplier associated with the capital accumulation constraint (2.2). Substituting for R_{it}, the first order conditions become:

$$(2.3b)\quad w_t = p_t F_L\left(K_{it}, L_{it}\right)$$

$$(2.4b)\quad \lambda_{it} = p_t^I + p_t C_I\left(I_{it}, K_{it}\right)$$

$$(2.5b)\quad \lambda_{it} = p_t F_K\left(K_{it}, L_{it}\right) - p_t C_K\left(I_{it}, K_{it}\right) + (1-\delta)E\left[\gamma_{t+1}\lambda_{i,t+1}\middle|\Omega_{it}\right]$$

Rearranging equation (2.5b) yields:

$$(2.6)\quad F_K\left(K_{it}, L_{it}\right) - C_K\left(I_{it}, K_{it}\right) = \left\{1 - \frac{(1-\delta)E\left[\gamma_{t+1}\lambda_{i,t+1}\middle|\Omega_{it}\right]}{\lambda_{it}}\right\}\frac{\lambda_{it}}{p_t}$$

Equation (2.6) represents the standard result of the neoclassical investment theory: the firm will accumulate capital to the point at which the marginal return on capital equals the shadow user cost of capital[13].

Equation (2.4b) can also be re-written as:

$$(2.7)\quad C_I\left(I_{it}, K_{it}\right) = \frac{\lambda_{it} - p_t^I}{p_t} = \left(\frac{\lambda_{it}}{p_t^I} - 1\right)\frac{p_t^I}{p_t} = \left(q_{it} - 1\right)\frac{p_t^I}{p_t}$$

where

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[13] With no adjustment costs, $\lambda_{it}=p_t^I$ from equation (2.4b), and the right-hand side of equation (2.6) becomes the familiar expression for the user cost (or rental price) of capital (see Jorgenson, 1963).

$$(2.8) \quad q_{it} = \frac{\lambda_{it}}{p_t^I} = \frac{\left(\partial V_{it} / \partial K_{i,t-1}\right)}{(1-\delta)p_t^I}$$

known as *marginal q*, represents the ratio of the market value of an *additional* unit of capital to its replacement cost. From equation (2.7) we get that, in the absence of adjustment costs (i.e. $C_I(I_{it},K_{it})=0$), the firm invests up to the point where marginal q obtains the value of unity. With strictly convex adjustment costs, the level of investment is an increasing function of the deviation of marginal q from unity.

To obtain an investment specification from the first order condition in (2.7), a functional form for the cost-of-adjustment function is required. A widely-used parameterisation assumes the following quadratic form:

$$(2.9) \quad C(I_{it}, K_{it}) = \frac{b}{2}\left[\left(\frac{I}{K}\right)_{it} - c_i - \varepsilon_{it}\right]^2 K_{it}$$

This has the properties that adjustment costs are strictly convex in I_{it} and homogeneous of degree one in (I_{it},K_{it}). Total adjustment costs are quadratic about some "normal" rate of gross investment c_i (at which adjustment costs average zero), and marginal adjustment costs are linear in the observed rate of investment. The coefficient b can be thought of as parameterising the speed of adjustment. Finally, ε_{it} represents unobservable factors in adjustment costs. These may contain firm-specific effects and time effects common to all firms, in addition to an idiosyncratic time-varying shock.

Substituting the adjustment cost function into equation (2.7) and solving for investment yields an expression for investment as a function of marginal q:

$$(2.10) \quad \left(\frac{I}{K}\right)_{it} = c_i + \frac{1}{b}(q_{it} - 1)\frac{p_t^I}{p_t} + \varepsilon_{it}$$

Since we cannot observe the shadow value λ_{it}, marginal q_{it} is not directly observable either. What we can directly observe is *average q*, namely the ratio of the market value of *existing* capital to its replacement cost. However, Hayashi (1982) has shown that if the firm is a price taker in all markets and both the production function $F(K_{it},L_{it})$ and the adjustment cost function $C(I_{it},K_{it},)$ are linearly homogeneous in their arguments (i.e., the production technology displays constant returns to scale), then average q and marginal q are equal. Indeed, using the properties of linear homogeneous functions (e.g. $F(K,L) = KF_K + LF_L$) and equation (2.3b), equation (2.5b) can be re-written as:

$$(2.11)\quad \lambda_{it}(1-\delta)K_{i,t-1} = R_{it} + (1-\delta)E\left[\gamma_{t+1}\lambda_{i,t+1}\middle|\Omega_{it}\right]K_{it}$$

Solving (2.11) forward by repeated substitution then gives:

$$(2.12)\quad \frac{\lambda_{it}}{p_t^I} = \frac{V_{it}}{(1-\delta)p_t^I K_{i,t-1}} = q_{it}$$

where V_{it} is the market value of the firm and $(1-\delta)p_t^I K_{i,t-1}$ is the replacement value of the capital stock. Using average q constructed from financial market data as a measure of marginal q, the relation between investment and q can be expressed as:

$$(2.13)\quad \left(\frac{I}{K}\right)_{it} = c_i + dQ_{it} + \varepsilon_{it}$$

where d=1/b and

$$(2.14)\quad Q_{it} = \left[\frac{V_{it}}{(1-\delta)p_t^I K_{i,t-1}} - 1\right]\frac{p_t^I}{p_t}$$

Equation (2.13) is representative of an investment model under frictionless capital markets. To test for the impact of financial constraints, recent studies have used Q models augmented with a cash flow term, proxying for the change in net worth[14], so that the estimated model becomes:

$$(2.15)\quad \left(\frac{I}{K}\right)_{it} = c_i + dQ_{it} + f\left(\frac{C}{K}\right)_{it} + \varepsilon_{it}$$

As long as Q controls for investment opportunities under the null hypothesis of perfect capital markets, and the error term ε_{it} is uncorrelated with cash flow (or, alternatively, is uncorrelated with the variables used to instrument cash flow), then cash flow should have no effect under the null hypothesis. Therefore, a significantly positive value of the estimated coefficient f would violate the "full information" model and suggest the presence of financial constraints on investment.

Many empirical studies estimating Q models of investment have shown greater failure of the perfect-capital-market neoclassical investment model for firms selected to be *a priori* more likely to face capital-market frictions. The advantage of the classification approach is that even if the estimated effect of liquidity is biased upward (perhaps because measured Q is not a perfect control for investment opportunities), the difference between classes will not necessarily be biased. For instance, noting that liquidity-constrained firms are not in a position to pay out substantial dividends, Fazzari, Hubbard and Petersen (1988) classified firms on the basis of their payout behaviour and found the effect of cash flow on investment to be larger for the low-pay-out firms, and the differences across pay-out classes to be both statistically and economically significant. Comparing firms that are members of large industrial groups

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[14] Cash flow is an imperfect proxy for the change in net worth. Since cash flow (equal to earnings plus depreciation allowances) represents a series of accounting and financial decisions, its correlation with the change in net worth is not perfect. In spite of this, many studies have used cash flow as a proxy for the change in net worth because it is virtually the only such measure available for many firms.

(*keiretsu*) with independent firms, related work for Japan by Hoshi, Kashyap and Scharfstein (1989) found that investment is significantly related to cash flow for independent firms, but not for group firms. Other studies grouping firms by size, age, bond rating etc. have also found support for the hypothesis of limited capital access and binding financial constraints for firms that are in a weak information position[15].

Studies relying on regressions of investment on Q and cash flow suffer, however, not only from the well-known divergence of measured average q from marginal q (due for example to imperfect competition in the product market, non-constant returns to scale, and measurement problems), but also from a number of different interpretations. In particular, since expectations reflected in prices quoted on centralised securities markets will not in general reflect insiders' valuations of future investment projects, Q may be a poor proxy for investment opportunities. As a consequence, cash flow may not be picking up the desired liquidity effect but may be proxying for information about future profitability not captured by Q. This provides an explanation for why in practice it is difficult to find any sub-samples for which there is no evidence of mis-specification of the basic structural Q model. Although cash flow variables have generally significantly larger coefficients in the sub-samples that are considered more likely to be financially constrained, such terms also have coefficients that are significantly different from zero for the sub-samples that are considered less likely to be financially constrained.

An alternative interpretation of this finding is that both sub-samples of firms are subject to financing constraints, but to differing degrees. Thus all firms may face a cost premium for external finance, but some firms may face a much higher cost premium than others. This interpretation has been recently questioned by Kaplan and Zingales (1997), who argue that a

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[15] See, among others, Devereux and Schiantarelli (1990), Schaller (1993), Carpenter (1994), Chirinko and Schaller (1995), Baum and Thies (1997).

greater sensitivity of investment to cash flow does not provide reliable evidence of a larger differential cost between internal and external finance. Kaplan and Zingales identify financially constrained firms from the Fazzari *et al.* (1988) sample by examining their 10-K reports. Contrary to the working assumption of Fazzari *et al.*, Kaplan and Zingales find that firms with low dividend payout ratios do not necessarily have greater financial constraint, and that a high premium for external finance may actually be associated with lower sensitivity of investment to cash flow. Kaplan and Zingales point out that high-investment cash flow sensitivities appear to be driven by managers choosing to rely primarily on internal cash flow to invest despite the availability of additional low cost funds. This suggests that the relationship between cash flow and investment may reflect managerial agency considerations, rather than a measure of the firm's access to capital markets.

However, whilst the Kaplan and Zingales (1997) findings are interesting, it should be noted that their analysis proceeds under the alternative hypothesis that, given investment opportunities, cash flow really does affect investment spending, either for financial constraints or agency cost reasons. Hence, to the extent that empirical work succeeds in distinguishing between firms where the estimated coefficient on cash flow is zero and firms where the estimated coefficient on cash flow is significantly positive, the Kaplan-Zingales critique does not undermine the basic interpretation of such results as a rejection of the null hypothesis that internal finance does not matter for one group of firms, but not for the other.

One way to avoid using stock market data as proxies for marginal q is to estimate the shadow value of capital, λ_{it}, an idea developed for time series data by Abel and Blanchard (1986). Solving equation (2.5b) forward by repeated substitution gives:

$$(2.16)\quad \lambda_{it} = E\left[\sum_{s=0}^{\infty} \gamma_{t+s}(1-\delta)^{s} p_{t+s}\left\{F_K\left(K_{i,t+s}, L_{i,t+s}\right) - C_K\left(I_{i,t+s}, K_{i,t+s}\right)\right\} \middle| \Omega_{it}\right]$$

Equation (2.16) defines the (unobservable) shadow value λ_{it} as the discounted present value of future net receipts from a marginal unit of capital. A measure of λ_{it} can be computed by estimating a set of vector autoregression (VAR) forecasting equations for a subset of information available both to the firm and the econometrician, that is assumed to be related to the marginal revenue product of capital $p_t[F_K(K_{it},L_{it})-C_K(I_{it},K_{it})]$. The estimates from this VAR can then be used to provide an alternative measure of q_{it}, by substituting into equation (2.8).

As well as avoiding the use of stock market valuations, this approach has the advantage that it is not necessary to assume either perfect competition or constant returns to scale. However, since it depends heavily on the auxiliary forecasting model that is assumed, the risk of substantial measurement error in marginal q is not fully eliminated by this procedure. Gilchrist and Himmelberg (1995) use VAR forecasts to construct the expected value of marginal q conditional on observed fundamentals, and refer to this variable as "Fundamental Q". As one of the investment fundamentals in the VAR forecasting equations they explicitly include cash flow, in order to ensure that any information about the future marginal profitability of capital contained in cash flow is reflected in the proxy for marginal q. Notice, however, that this will correctly control for the forecasting information in cash flow only if the form assumed for the marginal product of capital is correct. Because their investment specification should isolate the role of cash flow as a forecasting variable, Gilchrist and Himmelberg interpret any additional sensitivity of investment to cash flow as evidence of financial constraints. In their estimates they find that investment still responds to cash flow, even after controlling for its role as a forecasting variable for future investment opportunities. Interestingly, they find significant effects from cash flow only for firms that have been identified a priori as financially constrained (small firms, firms with neither a bond rating nor a commercial paper rating), whilst for firms that are considered less likely to be financially

constrained (large firms, firms with either a bond rating or a commercial paper rating) they find no significant effects from cash flow.

In order to isolate the precise role of financial constraints in the investment process, another research approach uses time-series variation in net worth levels to test whether Euler equations of an optimising model for investment are satisfied. The Euler equation model is a first order condition describing the optimal evolution of capital stock over time. In other words, the Euler equation is a period-to-period arbitrage condition for the firm's investment spending with the following feasible perturbation interpretation: holding the capital stock constant in all other periods, a firm will choose the timing of its investment between two adjacent periods in order to equate the marginal costs and benefits across the periods. As well as models based on q, the Euler equation approach exploits the cross-sectional heterogeneity among different firms to test for the role of financial factors. However, by not using q explicitly to control for investment opportunities, it avoids problems of measuring marginal q that can complicate the interpretation of regressors controlling for liquidity effects, and makes it possible to take account of unquoted firms.

Combining equations (2.4a) and (2.5a) to eliminate λ_{it} and λ_{it+1}, the basic Euler equation model can be expressed as:

$$(2.17)\quad -(\partial R/\partial I)_{it} = (\partial R/\partial K)_{it} - (1-\delta)E\left[\gamma_{t+1}(\partial R/\partial I)_{i,t+1}\middle|\Omega_{it}\right]$$

Denoting the error made when forecasting $\gamma_{t+1}(\partial R/\partial I)_{i,t+1}$ based on information available in period t by:

$$(2.18)\quad \varepsilon_{i,t+1} = \gamma_{t+1}(\partial R/\partial I)_{i,t+1} - E\left[\gamma_{t+1}(\partial R/\partial I)_{i,t+1}\middle|\Omega_{it}\right]$$

and substituting the realised value for the one-period ahead expectation in equation (2.17) gives:

$$(2.19)\quad -(\partial R/\partial I)_{it} = (\partial R/\partial K)_{it} - (1-\delta)\gamma_{t+1}(\partial R/\partial I)_{i,t+1} + (1-\delta)\varepsilon_{i,t+1}$$

To obtain an empirical investment model, it then requires only that the marginal revenue product of capital and the marginal adjustment costs are specified in terms of observables. Substituting for the net receipts R yields:

$$(2.20)\quad p_t^I + p_t C_I(I_{it}, K_{it}) = p_t F_K(K_{it}, L_{it}) - p_t C_K(I_{it}, K_{it}) + \\ + (1-\delta)\gamma_{t+1}\left[p_{t+1}^I + p_{t+1} C_I(I_{i,t+1}, K_{i,t+1})\right] + (1-\delta)\varepsilon_{i,t+1}$$

If $F(K_{it},L_{it},)$ is constant returns to scale and $C(I_{it},K_{it},)$ is linearly homogeneous in I_{it} and K_{it}, using (2.3b) yields:

$$(2.21)\quad F_K(K_{it}, L_{it}) - C_K(I_{it}, K_{it}) = \left(\frac{\Pi}{pK}\right)_{it} + C_I(I_{it}, K_{it})\left(\frac{I}{K}\right)_{it}$$

where Π is gross operating profits, that is, sales $p_t[F(K_{it},L_{it})\text{-}C(I_{it},K_{it})]$ minus variable costs $w_t L_{it}$. Substituting (2.21) in (2.20) gives the expression:

$$(2.22)\quad p_t^I + p_t C_I(I_{it}, K_{it}) = \left(\frac{\Pi}{K}\right)_{it} + p_t C_I(I_{it}, K_{it})\left(\frac{I}{K}\right)_{it} + \\ + (1-\delta)\gamma_{t+1}\left[p_{t+1}^I + p_{t+1} C_I(I_{i,t+1}, K_{i,t+1})\right] + (1-\delta)\varepsilon_{i,t+1}$$

Assuming competitive markets and quadratic costs of adjustment of the form:

$$(2.23)\quad C(I_{it},K_{it})=\frac{b}{2}\left[\left(\frac{I}{K}\right)_{it}-c\right]^2 K_{it}$$

where the "normal" rate of gross investment c is here assumed to be constant across firms and non-stochastic, the Euler equation can be written as:

$$(2.24)\quad \left(\frac{I}{K}\right)_{i,t+1}=c(1-\phi_{t+1})+(1+c)\phi_{t+1}\left(\frac{I}{K}\right)_{it}-\phi_{t+1}\left(\frac{I}{K}\right)_{it}^2-\frac{\phi_{t+1}}{b}\left[\left(\frac{\Pi}{pK}\right)_{it}-J_t\right]+\varepsilon'_{i,t+1}$$

where

$$(2.25)\quad J_t=\left[1-(1-\delta)\gamma_{t+1}\frac{p^I_{t+1}}{p^I_t}\right]\frac{p^I_t}{p_t}$$

is the *ex-post* real user cost of capital in the sense of Jorgenson [see equation (2.6)], $\phi_{t+1}=p_t/[p_{t+1}(1-\delta)\gamma_{t+1}]$ is a real discount factor, and $\varepsilon'_{i,t+1}=-\varepsilon_{i,t+1}/(bp_{t+1}\gamma_{t+1})$. In equation (2.24) the coefficient on the lagged investment rate is positive and greater than one. The coefficient on the lagged squared investment rate is negative and greater than one in absolute value. Under the assumption of perfect capital markets, the common coefficient on the lagged gross operating profits and the user cost terms is negative and depends on the magnitude of the adjustment costs. If this assumption is incorrect, investment may be positively related to profits through the effect of liquidity constraints, and the basic Euler equation in (2.24) would be mis-specified.

Euler equation models for investment have been derived and estimated in a number of recent papers. Whited (1992) has tested the hypothesis of debt and liquidity constraints on US firms' investment, and found that when firms are split on the basis of two measures of financial distress (namely, the market value of debt relative to the market value of the firm, and the ratio of interest expenses to the sum of interest expenses and cash flow) the standard

Euler equation fits well for the a priori unconstrained group, but is rejected for the others. Hubbard, Kashyap, and Whited (1995) have found that the orthogonality conditions implied by the standard Euler equation are decisively rejected for firms with low pre-sample dividend payout ratios, but cannot be rejected for firms with high pre-sample dividend payout ratios. Moreover, both these studies have specified an alternative model with a borrowing constraint[16], and found that the additional variables affect investment for the sample of firms for which the perfect-capital markets model is rejected. Using a panel of UK firms, Bond and Meghir (1994) have estimated the Euler equation of the standard neoclassical model of capital accumulation extended to the case where the firm faces a hierarchy of costs for alternative sources of finance. Even after controlling for output fluctuations (imperfect competition) and debt (bankruptcy costs-taxes), current investment is found to be positively related to lagged gross operating profit and this rejection of the Euler equation is significant for firms paying low dividends. This result is inconsistent with the role played by the gross operating profits term in the standard investment model, but is to be expected if these firms are liquidity constrained.

Bond, Elston, Mairesse, and Mulkay (1997) have investigated the role of financial factors in investment decisions of manufacturing firms in Belgium, France, Germany and UK. A common belief is that the arms-length relationship between firms and suppliers of finance typical of the Anglo-American "market-based" systems is less effective than the continental European "bank-based" systems at dealing with problems of asymmetric information. A robust finding from the estimation of three different econometric models of investment (an accelerator and an error correction model, to which additional cash flow terms are added, and

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[16] In Whited (1992), the shadow cost of external financing depends on the firm's debt-to-assets ratio and the interest coverage. In Hubbard, Kashyap, and Whited (1995) the shadow cost of external funds depends on firm-specific cash flow and a measure of tightness in aggregate credit conditions.

an Euler equation model) is that the availability of internal finance appears to be both statistically and quantitatively more significant in the UK than in the three continental European countries[17]. This is consistent with the suggestion that financial constraints on investment may be relatively severe in the more "market-oriented" UK financial system.

Hall, Mairesse, Branstetter and Crepon (1998) employ a vector auto-regressive (VAR) methodology to test for the casual relationship among sales and cash flow on the one hand and investment and R&D on the other, using three large panels of firms in the high technology sectors in the United States, France and Japan. Both investment and R&D are found to be more highly sensitive to cash flow and sales in the US than in France and Japan. Thus, also these results seem to suggest the existence of a tighter correspondence between internal finance and investment in the market-based financial systems (the US) than in the bank-based financial systems.

The main results of papers investigating the effect of imperfect capital markets on Italian firms' investment decisions are reviewed in Section 2 of Chapter 4.

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[17] Estimates for the basic accelerator model show a significant positive effect from either current or lagged cash flow in each of the four countries. The cash flow effects are found to be smaller in the error correction models. This suggests that simple accelerator equations tend to exaggerate the importance of financial variables and cash flow variables proxy for omitted error correction terms. Nevertheless, cash flow is found to be statistically significant even in the error correction model for all countries except Belgium; and the Euler equation models suggest some evidence of excess sensitivity to internal finance, particularly for the UK.

3. Two empirical investment equations

We estimate two different econometric models of investment, which allow us to consider the sensitivity of our empirical findings to the choice of model specification. The models we use are an error correction model and an Euler equation.

Euler equations are explicitly derived from dynamic optimisation in the presence of symmetric, quadratic adjustment costs. Under these assumptions the Euler equation model has the advantage of controlling for all expectational influences on the investment decision. However, perhaps due to the restrictive form of the adjustment cost process, the coefficient estimates on key explanatory variables have often been found to reject the dynamics implied by the structural adjustment cost model. In these cases, the basic Euler equation may be mis-specified for reasons not related to financial constraints. This makes it difficult to draw reliable inferences on the impact of financial variables on the investment decision.

Error correction models specify a long run or "target" level of the capital stock, but allow a flexible specification of the adjustment dynamics to be estimated from the data. An important advantage of this specification is that, in contrast to more structural models such as Euler equations and Q models, it is generally not rejected out of hand by the data, and the estimated models have reasonable long-run and short-run properties. The main disadvantage is that the estimated dynamics compound influences from both capital adjustment and expectation-formation processes. Hence, the interpretation of additional financial variables as reflecting influences on expectations rather than financial constraints remains a possibility with this type of model.

3.1 An error correction specification

The point of departure for our model is the conventional neoclassical model for the determination of the optimal capital stock. Consider a profit-maximising firm subject to the usual capital accumulation constraint and to a constant elasticity of substitution production function with constant returns to scale:

$$(3.1) \quad Y_{it} = F(K_{it}, L_{it}) = A\left[\theta K_{it}^{-\rho} + (1-\theta)L_{it}^{-\rho}\right]^{-\frac{1}{\rho}}$$

where A, θ and ρ are, respectively, the efficiency, distribution and substitution parameters. In the absence of adjustment costs and with imperfect competition, the first order conditions yield:

$$(3.2) \quad \left(\frac{\theta}{A^{\rho}}\right)\left(\frac{Y_{it}}{K_{it}}\right)^{1+\rho} = \left[1 - \frac{(1-\delta)\gamma_{t+1}p^{I}_{it+1}}{p^{I}_{it}}\right]\frac{\mu p^{I}_{it}}{p_{it}}$$

where, to allow for imperfect competition, we let p_{it} depend on output, with the price elasticity of demand ($\varepsilon>1$) assumed constant, and mark-up μ equal to $[1-(1/\varepsilon)]^{-1}>0$.

The left-hand side of equation (3.2) is the marginal productivity of capital, $F_K(K_{it},L_{it})$. The right-hand side is the user cost of capital J_{it}. The marginal productivity condition gives the optimal capital stock as:

$$(3.3) \quad K^{*}_{it} = B\frac{Y_{it}}{J^{\sigma}_{it}}$$

where K^{*}_{it} denotes the desired capital stock, $\sigma=1/(1+\rho)$ is the (constant) elasticity of substitution, and $B=(\theta/A^{\rho})^{\sigma}$ is a constant term.

Letting k_{it}, y_{it} and j_{it} denote, respectively, the natural log of K_{it}, Y_{it} and J_{it}, the desired capital stock can be written as a log-linear function of output and the cost of capital:

$$(3.4) \quad k_{it}^{*} = b + y_{it} - \sigma j_{it}$$

We assume that the term b and the user cost of capital can be controlled for by including both time-specific and firm-specific effects. Equation (3.4) can therefore be rewritten as:

$$(3.5) \quad k_{it}^{*} = y_{it} + d_{t} + \eta_{i}$$

where d_t is a time dummy and η_i is an unobserved firm-specific effect.

To obtain an empirical investment model, equation (3.5) is nested within a dynamic regression model which allows for slow adjustment to this optimal capital stock level. Following Bean (1981), we then consider an error correction specification which has equation (3.5) as its long-run solution[18].

By introducing second-order dynamics, equation (3.5) takes the form:

$$(3.6) \quad k_{it} = \alpha_1 k_{i,t-1} + \alpha_2 k_{i,t-2} + \beta_0 y_{it} + \beta_1 y_{i,t-1} + \beta_2 y_{i,t-2} + d_t + \eta_i + \nu_{it}$$

Equation (3.6) has autoregressive components $k_{i,t-1}$ and $k_{i,t-2}$, and distributed lag components y_{it}, $y_{i,t-1}$ and $y_{i,t-2}$. Thus, equation (3.6) is an autoregressive distributed lag model ADL(2,2),

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[18] Error correction models are viewed as either a reparameterisation of the dynamic linear regression models in terms of differences and levels, or a restricted form of a dynamic linear regression model, which imposes long-run proportionality (linear homogeneity) among some regressors (Hendry, Pagan and Sargan, 1984). The error correction model can also been interpreted as: a method of adjusting a policy instrument to maintain a target variable close to its desired value (Phillips, 1957, who introduced the terminology of error correction to economics in his analysis of feedback control mechanism for stabilisation policy); a generalisation of the simple "partial adjustment mechanism" (Hendry and von Ungern Sternberg, 1981); a quasi reduced form derived from special cases of rational expectation models of intertemporal optimisation with costs of adjustment (Nickell, 1985).

where the indices in parentheses refer to the maximum lags of k and y respectively, and ν_{it} is an error term.

Subtracting $k_{i,t-1}$ from both sides of (3.6), then adding and subtracting $(\alpha_1-1)k_{i,t-2}$, $\beta_0 y_{i,t-1}$, $(\beta_0+\beta_1)y_{i,t-2}$ and $(\alpha_1+\alpha_2-1)y_{i,t-2}$ on the right hand side of equation (3.6) and rearranging yields[19]:

$$(3.7)\quad k_{it}-k_{i,t-1}=\Delta k_{it}=(\alpha_1-1)\Delta k_{i,t-1}+\beta_0\Delta y_{it}+(\beta_0+\beta_1)\Delta y_{i,t-1}+(\alpha_1+\alpha_2-1)(k_{i,t-2}-y_{i,t-2})+$$

$$+[(\alpha_1+\alpha_2-1)+(\beta_0+\beta_1+\beta_2)]y_{i,t-2}+d_t+\eta_i+\nu_{it}$$

Using the approximation $\Delta k_{it}\approx I_{it}/K_{i,t-1}-\delta$ and adding a cash flow term $(C_{it}/K_{i,t-1})$ to investigate the possibility of liquidity effects on investment gives an empirical model of the form:

$$(3.8)\quad \frac{I_{it}}{K_{i,t-1}}=\omega_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right)+\omega_2\Delta y_{it}+\omega_3\Delta y_{i,t-1}+\omega_4(k_{i,t-2}-y_{i,t-2})+$$

$$+\omega_5 y_{i,t-2}+\omega_6\left(\frac{C_{it}}{K_{i,t-1}}\right)+d_t+\eta_i+\nu_{it}$$

where $\omega_1=(\alpha_1-1)$, $\omega_2=\beta_0$, $\omega_3=(\beta_0+\beta_1)$, $\omega_4=(\alpha_1+\alpha_2-1)$ and $\omega_5=\omega_4(1-\xi)$. Here $\xi=-(\beta_0+\beta_1+\beta_2)/\omega_4$ represents the long-run elasticity. The long run properties of this model depend on the form of the error correction mechanism $(k_{i,t-2}-y_{i,t-2})$ and the lagged output term $y_{i,t-2}$. 'Error correcting' behaviour requires that $\omega_4<0$, so that a capital stock above (below) its desired level is

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[19] Imposing the unit restriction on the long run effects $-(\beta_0+\beta_1+\beta_2)/(\alpha_1+\alpha_2-1)$, the static long run solution of equation (3.7) (where $k_{it}=k_{i,t-1}=k_{i,t-2}$ and $y_{it}=y_{i,t-1}=y_{i,t-2}$) is, similarly to (3.5),

$$k_i=y_i+\frac{d_t+\eta_i}{(1-\alpha_1-\alpha_2)}$$

associated with lower (greater) future investment. The lagged output term tests the assumption of constant returns to scale: a significant positive (negative) coefficient on $y_{i,t-2}$ implies a long run elasticity ξ lower (greater) than unity and, consequently, increasing (decreasing) returns to scale[20].

The interpretation of the additional cash flow term in this model can be ambiguous. Since the lagged investment and output terms may not control for all relevant expectational influences on the investment decision, it is possible that the cash flow term could reflect the investment opportunities of the firm rather than the presence of financial constraints (see discussion in Section 2.2). Therefore, to test whether financial constraints are significant, we investigate differences in the coefficients on cash flow between firms in different positions. If the sensitivity of investment to cash flow is significantly positive for companies that are likely to find it difficult to credibly communicate private information, and zero for companies that are likely to be in a strong information position, this would support the view that imperfect capital markets can affect capital accumulation. In particular, we consider small firms and independent firms as a priori more likely to be facing significant financial constraints, and test whether investment is sensitive to cash flow for these firms.

3.2 An Euler equation specification

The version of the Euler equation model we estimate is based on Bond and Meghir (1994). In contrast to Section 2.2, this specification also allows for imperfect competition. From equation (2.17) the Euler equation characterising the optimal investment path of a profit-maximising firm can be expressed in this case as:

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[20] A long-run elasticity equal to unity would also follow from assuming a Cobb-Douglas production function.

$$(3.9)\quad p_{it}^{I}+\frac{p_{it}}{\mu}C_{I}\left(I_{it},K_{it}\right)=\frac{p_{it}}{\mu}\left[F_{K}\left(K_{it},L_{it}\right)-C_{K}\left(I_{it},K_{it}\right)\right]+$$

$$+\left(1-\delta\right)E\left[\gamma_{t+1}p_{it+1}^{I}+\gamma_{t+1}\frac{p_{it+1}}{\mu}C_{I}\left(I_{i,t+1},K_{i,t+1}\right)\middle|\Omega_{it}\right]$$

where, to allow for imperfect competition, we let p_{it} depend on output, with the price elasticity of demand ($\varepsilon>1$) assumed constant, and mark-up μ equal to $[1-(1/\varepsilon)]^{-1}>0$.

Assuming that the production technology displays constant returns to scale, we use the Euler Theorem for linear homogeneous functions (i.e., $F(\cdot)=KF_K+LF_L$ and $C(\cdot)=IC_I+KC_K$) and the first order condition for the variable inputs (i.e., $w_{it}=(p_{it}/\mu)F_L$) to derive:

$$(3.10)\quad F_{K}\left(K_{it},L_{it}\right)-C_{K}\left(I_{it},K_{it}\right)=\mu\left(\frac{\Pi}{pK}\right)_{it}+C_{I}\left(\frac{I}{K}\right)_{it}+\left(1-\mu\right)\left(\frac{Y}{K}\right)_{it}$$

where $Y_{it}=F(K_{it},L_{it})-C(I_{it},K_{it})$ is net output and $\Pi_{it}=p_{it}\left[F(K_{it},L_{it})-C(I_{it},K_{it})\right]-w_{it}L_{it}$ is gross operating profits. Assuming quadratic costs of adjustment [see (2.23)], and substituting (3.10) in (3.9), the Euler equation can be expressed as:

$$(3.11)\quad \left(\frac{I}{K}\right)_{it}-\alpha_{1}\left(\frac{I}{K}\right)_{it}^{2}=\alpha_{0}+\alpha_{2}E\left[\left(\frac{I}{K}\right)_{i,t+1}\middle|\Omega_{it}\right]+\alpha_{3}\left[\left(\frac{\Pi}{pK}\right)_{it}-J_{t}\right]+\alpha_{4}\left(\frac{Y}{K}\right)_{it}$$

where J_t is the real user cost of capital as defined in (2.25), $\phi_{it+1}=[p_{it}/p_{it+1}(1-\delta)\gamma_{t+1}]$ is the real discount rate term, $\alpha_0=[c/(1+c)]\cdot[(\phi_{it+1}-1)/\phi_{t+1}]$, $\alpha_1=1/(1+c)$, $\alpha_2=1/[(1+c)\phi_{it+1}]$, $\alpha_3=\mu/[b(1+c)]$, and $\alpha_4=(1-\mu)/[b(1+c)]$. Current investment is positively related to expected investment and to the marginal profits it generates, net of its user cost. Note that all the relevant expectational influences affecting investment are captured here by the one-step ahead investment forecast.

To implement the model in (3.11) we replace the unobserved $E[(I/K)_{i,t+1} \mid \Omega_{it}]$ by the realised $(I/K)_{i,t+1}$, plus a forecast error $\nu_{i,t+1}$, and take $(I/K)_{i,t+1}$ to the left-hand side of equation (3.11) to obtain a model that is linear in variables. In addition, instead of measuring the user cost of capital explicitly, we include both time and firm-specific effects to control for the variation in this term. Further, the real discount rate term ϕ_{it+1} and the "normal" rate of investment c are assumed to be constant through time and across firms and treated as parameters. The resulting empirical specification is then:

$$(3.12)\quad \left(\frac{I}{K}\right)_{i,t+1} = \beta_0 + \beta_1\left(\frac{I}{K}\right)_{it} - \beta_2\left(\frac{I}{K}\right)_{it}^2 - \beta_3\left(\frac{\Pi}{pK}\right)_{it} + \beta_4\left(\frac{Y}{K}\right)_{it} + d_{t+1} + \eta_i + \nu_{i,t+1}$$

where $\beta_0=c(1-\phi)$, $\beta_1=(1+c)\phi$, $\beta_2=\phi$, $\beta_3=\mu\phi/b$ and $\beta_4=\phi/b(\varepsilon-1)$. If the adjustment cost process is correctly specified and the firms face downward-sloping demand curves, the Euler equation model should control for the influence of financial variables on expectations on future profitability relevant for the investment decision. Thus, under the null of no financial constraints, $\beta_1\geq 1$, $\beta_2\geq 1$, $\beta_3\geq 0$ and, under constant returns to scale, $\beta_4\geq 0$. Under the alternative, investment is likely to be positively related to profits ($\beta_3<0$) through the effect of liquidity constraints, and the basic Euler equation in (3.12) would be mis-specified. In order to test for the absence of capital market frictions, the sign of the profit-capital term $(\Pi/K)_{it}$ should be checked. Since $(\Pi/K)_{it}$ is highly correlated with cash flow, the prediction of a negative sign on this term is expected to fail in the presence of financial constraints.

4. Estimators

In this section we briefly describe the estimators we use in the estimation of the error correction and the Euler equation models of investment.

Consider a simple linear dynamic model:

$$(4.1) \quad y_{it} = \alpha y_{i,t-1} + \beta x_{it}^{*} + (\eta_i + \nu_{it})$$

$$= X_{it}\delta + (\eta_i + \nu_{it})$$

for $i = 1, \ldots, N$ and $t = 2, \ldots, T$, where $\eta_i + \nu_{it} = u_{it}$ is the usual "fixed effects" decomposition of the error term, η_i is an unobserved individual-specific effect, and ν_{it} is a serially uncorrelated disturbance. The regressor x_{it}^{*} is assumed to be correlated with η_i ($E(x_{it}^{*}\eta_{it}) \neq 0$) and endogenous (i.e. $E(x_{it}^{*}\nu_{it}) \neq 0$, $E(x_{it}^{*}\nu_{i,t+s}) = 0$ for $s \geq 1$). Finally, $X_{it} = \begin{bmatrix} y_{i,t-1} & x_{it}^{*} \end{bmatrix}$ and $\delta = \begin{bmatrix} \alpha & \beta \end{bmatrix}'$.

Since $y_{i,t-1}$ and, by assumption, x_{it}^{*} are correlated with η_i, the OLS-levels estimates of α and β will be biased and inconsistent[21]. In order to control for the presence of the fixed effects η_i, we first consider using the Within-Groups estimator, that is OLS on the transformed equation:

$$(4.2) \quad (y_{it} - \bar{y}_i) = \alpha(y_{i,t-1} - \bar{y}_{i(-1)}) + \beta(x_{it}^{*} - \bar{x}_i^{*}) + (\nu_{it} - \bar{\nu}_i)$$

where $\bar{y}_i = \frac{1}{(T-1)}\sum_{t=2}^{T} y_{it}$ $\quad \bar{y}_{i(-1)} = \frac{1}{(T-1)}\sum_{t=1}^{T-1} y_{it}$ $\quad \bar{x}_i^{*} = \frac{1}{(T-1)}\sum_{t=2}^{T} x_{it}^{*}$

and $\bar{\nu}_i = \frac{1}{(T-1)}\sum_{t=2}^{T} \nu_{it}$ $\quad \bar{\eta}_i = \eta_i$

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[21] The bias of $\hat{\alpha}_{OLS}$ is likely to be positive since $E(y_{i,t-1}\eta_i) > 0$ for $\alpha > 0$.

When T is small, the Within-Groups estimator is consistent for large N only if all the regressors are strictly exogenous with respect to ν_{it}. Since in a dynamic model $(y_{i,t-1} - \bar{y}_{i(-1)})$ and $(\nu_{it} - \bar{\nu}_i)$ are negatively correlated through their mean components, the Within-Groups estimator $\hat{\alpha}_{wg}$ is likely to be biased downwards (Nickell, 1981). Similarly, $\hat{\beta}_{wg}$ is likely to be biased and inconsistent.

An alternative method of eliminating the unobserved effects η_i consists in taking the first differences of the original equation:

$$(4.3) \quad \Delta y_{it} = \alpha \Delta y_{i,t-1} + \beta \Delta x_{it}^{*} + \Delta \nu_{it} \qquad \text{for} \quad i = 1,\ldots,N \quad \text{and} \quad t = 3,\ldots,T$$

By taking first differences the error term is transformed into a moving average process, and will therefore be negatively correlated with the lagged dependent variable. As a consequence, the OLS first-differenced estimate of α will also be biased and inconsistent.

The standard solution to circumvent the problem of correlation between the error term and the explanatory variables is to use an instrumental variable procedure. The model in (4.3) can be estimated consistently by using a Generalised Method of Moments (GMM) estimator of the kind developed by Holtz-Eakin, Newey and Rosen (1988) and by Arellano and Bond (1991). If x_{it}^{*} is correlated with η_i and endogenous with respect to ν_{it}, a standard assumption on the initial conditions ($E(y_{i1}\nu_{it}) = 0$ for t=2,...,T) combined with the assumed absence of serial correlation in the ν_{it} yields the following moment conditions:

$$(4.4) \quad E\left(y_{i,t-s}\Delta\nu_{it}\right) = 0$$

$$(4.5) \quad E\left(x_{i,t-s}\Delta\nu_{it}\right) = 0$$

for $s \geq 2$[22]. If there is no serial correlation of the residuals ν_{it}, the error term in levels is transformed by first differencing into a first-order moving average process, and instruments dated t-2 and earlier are expected to be valid. Therefore, the instrument matrix Z_i is:

$$(4.6) \quad Z_i = \begin{bmatrix} y_{i1} & x^*_{i1} & 0 & 0 & 0 & 0 & \dots & 0 & \dots & 0 & 0 & \dots & 0 \\ 0 & 0 & y_{i1} & y_{i2} & x^*_{i1} & x^*_{i2} & \dots & 0 & \dots & 0 & 0 & \dots & 0 \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & 0 & \dots & y_{i1} & \dots & y_{i,T-2} & x^*_{i1} & \dots & x^*_{i,T-2} \end{bmatrix}$$

and by stacking across individuals to obtain $Z = (Z_1', Z_2', \dots, Z_N')'$ the GMM first differenced (hereafter GMMDIF) estimator has the form:

$$(4.7) \quad \hat{\delta} = \left(\overline{X}' Z A_N Z' \overline{X} \right)^{-1} \overline{X}' Z A_N Z' \overline{y}$$

where $\overline{X}$ is the similarly stacked matrix of observations on ΔX and $\overline{y}$ is the stacked vector of observations on Δy. The one-step GMMDIF estimator that we report is obtained by setting:

$$(4.8) \quad A_N = \left(\frac{1}{N} \sum_{i=1}^{N} Z_i' H Z_i \right)^{-1}$$

where H is a matrix given by:

$$(4.9) \quad H = \begin{bmatrix} 2 & -1 & 0 & \dots & 0 \\ -1 & 2 & -1 & \dots & 0 \\ 0 & -1 & 2 & \dots & 0 \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & 0 & \cdots & 2 \end{bmatrix}$$

We can also obtain a two-step GMMDIF estimator by setting:

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[22] In the case where $\nu_{it} \sim MA(\rho)$, the moment conditions in (4.4) and (4.5) are valid for $s \geq 2+\rho$.

$$(4.10)\quad A_N = \left(\frac{1}{N} \sum_{i=1}^{N} Z_i' \Delta \hat{v}_i \Delta \hat{v}_i' Z_i \right)^{-1}$$

where the vectors $\Delta \hat{v}_i$ are consistent estimates of the first-differenced residuals for each firm (see White, 1982), obtained from the one-step consistent estimator of δ. Note that when the residuals v_{it} are i.i.d., the one-step and the two-step estimators are asymptotically equivalent. Otherwise, the two-step estimator is more efficient. However, Arellano and Bond (1991) and Blundell and Bond (1998) have noted a serious small sample downward bias in the asymptotic standards errors for this two-step GMMDIF estimator. This small sample bias increases with the number of overidentifying restrictions. The problem is much less serious for the one-step GMM estimators. For this reason we will report only the results from a one-step GMM estimator, which may allow more reliable inference in finite samples.

In dynamic panel data models where the autoregressive parameter α is moderately large and the number of time series observations is moderately small, the GMMDIF estimator has been found to have serious finite sample bias and poor precision in simulation studies. In the case of a simple AR(1) model with unobserved individual-specific effects, Blundell and Bond (1998) show that the lagged levels of the series provide weak instruments for first differences in two important cases. First, as the value of the autoregressive parameter increases towards unity; and second, as the relative variance of the fixed effects increases.

Arellano and Bover (1995) have proposed an alternative estimator that is expected to improve on the properties of the standard first-differenced GMM estimator in these cases. Relatively mild restrictions on both the initial conditions process generating y_{i1} and the correlation between the regressors x_{it}^{*} and η_i yield the following extra moment conditions, which relate to the equations in levels,

$$(4.11)\quad E\left(u_{it}\Delta y_{i,t-s}\right)=0$$

$$(4.12)\quad E(u_{it}\Delta x^{*}_{i,t-s})=0$$

for s=1 [23,24]. The resulting linear estimator uses *differences* of y_{it} and x^{*}_{it} dated t-1 as instruments for the equations in levels, in addition to *levels* of y_{it} and x^{*}_{it} dated t-2 and earlier as instruments for the equations in first differences. The instrument matrix for this system can therefore be written as:

$$(4.13)\quad Z_i^{+}=\begin{bmatrix} Z_i^{D} & 0 \\ 0 & Z_i^{L} \end{bmatrix}$$

where Z_i^{D} is defined as in (4.6) and Z_i^{L} has the form:

$$(4.14)\quad Z_i^{L}=\begin{bmatrix} \Delta y_{i2} & \Delta x^{*}_{i2} & 0 & 0 & \dots & 0 & 0 \\ 0 & 0 & \Delta y_{i3} & \Delta x^{*}_{i3} & \dots & 0 & 0 \\ \vdots & \vdots & \vdots & \vdots & \ddots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \dots & \Delta y_{i,T-1} & \Delta x^{*}_{i,T-1} \end{bmatrix}$$

The GMM system (hereafter GMMSYS) estimator has the form:

$$(4.15)\quad \hat{\delta}=\left(X^{+\prime} Z^{+} A_N Z^{+\prime} X^{+} \right)^{-1} X^{+\prime} Z^{+} A_N Z^{+\prime} y^{+}$$

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[23] Necessary conditions for these additional moment conditions to be valid are

(a.1) $E\left(\Delta y_{i2}\eta_i\right)=0$

(a.2) $E\left(\Delta x^{*}_{it}\eta_i\right)=0$

Blundell and Bond (1999) show that the joint stationarity of the y_{it} and x^{*}_{it} processes is sufficient (but not necessary) for the validity of (4.11) and (4.12).

[24] In the case where ν_{it}~MA(ρ), the extra moment conditions take the form given in (4.11) and (4.12) with s=1+ρ.

where $X_i^+ = \left(\Delta X_{i3} \ldots \Delta X_{iT}, X_{i3} \ldots X_{iT}\right)'$

and $X^+ = \left(X_1^{+\prime} \ldots X_N^{+\prime} \right)'$

X_i^+ is the (stacked) matrix for each individual containing the (T-2) observations on ΔX and the (T-2) observations on X in levels, corresponding to periods 3,...,T for which instruments are observed; similarly, y_i^+ is the (stacked) vector containing the (T-2) observations on Δy and the (T-2) observations on y in levels. Also for the system estimator, we report the one-step GMM estimates. The choice of A_N to yield this one-step estimator is:

$$(4.15) \quad A_N = \left(\frac{1}{N} \sum_{i=1}^{N} Z_i^{+\prime} Z_i^+ \right)^{-1}$$

Although this is asymptotically inefficient relative to the two-step estimator[25], in most of their simulations for an AR(1) model Blundell and Bond (1998) find the finite sample distributions of the one-step and the two-step GMMSYS estimators to be similar, and again the inference based on the one-step estimator is found to be more reliable. In this case, Blundell and Bond show that the initial condition information exploited in the GMMSYS estimator greatly reduces the finite sample bias found for the standard GMMDIF estimator when the autoregressive parameter is high. They also observe that whilst the finite sample bias of the differenced estimator of α is generally downwards (in the direction of the OLS in first differences), the much smaller finite sample bias of the system estimator is generally upwards (in the direction of OLS levels). More generally, Blundell and Bond (1999) have subsequently

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[25] The calculation of the two-step GMMSYS estimator is analogous to that described for the two-step GMMDIF estimator. Note that, in the case of the system estimator, there is no one-step GMM estimator that is asymptotically equivalent to the two-step estimator, even in the special case of i.i.d. disturbances.

shown that the finite sample bias of the GMMDIF estimator in the presence of weak instruments will tend to be in the direction of the Within-Groups estimator.

Chapter 3

Corporate Financing and Governance in an International Perspective: A Review of the Financial Systems in Italy, the United Kingdom, and the United States

1. Introduction

The aim of this thesis is to investigate the impact of financial variables on the investment expenditures of Italian firms (Chapters 4, 5 and 6), and UK and US firms (Chapters 6 and 7). In order to understand how the institutional and corporate environment can reduce or increase imperfections in the capital markets, in this chapter we review and discuss the main characteristics of the systems of corporate financing and governance in Italy, the United Kingdom, and the United States.

A taxonomy of financial systems is presented in Section 2. Section 3 presents some international comparisons on the main characteristics of the different financial systems. Sections 4, 5 and 6 describe the main characteristics of the Italian, UK and the US financial systems, respectively.

2. A taxonomy of financial systems

Financial systems are the institutional arrangements designed to transfer savings into investments and to allocate funds among alternative uses in the non-financial sector. Financial

systems in different parts of the capitalist world differ markedly in the way this transfer is done and the institutions undertaking it. In particular, differing mechanisms of capital mobilisation and differing roles of banking systems can be observed. For this reason, the varying financial systems in the economically developed world are commonly divided up into two groups: *market-based systems* on the one hand and *bank-* (or *relationship-*) *based systems* on the other.

In the market-based system the transfer of savings into investments occurs mainly through highly competitive markets, in which the allocative process is driven by competitive market prices and protected by the prompt and unbiased enforcement of contracts. The financial institutions and intermediaries are highly specialised and thus, the system is characterised by a wide range of financial instruments and capital markets. Banks maintain arm's-length relationships with firms. They primarily meet the short-term financing needs of the corporate sector, and given the competition between markets and intermediaries, the market conditions prevail. Firms can build self-insurance against financial risks they do not want to bear on specific markets, and so it is partially possible to keep apart financing and risk.

In the relationship-based systems, the transfer occurs mainly through financial intermediaries. Long-term and short-term capital needs of firms are provided through credit by saving institutions and banks which, when allowed, act also as suppliers of equity capital. The financial markets are less developed and opportunities for diversification and hedging, insurance against financial risk through markets, are more limited.

Another major institutional difference between market-based and relationship-based financial systems is the level of ownership concentration and the working of the market for corporate control. The key features that characterise corporate control in the market-based systems are:

- A large number of listed companies whose shares and voting majority may be traded at the stock exchange and are, for the most part, widely held.
- Liquid capital markets in which property and control rights are intensively traded and company takeovers are frequent.
- Relatively few cross-holdings of equity between companies.

The shares are typically held by households either directly or indirectly via pension funds, mutual funds and insurance companies. This explains why the market-based systems are also known as *outsider control systems*. The institutional investors are engaged in portfolio management, but are not actively engaged in corporate control. Given the considerable distance between investors and management, monitoring is often "ex-post" and evaluative rather than "ex-ante" and "pro-active". Managerial discretion is then restrained by the existence of a highly active market for corporate control (hostile takeovers, leveraged buy-outs). As Herzel and Shepro (1990) state, "the most compelling argument in favour of hostile takeovers is that they are an important discipline on the managements of likely target companies". Market activity also provides the foundation for management compensation schemes, which contribute to the alignment of management's interests to shareholders' interests through incentives such as stock options. As Berglöf (1995) notes, "arm's-length finance is "corporate governance by objective"; investors do not interfere directly in strategic decisions as long as they are paid according to contract. [...] Arm's length finance does not rule out intervention. Nevertheless, the initial investors rely on the external mechanisms such as the market for corporate control or bankruptcy courts to achieve such intervention".

In the relationship-based systems a different mechanism of corporate control has evolved, which is known as the *insider control system*. Its key features are:

- A small number of listed companies, whose shares and voting majority is typically in the hands of a single shareholder or controlling block.
- Illiquid capital markets in which ownership and control rights are traded infrequently and company takeovers are virtually absent.
- Extensive use of inter-company cross-holdings, pyramiding of ownership and dual class stocks, which make it possible to concentrate voting power without concentrating ownership.

If arm's-length finance implies "governance by objective", relationship-based finance is "governance by intervention". High concentration of ownership and control in the hands of several kinds of active investors gives them both the incentive and the opportunity to directly exert influence on managerial behaviour, so that correction of managerial failure need not take place via the market for corporate control. Moreover, the substantial blocks of voting shares owned by large investors, along with other restrictions that may come from limitations on voting rights of outside common shareholders, serve as major structural barriers to unwanted takeovers.

The choice between arm's-length and relationship-based finance influences the nature of conflicts in the financial system. With arm's-length finance as the most important source of funding, the predominant conflict is likely to be between management and investors. Under relationship-based finance, conflicts are more likely to occur between different classes of investors: that is, between holders of control and investors with minority financial instruments. The basic issue of the two agency problems is the same: how to convince investors that they will be repaid in the future. However, the concrete manifestation of agency problems in a widely held firm often differ substantially from those in a closely held firm with a controlling shareholder, and conflicts in owner-managed firms are different from those in firms with professional management without substantial ownership stakes. Minority investors

in a relationship-based financial system also have fewer opportunities to make use of the outside "exit" option provided by liquid capital markets than do small shareholders in an arm's-length financial system with liquid capital markets.

Corporate laws and the institutions enforcing these laws also differ in the relationship-based and the market-based financial systems. Wymeersch (1994) identifies two broad corporate law traditions: a company-based and an enterprise-based legal system. The former, primarily associated with the market-based system, focuses on the firm as a legal entity and on the relationship between it and its investors. In contrast the latter, associated with the relationship-based system, places greater emphasis on the physical entity (e.g. the individual plant with its buildings, equipment and workers) and often takes a broader view of the stakeholders. This classification resembles to some extent the distinction made in the economic literature between the "nexus-of-contracts" view, which analyses the contracts between the various investors, and the "property rights" paradigm, where the specific assets at the core play an important role in bargaining (Hart and Moore, 1990).

A number of recent theoretical studies have analysed the expected costs and benefits of alternative financial systems. The most important benefit of market-based systems is that the existence of free markets relying on prices for guidance facilitates the allocation of scarce resources in the most productive way. This is not only in the best interest of shareholders but also of the economy as a whole. A second benefit is that the existence of competitive stock markets allows efficient risk sharing. The information incorporated in stock prices allows effective managerial incentive schemes to be provided. Finally, dispersed share ownership has the advantage that outside shareholders who are not bound by prior commitments are more likely to seek the highest value control group *at any point in time*, thus achieving value maximisation, at least over the short run (Franks and Mayer, 1997).

However, there are also potential disadvantages in the market-based system. The limited information available to diverse agents to screen and monitor firms, due to the separation

between industry and investors, may raise the cost of external finance. The danger of *short-termism* is another potential problem. In order to present favourable financial results in the short run, managers may overlook the importance of basic investments to sustain the firm's performance in the long run. Abrupt changes of corporate control, or the fear of this, can undermine a firm's reputation for maintaining long-term contractual relationships with its managers and employees. This discourages investments of a firm-specific nature, since the investor cannot be sure for how long those investments will pay off.

The market for corporate control can also bring about significant costs. Takeover battles are often very expensive: there are direct costs in the form of payments to advisers and underwriters, and indirect costs in the form of consumption of managerial time and effort (with both types of costs being borne by both the bidder and the target). Especially in the case of unsuccessful bids, these costs may be simply dead-weight costs that do not generate any offsetting benefits. Furthermore, hostile bids require a very high bid premium. If a potential bidder can see nothing other than an inefficient incumbent management in a potential target (and not also, for example, the possibility of strategic gains or synergies from a merger), then a bid may not be forthcoming unless it is a case of particularly great managerial failure.

Incentive share schemes as a device to improve managerial behaviour would seem to be less wasteful than takeovers. The trouble is that the available evidence indicates that there are practical limits to the extent to which pay-for-performance schemes can reduce conflicts between managers and shareholders[1]. Most importantly, executive compensation, like the

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[1] Another disadvantage is that, whilst reducing the incentive for managers to shirk, an executive share scheme compounds a different problem. There is an asymmetry between the attitudes to risk of managers and diversified shareholders (like institutions). A manager is inherently financially over-invested in the firm, and will therefore be more risk-averse than the firm's institutional shareholders, which have diversified investment portfolios. The use of shares and share options as incentive remuneration serves to further decrease the diversification of the manager's income stream.

market for corporate control, can solve problems of managerial misbehaviour but does nothing to mitigate financing costs stemming from asymmetric information between insiders and outsiders. Even if firms are perfectly controlled by stockholders, they will face financing costs associated with lack of information about the value of their opportunities and the potential for stockholders to act in their own self interest and contrary to the interest of creditors.

Costs and benefits are also considered to be present in the bank-based system. *Prima facie*, banking systems are expected to avoid some of the information deficiencies associated with securities markets. A primary rationale for the existence of banks is that they perform an important function in screening and monitoring firms. According to Diamond (1984), they can overcome the free-rider problem in information gathering that afflicts lending by a large number of dispersed investors. As a result of the diminished adverse selection (through information) and the reduced moral hazard (through control of the firm's investment decisions), banks have the capacity to provide cheap "informed" funds as opposed to costly "uninformed" or arm's-length funds. Mayer (1988) has also suggested that there may be advantages to long-term relations between banks and firms. Long-term relations improve banks' evaluations of the quality of firms and allow better lending decisions to be made. If banks are better informed than other investors, they might be less inclined to favour investments that generate immediate signals of performance (Von Thadden, 1995). Banks may therefore diminish short-term biases that would otherwise affect lending decisions.

The presence of large shareholders further contributes to avoiding the free-rider problem of corporate control in relationship-based systems. Shleifer and Vishny (1986) provide a theoretical demonstration that concentrated shareholdings can mitigate free-rider problems of corporate control. This makes the need for external corrective measures through the market for corporate control less pressing, since the main owner(s) may be in a position to take disciplinary measures directly if deemed necessary. Managerial failure can be corrected without changing ownership.

Information is also particularly important in the refinancing of failing firms. Failure of creditors to distinguish between companies with good or bad prospects during periods of financial difficulties may result in premature liquidations. By close monitoring and control of the actions of managers of firms in financial difficulty, banks should be able to reduce the costs of financial distress. Indirect bankruptcy costs should also be smaller in insider control systems since failing firms are expected to be supported by other members of a group.

We also mention some potential disadvantages of relationship-based systems. The effective limitations on outside competition imposed by long-term relationships between firms and strategic capital suppliers imply that there may be no price signals to guide investment decisions. Unlike arm's-length, market-based systems, where a number of competitive lenders can give a borrowing firm independent assessments of the costs of undertaking a project, the cost a borrower faces in the relationship-based system is simply what the strategic capital supplier(s) and the borrower negotiate. Since there can be substantial value created in the relationship, and the negotiation and allocation of this surplus is a function of each party's power, the effective cost of financing can deviate substantially from the risk-adjusted cost. The consequence can be a widespread and costly misallocation of resources due to lack of price signals. In fact, even if prices were accurate, the power structures may not allow movement in a direction indicated by the prices, since the relationship-based system lacks a self-activating mechanism (like takeovers) to rectify the misallocation of resources when it becomes excessive. Another problem with relationship-based systems is their potential resistance to change. The opacity and collusive practices that sustain a relationship-based system entrench incumbents at the expense of new entrants (Rajan and Zingales, 1999).

Shleifer and Vishny (1997) suggest that there may also be significant disadvantages to concentrated shareholdings: "A fundamental problem is that large investors represent their own interests, which need not coincide with the interests of their investors in the firm, or with the interests of employees and managers. In the process of using his control rights to

maximise his own welfare, the large investor can therefore redistribute wealth -in both efficient and inefficient ways- from others". The resolution of one problem, the principal-agent relation between shareholders and managers, may come at the expense of another, the abuse of minority shareholders. A second disadvantage of concentrated ownership is that it forces managers and other inside shareholders to bear excessive company-specific risks -risks that could be borne at lower cost by well-diversified outside stockholders (Demsetz and Lehn, 1985).

Summing up, we cannot say that one system is superior over the other on theoretical grounds. Each system has strengths and weaknesses. The primary strength of the relationship-based systems appears to be their use of the lower-cost direct monitoring of managers by banks and large shareholders. This reduces the costs associated with informational asymmetries in the capital markets and, as a result of the concentration of ownership, encourages more active corporate governance and development of long-term relations. However, concentrated ownership may be used to extract private benefits from firms rather than to pursue wider corporate interests. In addition, there may be positive advantages in not establishing close, long-term relations. Where changes in corporate policy are required then the replacement of commitments, vested interests, pressure groups, etc. by a market in corporate control may be beneficial. Indeed, the primary strength of outsider, arm's length systems is that they appear to be more responsive to change (see Mayer, 1998, and Allen and Gale, 1999).

3. Financial systems and corporate finance: a review of the international evidence

Following the previous classification scheme, the United States and the United Kingdom are typically referred to as market-based countries, while Japan and the Continental European countries are characterised as bank-based. As is obvious from this classification, there are substantial variations within the two taxonomies. Indeed, some of the most interesting international differences from an institutional point of view are found within the group of relationship-based countries[2].

The theoretical analysis suggests that the financing patterns of firms in the different countries should reflect the differences between the respective financial and corporate governance systems. There are two possible ways of analysing how firms are financed in different countries. One can focus either on financial flows and use a flow-of-funds framework, or alternatively on stock variables, in which case one studies the capital structures in the non-financial sector. Capital structures are typically measured on the basis of balance sheet data[3]. The empirical evidence contained in older studies[4] suggests that differences between specific national patterns of company financing reflect differences in the respective financial systems. The equity ratio (leverage) was found to be larger (smaller) on average in

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[2] For example, a taxonomy of systems of corporate governance, largely based on the identity of oligarchic groups, identifies different classes of relationship-based systems for Germanic countries (e.g. Germany, where banks and employees are influential), Latin countries (e.g. France and Italy, where family control is relatively important), and Japan (where banks serve as the nucleus of mutually related, vertically and horizontally integrated groups of firms). La Porta *et al.* (1996) classify countries according to the legal origin of the rules protecting investors, which is either English (in the US and the UK), French (in France and Italy), German (in Germany and Japan), or Scandinavian.

[3] The interpretation of this data is, however, difficult not only because of differing national accounting standards, but also because balance sheets are available for a limited number of (usually listed) companies. It is therefore doubtful to what extent findings based on accounting data are representative of the entire business sector.

[4] See, for example, Rutteford (1988), Berglöf (1990), and Borio (1990).

countries with market-based financial systems. However, in a recent comparative study of capital structure, Rajan and Zingales (1995) do not find any systematic difference between the level of leverage in the market-based and the relationship-based countries (Table 3.1). This raises the question of whether differences in the importance of the banking sector have any effect on firms' financing decisions.

Rather than leverage, a better measure of the importance of the banking sector in financing firms is the ratio of bank loans made to the private sector to the gross domestic product. Rajan and Zingales (1995) calculate the ratio for 1986: the evidence suggests that the banking sector is more important in the bank-based than in the market-based economies (Table VIII, p. 1448). This distinction is also supported by other measures of the importance of financial markets, such as the number of publicly listed firms, the extent of secondary equity and debt markets, and the ratio of bank loans to all forms of finance (Table 3.2). Bank-based countries appear to have the least well developed external capital markets. They have small equity and bond markets, and bank loans account for a high percentage of firms' financing. By contrast, market-based countries have substantial secondary capital markets, and banks are a less important source of finance.

In light of this evidence, the difference between bank-based and market-based countries is reflected more in the choice between public (stock and bonds) and private financing (bank loans) than in the amount of leverage. A possible explanation for this finding is that, in spite of the greater availability of debt finance from banks, firms in bank-based countries may not want to borrow beyond a point, due to costs of excessive bank debt[5]. An alternative explanation is that banks in these countries provide both debt and equity finance to firms so

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[5] Sharpe (1990) and Rajan (1992) point out that long-term relations provide the bank with such an informational advantage that the strength of competition from other intermediaries or from the financial market is reduced. This gives the bank a monopoly power that can be used to squeeze the profits of the "informationally" captive firms by making continuation of its support conditional on higher interest rates.

that the greater availability of financing is not reflected in the leverage ratio. Indeed, Prowse (1997) reports that in 1995 the share of the outstanding corporate equity held by banks is respectively 10.3% and 13.3% in Germany and Japan, against only 0.2% in the United States.

Up to this point the analysis has been restricted to stock-based measures of the existing capital structure. We now consider evidence on the choice of financing based on flow-of-funds data. An important reason for extending our analysis is that data on capital structure do not distinguish between equity built up through retained earnings and equity obtained through stock issues. The flow-of-funds analysis sets out to determine the cash flows and traces the sources and uses of funds for firms during a given period. The logical relationship between this and the former method of measurement is that, apart from value changes, observable capital structures are the outgrowth of financial flows accumulated over the years[6].

The first comprehensive studies to compare the financial flows in the corporate sectors of different countries were presented by Mayer (1988, 1990). Mayer (1990) analysed the financial behaviour of companies in eight industrial countries during the years 1975 to 1985. Four important findings emerge from the empirical analysis (Table 3.3). First, internal finance is the dominant mode of financing in all countries. Second, the share of internal financing in total financing is higher in market-based than in bank-based countries. Third, there is not one single developed country in which the issue of shares contributes significantly to the financing of business. Fourth, in all countries the most important external sources of funds are the banks as providers of loans.

Firms' reliance on inside finance is suggestive of the existence of a wedge between the cost of internal and external finance. From the perspective of Jensen and Meckling (1976),

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[6] In contrast to stock-based measures of capital structure, flow-of-funds data are typically available for the entire business sector. This raises the issue of different statistical definitions of this sector in different countries and of different methods applied by the respective national statistical authorities. Because of these methodological problems, international comparisons based on the flow-of-funds approach should be interpreted cautiously.

one might argue that internal finance has priority because the agency costs of internal finance are lower than the agency costs of outside bank or market finance. This is also the explanation given by Myers and Majluf (1984) in the context of a model with asymmetric information and signalling. Internal finance is taken to have no agency costs because it represents the use of funds available to the firm on account of the firm itself. External finance does have agency costs (signalling costs, monitoring costs, simple inefficiencies) because information asymmetries and externalities preclude the attainment of a first-best allocation in the arrangement between the firm and its outside financiers.

Flow-of-funds studies are important for another reason. The fact that market-based financial systems seem to rely more heavily on self-financing than relationship-based systems could suggest that outside finance in the former is relatively more expensive than in the latter. Indeed, this finding may be taken as an indicator of the importance of a relationship-based system in reducing or eliminating information problems in the relation between entrepreneurs and financiers.

Table 3.1

Extent of adjusted leverage in different countries

Leverage measures are calculated for all non-financial companies reporting consolidated balance sheets in 1991. In the 'book' column, equity is measured at book value. In the 'market' column, equity is measured at market value. For instance, this alters the value of assets as follows: the (quasi) market value of assets is obtained by subtracting the book value of common equity from book assets and adding back the market value of common equity. Adjusted liabilities are total liabilities less pension liabilities (in Germany) less cash. Adjusted debt is the book value of debt less the value of cash and marketable securities. Adjusted assets are total assets less cash and short-term securities, less pension liabilities (in Germany), less intangibles. Adjusted book equity is book equity plus provisions plus deferred taxes less intangibles. Non-equity liabilities to total assets is the sum of all adjusted liabilities divided by the value of adjusted assets. Debt to total assets is the value of short-term plus long-term adjusted debt divided by total adjusted assets. Debt to net assets is the book value of adjusted debt divided by net adjusted assets where net adjusted assets is adjusted assets minus accounts payable and other current liabilities. Debt to total capital is the book value of adjusted debt divided by the sum of the book value of adjusted debt and adjusted equity. Interest coverage ratio is the income before interest and taxes divided by interest expenses. EBIT is earnings before interest and taxes. EBITDA is earnings before interest, taxes and depreciation.

	Non-equity liabilities to total assets (Medians)		Debt to total assets (Medians)		Debt to net assets (Medians)		Debt to capital (Medians)		Interest coverage ratio (Medians)	
Country	Book	Market	Book	Market	Book	Market	Book	Market	EBIT/ Interest	EBITDA/ Interest
US	0.52	0.42	0.25	0.16	0.32	0.20	0.33	0.23	2.41	4.05
Japan	0.62	0.37	0.21	0.12	0.33	0.16	0.37	0.17	2.46	4.66
Germany	0.50	0.41	0.11	0.10	0.17	0.13	0.18	0.15	3.20	6.81
France	0.69	0.59	0.18	0.13	0.32	0.25	0.34	0.28	2.64	4.35
Italy	0.68	0.68	0.21	0.21	0.33	0.31	0.39	0.36	1.81	3.24
UK	0.47	0.35	0.10	0.08	0.16	0.10	0.16	0.11	4.79	6.44
Canada	0.48	0.49	0.32	0.26	0.36	0.30	0.37	0.32	1.55	3.05

Source: Rajan and Zingales (1995)

Table 3.2

Importance of external and bank finance by country

Country	Number of publicly traded firms (1996)	Market capitalisation as a fraction of GDP (1996)	Corporate debt as a fraction of GDP (1996)	Bank loans as a fraction of all forms of finance (1996)	Domestic bank credit to the private sector as a fraction of GDP (1991)	Bond market capitalisation as a fraction of GDP (1991)
US	8479	111	64	21	71	23.3
Japan	2334	67	39	59	104	4.7
Germany	681	29	58	55	87	0.1
France	686	38	49	49	80	5.6
Italy	217	21	37	50	33	0.7
UK	2433	150	45	37	54	2.5

Source: Cecchetti (1999) and Rajan and Zingales (1995).

Table 3.3

Average Net Financing of Non-financial Enterprises, 1979-85.

	Canada	Finland	France	Germany	Italy	Japan	UK	US
Retentions	76.4	64.4	61.4	70.9	51.9	57.9	102.4	85.9
Capital transfers	0.0	0.2	2.0	8.6	7.7	0.0	4.1	0.0
Short-term securities	-0.8	3.7	-0.1	-0.1	-1.3	NA	1.7	0.4
Loans	15.2	28.1	37.3	12.1	27.7	50.4	7.6	24.4
Trade credit	-4.4	-1.4	-0.6	-2.1	0.0	-11.2	-1.1	-1.4
Bonds	8.5	2.8	1.6	-1.0	1.6	2.1	-1.1	11.6
Shares	2.5	-0.1	6.3	0.6	8.2	4.6	-3.3	1.1
Other	1.3	7.4	-1.4	10.9	1.0	-3.8	3.2	-16.9
Statistical adj.	1.2	-5.0	-6.4	0.0	3.2	NA	-13.4	-5.1
Total	99.9	100.1	100.1	99.9	100.0	100.0	100.1	100.0

Source: Mayer (1990)

4. The Italian financial system

The Italian industrial and financial system contains a number of interesting features that make it quite unlike those of the other major industrialised economies.

One important feature is the large number of small and medium-sized firms, often combined within so-called "industrial districts"[7], which represent a very dynamic (probably the most dynamic) part of the productive system. According to recent calculations by the Istituto Tagliacarne (1995) on Eurostat data, Italian enterprises employ 6 workers on average, while German and British enterprises employ 9 and 8 workers respectively. Small and medium-sized enterprises (i.e., enterprises with fewer than 500 employees) account for 70% of the total added value of the Italian industry (Bongiovanni, 1994), and nearly 70% of the country's workforce is accounted for by companies employing fewer than 100 people[8]. The great number of small businesses partially reflects the Italian pattern of manufacturing in labour-intensive and resource-intensive industries, such as textiles and ceramics, which are characterised by fragmentation of production units and low product differentiation.

Another important characteristic is represented by the significant role still played by the state in the Italian economy. State-controlled companies are a large fraction of the total: Barca (1996) reports that about 50% of medium and large Italian companies (i.e., companies with more than 200 employees) are state controlled[9]. The massive presence of the State is (at least

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[7] Brusco (1982) defines industrial districts as "monocultural industrial areas in which all firms have a very low degree of vertical integration and the production process is carried on through the collaboration of a number of firms".

[8] In contrast, the figures are sharply lower in France where similar small companies account for only 30% of employment. In the UK, the percentage falls to 28%, even more in Germany to 20%, while in the US it is 19% (Financial Times Survey, December 13, 1999).

[9] In 1991 the state owned 54.6% of enterprises (equivalent to 93.3% of total employment) in the mining sector, 43.7% (41.3%) in the synthetic fibres industry, 34% (52.3%) in the plant engineering and construction sector,

partially) explained by the nationalisation of a large part of the industrial system that took place after the Great Crash in 1929. The refinancing of the troubled mixed banks, which found it impossible to liquidate their numerous holdings in the crisis-torn industrial groups, was accomplished by a government buy-out of their industrial holdings that were transferred to a new agency especially created for this purpose in 1933 -the Institute for Industrial Reconstruction[10] (IRI). State ownership was then maintained in the following decades, as state-owned companies were considered an effective tool for speeding up reconstruction in the years after the Second World War, and later as a source of funds and consensus for the political parties (Barca *et al.*, 1998). As well as acting as an owner, the State has been an important intermediary in the allocation of resources to the private sector by providing subsidised loans, transferring large funds to financially distressed enterprises, and buying out mis-managed companies[11]. Only recently has its role been partially reduced following some

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26.9% (52.3%) in the energy sector, 24.4% (22.5%) in the electronics industry, 23.9% (49.3%) in the iron and steel industry (Mediobanca, 1992, "Le principali societa' italiane").

[10] The industrial holdings transferred to IRI amounted to 21% of all the equity capital of limited companies in Italy at the time. In particular, IRI owned 100% of Italy's defence-related steel industry and coal mining, 90% of its shipbuilding, 80% of maritime shipping, 80% of locomotive manufacture, 40% of the non-military steel industry, 30% of electricity generation. In addition, IRI owned a number of mechanical engineering firms, controlled the three largest commercial banks and the telephone service in central and northern Italy, and possessed very extensive real estate holdings (Barca *et al.*, 1998).

[11] In addition to IRI, three other public conglomerates (ENI, EFIM and GEPI) were created in the post-war period. Similarly to IRI, EFIM and GEPI were conceived and developed as a safety net for financially distressed banks and industries, rather than being the outcome of an explicit industrial policy design. EFIM (Ente per il Finanziamento delle Industrie Manifatturiere), which took over in 1962 the activities of the state-owned Fondo Industria Manifatturiera set up in 1947, acted as a channel to provide government financial resources to ailing manufacturing firms in need of fresh capital. GEPI (Gestione e Partecipazioni Industriali) was created in 1971 in order to take over private companies experiencing temporary difficulties and turn them back to the private sector after reorganisation. The creation in 1953 of the oil and gas conglomerate, ENI (Ente Nazionale Idrocarburi), had instead stronger policy motivations. It was aimed at promoting production, refinement, sale and distribution of oil and gas according to public policy criteria. As a result, it preserved for a long time a high degree of integration. Only recently did its activities transcend its original sphere.

regulatory changes induced by the European Union and stronger competition in the international capital markets[12].

The Italian financial system differs in many respects from both the market-oriented Anglo-Saxon model and the bank-based German and Japanese models. Unlike the Anglo-Saxon market-based systems, the Italian financial system is characterised by the limited development of organised stock and private bond markets. The Milan stock exchange ranks last both for capitalisation and for volume of transactions measured as a percentage of GNP among the G7 countries. The number of companies listed at the end of 1993 was 240, as opposed to the 2,000 domestic companies listed in London. The marginal role of the Italian stock market can be explained not only by the large number of small firms, but also by the limited legal protection of minority shareholders[13] and, in particular, by the predominant role played by the market for government debt in attracting household savings.

In contrast to the market-based systems (and Japan), financial institutions hold a small fraction of Italian listed firms' equity (Table 4.1) and, in general, are not active investors. Moreover, until very recently hostile take-overs have been virtually absent, and major corporate rescue plans have been typically conducted through state agencies, allied groups or through Mediobanca, a merchant bank, itself linked through a web of inter-corporate shareholdings to the main dynasties of Italian capitalism[14].

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[12] In the 1992-1994 period, more than L15 trillion (over 1% of 1993 GDP) were raised through privatisation of state-owned enterprises (OECD, 1995, p. 97).

[13] According to La Porta *et al.* (1997, 1998) Italy ranks last among the G7 countries with regard to the protection of shareholders rights and the enforcement of legal rules.

[14] By holding strategic shares in private companies, Mediobanca has been playing the role of hidden director able to favour the control held by the existing majority (the founding families in most of the cases). Thus, Mediobanca has come to play a role not dissimilar to that of Japan's main banks, though it mostly specialises in ex-post monitoring, i.e., in devising rescue and restructuring plans once incumbent entrepreneurs fail to deliver satisfactory results (Barca *et al.*, 1998).

Lacking an active market for corporate control[15] and an active role of financial institutions in the corporate governance of firms, separation between ownership and control in the Italian private sector has been achieved mainly by means of "implicit rules". These allow the entrepreneurs to gain the financial help of other agents on the basis of informally stated systems of safeguards, mainly based on trust and personal relationships: families and coalitions (particularly common among smaller firms) and the diffusion of business groups.

4.1 Business groups

The term "business group" denotes a set of legally independent companies (the "member firms") connected via equity linkages that jointly guarantee a common control over all the activities of the group. Member firms usually have shareholdings in other firms belonging to the same group, while shares of their own capital are held by other member firms. A firm with no shareholdings in other member firms is defined as an "operating company". A firm whose equity capital is possessed by no other firms within the same group is referred to as the group's parent "holding company".

A taxonomy of the structure of business groups distinguishes them between the "A-type" and the "B-type" groups (Goto, 1982). The former is composed of a number of firms, basically equal in power, connected through a network of mutual equity linkages. No parent holding company exists within "A-type" groups, and co-ordination of activities is mainly secured through informal exchanges and tacit agreements. The latter centres around a single holding company that controls, directly or indirectly, the other member firms, and all the monitoring and decision-making activities are hierarchically organised. A-type groups are

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[15] Over the 1990-1992 period mergers and acquisitions amounted to 947 in Italy, against 3,186 in the United Kingdom, 3,245 in Germany and 2,595 in France (OECD, 1995, p. 79).

typical of the Japanese economic system (the so-called *keiretsu*); B-type groups are largely predominant in Europe, including Italy, in the form of *pyramidal groups*.

The Italian pyramidal groups generally present the following characteristics:

- a number of companies, some of which can be listed in the stock market, are controlled by the same entrepreneur (usually an individual or the founding family) via a chain of vertical and unidirectional linkages, i.e. at each level of the pyramid, firms own a control stake in firms belonging to the immediately lower level;

- the stock pyramiding effect enables one or more individuals to control a wide set of activities with a limited share of assets owned, i.e. without concentrating (cash flow) ownership[16]. Indeed, each firm in the pyramidal group, though legally independent, is controlled by the head of the group (the holding company), since the voting rights of the minority shareholders are spread out over a large number of firms, while those of the controlling shareholder are concentrated at the top of the pyramid;

- pyramidal groups often operate in many different markets, not necessarily connected to each other, thus reproducing the diversified structure of the Anglo-Saxon conglomerates. However, the fact that various activities are organised through legally independent units can allow pyramidal groups to enjoy greater flexibility and managerial autonomy than the multi-divisional (M-form) corporations;

- pyramidal groups can rely on a number of financing sources that is much larger than those normally available to economically independent firms, since the diversified structure

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[16] Several other objectives may lie behind the adoption of the pyramid group structure compared to a divisional one: to limit the liability of that particular unit to the capital invested in each unit of production; to enrich the incentives for unit managers; to reap fiscal benefits or state subsidies (by turning some small units into "small firms").

allows them to present to the market various combinations of the single economic activities of the group. Moreover, the possibility of an internal capital market within the business groups can partially act as a substitute for the external capital market;

in the absence of comprehensive legislation on groups, the fragmentation of business into a large number of companies enhances the opportunities for withholding relevant information from minority shareholders, for escaping existing disclosure regulations and for reaping fiscal benefits or state subsidies.

Most large and medium-sized private Italian companies belong to a group organised as a pyramid with a holding company at the top controlling one or more subsidiaries that, in turn, control other subsidiaries and so on. An empirical investigation of a representative sample of manufacturing firms with more than 50 employees showed that, in 1992, 56% of manufacturing firms were organised within pyramidal groups (Table 4.2). The diffusion of this mode of organisation is greater among larger companies: nearly all manufacturing firms with more than 1,000 employees, and all listed companies, belong to pyramidal groups. But it is also present among small ones (almost 40% of firms with 50-99 employees are part of a group). The extent of this phenomenon calls for a reassessment of the true-size distribution of Italian industrial firms. By considering all companies belonging to a group as one "economic" company, the number of employees in large companies turns out to be almost double the figure generally taken into account[17] (Table 4.3).

One of the main peculiarities of the large Italian groups is that the first level down from the top is often represented by listed companies in which the main shareholder (the owner family) maintains control through proxy voting arrangements and cross shareholdings with

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[17] The classification of firms according to "economic" companies further stresses another notable feature of the Italian size distribution, the "lack" of medium-sized companies, where the "lack" is measured in terms of deviations from a neutral Gibrat-Simon distribution (see Barca and Magnani, 1989).

allied groups. There are relatively few cross shareholdings among different groups[18] (the law limits the voting rights of these shares), but there are very strong intra-group cross shareholdings. In general, the characteristics of the first levels of Italian groups are aimed, on the one hand, at ensuring the control of a large amount of assets with a small fraction of voting rights and, on the other hand, at shielding the controlling group from the threat of hostile take-overs[19].

Research on data from Italian groups with listed companies has shown that the separation between ownership and control is high: in family controlled groups the average separation, calculated as the ratio between capital under control and capital owned by agents who exert control, is 8 (Table 4.4). This means that for each unit of the holding company owned the controlling shareholders are able to control, on average, 8 units owned by shareholders involved in the financing of other firms belonging to the same group. The highest values have been measured for Carlo De Benedetti and the Agnelli family with, respectively, a multiplier equal to 24 and 16 (Barca *et al.*, 1994).

The high degree of separation of ownership and control has been achieved through time both by expanding the group structure and by diluting the capital held by the family or by companies in the higher ranks of the group. The latter has undoubtedly led to some weakening of family control, especially in those group companies that, by being closer to the core business, are preferred by external shareholders. Table 4.5 illustrates this by reporting the

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[18] The capitalisation of inter-group equity links at the end of 1987 was equal to 7,404 billion lire (equal to 6.4% of the gross capitalisation of the stock exchange). About one third of these inter-group shareholdings were held by the merchant bank Mediobanca.

[19] According to the Italian financial newspaper *Il Sole 24 Ore* (1997), 60% of the Milan stock exchange capitalisation in 1995 was represented by companies controlled by only one shareholder and the remaining 40% could not become the target of hostile take-overs either because of their corporate charter or because of alliances among shareholders with controlling stakes in the firm.

main shareholders of two major Italian corporations (Fiat and Falck) in 1947 and 1993. In 1947 both the Agnelli and the Falck family owned more than 70% of Fiat and Falck, thus hàving full control of the respective groups. In 1993 the founding families still held large blocks of shares but these were certainly not sufficient to exert control. Only agreements between the founding family and the leading financial and industrial companies allowed control to be still exerted. In the case of the Falck group, the coalition centred around the Falck family owned more than 50% of the shares, whereas in the case of Fiat the block organised around the Agnelli family owned less than 35% of the shares. These examples show how the weakening of the group structure has given rise, as far as these companies are concerned, to a new ownership structure, made up of founding families, banks and insurance companies and industrial firms. Non-banking firms play an important role in Falck through cross-shareholdings, whereas in Fiat the supporting role is played only by banks and insurance companies (Assicurazioni Generali) via shareholdings and through the threat of "white knight" in case of takeovers (Barca *et al.*, 1998).

Large corporate groups have also expanded by listing many companies under their control. These listings had two financial benefits for the controlling family: an immediate flow of capital due to the sale of a large amount of shares and the possibility to collect funds in the future both through the selling of shares not necessary for control and through new equity issues. Moreover, the listing of so many companies belonging to the same group gave controlling shareholders the possibility to solve financial problems in some of the group's firms or businesses through new equity issues in subsidiaries with good economic performance. Obviously, for such a mechanism to work, the quoted companies must obtain a profit high enough to convince the investors to buy shares in firms belonging to the group. In fact, a study by Buzzacchi and Pagnini (1994) provides evidence that listed companies belonging to a group have a greater level of profitability (measured by the return on equity ratio) and a lower profit variability than unlisted companies belonging to groups with listed

companies. Nevertheless, underpricing (i.e., the difference between issue price and the first trading price) in Italian initial public offerings (IPOs) has historically been particularly high (Buzzacchi and Colombo, 1996). In Table 4.6, data regarding the gross capitalisation of the largest corporate groups are given, both in absolute terms and as a percentage of the total capitalisation of the Italian stock-exchange. The data show that during the last fifteen years the importance of the main groups as a share of the total value of the market has been very high and stable. In particular, the largest corporate group accounts for more than 20% of the market, the largest three groups for half of the market and the largest ten groups for about 80% of the total capitalisation. The largest ten groups by capitalisation controlled 47 firms with listed shares at the end of 1996 (Zattoni, 1999).

It is only below the first levels that the structure of large Italian corporate groups tends to be more similar to the structure of groups located in other countries, i.e. it is below the third or fourth level from the top that we find non-listed companies with operating responsibility in some industry or business and controlled with a very high percentage of equity.

The pyramidal group structure can help firms in reducing the impact of financing constraints due to capital markets imperfections. Indeed, membership in a pyramidal group can mitigate the informational problems faced by the individual companies by improving access to external capital markets and allowing the formation of an internal capital market that may partially replace the capital allocation function of the external market. Buzzacchi and Pagnini (1994) analyse a sample of 512 Italian companies belonging to a group and conclude that the transfer of funds among firms affiliated to the same group is particularly relevant. The measured intra-group inflows and outflows of funds represent respectively 36.9% and 56.2% of the total net sources of funds[20] (equal to sum of the firms' internal funds, net debt and

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[20] The sample analysed by Buzzacchi and Pagnini (1994) does not include all the legally independent companies that constitute a single corporate group. The majority of these companies are companies at the top levels of the

equity raised in the external capital markets, and net debt and equity raised in the intra-group internal capital market). Moreover, the intra-group net transfers of funds (-19.3%) have the opposite sign and are only marginally lower then the external net sources of funds (23.8%). The internal capital market seems to act, therefore, as a substitute for the external capital market, in the sense that the funds raised in the external capital markets or the excess cash flow in some of the group firms are allocated through intra-group transfers to the individual companies that cannot fully finance their investment projects through internal funds and may otherwise face higher interest rates and equity premia.

4.2 Family and coalition control

Along with pyramidal group control, a second mode of private corporate control is represented in Italy by implicit rules such as family and coalition control. Family control is defined as an ownership structure where the non-controlling owners belong to the same family. Coalition control defines an ownership structure where the entrepreneur and the non-controlling owners have related commercial interests and/or are linked through contracts. From a study made by Barca *et al.* (1994) for a stratified random sample of industrial companies with more than 50 employees, it is estimated that one third of all companies (amounting to 17% of total employment) were run through family control; and 13.7% of companies (with 9% of employment) via coalition control.

As well as being a way of running small and medium-sized enterprises, family and coalition control are also employed as a means to govern the separation between ownership and control in the corporate groups. Referring exclusively to the companies at the top of a pyramidal group and attributing their model of control to all companies in the group, Barca *et*

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pyramidal group structure. This explains why inflows and outflows measures of intra-group transfers are not the same.

al. (1994) find that 40.7% of the 4,200 companies linked through a chain of control to listed companies are run through family control and 18.8% through coalition control (see Table 4.7). Furthermore, many holding companies at the top of large corporate groups are organised as limited partnerships (SAPA) or limited liability companies (SRL), so as to further lock in family or coalition shareholders by binding contractual agreements (see Table 4.4).

Implicit rules are often complemented by contracts. To further prevent individual deviations from family and coalition relations, clauses are often adopted in company by-laws to restrict the transfer of shares, mostly by granting all existing shareholders the chance to buy-out the shares at the offered price (pre-emptive clause) in the event of an external offer. Barca *et al.* (1994) report that 41% of small and medium-sized industrial firms employ these clauses, and the figure becomes 47% for small and medium-sized firms with family or coalition control. Interestingly, by-law clauses restricting the transfer of shares are also relatively common when absolute control is adopted, that is, when the controlling owner is an individual who owns the majority of the voting rights. Voting agreements ("patti di sindacato") are also common among the listed companies. In 1997 shareholder agreements were adopted in 70 listed companies. In 35 companies voting agreements accounted for more than 50% of the voting shares. Of these 35, 14 had a main shareholder that alone held the absolute majority. Voting agreements were usually employed to restrict the transfer of shares covered by the agreement (83% of the cases) and to appoint directors or auditors at the ordinary shareholders' meetings (Table 4.8).

The predominance of pyramidal groups and family business in Italy reduces the conflicts of interest between controlling owners and managers, since the former are either the managers, or have a strong incentive to monitor the latter. In comparison with the Anglo-Saxon countries, this implies lower pay-performance sensitivity and a limited use of long-term incentives for executive compensation. According to the 1995 survey by Hewitt Associates (reported by The Wall Street Journal) based on companies with median annual revenues of

approximately $500 million in 1995, base salary accounts for 74% of total compensation of an Italian CEO, compared to 40.4% for an American CEO (54% for a German one). On the other hand, stock options and plans appear not to exist in Italy, while they cover on average 26.5% of total CEO pay in the US (8.6% in Germany). Brunello *et al.* (1997) report that from a cross country compensation survey by Towers Perrins (1996) based on companies with approximately $250 million in annual sales, long-term incentives represented only 4% of the Italian CEOs' total remuneration in 1995, against 15% in the UK and 28% in the US.

4.3 Ownership structure

Another important difference between the Italian and the market-based systems is that in the Italian industrial sector there are no widely-held companies, and direct ownership is highly concentrated. Among the companies listed on the Italian stock exchange, in 1996 the largest shareholder owned on average 48% of the shares, and the largest three shareholders 62% (Bianchi *et al.*, 1997). Ownership concentration of listed companies is inversely related to firm size. In particular, the larger the market capitalisation, the smaller the share owned by the main shareholder and by the large minority shareholders, and the larger the share owned by the "market", i.e. the sum of all holdings lower than 2% (Bianchi *et al.*, 1997). As for the manufacturing companies as a whole, the "Indagine sugli investimenti della Banca d'Italia" (1997) on a representative sample of manufacturing companies with more than 50 employees reports that in 1996 the largest shareholder owned on average 67.8% of a company, and the three largest shareholders owned approximately 90%. As opposed to listed companies, ownership concentration, measured by the stake of the largest shareholder, is greater in larger firms: the largest stake is on average 64.9% in firms with less than 100 employees, and 82.5% in those with more than 1,000 employees.

From a comparison with the main industrial countries, Italian firms appear to have the largest concentration of shares in the hands of the main shareholder (Tables 4.9 and 4.10). In

the largest 500 Italian non-financial firms the main shareholder has in more than 96% of the cases the outright control (more than 50% of the shares) of the firm, against 66%, 55% and 5.3% in Germany, France, and the UK. The high degree of ownership concentration in Italian companies cannot be simply imputed to the wide diffusion of the pyramidal group structure among large and medium-sized companies. The last columns in Tables 4.9 and 4.10 present information on the ownership structure of the economic groups, with the shares in any company belonging to a pyramidal group being attributed to their "ultimate owners" -either the head of the group or other shareholders at the top of the ownership chains- in due proportion. In 65% of the cases, the largest shareholder owns more than 50% of the shares of Italian corporate groups (Table 4.9).

Average ownership by type of investor is reported in Table 4.11. Figures relate to legal companies, not to "economic" companies. Thus they underestimate the controlling role played by individuals, and overestimate the role played by companies. Individuals own a large share in smaller companies and a very small share in the largest companies (6.1% in the firms with more than 1,000 employees). However, holding companies and private domestic non-financial companies have significant shareholdings also in small and medium-sized firms (27.3% in firms with less than 100 employees). The larger the firm size the more important are the shareholdings by foreign companies, the state and, in particular, holding companies. As for listed companies, the main shareholders in 1993 were households, the state and non-financial companies (Table 4.1).

4.4 Role of banks

Although the above features make the Italian system more similar to the relationship-based German and Japanese models than to the Anglo-Saxon model, there are also important differences with the former. A distinctive feature of the bank-based systems is that banks perform an important monitoring role and replace the missing external markets for corporate

control. In many cases, this results in a direct involvement of (universal) banks in the management of firms. In contrast, in spite of the relevance of bank loans in firms' liabilities[21], the Italian financial system is characterised by a rigid separation between banks and firms. On the one hand, the bank law of 1936, which regulated financial intermediaries until 1993, did not allow commercial banks to hold shares[22]. Only after the reform of 1993 have banks been permitted to engage in universal banking. On the other hand, since, as previously mentioned, most of the non-financial firms are under the control of a limited number of shareholders, usually linked through a web of personal and family relationships, banks exercise no ultimate authority on managers and fulfil only a credit function.

As a consequence, Italian firms maintain borrowing relationships with a large number of banks and, especially for the larger firms, no particular institution tends to assume the role of main bank. Indeed, the widespread practice of multiple loans has been a distinctive feature of bank lending in Italy[23]. Barca (1996) reports that the average number of banks financing a

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[21] According to recent calculations by Alonso and Iturriaga (1997) on the B.A.C.H. (Bank for the Accounts of Companies Harmonised) database, in 1990 the share of bank finance on total assets was equal to 20.9% in Italy, against 15.7% in Germany, 15.7% in the United Kingdom, 14.1% in France and 10.9% in the United States. See also Table 4.12.

[22] Following the 1929 Great Crash and the creation of the Institute for Industrial Reconstruction (IRI) in 1933, the banking reform of 1936 prohibited commercial banks (with the exception of special credit institutions) from holding equity participations in industrial companies and required maturity specialisation in their lending activities, assigning short-term credit business to ordinary banks ("banche ordinarie") and medium- and long-term credit to special credit institutions ("istituti di credito speciale"). Thus, the German-style mixed bank vanished from the Italian scene. The banking reform of 1936 allowed only special credit institutions to hold shares in non-financial firms. Nonetheless, share holding in non-financial firms has been traditionally low even for special credit institutions: by mid 1993 this amounted to 1,800 billion lire, approximately 0.5% of their loans outstanding.

[23] Several reasons explain the fragmentation of credit relationships in Italy. Multiple credit relationships can help firms to solve the hold-up problem associated with main bank lending (a main bank could exploit its monopolistic position by charging higher interest rates) and, by pitting banks against one another, to lower the average cost of debt. From the banks' point of view, multiple-credit relationships could be seen as a sort of

firm ranges from 5 for the smallest firms to 30 for the largest ones. Multiple loans allow banks to share idiosyncratic risks, but reduce their incentives to monitor firms both ex ante and ex post, contrary to the monitoring view of financial intermediation. Indeed, Italian banks prefer in general an arm's-length relationship with firms to relational financing: while minimising their irreversible investments in stable, long-term customer relationships, they rely on the opportunity to discontinue credit to their clients or to forfeit their clients' personal wealth[24].

4.5 Financing patterns

As well as not being classifiable as either market-based or bank-based, the Italian financial system cannot be characterised as either a "high internal finance" or a Japanese-type bank-based-system. The last dichotomy, suggested by Corbett and Jenkinson (1994), is derived from the analysis of firms' net sources of finance. Table 4.12 presents non-financial firms' net sources of finance for Germany, Japan, UK, US (supplied by Corbett and Jenkinson, 1997), and Italy (supplied by Cobham *et al.*, 1997). The level of internal finance in Italy is in line with that of some of the "high internal finance" countries like Germany and UK[25] (although significantly lower than that of the US firms). Nonetheless, the level of bank finance is

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"insurance policy", in which the risks are shared among banks and the involvement of other lenders reduces individual losses if firms fall into financial distress. Structural and institutional factors may also be responsible for credit fragmentation. The small average size of Italian banks and the need to avoid excessive concentration of risk may have induced banks to share the financing of large borrowers. The operational and maturity specialisation imposed on banks between 1936 and 1993 contributed to limit the amount of credit extended by individual banks and the time horizon of their financing. This could have induced firms to maintain relationships with numerous banks in order to stabilise overall credit flows over time.

[24] Apart from multiple bank lending, two additional features of the credit relation reveal the attitude of Italian banks: the predominance of overdraft loans (84% of total loans), which makes *ex-ante* screening of the borrowers' quality less important; and the use of collateral (35% of loans at commercial banks are fully collateralised, 15% partially), which reduces the incentive for *interim* and *ex-post* monitoring.

[25] Note, however, that the share of internal finance was found to be comparatively low in Italy in the earlier study of Mayer (1990). See Table 3.3.

significantly more important, and second only to Japan. The coexistence of relatively high levels of internal finance and bank finance is made possible by the fact that bond finance and trade credit, in net terms, are strongly negative and well below that of other countries. Indeed, Italian firms invest significantly in high-yield government bonds and use them as a near-liquid asset.

4.6 Summary

On the whole, the key characteristic of the Italian financial system is represented by the strength of the firm managers vis-à-vis both financial markets and financial intermediaries. The predominant model for large firms is one in which a small number of shareholders closely associated with the firm's management hold well over half the shares, while for small firms it is one where the firm is owned by the manager and his/her family and other associates. In both cases, firms' managers retain a high level of autonomy and independence from the financial system. As sources of finance, firms' owners rely mainly on internal finance and bank debt, where the latter is characterised by short-term debt and higher interest rates for smaller firms.

As regards the Italian corporate governance system, the main agency problem does not come from a conflict between "strong managers and weak owners" (typical of the widely-held Anglo-Saxon corporations), but instead from a conflict between "strong blockholders and weak minority owners" (Becht, 1999). In particular, whilst pyramidal groups may spur firms' growth by relaxing financing constraints, they also present potentially severe conflicts of interests between insiders and external shareholders. An empirical study by Bianco and Casavola (1999) emphasises the ambiguous effects of pyramidal group structures on firm performance in Italy. On the positive side, by enabling ownership to be separated from control, pyramidal groups have facilitated the growth of entrepreneurial projects, and internal capital markets may have helped viable projects to be financed. On the negative side, "the perceived risks of expropriation may have imposed severe limits on the overall performance

of the system. [The empirical] results also suggest that the system may have suffered especially from a dynamic inefficiency problem, in that the concentration of ownership may have made control insufficiently contestable, hampering the efficient selection of controlling agents" (Bianco and Casavola, 1999, p. 1068).

Table 4.1

Direct ownership of listed companies in major industrial countries

Type of owner	US	Japan	UK	Germany	Italy	
					All listed companies	Listed co. except banks
Financial institutions	**39.8**	**47.0**	**60.8**	**19.5**	**13.9**	**6.0**
Banks	0.3	25.2	0.9	8.9	10.9	2.8 (1)
Insurance companies	5.2	17.3	18.4	10.6	0.8 (5)	0.8 (5)
Pension funds	24.8	0.9	30.4	-	-	-
Other financial institutions	9.5	3.6	11.1	-	2.2 (2)	2.4 (2)
Non financial owners	**53.5**	**48.8**	**26.9**	**62.8**	**81.8**	**88.8**
Non financial companies	-	25.1	3.6	39.2	21.6 (3)	27.3 (3)
State	-	0.6	2.0	6.8	28.0 (4)	26.8 (4)
Households	53.5	23.1	21.3	16.8	32.2 (5)	34.6 (5)
Foreign owners	**6.7**	**4.2**	**12.3**	**17.7**	**4.3**	**5.3**
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Barca (1996)

(1) Shares held by Mediobanca, by the pension fund of the Bank of Italy, and shares held on pledge.
(2) Includes an estimate of voting shares below disclosure requirement held by the unit trust system.
(3) Shares held by companies belonging to the same pyramidal group (whether holdings or subsidiaries) and by other companies.
(4) Shares directly held by the State and through non-banking State companies.
(5) All owners with less than 2% of share capital cannot be identified and are allocated to Households in this Table. This particularly affects the figure given for Insurance Companies, which includes only holdings by insurance companies that are bigger than 2% of share capital.

Table 4.2

Diffusion of groups among manufacturing companies (1992)

Size classes (employees)	Percentages of firms		Percentages of employees	
	Not organised in groups	Organised in groups	Not organised in groups	Organised in groups
50 - 99	60.51	39.49	60.69	39.31
100 - 199	31.35	68.65	29.88	70.22
200 - 499	17.28	82.72	15.24	84.76
500 - 999	11.24	88.76	10.64	89.36
≥ 1000	0.81	99.19	0.28	99.72
Total	43.75	56.25	19.93	80.07

Source: Barca, Bianchi, Brioschi, Buzzacchi, Casavola, Filippa, Pagnini (1994).

Table 4.3

Size distribution of legal and "economic" companies [1]

Size classes (employees)	Legal companies				"Economic" companies			
	Companies		Employees		Companies		Employees	
	number	%	Number	%	number	%	number	%
50 - 99	6,503	55.8	444,766	19.1	5,080	55.7	344,390	14.4
100 - 199	3,009	25.9	410,568	17.7	2,189	24.0	300.041	12.5
200 - 499	1,512	13.0	449,820	19.3	1,234	13.5	371,117	15.5
500 - 999	375	3.2	255,089	11.0	326	3.6	220,602	9.2
1000 - 1999	141	1.2	186,372	8.0	166	1.8	224,797	9.4
2000 - 4999	68	0.6	194,223	8.4	84	0.9	250,375	10.5
≥ 5000	30	0.3	383,716	16.5	34	0.4	679,781	28.4
Total	11,638	100.0	2,324,554	100.0	9,114	100.0	2,391,102	100.0

Source: Barca, Bianchi, Brioschi, Buzzacchi, Casavola, Filippa, Pagnini (1994).

[1] Only groups with at least one domestic manufacturing company with 50 or more employees are taken into account. The sample of "economic" companies is equal to the sum of corporate groups and companies that do not belong to a group. The dimension of corporate groups is given by the sum of the employees of the individual domestic companies belonging to the group.

Table 4.4

Separation between ownership and control through pyramidal groups in Italian companies [1] (weighted percentage) [2]

Type of controlling head	Control structure			Control-ownership leverage [3]		
	1991	1992	1993	1991	1992	1993
Italy: non-banking private sector	**47.6**	**45.7**	**43.3**	**8.4**	**7.6**	**7.9**
Individuals and partnerships	12.3	12.2	11.2	4.4	4.2	4.0
Limited partnership (SAPA) and limited liability companies (SRL)	22.1	20.2	19.4	11.1	92.2	9.7
Other limited companies	1.9	1.9	1.6	2.6	2.1	2.3
Coalitions [4]	12.3	11.4	11.1	-	-	-
Italy: State and non-banking State companies	**42.0**	**41.7**	**40.5**	**1.7**	**1.7**	**1.9**
Italy: banks	**6.7**	**9.1**	**12.7**	**1.2**	**1.3**	**1.5**
State-owned	5.4	7.8	11.9	1.1	1.3	1.5
Private	1.3	1.3	0.8	1.4	1.4	1.3
Foreign control	2.7	3.4	3.6	1.9	1.9	2.3
Total	**100.0**	**100.0**	**100.0**	**2.7**	**2.5**	**2.7**

Source: Barca, Bianchi, Brioschi, Buzzacchi, Casavola, Filippa, Pagnini (1994).

(1) Companies belonging to pyramidal groups with at least one listed parent company.
(2) Each company is weighted with a composite index of its net worth and of its "integrated employment" (defined as the employment of the company plus a share of the employment of directly and indirectly owned companies equal to the directly or indirectly owned shares).
(3) Ratio between "capital" under control and "capital" owned by agents who exert control.
(4) Coalitions of different owners: since members of the coalition are not identified, shares owned by coalitions and control-ownership leverage cannot be identified.

Table 4.5

Main shareholders of two major Italian groups: 1947 and 1993 [1]

Fiat Group		Falck Group	
Shareholders	Shares	Shareholders	Shares
FIAT SPA (1947)		**A.F.L. FALCK (1947)**	
Agnelli family	*70.2*	*Falck family*	*73.1*
persons (37)	*10.5*	*persons (40)*	*11.8*
Vatican	*0.4*	*Vatican*	*0.7*
banks (10)	*2.8*	*non-banking firms (3)*	*14.4*
non-banking firms	*2.5*	*"others"*	*0.0*
"others" (2207)	*13.6*		
FIAT SPA (1993)		**A.F.L. FALCK (1993)**	
Agnelli family	*24.8*	*Falck family (6)*	*32.3*
via IFI* (2)	18.1	*banks*	*4.8*
via IFIL* (3)	1.9	IMI	4.8
via Fimepar (4)	4.8	*non-banking firms*	28.3
banks	*11.0*	Italmobiliare* (Pesenti)	*11.8*
Istituto San Paolo	3.4	Siderca Techint* (Rocca)	5.9
Mediobanca*	3.2	Ilva* (IRI)	4.9
Deutsche Bank*	2.4	Finarvedi* (Arvedi)	4.7
Banco di Roma	2.0	Sofinda* (Danieli)	2.9
non-banking firms	*4.8*	Pirelli & C.*	2.0
Assicurazioni Generali*	2.4	RAS*	1.0
Alcatel*	2.0	*"others"*	*34.6*
"others"	*59.4*		
* Belonging to shareholders' voting and block agreements		* Belonging to shareholders' voting and block agreements	

Source: Barca, Betrucci, Capello and Casavola (1997).

[1] As a percentage of total voting capital, ordinary and preferred. Number of shareholders -when known- in brackets.

Table 4.6

Gross capitalisation of Italian large corporate groups (in value and as percentage of the total capitalisation of the stock exchange)

Gross capitalisation regarding:	End 1980		End 1987		End 1996	
	Value in billion £ it.	% of total	Value in billion £ it.	% of total	Value in billion £ it.	% of total
- largest group	6,445	26.07	29,910	20.39	96,674	25.03
- largest three groups	11,486	46.47	77,139	52.59	200,451	51.90
- largest five groups	14,808	59.91	105,102	71.65	248,213	64.27
- largest ten groups	19,237	77.83	122,096	83.24	296,828	76.86

Source: Zattoni (1999)

Table 4.7

Models of control of medium and large sized Italian companies belonging to a pyramidal group with at least one listed company (1993)

Models of control [1]	According to the model employed in each legal company		According to the model employed in the head of group		
			Numbers of groups	Proportions	
	Unweighted (%)	Weighted [2] (%)		Unweighted (%)	Weighted [2] (%)
Absolute control [3]	14.0	4.4	45	20.0	8.0
Family control [4]	2.4	2.3	47	40.7	22.1
Coalition control [5]:	2.4	4.9	53	18.8	13.4
through syndicate	0.5	3.1	-	-	-
through implicit agreement	3.2	8.0	-	-	-
State ownership	15.2	50.2	13	15.2	53.5
Group control	64.7	32.0	-	-	-
Foreign control	-	-	20	5.3	3.0
Total	100.0	100.0		100.0	100.0
(absolute number)	(4252)	(4252)	178	(4252)	(4252)

Source: Barca, Bianchi, Brioschi, Buzzacchi, Casavola, Filippa, Pagnini (1994).

[1] Companies belonging to pyramidal groups with at least one listed parent company.
[2] Companies are weighted by their employment.
[3] Absolute control is defined as an ownership structure where the controlling owner is an individual who owns the majority of the voting rights.
[4] Family control is defined as an ownership structure where the non-controlling owners belong to the same family as the entrepreneur.
[5] Coalition control is defined as an ownership structure where there is unambiguous evidence of the entrepreneur and the non-controlling owners have related commercial interests and/or being linked through contracts.

Table 4.8

Voting agreements in listed companies (1997)

Companies with voting agreements		Clauses of the voting agreements				
		(1) Restraining	(2) Directors appointments	(3) Consistency of action	(4) Consultation	(5) Vote
Number of companies	70	58	31	18	8	18
Average number of participants	13					
Average proportion of shares covered by agreement	49.1%	82.9%	44.3%	25.7%	11.4%	25.7%
Average holding of the largest shareholder	34.4%					

Source: Esposito (1998).

(1) **Restraining ("Blocco"):** restrictions concerning the transfer of shares covered by the agreement (e.g., prohibition to sell and pre-emption obligations);
(2) **Directors appointments ("Nomina amministratori"):** voting agreements limited to ordinary shareholders' meetings to appoint directors or auditors;
(3) **Consistency of action ("Uniformità di indirizzo"):** agreements providing for the set-up bodies within the voting trust (meeting, executive meeting). They have all been considered important for the purposes of determining the take-over bid threshold, except in cases where there is a controlling shareholder, actual or ex-officio;
(4) **Consultation ("Consultazione"):** same as consistency but "weaker", since there are no bodies established within the voting trust;
(5) **Vote ("Voto"):** same as consistency but "stronger" in that participants are obliged, in the shareholders' meeting, to conform to the decisions taken by the executive committee, even though they were not adopted unanimously.

Table 4.9

Ownership concentration in Italy compared to that in the main industrial countries: distribution according to the shares held by the main shareholder

Largest owner's share		Main shareholder in the individual companies							Groups' main shareholder
		Listed companies	500 large non-financial companies		400 large non-financial companies		470 large manufacturing companies		Corporate groups
		Italy	Italy	France	Italy	Germany	Italy	UK	Italy
From:	to:								
0	5	0.0	1.4	2.0	1.5		1.3	8.7	0.0
5	10	0.0	0.0		0.0		0.0	30.6	0.8
10	15	0.0	0.0		0.0	12.0	0.0	26.6	0.0
15	20	0.0	0.0	42.0	0.0		0.0		2.5
20	25	0.5	0.0		0.0		0.0		1.6
25	30	1.4	0.0		0.0		0.0	28.7	1.6
30	50	9.5	2.4		3.1	23.0	1.8		27.9
> 50		89.1	96.0	55.0	95.0	66.0	96.9	5.3	65.6
Total		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Barca, Bianchi, Brioschi, Buzzacchi, Casavola, Filippa, Pagnini (1994).

Table 4.10

Ownership concentration in Italy compared to that in the main industrial countries: shareholdings of the largest five shareholders

Statistics	Five largest shareholders in the individual companies									Groups' five largest shareholders
	Listed companies	400 large non-financial companies		85 large non-financial companies		511 large companies		734 large non-financial companies		Corporate groups
	Italy	Italy	Germany	Italy	UK	Italy	US	Italy	Japan	Italy
Mean	69.3	85.6	40.1	83.4	20.9	82.4	24.8	87.0	33.1	62.2
Median	71.5	99.9	33.1	90.0	15.1	90.0	-	99.9	29.7	60.6
Standard deviation	16.1	20.6	15.2	18.8	16.0	20.9	15.8	19.7	13.8	23.2
Min. share	18.6	0.0	10.5	37.2	5.0	0.0	1.3	0.0	10.9	8.7
Max. share	96.7	100.0	95.0	100.0	87.7	100.0	87.4	100.0	85.0	100.0

Source: Barca, Bianchi, Brioschi, Buzzacchi, Casavola, Filippa, Pagnini (1994).

Table 4.11

Average ownership by type of investor (1992) [1]

Size classes (employees)	Individual	Foreign company	State-owned company	Holding company	Other non financial company	Financial company
50 - 99	62.86	5.30	1.99	13.65	13.64	0.00
100 - 199	37.71	7.69	6.33	28.01	18.64	0.20
200 - 499	25.12	14.13	6.84	33.62	17.52	0.53
500 - 999	14.37	20.13	15.59	34.04	12.27	0.91
1000 -	6.10	22.98	14.55	42.63	8.16	0.58
Total	48.03	8.05	4.59	21.57	15.33	0.17

Source: Barca, Bianchi, Brioschi, Buzzacchi, Casavola, Filippa, Pagnini (1994).

[1] The values are weighted in order to take into account the different coverage of the sample by size, sector and geographical area. Row sums do not add up to 100% because in the survey only information regarding the 10 largest shareholders was asked.

Table 4.12

Net sources of finance (1983-93): Italy, Germany, Japan, UK and US

Net sources of finance	Italy	Germany*	Japan	UK	US
Internal finance	83.7	84.7	69.2	83.0	105.2
Bank loans	20.9	9.8	25.1	16.1	5.1
Bonds	-6.4	-2.4	5.5	7.3	18.6
Equity	4.7	0.3	3.6	-4.8	-15.6
Trade credit	-6.5	-0.6	-2.6	-0.4	-1.9
Capital transfers	-	8.0	-	0.1	-
Other	3.6	-4.3	-0.8	3.0	-1.8
Statistical adj.	-	3.9	-	-4.2	-9.6

Source: Data for Italy supplied by Cobham, Cosci and Mattesini (1997), data for Germany, Japan, UK and US supplied by Corbett and Jenkinson (1997).

* Data for Germany are over the period 1983-92.

5. The UK financial system

The differences in finance and governance between the (relationship-based) Continental European countries and the (market-based) United Kingdom can be imputed to major differences both in the historical evolution and in the legal environments of the respective financial systems.

The British system of industrial finance developed in the first half of the 19th century during the Industrial Revolution. Several of its initial traits proved long-lasting: minimal regulation, strong reliance on retained earnings for the finance of capital accumulation, arm's-length borrower-lender relationships based on short-term loans and tradeable notes.

The separation between banks and industrial firms, which distinguishes the present financial system in the UK, can be traced back to its early industrialisation period. When the process of industrialisation started, Britain was a very successful mercantilist and trading nation. The wealth accumulated in such activities was concentrated in the hands of rather few individuals, essentially merchants and bankers. Traditionally, the latter were not involved in commerce, and their role was limited to the provision of short-term funds to the former. The subsequent industrialisation period was therefore characterised by large availability of internal finance and limited need for external funds that favoured a relatively minor involvement of the banking and financial system in the financing of industry (which mainly took place in the form of short-term finance). This relationship between banks and firms has not changed through time, owing also to prudential rules that have constrained the mixture of banking and commerce. Actually, a distinctive feature of banking in the UK today is that there are few explicit legal restrictions on the types of business a bank can undertake. As a result, the UK is sometimes listed as providing very wide banking powers, among which is the ability to hold the equities of commercial firms and a commercial firm's ability to hold bank equities. Nevertheless, informal regulation from the Bank of England appears to have been sufficiently

strict to have effectively precluded significant equity investments by deposit banks[26]. Prowse (1994) reports that the percentage of outstanding shares owned in 1990 by British banks is 4.3, against zero, 18.9 and 10 in the US, Japan and Germany, respectively.

The characteristics of the legal and regulatory environment are also important to understand the relative importance of the securities markets. The UK has traditionally been the European State with the most extensive investor protection and most stringent rules on the disclosure of equity stakes. The first legislation on disclosure dates back to 1945, when the Cohen Committee recommended that the beneficial ownership of shares should be disclosed. UK Company Law imposes a disclosure threshold of 3% for stakes rather than 10% as laid down in the European Directive on ownership transparency[27]. The City Code on Takeovers and Mergers, introduced in 1968, provides some protection to the minority shareholders of listed companies subject to takeovers. As La Porta *et al.* (1997) state, "in the area of protection against expropriation by insiders, common law countries protect both shareholders and creditors the most".

In the UK, as in the other advanced countries, retained earnings have formed the financial basis of enterprise growth for going concerns. In spite of the presence of an extensive market for securities, the role played by capital markets in the financing of UK industrial companies is debatable. By the middle of the 19th century, firms in railroads and utilities were able to raise large sums of external debt finance through British merchant banks. However, industrial

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[26] Charkham (1994, pp. 299-300) argues that "UK banks do not take equity stakes to cement the relationship with a customer or to secure influence. Historically the acquisition of such stakes has often been accidental [...]. The general UK stance is that such interdependence is potentially dangerous. The banks consider equity stakes a poor use of funds and unnecessary for a relationship with clients: besides, there could be a conflict of interest between their role as lender and their role as shareholder".

[27] The European Directive on ownership transparency is officially known as "Council Directive 88/627/EEC on the information to be published when a major holding in a listed company is acquired or disposed of".

ventures raised much less. Industrial securities were regarded as speculative, and promoters and bankers were not equipped to appraise the idiosyncratic risks involved in screening firms and monitoring their management. The developing stock market specialised in floating public securities and overseas investment, but stayed away from giving financial support to new industrial firms. As Cottrell (1980) and Kennedy (1987) have argued, the British capital market did not encourage taking a long-run view of enterprise development potential. Between 1882 and 1913, innovative industries like chemistry, engineering and electricity accounted for only 21% of domestic industrial and transport new security issues, while breweries and railways accounted for 55%. Financing patterns of non-financial corporations in the last decades confirm the marginal contribution of securities markets to funding investment. Browne (1994) reports that the average net contribution of shares to funding physical investment has been negative both in the 1970s (-4.9% and –1.6% in the first and in the second half of the decade, respectively) and the 1980s (-6.7% and –5.5% in the first and in the second half, respectively). On the other hand, retained earnings were the dominant source of finance, with an average net contribution of 106% over the 1970s and the 1980s.

The stock market has played, however, an important role in the development of the modern UK corporate organisation -characterised by the separation between ownership and control- and of the instruments necessary to reduce the agency problems linked to it. Owner control of British firms, even in relatively capital-intensive sectors such as steel, persisted until the end of World War II[28]. It was only in the 1940s and 1950s that many UK firms which

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[28] Payne (1978, pp.212-213) notes that "such a large proportion (58 percent) of the 82 largest industrial companies... were characterised in 1935 by a dominant ownership interest, and so few (9 percent) by no discernible dominance of ownership". Hannah (1980, p.53) corroborates this conclusion, noting that "the separation of ownership and control, for instance, had not progressed far enough to displace founding or family directors from company boards; 110 of the 200 largest firms in 1919, or 55 percent, had family board members, as did 140, or 70 percent, in 1930, and 119, or 59.5 percent, in 1948".

had remained proprietary took advantage of a growing demand by portfolio investors for corporate equities and liquidated their holdings by floating ordinary stock to the public. During the second half of the 1950s, a merger and acquisition movement resulted in a marked concentration of British industry. The 100 largest companies increased their control of assets of all companies quoted on the London Stock Exchange from 56% in 1954 to 66% in 1964 and 73% in 1968 (Thomas, 1978). In this merger and acquisition wave, the "hostile takeover" appeared for the first time on a significant scale amongst any of the advanced economies. The attempt by managers to make their companies less attractive targets through reductions in liquid assets was one cause of an increase in the corporate dividend pay-out ratio from 30% in 1958-59 to 37% in 1961-62 (Thomas, 1978).

The deregulated environment of the 1980s further advanced the power of market control and eroded financial commitment. Dividends and stock prices soared, as did the salaries of top managers of industrial enterprises who co-operated with the forces of market control. In 1987 the market capitalisation of quoted companies was 86% of the value of GDP in Britain but only 16% in Germany (Charkham, 1994). By the 1980s and early 1990s pay-out ratios of UK non-financial companies exceeded the high pay-out ratios of American corporations by between 5 and 20% (Economist, 1994, no. 31, p.109).

The UK differs today from the other Continental European countries not only in terms of a higher proportion of firms that are listed on the stock exchange, but also in terms of ownership concentration and the main shareholder classes. Whereas a large majority of listed companies from Continental European countries have a dominating main shareholder or investment group, most UK listed firms have diffuse voting rights. The proportion of votes controlled by the largest investor varies between 34% in Spain and 52% in Austria, as opposed to just 10% in the UK. Therefore, concentration of control appears to be significantly greater on the Continent than in the UK (Figure 5.1).

The picture looks very different when one goes down to the second largest shareholdings The median size is zero in most countries, and the mean size below 10% in all countries (Figure 5.2). The average size of the third or fourth voting blocks is negligible from a control perspective. Control is therefore concentrated on the Continent not only because of the existence of large blockholders but also because of the absence of other voting blocks. In contrast, the second and third voting blocks are not insignificant in the UK. In fact, they are not much smaller than the largest voting block (Figure 5.3). Even beyond the tenth largest shareholders, the mean voting block is greater than 3%. No individual investor therefore exerts dominant control; instead it can only come from a coalition of investors.

Another striking feature of the UK financial system is that institutional investors are the most important category of shareholders. From 1963 to 1992, ownership of UK equities by institutional shareholders soared from around 30% to 60% (Table 5.1). This compares with approximately 20% of institutional ownership in Germany (Franks and Mayer, 1995). The growth in institutional ownership was attributable to (i) increased demand for pension provision and long term savings by individuals, and the increased supply of equity as companies went public; and (ii) the decline in private share ownership which was put down to two main factors. First the oil crisis in 1974, which resulted in a fall in stock market values and a rush to sell equity holdings. Second the UK tax system, which discouraged direct private ownership during the 1960s and 70s mainly as a result of the imposition of Capital Gains Tax (CGT) in 1965. Combined with very high tax rates in late 1970s, this led to increased demand for tax-favoured institutional products and services.

Although financial institutions own a large share of the outstanding corporate equity in the aggregate, they are not major players from a principal-agent perspective. Indeed, they have

strong incentives from portfolio regulations[29] and insider trading laws to keep their portfolios liquid by trading very small holdings in a wide variety of companies and to refrain from active involvement in corporate strategy[30]. The passive stance adopted by institutions, along with some of the characteristics of the British system of corporate governance, such as the proxy voting and the one-tier board structure[31], provides an explanation for the significant discretionary powers of directors of UK companies.

With limited direct investor involvement and with few impediments to transfers of ownership and control, managerial failure in the UK would be expected to be disciplined by the market for corporate control. Indeed, along with the US, the UK is one of the few countries with an active market for corporate control. On average, every year 4% of listed UK companies are taken over (Franks, Mayer and Ronneboog, 1998). The disciplinary role of takeovers in the UK is confirmed in the empirical studies by Nuttall (1999) and Dickerson *et al.* (1998), which found evidence of under-performance for hostile takeover targets[32].

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[29] Mutual funds (unit trusts) are subject to regulations under the Financial Service Act of 1986 regarding their power to take large stakes in firms for corporate control purposes. At the same time, there is a limit, usually of 5%, on the percentage of outstanding shares that may be held by a pension fund or insurance company.

[30] Plender (1997) reports that institutions do not frequently exercise their voting rights: only about 28% of pension funds cast their vote on a regular basis, 21% never vote and 32% vote only on extraordinary items.

[31] Contrary to German public companies, UK public companies do not have a two-tier board structure. Both executive and non-executive (outside) directors sit on the same board and the chairman of the board can be an executive director. Moreover, Franks, Mayer and Renneboog (1998) report that executive directors outnumber non-executive directors in listed industrial companies (60% versus 40%).

[32] However, a recent study by Franks and Mayer (1996) questions the disciplinary role of takeovers in the UK. From a sample of contested and friendly bids in the UK in 1985-86, Franks and Mayer found no statistical difference in either the share-price performance or the dividend performance of targets of hostile bids compared to targets of friendly bids over the two years prior to the bid. In addition, it was found that only 12% of targets of successful hostile bids had reduced or omitted their dividends in the two years prior to the bid, compared to a figure of 41% for a random sample of poorly performing firms.

Table 5.1

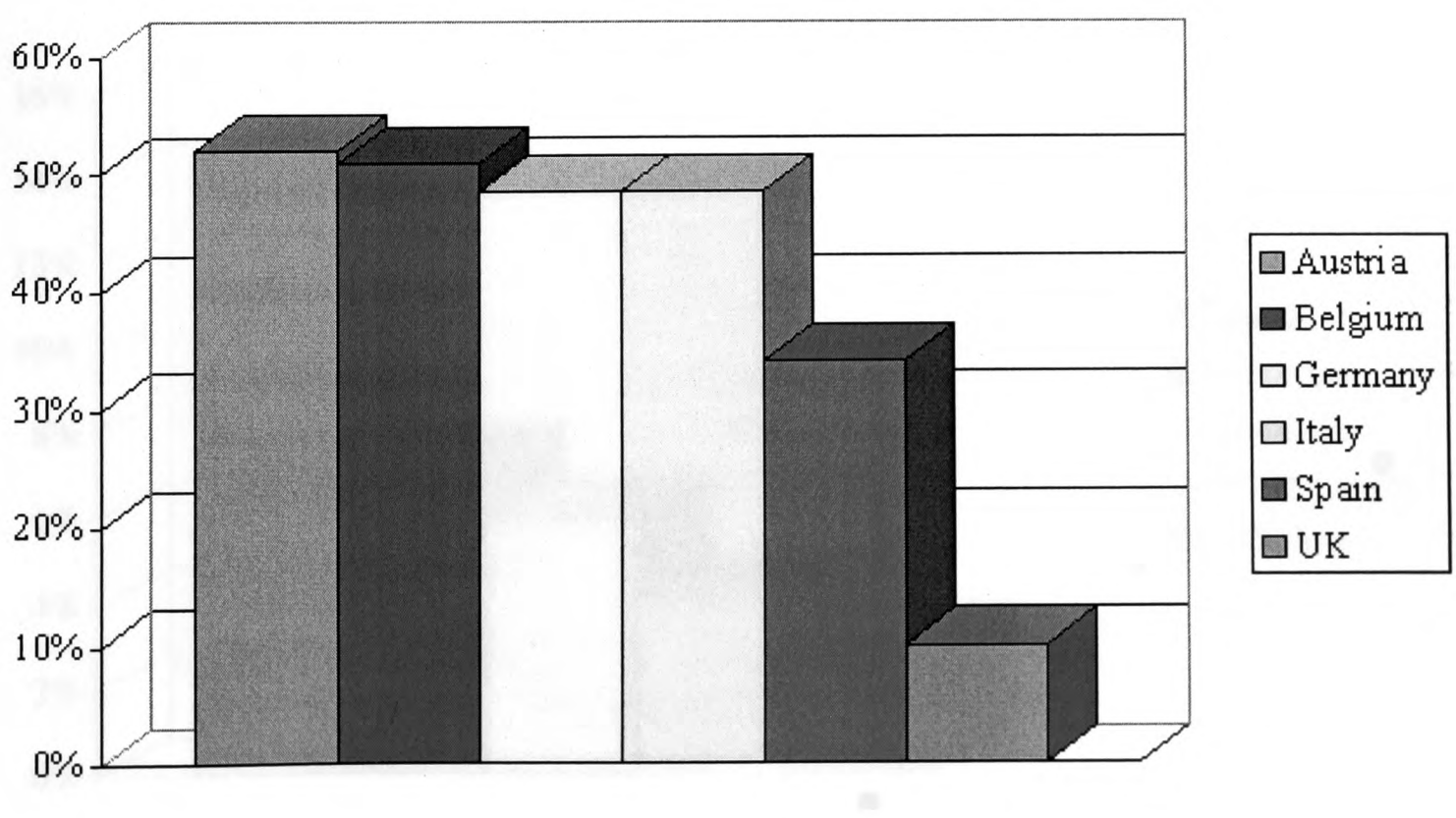
Beneficial ownership of listed UK equities

Sector of beneficial owner	Beneficial ownership of listed UK equities (%)						
	1963	1969	1975	1981	1991	1992	1994
Individuals	54.0	47.4	37.5	28.2	19.9	20.4	20.3
Other personal sector (mainly charities)	2.1	2.1	2.3	2.2	2.4	1.8	1.3
Public sector	1.5	2.6	3.6	3.0	1.3	1.8	0.8
Industrial and commercial companies	5.1	5.4	3.0	5.1	3.3	1.8	1.1
Overseas	7.0	6.6	5.6	3.6	12.8	13.1	16.3
Banks	1.4	1.7	0.7	0.3	0.2	0.5	0.4
Insurance companies	10.0	12.2	15.9	20.5	20.8	19.5	21.9
Pension funds	6.4	9.0	16.8	26.7	31.3	32.4	27.8
Unit trusts	1.3	2.9	4.1	3.6	5.7	6.2	6.8
Other financial institutions (mainly investment trusts)	11.3	10.1	10.5	6.8	2.3	2.5	3.3
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Stapledon (1996)

Figure 5.1

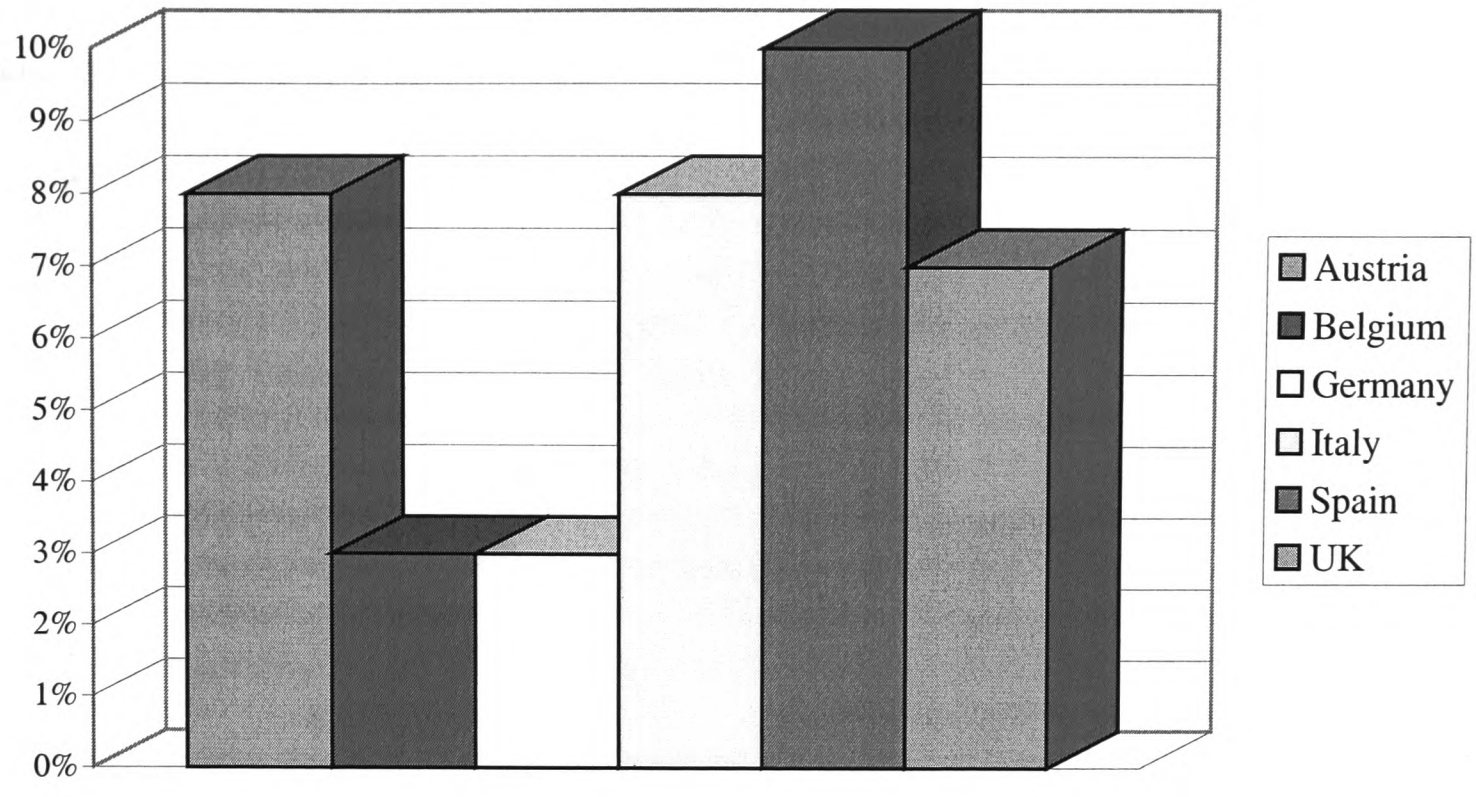
Percentage of Votes Cast by Largest Voting Block (Median)



Source: ECGN Project, "Who Controls Corporate Europe?".

Figure 5.2

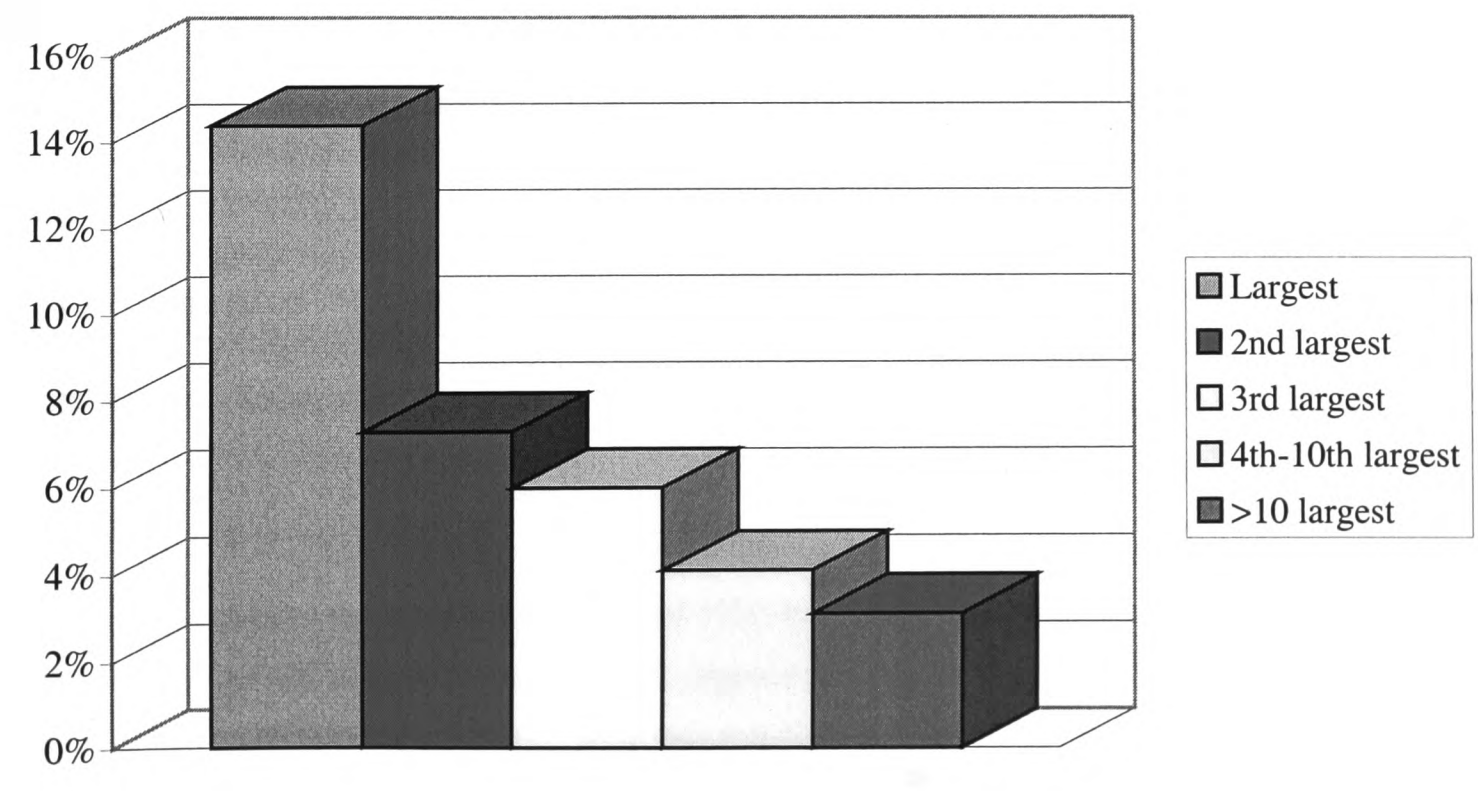
Percentage of Votes Cast by Second Largest Voting Block (Mean)



Source: ECGN Project, "Who Controls Corporate Europe?".

Figure 5.3

Size of voting blocks in the UK (Mean)



Source: Goergen and Renneboog (1998)

6. The US financial system

The US financial system also presents highly developed capital markets, low concentration of ownership, and arm's-length, short-term relations between financial intermediaries and industry.

Banking law and regulation have customarily restricted the non-banking activities of banks and the banking activities of non-banking firms. While such separation may be surprising in a free market system that, in general, permits private firms to engage in any lawful business, it is understandable in a historical and institutional context.

At the beginning of the 20th century US banks played an important role in collecting funds to finance emerging firms with long-term loans and equity and performed an active role in their corporate governance. Partners of merchant banks sat on company boards and guaranteed through their reputation a good management of the companies to the dispersed shareholders and creditors, unable to perform such monitoring. The concentration of financial and industrial power induced, however, a strong political opposition. Between 1927 and 1934, US financial regulation was completely reshaped, opening the way for impersonal market-based finance. First, the MacFadden Act (1927) *de facto* stopped the trend towards a wider use of branch banking. Second, the Glass-Steagall Act (1933) mandated a full separation between commercial banking and investment banking[33] (banks could either take deposits and make loans or engage in the origination and distribution of corporate securities) and introduced federal deposit insurance, thus favouring small banks and, indirectly, the fragmentation of the

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[33] Passed in the wake of the stock market crash of 1929, the failure of thousands of banks during the same years, and the slide of the US economy into the worst depression of its history, the Act was motivated by Congress' perceptions that some commercial banks' securities activities had helped fuel the stock market speculation of the late 1920s prior to the crash; that some banks had not honoured their fiduciary responsibilities to their customers because of improper securities activities; and that the failures of some banks in the early 1930s were related to their securities activities.

banking sector. Third, the Securities Exchange Act (SEA) of 1934 instituted the Securities and Exchange Commission to regulate the securities markets and their intermediaries, thus encouraging the use of equity and bond markets.

Today, prohibitions on commercial bank underwriting of debt and affiliation with companies dealing in securities are breaking down. However, the prohibition on bank ownership of equity remains stable. Bank trust departments are commercial banks' only direct link to non-default decision rights over non-banks. However, diversification requirements limit the amount of control that commercial banks can exercise over non-banks through their trust departments. Bank trust funds may not invest more than 10% of their assets in the stock of any single corporation, and there are often other trustee laws that encourage further fragmentation of trust holdings.

Bank holding companies are commercial banks' only indirect link to non-default decision rights over non-banks. Bank holding companies emerged as a response to the restrictions on branching and interstate banks. In the 1950s US banks began to evade branching restrictions by founding holding companies and chaining banks together as separately incorporated subsidiaries. With respect to equity holdings, bank holding companies are not as stringently regulated as their bank subsidiaries. Bank holding companies may own stock. The Bank Holding Act of 1956[34], however, restricts a holding company's activities to those closely related to banking. A bank holding company cannot own more than 5% of the voting stock of any non-banking company and cannot otherwise control an industrial firm. Bank holding companies can own more than 5% (up to 25%), but only if the additional stock is non-voting.

The legislation that resulted from the Great Depression ended relationship-based finance and laid the framework for the modern US financial sector. Since US commercial banks were

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[34] The Act was motivated by Congress' desire both to prevent the spread of interstate operations by holding companies and the expansion of bank holding companies into "non-banking" activities through affiliates.

precluded from both direct investments in the equity capital of non-financial businesses and the underwriting, distribution and market-making of their securities, such financing took place via direct sale of securities to the public by investment banks acting as underwriters. The allocation of capital became "market-oriented". At the same time, the strong protection accorded to equity-holders, obtained through strong legal rules, rigorous legal enforcement and extensive disclosure of corporate information, fostered the rapid democratisation of the capital markets, and resulted in more direct investment by individuals and, recently, indirect individual participation through pension funds and mutual funds.

Non-banking financial institutions have helped fashion for the US the most diverse and rich set of corporate financial markets in the world. Despite the fact that institutional investors have enough assets to influence large corporations, portfolio rules raise the cost of their systematically taking control positions[35]. According to the Investment Company Act of 1940 mutual funds that own more than 10% of the stock of any company are subject to regulatory and tax restrictions. The mutual fund that uses its portfolio to control companies would be

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[35] Coffee (1991) argues that the primary explanation for institutional passivity is not over-regulation, but the insufficiency of existing incentives to motivate institutional money managers to monitor. Indeed, the question of who holds institutional managers responsible has been largely ignored. The problem of agency costs is particularly complicated in the case of institutional investors. First, the usual mechanisms of corporate accountability (such as takeovers and managerial compensation devices) are either unavailable or largely compromised at the institutional level. Second, the problem of collective action is potentially more severe at the institutional investor level than at the corporate level. Not only are the beneficiaries of a pension fund as dispersed as the shareholders in large corporations, but there is no analogue to the large shareholder in the public corporation who may be willing to undertake monitoring and similar expenditures that benefit other shareholders. In other words, the free-rider problem associated with shareholder monitoring is much more severe for institutional investors compared to public corporations. On the basis of this evidence, Coffee (1991) suggests that other factors like conflicts of interest, a preference for liquidity, and collective action deserve greater weight in any theory of institutional behaviour. In particular, there exists a trade-off between liquidity and control. Investors that want liquidity may hesitate to accept control.

taxed unfavourably on its entire portfolio, since the tax code allows only diversified funds[36] to pass income through to shareholders, untaxed to the conduit mutual fund. Pension funds' investments are governed by the Employee Retirement Income Securities Act of 1974 (ERISA). ERISA requires all pension funds to be diversified, allowing little scope to acquire an influential position in a company. It also prohibits pension plans from taking a stake of more than 10% in the stock of the plan's sponsor. State law regulates US insurance companies' stock investments. Under New York insurance law, which currently applies to almost 60% of total life insurance industry assets, a life insurer may invest no more than 20% of its assets in the equity of one company. Property and casualty insurers are prohibited outright from owing a non-insurer. Other states have similar rules; California, Illinois, and Texas prohibit life insurers from investing more than 10% of their capital and surplus in any company. Forty states limit insurer investment in common stocks to between 2% and 25% of assets. There are also impediments to non-financial firms taking large stakes in firms. Dividend tax rules discourage inter-corporate holdings of stocks. Besides, US antitrust laws have historically been hostile to the inter-corporate ties that would be implied by large inter-corporate holdings (Prowse, 1994).

In addition to regulations specific to particular institutions, US securities laws discourage concentrated active shareholding by any one investor. First, Sections 13 and 14 of the SEA require that when a 5% shareholder group is formed a filing must be made outlining the group's plans and revealing its ownership and source of financing. Second, under Section 20 any stockholder who exercises control over a firm through either a majority or a minority shareholding may be liable for the acts of the firm. Third, beneficial owners holding blocks

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[36] The fund must have at least half of its investments in companies constituting no more than 5% of the portfolio *and* constituting no more than 10% of the *portfolio company's* outstanding stock; for the other half, no more than 25% of the fund's assets can go into a single company's stock (Roe, 1990).

that are larger than 10% are classed as "insiders", even when they claim to have no insider information. The ability of 10%+ insiders to trade in the shares of a company is seriously restricted because their trades are continuously monitored by the SEC. Fourth, all creditors are discouraged from taking an equity position in a company, since their loans are potentially vulnerable to subordination should they be seen to exert control over the firm.

Owing to the legal restrictions on concentrated ownership, it is not surprising that firms are relatively widely held in the US. Only 3.6% of all domestic corporations included in the S&P 500, S&P MidCap 400 and S&P SmallCap 600 have a majority shareholder that controls at least 50% of the voting rights (Dietl, 1998). The OECD (1997) estimates that in the US the largest five shareholders hold on average 20-25% of the outstanding shares. Becht (1997) analyses 5%+ beneficial ownership of 6559 US listed companies originating from the SEC filings of Form 13D and 13G[37] (see Figure 6.1). The mean and the median shareholdings of the largest block are, respectively, 22.8% and 15.1%. For the second largest block the mean is 11.3% and the median 9%. The mean of C3 (the sum of the shares outstanding for the three largest shareholders) is 32.3%. The mean of C5 is 39.8%, and of C20 is 43.6%. However, there is a small proportion of US companies with concentrated ownership, e.g. 10.7% of all the companies considered has a "float" (percentage of outstanding shares that are not in the hands of a 5% beneficial owner) of less than 10%. Figure 6.2 summarises the identities of shareholders of listed corporations. The vast majority of shares is held by individuals (51.4%) and financial institutions[38] (44.4%).

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[37] These figures cannot be compared directly with the figures for the European companies reported in Figures 5.1 and 5.2. Since Becht (1997) uses only information on 5%+ beneficial ownership, his figures do not take into account small (i.e., below 5%) shareholdings, thus underestimating the degree of ownership dispersion in the US.

[38] Institutional agents usually hold highly diversified portfolios with small stakes in many companies. For example, in 1990 the California Public Employees Retirement System (CalPERS) reportedly held stock in more than 2,000 US companies; its single largest holding was 0.71% of a company equity.

The ownership structure partly explains the existence of an active market for corporate control. The wider corporations are held, the less mechanisms shareholders can use effectively to influence managerial decision-making in a direct manner. In the US, direct mechanisms of influence can be utilised even less effectively because of the non-professionalism associated with ownership by individuals. Prowse (1994) reports that the average annual volume of completed domestic takeovers as a percentage of total market capitalisation over the period 1985-1989 equals 41.1% in the US (against 18.7%, 3.1% and 2.3% in the UK, Japan, and Germany, respectively). However, of all the attempted transactions in the period 1985-1989, only 17.8% could be termed hostile in the US (against 37.1% in the UK and 9.6% for the rest of Europe).

The consequences of increased institutional equity ownership on both the liquidity of the US stock markets and the performance of US corporations has also been a matter of intense debate. Critics like Lowenstein (1988) assert that the rapid institutionalisation of the stock market has adversely affected the stock market as well as corporations. Since institutional investors are subject to an incentive system that rewards short-term returns, this results in excessive and myopic trading. On the other hand, Jones *et al.* (1990) argue that the dramatic increase in trading volume that has accompanied the growth of institutional ownership has in fact enhanced stock market liquidity, and thereby lowered the required return on equity and therefore the cost of capital. In general, the empirical evidence[39] confirms that there is a fundamental conflict between liquidity and control as the primary investment objective of institutional investors. In the US liquidity has proved to be the dominant investment objective, as "exit" rather than "voice" has emerged to be the preferred option for institutional investors with regard to corporate governance issues.

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[39] See Samuel (1996) for instance.

Another salient feature of the US financial system is that historically internal funds have been the main source of corporate financing. During the period 1970-85, internal funds were 67% of the gross sources, and 86% of the net sources, of funds for non-financial corporations. For the same period, new equity issues represented just 0.8% of the gross sources and 1.1% of the net sources of funds for non-financial corporations (Hall, 1994). In recent years the importance of the corporate bond market has grown significantly. The net contribution of bonds to funding physical investment soared from 8.9% in the first half of the 1980s to 20.4% in the second half of the decade (Browne, 1994).

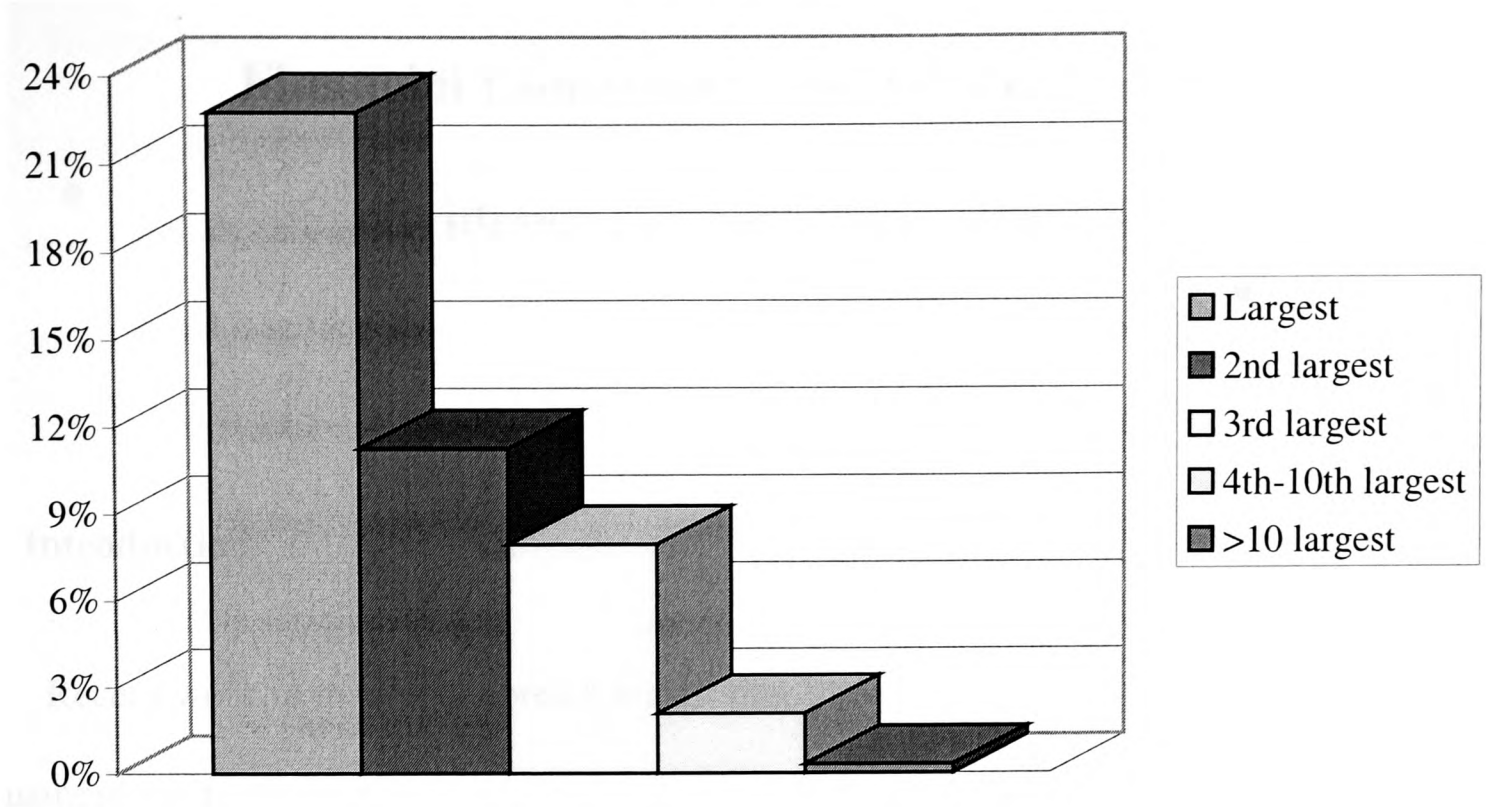
Overall, the US financial system, with quite unrestricted markets for capital, labour, goods and services, ensures rapid adjustment to changing circumstances, and extensive funding of emerging industries[40]. These benefits, however, come at a price. The responsiveness and flexibility of the system are achieved at the expense of failing to build up long-term and stable economic relationships. This has led some to observe that managers in the US are myopic, focusing on boosting the next quarterly earnings figures while under-investing in long-term assets such as research and development and training (e.g. Porter, 1992; Prodham, 1993). However, according to others, there is no concrete evidence to support these claims (e.g. Shleifer and Vishny, 1997; Rajan and Zingales, 1999).

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[40] As Porter (p.73, 1992) states, the American financial system "is at its best with companies in obviously high-technology or emerging industries, especially those with rapid growth and high perceived upside potential. [...] In these cases, investors recognise that current earnings are irrelevant and seek other value proxies such as patents, new product announcements, research pipelines, and growth of new service locations that are more supportive of investment".

Figure 6.1

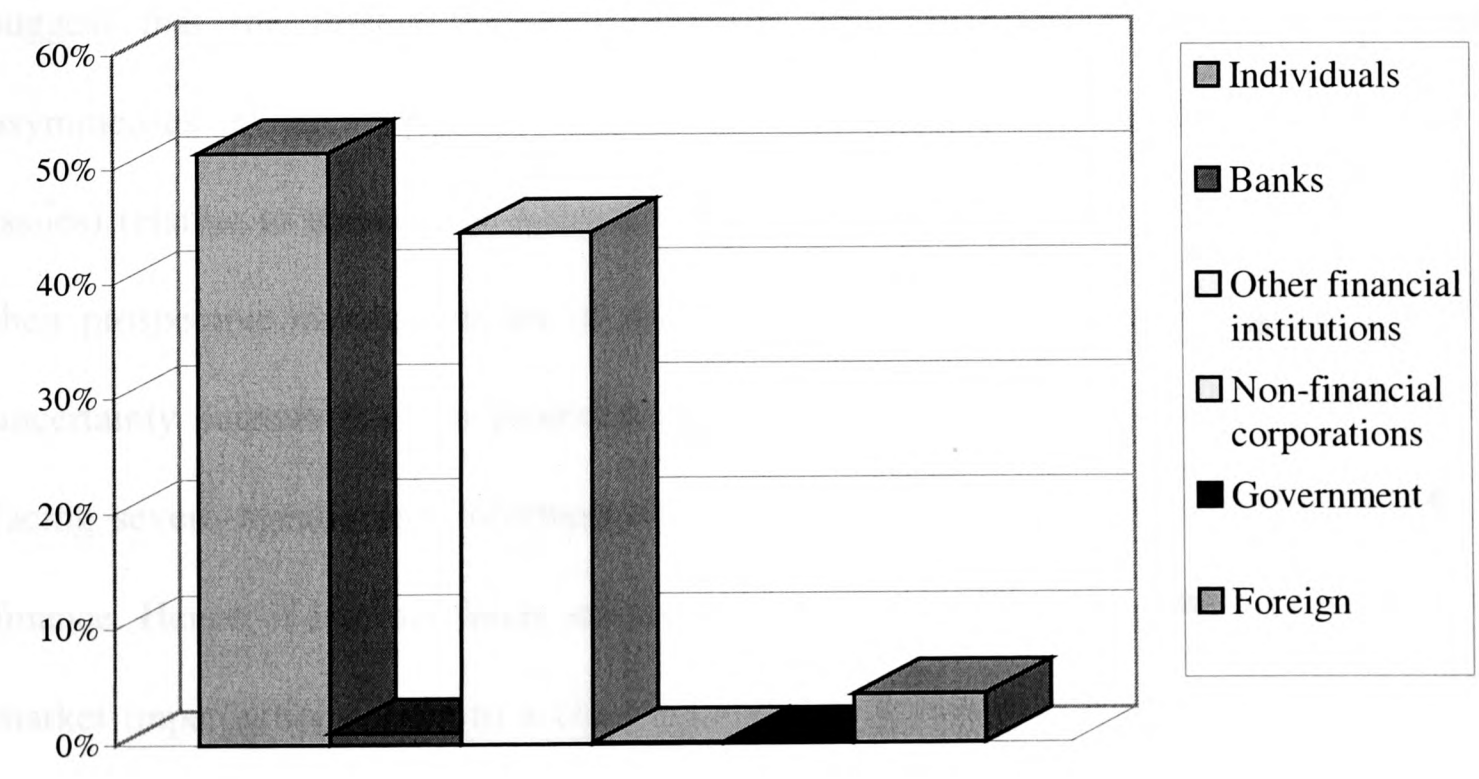
Size of voting blocks in the US (mean)



Source: Becht (1997)

Figure 6.2

Ownership of common stock in the US (1994)



Source: OECD (1997)

Chapter 4

Financial Constraints and Fixed Investment: Evidence from Italian Panel Data

1. Introduction

Recent work in macroeconomics argues that imperfections in capital markets may magnify business cycle fluctuations by propagating relatively modest shocks (see Bernanke *et al.*, 1998). Evidence for such a mechanism (also known as the "financial accelerator") consists largely of firm-level studies showing that the availability of internal funds may have an important impact on investment decisions. Departing from the traditional neoclassical investment model under full information and perfect capital markets, most of these studies suggest that the linkage between liquidity and investment results from informational asymmetries in capital markets that increase the cost of external finance (debt and stock issues) relative to the cost of internal finance (retained earnings). As a consequence, unless their prospective investments are of sufficiently high quality to compensate lenders for their uncertainty surrounding the project's prospective payoff, the investment projects of firms facing severe agency and information costs will be limited by the availability of internal finance. Hence, if internal funds are lower than desired investment, the existence of capital-market imperfections leads to a close relationship between internal finance and investment: holding constant expected future profitability and the firm's investment opportunities, positive shocks to internal net worth will increase investment spending, both because firms are in a

position to draw upon relatively inexpensive internal funds, and because additional collateral reduces costs of external financing.

To test for the importance of financial constraints on firms' investment decisions and to investigate the sensitivity of the empirical findings to the choice of alternative specifications, in this chapter we use two different econometric models of investment, described in Chapter 2, Section 3. The first model is an error correction specification augmented with an additional cash flow term to investigate the impact of liquidity constraints. Since with this type of model a significant cash flow effect may reflect information about expected future profitability rather than financial constraints, we also estimate an Euler equation specification based on a structural relation between investment rates in successive periods, derived from dynamic optimisation in the presence of symmetric, quadratic costs of adjustment. Under these assumptions the Euler equation model should control for all expectational influences on the investment decision, so that evidence of mis-specification associated with the role of financial variables is perhaps less easily explained away as merely capturing investment opportunities and expectations of future profitability. In both cases, we also investigate how the impact of cash flow and profits variables differs across sub-samples of firms, according to firm size and corporate structure.

A major problem in the estimation of dynamic models using company panel data is that the lagged values of the dependent variable are correlated with unobserved company-specific effects. To deal with this problem, in the stochastic specification we allow for firm-specific effects in the error term and for the endogeneity of regressors. As discussed in Chapter 2, Section 4, this is commonly achieved by taking first differences of the original model and using a Generalised Method of Moments (GMM) estimator due to Hansen (1982) and White (1982). However, the first-differenced GMM estimator has been found to have poor finite sample properties (bias and imprecision) when the lagged levels of the series are only weakly

correlated with subsequent first differences, so that the instruments available for the first-differenced equations are weak. For this reason, we also use a relatively novel estimator, proposed by Arellano and Bover (1995), that is expected to improve the properties of the standard first-differenced GMM estimator. This estimator, known as a system GMM estimator, uses lagged differences of the regressors as instruments for the equations in levels, in addition to lagged levels of the regressors as instruments for the equations in first differences.

The empirical analysis is based on a panel of 710 individual Italian firms, obtained by combining information from two different sources. The first source is the Mediocredito Centrale survey of manufacturing firms, covering the period 1992-1994. The second source is the Centrale dei Bilanci database consisting of financial statements of 1309 firms over the period 1986 to 1996. The availability of accounting and qualitative data on individual companies makes it possible to take into explicit account heterogeneity across firms. Firms that are more likely to be able to communicate private information credibly to the capital market should be less affected by problems of asymmetric information. This implies that if capital market and information imperfections are important, we should find stronger evidence of financial constraints on investment for firms that are in a weak information position. To test this hypothesis, both the error correction model and the Euler equations are estimated on sub-samples separated according to characteristics which should be related to the firms' information position and/or ability to increase the supply of low cost internal finance. The characteristics we use are firm size and whether the firm is independent or controlled by a larger group.

This chapter is organised as follows. Section 2 contains a brief discussion of previous empirical evidence related to the influence of capital market imperfections on Italian firms'

investment. Section 3 outlines the sample-selection procedures and describes the data. Section 4 presents the empirical results, and Section 5 concludes.

2. Investment and financial constraints in Italy: a review of previous empirical evidence

The impact of the financial system on Italian firms' investment decisions has been analysed in a number of empirical studies. Cristini (1993) tests for the presence of financial constraints by endogenising the cost of debt in an Euler equation model of investment. The model is tested on a sample of 3076 manufacturing firms located in Lombardia, over the period 1982-1988. All firms are legally structured as limited liability companies and small-medium size, employing no more than 500 employees in 1982 and, on average, 83 employees over the whole period. The Euler equation is estimated for the full sample and for five sub-samples defined according to the firm's size measured in terms of 1982 capital stock. Euler equations are rejected for the full sample and the sub-sample of the smallest firms, whereas they perform better for larger firms. The failure of the empirical Euler equations to represent the accumulation process of the smallest firms, along with a larger positive cash flow coefficient for this group, seems to support the view that such firms suffer greater information costs and face binding financing constraints.

The estimation of an Euler equation model of investment by Rondi, Sembenelli and Zanetti (1992) provides apparently counter-intuitive results. Over the period 1964-1988 the availability of internal finance appears to have been a more important constraint on the investment spending of listed and state-owned companies. This evidence can be interpreted as reflecting manager-related agency problems in state-owned companies, and the need for listed companies to maintain relatively high and steady pay-out ratios. On the other hand, it is also

likely that the small dimension of the database (52 large and medium-sized companies) drives this result.

The response of different types of firms to adverse macroeconomic shocks, including monetary tightening, is analysed by Rondi, Sack, Schiantarelli and Sembenelli (1993). Their work is based on aggregate annual data for two samples of small and large Italian private companies over the period 1968-1991. Empirical results provide evidence on the role played by the financial accelerator in amplifying the negative effects of downturns, particularly for those firms (such as small ones) characterised by more severe information problems and low levels of collateral. The estimation of error correction models for the real stock of inventories and fixed investment, to which the coverage ratio (i.e., the ratio between cash flow and interest payments) is added as a regressor, displays a greater sensitivity of small firms' real choices to financial variables. This is consistent with the view that this type of firm finds it more difficult or more expensive to obtain external finance to smooth out negative shocks.

Galeotti, Schiantarelli, and Jaramillo (1994) study the consequences of imperfect substitutability between internal and external sources of finance for firms' investment decisions using two different panels of individual firms. The first sample is constituted by 3039 mainly small firms taken from the Centrale dei Bilanci database, over the period 1983-1987. The second one is the Ricerche e Studi sample of 43 mainly large companies over the period 1976-1987. A q model of investment is estimated for the quoted companies in the Ricerche e Studi sample. The fact that the cash flow term is found to be insignificant seems to confirm that large, established firms are less likely to face financial constraints. The estimates of an Euler equation model[1] for the Ricerche e Studi sample indicate that firms face agency

[1] In order to allow for the imperfect substitution of alternative sources of finance, agency costs are assumed to depend on the debt and liquid-assets-to-capital ratios. The estimated Euler equation is based on the assumptions of quadratic and external adjustment costs, perfect competition in the output market, and quadratic agency/bankruptcy cost function.

costs of debt which are increasing in the debt-capital ratio and decreasing in the liquid-asset-to-capital ratio. Probably due to the shortness of the time dimension, estimation of an Euler equation for the Centrale dei Bilanci panel proves very difficult. However, the estimation of an unrestricted *ad hoc* investment equation shows that smaller firms are much more sensitive than larger firms to fluctuations in cash flow (whereas variations in debt do not appear to play an important role for either group of firms).

Finally, Schiantarelli and Sembenelli (1995) make use of an unbalanced sample of 1229 companies over the period 1977-1990 to analyse the effect of the forms of ownership on leverage and investment choices by Italian firms. Firms are classified in three categories: members of large national business groups, subsidiaries of foreign firms, and other domestic firms. The average number of employees is 1127. However, the average size of firms that are members of national groups (2603 employees) is much bigger than the average size of subsidiaries of multinationals (1057 employees) and of other domestic companies (577 employees). The results obtained from leverage and investment equations imply that independent firms face greater information costs. Members of national groups and subsidiaries of multinational groups do not display excess sensitivity to cash flow in their investment decisions. Moreover, the estimates of leverage equations provide evidence that agency problems between managers and shareholders are more important for subsidiaries of foreign multinational corporations than for affiliates of large national business groups. This is consistent with the "free cash flow" hypothesis (Jensen, 1986), since controlling coalitions in domestic groups hold a large fraction of shares, while multinational corporations tend to have a more diffuse ownership structure.

3. Data

This section describes the main data set used for the study of the effects of capital market imperfections on Italian firms' investment expenditures. Two sub-sections describe the sample of companies and the variables used in the empirical analysis, and the main characteristics of the Italian industrial and financial system based on information from our sample of Italian companies.

3.1 Sample-selection procedures and data description

Two sources of information are used in the analysis. The first is the survey from Mediocredito Centrale, one of the main aims of the survey being the analysis of Italian firms' capital structure and the influence of financial policy on fixed and R&D investment. The Mediocredito Centrale survey was conducted in 1995 and is based on the response by 4431 manufacturing firms to a questionnaire concerning the period 1992 to 1994. Since the survey was conducted on individual corporations, the Mediocredito Centrale data set includes both "economically" independent companies[2] and companies that are wholly or largely owned subsidiaries of a group. In the survey, firms with more than 10 and less than 500 employees were selected on a sample basis, while firms with more than 500 employees were selected on a census basis.

The second source of information is an unbalanced panel data set on company accounts collected and recorded by Centrale dei Bilanci (Balance Sheet Centre). The Centrale dei Bilanci data are taken from the financial statements of 1309 firms in the period 1986 to 1996, and have been matched with the Mediocredito Centrale data set. After dropping holding

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[2] An individual company is defined as "economically" independent if it is not part of a group, that is, if the company neither controls nor is controlled by another company.

companies, firms with fewer than 50 employees, and firms not legally structured as limited liability companies (S.p.A.), we obtained an initial sample of 855 manufacturing firms, all of which have balance sheets reported in 1992 and 1993 and at least four complete consecutive annual observations.

Since the Mediocredito Centrale survey provides information only on legally independent companies, the data drawn from the Centrale dei Bilanci database consist of unconsolidated accounts for individual corporations. This may underestimate the importance of financial constraints for group members, if investment spending is constrained by the internal funds of the group as a whole, rather than by the internal funds of the group member itself. This possibility is investigated in Chapter 6, when we estimate investment equations for a sample of Italian companies for which consolidated accounts are available in the Centrale dei Bilanci database.

The main variables we use in our descriptive and econometric analyses are flows of investment, sales, value added, gross operating profits, cash flow and financial debt. Investment is reported spending on plant, property and equipment, and it excludes spending on acquisitions and intangible assets[3]. Gross operating profits are equal to the difference between gross output (total sales plus the change in finished good inventories) and current costs (the sum of labour compensation, costs of goods sold plus general, selling and other expenses). Cash flow is constructed by subtracting the wage bill, net interest and taxes from value added. Wherever data on variable costs are not available, cash flow is computed by the conventional method of adding back the reported value of depreciation to the reported value of profits (net of interest and taxes). In this case, gross operating profits are obtained by adding back interest

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[3] Investment spending is gross of disposals, since no measure of disposals of fixed assets is available from the company accounts.

payments and taxes to this measure of cash flow[4]. Finally, debt is given by the sum of short- and long-term financial debt taken at book value. All these variables are available from balance sheets and income statements. All flow variables were deflated using an output price index for Italy[5].

A measure of the stock of capital at current replacement cost ($p_t^I K_t$) was estimated from the flow data on investment ($p_t^I I_t$) using a standard perpetual inventory method:

$$p_t^I K_t = (1-\delta) p_{t-1}^I K_{t-1} \left(\frac{p_t^I}{p_{t-1}^I} \right) + p_t^I I_t$$

where K_t is the capital stock, p_t^I is the price of investment goods, I_t is real investment and δ is the depreciation rate. The starting value was based on the net book value of tangible fixed capital assets (net capital stock is given by gross book value less accumulated depreciation), adjusted for inflation in the previous three years. Subsequent values were obtained using accounts data on investment, a national price index for investment goods prices[6], and a depreciation rate of 8%.

After computing the main variables used in the investment models, we selected firms and observations meeting the following criteria:

- nominal growth rate of sales greater than -50% and smaller than 100%
- strictly positive capital stock

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[4] Obviously, the "top-down" and the "bottom-up" approaches for computing cash flow and gross operating profits give same values when both are available.

[5] The output price index is an implicit GDP deflator for the manufacturing sector, obtained from the OECD Quarterly National Accounts.

[6] The investment goods price index is an implicit deflator for gross fixed capital formation, obtained from the OECD Quarterly National Accounts.

- no major mergers or acquisitions (or disposals) of relevant part of the firms' operations
- fixed investment to beginning-of-period capital stock ratio below the 95th percentile
- cash flow to beginning-of-period capital stock ratio above the 1st and below the 99th percentile
- sales to end-of-period capital stock ratio above the 1st and below the 99th percentile

In the cases in which some observations were discarded, we retained the available time series of consecutive annual observations for the firms affected, provided that the balance sheets for the years 1992 and 1993 and at least four consecutive annual observations were available. These selection criteria left an unbalanced panel of 710 companies, 234 of which have complete observations from 1986 to 1996. The exact structure of the sample by number of observations per company and number of companies per year is reported in Table 3.1 and Table 3.2.

To illustrate the composition of the sample, companies have been classified into four categories on the basis of the number of employees in the first year of observation: small firms (i.e., firms with less than 101 employees), medium-sized firms (more than 100 and less than 251 employees) and large firms (split in two sub-samples, one including firms with 251-500 employees and the other firms with more than 500 employees). The sample distribution of firms by size, founding year, location, industrial sector and Pavitt sector[7] is reported in Tables 3.3, 3.4, 3.5, 3.6 and 3.7.

[7] See Pavitt (1990).

Table 3.1

Structure of the sample by number of observations per company

Annual observations	4	5	6	7	8	9	10	11
Number of companies	15	32	53	53	56	63	204	234

Table 3.2

Structure of the sample by number of companies per year

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number of companies	470	488	538	597	654	688	710	710	701	635	347

Table 3.3

Size distribution

Employees	Firms		Observations		Obs. / Firm
	Number	Percent	Number	Percent	
51-100	224	31.5	1981	30.3	8.84
101 -250	275	38.7	2613	40.0	9.50
251-500	77	10.8	712	10.9	9.25
> 500	134	18.9	1232	18.8	9.19
Total	710	100.0	6538	100.0	9.21

Table 3.4

Age distribution

Founding year	Firms		Observations		Obs. / Firm
	Number	Percent	Number	Percent	
before 1950	159	22.4	1487	22.7	9.35
1950 - 1969	205	28.9	1972	30.2	9.62
1970 - 1979	175	24.6	1668	25.5	9.53
after 1979	171	24.1	1411	21.6	8.25
Total	710	100.0	6538	100.0	9.21

Table 3.5

Regional distribution

Geographical areas	Firms		Observations		Obs. / Firm
	Number	Percent	Number	Percent	
North-west	334	47.0	3124	47.8	9.35
North-east	257	36.2	2342	35.8	9.11
Centre	75	10.6	684	10.5	9.12
South	44	6.2	388	5.9	8.82
Total	710	100.0	6538	100.0	9.21

Table 3.6

Sector distribution

Sectors	Firms		Employees	
	Number	Percent	Mean	Median
Food, Drink and Tobacco	30	4.2	205	132
Textiles, Clothing and Leather	134	18.9	376	148
Wood, Furniture and Paper	74	10.4	287	123
Building Materials and Glass	40	5.6	395	146
Rubber and Plastic	38	5.3	390	96
Chemicals and Drugs	36	5.1	667	210
Non-electrical machinery	196	27.6	406	134
Electrical machinery	59	8.3	936	230
Motor vehicles	36	5.1	1919	296
Metallurgy and Metal Products	45	6.3	496	213
Other	22	3.1	333	123
Total	710	100.0	515	141

Table 3.7

Sector distribution

Pavitt sector	Firms		Observations		Obs. / Firm
	Number	Percent	Number	Percent	
Traditional	303	42.7	2845	43.5	9.39
Scale	252	35.5	2274	34.8	9.02
Specialised	126	17.7	1168	17.9	9.27
High-tech	29	4.1	251	3.9	8.66
Total	710	100.0	6538	100.0	9.21

3.2 The Italian financial system: evidence from our data set

Our data set of 710 companies provides further information on the main characteristics of the Italian industrial and financial system. Although the sample over-estimates the weight of large companies, it is clear that the bulk of Italian manufacturing firms is represented by small and medium-sized firms. The sample mean and standard deviation of employment are, respectively, 515.3 and 1610; the 1st, 2nd and 3rd quartile are, respectively, 89, 141 and 331[8].

As discussed in Chapter 3, Section 4, an important feature of the Italian productive system is the high number of large and medium-sized private companies belonging to a group. 44.4% of the sample firms turn out to be part of a group. Membership in a group is highly correlated with the firm's size. Only 22.4% of firms with 51-100 employees are part of a group, against 88.8% of firms with more than 500 employees (Table 3.8). There are also substantial differences in group membership across sectors, with lower levels in the traditional sector and higher levels in the specialised, scale and, particularly, high-tech sectors (Table 3.9).

Information on group firms confirms the pyramidal structure typical of Italian groups. Since holding companies were excluded from our data set, we have 36.5% of the group firms that are in an intermediate position, that is, they are controlled but, at the same time, they control other group members, and 63.5% of the group firms that are only a controlled company[9] (Table 3.10 and Table 3.11). Notice that the larger the firm size the higher is the share of group firms in an intermediate position. The mean (median) number of employees and

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[8] Note that this is after excluding firms with fewer than 51 employees.

[9] A firm is controlled by another firm if the latter "exerts a determinant influence, usually through voting in the shareholder meetings, on the decisions concerning the medium and long term aims of the [former] firm, its strategies to pursue them, its financial and economic development, and its investment expenditures" (Mediocredito Centrale survey, explanatory note to Question 5.1).

legally independent firms in a business group (including foreign operating and parent companies) is, respectively, 9183 (1164) and 55 (10).

Questions 5.1 and 5.2 of the Mediocredito Centrale survey provide some interesting information on the Italian firms' ownership structure. The text of these questions is presented in Appendix A. The great majority of "economically" independent Italian firms is owned by the manager/director and his/her family and other associates. In more than 70% of such firms there is a family tie among the individuals who share the direct control of the firm. Not only are firms owned by individuals rather than financial institutions, but their equity is also shared among very few people. The largest shareholder holds on average 56.8% of shares, and the average sum of shares held by the largest three shareholders is more than 90% (Table 3.12). This confirms the absence of public companies in the industrial Italian sector, and the prevalence of family control even among the largest firms.

This information emphasises the basic features of the Italian productive system. On the one hand, there are a large number of small and medium-sized firms mainly controlled by individuals or private families ("capitalismo familiare"), which are reluctant to share the control of the firm with banks and other financial intermediaries. On the other hand, most of the large firms belong to groups, where control is exercised over several separate companies through pyramidal structures that allow a concentration of control. Moreover, partly for historical reasons, large business groups have several informal relations with national financial institutions, which play an important role not only in financing but also in acting as exclusive clubs where mutual shareholdings are organised and, more generally, decisions on corporate control are taken.

From the Mediocredito Centrale survey we can also gain an insight into the financing of capital accumulation. Question 14.5 asks firms to indicate the share of investment spending

which has been financed through different (gross) sources of finance[10]. Fixed investment spending is mainly financed through internal finance (on average, 60% of total sources of finance), subsidised long term credit (14.4%), market-rate long term credit (11.2%), and leasing[11] (7.5%). New equity issues represent only 1.6% of sources of finance (Table 3.13). The importance of internal finance increases with firm size: internal finance represents on average more than 70% of the sources of finance for firms with more than 500 employees, as opposed to about 57% for firms with fewer than 251 employees. Of great importance is the fact that subsidised long-term credit represents a considerably more significant source of finance for smaller firms than it does for larger ones. This suggests that subsidised credit has a compensatory and "supplementary" function: it represents an alternative source of finance and helps to keep down the real cost of capital for those (smaller) firms that are more likely to face financial constraints. Table 3.14 provides information on firms' sources of finance according to whether companies are independent or part of a group. Independent firms appear to rely relatively more on risky outside finance than do firms belonging to groups. On average, independent firms finance more than 25% of their fixed investment through leasing and market rate long-term debt, against 14% for firms belonging to a group. On the other hand, only 55.7% of independent firms' investment expenditures are financed through internal finance, against 66.4% of group members' investment. Hence, from this evidence small, independent firms appear to be the most reliant on external sources of finance.

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[10] Note that short-term debt has not been considered among the sources of finance for investment spending.

[11] Leasing represents a particularly important source of finance for smaller firms. The share of market interest rate credit is particularly low for firms located in the South (3.5%), which however benefit by a significant amount of non-recoverable grants (9% against a sample average of 2.6%). On a sector basis, the main differences concern high-tech firms, which show higher shares of internal finance (75%) and equity issues (4%), and lower shares of subsidised and market interest rate long term credit (respectively, 10% and 1.5%).

In order to investigate the importance of credit rationing, the survey included a question on whether firms had asked for but not obtained a higher amount of bank credit in the period 1992-94. In general, there is little evidence of credit rationing: despite the economic downturn, only 5% of firms reported that they could not obtain further credit. This proportion did not differ greatly from one size class to the other[12]. Only firms in the South showed a higher incidence of credit rationing (11% of firms). This result does not necessarily imply that Italian firms are not financially constrained. It simply says that credit rationing represents a marginal phenomenon, but it does not rule out that financial constraints on firms' economic activity can operate through different channels (like, for instance, higher interest rates charged to a priori riskier firms; see discussion in Chapter 2, Section 2.1).

Other interesting information on Italian firms' financial structure emerges from the analysis of accounting data. Tables 3.15 and 3.16 present, respectively, the composition of the firms' liabilities and the mean values of some debt indicators over the period 1986-1996. In all size classes of firms, the stock of (book-value) financial debt is considerably high when compared either to the beginning-of-period replacement value of the capital stock or to firms' total assets. The debt ratio does not change markedly among different size classes. However, interesting differences emerge with respect to the maturity distribution of outstanding debt and the weight of interest expenses. Larger firms hold a larger share of their financial debt (and, in particular, of their bank debt) as long-term debt. At the same time, small firms show higher levels of the ratio of interest expenses (net of interest income) to sales and the interest-coverage ratio (the ratio of interest expenses to the sum of interest expenses plus cash flow). These ratios suggest that large firms should be less likely to incur costs of financial distress

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[12] However, a discriminant analysis carried out on the full sample of the Mediocredito Centrale data set concerning the same question concluded that the likelihood of credit rationing is higher for small, independent, high-tech and high leverage firms (Ministero dell'Indutria and Mediocredito Centrale, "Indagine sulle imprese manifatturiere", 1997).

than small firms. Larger firms face also lower financial costs per unit of debt: the ratio of interest payments to debt is, on average, 16.1% for firms with more than 500 employees, against 17.5, 18.6 and 21.0% for firms with, respectively, 251-500, 101-250 and 51-100 employees respectively. At the same time, the interest payments-liabilities ratio is, on average, higher for smaller firms. The higher likelihood of financial distress and greater reliability on short-term debt help to explain the higher interest rates charged to smaller firms.

In Figure 3.1 we present plots of the mean values of the fixed investment to (beginning-of-period) capital ratio, and the cash flow to capital ratio. Over the period 1990 to 1993 the mean investment rate decreased significantly. Only from 1994 has there been a general recovery in the investment rate (Figure 3.1). Likewise, the cash flow to capital ratio decreased steadily until 1992, and starting from 1993 there have been the first signs of recovery of profitability (Figure 3.1). Figure 3.2 presents plots of the net interest to gross operating profits ratio and the interest coverage ratio (defined as the ratio of interest expenses to the sum of cash flow and interest expenses). The weight of net interest expenses relative to earnings steadily increased from 1989 to 1992, and only after 1993 went back to the values recorded in the mid-eighties.

Table 3.17 focuses more directly on how Italian firms finance total investment. Total investment (TI_t) is defined as the change in book capital (the book value of long-term debt, short-term debt, and equity) from t-1 to t, plus depreciation. The financing of total investment is split among internal funds (IF_t), and external financing, that is, long-term debt ($dLTD_t$), short-term debt ($dSTD_t$), and net new issues of stock (dS_t),

$$TI_t = IF_t + dLTD_t + dSTD_t + dS_t$$

Investment averages 11.8% percent of book capital in 1987-96, and internal funds are about 7.2%. Thus, internally generated funds cover about 64.4% percent of total investment.

This value is close to that obtained from the Mediocredito Centrale survey for the share of fixed investment financed through internal finance (see Table 3.13). New issues of stock (net of share repurchases) and long-term debt finance only 2.4% and 4.3% of investment, respectively, while 28.9% comes from short-term debt. Also the financing pattern by firm size mirrors the evidence obtained from Mediocredito Centrale survey (see Table 3.14). Small firms finance a larger share of total investment through external finance than do larger firms. Over the period 1987 to 1996 the share of total investment financed through internal finance was about 59% for firms with fewer than 250 employees, and 66.5% for firms with more than 250 employees.

Figure 3.3 shows investment and its financing year by year. The figure suggests that net new issues of stock do not move closely with investment. In fact, when the variables are measured relative to book capital as in Table 3.17 and Figure 3.3, the correlation of total investment, TI_t, and net new issues of stock, dS_t, is only 0.196. Figure 3.3 suggests that cash flow moves more closely with investment. The correlation between TI_t and IF_t is indeed higher, 0.474, but far from perfect. The source of financing most correlated with investment is short-term debt. The correlation between TI_t and $dSTD_t$ is 0.803[13]. Interestingly, the correlation between TI_t and net new long-term debt is very low (0.25). These correlations confirm the impression given by Figure 3.3 that (short-term) debt plays a key role in accommodating year-by-year variation in total investment.

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[13] In particular, the correlation between total investment and short-term financial debt is 0.545, and the correlation between investment and trade debt is 0.544.

Table 3.8

Group membership by size

Employees	The firm is part of a group		Total
	NO	YES	
51-100	174 (77.68%)	50 (22.42%)	224
101-250	182 (66.18%)	93 (33.82%)	275
251-500	24 (31.17%)	53 (68.83%)	77
> 500	15 (11.19%)	119 (88.81%)	134
Total	395 (55.63%)	315 (44.37%)	710

Table 3.9

Group membership by sector

Pavitt sector	The firm is part of a group		Total
	NO	YES	
Traditional	198 (65.35%)	105 (34.65%)	303
Scale	114 (45.24%)	138 (54.76%)	252
Specialised	75 (59.52%)	51 (40.48%)	126
High-tech	8 (27.59%)	21 (72.41%)	29
Total	395 (55.63%)	315 (44.37%)	710

Table 3.10

Group position by size

Employees	Firm's position in the group		Total
	Intermediate	Only controlled	
51-100	4 (8.00%)	46 (92.00%)	50
101-250	25 (26.88%)	68 (73.12%)	93
251-500	20 (37.74%)	33 (62.26%)	53
> 500	66 (55.46%)	53 (44.54%)	119
Total	115 (36.51%)	200 (63.49%)	315

Table 3.11

Group position by sector

Pavitt sector	Firm's position in the group		Total
	Intermediate	Only controlled	
Traditional	33 (30.48%)	73 (69.52%)	105
Scale	56 (40.58%)	82 (59.42%)	138
Specialised	18 (35.29%)	33 (64.71%)	51
High-tech	9 (42.86%)	12 (57.14%)	21
Total	115 (36.51%)	200 63.49%)	315

Table 3.12

Ownership structure

Employees	"Economically" independent firms			
	Largest shareholder (%)	Second largest shareholder (%)	Third largest shareholder (%)	Other shareholders (%)
51-100	56.37	21.81	11.37	10.45
101-250	56.30	22.78	11.35	9.57
251-500	55.42	23.74	15.49	5.35
> 500	70.50	15.35	9.07	5.08
Total	56.79	22.14	11.51	9.56

Table 3.13

Fixed Investment: gross sources of finance (unweighted average)

Gross sources	Employees				Total
of finance	51-100	101-250	251-500	> 500	
New equity	1.59	1.73	0.25	2.29	1.57
Internal finance	56.40	57.75	66.93	71.58	60.03
Long-term credit [1]	8.75	13.73	10.95	9.31	11.18
Long-term credit [2]	17.41	14.27	10.85	9.68	14.38
Non-recoverable grants	3.42	2.30	1.62	2.45	2.62
Leasing	10.00	7.35	6.60	2.15	7.54
Investment grants	1.60	1.70	1.03	1.75	1.59
Other sources	0.83	1.17	1.77	0.79	1.09
Total	100.00	100.00	100.00	100.00	100.00

[1] Market rate long term credit
[2] Subsidised long term credit

Table 3.14.a

Fixed Investment (group firms): gross sources of finance (unweighted average)

Gross sources of finance	Employees				Total
	51-100	101-250	251-500	> 500	
New equity	0.00	2.56	0.26	2.29	1.53
Internal finance	66.37	61.83	66.52	73.36	66.42
Long-term credit [1]	7.08	13.16	11.48	8.31	10.48
Long-term credit [2]	16.50	13.06	12.94	9.97	12.96
Non-recoverable grants	4.35	3.13	1.66	2.75	2.98
Leasing	5.17	5.04	4.34	1.10	3.98
Investment grants	0.53	0.44	0.80	1.29	0.73
Other sources	0.00	0.78	2.00	0.93	0.92
Total	100.00	100.00	100.00	100.00	100.00

[1] Market rate long term credit
[2] Subsidised long term credit

Table 3.14.b

Fixed Investment (independent firms): gross sources of finance (unweighted average)

Gross sources of finance	Employees				Total
	51-100	101-250	251-500	> 500	
New equity	2.07	1.29	0.22	2.31	1.60
Internal finance	53.36	55.55	67.83	63.54	55.66
Long-term credit [1]	9.25	14.04	9.78	13.85	11.66
Long-term credit [2]	17.68	14.93	6.30	8.38	15.35
Non-recoverable grants	3.15	1.85	1.52	1.15	2.37
Leasing	11.47	8.59	11.52	6.92	9.98
Investment grants	1.92	2.38	1.52	3.85	2.18
Other sources	1.10	1.37	1.31	0.00	1.20
Total	100.00	100.00	100.00	100.00	100.00

[1] Market rate long term credit
[2] Subsidised long term credit

Table 3.15

Capital structure

Mean values	Employees				Total
Liabilities (book value)	51-100	101-250	251-500	> 500	
1) **Equity**	**24.41**	**25.00**	**28.07**	**27.06**	**25.54**
Issued equity	11.98	12.28	13.29	17.41	13.26
Net reserves	11.39	11.92	14.10	9.62	11.62
2) **Retirement reserves**	**7.30**	**8.65**	**9.08**	**10.27**	**8.59**
3) **Long-term debt**	**11.26**	**11.46**	**11.10**	**10.09**	**11.10**
Long-term financial debt	8.72	9.04	9.60	9.01	9.00
long-term bank debt	*6.46*	*7.18*	*6.62*	*6.74*	*6.82*
4) **Short-term liabilities**	**57.04**	**54.89**	**51.75**	**52.58**	**54.76**
Short-term financial debt	20.56	19.94	19.88	18.74	19.89
short-term bank debt	*18.91*	*18.44*	*17.10*	*14.57*	*17.71*
Trade debt	27.55	25.59	22.70	24.01	25.57
Total liabilities (1+2+3+4)	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**

Table 3.16

Debt ratios

Mean values	Employees				Total
	51-100	101-250	251-500	> 500	
Total financial debt / capital stock (K_{t-1}) (%)	98.91	100.67	104.98	99.26	100.33
Short-term financial debt / capital stock (K_{t-1}) (%)	73.84	71.28	73.34	68.32	71.72
Long-term financial debt / capital stock (K_{t-1}) (%)	25.07	29.39	31.63	30.94	28.62
Short-term financial debt / total financial debt (%)	68.71	64.93	64.92	64.26	65.94
Short-term bank debt / total bank debt (%)	72.32	68.61	67.96	63.14	68.60
Interest expenses / total financial debt (%)	21.01	18.65	17.46	16.12	18.45
Interest expenses / liabilities (%)	6.29	5.69	5.31	5.04	5.71
Net interest expenses / sales (%)	3.42	3.04	2.61	2.09	2.94
Net interest expenses / gross operating profits (%)	33.86	31.04	27.74	21.97	29.84
Interest coverage ratio (%)	43.49	42.01	41.92	38.50	42.56

Table 3.17

Total investment and forms of financing as percent of beginning of year book capital (mean values)

$$TI_t = IF_t + dLTD_t + dSTD_t + dS_t$$

Years	Employees	TI_t [1]	IF_t [2]	$dLTD_t$ [3]	$dSTD_t$ [4]	dS_t [5]
	51-100	13.97	7.46	0.24	6.04	0.23
	101-250	14.04	7.62	0.51	5.57	0.34
1987-91	251-500	12.76	7.43	0.32	4.65	0.36
	> 500	12.71	7.37	0.36	4.41	0.57
	Total	**13.64**	**7.50**	**0.76**	**5.03**	**0.35**
	51-100	11.91	8.04	0.21	3.58	0.08
	101-250	10.37	6.81	0.40	3.03	0.13
1991-96	251-500	8.15	6.46	-0.19	1.57	0.31
	> 500	6.88	5.63	-0.25	1.60	-0.10
	Total	**9.91**	**6.91**	**0.29**	**2.63**	**0.09**
	51-100	12.94	7.75	0.45	4.58	0.16
	101-250	12.21	7.21	0.91	3.85	0.23
1987-96	251-500	10.45	6.95	0.12	3.04	0.34
	> 500	9.79	6.50	0.11	2.95	0.23
	Total	**11.78**	**7.21**	**0.53**	**3.83**	**0.22**

[1] Total investment, TI_t, is the change in book capital (the book value of long-term debt, short-term debt, and equity) from t-1 to t, plus depreciation.

[2] Internal funds, IF_t, is the sum of income before extraordinary items and discontinued operations, depreciation expense, and income statement deferred taxes, minus dividends paid on common and preferred stock.

[3] $dLTD_t$ is the change in the book value of long-term debt from year t-1 to t.

[4] $dSTD_t$ is the change in the book value of short-term debt, measured by debt in current liabilities or current liabilities.

[5] The net flow from the sale and repurchase of stock, $dS_t = TI_t - IF_t - dSTD_t - dLTD_t$, balances the cash flow identity.

Figure 3.1

Investment and cash flow to beginning-of-period capital

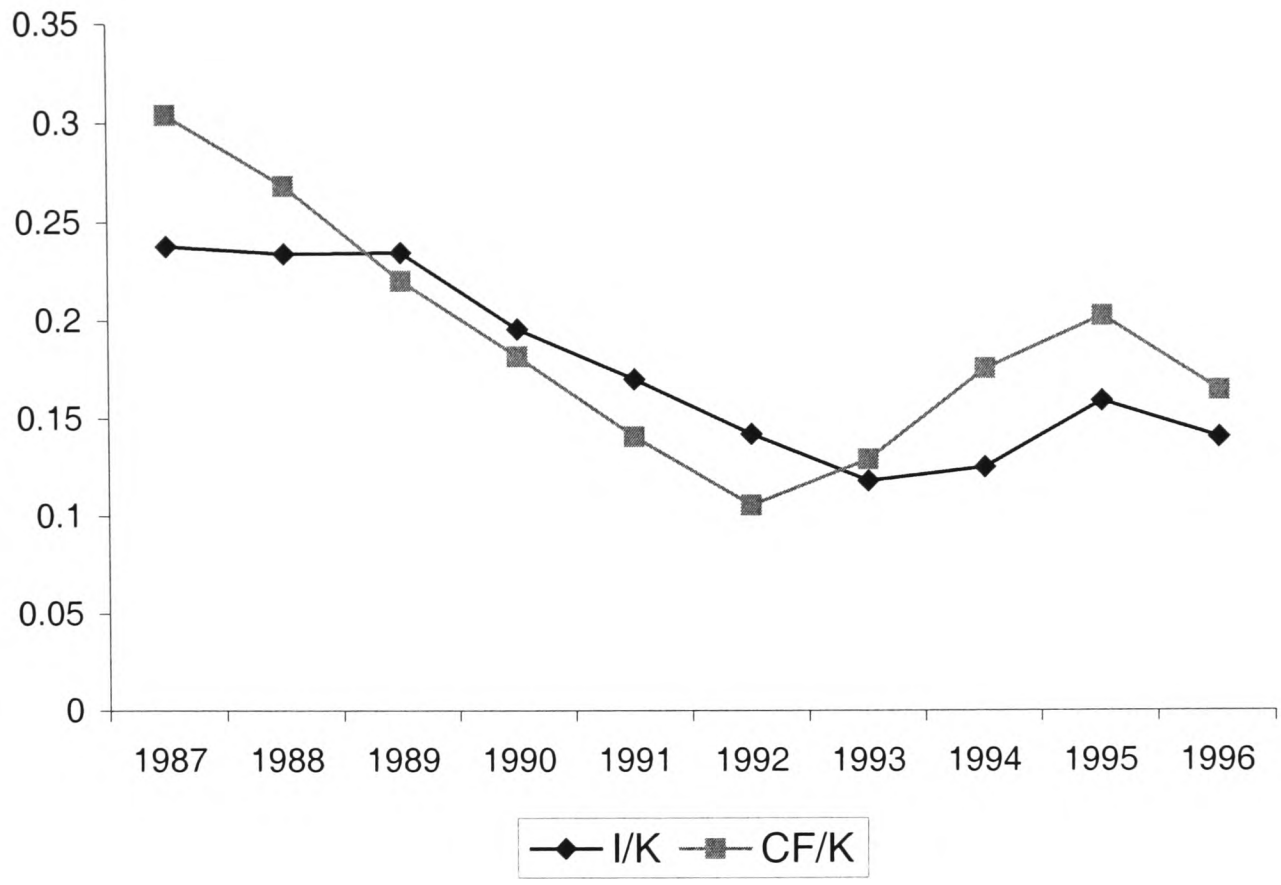


Figure 3.2

Net interest expenses to gross operating profits and interest coverage ratio

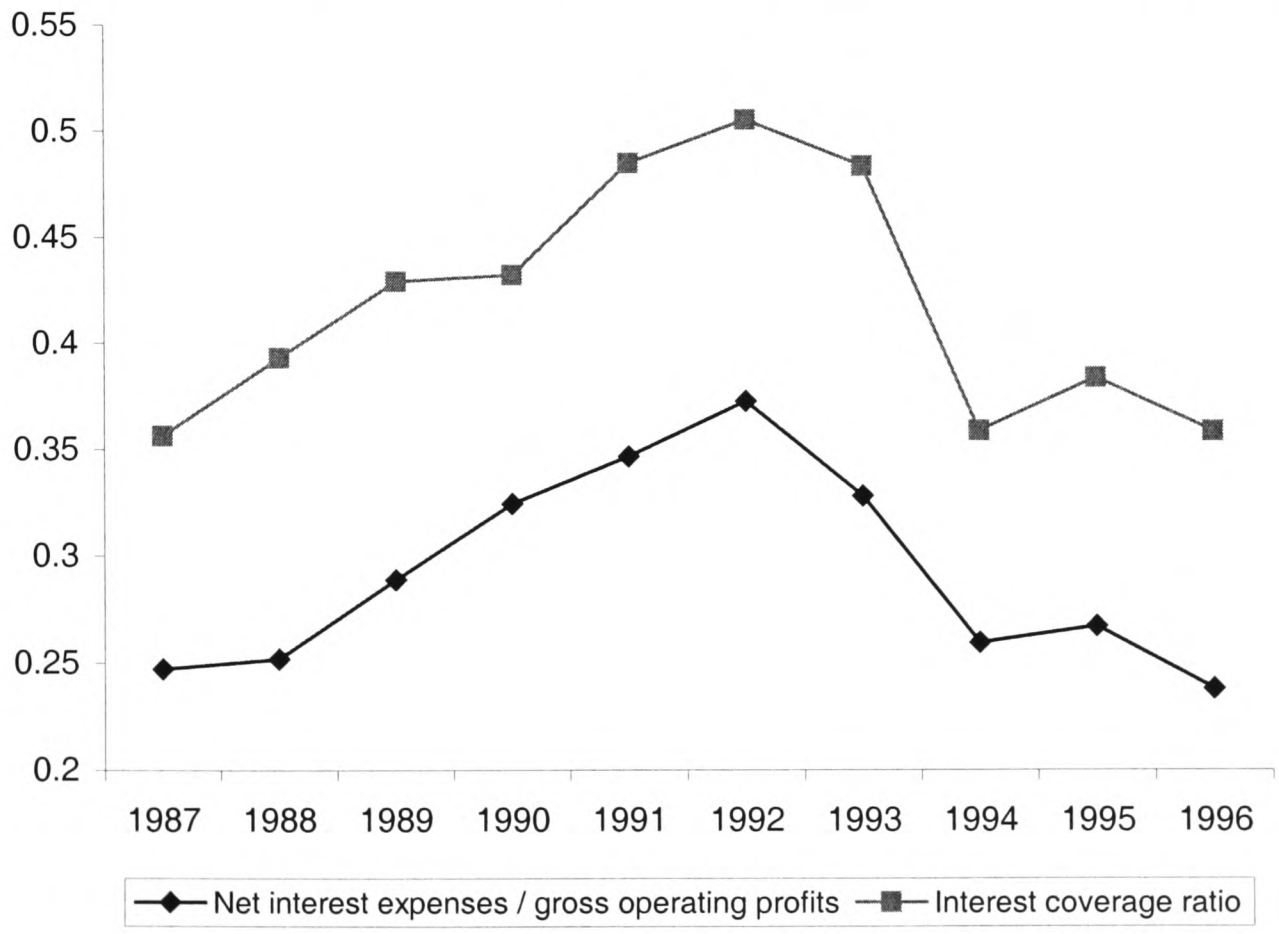
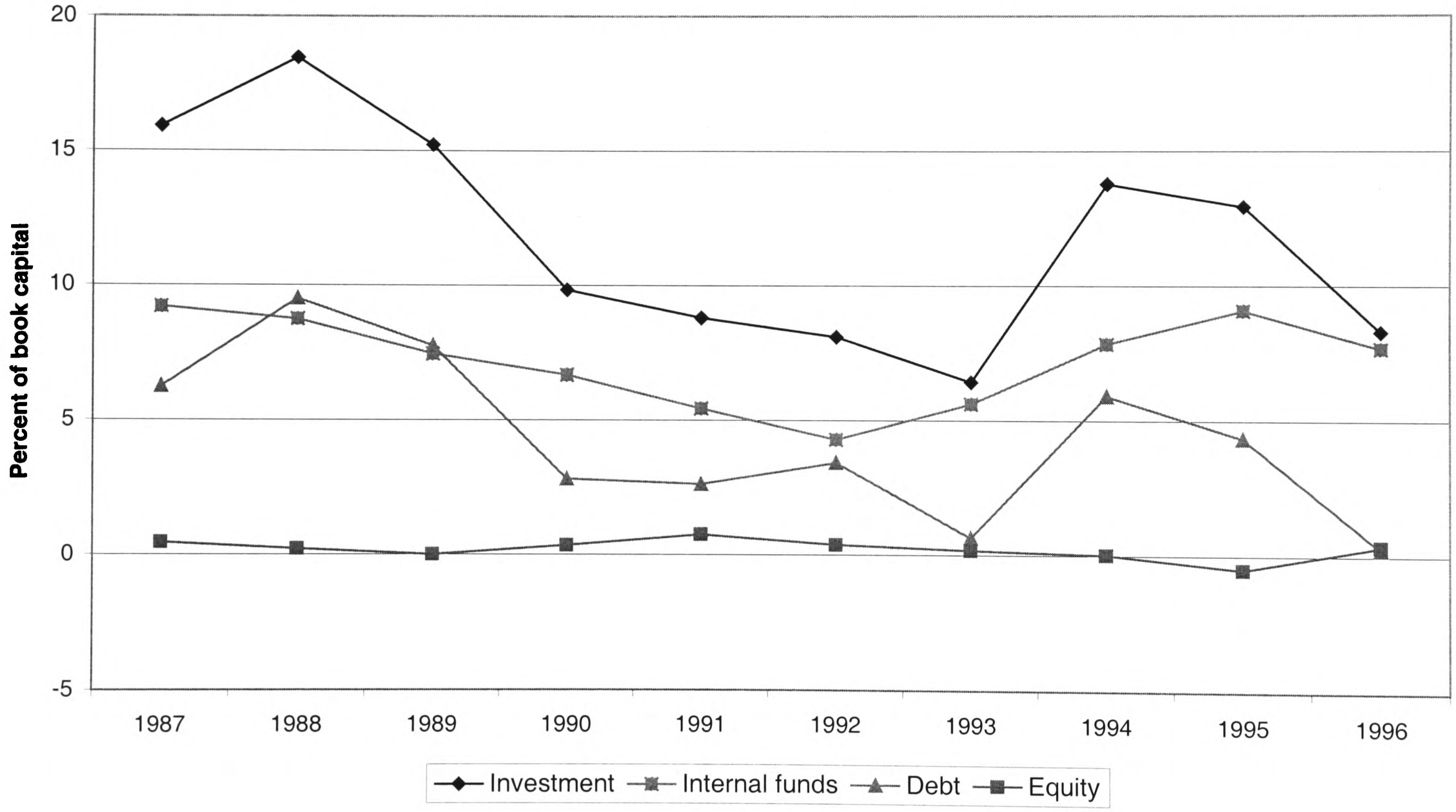


Figure 3.3
Total investment and its financing



4. Econometric results

The econometric analysis is based on the unbalanced panel data of 710 Italian manufacturing companies over the period 1986 to 1996 described in Section 3 of this chapter. In this data set we identify firms that may face different degrees of capital market imperfections and test whether there are significant differences in their investment behaviour. To do this, from the Mediocredito Centrale survey we have gathered additional information about the firms in our sample which is typically not available in the companies' financial statements. Firms are then classified in two different ways that are intended to capture their informational positions.

A first classification separates small firms from large firms[14]. Small firms are more likely to face financial constraints, both because they find it more difficult to convey information to outside investors, and because the probability they suffer from idiosyncratic risk is higher. Moreover, for a given cost premium, small firms may be more dependent on external funds than larger firms (see Table 3.14). Firms with fewer than 150 employees in the first year of observation are classified as small; the remaining firms are classified as large.

Our second classification separates independent firms from firms that belong to a company group. Membership in an interrelated group of firms can mitigate informational problems by improving access to external capital markets and allowing the formation of an internal capital market that may partially replace the capital allocation function of the external market. Data on firm affiliation are obtained from the Mediocredito Centrale survey, which contains a question asking whether the firm is part of a group. A firm is classified as a group member if either an industrial group or a holding company (holding companies themselves are excluded from our panel data) controls it. The remaining firms are classified as independent[15].

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[14] See Devereux and Schiantarelli (1990) and Gilchrist and Himmelberg (1995) for related empirical studies.

[15] See Hoshi *et al.* (1991), and Chirinko and Schaller (1995) for related empirical studies.

It is of interest to note that the characteristics considered above are highly correlated. 70.6% of independent firms are classified as small firms, while 74.6% of group firms are classified as large firms. For this reason, firms are further split according to both their size and their form of control. Notice that, in order to compare the regression results from different kinds of estimators, the analysis initially focuses on the results for the complementary subsets of small independent firms, and either large or group firms. Attention is drawn to this classification because small independent companies, as opposed to either group or large companies, should represent the class for which capital market imperfections are the most severe.

Table 4.1 reports the mean and standard deviation of the variables used in the econometric analysis. The mean values of the investment to capital (I/K) and the cash flow to capital (C/K) ratios appear very similar in the different samples. The average growth rate of real output (Δy) is larger on average for small firms, in particular for small group firms (but notice the high standard deviation as compared with other subsets of firms). The gross operating profits to capital (Π/K) rates are larger on average for independent firms, and especially for small independent firms. Finally, the output-capital ratio (Y/K) is smaller on average for group firms, and particularly for large group firms (i.e., these firms are more capital intensive).

4.1 The error correction model: results from different estimators

We begin our empirical investigation by comparing the results of estimating an error correction model using a range of different estimators. The objective is to assess the validity of alternative instrument sets in this application. To make the analysis clear, results are reported for the full sample of firms and for two sub-samples: the sample of 279 small independent firms and the complementary sample of 431 either large or group firms.

Table 4.2, column (i), presents OLS levels regression results for the error correction model of the form outlined in equation (3.8), Chapter 2:

$$\frac{I_{it}}{K_{i,t-1}} = \omega_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \omega_2\Delta y_{it} + \omega_3\Delta y_{i,t-1} + \omega_4\left(k_{i,t-2} - y_{i,t-2}\right) +$$

$$+\omega_5 y_{i,t-2} + \omega_6\left(\frac{C_{it}}{K_{i,t-1}}\right) + d_t + \eta_i + \nu_{it}$$

The OLS levels estimator does not control for the possibility of unobserved firm-specific effects and may result in upward-biased estimates of the coefficients on the lagged dependent variables if firm-specific effects are important. Given the construction of the error correction model, not only is the coefficient on the lagged investment to capital ratio (equal to α_1-1) expected to be upward-biased, but also the coefficient on the error correction term (equal to $\alpha_1+\alpha_2$-1). Indeed, the OLS levels estimator fails to identify any error correction mechanism, as the coefficients on the error correction term are close to zero in any sample. At the same time, the coefficients on the lagged dependent variable are significantly positive, and imply an autoregressive coefficient α_1 much larger than unity.

In order to obtain consistent estimates when the explanatory variables are correlated with firm-specific effects, it is necessary to use an estimator that controls for the presence of firm-specific effects. Table 4.2, column (ii), presents the results from the Within-Groups estimator. In contrast to OLS levels, the coefficients on lagged dependent variables are expected to be downward-biased in this case. There is certainly a substantial difference in the coefficient estimates using the Within-Groups estimator. The coefficient on the lagged dependent variable is significantly smaller than in the OLS levels estimation, and has a negative value. The point estimates thus identify a value for the autoregressive coefficient α_1 slightly below unity. The error correction term is now significantly negative. Finally, the Within-Groups estimator

rejects the hypothesis of constant returns to scale: the lagged output term y_{t-2} is significantly negative in each sample. Since the coefficient on the lagged output term is by construction equal to $[(\alpha_1+\alpha_2-1) + (\beta_0+\beta_1+\beta_2)]$, this appearance non-constant returns to scale may be the result of the under-estimation of the sum of autoregressive coefficients α_1 and α_2.

A different way to remove firm-specific effects consists in taking first differences of the original equation. In order to avoid the problem of correlation between the first-differenced error term and the first-differenced explanatory variables, we estimate the error correction model of investment using an instrumental variable procedure as outlined in Chapter 2, Section 4. One-step GMM first differences results are presented in Table 4.2, columns (iii) and (iv). The instruments used are the lagged values of all the right-hand side variables of equation (3.8) except $y_{i,t-2}$, which allows for contemporaneous correlation between these variables and shocks to the investment equation, as well as correlation with unobserved firm-specific effects. In column (iii) the instrument set dates from t-2 to t-5, while in column (iv) we allow for an MA(1) error in the levels equation and exclude the instruments dated t-2. The Sargan test of overidentifying restrictions, distributed as a χ^2 statistic under the null of validity, checks for the validity of the instrument set[16]. Although second order serial correlation in the differenced residuals is not detected[17,18], the Sargan statistic clearly rejects the validity of the t-2 instruments in the equation for the full sample of firms, while it does not reject the validity

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[16] The Sargan statistic is proportional to the minimised value of the objective function that yields the (two-step) GMM estimator and tests for correlation between the residuals and the overidentifying restrictions.

[17] The test for second order serial correlation in the differenced residuals (sc_2) exploits the property that $N^{-1/2}(\Delta\hat{v}_{-2}\Delta\hat{v})$ is asymptotically normally distributed with known variance, where $\Delta\hat{v}_{-2}$ is the stacked vector of the twice-lagged residuals from the differenced model and $\Delta\hat{v}$ is the conformable vector of residuals not lagged twice. Essentially this tests for zero elements on the second off-diagonal of the estimated serial covariance matrix.

[18] Consistent with results of Sargan tests, there is some indication of second order serial correlation in columns (iv) and (vi) of Table 4.2.a, and especially Table 4.2.c.

of the t-3 instruments. At the same time, the Sargan difference test rejects the validity of the t-2 instruments in the equations for each sample of firms[19]. In contrast, Sargan difference tests between instrument sets dated, respectively, t-3 and t-4 did not reject the validity of the former[20]. Therefore, from now on we concentrate on results using instruments dating from t-3 backwards.

From the results in Table 4.2, column (iv), it can immediately be noted how the cost of achieving consistency in the parameter estimates is a general increase in the standard errors compared to the OLS and Within-Groups estimates. Both the current and lagged growth in sales have positive estimated coefficients in the equations for the full sample and the subset of small independent firms, and negative coefficients in the equation for the subset of either large or group firms. The coefficient estimates of the lagged dependent variable and the error correction term are negatively signed and statistically significant in each sample. The output term y_{t-2} is negatively signed: this would reject the hypothesis of constant returns to scale (particularly in the results for either large or group firms). Finally, the cash flow term is close to zero for the full sample of firms, negatively signed for the sub-sample of either large or group firms, and positively signed and weakly significant for the sub-sample of small independent firms (t=1.72).

In comparing column (iv) and columns (i) and (ii) of Table 4.2 we would expect the GMMDIF coefficient estimates on the lagged dependent variable and especially the error correction term to be in between the (upward-biased) OLS levels and the (downward-biased)

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[19] The Sargan difference statistic is the difference between the two Sargan statistics, which is asymptotically distributed as χ^2 provided the smaller instrument set is a strict subset of the larger instrument set, and tests the validity of the additional instruments included in the latter (but not the former).

[20] The Sargan difference statistic between instruments dated, respectively, t-3 and t-4 has a p-value of 6.3% for the full sample of firms, 41.4% for the sample of either large or group firms, and 60.4% for the sample of small independent firms.

Within-Groups estimates. This is not the case: the GMMDIF estimates of both coefficients are lower than the Within-Groups estimates. This suggests that the GMMDIF estimates of these coefficients may also be downward-biased[21].

As discussed in Chapter 2, Section 4, this result may be due to weak instruments. To reduce the small sample bias that characterises the first-differenced GMM estimator when the instruments available are weak, we estimate the error correction model of investment by using a system GMM estimator as described in Chapter 2. The results from the one-step GMMSYS estimator are presented in Table 4.2, columns (v) and (vi). The Sargan and the Sargan difference tests clearly reject the validity of the instrument set which includes levels of the right-hand side variables dated from t-2 to t-5 for the equations in first differences, and differences of the dependent variable and sales growth dated t-1 for the equations in levels. Therefore, we focus on results using an instrument set which includes levels of the right hand side variables dated from t-3 to t-5 for the equations in first differences, and differences of the dependent variable and sales growth dated t-2 for the equations in levels [i.e. we again allow for the error term v_{it} to be MA(1)].

Notice that we only use differences of the dependent variable and the output growth term as instruments for the equations in levels. This is due to the fact that, for both the subset of small independent firms and the subset of either large or group firms, a Sargan difference test between the GMMDIF (with instrument set dated from t-3 to t-5) and the GMMSYS (with instrument set dated from t-3 to t-5 for the equations in first differences, and t-2 for the equations in levels) estimators rejected the validity of the extra moment conditions when also differences of both the cash flow and the error correction terms were used as instruments for

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[21] The GMMDIF estimates of the sum of the autoregressive coefficients are, respectively, 0.64, 0.53 and 0.43 for the full sample of firms, the sample of either large or group firms and the sample of small independent firms, as opposed to the Within-Groups estimates equal to 0.66, 0.68 and 0.62.

the equations in levels[22]. In contrast, the Sargan statistic does not reject the validity of the instrument set used in our preferred GMMSYS estimates reported in Table 4.2. This may be explained by the fact that first differences of the right-hand side variables in the autoregressive-distributed lag representation of this model appear to be invalid instruments for the equations in levels, because of their correlation with the unobserved firm-specific effect η_i. However, first differences of the investment rate and of the sales growth term may be valid instruments because they correspond to second differences (uncorrelated with η_i) of, respectively, the components k_t and y_t of the autoregressive-distributed lag representation outlined in equation (3.6), Chapter 2. Indeed, $\Delta(I_t/K_{t-1})\approx\Delta(\Delta k_t)=\Delta^2 k_t$, and $\Delta(\Delta y_t)=\Delta^2 y_t$.

The Sargan difference test between the GMMSYS estimator in column (vi) and the GMMDIF estimator in column (iv) does not reject the validity of the extra moment conditions exploited by the system estimator in any of the three samples[23]. There are, however, substantial differences among the coefficient estimates comparing the system and the differenced estimator. The coefficients on both the lagged dependent variable and the error correction term are notably higher in the system estimates in each of the samples[24]. In the equation for the subset of small independent firms, where the downward bias of the GMMDIF estimator appeared to be greatest, the GMMSYS estimate of the error correction coefficient is significantly higher than the Within-Groups estimate, lower than the OLS levels estimate, and

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[22] $\chi^2(15)=25.78$, p=0.040 for the sample of small independent firms, $\chi^2(15)=29.61$, p=0.013 for the sample of either large or group firms, although $\chi^2(15)=17.22$, p=0.306 for the full sample of firms.

[23] In the preferred results for small independent firms [Table 4.2.c, column (vi)] we also detect significant second-order serial correlation in the first-differenced residuals, which is consistent with the rejection of the instruments dated *t*-2.

[24] The GMMSYS estimates of the sum of the autoregressive coefficients are 0.83 for the full sample of firms, 0.84 for the sample of either large or group firms, and 0.85 for the sample of small independent firms (see also footnote 21).

does not significantly differ from the corresponding coefficients estimated in the equations for the other two samples. On the whole, the system estimator seems to give more reasonable results than the first-differenced estimator: the sum of the estimated autoregressive coefficients is significantly higher than the sum from the Within-Groups estimator; the assumption of constant returns to scale cannot be rejected in any of the three samples; and the coefficients on the sales growth and the cash flow terms are in general positive and more precisely estimated[25]. As a consequence, the regression results from the system estimator with instruments dated *t*-3 and earlier are our preferred results, and from now on we focus on these GMMSYS estimates to analyse the differences in the impact of cash flow on investment decisions for different sub-samples of firms.

4.2 Evidence from the error correction model

By analysing the regression results from this GMMSYS estimator for the full sample of firms (Table 4.2.a), two main facts stand out in relation to the sensitivity of investment to cash flow. First, the cash flow term is positive and statistically significant (t=1.91). Second, the point estimate is similar to the cash flow coefficients that have been estimated in error correction model equations using company data for other continental European countries, and lower than the coefficients estimated for the UK[26]. This information suggests that financial factors may play an important role in the investment decisions of Italian companies. However, this sensitivity to cash flow may be interpreted as reflecting expectational influences on the investment decision, rather than liquidity constraints. Therefore, in order to test whether the cash flow sensitivity of investment reflects financial constraints arising from capital-market

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[25] In contrast to the GMMDIF estimates, the GMMSYS estimates of the sales growth term are positive in each sample. The GMMSYS estimates of the lagged sales growth term are also statistically significant in each sample.

[26] See Bond *et al.* (1997) and Bond, Harhoff and Van Reenen (1999).

imperfections, we now investigate the responses of investment to internal finance across classes of firms likely to be in different information positions.

The regression results presented in Table 4.2.b and 4.2.c indicate that the sensitivity of investment to cash flow is positive and significant for the sample of small independent firms, and zero for the sample of either large or group firms. This evidence is robust to using GMMDIF as well as GMMSYS estimates. Although GMMDIF estimates of the cash flow coefficient are less precise, this suggests that our main findings are not driven by the estimator we use.

Table 4.3 presents regression results from the GMMSYS estimator for sub-samples of firms defined by either size [columns (i) and (ii)] or group membership [columns (iv) and (v)]. The Sargan test does not reject the validity of the instrument set in any of the sub-samples. As expected, current and lagged output growth terms are generally positive, although they are jointly significant only in the equation for independent firms[27]. The lagged dependent variable is generally negatively signed, and marginally significant in the equations for independent firms (t=1.77) and for small firms (t=1.74). More importantly, the error correction term is significantly negative in all samples. Finally, there is some indication of a different impact of cash flow on investment spending across classes of firms. The cash flow term is significant neither in the equation for small firms nor in the equation for large firms. On the other hand, it is positive and significant both in the equation for group firms (t=2.39) and in the equation for independent firms (t=2.43). A greater point estimate for the sample of independent firms indicates that the sensitivity of investment spending to financial variables is greater for firms that are likely to face more severe capital market imperfections. This suggests that the cash

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[27] The Wald test of the hypothesis that the estimated sales growth terms are jointly zero has a p-value of 0.4% in the equation for the sample of independent firms, and p-values of 62.1%, 22% and 36.5% in the equations for the samples of group firms, large firms, and small firms respectively.

flow term may reflect not only investment opportunities, but also the different impact of liquidity constraints across firms.

To test whether the difference in the cash flow coefficients across the sub-samples of independent and group firms is statistically significant, we define a dummy variable which is zero when a firm is part of a group, and one when a firm is independent. We then interact this dummy with all right-hand side variables, including year dummies, and estimate the error correction model as before for the full sample of firms[28]. This formulation allows all the parameters of the model to differ across observations in the two sub-samples. As a result, the first six terms, not interacted with the dummy, are identical to the coefficients estimated for the sample of independent firms, whereas the remaining six coefficients, interacted with the dummy, estimate the difference of the coefficients on each variable across the subsets of independent and group firms. The point estimates and the standard errors of the differences in the estimated coefficients across these two sub-samples are presented in Table 4.3, column (vi)[29]. The Wald test of the hypothesis that all differences in the estimated coefficients are jointly zero has a p-value of 58.4%, and the t-value for the difference in the cash flow coefficient is 1.02. This shows that the difference between the cash flow coefficients estimated for the sub-samples of independent and group firms is not significant. Hence, the evidence on the existence of a different role of financial factors between group firms and independent firms appears to be weak.

However, since the overlap between the different classes of firms is quite large, a split by either size or group membership does not provide a genuinely independent test for the importance of financial constraints arising from asymmetric information. The analysis of the

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[28] Lagged values of all these interaction terms are also included in the instrument set.

[29] The same exercise has been conducted for the samples of large and small firms. The results are reported in Table 4.3, column (iii).

results for the four sub-samples of firms split by both size and group membership (Table 4.4) suggests that a simple classification by either size or group membership is not sufficient to correctly identify firms facing different information problems. Indeed, cash flow appears to have no effect on the investment spending of large independent and small group firms [Table 4.4, columns (ii) and (iv)]. On the other hand, a positive and significant cash flow effect is detected for the classes of large group companies and small independent firms [Table 4.4, columns (i) and (v)]. Moreover, the cash flow effect appears to be much stronger in the equation for the subset of small independent firms, as is also confirmed by tests of the differences in these coefficients across sub-samples[30].

From the previous results, it seems reasonable to compare the investment equations for the sample of small independent firms, on the one hand, and the sample of either large or group firms, on the other hand. In Table 4.5 we present the regression results from the GMMSYS estimator of an error correction model for the subset of either large or group firms [column (i)] and the subset of small independent firms [column (ii)]. While the point estimate of the cash flow term is statistically significant for the subset of small independent firms (t=2.56), it is not significant for the subset of either large or group firms (t=0.84). The difference in these cash flow coefficients across the two sub-samples, presented in column (iii), is also statistically significant (t=1.96).

Finally, in Table 4.5, column (iv), we report the result of the estimation of an error correction model for the full sample of firms, where we allow only the coefficient on the cash flow term to vary across the sub-samples of small independent and either large or group

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[30] The t-values of the estimated differences in the cash flow coefficients between the sample of small independent firms and the samples of small group, large independent, and large group firms are, respectively, 2.12, 1.58 and 1.49.

firms[31]. The first five coefficients here relate to estimates of the non-cash flow coefficients, common across the two subsets of firms, while the remaining two coefficients relate to estimates of the cash flow coefficient for the sample of either large or group firms and the sample of small independent firms respectively. As in column (ii), the coefficient estimate of the cash flow term is positive and statistically significant for the subset of small independent firms (t=2.23), and insignificant for the subset of either large or group firms (t=0.32). The difference in the cash flow coefficients across these two sub-samples is found to be significant (t=1.90) also in this specification. These findings confirm the intuition that financial constraints are likely to affect to a greater extent small firms that are not part of a group, and explain why we initially concentrated on the sub-samples of small independent firms and either large or group firms. Indeed, whether they are part of a group or independent, firms that are classified as large appear to suffer financial constraints to a lesser extent. At the same time, the financing constraints that are likely to affect small firms' investment decisions seem to be mitigated by membership in a group.

These regression results for the error correction model of investment generally indicate that firms in weak information positions have larger cash flow coefficient estimates. In principle, the significance of cash flow terms in the error correction model could be interpreted as reflecting expectations-formation rather than financial market imperfections. However, differences across firms classified according to their information and liquidity position suggest that the positive effect of cash flow reflects not only expectations of future profitability and investment opportunities, but also financial constraints on capital

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[31] To do this, we include interactions of the cash flow term with two distinct variables, that take the value of one for, respectively, small independent firms and either large or group firms (and zero otherwise in each case). This specification imposes common coefficients on the non-cash flow variables, including year dummies, across the two sub-samples. A Wald test of joint significance of the differences amongst the non-cash flow variables across these sub-samples did not reject the validity of this restriction (p-value equal to 45.5%).

accumulation. Moreover, the fact that we do find the cash flow coefficient to be zero, rather than simply smaller, for the firms in stronger information positions, suggests that this finding cannot be explained by the Kaplan and Zingales (1997) critique (see Chapter 2, Section 2.2).

4.3 Evidence from the Euler equation model

This section presents regression results for an Euler equation model of the form outlined in equation (3.12), Chapter 2:

$$\left(\frac{I}{K}\right)_{it} = \beta_0 + \beta_1\left(\frac{I}{K}\right)_{i,t-1} - \beta_2\left(\frac{I}{K}\right)^2_{i,t-1} - \beta_3\left(\frac{\Pi}{pK}\right)_{i,t-1} + \beta_4\left(\frac{Y}{K}\right)_{i,t-1} + d_t + \eta_i + \nu_{it}$$

As opposed to the error correction model, the Euler equation models for investment have the advantage of being theoretically more satisfactory, since they are explicitly derived from a dynamic optimisation framework and control for the role of expected future profitability under the assumed structure. Unfortunately, they also suffer from the disadvantage that requirements of model tractability mean that a very restrictive form of adjustment cost process is specified. This may be one reason why such models tend to fit the data rather poorly and the point estimates of the coefficients on the lagged dependent variables are often inconsistent with the theory[32].

This work uses Euler equations to analyse the importance of financial constraints from three angles. The first is based on the idea that the error term in the Euler equation reflects

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[32] Nickell and Nicolitsas (1996) point out that "a quick survey of five recent papers reveals that of the 70 reported Euler type equations, only 10 had point estimates of the lagged dependent variable exceeding unity". Also the previous results from the estimation of Euler equations for investment on Italian data are extremely poor. In the Euler equations estimated by Cristini (1993), the values of the lagged investment terms are usually inconsistent with the theoretical restrictions, whereas Galeotti *et al.* (1994) state that "estimating Euler equations [...] proved very hard, as variables were often wrongly signed or insignificant".

expectational errors and should be orthogonal to information available in period t-1 under the null hypothesis of perfect capital markets and rational expectations. If financial constraints bind, the Euler equation should depend on the shadow cost of external financing. The model would therefore be mis-specified and the error term from estimating the perfect-capital-markets model would not be orthogonal to variables in the information set in period t-1. Since the properties of the test of overidentifying restrictions may be poor, a second more direct test for the importance of financial constraints checks for the sign of the coefficient on the gross operating profits term. Under the null of perfect capital markets, the coefficient on the gross operating profits term should be negative. Under the alternative, investment spending is positively related to profits through the effect of financial constraints. Finally, our third set of tests takes explicit account of the likelihood that firms are heterogeneous. If imperfections in capital markets are important only for some type of firms, we should find evidence against the perfect-capital markets Euler equation model only for those firms that find it difficult both to communicate private information credibly to outside investors and to increase the supply of low cost internal funds. To test this hypothesis, similarly to what we have done in the previous section, Euler equations are estimated on samples separated according to characteristics which should capture firms' different information and liquidity positions.

The Euler equations for investment have first been estimated for the full sample of firms and for the two sub-samples of small independent firms and either large or group firms. Table 4.6 reports the regression results from the different estimators. Both the Sargan and the Sargan difference tests reject the validity of the t-2 instruments for the GMMDIF estimator [column (iii)] and the validity of the instruments in levels dated t-2 and the instruments in first differences dated t-1 for the GMMSYS estimator[33] [column (v)]. In contrast, the t-3

[33] Notice that here the GMMSYS estimator uses lagged differences of all the right-hand side variables as instruments for the equations in levels.

instruments are not rejected for the differenced estimator [column (iv)]. Likewise, the Sargan test does not reject for the system estimator the validity of the instrument set including levels of the right-hand side variables dated t-3 for the equations in first differences, and differences of the right-hand side variables dated t-2 for the equations in levels [column (vi)].

There are again differences between the regression results from the first-differenced and the system GMM estimators. The results from the former imply for each of the three samples dynamics which are estimated very imprecisely, and point estimates which are quite different from the theoretical predictions. The results from the latter do not reject the dynamics implied by the structural adjustment cost model: the coefficient estimates on the lagged dependent variable are not significantly different from one, and the lagged squared terms are less than -1. Moreover, these coefficients are estimated with greater precision. Hence, we again take the GMMSYS estimator as our preferred estimator[34].

In relation to the full sample of firms, the major discrepancy between the estimated model and the basic theoretical structure is the significant positive coefficient found for the gross operating profits variable [Table 4.6.a, column (vi)]. The theoretical model implies that the gross operating profits term should be negative, under the assumption of perfect capital markets. If the assumption that firms can raise as much as finance as they desire at a given cost is incorrect, then the gross operating profits term may reflect liquidity constraints as well as marginal profitability (given the high correlation between gross operating profits and cash flow). This apparent excess sensitivity of investment spending to gross operating profits, along with the fact that the Sargan test only marginally accepts the orthogonality conditions underlying the Euler equation specification [$\chi^2(60)=77.26$, $p=0.066$], is suggestive of a mis-

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[34] Notice, however, that the GMMDIF estimates are very similar to the GMMSYS estimates of the gross operating profits term.

specification of the model and indicative of the existence of capital-market imperfections and liquidity constraints for at least some of the firms.

To further investigate the excess sensitivity of investment to financial variables, Table 4.7 reports the regression results of the Euler equation model for firms split by *either* size *or* group membership. Interesting differences arise across these sub-samples. Validity of the orthogonality conditions is only marginally accepted for the sample of independent firms [$\chi^2(60)=78.36$, $p=0.056$], whereas it is not rejected for the sample of group firms. The gross operating profits term is positive and significant in both equations ($t=2.07$ and $t=3.24$, respectively), and is greater for the sample of independent firms[35]. These results are suggestive of a more important role played by financial factors in the investment decisions of firms that are not part of a group. As regards firms classified according to size, the gross operating profits term is positive and significant for both samples of large ($t=1.86$) and small ($t=3.72$) firms, and greater for the latter. While the overall difference in the coefficient estimates across the two samples is not particularly strong (overall p-value equal to 15.1%), the difference in the coefficients on the gross operating profits term is statistically significant ($t=2.00$). Although the Sargan statistic does not detect the presence of mis-specification in the equations for both samples, the difference in the gross operating profits coefficients is indicative of more severe financial constraints faced by firms of smaller size.

Table 4.8 also presents regression results of the Euler equation model for firms split by *both* size *and* group membership. The Sargan statistic does not reject the validity of the orthogonality conditions in any of the samples. This may reflect the fact that the power of the Sargan test to detect mis-specification is likely to fall as sample size gets smaller. As implied by the theoretical model under the assumption of perfect capital markets, the point estimate of

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[35] However, the difference in the gross operating profits terms across the two samples is not statistically significant.

the coefficient on the profits term is negatively signed in the equation for large independent firms. In contrast, it is positive and significant for the samples of large group and small independent firms, and weakly significant for the sample of small group firms. Moreover, differences in the point estimates of the profits term again indicate that mis-specification due to capital-market imperfections is more important for small firms that are not part of a group.

In Table 4.9 we analyse and compare the estimates of an Euler equation model of investment for the sample of either large or group firms and the sample of small independent firms. The perfect capital market assumption is rejected for both samples, as the gross operating profits term is positive and significant in the equation for small independent firms (t=3.28) and in the equation for either large or group firms (t=2.34). However, the point estimate is much greater for the sample of small independent firms. Indeed, the main difference in the coefficient estimates across the two subsets of firms is in the gross operating profits term. The t-value for the difference in the gross operating profits terms is 1.91, while the overall p-value of the Wald test of joint significance of the coefficient differences is only 35.4%. These findings are consistent with the econometric evidence drawn from the error correction model estimates, and suggest that the role of financial factors is particularly important in the investment decisions of small independent firms.

Overall, these results suggest that for the sample of small independent firms, informational asymmetries and incentive problems generate significant departures from the model derived under the assumption of perfect capital markets. Company investment decisions appear to be quite sensitive to the availability of internal funds. This finding appears to be robust to the more structural approach of the Euler equations. Moreover, evidence of mis-specification of the Euler equation model under the null of no financial constraints provides further support to the interpretation that a positive cash flow term in the error correction model reflects the presence of financial constraints, and not exclusively expectational influences.

Table 4.1.a

Means (standard deviations) of variables used in estimation

	Full sample	Large firms	Small firms	Group firms	Indep. firms
I_t/K_{t-1}	0.171	0.166	0.175	0.166	0.174
	(.149)	(.139)	(.159)	(.140)	(.156)
Δy_t	0.073	0.066	0.080	0.072	0.074
	(.173)	(.166)	(.180)	(.178)	(.169)
$(k\text{-}y)_{t-2}$	-1.187	-1.166	-1.209	-1.130	-1.231
	(.594)	(.579)	(.608)	(.576)	(.603)
y_{t-2}	10.466	11.249	9.661	11.193	9.903
	(1.278)	(1.222)	(.706)	(1.382)	(.832)
C_t/K_{t-1}	0.178	0.174	0.182	0.176	0.179
	(.213)	(.226)	(.199)	(.238)	(.193)
$(I/K)_{t-1}$	0.147	0.146	0.148	0.145	0.148
	(.100)	(.095)	(.105)	(.096)	(.104)
$(I/K)^2_{t-1}$	0.032	0.030	0.033	0.030	0.033
	(.041)	(.039)	(.044)	(.039)	(.043)
$(Y/K)_{t-1}$	3.706	3.578	3.837	3.478	3.882
	(2.195)	(2.120)	(2.262)	(2.045)	(2.289)
$(\Pi/K)_{t-1}$	0.342	0.329	0.355	0.322	0.357
	(.260)	(.268)	(.251)	(.275)	(.247)
No. Firms	710	351	359	315	395

Table 4.1.b

Means (standard deviations) of variables used in estimation

	Either large or group firms	Large group firms	Large independent firms	Small group firms	Small independent firms
I_t/K_{t-1}	0.167 (.141)	0.166 (.137)	0.167 (.144)	0.167 (.151)	0.177 (.161)
Δy_t	0.069 (.171)	0.067 (.173)	0.063 (.151)	0.086 (.194)	0.079 (.176)
$(k\text{-}y)_{t-2}$	-1.166 (.585)	-1.119 (.563)	-1.254 (.599)	-1.166 (.614)	-1.221 (.605)
y_{t-2}	11.000 (1.264)	11.636 (1.260)	10.522 (.714)	9.808 (.622)	9.621 (.723)
C_t/K_{t-1}	0.176 (.224)	0.173 (.246)	0.176 (.185)	0.186 (.211)	0.181 (.196)
$(I/K)_{t-1}$	0.145 (.097)	0.146 (.094)	0.145 (.099)	0.141 (.102)	0.150 (.106)
$(I/K)^2_{t-1}$	0.030 (.039)	0.030 (.038)	0.031 (.040)	0.030 (.042)	0.034 (.044)
$(Y/K)_{t-1}$	3.606 (2.133)	3.395 (1.989)	3.921 (2.307)	3.738 (2.192)	3.864 (2.281)
$(\Pi/K)_{t-1}$	0.330 (.268)	0.317 (.275)	0.350 (.252)	0.337 (.272)	0.360 (.245)
No. Firms	431	235	116	80	279

Table 4.2.a

Error correction model: full sample of firms

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
I_{t-1}/K_{t-2}	0.3181	-0.0405	-0.2519	-0.2350	-0.1587	-0.0710
	(.0159)	(.0208)	(.0617)	(.0812)	(.0637)	(.0638)
Δy_t	0.0547	0.0833	-0.0190	0.0506	0.1425	0.0470
	(.0129)	(.0141)	(.0701)	(.0709)	(.0688)	(.0749)
Δy_{t-1}	0.0964	0.1541	0.0542	0.1141	0.3803	0.1799
	(.0117)	(.0141)	(.0690)	(.0845)	(.0561)	(.0787)
$(k-y)_{t-2}$	-0.0169	-0.3397	-0.5032	-0.3635	-0.4177	-0.1690
	(.0031)	(.0145)	(.0496)	(.0656)	(.0602)	(.0485)
y_{t-2}	-0.0002	-0.1891	-0.4489	-0.3294	-0.0397	-0.0038
	(.0014)	(.0151)	(.0860)	(.1033)	(.0379)	(.0221)
C_t/K_{t-1}	0.0877	0.0215	-0.1410	-0.0073	-0.0623	0.1074
	(.0114)	(.0140)	(.0487)	(.0568)	(.0503)	(.0561)
No. Firms	710	710	710	710	710	710
Obs.	5118	4408	4408	4408	4408	4408
Df	5103	4394	4394	4394	4393	4393
sc_1 [695]	-2.465[710]	-13.544	-7.185	-5.175	-8.570	-6.148
sc_2 [663]	-1.311 [695]	1.299	1.200	-1.438	0.565	-1.516
z_1 [6]	924.47	773.41	355.16	67.47	145.99	32.34
z_2 [8]	115.75	181.94	63.00	29.93	26.25	20.39
Sargan	-	-	136.38 [101] p=0.001	76.13 [69] p=0.260	169.96 [117] p=0.001	89.52 [83] p=0.293

Validity of t-2 instruments:
(a) Difference Sargan test (GMMDIF estimators) = 60.25 [32], p = 0.002
(b) Difference Sargan test (GMMSYS estimators) = 80.44 [34], p = 0.000
Validity of the extra moment conditions exploited by the GMMSYS estimator:
Difference Sargan test (t-3 instruments) = 13.39 [14], p = 0.496

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are I_{t-2}/K_{t-3} to I_{t-5}/K_{t-6}, Δy_{t-2} to Δy_{t-5}, $(k-y)_{t-2}$ to $(k-y)_{t-5}$, and C_{t-2}/K_{t-3} to C_{t-5}/K_{t-6}.
Instruments used in column (iv) are I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (v) are: differenced equations: I_{t-2}/K_{t-3} to I_{t-5}/K_{t-6}, Δy_{t-2} to Δy_{t-5}, $(k-y)_{t-2}$ to $(k-y)_{t-5}$, and C_{t-2}/K_{t-3} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.
Instruments used in column (vi) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1996. Time dummies are included as regressors in all equations. Asymptotic standard errors are reported in parenthesis. Standard errors and test statistics are robust to general time-series and cross-section heteroskedasticity. sc_i is a test for serial correlation of order i in the first-differenced residuals [except column (i)], asymptotically standard normal. z_1 is a test of the joint significance of the reported coefficients, while z_2 is a test of the joint significance of the time dummies, asymptotically distributed as χ^2[df] under the null. Sargan is a test of the overidentifying restrictions, asymptotically distributed as χ^2[df] under the null of validity (see Sargan, 1958). All estimations carried out using Arellano and Bond (1988) DPD97 package one-step results (two-step Sargan test).

Table 4.2.b

Error correction model: sample of either large or group firms

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
I_{t-1}/K_{t-2}	0.3557	-0.0183	-0.2450	-0.3920	-0.0014	-0.0563
	(.0208)	(.0280)	(.0796)	(.1169)	(.0601)	(.0852)
Δy_t	0.0409	0.0652	-0.0873	-0.0494	0.0970	0.0700
	(.0169)	(.0179)	(.0648)	(.0692)	(.0638)	(.0623)
Δy_{t-1}	0.0866	0.1258	-0.0631	-0.0698	0.2872	0.1363
	(.0144)	(.0169)	(.0803)	(.0953)	(.0503)	(.0687)
$(k-y)_{t-2}$	-0.0198	-0.3153	-0.4585	-0.4706	-0.2384	-0.1603
	(.0038)	(.0161)	(.0570)	(.0859)	(.0434)	(.0440)
y_{t-2}	0.0009	-0.1933	-0.5272	-0.6413	0.0377	0.0192
	(.0017)	(.0181)	(.1033)	(.1432)	(.0289)	(.0272)
C_t/K_{t-1}	0.0667	0.0107	-0.1518	-0.1280	-0.0179	0.0431
	(.0123)	(.0154)	(.0605)	(.0743)	(.0482)	(.0513)
No. Firms	431	431	431	431	431	431
Obs.	3136	2705	2705	2705	2705	2705
df	3121	2691	2691	2691	2690	2690
sc_1 [425]	-2.681 [431]	-9.955	-5.188	-2.057	-8.106	-4.581
sc_2 [408]	-0.102 [425]	1.007	0.746	-0.661	0.229	-0.987
z_1 [6]	566.78	590.16	225.15	43.76	93.14	24.46
z_2 [8]	85.99	134.80	48.03	36.52	17.20	23.03
Sargan	-	-	111.29 [101] p=0.227	72.08 [69] p=0.376	146.43 [117] p=0.034	93.53 [83] p=0.202

Validity of t-2 instruments:
(a) Difference Sargan test (GMMDIF estimators) = 47.10 [32], p = 0.042
(b) Difference Sargan test (GMMSYS estimators) = 52.90 [34], p = 0.020
Validity of the extra moment conditions exploited by the GMMSYS estimator:
Difference Sargan test (t-3 instruments) = 21.45 [14], p = 0.091

See Table 4.2.a

Table 4.2.c

Error correction model: sample of small independent firms

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
I_{t-1}/K_{t-2}	0.2665	-0.0741	-0.4095	-0.4385	-0.2438	-0.1840
	(.0239)	(.0294)	(.0794)	(.1019)	(.0990)	(.0860)
Δy_t	0.0709	0.1136	0.2045	0.0505	0.0928	0.0693
	(.0203)	(.0226)	(.0972)	(.1293)	(.0906)	(.1082)
Δy_{t-1}	0.1132	0.2025	0.2700	0.3821	0.2324	0.2379
	(.0197)	(.0236)	(.1070)	(.1198)	(.1080)	(.0985)
$(k-y)_{t-2}$	-0.0098	-0.3828	-0.7200	-0.5720	-0.4850	-0.1548
	(.0053)	(.0277)	(.0804)	(.1114)	(.1114)	(.0713)
y_{t-2}	0.0039	-0.1791	-0.4090	-0.2615	-0.2420	-0.0397
	(.0043)	(.0260)	(.1195)	(.1676)	(.1168)	(.0557)
C_t/K_{t-1}	0.1314	0.0378	0.1441	0.1735	0.0946	0.3006
	(.0222)	(.0284)	(.0603)	(.1009)	(.1113)	(.1173)
No. Firms	279	279	279	279	279	279
Obs.	1982	1703	1703	1703	1703	1703
df	1967	1689	1689	1689	1688	1688
sc_1 [270]	-0.776 [279]	-9.168	-5.211	-3.554	-5.526	-3.975
sc_2 [255]	-2.037 [270]	0.939	1.453	-1.677	0.073	-2.662
z_1 [6]	392.11	273.31	162.33	66.55	59.83	21.82
z_2 [8]	37.77	63.54	48.23	17.53	15.68	10.91
Sargan	-	-	110.39 [101]	63.03 [69]	115.45 [117]	66.41 [83]
			p=0.246	p=0.679	p=0.239	p=0.909

Validity of t-2 instruments:
(a) Difference Sargan test (GMMDIF estimators) = 47.36 [32], p = 0.039
(b) Difference Sargan test (GMMSYS estimators) = 49.04 [34], p = 0.046
Validity of the extra moment conditions exploited by the GMMSYS estimator:
Difference Sargan test (t-3 instruments) = 3.38 [14], p = 0.998

See Table 4.2.a

Table 4.3

Error correction model: GMMSYS estimator

I_t/K_{t-1}	(i) Large firms	(ii) Small firms	(iii) Differences (i) - (ii)	(iv) Group firms	(v) Indep. firms	(vi) Differences (iv) - (v)
I_{t-1}/K_{t-2}	-0.0757	-0.1400	0.0643	-0.0305	-0.1291	0.0987
	(.0869)	(.0791)	(.1176)	(.0953)	(.0741)	(.1207)
Δy_t	0.0392	0.0342	0.0050	0.0414	0.0967	-0.0553
	(.0648)	(.0909)	(.1116)	(.0616)	(.0958)	(.1139)
Δy_{t-1}	0.1264	0.1195	0.0069	0.0711	0.2991	-0.2279
	(.0726)	(.0854)	(.1121)	(.0778)	(.0892)	(.1184)
$(k-y)_{t-2}$	-0.2016	-0.1341	-0.0676	-0.1222	-0.1468	0.0245
	(.0568)	(.0590)	(.0819)	(.0487)	(.0617)	(.0786)
y_{t-2}	0.0858	-0.0558	0.1416	0.0087	-0.0527	0.0606
	(.0402)	(.0451)	(.0605)	(.0251)	(.0420)	(.0489)
C_t/K_{t-1}	0.0394	0.1307	-0.0913	0.1211	0.2305	-0.1094
	(.0622)	(.0874)	(.1073)	(.0506)	(.0948)	(.1074)
No. Firms	351	359	710	315	395	710
Obs.	2243	2165	4408	1918	2490	4408
Df	2228	2150	4378	1903	2475	4378
sc_1	-4.424 [347]	-4.439 [348]	-6.241 [695]	-3.924 [310]	-5.081 [385]	-6.393 [695]
sc_2	-0.933 [337]	-2.243 [326]	-2.362 [663]	-1.947 [294]	-1.898 [369]	-2.627 [663]
z_1 [6]	28.61	12.14	-	18.31	26.54	-
z_2 [8]	21.45	14.74	-	27.17	8.99	-
Sargan	78.79 [83]	71.90 [83]	150.69 [166]	81.07 [83]	80.43 [83]	161.51 [166]
	p=0.610	p=0.803	p=0.797	p=0.539	p=0.559	p=0.584
Wald [6]	-	-	9.09	-	-	8.95
			p=0.169			p=0.584

Column (iii) presents the coefficient differences across the sample of large firms and the sample of small firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is zero when a firm is large, and one when a firm is small.
Column (vi) presents the coefficient differences across the sample of group firms and the sample of independent firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is zero when a firm is part of a group, and one when a firm is independent
Interactions of the dummy variables with time dummies are included in both cases. Wald is a test for differences across regimes.

GMMSYS estimates.
Time dummies included as instruments in all equations. Instruments used in columns (i), (ii), (iv) and (v) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. In columns (iii) and (vi) the interactions of the dummy variables with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1989-1996. See also notes for Table 4.2.a

Table 4.4

Error correction model: GMMSYS estimator

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	Large group firms	Large indep. firms	Differences (i) - (ii)	Small group firms	Small indep. firms	Differences (iv) - (v)
I_{t-1}/K_{t-2}	-0.0420	-0.2139	0.1719	-0.1175	-0.1840	0.0665
	(.0902)	(.0910)	(.1282)	(.1242)	(.0860)	(.1511)
Δy_t	-0.0008	0.1430	-0.1437	0.0877	0.0693	0.0184
	(.0641)	(.0877)	(.1086)	(.0921)	(.1082)	(.1421)
Δy_{t-1}	0.0545	0.1970	-0.1426	0.0431	0.2379	-0.1948
	(.0661)	(.0906)	(.1122)	(.0818)	(.0985)	(.1281)
$(k-y)_{t-2}$	-0.1641	-0.2038	0.0397	-0.0720	-0.1548	0.0828
	(.0512)	(.0675)	(.0848)	(.0670)	(.0713)	(.0978)
y_{t-2}	0.0437	0.0579	-0.0142	-0.0612	-0.0397	-0.0215
	(.0340)	(.0498)	(.0603)	(.0607)	(.0557)	(.0824)
C_t/K_{t-1}	0.1067	0.0480	0.0587	0.0012	0.3006	-0.2994
	(.0560)	(.1083)	(.1220)	(.0782)	(.1173)	(.1410)
No. Firms	235	116	351	80	279	359
Obs.	1456	787	2243	462	1703	2165
df	1441	772	2213	447	1688	2135
sc_1	-4.108 [232]	-3.615 [115]	-5.470 [347]	-2.280 [78]	-3.975 [270]	-4.507 [348]
sc_2	-2.351 [223]	-0.046 [114]	-1.847 [337]	-1.072 [71]	-2.662 [255]	-2.863 [326]
z_1 [6]	28.23	21.56	-	4.93	21.82	-
z_2 [8]	31.24	13.09	-	17.87	10.91	-
Sargan	75.47 [83]	86.65 [83]	162.12 [166]	67.17 [83]	66.41 [83]	132.58 [166]
	p=0.709	p=0.370	p=0.571	p=0.897	p=0.909	p=0.974
Wald [6]	-	-	4.17	-	-	11.08
			p=0.653			p=0.086

Column (iii) presents the coefficient differences across the sample of large group firms and the sample of large independent firms, obtained by interacting all right-hand side variables in the equation for the sample of large firms with a dummy variable which is zero when a firm is part of a group, and one when a firm is independent.
Column (vi) presents the coefficient differences across the sample of small group firms and the sample of small independent firms, obtained by interacting all right-hand side variables in the equation for the sample of small firms with a dummy variable which is zero when a firm is part of a group, and one when a firm is independent.
Interactions of the dummy variables with time dummies are included in both cases. Wald is a test for differences across regimes.

GMMSYS estimates: see Table 4.3

Notes. Sample period: 1989-1996. See also notes for Table 4.2.a

Table 4.5

Error correction model: GMMSYS estimator

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	Either large or group firms	Small indep. firms	Differences (ii) - (iii)	Full sample
I_{t-1}/K_{t-2}	-0.0563	-0.1840	0.1310	-0.1491
	(.0852)	(.0860)	(.1211)	(.0623)
Δy_t	0.0700	0.0693	0.0003	0.0908
	(.0623)	(.1082)	(.1249)	(.0711)
Δy_{t-1}	0.1363	0.2379	-0.1045	-0.2082
	(.0687)	(.0985)	(.1201)	(.0759)
$(k-y)_{t-2}$	-0.1603	-0.1548	-0.0032	-0.2148
	(.0440)	(.0713)	(.0836)	(.0536)
y_{t-2}	0.0192	-0.0397	0.0590	0.0010
	(.0272)	(.0557)	(.0619)	(.0256)
C_t/K_{t-1}	0.0431	0.3006	-0.2501	-
	(.0513)	(.1173)	(.1279)	
$I[D_i=0]\cdot C_t/K_{t-1}$	-	-	-	0.0202
				(.0624)
$I[D_i=1]\cdot C_t/K_{t-1}$	-	-	-	0.2482
				(.1112)
No. Firms	431	279	710	710
Obs.	2705	1703	4408	4408
Df	2690	1688	4378	4392
sc_1	-4.581 [425]	-3.975 [270]	-6.073 [695]	-5.936 [695]
sc_2	-0.987 [408]	-2.662 [255]	-2.571 [663]	-2.016 [663]
Sargan	93.53 [83]	66.41 [83]	159.43 [166]	106.92 [100]
	p=0.202	p=0.909	p=0.629	p=0.300
Wald [6]	-	-	8.76 p=0.187	

Column (iii) presents the coefficient differences across the sample of either large or group firms and the sample of small and independent firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is zero when a firm is either large or part of a group, and one when a firm is both small and independent. Interactions of the dummy variable with time dummies are also included. Wald is a test for differences across regimes.
In column (iv) the cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. $D_i=0$ identifies either large or group firms, $D_i=1$ small independent firms.

GMMSYS estimates.
Time dummies included as instruments in all equations. Instruments used in all columns are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. In column (iii) the interactions of the dummy variables with the right-hand side variables and the time dummies are also included in the instrument set. In column (iv) the interactions of the dummy variables with the cash flow term are also included in the instrument set.

Notes. Sample period: 1989-1996. See also notes for Table 4.2.a

Table 4.6.a

Euler equation model: full sample of firms

$(I/K)_t$	(i) OLS levels	(ii) Within Groups	(iii) GMMDIF	(iv) GMMDIF	(v) GMMSYS	(vi) GMMSYS
$(I/K)_{t-1}$	0.5932	0.2073	0.2842	0.4848	0.2883	1.0161
	(.0406)	(.0447)	(.0713)	(.3289)	(.0798)	(.2016)
$(I/K)^2_{t-1}$	-0.5316	-0.0118	0.0964	-0.6986	0.0104	-1.9242
	(.1023)	(.1084)	(.1634)	(.7284)	(.1827)	(.5072)
$(Y/K)_{t-1}$	0.0030	0.0842	0.0677	0.0277	0.0890	0.0286
	(.0017)	(.0068)	(.0145)	(.0271)	(.0098)	(.0112)
$(\Pi/K)_{t-1}$	0.0635	-0.0149	-0.0040	0.0902	-0.0169	0.1059
	(.0083)	(.0127)	(.0189)	(.0389)	(.0212)	(.0311)
No. Firms	710	710	710	710	710	710
Obs.	5828	5118	5118	5118	5118	5118
Df	5814	5105	5105	5105	5104	5104
sc_1 [710]	-3.403 [710]	-15.593	-14.869	-6.391	-14.816	-8.410
sc_2 [695]	-0.541 [710]	-0.360	1.023	-0.288	0.851	-0.280
z_1 [4]	1106.60	339.79	278.64	23.29	1078.30	343.87
z_2 [9]	211.13	133.33	104.83	61.48	102.83	65.53
Sargan	-	-	140.93 [64] p=0.000	28.06 [28] p=0.461	180.58 [100] p=0.000	77.26 [60] p=0.066

Validity of t-2 instruments:
(a) Difference Sargan test (GMMDIF estimators) = 112.87 [36], p = 0.000
(b) Difference Sargan test (GMMSYS estimators) = 103.32 [40], p = 0.000
Validity of the extra moment conditions exploited by the GMMSYS estimator:
Difference Sargan test (t-3 instruments) = 49.02 [32], p = 0.028

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (i) are $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$.
Instruments used in column (ii) are $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are: differenced equations: $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-1}$, $\Delta(I/K)^2_{t-1}$, $\Delta(Y/K)_{t-1}$, and $\Delta(\Pi/K)_{t-1}$.
Instruments used in column (iv) are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.

Notes. Sample period: 1988-1996. See also notes for Table 4.2.a

Table 4.6.b

Euler equation model: either large or group firms

$(I/K)_t$	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
$(I/K)_{t-1}$	0.6225	0.2096	0.2906	0.6402	0.2947	1.0745
	(.0505)	(.0559)	(.0870)	(.4546)	(.1067)	(.2422)
$(I/K)^2_{t-1}$	-0.5141	0.0357	0.1081	-0.8368	0.0027	-1.9869
	(.1331)	(.1379)	(.2045)	(1.0266)	(.2426)	(.6300)
$(Y/K)_{t-1}$	0.0060	0.0819	0.0696	0.0149	0.0823	0.0234
	(.0023)	(.0080)	(.0128)	(.0257)	(.0126)	(.0129)
$(\Pi/K)_{t-1}$	0.0484	-0.0246	-0.0282	0.0531	-0.0023	0.0741
	(.0095)	(.0154)	(.0204)	(.0417)	(.0232)	(.0316)
No. Firms	431	431	431	431	431	431
Obs.	3567	3136	3136	3136	3136	3136
Df	3553	3123	3123	3123	3122	3122
sc_1 [431]	-3.593 [431]	-11.661	-11.417	-5.353	-10.721	-6.967
sc_2 [425]	0.126 [431]	0.004	0.847	0.331	0.742	0.069
z_1 [4]	783.79	246.71	193.34	15.60	837.67	268.29
z_2 [9]	141.18	107.66	91.44	61.54	84.54	60.86
Sargan	-	-	101.19 [64] p=0.002	27.76 [28] p=0.477	142.47 [100] p=0.003	55.10 [60] p=0.655

Validity of t-2 instruments:
(a) Difference Sargan test (GMMDIF estimators) = 73.43 [36], p = 0.000
(b) Difference Sargan test (GMMSYS estimators) = 87.37 [40], p = 0.000
Validity of the extra moment conditions exploited by the GMMSYS estimator:
Difference Sargan test (t-3 instruments) = 27.34 [32], p = 0.702

See Table 4.6.a

Table 4.6.c

Euler equation model: small independent firms

$(I/K)_t$	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
$(I/K)_{t-1}$	0.5429	0.2026	0.2483	0.1378	0.3849	0.7201
	(.0644)	(.0700)	(.1170)	(.3749)	(.1070)	(.2531)
$(I/K)^2_{t-1}$	-0.5415	-0.0622	0.1080	-0.2740	-0.2537	-1.3784
	(.1548)	(.1656)	(.2612)	(.7839)	(.2558)	(.5949)
$(Y/K)_{t-1}$	-0.0018	0.0868	0.0944	0.0464	0.0789	0.0249
	(.0026)	(.0122)	(.0337)	(.0576)	(.0123)	(.0128)
$(\Pi/K)_{t-1}$	0.0995	0.0083	0.0091	0.1822	-0.0040	0.2105
	(.0133)	(.0196)	(.0379)	(.0798)	(.0375)	(.0641)
No. Firms	279	279	279	279	279	279
Obs.	2261	1982	1982	1982	1982	1982
Df	2247	1969	1969	1969	1968	1968
sc_1 [279]	-1.259 [279]	-10.294	-9.373	-4.003	-10.971	-5.650
sc_2 [270]	-1.191 [279]	-0.591	0.476	-1.419	0.302	-0.684
z_1 [4]	412.80	124.84	114.47	13.70	306.29	102.40
z_2 [9]	74.46	41.96	29.46	17.85	31.21	21.19
Sargan	-	-	104.55 [64] p=0.001	24.21 [28] p=0.670	148.75 [100] p=0.001	69.86 [60] p=0.180

Validity of t-2 instruments:
(a) Difference Sargan test (GMMDIF estimators) = 80.34 [36], p = 0.000
(b) Difference Sargan test (GMMSYS estimators) = 78.89 [40], p = 0.000
Validity of the extra moment conditions exploited by the GMMSYS estimator:
Difference Sargan test (t-3 instruments) = 45.65 [32], p = 0.056

See Table 4.6.a

Table 4.7

Euler equation model: GMMSYS estimator

$(I/K)_t$	(i) Large firms	(ii) Small firms	(iii) Differences (i) - (ii)	(iv) Group firms	(v) Indep. Firms	(vi) Differences (iv) - (v)
$(I/K)_{t-1}$	0.8935	0.8404	0.0531	1.0829	0.9789	0.1040
	(.2039)	(.2395)	(.3145)	(.2418)	(.2502)	(.3480)
$(I/K)^2_{t-1}$	-1.5127	-1.5799	0.0672	-1.9754	-1.9291	-0.0463
	(.5478)	(.5894)	(.8047)	(.6569)	(.6126)	(.8982)
$(Y/K)_{t-1}$	0.0412	0.0123	0.0289	0.0052	0.0387	-0.0335
	(.0116)	(.0106)	(.0157)	(.0130)	(.0129)	(.0183)
$(\Pi/K)_{t-1}$	0.0626	0.1807	-0.1181	0.0991	0.1238	-0.0247
	(.0336)	(.0486)	(.0591)	(.0306)	(.0599)	(.0672)
No. firms	351	359	710	315	395	710
Obs.	2594	2524	5118	2233	2285	5118
Df	2580	2510	5090	2219	2871	5090
sc_1	-6.150 [351]	-6.630 [359]	-9.028 [710]	-6.545 [315]	-6.618 [395]	-8.977 [710]
sc_2	-0.132 [347]	-0.180 [348]	-0.223 [695]	-1.021 [310]	0.087 [385]	-0.468 [695]
z_1 [4]	315.38	92.34	-	154.53	200.95	-
z_2 [9]	48.93	29.77	-	43.90	37.67	-
Sargan	60.54 [60]	69.66 [60]	130.19 [120]	71.26 [60]	78.36 [60]	140.62 [120]
	p=0.456	p=0.184	p=0.247	p=0.152	p=0.056	p=0.035
Wald [4]	-	-	6.73	-	-	6.91
			p=0.151			p=0.141

Column (iii) presents the coefficient differences across the sample of large firms and the sample of small firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is zero when a firm is large, and one when a firm is small.
Column (vi) presents the coefficient differences across the sample of group firms and the sample of independent firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is zero when a firm is part of a group, and one when a firm is independent.
Interactions of the dummy variables with time dummies are included in both cases. Wald is a test for differences across regimes.

GMMSYS estimates.
Time dummies included as instruments in all equations. Instruments used in columns (i), (ii), (iv) and (v) are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$. In column (iii) and (vi) the interactions of the dummy variables with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1988-1996. See also notes for Table 4.2.a

Table 4.8

Euler equation model: GMMSYS estimator

$(I/K)_t$	(i) Large group firms	(ii) Large indep. firms	(iii) Differences (i) - (ii)	(iv) Small group firms	(v) Small indep. firms	(vi) Differences (iv) - (v)
$(I/K)_{t-1}$	0.7805	1.3153	-0.5348	0.8590	0.7201	0.1389
	(.2137)	(.3065)	(.3736)	(.3752)	(.2531)	(.4526)
$(I/K)^2_{t-1}$	-1.3023	-2.9891	1.6868	-1.0819	-1.3784	0.2965
	(.5917)	(.7753)	(.9753)	(.9576)	(.5949)	(1.1273)
$(Y/K)_{t-1}$	0.0388	0.0551	-0.0163	0.0039	0.0249	-0.0210
	(.0138)	(.0154)	(.0207)	(.0105)	(.0128)	(.0166)
$(\Pi/K)_{t-1}$	0.0836	-0.0444	0.1280	0.0983	0.2105	-0.1122
	(.0328)	(.0729)	(.0799)	(.0563)	(.0641)	(.0853)
No. firms	235	116	351	80	279	359
Obs.	1691	903	2594	542	1982	2524
Df	1677	889	2566	528	1968	2496
sc_1	-5.746 [235]	-4.620 [116]	-7.310 [351]	-4.344 [80]	-5.650 [279]	-6.960 [359]
sc_2	-1.938 [232]	0.562 [115]	-1.023 [347]	1.186 [78]	-0.684 [270]	-0.132 [348]
z_1 [4]	203.12	87.81	-	18.53	102.40	-
z_2 [9]	37.19	40.08	-	20.58	21.19	-
Sargan	56.01 [60]	61.36 [60]	117.32 [120]	56.58 [60]	69.84 [60]	127.39 [120]
	p=0.622	p=0.427	p=0.552	p=0.601	p=0.180	p=0.305
Wald [4]	-	-	6.24	-	-	6.93
			p=0.182			p=0.139

Column (iii) presents the coefficient differences across the sample of large group firms and the sample of large independent firms, obtained by interacting all right-hand side variables in the equation for the sample of large firms with a dummy variable which is zero when a firm is part of a group, and one when a firm is independent.
Column (vi) presents the coefficient differences across the sample of small group firms and the sample of small independent firms, obtained by interacting all right-hand side variables in the equation for the sample of small firms with a dummy variable which is zero when the firm is part of a group, and one when the firm is independent.
Interactions of the dummy variables with time dummies are included in both cases. Wald is a test for differences across regimes.

GMMSYS estimates: see Table 4.7

Notes. Sample period: 1988-1996. See also notes for Table 4.2.a

Table 4.9

Euler equation model: GMMSYS estimator

$(I/K)_t$	(i)	(ii)	(iii)
	Either large or group firms	Small indep. firms	Differences (ii) - (iii)
$(I/K)_{t-1}$	1.0745	0.7201	0.3545
	(.2422)	(.2531)	(.3503)
$(I/K)^2_{t-1}$	-1.9869	-1.3784	-0.6086
	(.6300)	(.5949)	(.8665)
$(Y/K)_{t-1}$	0.0234	0.0249	-0.0015
	(.0129)	(.0128)	(.0182)
$(\Pi/K)_{t-1}$	0.0741	0.2105	-0.1363
	(.0316)	(.0641)	(.0714)
No. firms	431	279	710
Obs.	3136	1982	5118
df	3122	1968	5090
sc_1	-6.967 [431]	-5.650 [279]	-8.953 [710]
sc_2	0.069 [425]	-0.684 [270]	-0.417 [695]
z_1 [4]	268.29	102.40	-
z_2 [9]	60.86	21.19	-
Sargan	55.10 [60]	69.87 [60]	124.96 [120]
	p=0.655	p=0.180	p=0.360
Wald [4]	-	-	4.41
			p=0.354

Column (iii) presents the coefficient differences across the sample of either large or group firms and the sample of small and independent firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is zero when a firm is either large or part of a group, and one when a firm is both small and independent. Interactions of the dummy variable with time dummies are also included. Wald is a test for differences across regimes.

GMMSYS estimates: see Table 4.7

Notes. Sample period: 1988-1996. See also notes for Table 4.2.a

5. Conclusions

Capital market imperfections may cause investment activity to depend on the availability of internal funds. Whether such constraints exist is an important empirical issue. Evidence on this issue provides insight into investment behaviour by the firm and contributes to the understanding of business cycles.

The present study uses panel data for Italian company accounts over the period 1986 to 1996 to estimate two different empirical models of company investment, which allows us to consider the sensitivity of the empirical findings to the choice of model specification. The first model we estimate is an error correction model, to which a cash flow term, proxying for internal net worth, is added to investigate the impact of financial constraints on investment. Since in the error correction specification such additional financial variables can reflect information that affects expectations of future profitability rather than simply the impact of liquidity constraints, we also estimate an Euler equation model explicitly derived from a dynamic optimisation problem in the presence of symmetric, quadratic costs of adjustment. Under this assumed structure and the assumption of rational expectations, the Euler equation model has the advantage of controlling for all expectational influences on the investment decision, so that significant evidence of mis-specification associated with profit variables is more likely to reflect the effect of capital market imperfections on firms' investment spending.

For the full sample of 710 manufacturing firms, the regression results from a system GMM estimator provide evidence of the existence of financial constraints on investment spending. On the one hand, the coefficient estimate of the cash flow term in the error correction specification is found to be significantly positive. On the other hand, the Euler equation model derived under the null of financial constraints is strongly rejected: although the dynamics implied by the adjustment-cost model are not rejected by the data and we allow for imperfect

competition, the gross operating profits term has the wrong sign for the Euler equation interpretation of the model.

Following Fazzari, Hubbard and Petersen (1988), Hoshi, Kashyap and Scharfstein (1991) and others, we also employ a split-sample approach, dividing the full sample of firms according to size and form of control. We posit that firms that are in a strong position to communicate private information credibly to outside investors and/or are able to increase the supply of low cost internal finance (large firms, group members) are less likely to face financial constraints than firms in a weak informational and liquidity position (small firms, independent firms). Our findings appear to be consistent with these a priori hypotheses. In the estimates for the error correction model, we find a strong effect from cash flow for the sample of small independent firms, whereas we find no effect from cash flow for the sample of either large or group firms. At the same time, the regression results for the Euler equation model suggest that there are important departures from the perfect-capital-market specification for small independent firms.

Estimates of both the error correction and the Euler equation models indicate that the assumption of perfect capital markets cannot be rejected for the samples of large independent and small group firms. The regression results for the sample of large group firms are somewhat puzzling. Both the cash flow term in the error correction specification and the gross operating profits term in the Euler equation appear to be significantly positive, even though the point estimates are lower than in the equations for the sample of small independent firms. One explanation for this result might come from the principle-agent theory. The literature on asymmetric information suggests that the positive correlation between cash flow and investment may result from costly external finance, so that a fall in cash flow, given unchanged investment opportunities, may result in lower investment. On the other hand, principal-agent models (such as Jensen, 1986) suggest that imperfectly monitored managers

may over-invest free cash flow, so that a fall in internal funds may reduce wasteful expenditures and unprofitable investment. Indeed, large diversified companies are often cited as a possible case in which firms tend to over-invest, and the effect of cash flow on investment for large group companies may be a reflection of this.

Apart from improving the understanding of investment behaviour, quantitatively important financial constraints on firms' investment spending carry substantial implications for public policy. Several authors have highlighted the role of financial structure as a propagation mechanism amplifying macroeconomic shocks. Consistent with our findings, recent empirical literature for the United States (Gertler and Gilchrist, 1994) and Italy (Rondi *et al.*, 1993) suggests that sales, inventories and the amount of debt received by small firms decrease more sharply relative to large firms in response to monetary tightening and "credit crunches". Since the firms which appear to face binding financial constraints on investment (i.e. small independent firms) represent the most numerous (and, supposedly, the most dynamic) part of the Italian manufacturing sector, both the introduction of new financial instruments and the adoption of policies designed to circumvent information barriers could potentially help to reduce business cycle fluctuations in Italy. As a matter of fact, one of the aims of both the recent reform of corporation tax and the ongoing reform of company law in Italy is the reduction of cost differences between different sources of finance and the definition of new clear rules for company structure and the relationships between firm insiders and outside investors.

APPENDIX A

The following questions are part of the Mediocredito Centrale questionnaire, as reported in Ministero dell'Industria and Mediocredito Centrale, "Indagine sulle imprese manifatturiere. Sesto rapporto sull'industria italiana e sulla politica industriale", 1997.

5.1

Agents (anonymous)	Capital share held by the agent with the right to vote in a shareholders' meeting	Does the agent control the company?
Agent (a)	☐ %	☐ yes ☐ no
Agent (b)	☐ %	☐ yes ☐ no
Agent (c)	☐ %	☐ yes ☐ no
Other agents	☐ %	☐ yes ☐ no
Total	100 %	

5.2 In the case in which the company is controlled by more than one individual, indicate whether there is a family tie among the individuals sharing the direct control of the firm.

☐ No ☐ Only among few individuals ☐ Yes, among all individuals

6.1 Does the firm belong to a group?

☐ No ☐ Yes

6.2 If the firm belongs to a group, the firm is

☐ the holding company

☐ in an intermediate position (the firm is controlled but, at the same time, controls other firms belonging to the group)

☐ only controlled

Chapter 5

Financial Constraints and R&D Investment: Evidence from Italian Panel Data

1. Introduction

The theory of asymmetric information in capital markets implies that firms that cannot credibly communicate the true value of new projects to outside investors may face greater financial constraints than firms in a strong information position. Investment in research and development represents a case in which information asymmetries between firms and suppliers of external finance are likely to be more severe.

There are various theoretical arguments that provide an explanation as to why information and incentive problems should be particularly relevant for R&D investment. Since past experience can offer little guidance in assessing the prospects of R&D and innovation-based physical investment, outside investors find it difficult to sort out good and bad innovative projects. In addition, even when firms can costlessly transmit information to outsiders, strategic considerations may induce firms to maintain information asymmetries. As Bhattacharya and Ritter (1983) point out, firms may have little incentive to communicate information on an innovative project to outside lenders, fearing its disclosure to potential rivals[1]. Finally, expenditure on R&D can only be backed by the (highly uncertain) revenue

[1] Levin *et al.* (1987) report that in most industries in the United States firms consider secrecy an important way to protect their intellectual property, since patent protection is viewed as an ineffective method of appropriating the returns to R&D.

that it generates, since an R&D project that fails generally leaves behind few tangible assets of value. Therefore, lenders prefer to use physical assets to secure loans and may be reluctant to lend when the project involves substantial R&D investment rather than investment in plant, machinery and especially buildings.

Information asymmetries in the capital markets explain why firms can find it difficult to obtain adequate external financing for R&D, and innovative projects are primarily funded by current profits and accumulated funds. This underlies the view that a firm must possess some monopoly power, along with the associated monopoly profits, for it to carry on doing R&D.

Despite the strong a priori beliefs, previous studies on R&D emphasising financial considerations provide little evidence that R&D spending is significantly affected by internal finance. With the exception of Gabrowski (1968), tests based on cross sectional data, such as Scherer (1965), Mueller (1967) and Elliott (1971), find no significant effect of corporate financial liquidity on R&D spending. Recent studies based on panel data have been somewhat more successful. Work by Hall (1992), Hao and Jaffe (1993), and Himmelberg and Petersen (1994) on US data find that R&D expenditure is positively related to the firms' internal finance. Bond *et al.* (1999), however, find no cash flow effect on R&D spending for samples of both British and German companies.

The absence of robust findings concerning the role of internal finance has several possible explanations. Accounting measures of cash flow (used as a proxy for the change in internal finance in most of the empirical studies) may be misleading to the extent that R&D and other investments in intangible capital are expensed and not capitalised [Gabrowski and Mueller (1978)]. Moreover, estimates of the cash flow effect on R&D spending may be influenced by the likely existence of high adjustment costs for R&D[2]. Since an R&D programme often

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[2] Hiring and firing of research workers is costly because researchers require a great deal of firm-specific knowledge, training new workers is expensive and, perhaps more importantly, fired specialists can transmit valuable knowledge to competitors who hire them (see, for example, Grabowski, 1968, Pakes and Nitzan, 1983,

involves significant sunk costs, and large fluctuations in R&D investment are very costly, current R&D expenditure may be relatively unresponsive to "transitory" changes in the flow of internal funds.

Himmelberg and Petersen (1994) address the latter problem by analysing the relationship between R&D expenditure and "permanent" cash flow for a panel of small US firms in high-tech industries. Alternatively, the role of financial constraints can be better understood by investigating firms' R&D participation decisions. In the presence of a significant wedge between the cost of internal and external finance, a firm having (and expecting to have) strong cash flow should be more likely to set up R&D facilities than firms in a weak liquidity position, because they do not (expect to) have to rely on more expensive external funds. The importance of capital market imperfections can therefore also be tested by comparing the relationship between internal finance and fixed investment separately for samples of R&D performing and non-R&D performing companies. If there is a significant cost premium for external finance, the firms that do engage in R&D should consist primarily of firms that display a lower sensitivity of fixed investment to cash flow, that is, firms who are less likely to encounter binding financial constraints.

The remainder of the chapter is organised as follows. Section 2 presents some stylised facts on technological change in Italy. Based on the Mediocredito Centrale data, Section 3 provides detailed information on R&D investment in the Italian manufacturing sector. Section 4 exâmines the relationship between innovative investment and firm finance. The main econometric results are reported in Section 5, where fixed investment equations are estimated for samples of R&D and non-R&D performing firms. Section 6 presents probit models of R&D participation. Section 7 offers some concluding comments.

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and Levin *et al.*, 1987). Bernstein and Nadiri (1989) estimate that marginal adjustment costs for R&D are higher than marginal adjustment costs for physical investment in all four of the two-digit US industries they analyse.

2. R&D investment in Italy

An important feature of the Italian production system is the low share of high technology spending when compared with that of the main trading partners. Among G7 countries Italy has the lowest R&D intensity (measured by the ratio of business enterprise R&D to production), with the share of R&D spending financed by industry being particularly low (Table 2.1). Other technological indicators, like patents (Figure 2.1) or trade of high-tech products, confirm the low degree of technological innovation in Italy.

The technological gap between Italy and other developed countries is a structural one, and has accompanied the development of the Italian economy in the period after the Second World War. This gap may be attributed to three main causes. First, the industrialisation process in Italy started later than in other European countries. Second, because the bulk of Italian manufacturing firms is represented by small and medium-sized firms, few companies can afford large R&D expenditures in the long run[3]. Third, the industrial system is historically concentrated on the production of durables with low or average technological content, with the notable exception of a few industries producing highly specialised capital goods. These factors are obviously interrelated. For example, the delayed industrialisation process caused production to be mainly concentrated on the traditional sector, which resulted in the emergence of a system characterised by a large number of small firms. At the same time, the low degree of market concentration and the high profits associated with the typical "made in Italy" products have posed an obstacle to the process of catching-up to the technological level of the most advanced countries.

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[3] The lack of institutions specialised in the financing of venture capital has contributed to reduce the ability of small and medium-sized firms to start in new lines of business, despite the potential technological and human capital spillovers existing in industrial districts.

The Italian paradox is that the long-run economic performance has been comparable to that of the technologically advanced foreign competitors. The growth rate has been similar to, if not greater than, the growth rate of other European countries. As a consequence, there has been no real pressure for a radical change to an industrial environment characterised by products with low innovative content and the importation of technological knowledge that cannot be autonomously produced.

However, in a historical phase characterised by growing economic integration and increasing global competition, it is natural to question whether such a production model can still be successful. It is therefore important to analyse in greater detail the determinants of R&D investment in Italy in order to pick up those factors that can prevent companies from undertaking innovative projects.

Table 2.1

Basic indicators of innovation activity[1] (%)

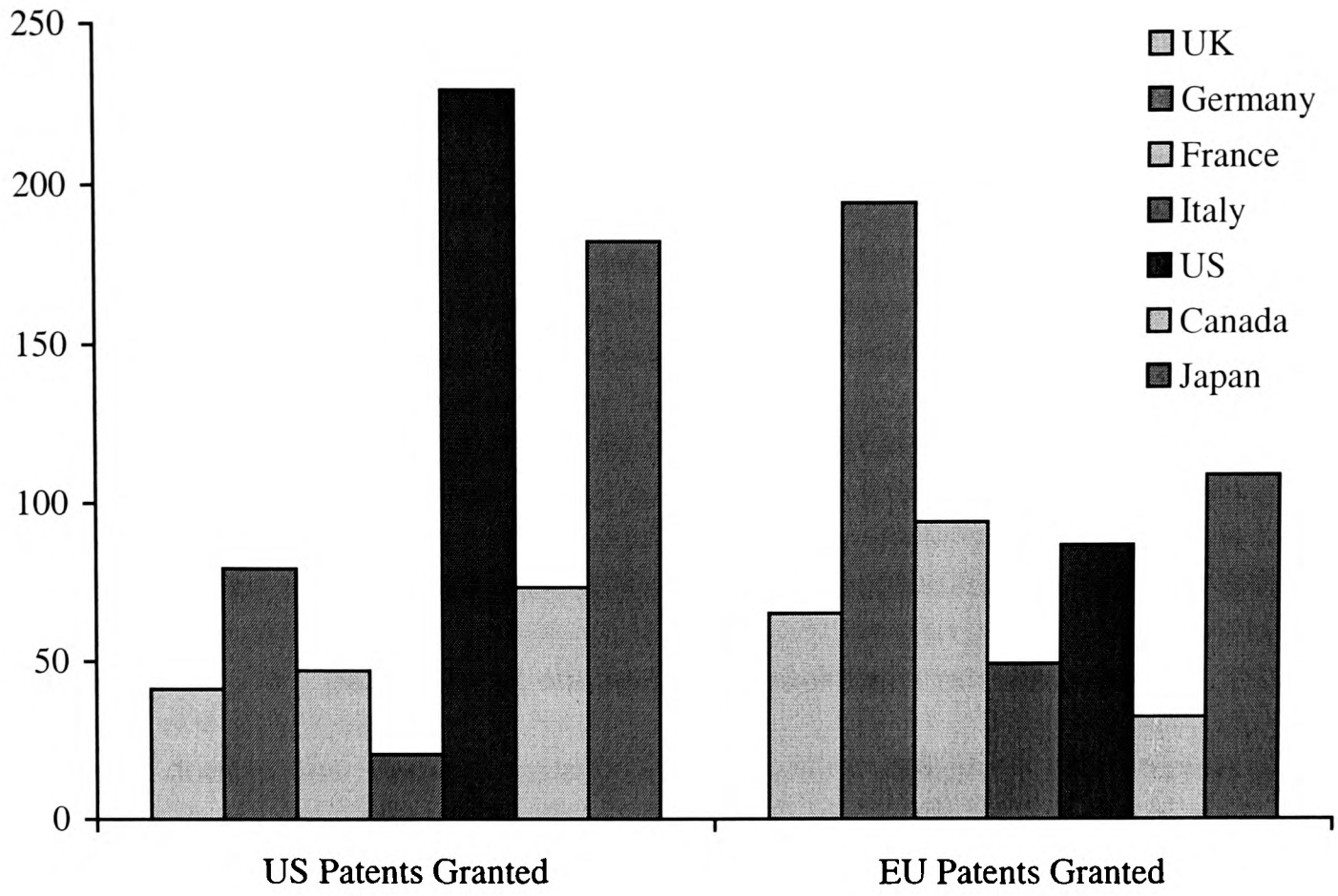
	Italy	US	Japan	Germany	France	UK	Canada
Gross domestic R&D spending (% of GDP)	1.38	2.68	2.99	2.53	2.36	2.12	1.51
Share in total OECD industrial R&D spending	3.0	45.1	20.5	9.8	6.2	5.8	1.7
Share in total OECD business R&D personnel	2.1	50.5	21.8	7.9	3.8	5.9	2.0
Share of R&D spending financed by industry	44	51	78	62	44	50	41
R&D intensity (total manufacturing)[2]	0.9	3.4	2.3	2.4	2.2	2.0	1.0
Technology balance of payments (coverage ratio)[3]	0.58	5.26	0.91	0.87	0.76	0.96	0.93

Source: OECD (1995)

1. 1992
2. Business-enterprise R&D spending / production
3. The technology balance of payments is defined as the ratio between receipts and payments in operations relative to elements of industrial property and services with a technical and intellectual content. See OECD (1993), *Industrial Policy in OECD Countries*, p. 128, box 11.

Figure 2.1: US and EU patents in 1998

(number of patents per million of the population)



Source: US Patent and Trademark Office, European Patent Office

3. Innovative investment: evidence from the Italian data set

Detailed information on innovative behaviour in the Italian manufacturing sector is contained in the Mediocredito Centrale survey. This is based on the response of 4331 manufacturing firms to a questionnaire concerning the period 1992-1994. Here, however, the focus is on a subset of 707 firms that provide information on their R&D spending for the years 1992-1994 and for which company accounting data for at least four consecutive years are available over the period 1986 to 1996[4]. In order to pick up several facets of technological change, a variety of measures of innovation have been used. They may be broadly classified as measures of either innovative inputs or outputs.

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[4] For a more detailed description of the sample-selection criteria, see Chapter 4, Section 3.

3.1 Measures of innovative input

Measures of inputs to the innovation process are useful to summarise a firm's effort devoted to technological change. They consist of the R&D participation rate, the expenditure on R&D investment and the personnel engaged in R&D. Over the period 1992-94, 58.6% of the sample firms undertook R&D investment[5]. As expected, the percentage of firms investing in R&D rises with firm size (Table 3.1.a) and as we move from the traditional and scale sectors to the specialised and high-tech sectors (Table 3.1.b).

A similar pattern is shown by data on annual R&D expenditure[6] (Table 3.2). R&D intensity increases with firm size, and is considerably higher for high-tech firms: the mean and the value at the 75th percentile of the R&D to sales ratio are, respectively, 3.6% and 6.1%, which are double the values recorded for the firms in the other sectors (Table 3.2.a). Moreover, an above average ratio of R&D to sales is recorded in the following industries, which are defined as "high-R&D" industries: vehicles, electrical machinery, non-electrical machinery, chemicals and drugs, and rubber and plastics[7] (Table 3.3.a). Tables 3.2.b and 3.3.b also present the R&D to sales ratio for the firms performing R&D. It is noteworthy that the R&D to sales ratio does not vary significantly with firm size once we focus on R&D performing firms (Table 3.2.b). This suggests that the positive relationship between R&D

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[5] In Question 13 of the Mediocredito Centrale survey firms are asked to indicate whether in the years 1992-94 they have engaged in R&D or not. The Mediocredito Centrale survey specifically defines R&D to include basic research, applied research, and experimental development. Definitions of these three terms are included in the survey questionnaire, and can be found in Ministero dell'Indutria and Mediocredito Centrale, "Indagine sulle imprese manifatturiere", 1997.

[6] In Question 13.1 of the Mediocredito Centrale survey R&D performing firms are asked to report annual R&D expenditures for the years 1992-94.

[7] With the exception of the rubber and plastics industry, the highest R&D participation rates are also recorded in the "high-R&D" industries (see Table 3.1).

intensity and firm size in Table 3.2.a is mainly driven by the fact that R&D participation is greater for larger firms.

For the period 1992-94, Tables 3.4.a and 3.4.b present the ratio of fixed investment to sales for the full sample of firms and the sample of R&D performing firms respectively. On average, Italian manufacturing firms allocate more funding to physical investment than to R&D. The ratio of R&D to R&D plus physical investment is 18% for the full sample of firms, and 28% for the sample of R&D performing firms. The only notable exception is represented by high-tech firms: the ratio is equal to 47% for the full sample of firms classified as high-tech, and 52% if only high-tech R&D performing firms are taken into account.

The last two columns of Tables 3.2 and 3.4 decompose the standard deviation of the investment ratios into its between-firm and within-firm components. "Between-firm" refers to differences in firm-specific averages across firms, where the averages for each firm are computed over time. "Within-firm" refers to deviations of variables from these firm-specific means. For the sample of R&D performing firms the within-firm variance of physical investment is about 36% of its total variance (Table 3.4.b), whereas the within-firm variance of R&D investment is only 9% (Table 3.2.b). The comparison is even more compelling when focusing on R&D performing firms in the "high-R&D" industries. The between-firm variances of the R&D to sales and the fixed investment to sales ratios are of the same magnitude. The within-firm variances, however, are very different. The within-firm variance of physical investment is six times greater than the within-firm variance of R&D. Moreover, the within-firm variance for physical investment is about 35% of its total variance, as compared to only 10% for R&D investment. Himmelberg and Petersen (1994) document a similar pattern in the variance decomposition of fixed investment and R&D investment for US firms. This "smooth" behaviour of R&D investment is consistent with the hypothesis that adjustment costs are high for R&D.

One last measure of innovative effort is presented in Table 3.5, the ratio of R&D employment to total employment. As expected, the ratio is higher in the high-tech sector and, more generally, in the "high-R&D" industries. However, similar to the mean value of the R&D/sales ratio for R&D performing firms (Table 3.2.b), this ratio does not change significantly with firm size. This seems to be consistent with the empirical regularity that R&D intensity is independent of size[8].

3.2 Measures of innovative output

Another way to analyse innovation and technological change is to focus on measures of innovative output. Table 3.6 provides information on the number and type of innovations reported in the period 1992-94[9]. Amongst the 648 responding firms, 37.8% reported both product and process innovation, 11.9% only product innovation, 27.7% only process innovation, and 22.6% no innovation. Overall, 49.6% of firms report product innovation in the period 1992-94. Again, innovative behaviour is greater in the high-tech and in the specialised sectors (where the percentage of firms reporting product innovation is, respectively, 72.7% and 64.7%). However, there is no evidence of a positive effect of firm size on product innovation[10]. Moreover, 30.6% of firms that did not undertake any investment in R&D in the period 1992-94 report product innovation[11] (Table 3.6.c). This last finding may indicate that a significant number of Italian firms introduce technical changes through licensing or imitation

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[8] See Cohen and Keppler (1996) for a recent review of this issue.

[9] In Question 12 of the Mediocredito Centrale survey firms are asked to indicate whether in the years 1992-94 they have obtained a) only product innovation, b) only process innovation, c) both product and process innovation, and d) no innovation.

[10] But process innovation is much greater for firms with more than 500 employees (process innovation being realised by 81.8% of these firms).

[11] 50.2% of non-R&D performing firms also report process innovation. In contrast, 64.3% of R&D performing firms report product innovation, and 77.1% report process innovation (Table 3.6.c).

of the knowledge embodied in the competitors' new processes or products. Perhaps more importantly, this also casts some doubt on whether reported innovations are a satisfactory measure of technological change. Indeed, some of the reported technological innovations may only be (marginal) improvements of existing products and processes, and it is debatable whether they should be considered as truly innovative.

Table 3.7 provides information on the distribution of R&D expenditure[12]. On average, 59.5% of R&D expenditure is devoted to the improvement and introduction of products, and 37.9% to the improvement and introduction of productive processes. As expected, product innovation is greater in the high-tech and in the specialised sectors (respectively 73.3% and 63.8% of R&D expenditure), whereas process innovation is proportionally greater in the traditional and scale sectors (respectively 39.1% and 40.8% of R&D expenditure). On average, the improvement of existing products/processes represents 57.3% of R&D expenditure, whereas only 40.1% of R&D spending is devoted to "true" innovative projects, that is, to the introduction of new products/processes.

Finally, Table 3.8 presents a further measure of innovative output, the percentage of sales attributable to the introduction of new products in the last three years[13]. On average, new products account for 13.3% of sales in 1994. The weight of new products in firms' sales does not change significantly with firm size. However, it is greater for high-tech and specialised firms (respectively 18.6% and 16.2% of firms' sales), and in those industries classified as "high-R&D" (16.4%, against 10.1% in the industries classified as "low-R&D"). It is also

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[12] In Question 13.3 of the Mediocredito Centrale survey R&D performing firms are asked to indicate the percentage of their R&D expenditures devoted to a) the improvement of existing productive processes, b) the improvement of existing products, c) the introduction of new products, d) the introduction of new productive processes, and e) other objectives.

[13] In Question 2.3.1 of the Mediocredito Centrale survey firms are asked to indicate for each year of the period 1992-94 the percentage of sales attributable to the introduction of new products in the last three years.

interesting to distinguish between the contribution made by new products to sales for R&D performing and non-R&D performing firms. Sale of new products contributes to 17.4% of R&D performers' total sales, and 8.1% of non-R&D performers' total sales.

For firms reporting product innovation in 1992-94, new products account on average for 26.3% of sales (Table 3.8.c). The contribution made by new products to sales is of the same order of magnitude in all the sectors. The relevant difference across sectors lies, however, in that for the traditional and scale sectors the weight of new products is substantially the same regardless of whether the firm undertakes R&D investment or not (new products account for 26.8% of R&D performers' sales, and 26.6% of non-R&D performers' sales). In contrast, in the specialised and the high-tech sectors, the weight of new products is much greater for the firms undertaking R&D investment (new products account for 27.6% of R&D performers' sales, against 13.2% of non-R&D performers' sales). One interpretation of this result is that imitation and licensing constitute an effective means of introducing technological change and competing with rival firms in the low-tech sectors. On the other hand, imitation appears to be a less effective means of competing in the "high-R&D" intensity sectors, which usually present a greater degree of appropriability. This is due to strong patent protection (particularly important in the pharmaceutical industry), high imitation costs and long imitation lags (especially in the industrial machinery sectors, where the relative complexity of the products makes reverse engineering difficult even in the absence of patent protection, and firms must make substantial investments to utilise technology licensed from other firms).

Table 3.1

R&D participation rate

Table 3.1.a

Employees	Low-R&D industries[1]		High-R&D industries[1]		All industries		Total
	R&D: no	R&D: yes	R&D: no	R&D: yes	R&D: no	R&D: yes	
51-100	70	38	47	69	117	107	224
101-250	73	70	40	92	113	162	275
251-500	24	14	7	32	31	46	77
> 500	19	35	13	64	32	99	131
Total	186	157	107	257	293	414	
Total	343		364		707		707

[1] See Table 3.3.a for definition

Table 3.1.b

Pavitt sector	Low-R&D industries[1]		High-R&D industries[1]		All industries		Total
	R&D: no	R&D: yes	R&D: no	R&D: yes	R&D: no	R&D: yes	
Traditional	117	105	34	46	151	151	302
Scale	59	43	47	101	106	144	250
Specialised	9	8	23	86	32	94	126
High-tech	1	1	3	24	4	25	29
Total	186	157	107	257	293	414	
Total	343		364		707		707

[1] See Table 3.3.a for definition

Table 3.2

R&D spending to sales ratio (1992-94)

Table 3.2.a

Full sample of firms	Mean	75th percentile	Overall standard deviation	Between firms standard deviation	Within firms standard deviation
Full sample	0.010	0.010	0.021	0.022	0.006
Employees					
51-100	0.009	0.008	0.021	0.022	0.005
101-250	0.009	0.009	0.019	0.017	0.008
251-500	0.010	0.011	0.018	0.018	0.004
more than 500	0.015	0.020	0.025	0.031	0.003
Pavitt sector					
Traditional	0.006	0.006	0.014	0.013	0.005
Scale	0.008	0.008	0.020	0.020	0.005
Specialised	0.017	0.023	0.024	0.025	0.009
High-tech	0.036	0.061	0.039	0.046	0.008

Table 3.2.b

R&D performing firms	Mean	75th percentile	Overall standard deviation	Between firms standard deviation	Within firms standard deviation
Full sample	0.018	0.022	0.025	0.026	0.009
Employees					
51-100	0.019	0.020	0.027	0.029	0.007
101-250	0.016	0.019	0.023	0.020	0.011
251-500	0.018	0.026	0.021	0.021	0.005
more than 500	0.022	0.030	0.028	0.034	0.004
Pavitt sector					
Traditional	0.013	0.014	0.018	0.017	0.007
Scale	0.016	0.018	0.025	0.025	0.008
Specialised	0.024	0.032	0.026	0.027	0.011
High-tech	0.044	0.070	0.039	0.046	0.008

Table 3.3.a

Industry breakdown for R&D and non-R&D performers

	R&D / sales (%)	Number of firms	% of sample	"High-R&D" industry?
Food, Drink and Tobacco	0.2	30	4.2	No
Textiles, Clothing and Leather	0.5	134	18.9	No
Wood, Furniture and Paper	0.4	74	10.5	No
Building Materials and Glass	0.3	40	5.7	No
Chemicals (inc. drugs)	1.4	36	5.1	Yes
Rubber and Plastics	1.0	38	5.4	Yes
Non-electrical Machinery	1.5	196	27.7	Yes
Electrical Machinery	1.7	58	8.2	Yes
Motor Vehicles	2.1	36	5.2	Yes
Metal Products	0.3	44	6.2	No
Others	0.8	21	3.0	No
Total	1.0	707	100.0	-

Table 3.3.b

Industry breakdown for R&D performers

	R&D / sales (%)	Number of firms	% of sample	% of industry
Food, Drink and Tobacco	0.3	20	4.8	66.7
Textiles, Clothing and Leather	1.2	61	14.7	45.5
Wood, Furniture and Paper	1.0	31	7.5	41.9
Building Materials and Glass	0.7	20	4.8	50.0
Chemicals (inc. drugs)	2.1	26	6.3	72.2
Rubber and Plastics	2.1	19	4.6	50.0
Non-electrical Machinery	2.2	138	33.3	70.4
Electrical Machinery	2.1	47	11.4	81.0
Motor Vehicles	2.8	27	6.5	75.0
Metal Products	1.4	15	3.6	34.1
Others	2.1	10	2.4	46.6
Total	1.8	414	100.0	58.6

Table 3.4

Fixed investment spending to sales ratio (1992-94)

Table 3.4.a

Full sample of firms	Mean	75th percentile	Overall Standard deviation	Between firms standard deviation	Within firms standard deviation
Full sample	0.046	0.061	0.044	0.036	0.027
Employees					
51-100	0.046	0.058	0.047	0.037	0.029
101-250	0.046	0.064	0.046	0.036	0.028
251-500	0.044	0.064	0.036	0.029	0.022
more than 500	0.047	0.062	0.041	0.037	0.023
Pavitt sector					
Traditional	0.043	0.058	0.044	0.036	0.026
Scale	0.054	0.073	0.045	0.035	0.029
Specialised	0.038	0.048	0.044	0.035	0.027
High-tech	0.041	0.048	0.034	0.025	0.023

Table 3.4.b

R&D performing firms	Mean	75th percentile	Overall standard deviation	Between firms standard deviation	Within firms standard deviation
Full sample	0.046	0.063	0.043	0.035	0.026
Employees					
51-100	0.050	0.067	0.048	0.038	0.030
101-250	0.043	0.060	0.044	0.036	0.027
251-500	0.046	0.067	0.036	0.031	0.020
more than 500	0.049	0.065	0.041	0.035	0.022
Pavitt sector					
Traditional	0.046	0.063	0.046	0.039	0.026
Scale	0.054	0.073	0.042	0.034	0.027
Specialised	0.037	0.051	0.041	0.032	0.026
High-tech	0.040	0.044	0.033	0.026	0.021

Table 3.5

Employees in R&D to total employees ratio (1992-94, %)

Table 3.5.a

Full sample	Number of employees				
Pavitt sector	51-100	101-250	251-500	> 500	Total
Traditional	1.32	1.73	0.77	0.63	1.40
Scale	1.82	1.86	2.21	2.31	1.96
Specialised	3.98	4.33	5.42	3.22	4.26
High-tech	12.90	4.23	9.98	9.64	9.17
Total	2.31	2.29	2.78	2.49	2.38

Table 3.5.b

R&D performers	Number of employees				
Pavitt sector	51-100	101-250	251-500	> 500	Total
Traditional	3.30	3.14	2.32	1.04	2.89
Scale	4.08	3.51	3.14	3.32	3.60
Specialised	6.24	5.55	6.30	3.75	5.77
High-tech	16.42	5.29	12.47	9.64	10.65
Total	4.86	3.87	4.72	3.56	4.21

Table 3.6

Number of innovating firms (1992-94)

Table 3.6.a

Employees	Product innovation		Process innovation		Both product and process innovation		No innovation		Total
	No.	%	No.	%	No.	%	No.	%	No.
51-100	32	*14.3*	61	*27.2*	83	*37.1*	48	*21.4*	224
101-250	33	*12.0*	70	*25.5*	97	*35.4*	74	*27.0*	274
251-500	9	*12.2*	23	*31.1*	28	*37.8*	14	*18.9*	74
> 500	3	*3.9*	25	*32.9*	37	*48.7*	11	*14.5*	76
Total	77	*11.9*	179	*27.6*	245	*37.8*	147	*22.7*	648

Table 3.6.b

Pavitt sector	Product innovation		Process innovation		Both product and process innovation		No innovation		Total
	No.	%	No.	%	No.	%	No.	%	No.
Traditional	32	*11.2*	79	*27.6*	91	*31.8*	84	*29.4*	286
Scale	18	*8.1*	72	*32.6*	88	*39.8*	43	*19.5*	221
Specialised	25	*21.0*	23	*19.3*	52	*43.7*	19	*16.0*	119
High-tech	2	*9.1*	5	*22.7*	14	*63.6*	1	*4.5*	22
Total	77	*11.9*	179	*27.6*	245	*37.8*	147	*22.7*	648

Table 3.6.c

R&D	Product innovation		Process innovation		Both product and process innovation		No innovation		Total
	No.	%	No.	%	No.	%	No.	%	No.
R&D: no	31	*11.0*	86	*30.6*	55	*19.6*	109	*38.8*	281
R&D: yes	46	*12.5*	93	*25.3*	190	*51.8*	38	*10.4*	367
Total	77	*11.9*	179	*27.6*	245	*37.8*	147	*22.7*	648

Table 3.7

Distribution of R&D expenditure (1992-94, %)

Table 3.7.a

Employees	Improvement of productive processes	Improvement of existing products	Introduction of new products	Introduction of new processes	Other aims
51-100	24.17	31.68	25.20	17.05	1.90
101-250	21.43	36.69	24.73	14.86	2.30
251-500	23.13	31.71	29.64	12.56	2.96
more than 500	23.08	36.88	20.50	14.87	4.67
Total	22.68	34.64	24.87	15.21	2.61

Table 3.7.b

Pavitt sector	Improvement of productive processes	Improvement of existing products	Introduction of new products	Introduction of new processes	Other aims
Traditional	22.02	36.77	22.38	17.09	1.74
Scale	24.64	30.82	23.90	16.20	4.44
Specialised	22.44	34.40	29.42	12.09	1.65
High-tech	15.89	44.67	28.67	9.06	1.72
Total	22.68	34.64	24.87	15.21	2.61

Table 3.8

Percentage of sales attributable to the introduction of new products (1992-94, %)

Table 3.8.a

Employees	R&D: no	R&D: yes	Total
51-100	5.36	18.76	11.81
101-250	10.78	17.85	14.91
251-500	7.24	15.71	12.39
more than 500	9.33	14.55	12.80
Total	8.08	17.39	13.32

Table 3.8.b

Pavitt sector	R&D: no	R&D: yes	Total
Traditional	8.21	14.82	11.37
Scale	7.96	18.71	13.84
Specialised	7.97	19.01	16.23
High-tech	6.67	20.65	18.55
Total	8.08	17.39	13.32

Table 3.8.c

Pavitt sector	*Firms reporting product innovation*		
	R&D: no	R&D: yes	Total
Traditional	26.05	24.82	25.22
Scale	27.50	29.01	28.62
Specialised	13.64	27.23	24.66
High-tech	10.00	29.25	26.50
Total	23.95	27.08	26.26

4. Innovative investment and firm finance: evidence from the Italian data set

The efficient allocation of funds among projects and firms can be severely limited by informational problems. A key feature of R&D investment is that sorting out good and bad projects is more difficult than in more traditional fields. As a result, firms undertaking R&D investment can issue new stocks or borrow only at a substantial premium. Information asymmetries can therefore explain the high cost usually incurred by firms when financing innovative investment projects from external finance. Moreover, if R&D investment is a major component of the firm's investment, the firm will be more likely to use equity rather than debt as an external source of finance, because of the low collateralisable value of innovative investment and the high probability that profits generated by R&D will be insufficient to cover interest payments. These arguments suggest that 1) internal finance should be the predominant source of finance for innovative projects, and 2) relevant R&D expenditure by small and/or undiversified firms is more likely to be financed from new equity (once internal finance has been exhausted), and hence the percentage of debt in the capital structure of these firms should be lower than for larger and/or diversified firms.

From the Mediocredito Centrale survey we can gain an insight into the financing of R&D and fixed investment. Questions 13.4 and 14.5 ask firms to indicate the share of R&D and physical investment spending which has been financed from different (gross) sources of finance over the period 1992 to 1994. R&D investment is financed predominantly from internal finance, which on average represents 83.4% of total sources of finance (Table 4.1). Internal finance also represents the main source of finance for fixed investment, with a share equal to 64.2% (Table 4.2). Contrary to the case of physical investment, the share of R&D investment financed from internal finance decreases with firm size (Table 4.1.a).

The main differences are in the financing patterns of companies with more than 500 employees, on the one hand, and in the financing patterns of firms with fewer than 500

employees, on the other hand. The former are characterised by a relatively high share of R&D investment financed from long-term debt (17.2%), in line with the value recorded for the financing of physical investment (20.3%). The latter, however, have a low share of R&D investment financed from long-term debt (10.7%, with the share of market-rate long-term debt equal to 3.7%), which is much lower than the share of fixed investment funded by debt (28%, with the share of market-rate long-term debt equal to 12.6%). Such differences in the firms' capital structure are supportive of the argument that large and (supposedly) diversified companies find it relatively easier to finance innovative projects from debt. This reflects the ability to cross-finance their activities and to use existing assets as security against loans raised. At the same time, the practice of multiple loans, typical of bank lending in Italy, allows banks to share idiosyncratic risk, thereby reducing the cost of debt for the largest firms (see Chapter 3, Section 4).

The share of R&D investment financed from different sources of finance is also reported, in Table 4.1.b, for firms grouped according to the Pavitt classification. Focusing on the financing patterns of high-tech firms, long-term debt plays an irrelevant role in the financing of R&D investment, whereas the share financed from new equity issues (8.9%) is much more significant than in the other sectors (1.1%). This seems to confirm the intuition that, when R&D investment represents a major component of the firm's investment (as is the case for high-tech companies), firms prefer equity to debt as an external source of finance.

Evidence of the importance of liquidity as a determinant of innovative behaviour is also provided by comparison between the share of fixed investment financed from internal finance for R&D and non-R&D performing firms (Table 4.3). On average, 65% of R&D performers' fixed investment is financed from internal finance, against 61.5% of non-R&D performers' fixed investment[14]. The comparison is, however, more compelling if we focus on firms in the

[14] If also leasing is included among the sources of finance, the share of physical investment financed from internal finance reduces to 62% for R&D performers and 57.3% for non-R&D performers.

"high-R&D" industries, where companies that do not perform R&D are more likely to be at a greater disadvantage with respect to firms undertaking innovative investment. In this case, the share of physical investment financed from internal finance is 71.6% for R&D performing firms, and 59.3% for non-R&D performing firms[15] (Table 4.3). This information indicates that firms that are able to finance a larger share of their fixed investment from internal finance are more likely to undertake R&D investment (see also Section 6). This supports the view that capital market imperfections can affect innovation and technological change: because of the information costs associated with external finance, firms who are short of internal funds will find it difficult to fund R&D expenditure and may pass up innovative projects with positive net present value.

[15] If also leasing is included among the sources of finance, the share of physical investment financed from internal finance reduces to 68.6% for R&D performing firms and 55.2% for non-R&D performing firms.

Table 4.1

Gross sources of finance of R&D investment, 1992-94
(unweighted averages)

Table 4.1.a

Gross sources of finance (R&D)	Employees				
	51-100	101-250	251-500	> 500	Total
New equity	1.43	1.38	1.44	1.92	1.48
Internal finance	86.16	84.38	80.67	77.48	83.44
Long-term credit [1]	2.29	4.97	2.78	7.12	4.23
Long-term credit [2]	7.19	6.75	7.22	10.04	7.41
Non-recoverable grants	2.50	2.22	2.11	2.58	2.34
Investment grants	0.43	0.31	0.00	0.87	0.39
Other sources	0.00	0.00	5.78	0.00	0.71

[1] Market rate long term credit
[2] Subsidised long term credit

Table 4.1.b

Gross sources of finance (R&D)	Pavitt sector				
	Traditional	Scale	Specialised	High-tech	Total
New equity	1.08	0.72	1.51	8.95	1.48
Internal finance	82.01	89.17	78.64	80.11	83.44
Long-term credit [1]	6.15	2.03	5.06	0.00	4.23
Long-term credit [2]	6.50	7.09	10.81	0.63	7.41
Non-recoverable grants	2.11	0.77	3.74	7.42	2.34
Investment grants	0.29	0.21	0.23	2.89	0.39
Other sources	1.87	0.00	0.00	0.00	0.71

[1] Market rate long term credit
[2] Subsidised long term credit

Table 4.2

Gross sources of finance (excluding leasing) of fixed investment, 1992-94 (unweighted averages)

Table 4.2.a

Gross sources of finance	Employees				
	51-100	101-250	251-500	> 500	Total
New equity	1.64	1.87	0.27	2.30	1.65
Internal finance	61.45	62.43	70.42	72.21	64.24
Long-term credit [1]	10.28	14.96	12.22	10.56	12.53
Long-term credit [2]	19.46	15.49	12.24	9.70	15.73
Non-recoverable grants	4.12	2.45	1.72	2.64	2.95
Investment grants	2.17	1.98	1.35	1.82	1.95
Other sources	0.88	0.82	1.78	0.78	0.95

[1] Market rate long term credit
[2] Subsidised long term credit

Table 4.2.b

Gross sources of finance	Pavitt sector				
	Traditional	Scale	Specialised	High-tech	Total
New equity	1.35	1.45	2.35	3.64	1.65
Internal finance	57.34	67.47	73.06	70.68	64.24
Long-term credit [1]	15.27	11.79	9.74	1.36	12.53
Long-term credit [2]	19.05	13.82	12.04	13.28	15.73
Non-recoverable grants	3.06	2.95	1.71	7.70	2.95
Investment grants	2.28	2.09	0.59	3.33	1.95
Other sources	1.65	0.42	0.51	0.01	0.95

[1] Market rate long term credit
[2] Subsidised long term credit

Table 4.3

Share of fixed investment financed from internal finance, 1992-94
(gross sources of finance, excluding leasing - unweighted averages)

Table 4.3.a

Employees	Low-R&D industries		High-R&D industries		All industries	
	R&D: no	R&D: yes	R&D: no	R&D: yes	R&D: no	R&D: yes
51-100	60.72	49.85	61.20	64.06	60.92	58.94
101-250	61.62	52.83	51.84	73.64	57.89	64.74
251-500	62.66	63.62	92.86	73.69	70.21	70.56
> 500	85.30	61.19	57.00	78.16	71.15	72.61
Total	62.91	54.24	59.27	71.55	61.49	65.00
Total	58.96		67.65		63.50	

Table 4.3.b

Pavitt	Low-R&D industries		High-R&D industries		All industries	
sectors	R&D: no	R&D: yes	R&D: no	R&D: yes	R&D: no	R&D: yes
Traditional	55.47	55.76	56.39	59.16	55.71	56.78
Scale	72.32	54.24	55.17	75.16	64.19	69.62
Specialised	88.89	36.49	74.37	73.76	78.88	70.04
High-tech	70.00	-	50.00	72.90	56.67	72.90
Total	62.91	54.24	59.27	71.55	61.49	65.00
Total	58.96		67.65		63.50	

Table 4.3.c

	Low-R&D industries		High-R&D industries	
	R&D: no	R&D: yes	R&D: no	R&D: yes
Food, Drink and Tobacco	48.89	60.09	-	-
Textiles, Clothing and Leather	64.32	60.72	-	-
Wood, Furniture and Paper	62.95	57.42	-	-
Building Materials and Glass	56.75	36.12	-	-
Rubber and Plastic	-	-	47.41	67.05
Chemicals and Drugs	-	-	46.60	69.45
Non-electrical machinery	-	-	63.49	67.86
Electrical machinery	-	-	78.25	84.47
Motor vehicles	-	-	48.13	72.99
Metallurgy and Metal Products	62.44	36.73	-	-
Other	78.89	31.98	-	-

5. Econometric results

In this section we investigate the sensitivity of R&D and fixed investment to cash flow. The company data we use consist of accounting data for the period 1986 to 1996 drawn from the Centrale dei Bilanci data set. These data correspond to the panel of Italian firms that has been used for the empirical analysis in Chapter 4[16]. Since there is no provision of R&D disclosure in the Italian accounting conventions, the only information available on R&D expenditure is that from the Mediocredito Centrale survey. The survey information is, however, limited to the period 1992-94. This makes it difficult, if not impossible, to estimate a dynamic model of R&D investment.

Even though a long time series on R&D investment is not available, this does not prevent us from testing the importance of financial constraints on R&D investment. As we discussed in the introduction to this chapter, most of the previous empirical studies exploiting a longer time series dimension have found the relationship between annual R&D spending and cash flow to be rather weak. This evidence has usually been interpreted as reflecting the particular nature of R&D investment: because of the high costs of adjustment, R&D spending is less likely to respond to liquidity fluctuations than fixed capital and inventory investment.

Hence, in order to pick up the effect of liquidity constraints on innovative behaviour, it may be more informative to investigate the relationship between physical investment and cash flow for samples which distinguish between R&D performing and non-R&D performing firms. In the presence of severe capital market imperfections, firms engaging in R&D should consist predominantly of those firms that are confident that they can finance their (long-run) R&D commitments from internal sources or firms that face a low cost premium for external finance. In this case, financing constraints would tend not to be binding for these companies,

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[16] The sample used in this chapter consists of 707 instead of 710 firms, since three firms have been omitted due to the lack of any information on R&D investment.

so the fixed investment of R&D performing firms may be expected to display lower sensitivity to financial variables than the fixed investment of the non-R&D performing firms. If, however, capital market imperfections are not significant for any types of firms, we should find no sensitivity to financial variables in the investment behaviour of both the R&D and the non-R&D performing firms.

Here we define as R&D performers (non-R&D performers) those firms that in the Mediocredito Centrale survey declare to have (not) engaged in R&D over the period 1992 to 1994. Hence, we assume that firms that do not engage in R&D in the years 1992-94 do not engage in R&D over the whole period 1986 to 1996. Tables B.1 and B.2 in Appendix B report descriptive statistics of the variables used in the econometric analysis for the full sample of firms and the samples of firms in the "high-R&D" industries[17]. The samples of R&D performing and non-R&D performing firms are very similar in terms of investment rates and output growth. R&D performers appear, however, to be bigger (higher output term y_{t-2}) and more "profitable" (higher cash flow and gross operating profits ratios).

Differences in profitability are particularly relevant when comparing small and independent R&D firms with small and independent non-R&D firms[18]. Figures B.1, B.2 and B.3 in Appendix B present the ratio of cash flow to the beginning-of-period capital stock for R&D and non-R&D firms in the "high-R&D" industries over the period 1987 to 1996. Note that in the years for which R&D information is available from the Mediocredito Centrale survey the cash flow to capital ratio for the R&D performers is much greater than the ratio for the non-R&D performers. Again the main difference is found amongst the small and independent firms, where the cash flow ratio for the R&D firms is about 45% greater than the ratio for the non-R&D firms in the years 1992-94 (Figure B.3).

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[17] For the description of these variables, see Chapter 4, Section 3.

[18] For the definition of "small independent" firms and "either large or group" firms, see Section 4 of Chapter 4.

Researchers using company accounts data have usually constructed a cash flow measure that adds back R&D expenditures to conventionally used cash flow, since most R&D costs are expensed in company accounts (see for example Hall, 1992, and Himmelberg and Petersen, 1994). Since information on R&D expenditures is not available from Italian company accounts, it is not possible to construct such a measure for our sample of firms[19]. A measure of cash flow gross of R&D costs can, however, be constructed for the years 1992-94 by using information on R&D expenditures from the Mediocredito Centrale survey. For the R&D performing firms in all industries, cash flow gross of R&D costs is on average equal to 20.5% of the beginning-of-period capital stock. Over the same period, cash flow net of R&D costs is equal to 15.1% of the capital stock for the R&D firms, and 12.5% for the non-R&D firms.

5.1 Evidence from the error correction model

Table 5.1 presents regression results from a GMM system estimator of an error correction model of fixed investment of the form outlined in equation (3.8), Chapter 2:

$$\frac{I_{it}}{K_{i,t-1}} = \omega_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \omega_2\Delta y_{it} + \omega_3\Delta y_{i,t-1} + \omega_4\left(k_{i,t-2} - y_{i,t-2}\right) +$$

$$+\omega_5 y_{i,t-2} + \omega_6\left(\frac{C_{it}}{K_{i,t-1}}\right) + d_t + \eta_i + \nu_{it}$$

As for the preferred GMMSYS estimator in Section 4 of Chapter 4, the instrument set used here contains levels of the right hand side variables dated from *t*-3 to *t*-5 for the equations in

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[19] This measurement error in the cash flow variable can provide an alternative explanation for why cash flow is found to be uninformative in the investment equations for the sample of R&D performing firms. However, Bond *et al.* (1999) estimate error correction models of investment for samples of UK and German firms and report that regression results obtained using cash flow measured net of R&D expenditures are similar to the results obtained using cash flow measured gross of R&D expenditures.

first differences, and differences of the dependent variable and sales growth dated *t*-2 for the equations in levels.

Column (i) of Table 5.1 contains the regression results for the full sample of 707 firms. In column (ii), we allow the coefficients on the cash flow term and the year dummies to be different for the firms that perform any R&D compared to the firms that do not. To do this, the cash flow term and the time dummies are interacted with two distinct dummy variables that take the value of one for, respectively, R&D performing firms and non-R&D performing firms. Interactions of the cash flow term and the time dummies with these two dummy variables are also included in the instrument set (the precise instruments used in the estimation are reported in the notes to Table 5.1). The sensitivity of fixed investment to cash flow appears to be greater for non-R&D performing firms, but the cash flow coefficients are statistically insignificant in both sub-samples, as is the difference in this coefficient between the two sub-samples.

The absence of a significant difference in the estimated cash flow coefficients for the two samples of R&D and non-R&D firms may be attributed to the fact that we have compared companies located in different industries. Indeed, most of the non-R&D performing firms are located in low-tech industries, where there is less need and opportunity to do R&D. To pick up differences between R&D and non-R&D firms operating in similar industries, we therefore focus on firms in the "high-R&D" industries, that is, on firms whose main activity is located in industries with an above average ratio of R&D to sales (see Section 3). For these companies, innovative behaviour is more likely to be required for the firm to be competitive and successful, and differences in R&D status cannot simply be ascribed to differences in the industrial structure.

Table 5.2 presents the results of fixed investment equations re-estimated for the sample of firms in the "high-R&D" industries. While we find no effect from cash flow for the R&D performing firms, this effect is found to be positive and significant (t=2.62) for the non-R&D

performers. Moreover, the difference in the cash flow coefficients across the two samples is statistically significant (t=2.08).

Although this first evidence is suggestive of stronger investment/cash flow sensitivity for the non-R&D performing firms, its interpretation is open to two main objections. First, by including interactions with R&D status in the instrument set for the levels equations in the system estimator we implicitly assume that R&D status is uncorrelated with firm-specific effects in the investment equation. There is no indication that this is a problem from the Sargan test of instrument validity. However, to account for the possibility that R&D status is correlated with firm-specific effects, in column (iii) of both Table 5.1 and Table 5.2 we report regression results for the same specification, but obtained including no interactions with the dummy variables that indicate R&D status in the instrument set. This does not change the interpretation of the results: the cash effect appears to be significantly greater in the equation for the non-R&D firms in the "high-R&D" industries.

Secondly, the estimates in column (ii) of Tables 5.1 and 5.2 were obtained by imposing common coefficients on the non-cash flow variables across the two samples of R&D and non-R&D firms. Were one or more of these coefficients significantly different across the two samples, differences in the estimated cash flow effect might be driven by the assumption of common non-cash flow coefficients, rather than by differences in firms' sensitivity to liquidity. To check for this possibility, in Tables 5.3 and 5.4 the error correction model is estimated separately for the sample of non-R&D firms [column (i)] and the sample of R&D firms [column (ii)]. While the cash flow term appears to have no effect on fixed investment for the R&D performers, it is positive and significant (t=2.79) in the equation for the non-R&D performers in the "high-R&D" industries [column (i), Table 5.4]. Column (iii) in each of these tables presents the point estimates and the standard errors of the differences in the

estimated coefficients across the two sub-samples[20]. The overall difference in the coefficient estimates on the five non-cash flow variables is insignificant (the Wald test of the hypothesis that the differences in the five estimated coefficients are jointly zero has a p-value equal to 36.6% in Table 5.3, and 66.3% in Table 5.4). Hence, the restriction that these coefficients are common, imposed in columns (ii) and (iii) of Tables 5.1 and 5.2, is not rejected. In addition, regression results in column (iii) of Table 5.4 show that the main difference across the samples of R&D and non-R&D firms in the "high-R&D" industries is the different sensitivity of investment to internal finance[21].

Overall, these findings seem to confirm the intuition that firms in the "high-R&D" industries that do not engage in R&D are more likely to be subject to significant financial constraints. Conversely, firms that do undertake innovative projects appear not be affected by financial constraints. In fact, as is also shown by the descriptive statistics in Section 3 and in Appendix B, R&D performing firms in the "high-R&D" industries finance a greater share of fixed investment from internal sources and have, on average, a higher cash flow to capital ratio. A key feature of the R&D performing firms appears to be the availability of a relatively

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[20] In order to estimate the coefficient differences on each variable across the subset of R&D and non-R&D firms we define a dummy variable that is equal to one for firms that perform R&D, and zero when a firm does not. We then interact this dummy with all the right hand side variables and estimate the error correction model for the full samples of firms. The differences in the estimated coefficients and the test statistics for this estimation are reported in column (iii), Tables 5.3 and 5.4.

[21] In Tables 5.3 and 5.4 interactions with R&D status are included in the instrument sets in order to make the regression results comparable with the results in column (ii) of Tables 5.1 and 5.2. We also estimated a specification where all the regressors are interacted with R&D status, but no interactions are included in the instrument set. This allows us to check the validity of the restriction of common coefficients on the non-cash flow variables that we have imposed in column (iii) of Tables 5.1 and 5.2. Under this specification, the Wald test of joint significance of the differences in the estimated coefficients on the non-cash flow variables has a p-value of 58.7% in the equation for the sample of firms in the "high-R&D" industries. The estimated cash flow coefficient is statistically significant (t=2.45) only for the sample of non-R&D performing firms. However, due to greater imprecision in the coefficient estimates, the difference in the cash flow coefficients is only weakly significant (t=1.57) in this specification.

large amount of internal funds, which makes possible the financing of long-term commitments to R&D and reduces the sensitivity of investment to cash flow.

5.2 Evidence from the Euler Equation model

To check the robustness of the previous findings, we also estimate for the samples of R&D and non-R&D performing firms an Euler equation model of fixed investment of the form outlined in equation (3.12), Chapter 2:

$$\left(\frac{I}{K}\right)_{it} = \beta_0 + \beta_1\left(\frac{I}{K}\right)_{i,t-1} - \beta_2\left(\frac{I}{K}\right)^2_{i,t-1} - \beta_3\left(\frac{\Pi}{pK}\right)_{i,t-1} + \beta_4\left(\frac{Y}{K}\right)_{i,t-1} + d_t + \eta_i + \nu_{it}$$

As in Section 4 of Chapter 4, the preferred estimator is a system GMM estimator that uses an instrument set that includes levels of the right-hand side variables dated *t*-3 for the equations in first differences, and differences of all the right-hand side variables dated *t*-2 for the equations in levels.

Tables 5.5 and 5.6 present the GMMSYS estimates of the equations for the full sample of firms and the sample of firms in the "high-R&D" industries, respectively. The differences between R&D and non-R&D firms are now evident in both cases. Focusing on the sample of firms in the "high-R&D" industries (Table 5.6), the estimated coefficient on the gross operating profits term is positive and significant in the equation for the non-R&D performing firms, and negative (though insignificant) for the R&D performers. The latter result is an important one, since a negative sign on the profit-capital term is what the Euler equation model predicts under the null of no financial constraints. Although the Sargan statistic does not detect the presence of mis-specification in the equation for the non-R&D performers, the

difference across samples in the gross operating profits coefficient (t=2.90) is indicative of binding financial constraints faced by firms not conducting R&D[22].

Another important difference between the samples of R&D and non-R&D performing firms is represented by the estimated coefficient on the sales term. In the Euler equation estimated here, a significantly positive coefficient on this sales term is indicative of imperfect competition, that is, of market power. While the estimated coefficient on the sales-capital term is close to zero in the equation for the non-R&D performing firms, it is positive and significant (t=3.25) in the equation for the R&D performing firms (Table 5.6). Likewise, the difference in the sales coefficient across the two samples is statistically significant (t=2.05). This result supports the view that a firm must possess some market power for it to carry on R&D. Indeed, profits associated with market power allow firms to finance R&D from internal funds, and reduce the need for external financing.

The Euler equations estimated above implicitly assume that the firm's choice of R&D status is exogenously determined. In order to take into account the possible endogeneity of such a choice, the Euler equation model of investment was re-estimated for the full sample of firms (both in all industries and in the "high-R&D" industries) with all the explanatory variables (including time dummies) interacted with the dummy for R&D status, but without including these interaction terms in the instrument set. The regression results, presented in Table 5.7, confirm the greater impact of financial variables on investment for non-R&D performing firms[23]. The gross operating profits term is again significantly positive in the

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[22] Moreover, the point estimates on the lagged investment term are more consistent with the dynamics implied by the structural adjustment cost model in the results for R&D firms than in the results for non-R&D firms.

[23] Since no interactions with the dummy variables indicating for the R&D status were included in the instrument set, here it is not possible to replicate the results separately for each sub-sample of firms. This explains why in Table 5.7 no test statistics are reported for the estimation using only the sample of non-R&D performing firms [columns (i) and (iv)] and the estimation using only the sample of R&D performing firms [columns (ii) and (v)].

equation for the non-R&D performers, and close to zero for the R&D performers. At the same time, there is some evidence of some market power enjoyed by the R&D performing firms. However, due to greater imprecision of the coefficient estimates, the differences in the coefficients on the sales and the gross operating profits terms are not statistically significant in this estimation.

5.3 Comparisons with other factors

Up to this point, when estimating models of fixed investment for R&D and non-R&D performers we have not taken into account other factors that can affect the firms' information position. Regression results presented in Section 4 of Chapter 4 suggested that the importance of capital market imperfections varies with firm size and group membership. In particular, it was suggested that small independent firms are more likely to face financial constraints than either large firms or group firms. This casts some doubt on the interpretation given to the different coefficient estimates in the investment equations for the R&D and the non-R&D performing firms. A positive and significant cash flow effect in the equation for the non-R&D performers could be explained by the relative weight of small independent firms amongst the non-R&D firms, rather than by the importance of the firm's R&D status *per se*. Likewise, the absence of binding financial constraints for the R&D performers may simply reflect the greater number of either large or group firms amongst the R&D firms[24].

Table 5.8 presents the regression results of an error correction model of fixed investment for the sample of 228 either large or group firms [column (i)] and the sample of 136 small independent firms [column (iii)] in the "high-R&D" industries. One first notable result is that

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[24] In the "high-R&D" industries, either large or group firms represent 67.7% of R&D firms, and 50.5% of non-R&D firms. Only 54 (23.7%) out of 228 either large or group firms report no R&D investment, against 53 (39%) out of 136 small independent firms.

in the "high-R&D" industries the cash flow effect is statistically insignificant both in the equation for either large or group firms and in the equation for small independent firms. This contrasts with the regression results presented in Chapter 4, where cash flow appeared to have a significant effect in the investment equation for the full sample of small independent firms, and no effect in the investment equation for the full sample of either large or group firms. In fact, as is shown in Table B.4 in Appendix B, these differences in the investment-cash flow sensitivity hold only for firms in the "low-R&D" industries. In that case, the estimated coefficient on the cash flow term is statistically significant only in the equation for the sample of small independent firms. At the same time, the difference in the estimated cash flow coefficients across the sample of small independent firms and the sample of either large or group firms in the "low-R&D" industries is statistically significant.

To test whether the sensitivity of investment to cash flow is greater when a firm does not perform any R&D, in columns (ii) and (iv) of Table 5.8 the cash flow coefficient is allowed to vary according to the firm's R&D status[25]. An immediately evident result is that, both for either large or group firms and for small independent firms, the cash flow coefficient is significant and positive in the equations for the non-R&D performers. Conversely, there is no evidence of a relationship between fixed investment and cash flow in the equations for the R&D performers. Moreover, the difference in the estimated cash flow coefficients across R&D and non-R&D firms is significant both in the equation for the sample of small independent firms (t=1.87) and in the equation for the sample of either large or group firms (t=2.35). The latter result is particularly important, since based on the asymmetric information

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[25] The regression results reported in columns (ii) and (iv), Table 5.8, are obtained by including in the instrument set interactions of the cash flow term and the time dummies with the dummy variables that indicate R&D status. We also ran regressions with no interactions included in the instrument set. The coefficient point estimates were basically the same as in Table 5.8. However, due to greater imprecision of the estimates, the coefficient differences between R&D and non-R&D firms in the sub-samples of small independent and of either large or group firms were found to be statistically insignificant at the conventional level.

theory we might have expected no sensitivity of investment to cash flow for either large or group firms, that is, for those firms that should face less severe information costs. At the same time, the fact that small independent firms that perform R&D have no investment/cash flow sensitivity indicates that these firms, in spite of their (weak) information position, are less likely to face binding financial constraints. This may be due to the availability of a relatively large amount of internal net worth. Indeed, as is shown in Table B.2, the mean value of the cash flow to beginning-of-period capital stock ratio (C_t/K_{t-1}) is 0.217 for the small independent R&D firms, against 0.185 for the small independent non-R&D firms.

In column (i) of Tables 5.9 and 5.10 we present the regression results of an Euler equation model of fixed investment for the sample of either large or group firms and the sample of small independent firms in the "high-R&D" industries. As for the estimates of the error correction model in Table 5.8, financial variables appear to have a similar impact in the Euler equations for the two samples of firms. The difference in the estimated coefficients on the gross operating profits term across the sample of small independent firms and the sample of either large or group firms is statistically insignificant (t=0.93). Table B.5 shows, however, that this difference is statistically significant (t=2.14) for firms in the "low-R&D" industries.

In columns (ii) and (iii) of Tables 5.9 and 5.10, separate Euler equations are estimated for the R&D and non-R&D firms in each case. While the null of no financial constraints cannot be rejected for the samples of R&D performing firms (especially for large/group firms, where the gross operating profits coefficient has a negative sign), the positive and significant estimated coefficients on the gross operating profits term reject it for the samples of non-R&D performing firms. Similar to the regression results for the error correction model, the difference in the estimated coefficients on the gross operating profits terms across either large or group R&D and non-R&D firms is statistically significant (t=1.85). A further important difference is represented by the sales-capital term. Its estimate is positive and significant in the

equations for the R&D performers (t=2.20 for either large or group firms, t=2.41 for small independent firms), and close to zero for the non-R&D performers[26].

In Table 5.11 we test whether cash flow interactions with R&D status are more or less informative than cash flow interactions with size/group membership in picking up differences across firms in the investment sensitivity to cash flow. To do this, we interact the cash flow coefficients in an error correction specification with two distinct dummy variables which are equal to one when the firm is a non-R&D performer and when the firm is small and independent, respectively. The regression results presented in Table 5.11, columns (i) to (iii), are obtained by including these interactions in the instrument set. The results for the full sample of 707 firms [column (i)] indicate that cash flow interactions with both R&D status and size/group membership are (weakly) significant. For the firms in the "high-R&D" industries [column (ii)] only cash flow interactions with R&D status are significant, whereas for the firms in the "low-R&D" industries [column (iii)] only cash flow interactions with size/group membership are significant.

In Table 5.11, columns (iv) to (vi), we report regression results obtained by interacting the cash flow coefficient with the same dummy variables, but without any of these interactions included in the instrument set. These results provide further evidence that the interactions with R&D status "dominate" size/group membership interactions for firms in the "high-R&D" industries [column (v)], and are "dominated" by size/group membership interactions for firms in the "low-R&D" industries[27] [column (vi)].

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[26] Euler equations were also estimated with no interactions of the right hand side variables with R&D-status dummy variables included in the instrument set. Although the point estimates of the sales and the gross operating profits terms showed similar differences to those in Tables 5.9 and 5.10, due to much greater standard errors these differences in the estimated coefficients across the samples of R&D and non-R&D performing firms were statistically insignificant.

[27] Also for the Euler equation model we tested whether interactions of the coefficient on the gross operating profits term with R&D status are more or less informative than interactions with size/group membership. The

5.4 Further investigations

The econometric analysis indicates that in the "high-R&D" industries fixed investment spending by firms that do not perform R&D is sensitive to the availability of internal funds. This supports the view that the firm's decision to engage in R&D is significantly affected by the cost of external finance. Due to the wedge between the costs of external finance and internal finance, firms engaging in R&D are less likely to be facing binding financial constraints, since many of them are financing most of their expenditures internally. Following this line of thought, we would expect the cost premium on external finance to be higher the more risky are the innovative projects. Hence, internal finance should play a more central role when R&D investment is devoted to the introduction of new products/processes, rather than to the improvement of existing products/processes[28]. If information asymmetries are important, firms willing to undertake highly innovative investment projects could be particularly likely to have plentiful internal funds, in order to finance these high-risk R&D projects. Therefore, financial constraints would tend not to be binding for these companies, and so their fixed

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regression results where these interactions were included also in the instrument set mirrored the results for the error correction model in Table 5.11, with both R&D status interactions and size/group membership interactions being weakly significant for the full sample of 707 firms, and only the former (the latter) being significant for the sample of firms in the "high-R&D" ("low-R&D") industries. The results obtained without any interactions in the instrument set provided less clear-cut evidence. Size/group membership interactions were more informative than R&D status interactions for the sample of firms in the "low-R&D" industries. On the other hand, all the interactions were not significant at the conventional level in the Euler equations for the full sample of firms and the sample of firms in the "high-R&D" industries.

[28] The greater risk of R&D devoted towards the introduction of new products can be attributed to three main causes. First, because the product is novel, it is particularly difficult to assess the market-place. Second, in the high technology area, products or services tend to be of a shorter life than in the more conventional sectors. Third, financing is often required to conduct R&D at the pre-product stage. Here there is not only the uncertainty of the market for the product, but also whether the research will even lead to a product, as well as the timetable for this delivery.

investment should display lower sensitivity to cash flow than the fixed investment of the non-R&D performing firms or the firms engaged in less innovative R&D projects.

The Mediocredito Centrale survey contains information on the aims of R&D investment. Here we define as highly innovative the R&D projects whose objective is to introduce either new products or new production processes. In the "high-R&D" industries, the mean and median value of the percentage of R&D spending devoted towards the introduction of new products and processes are 40.4% and 45%, respectively. To test the hypothesis that firms engaging in highly innovative R&D projects are less financially constrained, we then examine fixed investment equations for the sub-samples of "highly innovative" and "less innovative" R&D performing firms in the "high-R&D" industries[29].

In Table 5.12, column (ii), we define as highly innovative those firms that devote more than 45% of their R&D expenditure to the introduction of new products and processes. In column (iii) only firms devoting at least 60% of R&D spending towards the introduction of new products and processes are defined as highly innovative. The number of these firms (73) is equal to one third of the sample of R&D firms reporting information on the characteristics of their R&D activity. Regression results for an error correction model of fixed investment show no cash flow sensitivity in the investment behaviour of highly innovative firms. In contrast, similar to the results for the non-R&D performing firms, estimates of cash flow coefficients are positive and significant in the equations for the less innovative R&D firms (t=1.58 and t=2.59 in columns (ii) and (iii), respectively). At the same time, in column (iii) the difference in the cash flow coefficients across the samples of highly innovative and less innovative R&D performing firms is also statistically significant[30] (t=1.82).

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[29] Since 33 firms in the high-R&D industries report no information on the characteristics of their R&D projects, the analysis here is restricted to a sample of 224 R&D performing firms.

[30] The regression results reported in Table 5.12 are obtained by including in the instrument set interactions of the cash flow term and the time dummies with the dummy variables that indicate highly innovative R&D investment.

Estimates for the Euler equation model confirm these results. Table 5.13 reports results for sub-samples divided according to whether 45% of R&D is directed to highly innovative activities, and Table 5.14 reports results using the 60% cut-off. The gross operating profits term is positive but close to zero for the less innovative firms. However, it is negative for the highly innovative firms, and significant (t=1.74) for the sample of firms that devote more than 60% of their R&D expenditure to the introduction of new products and processes (Table 5.14). In the latter case, the difference in the gross operating profits term across highly innovative and less innovative R&D firms is also statistically significant (t=1.80). Finally, the comparison between highly innovative and less innovative R&D performing firms provides evidence that firms enjoying greater monopoly profits are more likely to engage in high-risk innovative projects. Estimates of the coefficient on the sales-capital ratio are greater in the Euler equations for the highly innovative firms (t=3.44, column (iii), Table 5.13, and t=4.58, column (iii), Table 5.14), and the coefficient differences across these types of firms are statistically significant[31] (respectively, t=2.03 and t=2.99).

Overall, the results in this section indicate that firms that engage in (especially highly innovative) R&D have lower sensitivity of investment spending to financial variables than do firms that do not engage in R&D, or firms that engage in less innovative types of R&D. This evidence is consistent with the hypothesis that the latter are more likely to be subject to binding financing constraints. Although consistent with the hypothesis that some firms are choosing not to engage in (high-risk) R&D because of the cost premium on external finance,

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When no interactions are included in the instrument set, the point estimates on the cash flow coefficients are similar to those reported in Table 5.12, columns (ii) and (iii), but the coefficient differences across highly innovative and less innovative R&D performing firms are insignificant in both cases.

[31] The regression results presented in Tables 5.13 and 5.14 are obtained by including in the instrument set interactions of the right-hand side variables with the dummy variables that indicate innovative R&D investment. When no interactions are included in the instrument set, the coefficient point estimates are similar to those reported in Tables 5.13 and 5.14, although they are much less precise.

these findings provide only indirect evidence of this behaviour. Further evidence on the relationship between R&D participation and the availability of internal finance is provided in the next section, where probit models of R&D participation are estimated.

6. Evidence from R&D status probits

Regression results in the previous section provide indirect evidence that firms having strong cash flow are more likely to undertake R&D investment. An alternative way to test this hypothesis consists in estimating the relationship between internal finance and the R&D participation decision. For the sample of firms in the "high-R&D" industries, Table 6.1, column (i), reports a probit model for R&D status as a function of industry dummies, the natural log of lagged real sales (to control for size) and the lagged cash flow to beginning-of-period capital stock ratio. Since very few firms are observed to change R&D status in the period 1992-94[32], the probit model is estimated for one cross section in 1993, in order not to inflate the precision of the estimates. Similar patterns emerge when taking either 1992 or 1994 into consideration. As shown also in Table 3.1, there is a significant correlation between firm size and whether a firm performs R&D. More importantly, lagged cash flow is correlated with a greater probability of conducting R&D. The cash flow term is positive and significant at the 10% level, and its marginal effect on the R&D status is 0.22 (with a standard error of 0.13).

The importance of internal finance for R&D status can also be investigated from a slightly different perspective. In the presence of high information costs, the availability of internal finance enhances the firm's ability to invest. Firms that are able to finance a greater share of their investment from internal funds should therefore be more likely to undertake risky

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[32] Only 13% of the firms engaging in R&D in the period 1992-94 report no R&D expenditure in one of the three years. The infrequency of transitions from R&D to non-R&D status is consistent with the view that engaging in R&D implies a long-term commitment to financing an inflexible R&D budget.

innovative projects. Table 6.1, column (ii), offers evidence on this issue by reporting a probit model for R&D status where the cash flow term is substituted by the share of fixed investment that is financed from internal funds. The correlation between R&D status and the share of physical investment financed through internal funds is positive and significant at the 5% level, and is stronger than the relationship between cash flow and R&D status.

Finally, Table 6.1, column (iii), reports a probit model for R&D status as a function of industry dummies, lagged sales, lagged cash flow, and the share of fixed investment financed from internal funds. The share of fixed investment financed through internal funds still appears to be significantly correlated with a greater probability of performing R&D. On the other hand, the correlation between R&D status and lagged cash flow is now not significant at the 10% level.

On the whole, the results in this section are consistent with the hypothesis that the availability of internal finance is an important constraint for innovative behaviour. The finding of a significant correlation between internal finance and R&D status is consistent with the suggestion that, due to the cost premium on external finance, firms in a strong liquidity position are more likely to commit themselves to long-term R&D projects. However, our results are also consistent with other interpretations. One particular problem in our probit models is that, due to the very limited time-series variation in R&D status, we obtain only cross-section correlations, and so we cannot control for unobserved firm-specific effects. It is therefore possible that other factors are the main determinants of the decision to engage in R&D, and that causality runs from doing R&D to high profitability, which in turn causes high cash flow-capital ratios and, possibly, a high share of fixed investment financed through internal funds.

Table 5.1

Error correction model: all industries

I_t/K_{t-1}	(i)	(ii)	(iii)
I_{t-1}/K_{t-2}	-0.0779 (.0640)	-0.1264 (.0608)	-0.0888 (.083)
Δy_t	0.0541 (.0749)	0.0496 (.0660)	0.0585 (.1021
Δy_{t-1}	0.1843 (.0792)	0.1874 (.0772)	0.1852 (.0980
$(k-y)_{t-2}$	-0.1726 (.0490)	-0.1874 (.0540)	-0.1511 (.0672
y_{t-2}	-0.0045 (.0225)	-0.0057 (.0235)	-0.0059 (.0239
C_t/K_{t-1}	0.1030 (.0562)	-	-
I[R&D$_i$=0]$\cdot C_t/K_{t-1}$	-	0.1022 (.0956)	0.2030 (.1591)
I[R&D$_i$=1]$\cdot C_t/K_{t-1}$	-	0.0591 (.0593)	-0.0228 (.1101)
(C_t/K_{t-1}) difference	-	*0.0430* *(.1147)*	*0.2258* *(.2271)*
No. Firms	707	707	707
Obs.	4394	4394	4394
Df	4379	4369	4369
sc_1	-6.074 [692]	-6.275 [692]	-3.626 [692]
sc_2	-1.583 [660]	-1.837 [660]	-0.237 [660]
z_1 [6]	31.60	-	-
z_2 [8]	19.39	-	-
Sargan	90.65 [83] p=0.265	116.63 [100] p=0.122	84.94 [73] p=0.160

Column (i) contains regression results for the full sample of firms.
In columns (ii) and (iii) the cash flow coefficient is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. R&D$_i$=0 identifies non-R&D performing firms, R&D$_i$=1 identifies R&D performing firms. The term (C_t/K_{t-1}) *difference* represents the difference in the cash flow coefficients across the samples of non-R&D and R&D performing firms.
Full set of time dummies included as regressors in column (i). Full set of time dummies interacted with the dummy variables included as regressors in columns (ii) and (iii).

GMMSYS estimates
Time dummies included as instruments in all columns.
Instruments used are: differenced equations: (I_{t-3}/K_{t-4}) to (I_{t-5}/K_{t-6}), Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and (C_{t-3}/K_{t-4}) to (C_{t-5}/K_{t-6}); levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Interactions of the dummy variables with the cash flow variable and the time dummies included as instruments in column (ii).

Notes. Sample period: 1989-1996. See also notes for Table 4.2.a, Chapter 4.

Table 5.2

Error correction model: "high-R&D" industries

I_t/K_{t-1}	(i)	(ii)	(iii)
I_{t-1}/K_{t-2}	-0.0787 (.0849)	-0.0883 (.0558)	-0.0926 (.0871)
Δy_t	0.1222 (.0777)	0.0863 (.0612)	0.1083 (.0737)
Δy_{t-1}	0.0966 (.0921)	0.1207 (.0692)	0.0748 (.1010)
$(k-y)_{t-2}$	-0.1911 (.0714)	-0.1668 (.0511)	-0.1968 (.0814)
y_{t-2}	-0.0383 (.0327)	-0.0095 (.0335)	-0.0477 (.0383)
C_t/K_{t-1}	0.1346 (.0674)	-	-
I[R&D$_i$=0]$\cdot C_t/K_{t-1}$	-	0.3717 (.1421)	0.3473 (.1552)
I[R&D$_i$=1]$\cdot C_t/K_{t-1}$	-	0.0501 (.0540)	-0.0294 (.0914)
(C_t/K_{t-1}) difference	-	*0.3216* *(.1546)*	*0.3767* *(.2019)*
No. Firms	364	364	364
Obs.	2211	2211	2211
Df	2196	2186	2186
sc_1	-4.615 [354]	-5.448 [354]	-3.647 [354]
sc_2	-1.010 [340]	-1.614 [340]	-0.518 [340]
z_1 [6]	31.30	-	-
z_2 [8]	13.96	-	-
Sargan	82.70 [83] p=0.489	94.82 [100] p=0.627	75.80 [73] p=0.388

See Table 5.1.

Table 5.3

Error correction model: all industries

I_t/K_{t-1}	(i) Non-R&D performers	(ii) R&D performers	(iii) Differences (i) - (ii)
I_{t-1}/K_{t-2}	-0.0462 (.0880)	-0.1295 (.0696)	0.0833 (.1122)
Δy_t	-0.0069 (.0853)	0.0247 (.0745)	-0.0316 (.1132)
Δy_{t-1}	0.2640 (.1156)	0.0613 (.0904)	0.2027 (.1467)
$(k-y)_{t-2}$	-0.1005 (.0632)	-0.1952 (.0611)	0.0947 (.0879)
y_{t-2}	-0.0118 (.0255)	0.0094 (.0294)	-0.0211 (.0390)
C_t/K_{t-1}	0.1115 (.0889)	0.0617 (.0540)	0.0498 (.1040)
No. Firms	293	414	707
Obs.	1855	2539	4394
Df	1840	2524	4364
sc_1	-4.661 [289]	-5.235 [403]	-6.913 [692]
sc_2	-1.346 [276]	-1.275 [384]	-1.853 [660]
z_1 [6]	15.29	22.38	-
z_2 [8]	13.65	23.64	-
Sargan	66.38 [83] p=0.909	89.47 [83] p=0.294	155.85 [166] p=0.703
Wald [5]	-	-	5.42 p=0.366

Columns (i) and (ii) contain regression results for the sample of non-R&D performing firms and the sample of R&D performing firms, respectively.
Column (iii) presents the coefficient differences across the sample of non-R&D and R&D performing firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is one when a firm performs R&D, and zero when a firm does not. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the five estimated coefficients on the non-cash flow variables across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all equations are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. In column (iii) the interactions of the dummy variable with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1989-1996.

Table 5.4

Error correction model: "high-R&D" industries

I_t/K_{t-1}	(i)	(ii)	(iii)
	Non-R&D performers	R&D performers	Differences (i) - (ii)
I_{t-1}/K_{t-2}	-0.1194	-0.0090	-0.1104
	(.0792)	(.0710)	(.1064)
Δy_t	0.0616	0.0668	-0.0052
	(.0699)	(.0808)	(.1068)
Δy_{t-1}	0.1324	0.1523	-0.0199
	(.0698)	(.0541)	(.0883)
$(k-y)_{t-2}$	-0.1174	-0.1610	0.0436
	(.0547)	(.0540)	(.0768)
y_{t-2}	0.0574	-0.0038	0.0612
	(.0353)	(.0310)	(.0470)
C_t/K_{t-1}	0.1850	0.0074	0.1777
	(.0662)	(.0545)	(.0858)
No. Firms	107	257	364
Obs.	682	1529	2211
Df	667	1514	2181
sc_1	-2.819 [106]	-4.517 [248]	-5.321 [354]
sc_2	-2.240 [104]	-0.950 [236]	-2.240 [340]
z_1 [6]	27.72	18.46	-
z_2 [8]	9.10	17.28	-
Sargan	85.95 [83]	82.15 [83]	168.10 [166]
	p=0.391	p=0.506	p=0.440
Wald [5]	-	-	3.24
			p=0.663

See Table 5.3.

Table 5.5

Euler equation model: all industries

$(I/K)_t$	(i) Full sample	(ii) Non-R&D performers	(iii) R&D performers	(iv) Differences (ii) - (iii)
$(I/K)_{t-1}$	1.0326	0.5484	1.1778	-0.6294
	(.2045)	(.2745)	(.2466)	(.3690)
$(I/K)^2_{t-1}$	-1.9684	-0.9256	-2.3004	1.3749
	(.5149)	(.6948)	(.6248)	(.9344)
$(Y/K)_{t-1}$	0.0281	0.0196	0.0454	-0.0257
	(.0113)	(.0104)	(.0152)	(.0184)
$(\Pi/K)_{t-1}$	0.1062	0.1671	0.0208	0.1463
	(.0311)	(.0460)	(.0368)	(.0589)
No. Firms	707	293	414	707
Obs.	5101	2148	2953	5101
Df	5087	2134	2939	5073
sc_1	-8.384 [707]	-5.818 [293]	-6.696 [414]	-8.869 [707]
sc_2	-0.320 [692]	-0.850 [289]	0.263 [403]	-0.335 [692]
z_1 [4]	343.06	77.06	305.54	-
z_2 [9]	65.60	32.98	60.59	-
Sargan	76.29 [60]	70.27 [60]	69.85 [60]	140.02 [120]
	p=0.076	p=0.171	p=0.180	p=0.102
Wald [4]	-	-	-	13.41
				p=0.009

Column (i) contains regression results for the full sample of firms.
Columns (ii) and (iii) contain regression results for the sample of non-R&D performing firms and the sample of R&D performing firms, respectively.
Column (iv) presents the coefficient differences across the samples of non-R&D and R&D performing firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is one when a firm performs R&D, and zero when a firm does not. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the four estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all equations are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$. In column (iv) the interactions of the dummy variable with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1988-1996.

Table 5.6

Euler equation model: "high-R&D" industries

$(I/K)_t$	(i) Full sample	(ii) Non-R&D performers	(iii) R&D performers	(iv) Differences (ii) - (iii)
$(I/K)_{t-1}$	1.0989	0.6122	0.9474	-0.3352
	(.2338)	(.3906)	(.2313)	(.4540)
$(I/K)^2_{t-1}$	-1.9996	-1.2130	-1.5766	0.3636
	(.6382)	(.9773)	(.5959)	(1.1446)
$(Y/K)_{t-1}$	0.0206	0.0090	0.0432	-0.0341
	(.0112)	(.0100)	(.0133)	(.0166)
$(\Pi/K)_{t-1}$	0.0808	0.1608	-0.0195	0.1803
	(.0318)	(.0525)	(.0333)	(.0621)
No. Firms	364	107	257	364
Obs.	2575	789	1786	2575
df	2561	775	1772	2547
sc_1	-5.744 [364]	-3.894 [107]	-5.603 [257]	-6.814 [364]
sc_2	-0.293 [354]	-1.001 [106]	0.032 [248]	-0.586 [354]
z_1 [4]	206.07	36.43	166.73	-
z_2 [9]	36.82	21.21	45.96	-
Sargan	70.76 [60]	63.20 [60]	62.27 [60]	125.42 [120]
	p=0.161	p=0.364	p=0.395	p=0.349
Wald [4]	-	-	-	11.96
				p=0.018

See Table 5.5.

Table 5.7

Euler equation model

$(I/K)_t$	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	All industries			"High-R&D" industries		
	Non-R&D performers	R&D performers	Differences (i) - (ii)	Non-R&D performers	R&D performers	Differences (iv) - (v)
$(I/K)_{t-1}$	1.0574	0.9347	0.1227	1.5990	1.0648	0.5342
	(.3837)	(.3421)	(.5932)	(.5343)	(.3177)	(.6632)
$(I/K)^2_{t-1}$	-2.2683	-1.5668	-0.7015	-3.8127	-1.7513	-2.0614
	(1.0169)	(.8864)	(1.5765)	(1.5009)	(.8216)	(1.772)
$(Y/K)_{t-1}$	0.0173	0.0484	-0.0311	0.0066	0.0247	-0.0181
	(.0150)	(.0213)	(.0295)	(.0200)	(.0177)	(.0308)
$(\Pi/K)_{t-1}$	0.1937	0.0251	0.1686	0.2084	0.0355	0.1729
	(.0877)	(.0645)	(.1377)	(.0950)	(.0499)	(.1292)
No. Firms	-	-	707	-	-	364
Obs.	-	-	5101	-	-	2575
df	-	-	5083	-	-	2557
sc_1	-	-	-8.373 [707]	-	-	-5.894 [364]
sc_2	-	-	-0.366 [692]	-	-	-0.529 [354]
z_1 [4]	32.56	74.35	-	35.74	67.75	-
Sargan	-	-	72.53 [56] p=0.068	-	-	60.20 [56] p=0.326
Wald [4]	-	-	2.67 p=0.614	-	-	3.38 p=0.497

Columns (i) and (iv) [columns (ii) and (v)] present the coefficient estimates for the sample of non-R&D performing [R&D performing] firms, obtained by interacting all right-hand side variables in the equation for the full samples of firms with a dummy variable which is one [zero] when a firm performs R&D, and zero [one] when a firm does not.
Columns (iii) and (vi) present the coefficient differences across the samples of non-R&D and R&D performing firms, obtained by interacting all right-hand side variables in the equation for the full samples of firms with a dummy variable which is one when a firm performs R&D, and zero when a firm does not. A full set of time dummies are included as regressors in columns (iii) and (vi). Wald is a joint test for differences in the four estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments. Instruments used are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.

Notes. Sample period: 1988-1996.

Table 5.8

Error correction model: "high-R&D" industries

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	Either large or group firms	Either large or group firms	Small indep. firms	Small indep. firms
I_{t-1}/K_{t-2}	-0.0614	-0.0562	-0.3194	-0.2738
	(.1488)	(.1133)	(.0959)	(.1036)
Δy_t	0.0913	0.0633	0.0236	-0.0015
	(.0720)	(.0574)	(.0914)	(.0840)
Δy_{t-1}	0.0958	0.1327	0.1615	0.1948
	(.0944)	(.0702)	(.1344)	(.1228)
$(k-y)_{t-2}$	-0.1459	-0.2107	-0.2458	-0.1816
	(.0751)	(.0591)	(.0863)	(.0965)
y_{t-2}	-0.0075	0.0047	-0.0224	0.0456
	(.0254)	(.0364)	(.0684)	(.0818)
C_t/K_{t-1}	0.07761	-	0.1190	-
	(.0534)		(.1113)	
I[R&D$_i$=0]$\cdot C_t/K_{t-1}$	-	0.2658	-	0.2935
		(.0936)		(.1448)
I[R&D$_i$=1]$\cdot C_t/K_{t-1}$	-	0.0197	-	0.0101
		(.0493)		(.1403)
(C_t/K_{t-1}) difference	-	*0.2461*	-	*0.2834*
		(.1046)		*(.1514)*
No. Firms	228	228	136	136
Obs.	1419	1419	792	792
Df	1404	1394	777	767
sc_1	-2.531 [225]	-3.528 [225]	-3.343 [129]	-3.653 [129]
sc_2	-1.587 [217]	-1.389 [217]	-2.189 [123]	-2.426 [123]
z_1 [6]	21.78	-	22.09	-
z_2 [8]	12.08	-	9.82	-
Sargan	90.18 [83]	94.77 [100]	89.81 [83]	102.90 [100]
	p=0.276	p=0.629	p=0.286	p=0.401

Columns (i) and (iii) contain regression results for the sample of either large or group firms and the sample of small independent firms, respectively.
In columns (ii) and (iv) the cash flow coefficient is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. R&D$_i$=0 identifies non-R&D performing firms, R&D$_i$=1 identifies R&D performing firms. The term (C_t/K_{t-1}) *difference* represents the difference in the cash flow coefficients across the samples of non-R&D and R&D performing firms.
Full set of time dummies included as regressors in columns (i) and (iii). Full set of time dummies interacted with the dummy variables included as regressors in columns (ii) and (iv).

GMMSYS estimates
Instruments used are: differenced equations: (I_{t-3}/K_{t-4}) to (I_{t-5}/K_{t-6}), Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and (C_{t-3}/K_{t-4}) to (C_{t-5}/K_{t-6}); levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Time dummies included as instruments in columns (i) and (iii). Interactions of the dummy variables with the cash flow term and the time dummies included as instruments in columns (ii) and (iv).

Table 5.9

Euler equation model: either large or group firms ("high-R&D" industries)

$(I/K)_t$	(i)	(ii)	(iii)	(iv)
	Full sample	Non-R&D performers	R&D performers	Differences (ii) - (iii)
$(I/K)_{t-1}$	1.3512	0.6980	0.7877	-0.0898
	(.3472)	(.2909)	(.3586)	(.4618)
$(I/K)^2_{t-1}$	-2.5529	-1.0077	-1.0649	0.0573
	(1.0465)	(.6453)	(.9939)	(1.1850)
$(Y/K)_{t-1}$	0.0160	0.0090	0.0405	-0.0315
	(.0130)	(.0169)	(.0184)	(.0250)
$(\Pi/K)_{t-1}$	0.0516	0.0860	-0.0179	0.1039
	(.0277)	(.0460)	(.0321)	(.0561)
No. Firms	228	54	174	228
Obs.	1647	407	1240	1647
df	1633	393	1226	1619
sc_1	-5.329 [228]	-3.651 [54]	-4.282 [174]	-5.374 [228]
sc_2	-0.136 [225]	-1.004 [54]	0.115 [171]	-0.340 [225]
z_1 [4]	182.15	25.22	122.01	-
z_2 [9]	25.88	12.22	47.14	-
Sargan	53.39 [60]	48.39 [60]	59.60 [60]	101.95 [120]
	p=0.714	p=0.859	p=0.490	p=0.882
Wald [4]	-	-	-	5.88 p=0.209

Column (i) contains regression results for the sample of either large or group firms.
Columns (ii) and (iii) contain regression results for the sample of non-R&D performing firms and the sample of R&D performing firms, respectively.
Column (iv) presents the coefficient differences across the samples of non-R&D and R&D performing firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is one when a firm performs R&D, and zero when a firm does not. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the four estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations. Instruments used are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$. In column (iv) the interactions of the dummy variable with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1988-1996.

Table 5.10

Euler equation model: small independent firms ("high-R&D" industries)

$(I/K)_t$	(i)	(ii)	(iii)	(iv)
	Full sample	Non-R&D performers	R&D performers	Differences (ii) - (iii)
$(I/K)_{t-1}$	0.3958	0.4674	0.5405	-0.0730
	(.3301)	(.4643)	(.3631)	(.5894)
$(I/K)^2_{t-1}$	-0.6663	-1.0028	-0.9245	-0.0784
	(.7207)	(1.1807)	(.7635)	(1.4061)
$(Y/K)_{t-1}$	0.0135	0.0027	0.0164	-0.0136
	(.0056)	(.0062)	(.0068)	(.0092)
$(\Pi/K)_{t-1}$	0.1243	0.1888	0.0392	0.1495
	(.0734)	(.0828)	(.0710)	(.1090)
No. Firms	136	53	83	136
Obs.	928	382	546	928
Df	914	368	532	900
sc_1	-3.827 [136]	-2.947 [53]	-3.559 [83]	-4.619 [136]
sc_2	-0.622 [129]	-0.840 [52]	-0.378 [77]	-0.877 [129]
z_1 [4]	41.32	12.01	37.74	-
z_2 [9]	26.61	19.30	22.39	-
Sargan	68.62 [60]	47.76 [60]	53.00 [60]	103.02 [120]
	p=0.208	p=0.873	p=0.727	p=0.866
Wald [4]	-	-	-	4.32 p=0.365

Column (i) contains regression results for the sample of small independent firms.
Columns (ii) and (iii) contain regression results for the sample of non-R&D performing firms and the sample of R&D performing firms, respectively.
Column (iv) presents the coefficient differences across the samples of non-R&D and R&D performing firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is one when a firm performs R&D, and zero when a firm does not. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the four estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations. Instruments used are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$. In column (iv) the interactions of the dummy variable with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1988-1996.

Table 5.11

Horse races: R&D status vs. size/group membership

I_t/K_{t-1}	(i) Full sample	(ii) "High-R&D" industries	(iii) "Low-R&D" industries	(iv) Full sample	(v) "High-R&D" industries	(vi) "Low-R&D" industries
I_{t-1}/K_{t-2}	-0.1647 (.0655)	-0.2670 (.0972)	-0.1348 (.0692)	-0.0742 (.0688)	-0.0823 (.1043)	-0.0967 (.0703)
Δy_t	0.1937 (.0726)	0.1019 (.0743)	0.0030 (.0854)	0.0260 (.0696)	0.1102 (.0983)	-0.0288 (.0895)
Δy_{t-1}	0.1937 (.0726)	0.2163 (.0901)	0.0858 (.0645)	0.1826 (.0810)	0.1614 (.1008)	0.0906 (.0712)
$(k-y)_{t-2}$	-0.2253 (.0578)	-0.3320 (.0898)	-0.1155 (.0491)	-0.1664 (.0565)	-0.2076 (.0932)	-0.1041 (.0579)
y_{t-2}	-0.0079 (.0329)	-0.0526 (.0523)	0.0166 (.0307)	-0.0082 (.0065)	-0.0382 (.0355)	-0.0025 (.0310)
C_t/K_{t-1}	0.0296 (.0715)	0.0228 (.0606)	0.0934 (.1186)	0.0697 (.1103)	0.0417 (.0865)	0.0060 (.1519)
$I[R\&D_i=0]\cdot C_t/K_{t-1}$	0.1797 (.1213)	0.2381 (.1213)	0.0199 (.1242)	0.0998 (.1809)	0.2580 (.1333)	0.0200 (.1769)
$I[D_i=1]\cdot C_t/K_{t-1}$	0.2332 (.1372)	0.0059 (.1400)	0.2584 (.1273)	0.2182 (.1874)	0.0278 (.1571)	0.2954 (.1546)
No. Firms	707	364	343	707	364	343
Obs.	4394	2211	2183	4394	2211	2183
Df	4359	2176	2148	4368	2185	2157
sc_1	-5.729 [692]	-3.557 [354]	-4.441 [338]	-5.838 [692]	-8.119 [354]	-5.772 [338]
sc_2	-2.130 [660]	-1.880 [340]	-1.901 [320]	-1.529 [660]	-0.107 [340]	-1.341 [320]
Sargan	123.87 [117] p=0.314	130.11 [117] p=0.192	136.46 [117] p=0.105	73.92 [72] p=0.415	77.90 [72] p=0.297	81.60 [72] p=0.206

In all the columns there are interactions of the cash flow term with two dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. $R\&D_i=0$ identifies non-R&D performing firms, $D_i=1$ identifies small independent firms.
Full set of time dummies interacted with the dummy variables included as regressors in all the columns.

GMMSYS estimates
Time dummies included as instruments in all the columns.
Instruments used are: differenced equations: (I_{t-3}/K_{t-4}) to (I_{t-5}/K_{t-6}), Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and (C_{t-3}/K_{t-4}) to (C_{t-5}/K_{t-6}); levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Interactions of the dummy variables with the cash flow term and the time dummies included as instruments in columns (i), (ii) and (iii).

Notes. Sample period: 1989-1996.

Table 5.12

Error correction model: R&D performers with information on R&D activity

I_t/K_{t-1}	(i)	(ii)	(iii)
I_{t-1}/K_{t-2}	-0.0417 (.0829)	-0.0623 (.0918)	-0.1321 (.1006)
Δy_t	0.1040 (.0744)	0.0819 (.0660)	0.1088 (.0681)
Δy_{t-1}	0.1101 (.0519)	0.1031 (.0596)	0.0568 (.0847)
$(k-y)_{t-2}$	-0.1265 (.0523)	-0.1250 (.0621)	-0.1559 (.0622)
y_{t-2}	-0.0323 (.0302)	-0.0385 (.0306)	-0.0438 (.0399)
C_t/K_{t-1}	0.0647 (.0753)	-	-
$I[H_i=0]\cdot C_t/K_{t-1}$	-	0.1321 (.0835)	0.1713 (.0661)
$I[H_i=1]\cdot C_t/K_{t-1}$	-	0.0340 (.0868)	-0.0857 (.1240)
(C_t/K_{t-1}) difference	-	*0.0982* *(.1201)*	*0.2570* *(.1411)*
No. Firms	224	224	224
Obs.	1328	1328	1328
Df	1313	1303	1303
sc_1	-4.516 [215]	-4.516 [215]	-3.717 [215]
sc_2	-1.543 [205]	-1.543 [205]	-1.651 [205]
z_1 [6]	11.11	-	-
z_2 [8]	19.35	-	-
Sargan	99.69 [83] p=0.102	109.63 [100] p=0.240	99.02 [100] p=0.509

Column (i) contains regression results for the sample of R&D performing firms that report information on the characteristics of their R&D activity.
In column (ii) [(iii)] the cash flow coefficient is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. $H_i=0$ identifies firms that devote less than 45% (60%) of their R&D investment spending to the introduction of new products or new production processes, $H_i=1$ identifies firms that devote at least 45% (60%) of their R&D investment spending to the introduction of new products or new production processes.
Full set of time dummies included as regressors in column (i). Full set of time dummies interacted with the dummy variables included as regressors in columns (ii) and (iii).

GMMSYS estimates
Time dummies included as instruments in all equations.
Instruments used are: differenced equations: (I_{t-3}/K_{t-4}) to (I_{t-5}/K_{t-6}), Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and (C_{t-3}/K_{t-4}) to (C_{t-5}/K_{t-6}); levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Interactions of the dummy variables with the cash flow term and the time dummies included as instruments in columns (ii) and (iii).

Table 5.13

Euler equation model: R&D performers with information on R&D activity

$(I/K)_t$	(i)	(ii)	(iii)	(iv)
	R&D performers	Less Innovative firms	Highly innovative firms	Differences (ii) - (iii)
$(I/K)_{t-1}$	0.9497	0.8284	0.6853	0.1431
	(.2572)	(.3424)	(.2667)	(.4340)
$(I/K)^2_{t-1}$	-1.6410	-1.4586	-1.0304	-0.4283
	(.6425)	(.9217)	(.6771)	(1.1437)
$(Y/K)_{t-1}$	0.0437	0.0205	0.0695	-0.0490
	(.0146)	(.0131)	(.0202)	(.0241)
$(\Pi/K)_{t-1}$	0.0089	0.0116	-0.0256	0.0372
	(.0422)	(.0397)	(.0709)	(.0813)
No. Firms	224	112	112	224
Obs.	1552	762	790	1552
df	1538	748	776	1524
sc_1	-5.438 [224]	-4.515 [112]	-4.053 [112]	-6.017 [224]
sc_2	0.013 [215]	-0.260 [105]	0.001 [110]	-0.172 [215]
z_1 [4]	149.52	26.20	156.37	-
z_2 [9]	44.12	28.95	29.01	-
Sargan	61.90 [60]	66.08 [60]	67.54 [60]	133.59 [120]
	p=0.408	p=0.275	p=0.235	p=0.187
Wald [4]	-	-	-	7.24 p=0.124

Column (i) contains regression results for the sample of R&D performing firms that report information on the characteristics of their R&D activity.
Columns (ii) and (iii) contain regression results for the sample of "less-innovative" firms and the sample of "highly innovative" firms, respectively.
Column (iv) presents the coefficient differences across the samples of "less-innovative" and "highly-innovative" firms, obtained by interacting all right-hand side variables in the equation for the sample of R&D performing firms with a dummy variable which is one when a firm devotes at least 45% of its R&D spending towards the introduction of new products or new production processes, and zero when a firm devotes less than 45% of its R&D spending towards the introduction of new products or new production processes. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the four estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations. Instruments used are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$. In column (iv) the interactions of the dummy variable with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1988-1996.

Table 5.14

Euler equation model: R&D performers with information on R&D activity

$(I/K)_t$	(i)	(ii)	(iii)	(iv)
	R&D performers	Less innovative firms	Highly innovative firms	Differences (ii) - (iii)
$(I/K)_{t-1}$	0.9497	0.8269	0.8318	-0.0049
	(.2572)	(.3175)	(.2803)	(.4236)
$(I/K)^2_{t-1}$	-1.6410	-1.2737	-1.3756	0.1019
	(.6425)	(.8724)	(.6988)	(1.1178)
$(Y/K)_{t-1}$	0.0437	0.0240	0.0980	-0.0740
	(.0146)	(.0123)	(.0214)	(.0247)
$(\Pi/K)_{t-1}$	0.0089	0.0208	-0.1469	0.1677
	(.0422)	(.0393)	(.0845)	(.0932)
No. Firms	224	151	73	224
Obs.	1552	1022	530	1552
Df	1538	1008	516	1524
sc_1	-5.438 [224]	-4.684 [151]	-3.656 [73]	-5.868 [224]
sc_2	0.013 [215]	0.408 [144]	-0.479 [71]	0.091 [215]
z_1 [4]	149.52	55.67	77.96	-
z_2 [9]	44.12	31.87	28.21	-
Sargan	61.90 [60]	73.69 [60]	68.42 [60]	142.09 [120]
	p=0.408	p=0.110	p=0.213	p=0.082
Wald [4]	-	-	-	9.68 p=0.046

Column (i) contains regression results for the sample of R&D performing firms that report information on the characteristics of their R&D activity.
Columns (ii) and (iii) contain regression results for the sample of "less-innovative" firms and the sample of "highly innovative" firms, respectively.
Column (iv) presents the coefficient differences across the samples of "low-innovation" and "high-innovation" firms, obtained by interacting all right-hand side variables in the equation for the sample of R&D performing firms with a dummy variable which is one when a firm devotes at least 60% of its R&D spending towards the introduction of new products or new production processes, and zero when a firm devotes less than 60% of its R&D spending towards the introduction of new products or new production processes. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the four estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations. Instruments used are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$. In column (iv) the interactions of the dummy variable with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1989-1996.

Table 6.1

Probits for R&D performance in "high-R&D" industries

R&D=1	(i)	(ii)	(iii)
C_{t-1}/K_{t-2}	0.6481 (.3691)	-	0.6715 (.4367)
Internal finance[1]	-	0.4773 (.2109)	0.4360 (.2117)
y_{t-1}	0.2155 (.0624)	0.1686 (.0695)	0.1609 (.0694)
Industry dummies (6)	yes	yes	yes
Log L	-198.24	-177.64	-176.47
Pseudo R^2	0.0826	0.0868	0.0929
Observations[2]	364	309	309

The coefficients and standard errors are taken from probit ML estimates of whether a firm performed R&D in 1993.

[1] Share of fixed investment that is financed from internal funds (as declared by the firms in the Mediocredito Centrale survey - see also Table 4.2).

[2] In columns (ii) and (iii) only 309 observations are used since 55 firms do not report information on the financing of their investment expenditure.

7. Conclusions

Among G7 countries Italy has the lowest proportion of GDP devoted to business expenditure on research and development (BERD). This technological gap is commonly attributed to the low degree of market concentration and the large number of small firms, which in turn reflects the Italian pattern of manufacturing specialisation in labour- and resource-intensive industries. In addition to these factors, in this chapter we have provided evidence that suggests that imperfections in the capital market may have contributed to hamper innovative investment by Italian private firms. In fact, arm's-length relationships between companies and banks (exemplified by the practice of multiple bank lending and firms' marginal reliance on long-term credit) and the lack of institutions specialised in the financing of venture capital may have played an additional role in preventing Italian firms from engaging in R&D spending.

As Italian balance sheets lack quantitative information on firms' R&D expenditures, in this work we assembled company accounts data for a selected sample of manufacturing firms that provided information on their R&D activities in a survey conducted by Mediocredito Centrale. Since the survey information was limited to the period 1992-1994, it was not possible to estimate an R&D investment equation to directly test the importance of capital market imperfections on Italian firms' R&D expenditures. In order to investigate whether financial variables have a significant impact on innovative behaviour, we then examined the relationship between fixed investment and internal finance over the period 1986-1996 for samples that distinguished R&D and non-R&D performing firms (based on the survey information for the period 1992 to 1994). The rationale for this exercise was the observation that firms that expect to be able to finance a larger share of their investment from internal funds are both more likely to undertake long-term R&D investment and less likely to encounter binding financing constraints that affect their fixed investment spending.

The econometric analysis provided evidence that physical investment spending of non-R&D performing firms in the "high-R&D" industries displays a greater sensitivity to financial variables than the fixed investment of the R&D performing firms. This suggests that capital market imperfections can have a significant impact on Italian companies' innovative behaviour: because of the cost premium on external finance, only firms in a strong liquidity position (and for whom, therefore, financial constraints are less likely to be binding) will choose to undertake long-run commitments to R&D investment projects.

The basic findings of the work held up when subjected to a number of robustness tests which included the estimation of R&D status probits and of fixed investment equations for subsets of companies split according to either the firm's information position or the characteristics of its R&D activity. The main results for the fixed investment equations were also robust to using both an error correction specification and the more structural approach of the Euler equations. In the latter case, it is noteworthy that, contrary to most of the evidence reported in other empirical studies, the estimated coefficient on the gross operating profits term was significantly negative in the investment equation for the sample of firms in "high-R&D" industries that undertake highly innovative R&D projects. This is consistent both with the hypothesis that these firms face no cost premium on external finance, and with the hypothesis that those companies that commit to high-risk R&D projects are least likely to face binding financial constraints due to a plentiful supply of internal finance.

APPENDIX B

Table B.1

Means (standard deviations) of variables used in estimation

Variables	All industries			"High-R&D" industries		
	Full sample	Full sample: R&D firms	Full sample: non-R&D firms	Full sample	Full sample: R&D firms	Full sample: non-R&D firms
I_t/K_{t-1}	0.171 (.149)	0.174 (.146)	0.166 (.153)	0.174 (.147)	0.173 (.144)	0.178 (.154)
Δy_t	0.073 (.171)	0.078 (.175)	0.067 (.170)	0.080 (.183)	0.080 (.183)	0.081 (.184)
$(k\text{-}y)_{t-2}$	-1.186 (.593)	-1.207 (.570)	-1.158 (.623)	-1.215 (.580)	-1.246 (.552)	-1.144 (.634)
y_{t-2}	10.458 (1.270)	10.675 (1.319)	10.158 (1.135)	10.487 (1.367)	10.666 (1.379)	10.083 (1.249)
C_t/K_{t-1}	0.178 (.214)	0.186 (.223)	0.167 (.200)	0.199 (.198)	0.204 (.203)	0.189 (.185)
$(I/K)_{t-1}$	0.147 (.100)	0.151 (.098)	0.141 (.103)	0.150 (.098)	0.150 (.096)	0.151 (.104)
$(I/K)^2_{t-1}$	0.032 (.041)	0.032 (.041)	0.031 (.042)	0.032 (.041)	0.032 (.039)	0.033 (.044)
$(Y/K)_{t-1}$	3.702 (2.194)	3.741 (2.194)	3.650 (2.193)	3.775 (2.133)	3.851 (2.115)	3.602 (2.163)
$(\Pi/K)_{t-1}$	0.342 (.260)	0.354 (.270)	0.325 (.245)	0.359 (.285)	0.367 (.292)	0.341 (.268)
No. Firms	717	414	293	364	257	107

Table B.2

Means (standard deviations) of variables used in estimation ("high-R&D" industries)

Variables	Firms in the "high-R&D" industries					
	Either large or group firms	Either large or group firms: R&D firms	Either large or group firms: non-R&D firms	Small independent firms	Small independent firms: R&D firms	Small independent firms: non-R&D firms
I_t/K_{t-1}	0.169 (.135)	0.166 (.130)	0.175 (.150)	0.184 (.166)	0.187 (.172)	0.180 (.159)
Δy_t	0.077 (.180)	0.076 (.180)	0.080 (.179)	0.086 (.189)	0.088 (.190)	0.083 (.189)
$(k-y)_{t-2}$	-1.203 (.567)	-1.225 (.522)	-1.135 (.682)	-1.236 (.602)	-1.294 (.611)	-1.153 (.580)
y_{t-2}	11.038 (1.352)	11.142 (1.347)	10.719 (1.318)	9.511 (.672)	9.584 (.645)	9.406 (.696)
C_t/K_{t-1}	0.196 (.199)	0.199 (.205)	0.187 (.182)	0.204 (.209)	0.217 (.214)	0.185 (.201)
$(I/K)_{t-1}$	0.147 (.093)	0.146 (.089)	0.150 (.102)	0.156 (.108)	0.159 (.109)	0.152 (.106)
$(I/K)^2_{t-1}$	0.030 (.038)	0.029 (.035)	0.033 (.043)	0.036 (.046)	0.037 (.047)	0.034 (.045)
$(Y/K)_{t-1}$	3.717 (2.107)	3.741 (2.067)	3.646 (2.224)	3.875 (2.175)	4.099 (2.203)	3.554 (2.096)
$(\Pi/K)_{t-1}$	0.345 (.291)	0.344 (.292)	0.349 (.290)	0.384 (.272)	0.418 (.285)	0.335 (.243)
No. Firms	228	174	54	136	83	53

Table B.3

Means (standard deviations) of variables used in estimation

Variables	R&D performing firms in the "high-R&D" industries				
	Full sample	Firms that devote at least 45% of their R&D spending to product/process innovation	Firms that devote less than 45% of their R&D spending to product/process innovation	Firms that devote at least 60% of their R&D spending to product/process innovation	Firms that devote less than 60% of their R&D spending to product/process innovation
I_t/K_{t-1}	0.175 (.148)	0.190 (.152)	0.160 (.143)	0.190 (.160)	0.168 (.141)
Δy_t	0.082 (.178)	0.092 (.177)	0.070 (.179)	0.096 (.188)	0.074 (.1720
$(k\text{-}y)_{t-2}$	-1.239 (.551)	-1.198 (.535)	-1.282 (.563)	-1.129 (.521)	-1.296 (.557)
y_{t-2}	10.455 (1.256)	10.412 (1.232)	10.499 (1.280)	10.291 (1.014)	10.540 (1.357)
C_t/K_{t-1}	0.200 (.217)	0.203 (.208)	0.196 (.227)	0.209 (.227)	0.183 (.207)
$(I/K)_{t-1}$	0.151 (.098)	0.161 (.098)	0.140 (.097)	0.159 (.102)	0.147 (.096)
$(I/K)^2_{t-1}$	0.033 (.041)	0.036 (.042)	0.029 (.040)	0.036 (.043)	0.031 (.039)
$(Y/K)_{t-1}$	3.818 (2.026)	3.613 (1.875)	4.030 (2.152)	3.362 (1.685)	4.054 (2.145)
$(\Pi/K)_{t-1}$	0.367 (.277)	0.362 (.294)	0.373 (.260)	0.328 (.240)	0.387 (.292)
No. Firms	224	112	112	73	151

Table B.4

Error correction model: "low-R&D" industries

I_t/K_{t-1}	(i) Either large or group firms	(ii) Small indep. firms	(iii) Differences (i) - (ii)
I_{t-1}/K_{t-2}	-0.0761 (.1486)	-0.0500 (.1090)	-0.0261 (.1843)
Δy_t	0.1058 (.0508)	0.0280 (.0685)	0.0778 (.0852)
Δy_{t-1}	0.0654 (.0620)	0.1358 (.0684)	-0.0704 (.0923)
$(k-y)_{t-2}$	-0.1632 (.0692)	-0.1409 (.0667)	-0.0223 (.0961)
y_{t-2}	0.0560 (.0263)	0.0241 (.0151)	0.0318 (.0304)
C_t/K_{t-1}	-0.0104 (.0996)	0.2366 (.0652)	-0.2471 (.1191)
No. Firms	200	143	343
Obs.	1272	911	2183
Df	1257	896	2153
sc_1	-3.465 [197]	-3.013 [141]	-4.591 [338]
sc_2	-1.071 [188]	-2.077 [132]	-2.183 [320]
z_1 [6]	22.66	68.96	-
z_2 [8]	14.92	17.96	-
Sargan	93.63 [83] p=0.200	81.44 [83] p=0.528	175.07 [166] p=0.300
Wald [6]	-	-	10.77 [6] p=0.096

Column (iii) presents the coefficient differences across the sample of either large or group firms and the sample of small and independent firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms in the "low-R&D" industries with a dummy variable which is zero when a firm is either large or part of a group, and one when a firm is both small and independent. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the six estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. In column (iii) the interactions of the dummy variables with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1989-1996. See also notes for Table 4.2.a, Chapter 4.

Table B.5

Euler equation model: "low-R&D" industries

$(I/K)_t$	(i) Either large or group firms	(ii) Small indep. Firms	(iii) Differences (i) - (ii)
$(I/K)_{t-1}$	1.0036	0.8375	0.1661
	(.3016)	(.2448)	(.3885)
$(I/K)^2_{t-1}$	-1.8650	-1.5481	-0.3169
	(.9424)	(.5870)	(1.1103)
$(Y/K)_{t-1}$	0.0094	0.0028	0.0065
	(.0039)	(.0060)	(.0071)
$(\Pi/K)_{t-1}$	0.0481	0.1793	-0.1313
	(.0384)	(.0478)	(.0613)
No. Firms	200	143	343
Obs.	1472	1054	2526
Df	1458	1040	2498
sc_1	-5.019 [200]	-5.999 [143]	-7.720 [343]
sc_2	0.587 [197]	-0.701 [141]	-0.099 [338]
z_1 [4]	138.21	190.22	-
z_2 [9]	40.77	28.41	-
Sargan	63.40 [60]	60.54 [60]	124.76 [120]
	p=0.357	p=0.456	p=0.365
Wald [4]	-	-	5.48 [4]
			p=0.242

Column (iii) presents the coefficient differences across the sample of either large or group firms and the sample of small and independent firms, obtained by interacting all right-hand side variables in the equation for the full sample of firms in the "low-R&D" industries with a dummy variable which is zero when a firm is either large or part of a group, and one when a firm is both small and independent. Interactions of the dummy variable with time dummies are also included. Wald is a joint test for differences in the four estimated coefficients across these sub-samples.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in columns (i), (ii) are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.
In column (iii) the interactions of the dummy variables with the right-hand side variables and the time dummies are also included in the instrument set.

Notes. Sample period: 1988-1996. See also notes for Table 4.2.a, Chapter 4.

Figure B.1

Cash flow to capital ratio: firms in "high-R&D" industries

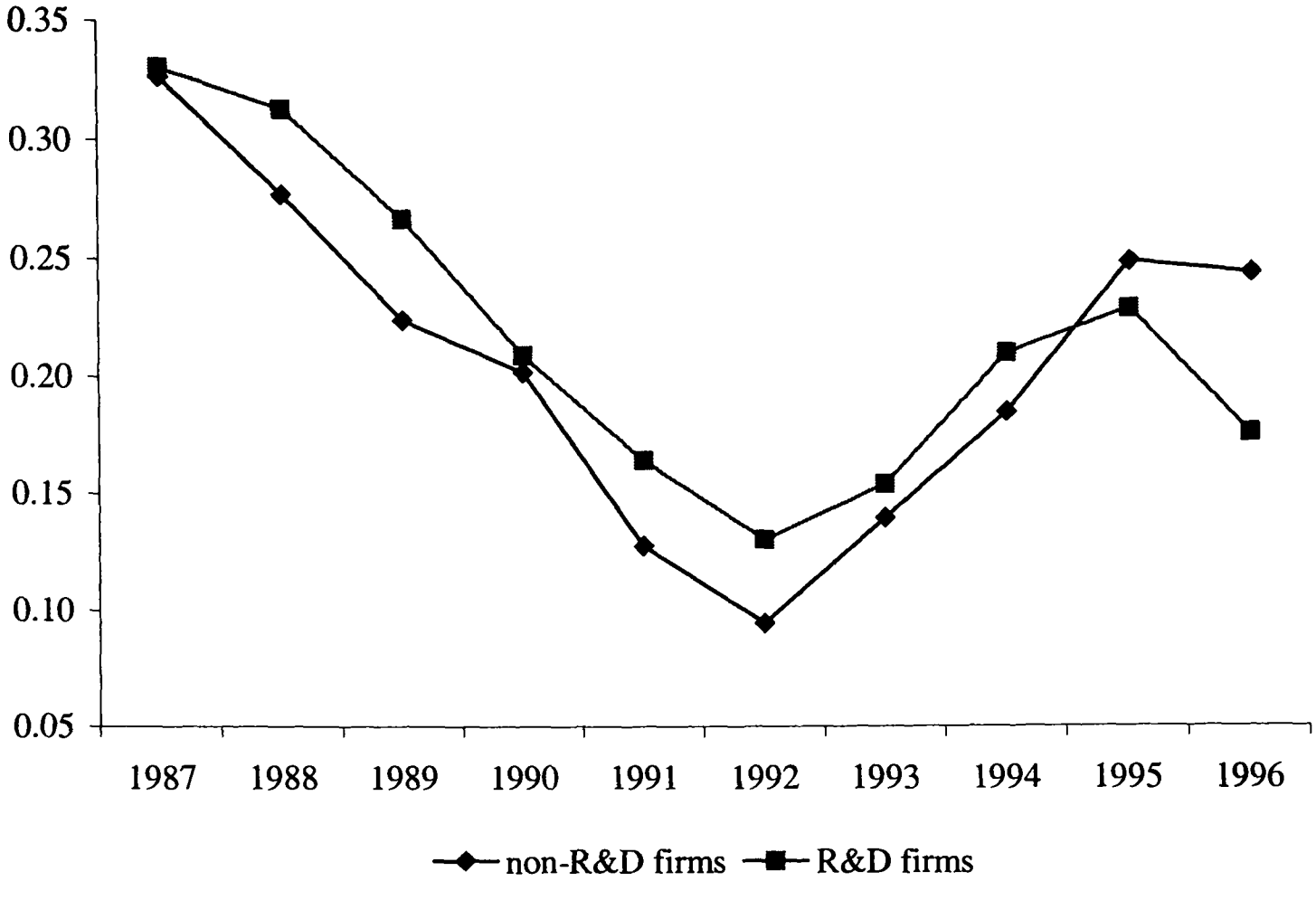


Figure B.2

Cash flow to capital ratio: either large or group firms in "high-R&D" industries

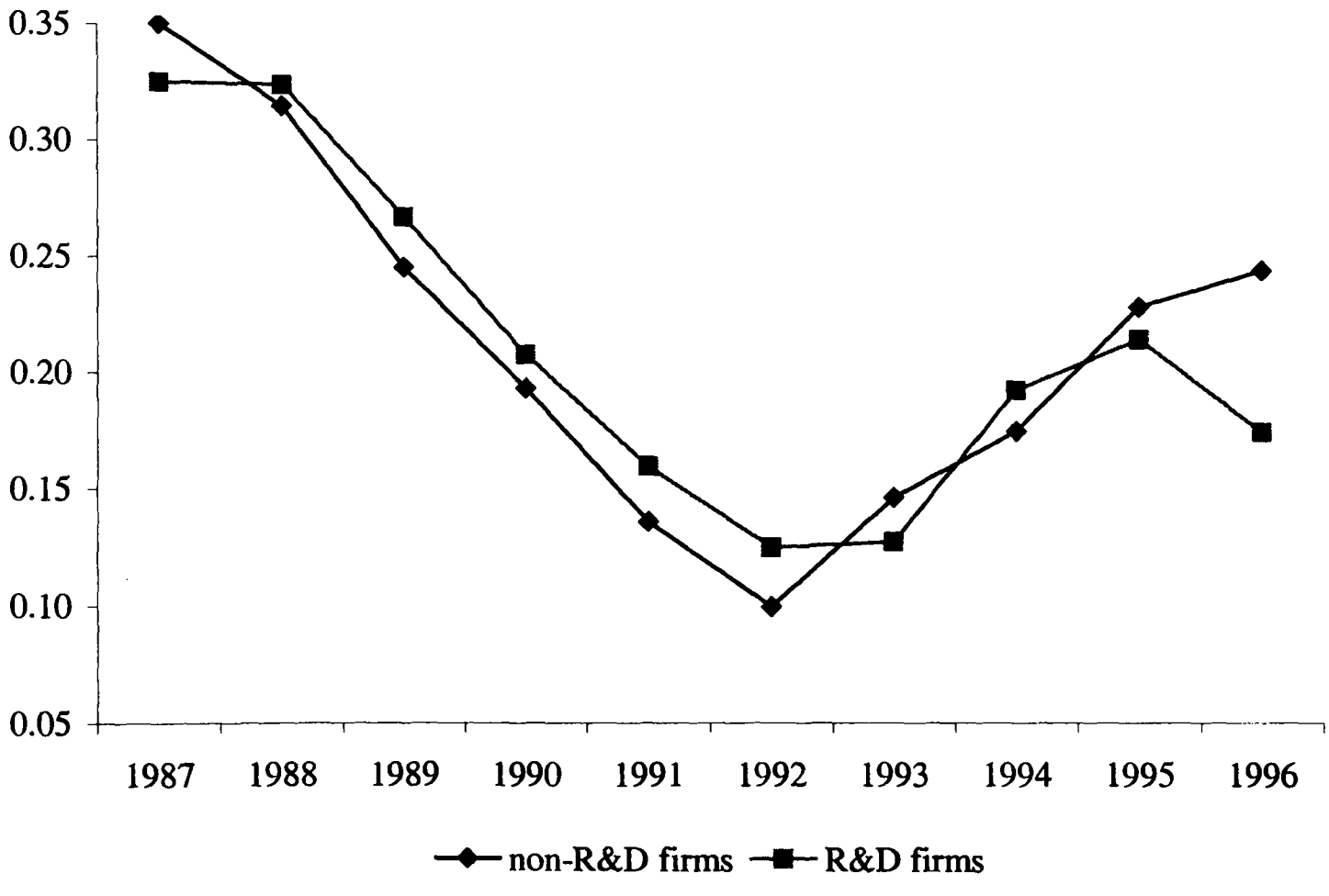
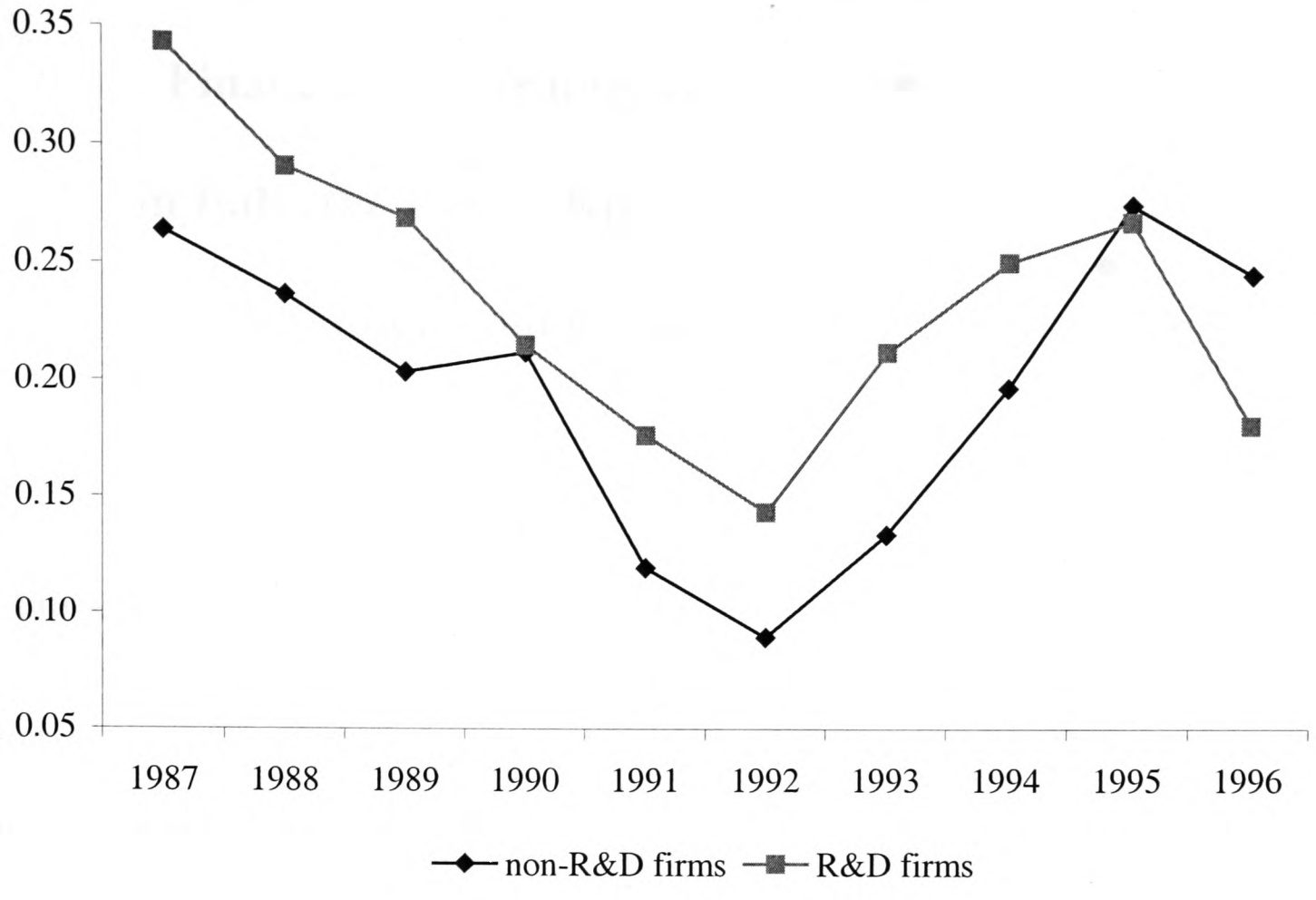


Figure B.3

Cash flow to capital ratio: small and independent firms in "high-R&D" industries



Chapter 6

Financial Constraints and Corporate Investment in Italy, the United Kingdom and the United States: A Comparison Using Company Panel Data

1. Introduction

Over the past decade there has been a resurgence of interest in the determinants of firms' investment decisions. The empirical shortcomings of existing models, developed under the assumption of perfect capital markets, and the theoretical advances in the field of information economics have stimulated a growing literature on the effects of financial constraints on investment.

Imperfect information in the capital markets has added a new dimension to the traditional neoclassical investment theory, according to which firms undertake any investment project with a positive net present value and the capital structure is irrelevant. Since informational asymmetries can prevent interest rates and securities prices from fully adjusting to allow firms to undertake all desired investment, the availability of internal finance may constrain investment directly (holding investment opportunities constant). Recent empirical studies based on firm-level panel data have taken into explicit account firm heterogeneity to identify companies that are more likely to face different degrees of capital market imperfections and to test whether their investment behaviour differs in the way predicted by the information cost models. This was the approach we have adopted in Chapters 4 and 5. While the cross-sectional differences usually support an important role for information-related frictions in

firms' financing and investment decisions, there are potential problems in testing the different sensitivity of investment to internal finance when firms are in different "regimes". First, one should expect zero sensitivity in the unconstrained regime, which is rarely found in practice –although we have been unusually successful in finding sub-samples with zero cash-flow sensitivity in our analysis of Italian manufacturing firms. Secondly, the regime that the firm is in is partly a choice variable of the firm itself, that is, the sample split may be endogenous. Rather than compare the sensitivities of investment spending to internal finance for firms in a different information position, in this chapter we carry out a comparative analysis of investment in physical capital for firms in three different countries: Italy, the United Kingdom, and the United States. Since the financial systems faced by firms in each country are quite different, as we described in Chapter 3, and these differences are exogenous, different responses of investment to internal finance in the three countries offer a potentially compelling source of identification.

The analysis of the impact of financial variables on the investment activity of UK, US and Italian firms is also important because it allows us to compare the performance of different financial systems and their impact on corporate investment. In the economic literature there is a long-standing debate on whether *insider control* systems are more or less likely to promote and sustain capital accumulation than the *outsider control* systems. The theoretical analysis suggests that in the former systems, which are typical of Continental Europe and Japan, high concentration of ownership and control in the hands of several kinds of "active" investors decreases the informational asymmetries between management and investors, thus reducing the "risk-premium" on external finance. On the other hand, it is suggested that in the market-based, outsider control systems, which are typical of Britain and the United States, highly dispersed ownership reduces the information available to diverse agents to screen and monitor firms, thus raising the "risk-premium" on external finance. Chapter 3 discussed in more detail these differences.

To test the hypothesis that firms in outsider control systems are more likely to face capital market imperfections than firms in insider control systems, we investigate the impact of financial variables on the investment behaviour of UK, US and Italian firms. To do this, we estimate for each country two different econometric models of investment: an error correction specification augmented with cash flow (to investigate the impact of financial constraints), and an Euler equation specification derived from dynamic optimisation in the presence of symmetric, quadratic costs of adjustment. Two econometric models are here estimated in order to check that any difference across the three countries is robust to alternative specifications of the investment model.

The empirical analysis is based on company accounts covering the period 1986 to 1997 for the UK and the US firms, and the period 1986 to 1996 for Italy. A problem usually arises when comparing US and UK firm-level data with Continental European company accounting data. The former are based on consolidated accounts data for company groups. The latter are generally based on unconsolidated accounts for individual corporations. Thus, the samples of Continental European firms also include firms that are subsidiaries of larger companies. At the same time, unconsolidated accounting data of a parent company refer to its economic activity as a legally independent company, and do not include the activities of the individual corporations controlled by the parent company.

The use of unconsolidated balance sheets to test for the importance of financial constraints on corporate investment is potentially open to criticism. In fact, there is a possibility that the investment spending by a legally independent subsidiary is constrained by the internal funds of the company group as a whole, rather than by the internal funds of the subsidiary itself, and that this will not be detected using unconsolidated data and investigating the sensitivity of the subsidiary's investment to its own internal finance. In this case the use of unconsolidated balance sheets would underestimate the impact of financial constraints on capital accumulation. In order to make the data across countries more comparable the Italian database

we study here has been assembled using consolidated balance sheets. Since these were available exclusively for the largest corporate groups and, in the majority of the cases, only from the beginning of the 1990s, the number of firms and of observations per firm in the Italian data set is lower than in the UK and US data sets. Despite these differences in the sample size, the comparisons across countries provide interesting evidence on the different impact of financial variables on firms' investment spending. In accord with the theoretical predictions, internal finance appears to play a more important role in the market-based economies than in Italy.

It should be stressed from the start that a stronger sensitivity of investment to internal finance in the Anglo-Saxon samples should not be interpreted as evidence of the superiority of the insider control systems over the outsider control systems. What this analysis suggests is that insider control systems may spur capital accumulation by relaxing financial constraints, because firms benefit from the economies of scale in monitoring the quality of management and investments that financial intermediaries and concentrated owners can provide. What this analysis does not address is the possibility that insider control systems may also suffer from a dynamic inefficiency problem, in that concentrated ownership may hamper the efficient selection of controlling agents and make firms more resistant to (necessary) changes in corporate policy. Indeed, as Meyer (1998) and Allen and Gale (1999) point out, the primary strength of the outsider control, market-based systems, and one possible reason for their "success" during the 1990s, is that they appear to be more responsive to change and (at least in the case of the US) more supportive of high technology investments.

This chapter is organised as follows. Section 2 describes the data and offers some aggregate comparisons and general descriptive statistics for the three countries here analysed. Section 3 presents the main empirical results. Section 4 offers some additional tests to check for the reliability and robustness of the general results. Section 5 concludes.

2. Data

This section describes the samples of UK, US and Italian companies, and presents descriptive statistics on output and investment obtained from national accounts and our firm-level data.

2.1 Company data: samples

The company data sets for the three countries are obtained from different sources. For the UK and the US the data are drawn from the Datastream on-line service. This consists of the consolidated accounts of all companies quoted on the London Stock Exchange and the largest companies quoted on the New York Stock Exchange. Datastream also provides company accounts for the Italian companies quoted on the Milan Stock Exchange. These data are, however, of limited use because few manufacturing companies are quoted on the Italian stock market and, more importantly, the accounts available are unconsolidated balance sheets for individual companies. Although legally independent, these companies may be part of a business group, as we described in Chapter 3. Unconsolidated company accounts make it difficult to draw any conclusions about the workings of the Italian financial system relative to the US and the UK. In fact, if the investment spending by a subsidiary is constrained by the cash flow of the company group as a whole, rather than by the cash flow of the subsidiary itself, this would not be detected by regressing the subsidiary's investment on its own cash flow using unconsolidated data. Hence, the impact of financial constraints in Italy could be underestimated with respect to the impact in Britain and the US.

Previous studies of investment spending based on Italian firm-level data, including those described in Chapters 4 and 5, have always used unconsolidated company accounts. In this chapter, in order to make the empirical findings for the three countries more comparable, the Italian data set consists of consolidated accounts obtained from the Centrale dei Bilanci (Balance Sheet Centre) database. This includes consolidated balance sheets of a selected

sample of large and medium sized private corporate groups. The Centrale dei Bilanci has been collecting consolidated accounts for Italian corporate groups since the second half of the 1980s. However, only since 1991 has the number of accounts available become significant, as the legislative decree 127/1991 (D.Lgs. 9 aprile 1991, n. 127) made the presentation of consolidated accounts by business groups compulsory. 196 consolidated accounts of private business groups were drawn from the Centrale dei Bilanci database. These groups need not be stock market quoted, even though some of the subsidiaries may be. Due to the pyramidal structure of the Italian corporate groups, some of the consolidated accounts belong to groups that, in turn, are members of a larger business group, whose accounts may or may not have been included in our data set. Since we are interested in investigating the impact of financial constraints on the investment spending of a group as a whole, consolidated accounts of 44 identified subsidiaries were excluded from the data set.

We use panel data on company accounts covering the period 1986-97 for the UK and US companies, and the period 1986-96 for the Italian companies. All firms have their main activity in the manufacturing sector, and firms with either less than four consecutive complete annual observations or fewer than 100 employees in the first year of observation were excluded. Since Datastream covers only the largest US quoted companies, all the US firms here analysed have more than 250 employees. The initial samples of firms that satisfied these requirements were 511 firms for the UK, 487 firms for the US, and 148 firms for Italy.

The main variables used in the econometric analysis are flows of investment, sales, gross operating profits, and cash flow. Investment spending is obtained from the sources and uses of funds account, and not inferred from changes in the balance sheet. Sales are used as a proxy for output. For the US and the UK gross operating profits are equal to the provision for depreciation of fixed assets plus operating profits before tax, interest and preference dividends. Since for the Italian data a measure of value added is usually available from the company accounts, gross operating profits are obtained where possible as the difference

between gross output (total sales plus the change in finished good inventories) and current costs (the sum of labour compensation, costs of goods sold plus general, selling and other expenses). Likewise, cash flow is constructed by subtracting the wage bill, net interest and taxes from the value added. Wherever data on variable costs are not available, cash flow is computed as for the UK and the US firms by adding back the reported value of depreciation of fixed assets to the reported value of profits (net of interest and taxes). All flow variables are deflated using national output price indices[1].

A measure of the stock of capital at current replacement cost ($p_t^I K_t$) was estimated from the flow data on investment ($p_t^I I_t$) using a standard perpetual inventory method:

$$(2.1) \quad p_t^I K_t = (1-\delta) p_{t-1}^I K_{t-1} \left(\frac{p_t^I}{p_{t-1}^I} \right) + p_t^I I_t$$

where K_t is the capital stock, p_t^I is the price of investment goods, I_t is real investment and δ is the depreciation rate. The starting value was based on the net book value of tangible fixed capital assets, adjusted for previous three years inflation. Subsequent values were obtained using accounts data on investment, a national price index for investment goods prices[2], and a depreciation rate of 8%.

After computing the main variables used in the investment models, we selected firms and observations meeting the following criteria:

- nominal growth rate of sales greater than -50% and smaller than 100%

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[1] The output price index is an implicit GDP deflator for the manufacturing sector, obtained from the OECD Quarterly National Accounts. For companies whose accounting period does not coincide with the calendar year, care was taken to use price changes over the relevant four-quarter period.

[2] The investment goods price index is an implicit deflator for gross fixed capital formation, obtained from the OECD Quarterly National Accounts. For companies whose accounting period does not coincide with the calendar year, care was taken to use price changes over the relevant four-quarter period.

- no major mergers or acquisitions (or disposals) of relevant part of the firms' operations
- fixed investment to beginning-of-period capital stock ratio below the 95th percentile
- cash flow to beginning-of-period capital stock ratio above the 1st and below the 99th percentile
- sales to end-of-period capital stock ratio above the 1st and below the 99th percentile

In the cases in which some observations were discarded, we retained the available time series of consecutive annual observations for the firms affected, provided that at least four consecutive annual observations were available. The final samples of firms that satisfied these requirements were 466 firms for the UK, 457 firms for the US, and 118 firms for Italy. The exact structure of the samples by number of observations per company and number of companies per year is reported in Table 2.1 and Table 2.2. In the UK sample, 155 companies (corresponding to 33.3% of the total observations) have complete observations from 1986 to 1997. In the US sample, 294 companies (corresponding to 64.3% of the total observations) have complete observations from 1986 to 1997. In the Italian sample, only 12 firms (corresponding to 10.2% of the total observations) have complete observations from 1986 to 1996. This is mainly due to the fact that until 1991 corporate groups were not obliged to present consolidated company accounts. In addition, some of the consolidated accounts prepared in the years prior to 1991 did not report in the *Statement of income and change in net worth* section items such as depreciation allowances or interest expenses that are necessary to compute the cash flow and profits variables.

Before describing the firm-level data in more detail, it is worthwhile looking at some aggregate comparisons across time and between countries for output and fixed investment. This is useful both for providing background information on the macroeconomic scenario in the countries analysed here over our sample period, and allows us to compare developments in our company samples to the aggregate patterns.

Table 2.1

Structure of the samples by number of observations per company

	Annual observations								
	4	5	6	7	8	9	10	11	12
UK firms (no.)	39	44	33	38	51	47	26	33	155
US firms (no.)	24	21	26	19	9	16	23	25	294
Italian firms (no.)	37	20	10	6	9	18	6	12	-

Table 2.2

Structure of the samples by number of companies per year

	Year											
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
UK firms (no.)	249	270	299	344	378	384	395	396	397	375	354	313
US firms (no.)	322	342	361	372	383	398	417	431	445	436	422	410
Italian firms (no.)	26	33	44	58	67	83	94	116	114	76	65	-

2.2 Aggregate patterns of output and investment

Annual average growth rates in real gross domestic product (GDP) are presented in Table 2.3 using OECD data for the major industrialised countries. Over the period 1974-97 the GDP growth rate has been similar across countries, with the notable exception of Japan, which presented an annual average growth rate of 3.2% over the whole period. In the years 1986-97 (the period considered for the econometric analysis), the US and the UK had on average relatively higher GDP growth rates than Italy and the other Continental European countries. The differences were particularly relevant after the recession in the early 1990s, with the recovery in the UK and (especially in) the US being much stronger than in Continental Europe. Over the period 1994-97 the average annual growth in real GDP rate was 3.3% in the US and the UK, against 2.2% in the Euro area and 1.8% in Italy, the country with the lowest growth rate in the European Union over this period.

Table 2.4.a contains information on total fixed investment as a proportion of GDP since 1960. Throughout the period 1960-97 the major Continental European countries invested a greater share of their GDP than the Anglo-Saxon countries did, although the gap appeared to have narrowed in the 1980s. After Japan, Italy had the highest fixed investment to GDP ratio over the period 1960-97. However, since the beginning of the 1980s, this ratio has fallen substantially (see Figure 2.1). As a result, in 1997 the proportion of total fixed investment in GDP was basically the same in Italy and the US, and only slightly lower in the UK. Table 2.5.a also presents the annual average growth rates in real total fixed investment. Over the period 1986-97, the average increase in real fixed investment in Italy was equal to only 1.3% (the lowest value among the major industrialised countries), against 2.9% and 3.2% in the US and the UK, respectively.

Table 2.4.b presents information on fixed investment net of housing investment as a proportion of GDP. Residential investment, which in the period 1960-97 represents a lower proportion of GDP in the US and the UK (4.7% and 3.7%, respectively) than in Japan (6.1%) and Continental Europe (6.6%, 6.7% and 6.8% in Germany, France, and Italy, respectively), accounts for part of the differences across countries in the total gross fixed capital formation figures, although not all of them. As is also shown in Figure 2.2, differences in fixed investment as a proportion of GDP among Italy, the UK and the US are less apparent when housing investment is excluded.

Table 2.4.c considers only machinery and equipment investment. An important difference between Table 2.4.c and Table 2.4.b is that most investment in machinery and equipment is done by the corporate sector, whereas a significant proportion of investment in infrastructure is likely to be financed by the public sector. After Japan, Italy had the largest proportion of GDP invested in machinery and equipment among the major industrialised countries over the period 1960-97. Even though this proportion decreased during the 1990s, it was still larger than that in the Anglo-Saxon countries. This indicates that part of the reduction in Italy's non-

residential fixed investment during the last decade is attributable to the curtailment of the infrastructure investment, reflecting the adoption by the Italian government of severe deficit reduction measures in the attempt to meet the Maastricht criteria[3]. Over the period 1986-97 the cyclical behaviour of UK investment in machinery and equipment resembles that in Italy. On the other hand, machinery and equipment investment as a proportion of GDP decreased slowly but consistently in the US over the period 1986-92. This was followed by a strong and steady increase, and in 1997 machinery and equipment investment rose to a level almost as high as the level recorded at the end of the 1970s (see Figure 2.3).

Finally, Table 2.5.b presents the annual average growth rate in real private non-residential investment. Over the period 1986-97 this has been higher in the UK and the US than in the major Continental European countries. The UK had the highest average growth rate of non-residential investment (4.6%), as the severe reduction in real investment in the years 1990-93 (average growth rate equal to -3.2%) was more than compensated by the high investment growth rates in the years 1986-89 (+9.6%) and 1994-97 (+7.3%). The average growth rate in real private non-residential investment was basically close to zero in the US over the period 1986-1993. However, the recovery started in 1992 resulted in an average investment growth rate equal to +9.4% in the years 1994-97. Similarly to the UK, Italy's investment was high in the years 1986-89 (average growth rate equal to +7.9%) and highly negative in the years 1990-1993 (-3.6%, the lowest rate among the major industrialised countries, with a trough of -18.5% in 1993). However, the recovery in the years 1994-97 was not as strong as in the UK (+5.3% on average, but +13.8% in 1995), although greater than that in Germany (0.7%) and France (1.8%).

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[3] The reduction of investment in infrastructure was also the consequence of the 1993 "Bribesville" scandal, following which many public commissions and infrastructure investments were either delayed or blocked.

Table 2.3

Gross Domestic Product
(percentage change from previous year)

	US	Japan	Germany	France	Italy	UK
1960-73	4.0	9.7	4.3	5.4	5.3	3.1
1974-79	2.9	3.6	2.4	2.8	3.6	1.5
1980-85	2.4	3.5	1.1	1.5	1.9	1.4
1986-89	3.3	4.5	2.8	3.4	3.2	4.0
1990-93	1.3	2.6	2.9	0.8	0.7	0.4
1994-97	3.3	1.7	1.9	2.2	1.8	3.3
1986-97	**2.6**	**2.9**	**2.5**	**2.1**	**1.9**	**2.6**
1974-97	**2.6**	**3.2**	**2.1**	**2.2**	**2.3**	**2.0**

Source: OECD Historical Statistics

Table 2.4.a

Gross Fixed Capital Formation as a percentage of GDP

	US	Japan	Germany	France	Italy	UK
1960-73	18.4	32.6	24.6	23.8	24.6	18.3
1974-79	19.4	31.9	20.5	23.6	24.1	19.4
1980-85	19.3	29.1	20.6	20.9	22.4	16.7
1986-89	18.3	29.0	19.6	20.3	20.0	18.7
1990-93	15.9	30.8	22.4	20.3	19.1	16.8
1994-97	16.9	28.8	20.9	17.6	16.9	15.4
1986-97	**17.1**	**29.5**	**21.0**	**19.4**	**18.6**	**17.0**
1974-97	**18.2**	**30.0**	**20.8**	**20.8**	**20.9**	**17.5**
1960-97	**18.3**	**31.0**	**22.2**	**21.9**	**22.3**	**17.8**

Source: OECD Historical Statistics

Table 2.4.b

Gross Non Residential Fixed Capital Formation
as a percentage of GDP

	US	Japan	Germany	France	Italy	UK
1960-73	13.5	26.5	17.3	16.3	16.6	14.6
1974-79	14.4	24.3	14.4	15.6	17.0	15.2
1980-85	15.0	23.5	14.2	14.4	15.8	13.3
1986-89	13.5	23.3	14.4	14.9	14.7	14.5
1990-93	12.2	25.3	16.2	15.3	13.8	13.5
1994-97	12.7	23.1	13.6	13.2	12.3	12.4
1986-97	**12.8**	**24.0**	**14.7**	**14.5**	**13.6**	**13.5**
1974-97	**13.8**	**24.0**	**14.5**	**14.7**	**15.0**	**13.9**
1960-97	**13.7**	**24.9**	**15.6**	**15.3**	**15.6**	**14.1**

Source: OECD Historical Statistics

Table 2.4.c

Gross Fixed Capital Formation in Machinery and Equipment
as a percentage of GDP

	US	Japan	Germany	France	Italy	UK
1960-73	6.8	14.1	9.1	9.0	9.5	8.6
1974-79	8.0	10.8	7.9	8.8	10.5	8.8
1980-85	8.0	10.3	8.2	8.5	10.2	8.9
1986-89	7.9	11.3	8.7	9.1	9.9	8.5
1990-93	7.3	11.6	9.7	9.1	9.0	7.6
1994-97	9.9	9.9	7.7	8.0	8.5	7.8
1986-97	**7.8**	**11.2**	**8.7**	**8.7**	**9.1**	**8.0**
1974-97	**7.9**	**10.8**	**8.3**	**8.7**	**9.7**	**8.2**
1960-97	**7.6**	**12.1**	**8.6**	**8.8**	**9.6**	**8.3**

Source: OECD Historical Statistics

Table 2.5.a

Real total gross fixed capital formation
(percentage change from previous year)

	US	Japan	Germany	France	Italy	UK
1986-89	1.0	8.4	4.0	6.7	4.4	7.9
1990-93	-0.2	2.1	3.1	-1.7	-2.6	-2.7
1994-97	6.2	1.7	0.6	0.8	2.2	4.4
1986-97	**2.9**	**4.1**	**2.6**	**2.0**	**1.3**	**3.2**

Source: OECD Historical Statistics

Table 2.5.b

Real gross private non-residential fixed capital formation
(percentage change from previous year)

	US	Japan	Germany	France	Italy	UK
1986-89	0.0	9.9	5.3	7.7	7.9	9.6
1990-93	-0.3	0.4	1.9	-1.8	-3.6	-3.2
1994-97	9.4	3.4	0.7	1.8	5.3	7.3
1986-97	**3.7**	**4.6**	**2.6**	**2.6**	**3.2**	**4.6**

Source: OECD Historical Statistics

Figure 2.1

Gross Fixed Capital Formation (% of GDP)

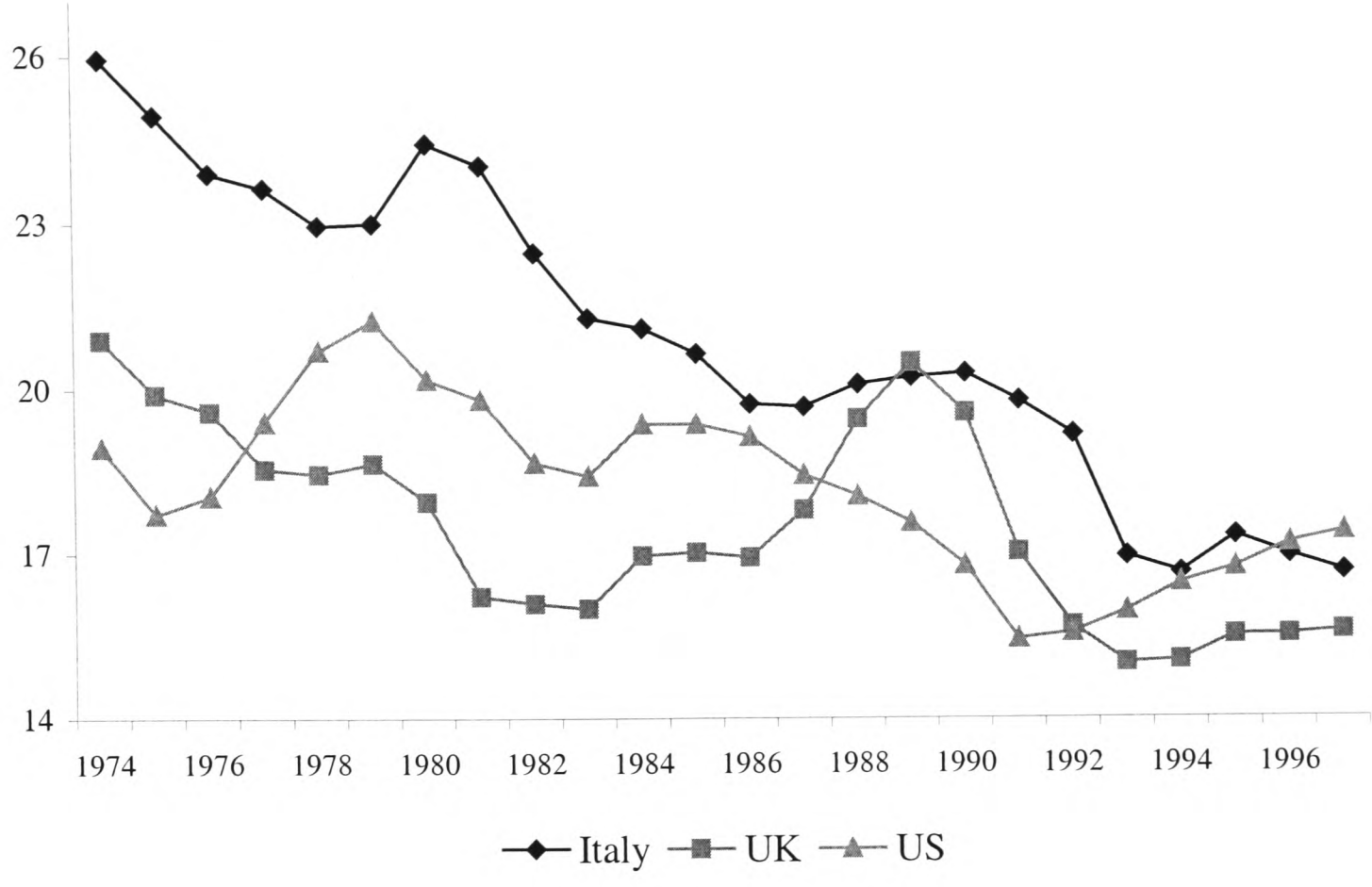


Figure 2.2

Gross Non Residential Fixed Capital Formation (% of GDP)

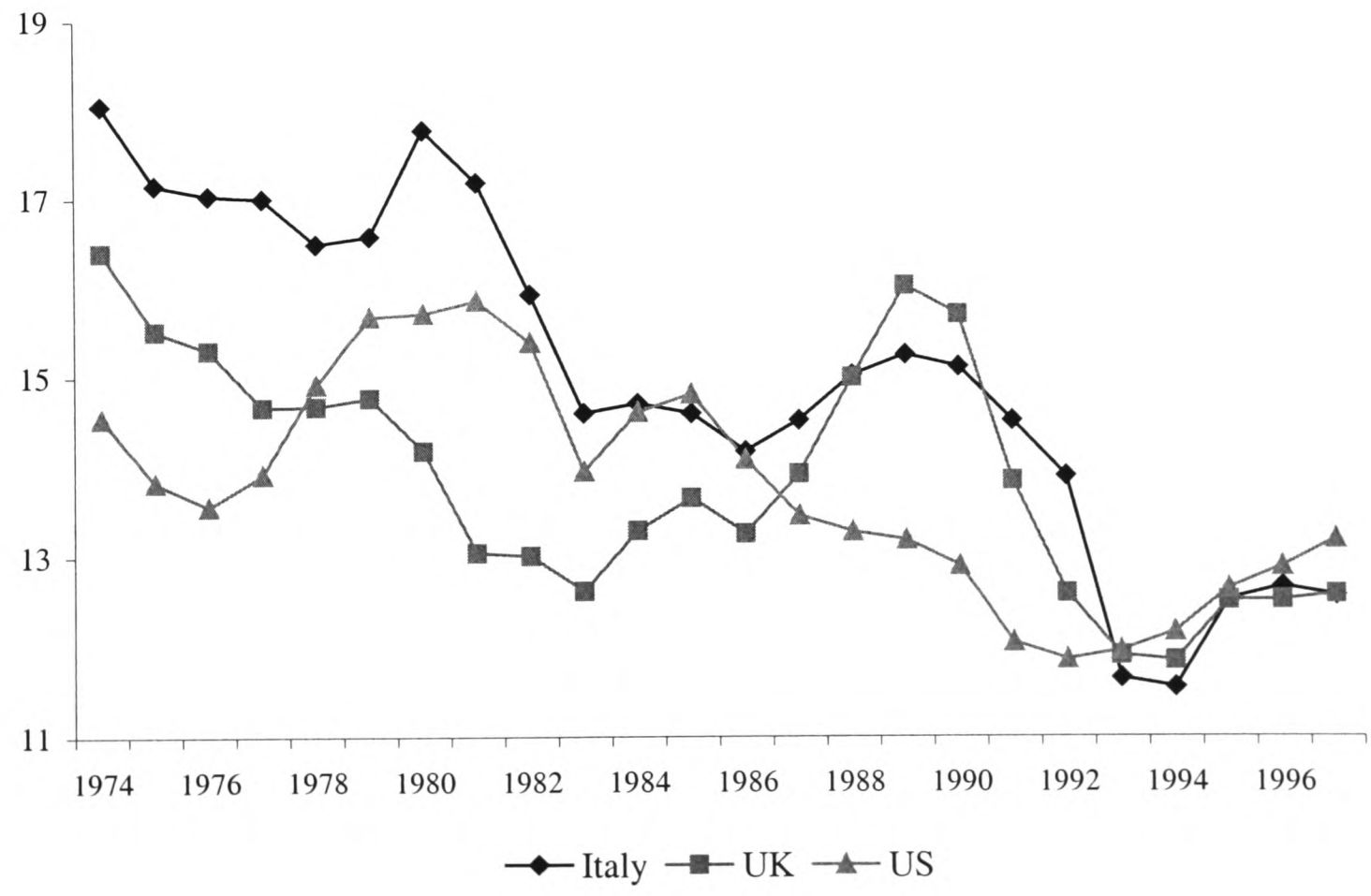
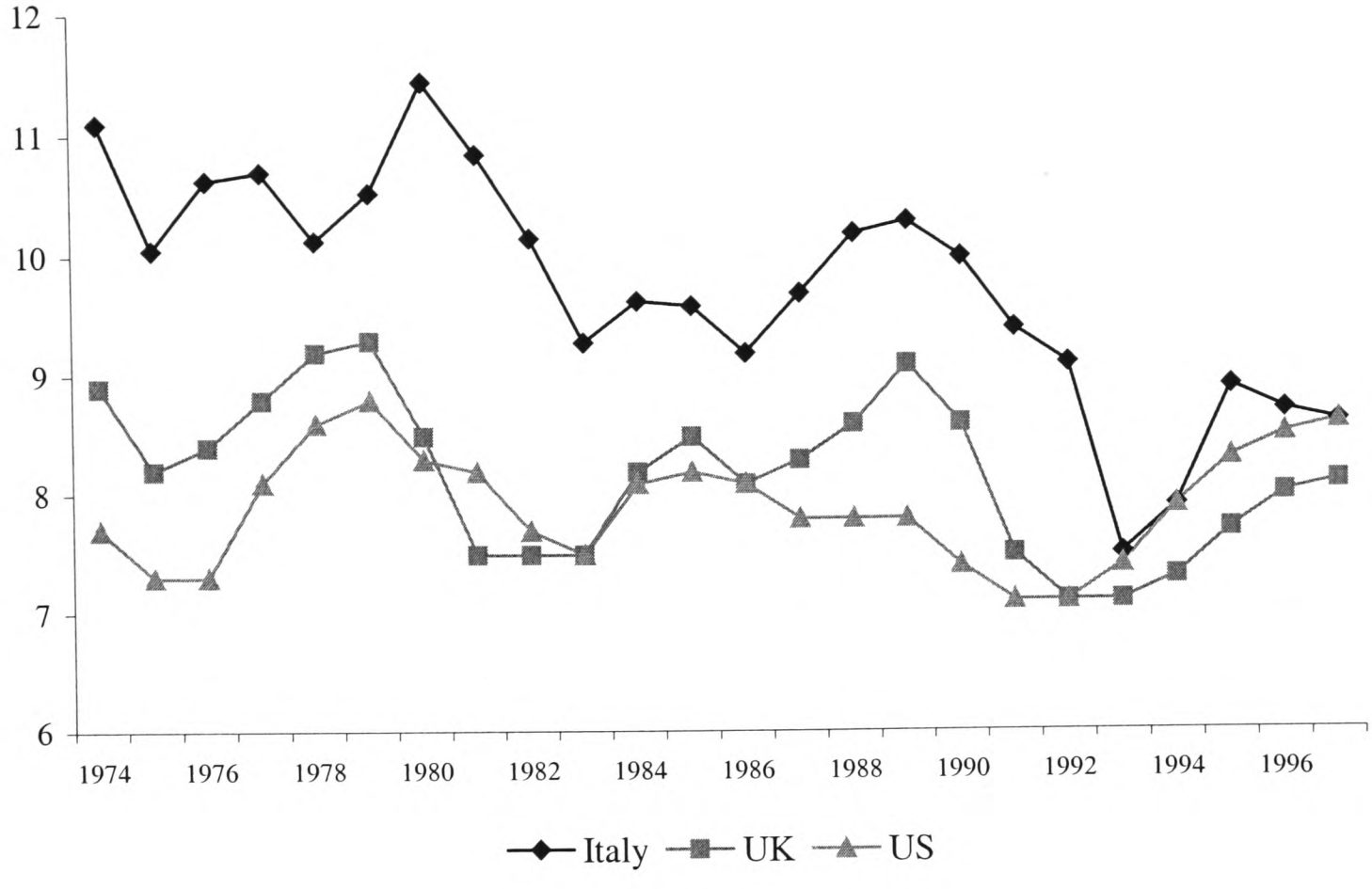


Figure 2.3

Machinery and Equipment Investment (% of GDP)



2.3 Company data: descriptive statistics

Turning now to the company data, Table 2.6 contains the sample distribution of firms by sector. The main differences in the sectoral distributions across samples are the relatively low percentage of Italian corporate groups in the "Electrical Machinery" sector, and the high percentage of Italian groups in the "Textiles, Clothing and Leather sector". The Italian data set also consists of a number of groups that cannot be strictly defined as manufacturing (firms in the Construction, Mines and Building Materials sectors). These "broadly" manufacturing corporate groups have been included in order to have a sufficiently high number of observations in the Italian sample.

Table 2.7 presents the sample distribution of firms by size. On average the British and Italian companies are of similar size (as measured by the first observation on employment for each firm). Although the mean British firm is larger, at the median firm size is alike (1153

employees in the UK and 1478 in Italy). On the other hand, the median firm size in terms of employment is about six times as large in the US sample as in the British and Italian sample, in spite of the fact that our samples consist of the largest manufacturing companies in each country for the most part[4].

Table 2.8 reports investment comparisons among the three samples. These comparisons are more difficult because Italian investment figures do not include acquisitions of new subsidiaries, whereas UK and US figures do. The "wide definition" of UK and US investment (including acquisitions) suggests that Italian and US firms invest a similar proportion of their sales, and more than UK firms. Excluding these acquisitions (the "narrow definition") reveals that at the median Italian firms invest a lot more than UK firms. Such a comparison was not possible with US firms, since separate investment figures for acquisitions of new companies were missing in the Datastream service. Overall, when comparable measures are used for our samples, the Italian firms appear to be investing a larger proportion of their total sales than the US companies and, in particular, the UK companies[5,6]. This appears consistent with the aggregate figures for machinery and equipment investment in Table 2.4.c and Figure 2.3.

Table 2.9 reports mean, median and standard deviation of the variables used in the econometric analysis. Figure 2.4 compares the annual growth rate in real sales among the three samples. US firms have on average higher profit and investment ratios than UK and Italian firms. The difference in the investment to capital (I_t/K_{t-1}) ratio between the US and the UK

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[4] Our data set contains company accounts of the ten largest Italian private manufacturing corporate groups. Moreover, 32% of the firms in the Italian sample are quoted on the Italian stock market.

[5] The values of the capital-sales (K/S) ratio provide further evidence that capital intensity is greater in our sample of Italian firms. The mean (median) values are 0.462 (0.388) for Italy, 0.431 (0.362) for the US, and 0.391 (0.344) for the UK.

[6] In the empirical work below we use the wide definition of investment for the UK. This is because acquisitions are far more important in the UK than Italy and leaving them out could bias the results. In the event, the results were similar whichever measure was used.

seems to reflect the higher investment intensity in the US. On the other hand, the difference between Italy and the US depends to some extent on the fact that the Italian firms are more capital intensive (as is shown by the values of the error correction term and the output to capital ratio). Figure 2.5 compares the evolution over time of the medians of the investment to capital ratios. The three countries display similar behaviour, even though the fall in the investment rate in the early 1990s appears to have been more severe in Italy and the UK than in the US (this is also consistent with the aggregate figures in Table 2.4.c and Figure 2.3).

Figure 2.6 also compares the evolution over time of the medians of the cash flow to capital ratios. Over the period 1987-1990 the cash flow rates were very similar in the UK and Italy, and only slightly higher in the US. Since the beginning of the 1990s the difference between the US on the one hand, and the UK and especially Italy on the other hand, has become larger. Moreover, while the cash flow rate of the US and the UK companies has been slowly increasing since 1992, the profitability of the Italian companies has further decreased. As a result, while in 1987 the median value of the cash flow-capital ratio for Italy was equal to 89.9% of the median value for the US, in 1996 it was equal to only 47.7%. The patterns for the cash flow rates appear to be consistent with those for the investment rates: higher investment rates are associated with higher profit rates and lower investment rates with lower profit rates. Notice, however, that in spite of the much lower profitability of the Italian companies over the period 1986-97, the investment rate has remained at levels that are not too dissimilar from those recorded for the US and UK companies.

Although these raw numbers seem to indicate a somewhat lower impact of profit variables on the capital accumulation of Italian corporate groups, these results do not allow us to draw any straightforward conclusions about capital market imperfections in the different financial systems. Other factors that are entirely unrelated to financial markets could provide a better explanation for this apparently lower sensitivity of investment to cash flow in Italy. We move now to an explicit econometric analysis to evaluate the evidence for financial constraints.

Table 2.6

Sample distribution by sector

Sectors	UK sample		US sample		Italian sample	
	No.	%	No.	%	No.	%
Food, Drink and Tobacco	53	11.4	43	9.4	12	10.2
Textiles, Clothing and Leather	55	11.8	18	3.9	18	15.3
Drugs and Cosmetics	11	2.4	23	5.0	7	5.9
Chemicals, Oil and Plastic	32	6.9	51	11.2	9	7.6
Wood, Furniture and Paper	70	15.0	79	17.3	5	4.2
Printing and Publishing	33	7.1	27	5.9	2	1.7
Non-electrical machinery	89	19.1	54	11.8	14	11.9
Electrical machinery	71	15.2	87	19.0	7	5.9
Motor vehicles	30	6.4	37	8.1	7	5.9
Metallurgy and Metal Products	16	3.4	17	3.7	7	5.9
Building Materials and Glass	-	-	9	2.0	8	6.8
Mines, Construction	-	-	-	-	9	7.6
Other	6	1.3	12	2.6	13	11.0
Total	466	100.0	457	100.0	118	100.0

Table 2.7

Sample distribution by firm size

	UK sample	US sample	Italian sample
number of firms	466	457	118
observations	4154	4739	776
Employment			
5th percentile	192	659	201
1st quartile	465	2800	656
median	1135	6700	1478
3rd quartile	3836	21667	2828
95th percentile	37466	92400	15774
max	302000	876800	248180
mean	7723	22538	5383
(standard deviation)	(23217)	(57066)	(23351)

Table 2.8

Investment comparisons across samples

		Mean	s.d.	Q25	Q50	Q75
UK	I/Y (wide)	0.055	0.044	0.028	0.044	0.069
	I/Y (narrow)	0.051	0.042	0.027	0.042	0.064
US	I/Y (wide)	0.063	0.047	0.034	0.052	0.077
Italy	I/Y (narrow)	0.062	0.046	0.030	0.051	0.081

Table 2.9

Means, medians and standard deviations of variables used in estimation

	UK *(1986 - 1997)*		**US** *(1986 - 1997)*		**Italy** *(1986 - 1996)*	
	Mean (*s.d.*)	Median	Mean (*s.d.*)	Median	Mean (*s.d.*)	Median
I_t/K_{t-1}	0.163 (.114)	0.133	0.175 (.095)	0.158	0.167 (.112)	0.140
Δy_t	0.060 (.153)	0.064	0.077 (.139)	0.072	0.080 (.199)	0.081
$(k\text{-}y)_{t-2}$	-1.091 (.516)	-1.088	-1.031 (.588)	-1.041	-0.981 (.652)	-0.953
y_{t-2}	11.514 (1.748)	11.230	14.132 (1.396)	14.089	13.210 (1.245)	13.002
C_t/K_{t-1}	0.247 (.167)	0.223	0.326 (.194)	0.293	0.205 (.244)	0.178
$(I/K)_{t-1}$	0.152 (.083)	0.137	0.159 (.071)	0.150	0.149 (.078)	0.139
$(I/K)^2_{t-1}$	0.030 (.033)	0.019	0.030 (.028)	0.023	0.028 (.029)	0.019
$(Y/K)_{t-1}$	3.408 (2.083)	2.942	3.328 (2.348)	2.790	3.228 (2.415)	2.582
$(\Pi/K)_{t-1}$	0.335 (.203)	0.304	0.439 (.247)	0.394	0.334 (.257)	0.275
No. firms	466		457		118	

Figure 2.4

Sales growth (median value)

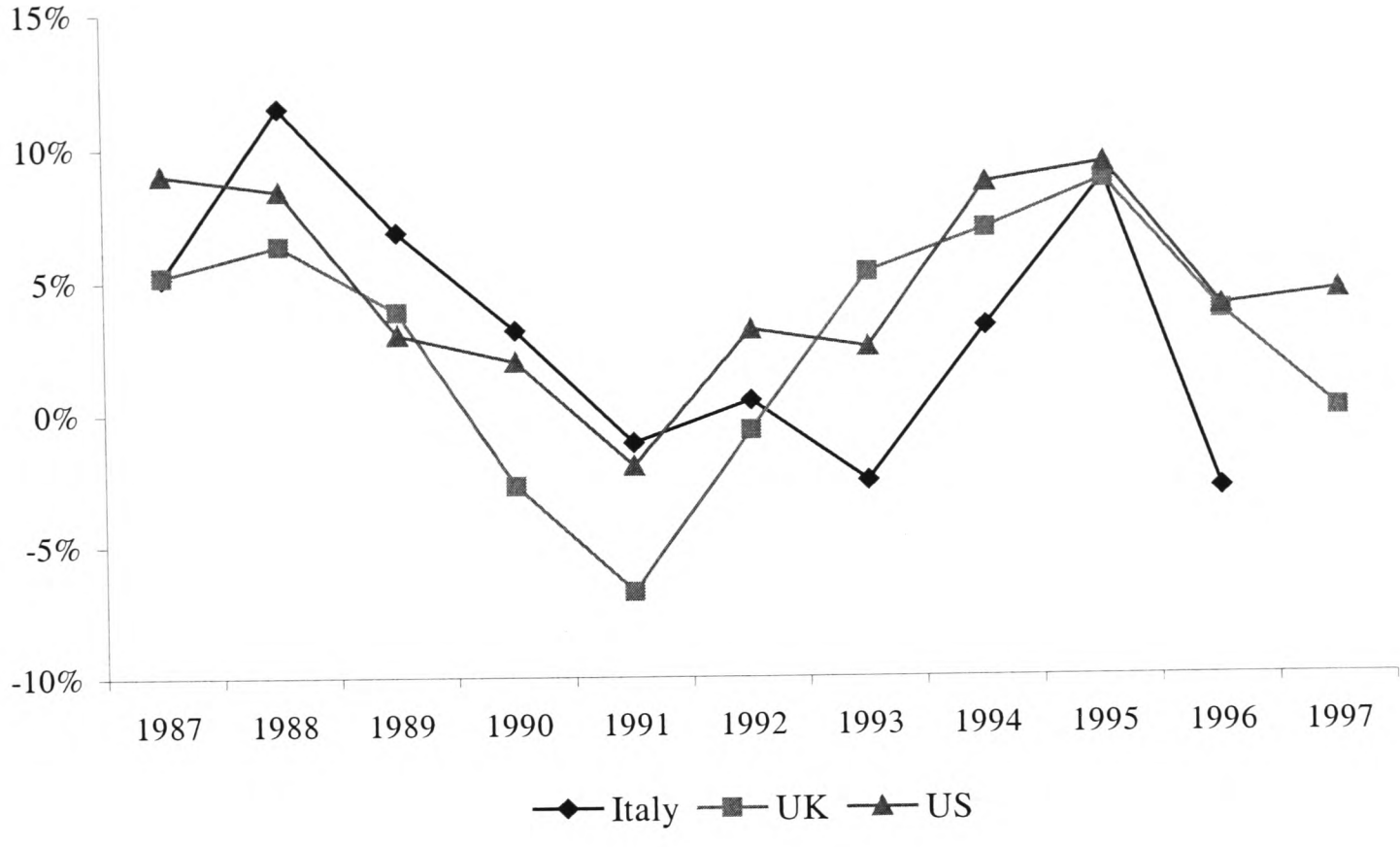


Figure 2.5

Investment to capital ratio (median value)

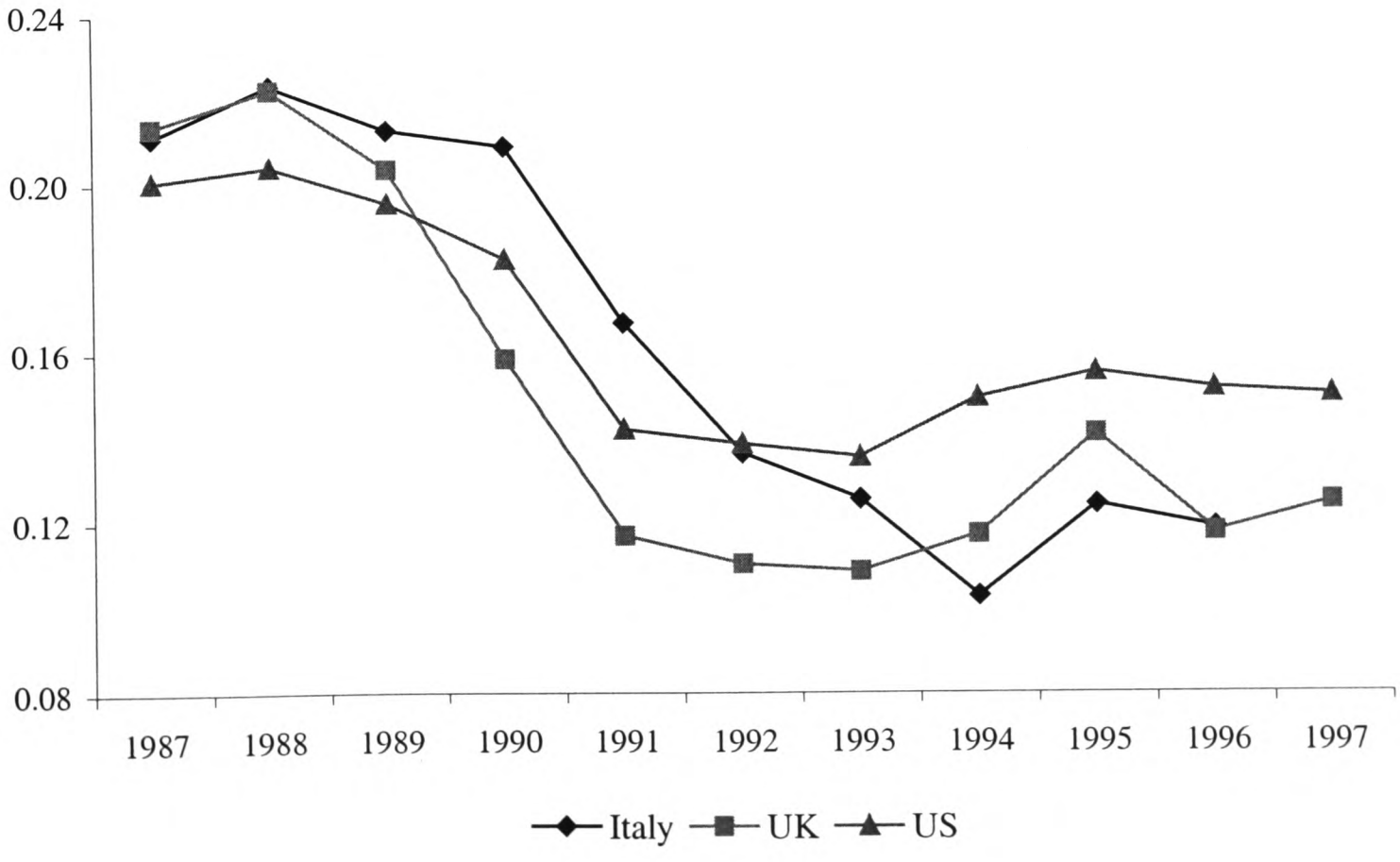
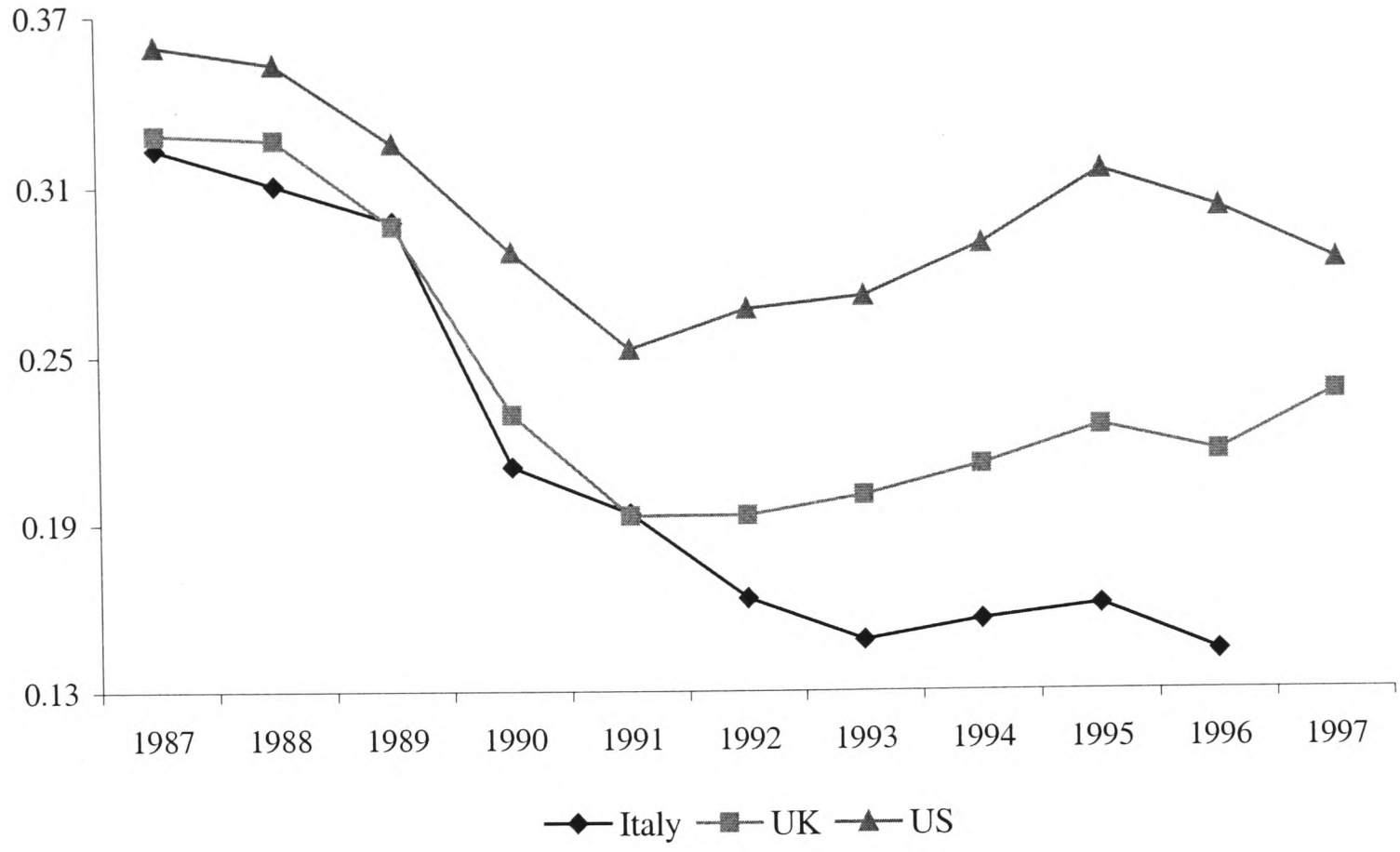


Figure 2.6

Cash flow to capital ratio (median value)



3. Econometric results

In order to test whether firms in different countries face capital market imperfections or not, in this section we compare the sensitivities of investment spending to the availability of internal finance for the samples of UK, US and Italian companies. Two different econometric models of physical investment are estimated: an error correction specification augmented with an additional cash flow term to investigate the impact of financial constraints, and an Euler equation specification derived from intertemporal optimisation in the presence of symmetric, quadratic costs of adjustment.

3.1 Evidence from the error correction model

We begin the empirical investigation by comparing for the three countries the results of an error correction model of investment of the form outlined in equation (3.8), Chapter 2:

$$\frac{I_{it}}{K_{i,t-1}} = \omega_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \omega_2\Delta y_{it} + \omega_3\Delta y_{i,t-1} + \omega_4\left(k_{i,t-2} - y_{i,t-2}\right) +$$

$$+\omega_5 y_{i,t-2} + \omega_6\left(\frac{C_{it}}{K_{i,t-1}}\right) + d_t + \eta_i + \nu_{it}$$

To estimate this model we employ a system GMM estimator, which controls for the presence of unobserved firm-specific effects and for the endogeneity of the current-dated explanatory variables. As is shown in Appendix C, the system GMM estimator produces more reasonable estimates of the autoregressive dynamics than the first-differenced GMM estimator does[7]. This is consistent with the analysis of Blundell and Bond (1998), who show that in autoregressive models with persistent series the first-differenced estimator can be subject to serious finite sample biases as a result of weak instruments, and that those biases can be greatly reduced by the inclusion of the levels equations in the system estimator. The instrument set used for the preferred system estimates includes the right-hand side variables in levels dated from t-3 to t-5 for the equations in first differences, and differences of the dependent variable and sales growth dated t-2 for the equations in levels[8].

Column (i), Table 3.1, contains the empirical results of estimating a basic error correction model (with no cash flow term) for the sample of British companies. It should be compared

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[7] This is certainly true for the samples of British and Italian firms. In the US case, the GMMDIF estimates are very similar to those produced by the GMMSYS estimator.

[8] This was also the preferred instrument set for estimating the error correction model of investment in Chapters 4 and 5. Two reasons explain the adoption of this instrument set here. For the samples of Italian and US firms it is because of the evidence of second order serial correlation in the first-differenced residuals. For the sample of UK (and US) firms, it is due to the fact that the validity of the instrument set dated from t-2 to t-5 for the equations in first differences, and t-1 for the equations in levels, was rejected by Difference Sargan comparison to the instrument set dated from t-3 to t-5 for the equations in first differences, and t-2 for the equations in levels (see Appendix C).

with column (i), Tables 3.2 and 3.3, which have an identically specified model for the samples of US and Italian companies. For each sample there is evidence of a correctly signed error correction term that is significant at conventional levels. The lagged output term y_{t-2} is statistically insignificant in all three countries, thus indicating that the restriction of a long-run elasticity equal to unity cannot be rejected. The lagged dependent variable is significantly negative in Italy, negative and weakly significant in the UK, and close to zero in the US. The output growth terms are jointly significant in the UK and the US, but not in Italy[9]. The lagged output growth term is statistically significant in the UK (t=4.07) and the US (t=1.98), while the current output growth term is significant at a 10% level only in the UK (t=1.69).

In Tables 3.1, 3.2 and 3.3, column (ii), current and lagged cash flow terms are added to the basic error correction specification. A clear difference emerges in these results insofar as the cash flow terms are jointly insignificant in the Italian sample (p=0.769), and jointly significant in the US (p=0.038) and the UK (p=0.002) samples. In columns (iii) and (iv) we drop current cash flow and lagged cash flow, respectively. In both cases, the sensitivity of investment to cash flow appears to be much greater in the UK, and to a lesser extent in the US, than it is in Italy. Imposing the unit restriction on the long-run elasticity by not including the lagged output term does not change this result: cash flow is still an informative indicator of investment for the Anglo-Saxon firms (particularly for the UK ones), but not for the Italian firms [column (v)].

The finding that cash flow has no effect in the investment equation for this sample of large Italian corporate groups may stem from the fact that their investment spending is fully explained by the variables accounting for the short-run and the long-run adjustment of the capital stock to changes in output. In fact, along with the cash flow term, the short-term output

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[9] The overall p-value of the Wald test of joint significance of the estimated coefficients on the sales growth variables is 0.1% for the UK sample, 0.3% for the US sample, and 69.5% for the Italian sample.

growth terms appear to have no influence on Italian corporate groups' investment spending, whereas both the lagged dependent variable and the error correction term have a significant impact. One possible reason for this result is that the error correction model, derived from introducing second-order dynamics into the equation for the desired capital stock[10], does not pick up the correct dynamics for the sample of Italian firms here analysed. To check for the possibility that further lags of the sales growth term have a significant impact on Italian groups' investment spending, we introduce third-order dynamics in the equation for the optimal capital stock [see equation (3.5), Chapter 2]. After rearranging, this gives an error correction model of the form:

$$(3.1)\quad \frac{I_{it}}{K_{i,t-1}} = \omega_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \omega_2\left(\frac{I_{i,t-2}}{K_{i,t-3}}\right) + \omega_3\Delta y_{it} + \omega_4\Delta y_{i,t-1} + \omega_5\Delta y_{i,t-2} +$$

$$+\omega_6\left(k_{i,t-3} - y_{i,t-3}\right) + \omega_7 y_{i,t-3} + d_t + \eta_i + \nu_{it}$$

where α_s and β_s are the coefficients of the autoregressive components k_{t-s} and the distributed lag components y_{t-s}, respectively, and $\omega_1=(\alpha_1-1)$, $\omega_2=(\alpha_1+\alpha_2-1)$, $\omega_3=\beta_0$, $\omega_4=(\beta_0+\beta_1)$, $\omega_5=(\beta_0+\beta_1+\beta_2)$, $\omega_6=(\alpha_1+\alpha_2+\alpha_3-1)$ and $\omega_7=\omega_6(1-\xi)$. Here $\xi=-(\beta_0+\beta_1+\beta_2+\beta_3)/\omega_6$ represents the long-run elasticity, d_t is a time dummy, η_i is an unobserved firm-specific effect, and ν_{it} is an error term.

Tables 3.4, 3.5 and 3.6, column (i), contain the regression results of estimating the error correction specification in equation (3.1)[11]. The error correction term, dated t-3, is negatively signed and statistically significant in each sample. The lagged dependent variables are close to

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[10] See equation (3.5), Chapter 2.

[11] Notice that since a minimum of five observations are required to estimate the error correction specification in equation (3.1), the samples used in this regression analysis contain only the companies for which at least five year-observations are available.

zero in the US sample, and negative and jointly significant in the UK and Italian samples. Again, the unit restriction on the long-run elasticity cannot be rejected: the lagged output term y_{t-3} is statistically insignificant in each country. The output growth terms are now jointly significant in all samples[12]. In particular, the current output growth term Δy_t is statistically insignificant in each country, whereas the twice-lagged output growth term Δy_{t-2} is significantly positive in each country, including Italy (t=2.44). In spite of this last result, Italian companies' investment spending still appears to be unaffected by the availability of internal finance. In column (ii), Table 3.6, the cash flow terms are jointly insignificant for the sample of Italian firms (p=0.900). On the other hand, they are jointly significant in the UK (where both current and lagged cash flow are statistically significant) and the US (where only current cash flow is significant at a 5% level). These results do not change when one drops the lagged cash flow terms, as in column (iii), and also the lagged output term y_{t-3}, as in column (iv): current cash flow is significant and positive in the UK and US samples, and insignificant and close to zero in the Italian sample. These findings show, therefore, that differences in the estimated cash flow effects across countries do not depend on the dynamics of the error correction specification.

To the extent that a significant cash flow effect picks up financial constraints on investment (and does not merely reflect influences on expectations), this first evidence from the error correction model is suggestive that, in contrast to Italian corporate groups, companies in the market-oriented, Anglo-Saxon countries face capital market imperfections. To check whether this result is robust to the choice of model specification, in the following section we also report estimates of an Euler equation model of investment.

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[12] The overall p-value of the Wald test of joint significance of the estimated coefficients on the sales variables is 0.1% for the UK sample, 0.9% for the US sample, and 4.8% for the Italian sample.

3.2 Evidence from the Euler equation model

Compared to the error correction model, the Euler equation specification has the advantage of controlling for all expectational influences on the investment decision. Therefore, evidence of a significant role of financial variables in this model is less easily explained away as merely capturing an expectational influence.

Table 3.7 presents for each of the three countries the system GMM regression results for an Euler equation model of investment of the form outlined in equation (3.12), Chapter 2:

$$\left(\frac{I}{K}\right)_{it} = \beta_0 + \beta_1\left(\frac{I}{K}\right)_{i,t-1} - \beta_2\left(\frac{I}{K}\right)^2_{i,t-1} - \beta_3\left(\frac{\Pi}{pK}\right)_{i,t-1} + \beta_4\left(\frac{Y}{K}\right)_{i,t-1} + d_t + \eta_i + \nu_{it}$$

The instrument set used in the estimation includes the right hand side variables in levels dated t-3 for the equations in first differences, and the all right-hand side variables in first differences dated t-2 for the equations in levels. This was also the preferred instrument set for estimation of the Euler equation models in Chapters 4 and 5. Instrument validity was tested using the Sargan test of over-identifying restrictions, and by Difference Sargan comparisons to the GMM estimator that just uses the equations in first differences. The system GMM estimates of the structural dynamics were generally more precise than the first-differenced GMM estimates (see Appendix C).

For each sample the GMMSYS estimates identify investment dynamics consistent with those implied by the structural adjustment model: the coefficient estimates on the lagged dependent variable are close to unity, and those on the lagged squared term are less than minus one. Only the estimated coefficients on the profits term differ significantly across countries. Under the assumption of perfect capital markets the coefficient on the gross operating profits term $(\Pi/K)_{i,t-1}$ is expected to be negative. This is not the case for the UK and US companies, where the estimated coefficients on the profits term are positive and highly

significant (t=5.05 and t=5.26, respectively). Conversely, for the sample of Italian firms the coefficient on the gross operating profits term is negative, though statistically not significantly different from zero.

This result does not change if we re-estimate the Euler equation model by not including the output term $(Y/K)_{i,t-1}$, which is found to be statistically insignificant in each sample. Again the coefficients on the profits term are significantly positive for the US and the UK, but not for Italy. Hence, consistent with evidence from the error correction model, regression results for the Euler equation model suggest that UK and US companies face significant financial constraints on investment.

4. Further investigations

We now consider some challenges to the robustness and interpretation of the results of the previous section. In particular we investigate whether cash flow is proxying for demand expectations in the estimated error correction models, and whether differences across countries in the cash flow-investment sensitivity are driven by differences in the composition of these samples by firm size.

4.1 Cash flow as a proxy for demand expectations

A major problem when using cash flow to proxy financial constraints is that the interpretation of cash flow coefficients is ambiguous. As emphasised in Chapter 2, cash flow could be proxying for unobserved expectations of future demand rather than liquidity constraints on investment. To check for this possibility, we make use of two different tests.

In Table 4.1, columns (i), (iii) and (v), we report regression results of an error correction model of investment augmented with future (one period ahead) rather than current cash

flow[13]. If cash flow reflected only expectations of future profitability, we would expect investment spending to be positively correlated with future cash flow. This does not appear to be the case in any of the countries. Future cash flow is statistically insignificant not only in Italy, where there is no evidence of any cash flow effect on investment, but also in the US and the UK, where current (and lagged) cash flow is positively correlated with investment expenditures. In Table 4.1, columns (ii), (iv) and (vi), both current and future cash flow are added to the basic error correction specification. Again future cash flow seems to play no role in the firms' investment decisions. On the other hand, in spite of the presence of future cash flow, cash flow has a significant impact on UK firms' investment spending, and a weakly significant impact on US firms' investment spending.

Another way to investigate whether differences across countries in the estimated investment-cash flow sensitivities reflect differences in the ability of current cash flow to proxy for expectations of future demand consists in examining forecasting equations for real sales. Of particular interest is the question of whether current cash flow is a more informative predictor of future sales in the UK and the US than it is in Italy. Were this the case, this could undermine the interpretation of the significance of the cash flow term in the UK and US investment equations as reflecting evidence for financial constraints. The Italian results are reported in column (iii) of Table 4.2 and should be compared with columns (i) and (ii) that have equivalent real sales equations for the UK and the US. We estimate a VAR(1) specification using all the variables included in the investment models. The cash flow term is significant and positive in each country, and appears to play a more important role in predicting future demand in the UK and in Italy than in the US. Therefore, current cash flow appears to be as good a predictor of future sales in Italy as it is in the UK, and possibly better

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[13] This future realisation of cash flow is of course treated as endogenous, and instrumented using lagged information.

than in the US. This suggests that the evidence of a greater investment-cash flow sensitivity in the British and American companies cannot be easily explained on the grounds of differences across countries in the informativeness of current cash flow in forecasting future real sales growth.

4.2 Firm size and cash flow

Differences across our samples of firms for these three countries in the role of cash flow and profits variables could also reflect differences in firm size, rather than information problems in the respective capital markets. Indeed, some previous studies have found stronger evidence of financial effects on investment among larger firms[14].

As previously observed in Section 2, the US data set includes only companies with more than 250 employees, whereas the Italian and British data sets include also companies with not less than 100 employees. By excluding firms having less than 250 employees from the Italian and UK samples, the composition of the Italian and UK samples by firm size still differs significantly from the composition of the US sample. The Italian and UK samples have median employment in their first years of observation of 1664 and 1403, respectively, against 6700 for the US sample.

In order to investigate whether firm size explains some of the differences across countries in the investment-cash flow sensitivity, investment equations are estimated for three sub-samples of firms of a relatively similar size. These samples consist, respectively, of 261 US

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[14] Devereux and Schiantarelli (1990) segment a sample of UK firms according to size measured as the real value of capital stock and report that sensitivity of investment to cash flow is greater for larger firms. In a recent paper Kadapakkam *et al.* (1998) analyse the impact of cash flow on firm investment in six OECD countries. They group data for each country according to firm size (measured in three different ways: market value of equity, total assets, and sales) and report that cash flow sensitivity is highest in the largest firm size group and smallest in the small firm size group. Both studies are based on the estimation of Q models of investment.

firms, 350 UK firms, and 109 Italian firms that have between 250 and 10,000 employees in their first years of observation. Such a sample selection makes the Italian and British samples more comparable to the US sample. The Italian and UK samples have now mean (median) employment in their first years of 2114 (1478) and 1729 (970), respectively, against 3766 (3350) for the US sample.

The results of estimating the error correction and the Euler equation model of investment models for these sub-samples are reported in Tables 4.3 and 4.4. Again there is almost no difference from the results for the full data sets. For the UK and the US, the coefficients on the cash flow term in the error correction model are positive and significant (t=3.57 and t=2.21, respectively), as well as the coefficients on the gross operating profits term in the Euler equation model (t=4.62 and t=3.96, respectively). On the other hand, no significant evidence of financial effects is found in the investment equations for the sample of Italian firms[15]. Therefore, this evidence suggests that the differences across countries in the cash flow sensitivity of investment cannot be explained away as simply reflecting differences in the composition of our samples by firm size.

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[15] For each country we also investigated whether financial effects are higher among larger (smaller) firms. For the sample of British companies with more than 5,000 employees, cash flow was found to have a greater impact on investment spending than for the sample of firms with fewer than 5,000 employees. The coefficient estimate of the cash flow term was 0.4280 (t=4.11) for the former, against 0.2255 (t=2.85) for the latter. This coefficient difference in the cash flow terms across the two samples was, however, statistically insignificant at the conventional level (t=1.55). For the US and Italy there was no evidence of a stronger cash flow effect in the investment equations for the largest firm size group. The fact that no significant difference according to size was found in the cash flow sensitivity of investment for these samples is not necessarily inconsistent with the evidence in Chapter 4, where financial variables were found to play an important role only in the investment decisions of small (and independent) Italian firms. In that case, the sample split may reflect more relevant differences in size, as firms having fewer (more) than 150 employees were classified as small (large). On the other hand, the nature of the samples analysed in this chapter is such that we have already focused on relatively large companies. Thus it may not be surprising that firm size has no significant effect in this context.

Table 3.1

Error correction model: sample of UK firms

I_t/K_{t-1}	(i) GMMSYS	(ii) GMMSYS	(iii) GMMSYS	(iv) GMMSYS	(v) GMMSYS
I_{t-1}/K_{t-2}	-0.1505 (.1092)	-0.2343 (.1056)	-0.2868 (.1047)	-0.1939 (.1032)	-0.1925 (.1024)
Δy_t	0.1283 (.0789)	0.1000 (.0673)	0.1383 (.0670)	0.1116 (.0662)	0.1122 (.0648)
Δy_{t-1}	0.2097 (.0515)	0.1025 (.0497)	0.1399 (.0495)	0.1224 (.0502)	0.1234 (.0500)
$(k-y)_{t-2}$	-0.1153 (.0344)	-0.0675 (.0359)	-0.0867 (.0347)	-0.0847 (.0355)	-0.0852 (.0356)
y_{t-2}	-0.0017 (.0110)	0.0001 (.0102)	-0.0022 (.0107)	-0.0009 (.0101)	-
C_t/K_{t-1}	-	0.1562 (.0873)	-	0.2400 (.0791)	0.2411 (.0790)
C_{t-1}/K_{t-2}	-	0.1666 (.0805)	0.2199 (.0768)	-	-
No. Firms	466	466	466	466	466
Obs.	2756	2756	2756	2756	2756
Df	2741	2739	2740	2740	2741
sc_1 [427]	-3.741	-3.118	-3.102	-3.255	-3.273
sc_2 [383]	-1.422	-2.030	-2.211	-1.866	-1.890
z_1	28.34 [5]	42.04 [7]	33.89 [6]	44.11 [6]	43.50 [5]
z_2 [9]	79.10	45.62	67.22	46.04	44.69
Sargan	74.71 [77] p=0.553	101.31 [96] p=0.336	102.03 [97] p=0.344	96.76 [97] p=0.488	97.97 [98] p=0.482
Wald (cash flow coefficients)	-	12.72 [2] p=0.002	-	-	-

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (i) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, and $(k-y)_{t-3}$ to $(k-y)_{t-5}$; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Instruments used in columns (ii), (iii), (iv) and (v) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1997. Time dummies are included as regressors in all equations. Asymptotic standard errors are reported in parenthesis. Standard errors and test statistics are robust to general time-series and cross-section heteroskedasticity. sc_i is a test for serial correlation of order i in the first-differenced residuals, asymptotically standard normal. z_1 is a test of the joint significance of the reported coefficients, while z_2 is a test of the joint significance of the time dummies, asymptotically distributed as χ^2[df] under the null. Wald (cash flow coefficients) is a test of joint significance of the estimated cash flow coefficients, asymptotically distributed as χ^2[df] under the null. Sargan is a test of the overidentifying restrictions, asymptotically distributed as χ^2[df] under the null of validity (see Sargan, 1958). All estimations carried out using Arellano and Bond (1988) DPD97 package one-step results (two-step Sargan test).

Table 3.2

Error correction model: sample of US firms

I_t/K_{t-1}	(i) GMMSYS	(ii) GMMSYS	(iii) GMMSYS	(iv) GMMSYS	(v) GMMSYS
I_{t-1}/K_{t-2}	-0.0350 (.1006)	-0.0558 (.0922)	-0.0949 (.0866)	-0.0528 (.0924)	-0.0409 (.0917)
Δy_t	0.0716 (.0517)	0.0602 (.0561)	0.0984 (.0472)	0.0524 (.0558)	0.0744 (.0519)
Δy_{t-1}	0.1728 (.0513)	0.1189 (.0599)	0.1471 (.0559)	0.1279 (.0591)	0.1504 (.0559)
$(k-y)_{t-2}$	-0.1699 (.0493)	-0.1401 (.0554)	-0.1641 (.0539)	-0.1533 (.0559)	-0.1430 (.0557)
y_{t-2}	-0.0289 (.0172)	-0.0241 (.0166)	-0.0257 (.0173)	-0.0255 (.0172)	-
C_t/K_{t-1}	-	0.1173 (.0767)	-	0.1401 (.0673)	0.1589 (.0665)
C_{t-1}/K_{t-2}	-	0.0516 (.0566)	0.0944 (.0498)	-	-
No. Firms	457	457	457	457	457
Obs.	3368	3368	3368	3368	3368
Df	3353	3351	3352	3352	3353
sc_1 [433]	-3.163	-3.421	-3.312	-3.416	-3.453
sc_2 [412]	-2.994	-3.247	-3.264	-3.243	-3.115
z_1	46.40 [5]	72.39 [7]	61.96 [6]	62.00 [6]	59.12 [5]
z_2 [9]	22.30	14.27	17.50	15.52	13.41
Sargan	87.87 [77] p=0.187	105.23 [96] p=0.244	115.96 [97] p=0.092	104.76 [97] p=0.277	106.37 [98] p=0.265
Wald (cash flow coefficients)	-	6.54 [2] p=0.038	-	-	-

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (i) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, and $(k-y)_{t-3}$ to $(k-y)_{t-5}$; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Instruments used in columns (ii), (iii), (iv) and (v) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1997. See also notes for Table 3.1.

Table 3.3

Error correction model: sample of Italian firms

I_t/K_{t-1}	(i) GMMSYS	(ii) GMMSYS	(iii) GMMSYS	(iv) GMMSYS	(v) GMMSYS
I_{t-1}/K_{t-2}	-0.3178 (.1190)	-0.2752 (.1076)	-0.2825 (.1059)	-0.2765 (.1087)	-0.2763 (.1083)
Δy_t	0.0395 (.0495)	0.0260 (.0501)	0.0404 (.0450)	0.0288 (.0503)	0.0235 (.0493)
Δy_{t-1}	0.0319 (.0864)	0.0080 (.0758)	0.0155 (.0745)	0.0236 (.0686)	0.0175 (.0734)
$(k-y)_{t-2}$	-0.1385 (.0562)	-0.1248 (.0665)	-0.1356 (.0638)	-0.1382 (.0580)	-0.1392 (.0576)
y_{t-2}	0.0166 (.0309)	0.0106 (.0299)	0.0122 (.0305)	0.0108 (.0308)	-
C_t/K_{t-1}	-	0.0281 (.0530)	-	0.0216 (.0524)	0.0252 (.0526)
C_{t-1}/K_{t-2}	-	0.0325 (.0554)	0.0270 (.0538)	-	-
No. Firms	118	118	118	118	118
Obs.	422	422	422	422	422
Df	408	406	407	407	407
sc_1 [81]	-1.144	-1.619	-1.627	-1.603	-1.610
sc_2 [61]	-2.865	-2.789	-2.751	-2.817	-2.839
z_1	13.45 [5]	14.87 [7]	14.99 [6]	13.25 [6]	12.74 [5]
z_2 [8]	26.67	30.31	28.94	28.86	29.37
Sargan	63.75 [66] p=0.555	71.99 [82] p=0.777	73.36 [83] p=0.766	67.79 [83] p=0.887	68.64 [84] p=0.888
Wald (cash flow coefficients)	-	0.52 [2] p=0.769	-	-	-

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (i) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, and $(k-y)_{t-3}$ to $(k-y)_{t-5}$; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Instruments used in columns (ii), (iii), (iv) and (v) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1996. See also notes for Table 3.1.

Table 3.4

Error correction model: sample of UK firms

I_t/K_{t-1}	(i) GMMSYS	(ii) GMMSYS	(iii) GMMSYS	(iv) GMMSYS
I_{t-1}/K_{t-2}	-0.1305 (.1214)	-0.2596 (.1087)	-0.1823 (.1056)	-0.1855 (.1050)
I_{t-2}/K_{t-3}	-0.0931 (.0477)	-0.0089 (.0482)	-0.0282 (.0448)	-0.0263 (.0457)
Δy_t	0.1075 (.0865)	0.0553 (.0771)	0.0801 (.0719)	0.0778 (.0706)
Δy_{t-1}	0.1769 (.0743)	0.0287 (.0633)	0.0482 (.0628)	0.0437 (.0645)
Δy_{t-2}	0.1809 (.0743)	0.1057 (.0450)	0.1242 (.0433)	0.1195 (.0422)
$(k-y)_{t-3}$	-0.1529 (.0395)	-0.0853 (.0405)	-0.0995 (.0387)	-0.0976 (.0393)
y_{t-3}	0.0020 (.0110)	0.0042 (.0107)	0.0031 (.0100)	-
C_t/K_{t-1}	-	0.2137 (.1007)	0.3369 (.0861)	0.3333 (.0852)
C_{t-1}/K_{t-2}	-	0.2062 (.1029)	-	-
C_{t-2}/K_{t-3}	-	0.0259 (.0602)	-	-
No. Firms	427	427	427	427
Obs.	2290	2290	2290	2290
Df	2274	2271	2273	2274
sc_1 [383]	-2.931	-2.278	-2.730	-2.701
sc_2 [350]	-1.479	-3.061	-2.528	-2.582
z_1	39.38 [7]	68.28 [10]	66.44 [8]	66.90 [7]
z_2 [8]	42.76	28.05	26.75	26.46
Sargan	79.65 [74] p=0.306	93.86 [92] p=0.427	99.62 [94] p=0.326	100.24 [95] p=0.337
Wald (cash flow coefficients)	-	21.83 [3] p=0.000	-	-

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (i) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, and $(k-y)_{t-3}$ to $(k-y)_{t-5}$; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Instruments used in columns (ii), (iii) and (iv) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1990-1997. See also notes for Table 3.1.

Table 3.5

Error correction model: sample of US firms

I_t/K_{t-1}	(i) GMMSYS	(ii) GMMSYS	(iii) GMMSYS	(iv) GMMSYS
I_{t-1}/K_{t-2}	-0.0619 (.0948)	-0.0368 (.0944)	-0.0655 (.0877)	-0.0632 (.0860)
I_{t-2}/K_{t-3}	0.0330 (.0680)	0.0716 (.0656)	0.0355 (.1190)	0.0471 (.0649)
Δy_t	0.0447 (.0553)	0.0139 (.0591)	0.0152 (.0574)	0.0303 (.0532)
Δy_{t-1}	0.2014 (.0658)	0.0969 (.0716)	0.1321 (.0691)	0.1508 (.0649)
Δy_{t-2}	0.0892 (.0383)	0.0573 (.0491)	0.0715 (.0480)	0.0803 (.0451)
$(k-y)_{t-3}$	-0.1066 (.0392)	-0.0756 (.0496)	-0.0873 (.0479)	-0.0806 (.0473)
y_{t-3}	-0.0199 (.0139)	-0.0152 (.0140)	-0.0172 (.0143)	-
C_t/K_{t-1}	-	0.2151 (.0767)	0.1997 (.0637)	0.2124 (.0637)
C_{t-1}/K_{t-2}	-	0.1189 (.0792)	-	-
C_{t-2}/K_{t-3}	-	-0.1021 (.0714)	-	-
No. Firms	433	433	433	433
Obs.	2911	2911	2911	2911
Df	2895	2892	2894	2895
sc_1 [412]	-2.598	-2.925	-2.909	-2.918
sc_2 [386]	-3.143	-3.953	-3.726	-3.855
z_1	65.03 [7]	89.12 [10]	89.36 [8]	82.89 [7]
z_2 [8]	24.30	11.71	13.32	12.82
Sargan	71.54 [74] p=0.559	86.90 [92] p=0.631	90.20 [94] p=0.592	90.21 [95] p=0.620
Wald (cash flow coefficients)	-	13.97 [3] p=0.003	-	-

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (i) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, and $(k-y)_{t-3}$ to $(k-y)_{t-5}$; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Instruments used in columns (ii), (iii) and (iv) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1990-1997. See also notes for Table 3.1.

Table 3.6

Error correction model: sample of Italian firms

I_t/K_{t-1}	(i) GMMSYS	(ii) GMMSYS	(iii) GMMSYS	(iv) GMMSYS
I_{t-1}/K_{t-2}	-0.2020 (.1490)	-0.1681 (.1324)	-0.1676 (.1342)	-0.1675 (.1343)
I_{t-2}/K_{t-3}	-0.1553 (.0893)	-0.2161 (.1058)	-0.2232 (.0936)	-0.2166 (.0933)
Δy_t	-0.0161 (.0659)	0.0058 (.0797)	0.0078 (.0695)	-0.0043 (.0748)
Δy_{t-1}	-0.0353 (.0898)	-0.0003 (.0848)	0.0069 (.0840)	-0.0084 (.0877)
Δy_{t-2}	0.1662 (.0681)	0.1831 (.0926)	0.1901 (.0800)	0.1699 (.0816)
$(k-y)_{t-3}$	-0.0957 (.0498)	-0.1127 (.07001)	-0.1202 (.0576)	-0.1206 (.0574)
y_{t-3}	0.0192 (.0319)	0.0220 (.0329)	0.0225 (.0337)	-
C_t/K_{t-1}	-	-0.0431 (.0701)	-0.0452 (.0684)	-0.0319 (.0668)
C_{t-1}/K_{t-2}	-	0.0187 (.0651)	-	-
C_{t-2}/K_{t-3}	-	0.0005 (.0757)	-	-
No. Firms	81	81	81	81
Obs.	304	304	304	304
Df	289	286	288	289
sc_1 [61]	-1.655	-2.283	-2.304	-2.269
sc_2 [51]	-1.845	-1.483	-1.422	-1.479
z_1	8.64 [7]	15.40 [10]	11.63 [8]	10.11 [7]
z_2 [7]	16.07	11.39	13.05	13.91
Sargan	36.06 [47] p=0.877	48.73 [57] p=0.774	48.74 [59] p=0.827	51.92 [60] p=0.762
Wald (cash flow coefficients)	-	0.58 [3] p=0.900	-	-

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (i) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-4}/K_{t-5}, Δy_{t-3} to Δy_{t-4}, and $(k-y)_{t-3}$ to $(k-y)_{t-4}$; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Instruments used in columns (ii), (iii) and (iv) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-4}/K_{t-5}, Δy_{t-3} to Δy_{t-4}, $(k-y)_{t-3}$ to $(k-y)_{t-4}$, and C_{t-3}/K_{t-4} to C_{t-4}/K_{t-5}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1990-1996. See also notes for Table 3.1.

Table 3.7

Euler equation model: samples of UK, US and Italian firms

$(I/K)_t$	(i)	(ii)	(iii)
	UK firms	US firms	Italian firms
$(I/K)_{t-1}$	0.9350	1.0855	0.8149
	(.2133)	(.1688)	(.2915)
$(I/K)^2_{t-1}$	-1.7796	-1.8959	-2.3225
	(.5312)	(.4655)	(.7868)
$(Y/K)_{t-1}$	0.0027	0.0001	0.0008
	(.0032)	(.0013)	(.0065)
$(\Pi/K)_{t-1}$	0.1440	0.1178	-0.0041
	(.0285)	(.0224)	(.0264)
No. Firms	466	457	118
Obs.	3222	3825	540
Df	3207	3810	526
sc_1	-5.960 [466]	-6.768 [457]	-1.843 [118]
sc_2	0.355 [427]	-2.727 [433]	-3.015 [81]
z_1	108.20 [4]	208.15 [4]	9.66 [4]
z_2	119.79 [10]	65.27 [10]	50.43 [9]
Sargan	65.85 [68]	75.30 [68]	63.87 [60]
	p=0.551	p=0.254	p=0.342

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.

Notes. Sample period: 1988-1997 in columns (i) and (ii), 1988-1996 in column (iii).
See also notes for Table 3.1.

Table 4.1

Error correction model: UK, US and Italian firms

I_t/K_{t-1}	(i) UK firms	(ii) UK firms	(iii) US firms	(iv) US firms	(v) Italian firms	(vi) Italian firms
I_{t-1}/K_{t-2}	-0.2441 (.1310)	-0.1864 (.1146)	-0.1175 (.1038)	-0.0423 (.1036)	-0.1583 (.1095)	-0.1584 (.1161)
Δy_t	0.2697 (.0839)	0.2042 (.0833)	0.1123 (.0553)	0.1129 (.0625)	-0.0578 (.0655)	-0.0576 (.0682)
Δy_{t-1}	0.1525 (.0625)	0.1180 (.0680)	0.1577 (.0670)	0.1072 (.0603)	0.1472 (.0759)	0.1474 (.0848)
$(k-y)_{t-2}$	-0.1197 (.0388)	-0.0994 (.0460)	-0.1985 (.0595)	-0.1190 (.0487)	-0.1251 (.0526)	-0.1253 (.0582)
y_{t-2}	-0.0061 (.0115)	0.0105 (.0125)	-0.0292 (.0190)	-0.0214 (.0174)	-0.0036 (.0242)	-0.0036 (.0243)
C_{t+1}/K_t	-0.0009 (.1048)	-0.0899 (.1117)	-0.0147 (.0809)	-0.0386 (.0867)	-0.0277 (.0403)	-0.0277 (.0415)
C_t/K_{t-1}	-	0.2656 (.1028)	-	0.1468 (.0905)	-	-0.0006 (.0665)
No. Firms	427	427	433	433	81	81
Obs.	2290	2290	2911	2911	304	304
Df	2275	2274	2896	2895	290	289
sc_1	-2.317 [383]	-3.064 [383]	-2.379 [412]	-2.701 [412]	-1.715 [82]	-1.716 [61]
sc_2	-1.465 [350]	-1.475 [350]	-3.219 [386]	-3.079 [386]	-1.516 [69]	-1.514 [51]
z_1	25.01 [6]	43.97 [7]	36.16 [6]	49.79 [7]	7.77 [6]	8.60 [7]
z_2	28.30 [8]	20.22 [8]	18.06 [8]	8.25 [8]	15.58 [7]	15.33 [7]
Sargan	59.96 [62]	52.37 [61]	78.65 [62]	76.02 [61]	53.98 [52]	53.86 [51]
	p=0.550	p=0.776	p=0.075	p=0.093	p=0.399	p=0.366

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-3}/K_{t-4} to I_{t-4}/K_{t-5}, Δy_{t-3} to Δy_{t-4}, $(k-y)_{t-3}$ to $(k-y)_{t-4}$, and C_{t-3}/K_{t-4} to C_{t-4}/K_{t-5}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1990-1997 in columns (i), (ii), (iii) and (iv), 1990-1996 in columns (v) and (vi).
See also notes for Table 3.1.

Table 4.2

VAR forecasting equations for real sales: UK, US and Italian firms

(OLS levels)

y_t	(i) UK firms	(ii) US firms	(iii) Italian firms
y_{t-1}	0.9956 (.0014)	0.9832 (.0017)	0.9939 (.0049)
I_{t-1}/K_{t-2}	0.2365 (.0241)	0.1159 (.0280)	-0.0470 (.0682)
C_{t-1}/K_{t-2}	0.1322 (.0163)	0.0475 (.0113)	0.1152 (.0488)
No. Firms	466	457	118
R^2	0.999	0.999	0.999
Obs.	3222	3825	540
Df	3209	3812	528

Notes. Sample period: 1988-1997 in columns (i) and (ii), 1988-1996 in column (iii).

Table 4.3

Error correction model: UK, US, and Italian firms

(firms with more than 250 and fewer than 10,000 employees)

I_t/K_{t-1}	(i) UK firms	(ii) US firms	(iii) Italian firms
I_{t-1}/K_{t-2}	-0.0629 (.1016)	-0.1132 (.0919)	-0.3355 (.1031)
Δy_t	0.1164 (.0766)	0.0374 (.0633)	0.0070 (.0453)
Δy_{t-1}	0.0547 (.0655)	0.1732 (.0685)	0.0193 (.0694)
$(k-y)_{t-2}$	-0.0840 (.0331)	-0.1466 (.0632)	-0.1533 (.0762)
y_{t-2}	0.0067 (.0237)	0.0237 (.0502)	-0.0198 (.0396)
C_t/K_{t-1}	0.2550 (.0714)	0.1774 (.0804)	0.0202 (.0544)
No. Firms	350	261	100
Obs.	2044	1780	350
Df	2028	1764	335
sc_1	-3.962 [316]	-3.013 [241]	-1.590 [67]
sc_2	-0.300 [287]	-3.198 [227]	-3.063 [51]
z_1	38.83 [6]	34.60 [6]	17.43 [6]
z_2	28.57 [9]	8.01 [9]	17.85 [8]
Sargan	100.77 [97]	104.19 [97]	69.12 [83]
	p=0.376	p=0.291	p=0.862

All samples include firms with more than 250 employees and fewer than 10,000 employees in the first year of observation.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1997 in columns (i) and (ii), 1989-1996 in column (iii). See also notes for Table 3.1.

Table 4.4

Euler equation model: UK, US, and Italian firms

(firms with more than 250 and fewer than 10,000 employees)

$(I/K)_t$	(i) UK firms	(ii) US firms	(iii) Italian firms
$(I/K)_{t-1}$	0.8748	0.9691	1.0471
	(.2339)	(.2360)	(.3599)
$(I/K)^2_{t-1}$	-1.5677	-1.7639	-2.8986
	(.5573)	(.5926)	(.9868)
$(Y/K)_{t-1}$	-0.0012	0.0008	0.0048
	(.0036)	(.0015)	(.0070)
$(\Pi/K)_{t-1}$	0.1561	0.1058	-0.0159
	(.0338)	(.0267)	(.0505)
No. Firms	350	261	100
Obs.	2394	2041	450
df	2379	2026	436
sc_1	-5.462 [350]	-5.007 [261]	-1.719 [100]
sc_2	0.552 [316]	-2.387 [241]	-2.985 [67]
z_1	97.01 [4]	87.94 [4]	13.42 [4]
z_2	110.21 [10]	38.59 [10]	26.64 [9]
Sargan	63.92 [68]	71.59 [68]	67.25 [60]
	p=0.618	p=0.360	p=0.243

All samples include firms with more than 250 employees and fewer than 10,000 employees in the first year of observation.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.

Notes. Sample period: 1988-1997 in columns (i) and (ii), 1988-1996 in column (iii).
See also notes for Table 3.1.

5. Conclusions

The aim of this chapter has been to investigate the importance of financial constraints in the determination of investment decisions at the company level. One common approach to this question consists in identifying companies that are more likely to face different degrees of capital market imperfections and in testing whether their investment behaviour differs in the way predicted by the asymmetric information models. One problem of employing cross-sectional differences to test the different sensitivity of company investment to financial variables is that the sample split may be endogenous, that is, the regime the firm is in is partly a choice variable of the firm itself. Rather than compare the sensitivities of investment spending to internal finance for firms in a different information position, in this chapter we carried out a comparative analysis for firms in three countries: Italy, Britain, and the United States. Since the financial and institutional environment faced by firms in each country is quite different, and these differences are exogenous, different responses of investment to financial variables in the three countries offer a potentially compelling source of identification of the impact of informational asymmetries in the capital markets.

In order to investigate the impact of financial constraints on the investment behaviour of the largest UK, US and Italian firms, two different econometric models of fixed investment were estimated for each country: an error correction specification augmented with cash flow (proxying for the change in firms' internal net worth) and an Euler equation specification derived from dynamic optimisation in the presence of symmetric, quadratic costs of adjustment. A result robust to both the specifications is that the sensitivity of investment to financial variables is statistically significant in the UK and the US, but not in Italy. This difference is not accounted for by differences in the size distribution of firms, or in the nature of the company accounts data available for Italy. Consolidated accounts have been used for all three countries considered in this chapter. Therefore, the results of this chapter also suggest

that our finding of little or no cash flow sensitivity for large, group firms in Chapter 4 cannot be attributed to the use of unconsolidated accounts data in the earlier study.

The significance of the cash flow terms in the error correction models for the samples of UK and US firms could in principle reflect influences on expectations rather than financial constraints, although if this is the correct interpretation it is perhaps surprising that no cash flow effect is observed for the sample of Italian firms. This interpretation is also less appealing in the context of the Euler equation model, where the model derived under the null of no financial constraints is strongly rejected in the UK and US samples, but not in the Italian sample. Our attempts to control for expected profitability by introducing future cash flow terms in the error correction models, and our investigation of forecasting models for future sales, also indicate that this explanation is unlikely to account for the difference we find across countries in the investment-cash flow sensitivity.

The availability of internal finance appears to have been a constraint on company investment only in the samples of British and American firms over the period 1986 to 1997. This finding is consistent with the suggestion that the market-based, outsider control financial systems in the UK and the US perform less well in channelling investment funds to firms with profitable investment opportunities than does the insider control system in Italy. There might, however, be alternative interpretations that are consistent with our findings. Even though consolidated company accounts were used for all three samples, national accounting definitions of the variables used in the estimation are not precisely the same across countries. Moreover, models of financial constraints predict that investment is only constrained when desired investment exceeds the supply of internal finance. Thus our results may simply reflect transient differences in the frequency of this event within our samples, rather than more fundamental differences in the effects of different financial systems. Descriptive statistics for the available company accounts data and macroeconomic comparisons among the three countries seem to suggest, however, that Italian corporate groups are, if anything, more likely

to have faced such an event more often than the UK and US corporations over the period 1986 to 1997.

The fact that investment expenditures by British and American firms appear to be sensitive to the availability of internal finance cannot be interpreted as evidence of the superiority of the Italian insider control financial system over the outsider control systems. Our empirical analysis only suggests that financial systems characterised by concentrated ownership structures and relationship-based finance can reduce informational asymmetries in the capital markets, thus relaxing financial constraints on investment. On the other hand, this analysis does not address the issue that insider control systems may suffer from a dynamic inefficiency problem, in that concentrated ownership may hamper the efficient selection of controlling agents and make firms more resistant to (necessary) changes in corporate policy. In this sense, the extraordinary success of the US high-tech companies seen in the last decade bears witness to the greater responsiveness of market-based, outsider control systems to the commercial and investment opportunities created by the emergence of new technologies.

APPENDIX C

Here we compare the results of estimating an error correction model and an Euler equation model of fixed investment for the samples of UK, US and Italian firms analysed in Chapter 6, using a range of different estimators and instrument sets.

C.1 *Error correction model*

Table C.1 presents regression results for an error correction model of the form outlined in equation (3.8), Chapter 2, for the sample of UK companies. As expected the coefficients on the lagged investment to capital ratio and the error correction term appear to be upward-biased in the OLS levels estimator [column (i)] and downward-biased in the Within-Groups estimator [column (ii)]. Columns (iii) and (iv), Table C.1, present the regression results from first-differenced GMM estimators with instrument sets dated from t-2 to t-5 and t-3 to t-5, respectively. Both the Sargan statistic and the test for second order serial correlation in the differenced residuals do not reject the validity of the t-2 instruments. However, the GMMDIF estimates of the coefficients on the lagged dependent variable and the error correction term are lower than the corresponding Within-Groups estimates. This suggests that, similarly to the Within-Groups estimates, the GMMDIF estimates of the autoregressive coefficients may be downward-biased. This may be due to weak instruments, because of a relatively small number of time periods, as discussed in Section 4 of Chapter 2.

To reduce the small sample bias that characterises the GMMDIF estimator when the instruments available are weak, we estimate the error correction model of investment using a system GMM estimator (see Chapter 2, Section 4). Table C.1, column (v) [column (vi)] presents the results for the one-step GMMSYS estimator with an instrument set that includes levels of the right-hand side variables dated from t-2 to t-5 (from t-3 to t-5) for the equations in first differences, and differences of the dependent variable and sales growth dated t-1 (t-2)

for the equations in levels. The Sargan statistic and the test for second order correlation in the differenced residuals do not reject the validity of the instrument set employed for the GMMSYS estimates in column (v). However, this timing of the instruments is rejected by the Sargan difference test compared to the GMMSYS estimates in column (vi) [$\chi^2(38)=54.91$, $p=0.037$].

The Sargan difference test between the GMMSYS estimator in column (vi) and the GMMDIF estimator in column (iv) does not reject the validity of the extra moment conditions exploited by the system estimator. Nevertheless, the GMMSYS regression results differ substantially from the GMMDIF results, as the sum of the estimated autoregressive coefficients is significantly higher in the former. The estimated coefficient on the error correction term is higher than the GMMDIF (and Within-Groups) estimate and lower than the OLS levels estimate. Moreover, the estimated coefficients on the sales growth and cash flow terms appear to be significant and more precise. Thus the preferred estimator for the sample of UK firms is a GMMSYS estimator with an instrument set including levels of the right-hand side variables dated from t-3 to t-5, and differences of the dependent variable and sales growth dated t-2.

Regression results for the sample of US firms are presented in Table C.2. The results in columns (i) and (ii) again suggest that the estimates of the autoregressive coefficients are upward-biased in the OLS levels estimates and downward-biased in the Within-Groups estimates. Regression results for a first-differenced GMM estimator with instrument set dated, respectively, from t-2 to t-5 and from t-3 to t-5 are reported in columns (iii) and (iv). The validity of the t-2 instruments is rejected here both by the Sargan test [$\chi^2(117)=142.51$, $p=0.055$] and the Sargan difference test between instruments sets dated t-2 and t-3 [$\chi^2(36)=58.76$, $p=0.010$]. The estimated coefficient on the error correction term in column (iv) is higher than in the Within-Groups estimates, and the lagged output coefficient is not

significantly different from zero. Therefore, for the sample of US firms, there is less indication of serious biases when using the GMMDIF estimator (with instrument set dated from *t*-3 to *t*-5). In fact, since for a large number of US companies (64% of the total) observations are available over the whole period 1986-1997, the problem of weak instruments due to a small time dimension of the sample should be less relevant.

The results from the one-step GMMSYS estimator, presented in columns (v) and (vi), support the conclusion that the GMMDIF estimates are not seriously biased in this case. The preferred GMMSYS regression results in Table C.2, column (vi), present estimates of the autoregressive coefficients that are only marginally different from the results from the corresponding GMMDIF estimator. Two features must be stressed regarding the system estimator. First, the validity of instrument sets including the right-hand side variables in levels dated from *t*-2 to *t*-5 for the equations in first differences, and differences of the dependent variable and sales growth dated *t*-1 for the equations in levels [column (v)], is rejected by the Sargan difference test compared to the GMMSYS estimates in column (vi) [$\chi^2(38)=53.60$, p=0.048]. Secondly, in the US sample the estimated coefficient on the error correction term (and the output growth terms) was not significantly different from zero (t=1.37) when the error correction model was estimated using a GMMSYS estimator with an instrument set that included the differences of *all* the right-hand side variables dated *t*-2 in the equations in levels. For these reasons, our preferred GMMSYS regression results for the sample of US companies are those in column (vi), where the instrument set includes levels of the right-hand side variables dated from *t*-3 to *t*-5 for the equations in first differences, and only differences of the dependent variable and sales growth dated *t*-2 for the equations in levels. In this case, the error correction term is significantly different from zero (t=2.74) and the sales growth terms are jointly significant.

Table C.3 reports regression results of an error correction model of investment for the sample of Italian firms (using consolidated accounts data). Due to the relatively low number

of observations, in columns (iii) to (vi) the instrument sets for the equations in first differences do not include variables dated to t-5 (as was the case for the samples of UK and US firms). The GMMDIF estimates of the autoregressive coefficients appear to be downward-biased [columns (iii) and (iv)], as the estimates of the coefficients on the lagged dependent variable and the error correction term are lower than the Within-Groups estimates [column (ii)]. As for the GMMSYS estimator, the diagnostics here reveal evidence of second serial order correlation in the residuals when using instruments in levels dated from t-2 for the equations in first differences and instruments in first differences dated t-1 for the equations in levels [column (v)], thus implying that it is necessary to use longer lags of the instruments. At the same time, the coefficient estimate of the error correction term obtained using an instrument set which includes also differences of the error correction and the cash flow terms dated t-2 for the equations in levels was not significantly different from zero (t=0.82). Therefore, as for the UK and US companies, the preferred estimator is a system GMM estimator with an instrument set including levels of the right-hand side variables dated from t-3 for the equations in first differences, and differences of the dependent variable and sales growth dated t-2 for the equations in levels [columns (vi)]. Regression results from the system GMM estimator obtained using an instrument set for the equations in first differences that also includes variables dated t-5 are reported in column (vii) of Table C.3.

C.2 *Euler equation model*

Table C.4 presents regression results of an Euler equation model of investment of the form outlined in equation (3.12), Chapter 2, for the sample of UK firms. Although the Sargan statistic and the test for second order serial correlation in the differenced residuals do not reject the validity of the instrumental variables in levels dated from t-2 for the equations in first differences, the values of the lagged investment terms are inconsistent with the theoretical restrictions in columns (iii) and (v). In contrast, the results from the GMMDIF estimator with

instruments dated *t*-3 [column (iv)] and the GMMSYS estimator with instruments in levels dated *t*-3 for the equations in first differences and instruments in first differences dated *t*-2 for the equations in levels [column (vi)] do not reject the dynamics implied by the structural adjustment cost model: the coefficient estimates on the lagged dependent variable are not significantly different from one, and those on the lagged squared term are less than minus one. The test of the joint significance of the reported coefficients indicates, however, that the GMMSYS estimates are more precise ($z_1[4]=108.2$, against $z_1[4]=12.88$ in the GMMDIF estimates).

A similar pattern is found in the regression results of the Euler equation for the sample of US firms (Table C.5). The dynamics of the model are consistent with the theoretical restrictions of the adjustment cost process both in the GMMDIF estimates with instruments dated *t*-3 [column (iv)] and the GMMSYS estimates with instruments in levels dated *t*-3 for the equations in first differences and instruments in first differences dated *t*-2 for the equations in levels [column (vi)]: the estimated coefficient on the lagged squared term is less than minus one, and that on the lagged dependent variable is close to unity. Again the only difference between the two estimators is that the latter provides more precise estimates than the former ($z_1[4]=208.15$, against $z_1[4]=72.21$).

Table C.6 presents regression results for the sample of 118 Italian business groups. Since second order serial correlation in the differenced residuals is detected, the validity of the instrument set used in columns (iii) and (v) is rejected. The Sargan test does not reject the validity of the instrument set used in columns (iv) and (vi). However, the regression results from the GMMDIF estimator (with instrumental variables dated *t*-3) reject the dynamics implied by the structural adjustment cost model, as the coefficient estimate on the lagged dependent variable is significantly lower than one [column (iv)]. In contrast, the dynamics of the Euler equation model are consistent with the theoretical restrictions in the GMMSYS estimates: the estimated coefficient on the lagged dependent variable is close to unity and that

on the lagged squared term is less than minus one [column (vi)]. Therefore, as for the samples of UK and US companies, the preferred estimator of the Euler equation model for the sample of Italian firms is a system GMM estimator with an instrument set including levels of the right hand side variables dated t-3 for the equations in first differences, and differences of the right hand side variables dated t-2 for the equations in levels.

Table C.1

Error correction model: sample of UK firms

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
I_{t-1}/K_{t-2}	0.1897	-0.1620	-0.1945	-0.2683	-0.0131	-0.1939
	(.0223)	(.0251)	(.0574)	(.1066)	(.0460)	(.1032)
Δy_t	0.1774	0.2165	0.1546	0.1256	0.1349	0.1116
	(.0160)	(.0177)	(.0539)	(.0624)	(.0604)	(.0662)
Δy_{t-1}	0.0088	0.0988	0.0913	0.0806	0.0520	0.1224
	(.0126)	(.0149)	(.0441)	(.0747)	(.0334)	(.0502)
$(k-y)_{t-2}$	-0.0144	-0.2823	-0.3339	-0.2983	-0.1236	-0.0847
	(.0043)	(.0176)	(.0516)	(.0617)	(.0337)	(.0355)
y_{t-2}	0.0006	-0.1087	-0.1911	-0.1791	-0.0124	-0.0009
	(.0009)	(.0139)	(.0477)	(.0695)	(.0107)	(.0101)
C_t/K_{t-1}	0.1664	0.1369	0.0329	0.0903	0.2032	0.2400
	(.0164)	(.0264)	(.0695)	(.0829)	(.0636)	(.0791)
No. Firms	466	466	466	466	466	466
Obs.	3222	2756	2756	2756	2756	2756
Df	3206	2741	2741	2741	2740	2740
sc_1	-3.306 [466]	-10.717 [427]	-9.435 [427]	-3.809 [427]	-10.732 [427]	-3.255 [427]
sc_2	2.515 [427]	1.419 [383]	1.328 [383]	-0.540 [383]	1.185 [383]	-1.866 [383]
z_1 [6]	758.44	556.08	143.05	54.24	69.95	44.11
z_2 [9]	115.80	88.48	42.39	32.76	29.51	46.04
Sargan	-	-	118.55 [117]	82.99 [81]	151.67 [135]	96.76 [97]
			p=0.443	p=0.418	p=0.155	p=0.488

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are I_{t-2}/K_{t-3} to I_{t-5}/K_{t-6}, Δy_{t-2} to Δy_{t-5}, $(k-y)_{t-2}$ to $(k-y)_{t-5}$, and C_{t-2}/K_{t-3} to C_{t-5}/K_{t-6}.
Instruments used in column (iv) are I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (v) are: differenced equations: I_{t-2}/K_{t-3} to I_{t-5}/K_{t-6}, Δy_{t-2} to Δy_{t-5}, $(k-y)_{t-2}$ to $(k-y)_{t-5}$, and C_{t-2}/K_{t-3} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.
Instruments used in column (vi) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1997. See also notes for Table 3.1.

Table C.2

Error correction model: sample of US firms

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
I_{t-1}/K_{t-2}	0.4805	0.1582	0.2098	0.0482	0.2324	-0.0528
	(.0170)	(.0224)	(.0573)	(.0820)	(.0641)	(.0924)
Δy_t	0.1196	0.1018	0.1010	0.0409	0.1219	0.0524
	(.0104)	(.0119)	(.0448)	(.0579)	(.0493)	(.0558)
Δy_{t-1}	0.0644	0.0960	0.1336	0.1292	0.1166	0.1279
	(.0092)	(.0116)	(.0434)	(.0568)	(.0352)	(.0591)
$(k-y)_{t-2}$	-0.0057	-0.1808	-0.1471	-0.1264	-0.1129	-0.1533
	(.0029)	(.0157)	(.0373)	(.0423)	(.0364)	(.0559)
y_{t-2}	-0.0012	-0.0554	-0.0137	0.0159	0.0052	-0.0255
	(.0010)	(.0117)	(.0371)	(.0490)	(.0142)	(.0172)
C_t/K_{t-1}	0.0843	0.1221	0.1688	0.2152	0.1961	0.1401
	(.0103)	(.0208)	(.0406)	(.0597)	(.0581)	(.0673)
No. Firms	457	457	457	457	457	457
Obs.	3825	3368	3368	3368	3368	3368
Df	3809	3353	3353	3353	3352	3352
sc_1	-0.844 [457]	-9.033 [433]	-8.502 [433]	-4.216 [433]	-8.835 [433]	-3.416 [433]
sc_2	-1.456 [433]	-1.819 [412]	-1.706 [412]	-2.671 [412]	-1.961 [412]	-3.243 [412]
z_1 [6]	2504.57	905.02	354.29	92.09	180.84	62.00
z_2 [9]	35.10	52.08	12.06	9.36	6.46	15.52
Sargan	-	-	142.51 [117]	83.75 [81]	158.36 [135]	104.76 [97]
			p=0.055	p=0.395	p=0.083	p=0.277

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are I_{t-2}/K_{t-3} to I_{t-5}/K_{t-6}, Δy_{t-2} to Δy_{t-5}, $(k-y)_{t-2}$ to $(k-y)_{t-5}$, and C_{t-2}/K_{t-3} to C_{t-5}/K_{t-6}.
Instruments used in column (iv) are I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (v) are: differenced equations: I_{t-2}/K_{t-3} to I_{t-5}/K_{t-6}, Δy_{t-2} to Δy_{t-5}, $(k-y)_{t-2}$ to $(k-y)_{t-5}$, and C_{t-2}/K_{t-3} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.
Instruments used in column (vi) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1997. See also notes for Table 3.1.

Table C.3

Error correction model: sample of Italian firms

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS	GMMSYS
I_{t-1}/K_{t-2}	0.2296	-0.2777	-0.5605	-0.6161	-0.0724	-0.2772	-0.2765
	(.0413)	(.0601)	(.0724)	(.1522)	(.0773)	(.1194)	(.1087)
Δy_t	0.0714	0.1115	0.0921	0.0644	0.0254	-0.0092	0.0288
	(.0251)	(.0272)	(.0427)	(.0614)	(.0546)	(.0598)	(.0503)
Δy_{t-1}	0.0418	0.1322	0.1882	0.0878	0.1060	0.0351	0.0236
	(.0217)	(.0298)	(.0519)	(.0751)	(.0450)	(.0824)	(.0686)
$(k\text{-}y)_{t-2}$	-0.0169	-0.4436	-0.7674	-0.8681	-0.1407	-0.1274	-0.1382
	(.0079)	(.0757)	(.0885)	(.1696)	(.0456)	(.0582)	(.0580)
y_{t-2}	-0.0003	-0.2535	-0.4890	-0.6653	0.0034	0.0109	0.0108
	(.0026)	(.0655)	(.0934)	(.1890)	(.0262)	(.0299)	(.0308)
C_t/K_{t-1}	0.0963	0.0067	-0.0037	-0.0553	0.0590	0.0147	0.0216
	(.0269)	(.0248)	(.0350)	(.0592)	(.0486)	(.0577)	(.0524)
No. Firms	118	118	118	118	118	118	118
Obs.	540	422	422	422	422	422	422
Df	525	408	408	408	407	407	407
sc_1	-0.062 [118]	-3.583 [81]	-2.158 [81]	-0.740 [81]	-3.678 [81]	-1.518 [81]	-1.603 [81]
sc_2	-1.322 [81]	-2.350 [61]	-1.447 [61]	-0.243 [61]	-2.557 [61]	-2.728 [61]	-2.817 [61]
z_1 [6]	129.12	63.50	100.67	34.17	20.80	10.00	13.25
z_2 [8]	44.93	29.08	36.38	21.70	24.92	26.85	28.86
Sargan	-	-	78.23 [80]	44.08 [48]	93.98 [96]	56.55 [62]	67.79 [83]
			p=0.535	p=0.634	p=0.539	p=0.672	p=0.887

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are I_{t-2}/K_{t-3} to I_{t-4}/K_{t-5}, Δy_{t-2} to Δy_{t-4}, $(k\text{-}y)_{t-2}$ to $(k\text{-}y)_{t-4}$, and C_{t-2}/K_{t-3} to C_{t-4}/K_{t-5}.
Instruments used in column (iv) are I_{t-3}/K_{t-4} to I_{t-4}/K_{t-5}, Δy_{t-3} to Δy_{t-4}, $(k\text{-}y)_{t-3}$ to $(k\text{-}y)_{t-4}$, and C_{t-3}/K_{t-4} to C_{t-4}/K_{t-5}.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (v) are: differenced equations: I_{t-2}/K_{t-3} to I_{t-4}/K_{t-5}, Δy_{t-2} to Δy_{t-4}, $(k\text{-}y)_{t-2}$ to $(k\text{-}y)_{t-4}$, and C_{t-2}/K_{t-3} to C_{t-4}/K_{t-5}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.
Instruments used in column (vi) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-4}/K_{t-5}, Δy_{t-3} to Δy_{t-4}, $(k\text{-}y)_{t-3}$ to $(k\text{-}y)_{t-4}$, and C_{t-3}/K_{t-4} to C_{t-4}/K_{t-5}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.
Instruments used in column (vi) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k\text{-}y)_{t-3}$ to $(k\text{-}y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1989-1996. See also notes for Table 3.1.

Table C.4

Euler equation model: sample of UK firms

$(I/K)_t$	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
$(I/K)_{t-1}$	0.7378	0.3583	0.5203	0.7435	0.5155	0.9350
	(.0483)	(.0549)	(.0837)	(.3437)	(.1030)	(.2133)
$(I/K)^2_{t-1}$	-1.0529	-0.6123	-0.7051	-1.4839	-0.7371	-1.7796
	(.1243)	(.1294)	(.1926)	(.7484)	(.2437)	(.5312)
$(Y/K)_{t-1}$	0.0003	0.0085	0.0047	0.0090	-0.0003	0.0027
	(.0007)	(.0019)	(.0043)	(.0066)	(.0019)	(.0032)
$(\Pi/K)_{t-1}$	0.1005	0.1265	0.1327	0.1161	0.1198	0.1440
	(.0081)	(.0140)	(.0225)	(.0455)	(.0185)	(.0285)
No. Firms	466	466	466	466	466	466
Obs.	3688	3222	3222	3222	3222	3222
Df	3673	3208	3208	3208	3207	3207
sc_1	-2.030 [466]	-13.250 [466]	-13.358 [466]	-4.282 [466]	-13.507 [466]	-5.960 [466]
sc_2	1.764 [466]	-1.057 [427]	1.206 [427]	-0.242 [427]	1.317 [427]	0.355 [427]
z_1 [4]	1070.70	278.96	138.84	12.88	135.32	108.20
z_2 [10]	179.62	136.52	121.71	119.01	163.61	119.79
Sargan	-	-	79.30 [72] p=0.260	37.23 [32] p=0.241	119.86 [112] p=0.289	65.85 [68] p=0.551

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$.
Instruments used in column (iv) are $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (v) are: differenced equations: $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-1}$, $\Delta(I/K)^2_{t-1}$, $\Delta(Y/K)_{t-1}$, and $\Delta(\Pi/K)_{t-1}$.
Instruments used in column (vi) are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.

Notes. Sample period: 1988-1997. See also notes for Table 3.1.

Table C.5

Euler equation model: sample of US firms

$(I/K)_t$	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
$(I/K)_{t-1}$	0.8888	0.5669	0.6935	0.8294	0.6202	1.0855
	(.0466)	(.0580)	(.0814)	(.1979)	(.1310)	(.1688)
$(I/K)^2_{t-1}$	-0.7775	-0.6006	-0.5656	-1.2319	-0.4874	-1.8959
	(.1250)	(.1589)	(.1971)	(.4775)	(.3168)	(.4655)
$(Y/K)_{t-1}$	0.0010	0.0045	0.0013	-0.0017	0.0008	0.0001
	(.0004)	(.0021)	(.0021)	(.0030)	(.0013)	(.0013)
$(\Pi/K)_{t-1}$	0.0377	0.1077	0.1174	0.1120	0.1383	0.1178
	(.0046)	(.0107)	(.0159)	(.0243)	(.0161)	(.0224)
No. Firms	457	457	457	457	457	457
Obs.	4282	3825	3825	3825	3825	3825
Df	4267	3811	3811	3811	3810	3810
sc_1	1.507 [457]	-10.653 [457]	-10.970 [457]	-5.948 [457]	-11.633 [457]	-6.768 [457]
sc_2	-1.837 [457]	-2.790 [433]	-2.004 [433]	-2.557 [433]	-2.258 [433]	-2.727 [433]
z_1 [4]	2725.10	970.31	476.10	72.21	338.12	208.15
z_2 [10]	84.58	63.71	54.31	59.85	51.81	65.27
Sargan	-	-	74.35 [72] p=0.402	35.97 [32] p=0.288	126.83 [112] p=0.160	75.30 [68] p=0.254

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$.
Instruments used in column (iv) are $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (v) are: differenced equations: $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-1}$, $\Delta(I/K)^2_{t-1}$, $\Delta(Y/K)_{t-1}$, and $\Delta(\Pi/K)_{t-1}$.
Instruments used in column (vi) are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.

Notes. Sample period: 1988-1997. See also notes for Table 3.1.

Table C.6

Euler equation model: sample of Italian firms

$(I/K)_t$	(i)	(ii)	(iii)	(iv)	(v)	(vi)
	OLS levels	Within Groups	GMMDIF	GMMDIF	GMMSYS	GMMSYS
$(I/K)_{t-1}$	0.9164	0.2741	0.2923	0.1316	0.3908	0.8149
	(.1263)	(.1410)	(.2225)	(.4923)	(.1950)	(.2915)
$(I/K)^2_{t-1}$	-1.6468	-0.7584	-0.4427	-0.9948	-0.5532	-2.3225
	(.3383)	(.3880)	(.5205)	(1.1666)	(.4805)	(.7868)
$(Y/K)_{t-1}$	-0.0002	0.0177	0.0078	-0.0086	0.0021	0.0008
	(.0017)	(.0060)	(.0149)	(.0075)	(.0052)	(.0065)
$(\Pi/K)_{t-1}$	0.0707	0.0346	0.0185	0.0050	0.0448	-0.0041
	(.0199)	(.0422)	(.0520)	(.0408)	(.0324)	(.0264)
No. Firms	118	118	118	118	118	118
Obs.	658	540	540	540	540	540
Df	644	527	527	527	526	526
sc_1	0.642 [118]	-4.327 [118]	-3.882 [118]	-0.767 [118]	-4.547 [118]	-1.843 [118]
sc_2	-1.214 [118]	-3.334 [81]	-2.856 [81]	-3.209 [81]	-2.690 [81]	-3.015 [81]
z_1 [4]	201.69	22.50	4.77	3.49	17.97	9.66
z_2 [9]	55.92	62.35	53.83	51.12	57.74	50.43
Sargan	-	-	70.99 [64] p=0.256	24.29 [28] p=0.666	100.22 [100] p=0.475	63.87 [60] p=0.342

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$.
Instruments used in column (iv) are $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (v) are: differenced equations: $(I/K)_{t-2}$ to $(I/K)_{t-3}$, $(I/K)^2_{t-2}$ to $(I/K)^2_{t-3}$, $(Y/K)_{t-2}$ to $(Y/K)_{t-3}$, and $(\Pi/K)_{t-2}$ to $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-1}$, $\Delta(I/K)^2_{t-1}$, $\Delta(Y/K)_{t-1}$, and $\Delta(\Pi/K)_{t-1}$.
Instruments used in column (vi) are: differenced equations: $(I/K)_{t-3}$, $(I/K)^2_{t-3}$, $(Y/K)_{t-3}$, and $(\Pi/K)_{t-3}$; levels equations: $\Delta(I/K)_{t-2}$, $\Delta(I/K)^2_{t-2}$, $\Delta(Y/K)_{t-2}$, and $\Delta(\Pi/K)_{t-2}$.

Notes. Sample period: 1988-1996. See also notes for Table 3.1.

Chapter 7

Ownership Structure and Corporate Investment: Evidence From United Kingdom and United States Panel Data

1. Introduction

The hypothesis that modern corporations are characterised by the separation of ownership and control, as first proposed by Berle and Means (1932), has led to a body of literature both in the US and the UK, examining the effects and significance of the ownership and control structure of the firm on its operation and performance. While earlier studies tended to find a positive association between ownership concentration and profitability (see Cubbin and Leech, 1983, and Short, 1994, for a review of these studies), Demsetz (1983) argued that the ownership structure of the firm that "emerges is an endogenous outcome of competitive selection in which various cost advantages and disadvantages are balanced to arrive at an equilibrium organisation of the firm". Accordingly, Demsetz concludes that there is no relationship between ownership structure and profitability. Demsetz and Lehn (1985), Holderness and Sheehan (1988) and Himmelberg *et al.* (1999) present evidence consistent with Demsetz's conclusions[1]. Evidence of the contrary has been recently presented by, among the others,

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[1] Demsetz and Lehn (1985) regress the accounting profit rate of 511 US companies in 1980 on different measures of ownership and find no significant correlation. Holderness and Sheehan (1988) investigate the effect of large shareholders on firm performance (as proxied by accounting rates of return and Tobin's Q) over the period 1979 to 1984 by comparing the mean values of the performance measures of 101 majority owned firms with a matched sample of 101 diffusely held firms. Their results suggest that there are no significant differences between majority owned and diffusely held firms. Himmelberg *et al.* (1999) analyse a sample of 600 US companies for

Morck *et al.* (1988), McConnell and Servaes (1990), Zeckhauser and Pound (1990), and Leech and Leahy (1991)[2].

As opposed to the large if controversial literature investigating the link between ownership structure and corporate value, there are few empirical studies that analyse the relationship between ownership structure and investment. Cho (1998) investigates the effect of ownership structure on capital accumulation, and concludes that, after controlling for the endogeneity of ownership structure, this is insignificant. Other studies have analysed whether ownership structure affects the relationship between financial variables and investment. Schaller (1993) and Ng and Schaller (1996) analyse Canadian company accounts data and find that firms where ownership is dispersed display a significant sensitivity of investment to financial factors, whereas the effect from financial factors is zero for firms with concentrated ownership. Their interpretation of this evidence is that concentrated ownership reduces agency costs due to stockholder-manager conflicts of interest. Using a panel of US firms from the 1970s, Hadlock (1998) finds a non-monotonic relationship between insider (i.e. managerial) shareholdings and company investment. As insider holdings increase from an initial point of zero, investment becomes more sensitive to cash flow. At higher levels of insider ownership, investment-cash flow sensitivities then decrease slowly with insider holdings. His interpretation of this evidence is that the relationship between investment and cash flow

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the period 1982-85 and show that ownership structure has no significant effect on firm performance once they control for the endogeneity of the ownership structure.

[2] Morck *et al.* (1988) and McConnell and Servaes (1990) find non-monotonic relationships between insider (i.e. managerial) shareholdings and firm performance (as proxied by Tobin's Q). McConnell and Servaes (1990) also find a strong positive relation between firm performance and the fraction of shares held by institutional investors. Zeckhauser and Pound (1990) find significantly lower earnings/price ratios for firms with large (15% owners) shareholders operating in open information structure industries as compared to the earnings/price ratios for firms without large shareholders. Leech and Lehay (1991) find a significant negative relationship between ownership concentration and profitability and growth.

reflects financial constraints on investment, rather than free-cash flow problems due to the separation of ownership and control.

In this chapter we provide some preliminary evidence on the influence of ownership structure on the sensitivity of investment to cash flow in Britain and in the United States. Patterns of ownership structure in the US and the UK differ markedly from patterns in other major industrialised countries. Ownership structure has two mutually related dimensions: the identity of shareholders and the concentration of ownership. While non-banking financial institutions are the dominant owners of common stock in the US and the UK, families and other companies are the most important owners in most other countries. Institutional share ownership has significantly increased in the US and the UK over the last three decades. Between 1970 and 1993 pension funds in the US grew from having less than 9% of the stock market to nearly one-third of the market. Mutual funds and insurers owned a further 16%, implying that nearly one-half of corporate equity was in institutional hands in 1993. The rise in institutional share ownership has gone even further in the UK. Institutional share ownership of the listed UK equity market grew from 29% in 1963 to 47.3% in 1975, and 60.6% in 1992 (Stapledon, 1996). Since institutional portfolios tend to be highly diversified, ownership tends to be much less concentrated in the UK and the US than it is in Continental Europe and Japan. The OECD (1997) estimates that in the US and the UK the largest five shareholders hold on average 20-25% of the outstanding shares. Ownership concentration is significantly higher in Japan and Germany, and especially in the Latin European countries. In Continental Europe concentrated ownership has given rise to an "insider system" of corporate control by which companies are owned and controlled by each other and by families. There is little control exercised by outside shareholders. In contrast, the UK and the US have "outsider systems" of corporate control dominated by a large number of small shareholders.

The structure of ownership affects the way in which companies are managed and controlled. The more concentrated the ownership, the more closely the firm insiders' interests

should coincide with those of shareholders, thus attenuating free-rider problems associated with management performance and funding distressed firms. For firms with concentrated ownership, potential investors face a lower risk that the firm will misrepresent the quality of its investment projects. This risk is higher for firms with very dispersed ownership, where there is little incentive for any one shareholder to undertake costly monitoring of the firm's performance. This raises the question as to how corporate control can be exercised in the presence of dispersed shareholders.

Agency cost theories suggest that a high dividend pay-out ratio, or a greater reliance on external sources of investment finance, may substitute for direct monitoring of firms by large shareholders. Grossman and Hart (1982) develop a principal-agent model where leverage can be used as a bonding mechanism to reduce management discretion and thus lessen a manager's potential opportunistic behaviour. Since leverage increases the probability of bankruptcy, which is costly to managers, leverage can be used as an effective certification device for manager quality. Rozeff (1982) argues that a high dividend pay-out ratio decreases the availability of internal sources of investment financing, thus increasing the amount of external funds that have to be raised in the capital market. If raising external finance subjects the firm's management to more effective monitoring than can be achieved by its existing shareholders, this greater discipline over management performance is a control benefit resulting from a high dividend policy. Rozeff develops a model that trades off this control benefit against the increasing transaction costs of more frequent capital issues, to derive an optimal dividend pay-out ratio. The model predicts that, other things being equal, firms with a less concentrated ownership structure will choose higher pay-out ratios. Rozeff finds some evidence that is consistent with this prediction from a cross-section of quoted US firms. Likewise, Bond and Chennels (2000) provide evidence of a significant negative relationship between ownership concentration and dividend policies from a panel of quoted UK firms.

Hence, if imperfections in capital markets are important and there is a wedge between the cost of internal and external finance, agency cost models suggest that a less concentrated ownership structure may result in a greater sensitivity of investment spending to the availability of low-cost internal funds. To the extent that institutional investors also tend to be relatively passive shareholders, preferring exit rather than voice in the exercise of corporate control, the monitoring motive for dividend payments/debt finance tends to be reinforced. In the presence of a cost premium on external finance, firms with a high level of institutional ownership should also display greater investment sensitivity to the availability of low-cost internal funds.

To investigate the impact of ownership structure on the link between investment and internal finance, we have obtained detailed data on beneficial share ownership for two samples of UK and US companies. This ownership information has been matched with company accounts data, giving annual observations on investment, profits and sales for the same companies. The resulting data sets allow us to test whether a high level of institutional ownership is associated with a greater sensitivity of investment to the availability of internal finance. The data also allow us to break down institutional ownership into different categories of institutions (only for the UK), to consider managerial ownership (only for the US), and to consider direct measures of ownership concentration.

The remainder of this chapter is organised as follows. Section 2 describes the UK data set and the patterns of share ownership that we find for this sample. Section 3 describes the US data set and the patterns of security ownership for this sample. Sections 4 and 5 present the main empirical results for the samples of UK and US firms, respectively. Section 6 concludes with a summary of the main results and some suggestions for future research.

2. UK data

This section describes the main data set used for the study of the effects of ownership structure in the UK. Three sub-sections describe the type of ownership information used; the sample of companies for which this was available; and the patterns of share ownership found for this sample.

2.1 UK ownership data

The main data set for the UK was provided by Dr. Steve Bond. This contains detailed data on share ownership which was purchased from CDA Spectrum for an Institute for Fiscal Studies project on "Institutional Share Ownership and Dividend Behaviour".

CDA Spectrum provides detailed share ownership information for quoted UK firms. The CDA Spectrum data covers either all registered holdings above 0.25% of the firm's total equity, or the largest 99 registered holdings if there are more than 99 holdings above this 0.25% threshold. CDA Spectrum also provides information on the identity of the beneficial owners for each separate shareholding. Since in the UK a large proportion of shares is registered to nominee accounts, CDA Spectrum records the identity of the beneficial owners behind most of these nominee accounts[3]. Using the name given for both registered and beneficial shareholders, each individual shareholding has been allocated to one of eight broad groups of ownership. The eight groups are individuals, pension funds, insurance companies, other financial institutions (including investment and unit trusts, banks, etc.), private clients of banks, non-financial companies, SEPON Ltd (the Stock Exchange clearing company, indicating a shareholding that is in the process of changing ownership) and other (which

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[3] Bond and Chennels (2000) report that for the sample used in this study CDA Spectrum identifies the beneficial owners for about 90% of the registered nominee holdings.

includes the Church Commissioners, local government bodies, higher educational establishments and foreign government agencies). Some nominee holdings which could not be further identified remained classified as nominee holdings, and were treated as non-identified holdings in the estimation process.

2.2 UK sample

The original data was based on an approximately random sample of just over 350 companies quoted in the UK stock market, alive at the beginning of 1985 (new entrants from 1986 and 1987 were also included to increase the sample slightly). Both ownership records and company accounting data, obtained from Datastream International, were available for all companies in the sample. The sample fell to 330 firms, once those with fewer than four years of available accounting data were excluded, plus a few where the change in sales suggested that a major merger or acquisition (or disposal) had occurred. Since we are interested in investigating the impact of ownership structure on spending in physical investment, non-manufacturing firms were also excluded from our sample. This left an unbalanced panel of 281 manufacturing companies covering the period 1985 to 1997.

The main variables used in the econometric analysis are flows of investment, sales, and cash flow. Investment is reported spending on plant, property and equipment, and it includes spending on acquisitions. Sales are used as a proxy for output. Cash flow is computed by adding back the reported value of depreciation to the reported value of profits (net of interest and taxes). As in Chapter 6, all the flow variables are deflated using an implicit GDP deflator for the UK manufacturing sector (OECD Quarterly National Accounts source). A measure of the stock of capital at current replacement cost was estimated from the flow data on investment using a standard perpetual inventory method [see equation (2.1), Chapter 6].

After computing the main variables used in the investment regressions, we excluded observations that appeared to contain substantial outliers. Specifically, observations were

discarded if the investment rate was either greater than one or above the 95th centile, if real sales increased by more than 100% or decreased by more than 50%, or if the observed ratio of either sales or cash flow to the capital stock fell in the first or the last centile of the empirical distribution of the sample. In these cases we retained the longest available time series of consecutive annual observations for the firms affected. We also required that at least four consecutive annual observations, complete with ownership information, were available for the firms included in our final sample. These selection criteria left an unbalanced panel of 264 companies, 49 of which have complete observations from 1985 to 1997. The exact structure of the sample by number of observations per company and number of companies per year is reported in Tables 2.1 and 2.2.

2.3 UK ownership patterns

Table 2.3 shows the distribution of beneficial share ownership between different classes of owners for the sample of 264 UK companies. The first column shows the average proportion of the total equity owned by each of the eight ownership groups (as defined in Section 2.1) obtained as the unweighted mean of ownership shares across the sample of 2351 firm-year observations. The second column shows each group's average ownership share of the equity for which we have identified beneficial ownership information. The third and fourth columns report these average ownership shares by category of holder, obtained by considering only holdings above 5% of the firm's total equity. We provide these statistics because they allow us to compare share ownership in the UK with share ownership in the US, where only information on 5% beneficial owners is available.

On average, the three categories of institutional shareholders collectively own at least 40.2% of the total equity, or 55.5% of the total identified equity. Pension funds account for 24% of total institutional ownership, insurance companies account for 28.5%, and other institutions for 47.5%.

Table 2.4 divides companies into two groups by firm size, defining "large" firms to be those with an above median level of employment in the first year of observation[4]. There are interesting differences between the ownership structures of larger firms and smaller firms. Pension funds and insurance companies are found to own a much larger proportion of the equity of larger firms, and individuals are found to own a much smaller proportion (at least in blocks larger than 0.25%). Share ownership is also found to be more dispersed for the sample of larger firms, with the largest (at most) 99 separate shareholdings accounting on average for 67% of the total equity for larger companies, compared to 78.3% for the sample of smaller companies.

Figures 2.1 and 2.2 show the sample proportions of individual and institutional ownership. Over the period 1985-97 the aggregate ownership pattern has been relatively stable, the only noticeable change having been the slow but steady decline in individual share ownership.

Table 2.5 presents different measures of ownership concentration based on the ownership information in the last year of observation for each firm. The measures used are the proportion of the firm's total equity owned by the largest shareholder (C1) and the proportion of the firm's total equity owned by the largest five shareholders (C5). For half of the firms, the largest single shareholder owns less than 10% of the firm's total equity. Only 18.6% of these firms have a single shareholder that owns more than 20% of the equity, and only 3.4% have a majority shareholder. The mean of the largest block is 14.1%, and the median is 10%. For the second largest block the mean is 7.5% and the median is 6.4%. The mean and the median of C5 are 35.3% and 33.4%, respectively. This evidence of highly dispersed ownership of quoted UK companies is consistent with previous studies[5].

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[4] The median number of employees in the first year of observation is 1,300 for this UK sample.

[5] See Leech and Leahy (1991).

Table 2.6 shows the distribution of these ownership concentration measures separately for the larger and smaller firms. A concentrated ownership structure is more common amongst the smaller companies, whereas a dispersed ownership structure is more common amongst the larger companies, where institutional ownership is also more significant. For example, the largest five shareholders control more than 30% of the equity in three-quarters of our small firms, but in only one-third of our large firms. Likewise, the largest shareholder owns at least 10% of the equity in 68% of our small firms, but in only 32% of our large firms.

Table 2.1

Structure of the UK sample by number of observations per company

Annual observations	4	5	6	7	8	9	10	11	12	13
Number of companies	29	28	28	15	21	19	18	18	39	49

Table 2.2

Structure of the UK sample by number of companies per year

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Number of companies	137	172	191	210	212	210	212	208	196	184	170	161	88

Table 2.3

UK firms' total shareholdings: by category of holder [1]

Shareholder category	Identified equity [2]	% of total identified equity [2]	Identified equity [3]	% of total identified equity [3]
% Individuals	19.90	27.47	10.60	42.28
% Pension funds	9.64	13.31	0.88	3.51
% Insurance companies	11.47	15.83	2.44	9.73
% Other fin. institutions	19.11	26.38	5.99	23.89
(% All fin. Institutions)	(40.21)	(55.50)	(9.31)	(37.14)
% Clients	6.80	9.39	2.17	8.66
% Company	3.76	5.19	2.77	11.05
% SEPON	0.69	0.95	0.07	0.28
% Other	1.08	1.49	0.15	0.60
% Total identified	72.45	100.00	25.07	100.00

[1] Figures reported are unweighted averages of the ownership shares computed for each firm-year observation in the sample
[2] Figures include all holdings above 0.25% of the firm's total equity reported
[3] Figures include only holdings above 5% of the firm's total equity

Table 2.4.a

UK firms' total shareholdings: by size of firm [1]

	Small firms		Large firms	
Shareholder category	Identified equity	% of total identified equity	Identified equity	% of total identified equity
% Individuals	32.99	42.14	7.60	11.35
% Pension funds	6.79	8.67	12.32	18.40
% Insurance companies	7.05	9.00	15.62	23.32
% Other fin. institutions	20.20	25.80	18.08	27.00
(% All fin. Institutions)	(34.04)	(43.48)	(46.02)	(68.72)
% Clients	6.01	7.68	7.55	11.27
% Company	4.09	5.22	3.44	5.14
% SEPON	0.58	0.74	0.80	1.19
% Other	0.57	0.73	1.56	2.33
% Total identified	78.29	100.00	66.97	100.00

[1] Figures reported are unweighted averages of the ownership shares computed for each firm-year observation in the sample. Figures include all holdings above 0.25% of the firm's total equity reported

Table 2.4.b

UK firms' total shareholdings: by size of firm [1]

	Small firms		Large firms	
Shareholder category	Identified equity	% of total identified equity	Identified equity	% of total identified equity
% Individuals	18.63	51.81	3.05	20.82
% Pension funds	1.31	3.64	0.48	3.28
% Insurance companies	2.58	7.17	2.31	15.77
% Other fin. institutions	8.35	23.22	3.78	25.80
(% All fin. Institutions)	(12.24)	(34.04)	(6.39)	(43.62)
% Clients	2.15	5.98	2.18	14.88
% Company	2.73	7.59	2.80	19.11
% SEPON	0.07	0.19	0.07	0.48
% Other	0.14	0.39	0.16	1.09
% Total identified	35.96	100.00	14.65	100.00

[1] Figures reported are unweighted averages of the ownership shares computed for each firm-year observation in the sample. Figures include only holdings above 5% of the firm's total equity reported

Table 2.5

Frequency distribution of C1 and C5 for 264 firms (last year of observation) in UK sample

Range	C1		C5	
	Frequency	Cumulative percentage	Frequency	Cumulative percentage
0 - 4.99	29	11.0	0	0.0
5 - 9.99	103	50.0	1	0.4
10 - 14.99	53	70.1	14	5.7
15 - 19.99	30	81.4	34	18.6
20 - 24.99	19	88.6	33	31.1
25 - 29.99	15	94.3	34	43.9
30 - 34.99	3	95.5	32	56.1
35 - 39.99	1	95.8	30	67.4
40 - 44.99	1	96.2	25	76.9
45 - 49.99	1	96.6	20	84.5
50 - 54.99	2	97.4	7	87.1
55 - 59.99	0	97.4	11	91.3
60 - 64.99	0	97.4	6	93.6
65 - 69.99	4	98.9	2	94.3
70 - 74.99	0	98.9	3	95.5
75 - 79.99	2	99.6	4	97.0
80 - 84.99	1	100.0	5	98.9
85 - 89.99	0	100.0	3	100.0
90 - 94.99	0	100.0	0	100.0
95 - 100.00	0	100.0	0	100.0
Mean		14.08		35.34
Median		10.01		33.39
S.d.		12.75		16.95

Table 2.6

Frequency distribution of C1 and C5 for small and large firms in UK sample (cumulative percentage)

	C1		C5	
Range	Small firms	Large firms	Small firms	Large firms
0 - 4.99	2.3	19.7	0.0	0.0
5 - 9.99	31.8	68.2	0.0	0.8
10 - 14.99	59.8	80.3	0.0	11.4
15 - 19.99	78.0	84.8	3.0	34.1
20 - 24.99	88.6	88.6	10.6	51.5
25 - 29.99	95.5	93.2	22.7	65.2
30 - 34.99	97.0	93.9	36.4	75.8
35 - 39.99	97.7	93.9	52.3	82.6
40 - 44.99	98.5	93.9	66.7	87.1
45 - 49.99	98.5	94.7	78.8	90.2
50 - 54.99	99.2	95.5	84.1	90.2
55 - 59.99	99.2	95.5	90.2	92.4
60 - 64.99	99.2	95.5	93.2	93.9
65 - 69.99	99.2	98.5	93.9	94.7
70 - 74.99	99.2	98.5	95.5	95.5
75 - 79.99	100.0	98.5	97.0	97.0
80 - 84.99	100.0	100.0	98.5	99.2
85 - 89.99	100.0	100.0	100.0	100.0
90 - 94.99	100.0	100.0	100.0	100.0
95 - 100.00	100.0	100.0	100.0	100.0
Mean	15.37	12.80	41.47	29.22
Median	12.55	7.61	39.12	24.47
S.d.	9.49	15.27	14.63	16.94

Figure 2.1

Share ownership in UK company database (% of total identified equity)

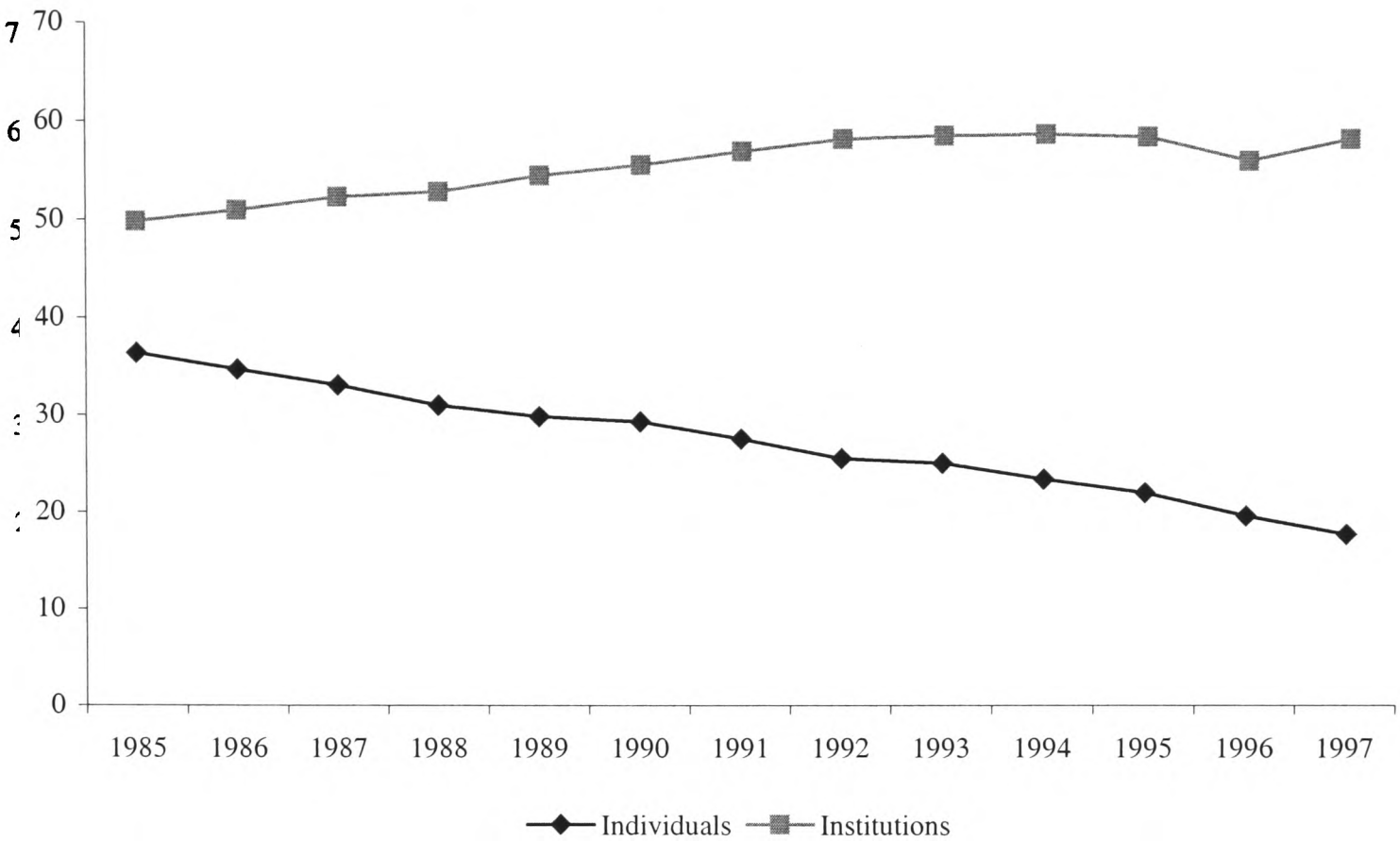
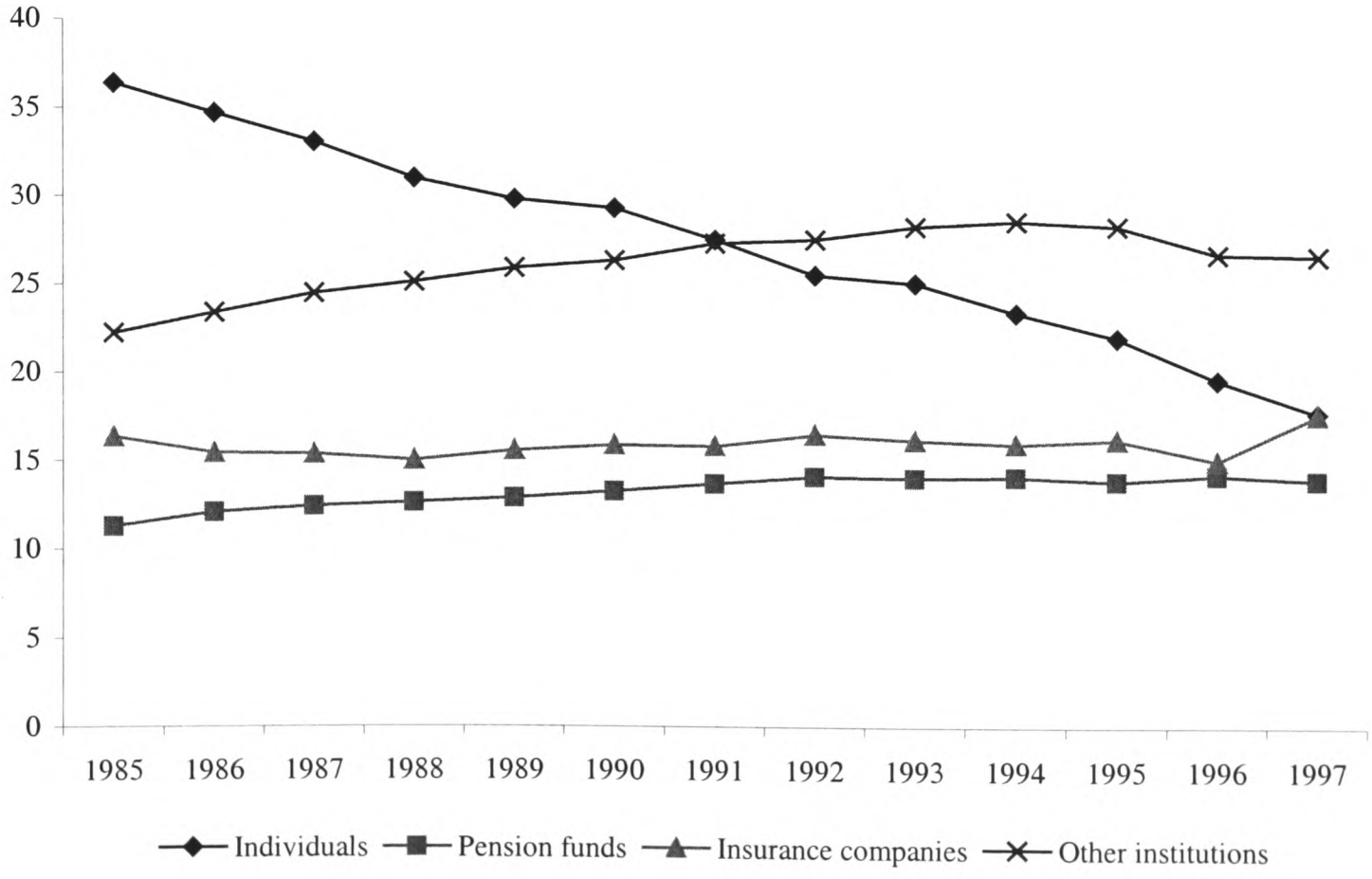


Figure 2.2

Share ownership in UK company database (% of total identified equity)



3. US data

This section describes the main data set of US firms. Three sub-sections describe the type of ownership information used; the sample of companies for which this was available; and the patterns of share ownership found for this sample.

3.1 US ownership data

To investigate whether ownership structure affects the relationship between company investment and internal finance, we have obtained data on ownership structure for a sample of 451 quoted US companies. The ownership data was downloaded free of charge from the "Edgar Online" web site (http://www.edgar-online.com). This contains Securities and Exchange Commission (SEC) filings for companies incorporated in the US and traded on at least one of the US stock exchanges. For the purpose of this study proxy statements filed by companies turned out to be the most convenient source of ownership information. Information disclosed in connection with general proxy solicitations is filed in Form DEF14A. This contains the basic information package for annual reports and additional information such as schedules detailing selected asset and liability accounts, management remuneration and transactions, and security ownership of directors, chief executives, and major shareholders. Major shareholders are beneficial owners of more than 5% of the outstanding voting stock of a company (less the treasury stock). Rule 13d-3 of the Securities Exchange Act of 1934 provides a clear definition of "beneficial owner". The first three provisions of the Rule are reported in Appendix D. Each 5% shareholding was initially allocated to one of the following ownership categories: individuals, non-financial companies, pension funds, insurance companies, other financial institutions (mainly including mutual funds) and other[6]. Due to the

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[6] The category of "other" shareholders includes universities, bank trusts, local authorities, and foreign government agencies.

US regulatory environment[7], with few exceptions pension funds and insurance companies do not hold 5% stakes. Thus all shareholdings of institutional investors have been allocated to the more general category of non-banking financial institutions. Since DEF14A filings provide information with respect to the beneficial ownership of outstanding stock by officers and directors, we also recorded both the name and holdings of all the officers and directors with holdings above 1% of the firm's outstanding voting stock, and the overall percentage of the firm's voting shares owned by officers and directors as a group.

3.2 US sample

We began with an unbalanced panel of 457 quoted US firms for which company accounts data for the period 1986 to 1997 had been obtained from Datastream International. This corresponded to the sample of US firms that was used for the empirical analysis in Chapter 6. These data were matched with ownership information drawn from the "Edgar Online" web site. For each company data on beneficial ownership was taken from the proxy statements filed in the last year of observation, rather than in the first year. This is because filings in electronic format are generally unavailable for years prior to 1990. Wherever DEF14A filings were not available in the last year of observation, beneficial ownership was obtained from proxy statements filed in the preceding years. We downloaded only one single DEF14A filing per company, as it was not possible to collect more information "by hand", due to the relatively high number of observations and beneficial owners per firm.

Proxy statements have been collected for 451 companies. In 396 of these companies there is at least one beneficial owner holding above 5% of the firm's total outstanding voting stock. In 55 of the companies there is no 5% beneficial owner. This means that for 12% of the

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[7] See Chapter 3, Section 6.

companies sampled the largest single shareholder owns less than 5% of the firm's total equity. Table 3.1 and 3.2 report the number of observations per company and the number of companies per year both for the sample of 451 firms and the sample of 396 firms with 5% beneficial ownership information[8].

3.3 US ownership patterns

The distribution of beneficial share ownership between the different categories of shareholders is shown in Table 3.3 for the sample of 396 companies that have one or more beneficial owners of at least 5% of the firm's outstanding common stock. The first column shows the average proportion of the total equity of the sample companies that is owned by each group of 5% beneficial owners, whilst the second column shows each group's average share of the equity for which we have identified 5% beneficial ownership information. The third column presents similar information to the first column, the only difference being that in the third column managerial and individual ownership includes overall security ownership by officers and directors.

On average, identified beneficial ownership information corresponds to 29.4% of the total equity for these US companies (Table 3.3). This is a much lower figure than for the sample of UK firms, for which information is available on 72.4% of the firm's total equity (Table 2.3). This difference between the US and the UK sample reflects the fact that in the former information is limited to beneficial owners of more than 5% of the firm's outstanding common stock. If information available for the sample of UK firms were limited to 5% stakes, the average proportion of the total equity for the UK companies owned by identified beneficial owners would be equal to 25.1% (see third column of Table 2.3).

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[8] For the sample of US firms used in this chapter we need not check for the presence of observations that contain substantial outliers. These were excluded when constructing the larger sample of 457 firms in Chapter 6.

On average, financial institutions own at least 14.8% of the total equity, or 50.3% of the total identified equity [Table 3.3, columns (i) and (ii)]. These figures mainly reflect mutual funds' shareholdings, as pension funds and insurance companies generally hold shares in blocks smaller than 5%. If ownership information is limited to 5% beneficial owners, the category of individuals on average owns 7.5% of the total equity, or 25.4% of the total identified equity. If we also take into account managerial holdings below 5% of the firm's total equity, the average proportion of the total equity owned by individuals is equal to 11.3%.

Table 3.4 divides the sample of 396 US companies into two groups by firm size, defining large firms to be those with an above median level of employment in the first year of observation[9]. This reveals a number of interesting differences between the ownership structures of larger firms and smaller firms. Share ownership appears to be more concentrated for the sample of smaller firms, with 5% beneficial owners accounting for 32.8% of the total equity on average, compared to only 26% for the sample of larger companies[10]. Moreover, the average proportion of the total identified equity owned by 5% individuals is found to be much greater in smaller firms (32.3%) than in larger firms (16.8%). On the other hand, the average proportion owned by financial institutions is found to be greater in larger firms (57.3%) than in smaller firms (44.7%).

Table 3.5 presents simple measures of ownership concentration. The measures used are the proportion of the firm's total equity owned by the largest shareholder (C1) and the proportion of the firm's total equity owned by the largest five shareholders (C5). These measures of ownership concentration are based on the sample of 396 companies that have one or more beneficial owners of at least 5% of the firm's outstanding common stock. For 35.9%

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[9] The median number of employees in the first year of observation is 6,700 for this US sample.

[10] These figures are similar to those recorded for the sample of UK firms, where 5% shareholders own on average 36% of the total equity in the smaller firms, and only 15% in the larger firms (Table 2.4.b).

of these companies, the largest shareholder owns less than 10% of the firm. Only 19.7% of these firms have a single shareholder that owns more than 20% of the equity, and only 4.8% have a majority shareholder[11]. The mean of the largest block is 17.2%, and the median is 11.5%. For the second largest block the median is 7%. The mean and the median of C5 are 29.3% and 25.4%, respectively. This evidence of highly dispersed ownership of quoted US companies is consistent with previous studies[12].

Table 3.6 shows the distribution of these ownership concentration measures separately for the larger and smaller firms (with at least one 5% beneficial owner). Similarly to the UK, a concentrated ownership structure is more common amongst the smaller companies, whereas a dispersed ownership structure is more common amongst the larger companies, where institutional ownership is also more significant. For example, the largest five 5% beneficial owners control more than 20% of the equity in about 70% of our small firms, but in only 60% of our large firms. Likewise, the largest shareholder owns at least 10% of the equity in 69% of our small firms, but in only 59% of our large firms[13].

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[11] If we also take into account companies with no 5% beneficial owners, for 43.7% of the 451 companies in the US sample the largest shareholder owns less than 10% of the firm. Only 17.3% of these firms have a single shareholder that owns more than 20% of the equity, and only 4.5% have a majority shareholder.

[12] See Demsetz and Lehn (1985) and Becht (1997).

[13] If we also take into account companies with no 5% beneficial owners, the largest shareholder owns at least 10% of the equity in two-thirds of our small firms, but in only 47% of our large firms.

Table 3.1.a

Structure of the US sample by number of observations per company (451 firms)

Annual observations	4	5	6	7	8	9	10	11	12
Number of companies	23	21	25	19	9	16	22	24	292

Table 3.1.b

Structure of the US sample by number of observations per company (396 firms)

Annual observations	4	5	6	7	8	9	10	11	12
Number of companies	23	19	23	15	7	15	21	22	251

Table 3.2.a

Structure of the US sample by number of companies per year (451 firms)

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Number of companies	317	337	355	366	378	393	413	427	441	432	418	407

Table 3.2.b

Structure of the US sample by number of companies per year (396 firms)

Year	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Number of companies	274	292	309	318	328	341	361	374	388	379	366	355

Table 3.3

US firms' total shareholdings: by category of holder [1] (396 firms)

Shareholder category	Identified equity [2]	% of total identified equity [2]	Identified equity [3]	% of total identified equity [3]
% Individuals	7.48	25.44	11.29	34.01
(% Management)	(5.70)	(19.39)	(9.84)	(29.64)
% Financial institutions	14.79	50.31	14.79	44.55
% Company	4.39	14.93	4.39	13.22
% Other	2.74	9.32	2.74	8.25
% Total identified	29.40	100.00	33.20	100.00

[1] Figures reported are unweighted averages of the ownership shares computed for each firm in the sample
[2] Figures include only holdings above 5% of the firm's total equity reported
[3] Figures include holdings by officers and directors below 5% of the firm's total equity

Table 3.4

US firms' total shareholdings: by size of firm [1] (396 firms)

	Small firms		Large firms	
Shareholder category	Identified equity [2]	% of total identified equity [2]	Identified equity [2]	% of total identified equity [2]
% Individuals	10.60	32.29	4.37	16.83
(% Management)	(7.98)	(24.31)	(3.41)	(13.13)
% Financial institutions	14.69	44.75	14.89	57.33
% Company	6.11	18.61	2.68	10.32
% Other	1.43	4.36	4.03	15.52
% Total identified	32.83	100.00	25.97	100.00

[1] Figures reported are unweighted averages of the ownership shares computed for each firm in the sample
[2] Figures include only holdings above 5% of the firm's total equity reported

Table 3.5

Frequency distribution of C1 and C5 for 396 firms (with at least one 5% beneficial owner) in US sample

Range	C1		C5	
	Frequency	Cumulative percentage	Frequency	Cumulative percentage
0 - 4.99	-	-	-	-
5 - 9.99	142	35.9	38	9.6
10 - 14.99	133	69.4	52	22.7
15 - 19.99	43	80.3	50	35.4
20 - 24.99	12	83.3	75	54.3
25 - 29.99	12	86.4	66	71.0
30 - 34.99	15	90.2	30	78.5
35 - 39.99	4	91.2	19	83.3
40 - 44.99	4	92.2	13	86.6
45 - 49.99	6	93.7	12	89.6
50 - 54.99	6	95.2	9	91.9
55 - 59.99	4	96.2	8	93.9
60 - 64.99	4	97.2	3	94.7
65 - 69.99	2	97.7	5	96.0
70 - 74.99	1	98.0	2	96.5
75 - 79.99	2	98.5	3	97.2
80 - 84.99	4	99.5	6	98.7
85 - 89.99	0	99.5	2	99.2
90 - 94.99	2	100.0	2	99.7
95 - 100.00	0	100.0	1	100.0
Mean		17.18		29.29
Median		11.46		25.41
S.d.		15.71		18.41

Table 3.6

Frequency distribution of C1 and C5 for small and large firms (with at least one 5% beneficial owner) in US sample (cumulative percentage)

	C1		C5	
Range	Small firms	Large firms	Small firms	Large firms
0 - 4.99	-	-	-	-
5 - 9.99	30.8	40.9	4.5	14.6
10 - 14.99	64.6	74.2	16.7	28.8
15 - 19.99	73.2	87.4	30.3	39.4
20 - 24.99	77.3	89.4	42.4	55.6
25 - 29.99	81.3	91.4	57.6	67.2
30 - 34.99	86.4	93.9	66.2	77.8
35 - 39.99	86.9	95.5	71.2	82.8
40 - 44.99	88.4	96.0	79.8	87.4
45 - 49.99	89.4	98.0	82.3	92.9
50 - 54.99	91.9	98.5	83.8	96.0
55 - 59.99	93.9	98.5	86.9	97.5
60 - 64.99	96.0	98.5	90.4	97.5
65 - 69.99	97.0	98.5	93.4	97.5
70 - 74.99	97.5	98.5	95.5	97.5
75 - 79.99	98.0	99.0	96.0	98.5
80 - 84.99	99.5	99.5	98.5	99.0
85 - 89.99	99.5	99.5	99.0	99.5
90 - 94.99	100.0	100.0	99.5	100.0
95 - 100.00	100.0	100.0	100.0	100.0
Mean	18.68	13.79	31.11	25.17
Median	12.00	10.70	26.40	21.95
S.d.	16.17	10.95	18.82	15.45

4. UK investment regressions

We begin our empirical investigation by reporting in Table 4.1 the results of estimating an error correction model of fixed investment of the form outlined in equation (3.8), Chapter 2:

$$\frac{I_{it}}{K_{i,t-1}} = \omega_1\left(\frac{I_{i,t-1}}{K_{i,t-2}}\right) + \omega_2\Delta y_{it} + \omega_3\Delta y_{i,t-1} + \omega_4\left(k_{i,t-2} - y_{i,t-2}\right) +$$

$$+ \omega_5 y_{i,t-2} + \omega_6\left(\frac{C_{it}}{K_{i,t-1}}\right) + d_t + \eta_i + \nu_{it}$$

We present results from four different estimators: OLS levels, Within Groups, GMM first differences (GMMDIF), and GMM system[14] (GMMSYS). OLS levels does not control for the possibility of unobserved firm-specific effects and may result in upward-biased estimates of the autoregressive coefficients if firm-specific effects are important. Within Groups is OLS after transforming the data to deviations from the means; this eliminates the firm-specific effects, but may result in downward-biased estimates of the autoregressive coefficients in panels with a small number of time periods.

An alternative way to remove firm-specific effects consists in using a first-differenced GMM estimator. GMM first differences eliminates the firm-specific effects by differencing the equations, and then uses lagged values of the right-hand side variables as instruments. If the error term is serially uncorrelated, then the error term in first differences is MA(1), and instruments dated t-2 and earlier should be valid in the differenced equations. This appears to be the case in the one-step GMMDIF estimation in Table 4.1, column (iii). Both the Sargan test of the over-identifying restrictions and the test of second-order serial correlation in the residuals do not reject the validity of the instrument set that includes all-right hand side

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[14] For a discussion of the main characteristics of these estimators, refer to Chapter 2, Section 4.

variables (except the output term $y_{i,t-2}$) dated t-2 and t-3[15,16]. However, the GMMDIF coefficient estimates of the lagged dependent variable, the error correction term, and the lagged output term are similar to the corresponding Within Groups estimates. This suggests that the GMMDIF estimates of the autoregressive coefficients may be downward-biased. This may be due to weak instruments, because of the relatively small number of time periods.

To reduce the small sample bias that characterises the GMMDIF estimator when the instruments available are weak, we estimate the error correction model of investment by using the system GMM estimator proposed by Arellano and Bover (1995). Column (iv) of Table 4.1 presents the results for the one-step GMMSYS estimator that uses differences of the dependent variable and the sales growth term dated t-1 as instruments for the equations in levels, in addition to levels of all right-hand side variables dated from t-2 to t-3 as instruments for the equations in first differences. The Sargan difference test between the GMMSYS estimator and the GMMDIF estimator does not reject the validity of the extra moment conditions exploited by the system estimator [$\chi^2(20)=17.72$, p=0.606].

On the whole, the system estimator gives more reasonable results than the first-differenced estimator. The sum of the estimated autoregressive coefficients is significantly higher than the sum from the Within-Groups estimator, and the coefficients on the sales growth and the cash flow terms are significant and more precise. Hence, the regression results from the system estimator are our preferred results, and from now on we focus on the GMMSYS estimates to analyse the effects from ownership structure on UK company investment.

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[15] Moreover, a Sargan difference test between instruments dated from t-2 to t-3 and instruments dated t-3 did not reject the validity of the instruments dated t-2 [$\chi^2(40)=49.32$, p=0.148].

[16] Due to the relatively low number of observations available, the instrumental variables are dated only to t-3. Using further lags of the right-hand side variables as instruments leaves the coefficient estimates substantially unchanged, but reduces the power of the tests of overidentifying restrictions.

Before proceeding to investigate the relationship between ownership structure and investment-cash flow sensitivity, in Table 4.2 we present different specifications of the error correction model. Since the system estimator does not reject the assumption of constant returns to scale, we impose the unit restriction on the long-run elasticity and drop the lagged output term. Column (i) presents an error correction model augmented with both current and lagged cash flow. The cash flow terms are positive and jointly significant[17]. Since current cash flow appears to have a relatively greater impact on investment spending than lagged cash flow, the empirical analysis will focus for simplicity on an error correction specification augmented only with current cash flow. The regression results for this specification are reported in Table 4.2, column (ii).

As in Section 3 of Chapter 6, the econometric evidence for the full sample of firms suggests that in the UK financial variables have a significant impact on company investment behaviour. In Table 4.2 we also investigate whether this impact changes with firm size. Column (iii) presents estimates for the sample of firms with below median employment. Estimates for the sample with above median employment are presented in column (iv). The cash flow effect is statistically significant only in the equation for the sample of large firms (t=2.28), although the difference in the cash flow coefficients across the two samples is insignificant (t=0.62). Since ownership structure appears to be closely related to firm size, tests were carried out to check that ownership structure effects do not simply reflect differential firm size effects on company investment. The results of these tests are presented at the end of this section.

We now turn to investigate whether ownership structure has any impact on the sensitivity of investment spending to the availability of internal finance. The impact of institutional equity ownership is shown in Table 4.3. Column (iv) reports GMMSYS estimates of an error

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[17] The Wald test of the hypothesis that current and lagged cash flow are jointly zero has a p-value of 0.4%.

correction model of investment for the full sample of UK firms, where coefficient on the cash flow term is allowed to vary across observations according to the level of total observed institutional ownership. To do this, the cash flow variable is interacted with two distinct dummy variables, identified by the indicator function $I[U_{it}]$, which are equal to one when the conditions in brackets are met, and zero otherwise. $U_{it}=0$ identifies observations where the level of institutional ownership is below the median value, and $U_{it}=1$ observations where the level of institutional ownership is above the median value[18]. The regression results in column (iv) are obtained by using an instrument set that also includes interactions of the cash flow variable with the dummy variables that indicate total institutional ownership. This implicitly assumes that ownership structure is uncorrelated with the unobserved firm-specific effects. Moreover, this specification imposes common coefficients on the non-cash flow variables across the two samples of observations with high and low total institutional ownership.

To check for the validity of this restriction, we estimated an error correction model for these two samples and the coefficient differences across them. Table 4.3, column (i), presents the coefficient estimates for the sample of observations with an above median level of institutional ownership. Column (ii) presents the coefficient estimates for the sample of observations with a below median level of institutional ownership[19]. Column (iii) reports the differences of the estimated coefficients across the two samples, which are generally not

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[18] The median value for the average share of total observed institutional ownership over the period 1985 to 1997 is 40%.

[19] Since a time-varying sample splitting criterion is adopted in this section, it is not possible to estimate separately investment equations for the two sub-samples. This explains why the diagnostics are not reported in columns (i) and (ii) of Table 4.3. The regression results in columns (i) and (ii), Table 4.3, are obtained by interacting the ownership dummies with all right-hand side variables and then estimating the error correction model for the full sample of firms. Lagged values of these interactions are included in the instrument set. The coefficient estimates of the terms interacted with the dummy that is one when the institutional ownership is above (below) the median are reported in column (i) [column (ii)]. The diagnostics of this estimation coincide with the diagnostics reported in column (iii), Table 4.3.

significant. In addition, a Wald test of joint significance of the differences amongst the non-cash flow coefficients does not reject the validity of the restriction of common coefficients for the non-cash flow variables across samples (p=95.2%).

The coefficient estimates of the cash flow terms in column (iv), Table 4.3, suggest that the level of total institutional ownership positively affects the cash flow sensitivity of investment. A significant effect from cash flow is found both for the observations where the level of institutional ownership is above the median (t=3.29) and for the observations with a below median level of institutional ownership (t=2.11). Although the point estimate of the cash flow coefficient is higher for the observations with an above median level of total institutional ownership, the difference in the cash flow coefficients between observations with a high and low level of institutional ownership is not significant at the conventional 5% level (t=1.35).

The investment regressions in Table 4.3, column (i) to (iv), provide some weak evidence that ownership structure affects investment expenditure. These results, however, implicitly assume that ownership structure is exogenous. Indeed, by including interactions with total institutional ownership in the instrument set for the levels equations in the system estimator, it is implicitly assumed that ownership structure is not correlated with the unobserved firm-specific effects.

To control for the possibility that ownership structure is endogenously determined, Table 4.3, column (v), presents GMMSYS estimates obtained using an instrument set that includes no interactions of cash flow with the dummy variables that indicate total institutional ownership. Under this specification, cash flow appears to have a similar impact on investment spending, regardless of whether the level of total institutional ownership is high or low. The cash flow effect is positive and weakly significant in both cases (t=1.74 and t=1.60, respectively), and the difference in the cash flow coefficients statistically insignificant (t=0.50). This evidence suggests that inferences based on the assumption that ownership

structure is uncorrelated with the firm-specific effects can lead to a misinterpretation of the regression results from the system GMM estimator.

The diagnostics also bring into question the validity of the assumption that ownership structure is uncorrelated with the firm-specific effects. The Sargan difference test between the estimates in column (v) and the estimates in column (iv) provides some (weak) evidence that the interactions of the cash flow variable with the institutional ownership dummy variables are not valid instruments [$\chi^2(19)=28.06$, $p=0.082$]. These findings suggest that endogeneity of the ownership structure can significantly affect the inferences one can draw regarding the relationship among ownership structure, investment, and internal finance. Therefore, in the following we will control for endogeneity of the ownership structure and present only GMMSYS regression results obtained using an instrument set that includes no interactions of any of the right-hand side variables with the ownership dummy variables.

Table 4.4, columns (i) to (iii), addresses the effects of different categories of institutional shareholders on the cash flow sensitivity of investment. In each column we report the GMMSYS regression results of estimating the error correction model for the full sample of UK firms, and allow the coefficients on the cash flow term to vary across observations according to whether the proportion of the firm's equity held by a particular type of institution is above or below the median level of ownership for that category of institutional owners. In column (i) we investigate the effect from high ($U_{it}=1$) and low ($U_{it}=0$) pension funds' total observed shareholdings[20]. The point estimates and the standard errors on the coefficient estimates of the cash flow terms are very similar regardless of whether pension fund ownership is high or low, thus indicating that pension funds' total shareholdings have no effect on the sensitivity of investment to cash flow.

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[20] The median value for the average share of total observed pension fund ownership over the period 1985 to 1997 is 9.04%.

Column (ii), Table 4.4, reports separate cash flow coefficients for observations with an above median (U_{it}=1) and a below median (U_{it}=0) level of insurance company ownership[21]. While statistically insignificant for observations with a low level of insurance company ownership, the estimated cash flow coefficient is highly significant (t=3.61) for observations with a high level of insurance company ownership. The difference between the cash flow coefficients estimated for the two sub-samples of observations with high and low insurance company ownership is also significant at a 5% confidence level (t=2.46).

Finally, column (iii), Table 4.4, presents separate cash flow coefficients for observations with an above median (U_{it}=1) and a below median (U_{it}=0) level of total observed other institutional ownership[22]. The estimated cash flow coefficient is positive and significant (t=1.95) for the sample of observations where other institutions' total shareholdings are high, and its point estimate higher than that for observations with low other institutional ownership, although the difference in these coefficients across samples is statistically insignificant (t=0.65).

The main finding from the regression results in Table 4.4, columns (i) to (iii), is that an increase in the level of total insurance company ownership increases the cash flow sensitivity of investment spending. However, there is no evidence of a strong positive relationship between pension fund and other institutional ownership and the investment-cash flow sensitivity. It is interesting to relate this finding of a stronger cash flow effect from ownership by insurance companies with evidence in Bond and Chennels (2000) of a particularly strong relationship between dividend pay-out ratios and the level of insurance company ownership for this sample of UK firms. The high level of dividends induced by high insurance company ownership reduces the firms' internal net worth and increases reliance on (uncollateralised)

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[21] The median value for the average share of total observed insurance company ownership is 10.75%.

[22] The median value for the average share of total observed other institutional ownership is 16.62%.

external sources of investment finance. If financial market imperfections were important, this would reduce investment spending, all else being equal.

In Table 4.4, column (iv), we investigate whether there is a significant effect on company investment behaviour from the observed proportion of equity owned directly by individual shareholders. The sensitivity of investment to cash flow appears to be negatively related to the observed proportion of individual ownership. The estimated cash flow coefficient is statistically significant only for the observations with a below median level of total observed individual ownership (t=3.22). This appears to be significantly greater than the cash flow coefficient for the observations with an above median level of individual ownership. In Table 4.4, column (v), we also present evidence on the effect on corporate investment from the observed proportion of equity owned by both individual shareholders and non-financial companies. Again the point estimate of the cash flow coefficient is greater for the observations where individual and non-financial company ownership is below the median level. In this case, however, the coefficient estimates of the cash flow terms are rather imprecise, and the difference in the cash flow coefficients across these sub-samples is statistically insignificant (t=0.83).

Table 4.5 investigates whether ownership concentration affects the relationship between investment and cash flow. Column (i) presents regression results for the full sample of firms, where the cash flow coefficient is allowed to vary across observations according to whether the proportion of the firm's equity owned by the largest shareholder is above (O_{it}=1) or below (O_{it}=0) the median level of equity held by the largest shareholder[23]. The estimated coefficient on the cash flow term is positive and significant in both cases. The point estimate is higher for the observations where ownership is less concentrated, but the coefficient difference across these two sub-samples is clearly insignificant. Column (ii) presents separate cash flow

[23] The median value for the proportion of the firm's equity owned by the largest shareholder is 9.83%.

coefficients for the observations where the proportion of equity owned by the largest shareholder is greater than 13.6% (O_{it}=1), and the observations where this proportion is lower than 13.6% (O_{it}=0). The former (latter) group of observations comprises one-third (two-thirds) of the total observations for this sample of UK firms. Evidence of a significant relationship between investment and cash flow is found for observations where ownership is dispersed (t=3.06), but not for observations where ownership is concentrated (t=0.58). The cash flow coefficient difference across observations is, however, only marginally significant (t=1.55).

In columns (iii) and (iv) of Table 4.5 the proportion of the firm's equity owned by the largest three shareholders is taken as a measure of ownership concentration. Column (iii) presents regression results for the full sample of firms, where the cash flow coefficient is allowed to vary across observations according to whether the proportion of the equity owned by the largest three shareholders is above (O_{it}=1) or below (O_{it}=0) the median level of equity held by the largest three shareholders[24]. Column (iv) presents separate cash flow coefficients for the observations where the proportion of equity owned by the largest three shareholder is greater than 28.25% (O_{it}=1), and the observations where this proportion is lower than 28.25% (O_{it}=0). The former (latter) group of observations again comprises one-third (two-thirds) of the total observations. Both in column (iii) and column (iv) the estimated cash flow coefficient is positive and significant only for the observations where the largest three shareholders own a small proportion of the firm's total equity (O_{it}=0). In column (iv) the difference in the cash flow coefficients between observations with concentrated and dispersed ownership is statistically significant (t=1.95).

The finding that ownership concentration reduces investment sensitivity to cash flow reflects evidence in Bond and Chennels (2000) that firms with a more concentrated ownership structure tend to have a lower dividend pay-out ratio. This is also consistent with the

[24] The median value for the proportion of the firm's equity owned by the largest three shareholders is 22.07%.

predictions of the agency cost theories of dividend behaviour. Since large shareholders have a greater incentive to monitor the company's performance, they do not require high dividend pay-out ratios as a substitute for active monitoring of management performance. In turn, since a relatively low level of dividends allows a greater availability of internal funds, firms are less likely to rely on external sources of investment finance. Therefore, they are less likely to face binding financial constraints on investment if capital market imperfections are important.

In the analysis of the relationship between ownership concentration and investment-cash flow sensitivity reported in Table 4.5 all the measures of ownership concentration were based on the proportion of the firm's equity owned by the largest shareholders. No attempt was made to investigate whether the identity of the largest shareholders has any effect on the relationship between investment and cash flow. Table 4.6 explores this possibility. In column (i) we separate cash flow coefficients across observations where: a) the largest shareholder is an *individual* (I_{it}=1) and owns a block of shares that is *above* the median proportion of equity held by the largest shareholder (O_{it}=1), b) the largest shareholder is *not* an *individual* (I_{it}=0) and owns a block of shares that is *above* the median proportion of equity held by the largest shareholder (O_{it}=1), c) the largest shareholder owns a block of shares that is *below* the median proportion of equity held by the largest shareholder[25] (O_{it}=0). Column (ii) reports the differences in the cash flow coefficients between observations where ownership is concentrated and the largest shareholder is an individual, and observations where a) ownership is concentrated and the largest shareholder is not an individual, and b) ownership is dispersed. The same exercise is repeated in columns (iii) and (iv), where the category *individual* for the largest shareholder is replaced by the category *institutional investor.*

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[25] For simplicity, no distinction between different categories of beneficial ownership is made for the observations where the proportion of the firm's equity owned by the largest shareholder is below the median value. This is because when ownership is dispersed the largest shareholder is likely to have a minor impact on managers' behaviour and the firm's performance, whatever his characteristics may be.

In column (i), Table 4.6, no cash flow effect is found for the observations where ownership is concentrated and the largest shareholder is an individual. On the other hand, the cash flow coefficient is positive and significant both for the observations where ownership is concentrated and the largest shareholder is not an individual (t=2.63) and for the observations where ownership is dispersed (t=2.41). In column (ii) also these differences in the cash flow coefficients appear to be (weakly) significant (t=1.72 and t=1.85, respectively). In column (iii), Table 4.6, the cash flow term is statistically significant for the observations where the largest shareholder is an institutional investor and ownership is concentrated (t=2.66), but not for the observations where ownership is concentrated and the largest investor is not an institution (t=1.15). This difference in the cash flow terms across observations with concentrated ownership is again (weakly) significant (t=1.62).

The regression results in Table 4.6 suggest that the characteristics of the main shareholder can affect the firm's investment behaviour, provided that this shareholder owns a relatively large proportion of the firm's equity. In particular, investment spending appears to be unrelated to the availability of internal finance when the largest shareholder is an individual who owns a substantial proportion of the total equity. Following this, in Table 4.7, column (i), we compare the cash flow effect for observations where ownership is concentrated and the largest shareholder is an individual with the cash flow effect for the remaining observations. The cash flow term is highly significant (t=2.99) only for the observations where either ownership is dispersed or the largest shareholder is not an individual. Moreover, this difference in the cash flow coefficients across observations with different ownership structure is statistically significant (t=1.90).

Overall, this set of results provides evidence of a significant relationship between ownership structure and the sensitivity of investment to the availability of internal funds. Cash flow appears to have no impact on the investment expenditures by firms where an individual shareholder exercises control. On the other hand, there appears to be a significant relationship

between investment and cash flow both when ownership is dispersed and when a financial institution owns a significant proportion of the firm's equity.

As noted before, ownership structure is closely related to firm size. The level of institutional ownership is higher and ownership structures are less concentrated for larger firms. Since the coefficient estimate of the cash flow term appears to be greater for larger firms [see Table 4.2, column (iv)], this poses the question of whether ownership structure effects do not simply proxy for differential firm size effects, rather than reflecting a truly causal influence on company investment behaviour. To check for this possibility, Table 4.8 includes additional interactions between the cash flow variable and a firm size indicator to some of the previous specifications where differences in the investment-cash flow sensitivity were found to be the most interesting. Large firms are defined as having employment more than the sample median (1,300 employees) in the initial year of observation. From the results in column (i), Table 4.8, it is clear that differences in the cash flow coefficients across observations with high and low total institutional ownership (see Table 4.3) reflect differential size. The coefficient estimate of the cash flow interaction with size appears to be statistically significant (t=2.23). On the other hand, the cash flow interaction with total institutional ownership is uninformative, once firm size effects are accounted for.

Column (ii), Table 4.8, presents results for observations split according to the level of insurance company ownership. The estimated coefficient of the cash flow interaction with size is relatively high but imprecise (t=0.88). However, the estimated coefficient on the cash flow term interacted with insurance company ownership is higher and statistically significant (t=1.92) even after controlling for firm size effects.

Table 4.8, column (iii), separates the effects of total individual ownership and firm size on company investment. The estimated coefficients of the cash flow interactions with both size and individual ownership have similar but insignificant point estimates. The two estimated coefficients are, however, jointly significant (p=0.063). This suggests that a significant cash

flow effect on investment is associated either with a low level of individual ownership or with large firm size, but our test is unable to discriminate between these two possibilities. This mainly reflects the fact that most observations in the two sub-samples are overlapping, that is, 82.3% of observations in the sample of firms with a low level of individual ownership are also included in the sample of large firms.

Finally, the cash flow interactions in column (iv) of Table 4.8 indicate that the strong cash flow effect estimated for observations where ownership is dispersed, or where ownership is concentrated but the largest shareholder is not an individual [see column (i), Table 4.7], cannot be explained away as simply reflecting firm size effects. Although 95.5% of the observations in the sample of larger firms present either dispersed ownership or a largest shareholder that is not an individual, the cash flow interaction with size is insignificant (t=1.44), whereas the ownership interaction remains significant (t=2.06). Overall, although differential firm size may explain part of the relationship between ownership structure and company investment behaviour, the regression results in columns (ii) and (iv) of Table 4.8 provide evidence of a significant impact from ownership structure[26]. This increases the confidence with which we can conclude that the estimated effects of ownership structure reflect a causal influence on the sensitivity of investment to the availability of internal finance.

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[26] In an econometric analysis similar to that in Table 4.8, we also investigated whether a significant cash flow effect on investment spending is more likely to be found when total insurance company ownership is high or, alternatively, when ownership is dispersed or ownership is concentrated and the largest shareholder is not an individual. Due to the high number of overlapping observations across the two sub-samples of observations with these characteristics (ownership is dispersed or the largest shareholder is not an individual in 93.4% of the observations with an above median level of total insurance company ownership) we were not able to discriminate between these two possibilities. The estimated coefficients of the cash flow interactions with the two ownership measures were jointly significant (p=0.009), but individually insignificant (t=1.44 and t=1.23, respectively).

Table 4.1

Error correction model: sample of UK firms with ownership information

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	OLS	Within Groups	GMMDIF	GMMSYS
I_{t-1}/K_{t-2}	0.1085	-0.2578	-0.3073	-0.0899
	(.0303)	(.0367)	(.0811)	(.0561)
Δy_t	0.2836	0.2792	0.1865	0.1935
	(.0330)	(.0362)	(.1003)	(.0906)
Δy_{t-1}	0.0428	0.1180	0.0914	0.1404
	(.0223)	(.0262)	(.0787)	(.0609)
$(k-y)_{t-2}$	-0.0117	-0.3506	-0.4129	-0.1198
	(.0057)	(.0277)	(.0862)	(.0541)
y_{t-2}	0.0008	-0.1877	-0.2994	0.0166
	(.0015)	(.0221)	(.0887)	(.0209)
C_t/K_{t-1}	0.1412	0.1243	0.0027	0.2528
	(.0381)	(.0458)	(.1077)	(.1114)
No. Firms	264	264	264	264
Obs.	1823	1559	1559	1559
Df	1806	1543	1543	1542
sc_1	-2.257 [264]	-7.733 [235]	-6.525 [235]	-8.085 [235]
sc_2	2.446 [235]	0.434 [207]	0.093 [207]	-0.540 [207]
z_1[6]	271.93	357.56	79.32	36.36
z_2[10]	115.51	79.69	27.98	27.63
Sargan	-	-	74.15 [71]	91.87 [91]
			p=0.376	p=0.455

GMMDIF estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iii) are I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in column (iv) are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1988-1997. Time dummies are included as regressors in all equations. Asymptotic standard errors are reported in parenthesis. Standard errors and test statistics are robust to general time-series and cross-section heteroskedasticity. sc_i is a test for serial correlation of order i in the first-differenced residuals [except column (i)], asymptotically standard normal. z_1 is a test of the joint significance of the reported coefficients, while z_2 is a test of the joint significance of the time dummies, asymptotically distributed as χ^2[df] under the null. Sargan is a test of the overidentifying restrictions, asymptotically distributed as χ^2[df] under the null of validity (see Sargan, 1958). All estimations carried out using Arellano and Bond (1988) DPD97 package one-step results (two-step Sargan test).

Table 4.2

Error correction model: sample of UK firms with ownership information

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	Full sample	Full sample	Small firms	Large firms
I_{t-1}/K_{t-2}	-0.1271	-0.0869	-0.0556	-0.1957
	(.0579)	(.0540)	(.0839)	(.0655)
Δy_t	0.1880	0.1784	0.0887	0.3586
	(.0863)	(.0844)	(.1053)	(.0908)
Δy_{t-1}	0.0905	0.1171	0.1614	0.0971
	(.0536)	(.0548)	(.0710)	(.0640)
$(k-y)_{t-2}$	-0.0830	-0.1094	-0.1499	-0.0808
	(.0491)	(.0495)	(.0673)	(.0432)
C_t/K_{t-1}	0.2455	0.2431	0.1743	0.2845
	(.1553)	(.1098)	(.1282)	(.1248)
C_{t-1}/K_{t-2}	0.1091	-	-	-
	(.1529)			
No. Firms	264	264	132	132
Obs.	1559	1559	743	816
Df	1542	1543	727	800
sc_1	-8.247 [235]	-8.153 [235]	-5.646 [113]	-6.546 [122]
sc_2	-0.759 [207]	-0.620 [207]	-2.034 [99]	-0.283 [108]
z_1	43.01 [6]	37.37 [5]	21.14 [5]	39.70 [5]
z_2	24.79 [10]	27.78 [10]	20.16 [10]	37.05 [10]
Sargan	92.29 [91]	96.31 [92]	87.54 [92]	93.24 [92]
	p=0.443	p=0.359	p=0.612	p=0.444
Wald	10.88 [2]	-	-	-
(cash flow terms)	p=0.004			

Small firms are firms with below median employment in the initial year of observation.
Large firms are firms with above median employment in the initial year of observation.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1987-1997. Wald is a test of joint significance of the coefficients on the cash flow terms asymptotically distributed as χ^2[df] under the null. See also notes for Table 4.1.

Table 4.3

I_t/K_{t-1}	(i) High total institutional ownership	(ii) Low total institutional ownership	(iii) Differences	(iv) Full sample	(v) Full sample
I_{t-1}/K_{t-2}	-0.1112 (.0547)	-0.0912 (.0633)	0.0200 (.0663)	-0.0880 (.0545)	-0.0887 (.0549)
Δy_t	0.0990 (.1077)	0.1661 (.0861)	0.0671 (.1300)	0.1154 (.0828)	0.1661 (.0850)
Δy_{t-1}	0.1352 (.0661)	0.1273 (.0669)	-0.0078 (.0729)	0.1286 (.0590)	0.1274 (.0592)
$(k-y)_{t-2}$	-0.1080 (.0393)	-0.1125 (.0390)	-0.0045 (.0103)	-0.1050 (.0481)	-0.1104 (.0493)
C_t/K_{t-1}	0.4557 (.1483)	0.2050 (.1331)	-0.2507 (.1896)	-	-
$I[U_{it}=1]\cdot C_t/K_{t-1}$	-	-	-	0.4351 (.1324)	0.2961 (.1703)
$I[U_{it}=0]\cdot C_t/K_{t-1}$	-	-	-	0.2614 (.1239)	0.2003 (.1253)
(C_t/K_{t-1}) *difference*	-	-	-	*-0.1736* *(.1282)*	*-0.0959* *(.1933)*
No. Firms	-	-	264	264	264
Obs.	-	-	1559	1559	1559
Df	-	-	1527	1542	1542
sc_1	-	-	-7.915 [235]	-7.975 [235]	-8.036 [235]
sc_2	-	-	-1.148 [207]	-0.654 [207]	-0.561 [207]
Sargan	-	-	193.21 [184] p=0.306	125.99 [110] p=0.141	97.93 [91] p=0.291
Wald [4]	-	-	0.695 p=0.952	-	-

In columns (i) and (ii), all right-hand side variables in the equation for the full sample of firms are interacted with two distinct dummy variables, identified by the indicator function I[·], which are equal to one when the conditions in brackets are verified, and zero otherwise. $U_{it}=0$ ($U_{it}=1$) identifies observations with a below (above) median level of total institutional ownership. A full set of time dummies interacted with the dummy variables is included in the estimation.
Column (iii) presents the coefficient differences across observations, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is one (zero) for observations with an above (below) median level of institutional ownership. Interactions of the dummy variable with time dummies are also included. Wald is a test for differences in the non-cash flow variables across regimes.
In columns (iv) and (v) the cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. $U_{it}=0$ ($U_{it}=1$) identifies observations with a below (above) median level of total institutional ownership.
The term (C_t/K_{t-1}) *difference* in columns (iv) and (v) is the difference in the cash flow coefficients across observations with a below median level of institutional ownership, and observations with an above median level of institutional ownership.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in columns (i), (ii), and (iii) are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-4}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$. Time dummies interacted with the dummy variables included as instruments in all equations.
Instruments used in columns (iv) and (v) are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$. In column (iv) interactions of the dummy variables with cash flow are also included in the instrument set.

Table 4.4

I_t/K_{t-1}	(i) Pension fund ownership	(ii) Insurance company ownership	(iii) Other institutional ownership	(iv) Individual ownership	(v) Individual and non-financial company ownership
I_{t-1}/K_{t-2}	-0.0865 (.0539)	-0.0946 (.0588)	-0.0893 (.0559)	-0.0900 (.0576)	-0.1153 (.0654)
Δy_t	0.1751 (.0824)	0.2135 (.0895)	0.1859 (.0856)	0.1788 (.0876)	0.1933 (.0913)
Δy_{t-1}	0.1188 (.0557)	0.1051 (.0570)	0.1192 (.0553)	0.1234 (.0579)	0.1887 (.0705)
$(k-y)_{t-2}$	-0.1086 (.0493)	-0.1116 (.0546)	-0.1121 (.0510)	-0.1225 (.0557)	-0.1682 (.0677)
$I[U_{it}=1]\cdot C_t/K_{t-1}$	0.2234 (.1393)	0.5376 (.1487)	0.2891 (.1480)	0.1076 (.1431)	0.0917 (.1492)
$I[U_{it}=0]\cdot C_t/K_{t-1}$	0.2566 (.1366)	0.1017 (.1278)	0.1777 (.1246)	0.4895 (.1518)	0.3121 (.2224)
(C_t/K_{t-1}) difference	*0.0331* *(.1677)*	*-0.4360* *(.1772)*	*-0.1114* *(.1711)*	*0.3819* *(.2033)*	*0.2204* *(.2662)*
No. Firms	264	264	264	264	264
Obs.	1559	1559	1559	1559	1559
Df	1542	1542	1542	1542	1542
sc_1	-8.163 [235]	-8.249 [235]	-8.161 [235]	-8.372 [235]	-7.865 [235]
sc_2	-0.502 [207]	-0.889 [207]	-0.522 [207]	-0.874 [207]	-0.686 [207]
Sargan	94.77 [91] p=0.373	99.75 [91] p=0.249	95.86 [91] p=0.343	103.17 [91] p=0.180	94.08 [91] p=0.392

In all the columns the cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.
In column (i) $U_{it}=0$ ($U_{it}=1$) identifies observations with a below (above) median level of pension fund ownership.
In column (ii) $U_{it}=0$ ($U_{it}=1$) identifies observations with a below (above) median level of insurance company ownership.
In column (iii) $U_{it}=0$ ($U_{it}=1$) identifies observations with a below (above) median level of other institutional ownership.
In column (iv) $U_{it}=0$ ($U_{it}=1$) identifies observations with a below (above) median level of individual ownership.
In column (v) $U_{it}=0$ ($U_{it}=1$) identifies observations with a below (above) median level of individual and non-financial company ownership.
The term (C_t/K_{t-1}) *difference* is the difference in the cash flow coefficients across observations with different ownership structure.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1987-1997. See also notes for Table 4.1.

Table 4.5

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	Largest shareholder's equity-holdings	Largest shareholder's equity-holdings	Largest three shareholders' equity-holdings	Largest three shareholders' equity-holdings
I_{t-1}/K_{t-2}	-0.0877	-0.0860	-0.0914	-0.0784
	(.0536)	(.0536)	(.0532)	(.0537)
Δy_t	0.1787	0.1754	0.1731	0.1625
	(.0844)	(.0850)	(.0860)	(.0847)
Δy_{t-1}	0.1180	0.1136	0.1176	0.1072
	(.0544)	(.0551)	(.0543)	(.0548)
$(k-y)_{t-2}$	-0.1123	-0.1078	-0.1101	-0.1026
	(.0493)	(.0478)	(.0471)	(.0468)
$I[O_{it}=1]\cdot C_t/K_{t-1}$	0.2103	0.0947	0.1522	0.1000
	(.1173)	(.1584)	(.1319)	(.1354)
$I[O_{it}=0]\cdot C_t/K_{t-1}$	0.3129	0.4329	0.4134	0.4329
	(.1453)	(.1344)	(.1496)	(.1344)
(C_t/K_{t-1}) *difference*	*0.1026*	*0.3064*	*0.2611*	*0.3329*
	(.1402)	*(.2069)*	*(.1860)*	*(.1710)*
No. Firms	264	264	264	264
Obs.	1559	1559	1559	1559
Df	1542	1542	1542	1542
sc_1	-8.160 [235]	-8.128 [235]	-8.188 [235]	-7.982 [235]
sc_2	-0.823 [207]	-0.810 [207]	-0.906 [207]	-0.662 [207]
Sargan	95.99 [91]	93.31 [91]	95.56 [91]	93.78 [91]
	p=0.340	p=0.413	p=0.351	p=0.400

In all the columns the cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

Column (i): $O_{it}=1$: the largest shareholder owns more than 9.83% of the firm's equity
$O_{it}=0$: the largest shareholder owns less than 9.83% of the firm's equity

Column (ii): $O_{it}=1$: the largest shareholder owns more than 13.6% of the firm's equity
$O_{it}=0$: the largest shareholder owns less than 13.6% of the firm's equity

Column (iii): $O_{it}=1$: the largest three shareholders own more than 22.07% of the firm's equity
$O_{it}=0$: the largest three shareholders own less than 22.07% of the firm's equity

Column (iv): $O_{it}=1$: the largest three shareholders own more than 28.25% of the firm's equity
$O_{it}=0$: the largest three shareholders own less than 28.25% of the firm's equity

The term (C_t/K_{t-1}) *difference* is the difference in the cash flow coefficients across observations with different ownership structure.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1987-1997. See also notes for Table 4.1.

Table 4.6

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	The largest shareholder is (not) an individual AND ownership is (not) concentrated		The largest shareholder is (not) a financial institution AND ownership is (not) concentrated	
I_{t-1}/K_{t-2}	-0.0824 (.0559)	-	-0.0799 (.0550)	-
Δy_t	0.1767 (.0866)	-	0.1604 (.0855)	-
Δy_{t-1}	0.1180 (.0549)	-	0.1193 (.0549)	-
$(k\text{-}y)_{t-2}$	-0.1149 (.0537)	-	-0.1091 (.0505)	-
$I[(O_{it}=1)\cdot(I_{it}=1)]\cdot C_t/K_{t-1}$	-0.0007 (.1616)	-	0.6366 (.2799)	-
$I[(O_{it}=1)\cdot(I_{it}=0)]\cdot C_t/K_{t-1}$	0.3814 (.1448)	*0.3821* *(.2218)*	0.1478 (.1285)	*-0.4888* *(.3008)*
$I[O_{it}=0]\cdot C_t/K_{t-1}$	0.3576 (.1484)	*0.3583* *(.1935)*	0.3459 (.1489)	*-0.2907* *(.3002)*
No. Firms	264	-	264	-
Obs.	1559	-	1559	-
Df	1541	-	1541	-
sc_1	-8.152 [235]	-	-7.850 [207]	-
sc_2	-0.746 [207]	-	-0.565 [207]	-
Sargan	94.85 [90] p=0.343	-	87.89 [90] p=0.543	-

In all the columns the cash flow term is interacted with three distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

All columns: $O_{it}=1$: the largest shareholder holds more than 9.83% (above median) of shares
$O_{it}=0$: the largest shareholder holds less than 9.83% (below median) of shares

Columns (i) - (ii): $I_{it}=1$: the largest shareholder is an individual
$I_{it}=0$: the largest shareholder is not an individual

Columns (iii) - (v): $I_{it}=1$: the largest shareholder is a financial institution
$I_{it}=0$: the largest shareholder is not a financial institution

Columns (ii) and (iv) report the coefficient differences between the cash flow term interacted with the dummy variables identified by $I[(O_{it}=1)\cdot(I_{it}=0)]$ and $I[O_{it}=0]$ and the cash flow term interacted with the dummy identified by $I[(O_{it}=1)\cdot(I_{it}=1)]$.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k\text{-}y)_{t-2}$ to $(k\text{-}y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1987-1997. See also notes for Table 4.1.

Table 4.7

I_t/K_{t-1}	(i) The largest shareholder is (not) an individual AND ownership is (not) concentrated	(ii) The largest shareholder is (not) a financial institution AND ownership is (not) concentrated
I_{t-1}/K_{t-2}	-0.0827 (.0559)	-0.0806 (.0553)
Δy_t	0.1768 (.0867)	0.1642 (.0852)
Δy_{t-1}	0.1182 (.0550)	0.1176 (.0551)
$(k-y)_{t-2}$	-0.1154 (.0535)	-0.1049 (.0500)
$I[(I_{it}=1)\cdot(O_{it}=1)]\cdot C_t/K_{t-1}$	-0.0016 (.1636)	0.5903 (.2745)
$I[1-(I_{it}=1)\cdot(O_{it}=1)]\cdot C_t/K_{t-1}$	0.3703 (.1236)	0.2188 (.1152)
(C_t/K_{t-1}) *difference*	*0.3719* *(.1959)*	*-0.3714* *(.2849)*
No. Firms	264	264
Obs.	1559	1559
Df	1542	1542
sc_1	-8.153 [235]	-7.810 [235]
sc_2	-0.782 [207]	-0.248 [207]
Sargan	95.49 [91] p=0.353	90.16 [91] p=0.505

In all the columns the cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

All columns $O_{it}=1$: the largest shareholder holds more than 9.83% (above median) of shares
$O_{it}=0$: the largest shareholder holds less than 9.83% (below median) of shares

Column (i): $I_{it}=1$: the largest shareholder is an individual
$I_{it}=0$: the largest shareholder is not an individual

Column (ii): $I_{it}=1$: the largest shareholder is a financial institution
$I_{it}=0$: the largest shareholder is not a financial institution

The term (C_t/K_{t-1}) *difference* is the difference in the cash flow coefficients across observations with different ownership structure.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1987-1997. See also notes for Table 4.1.

Table 4.8

Horse Races - Size versus ownership structure

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	I[G_{it}=1]: *High* Financial institutions' ownership	I[G_{it}=1]: *High* insurance companies' ownership	I[G_{it}=1]: *Low* individual ownership	I[G_{it}=1]: Dispersed ownership OR largest shareholder not an individual
I_{t-1}/K_{t-2}	-0.0967	-0.0966	-0.0932	-0.0899
	(.0581)	(.0594)	(.0582)	(.0563)
Δy_t	0.1656	0.2098	0.1810	0.1788
	(.0840)	(.0878)	(.0853)	(.0855)
Δy_{t-1}	0.1381	0.1099	0.1253	0.1211
	(.0592)	(.0570)	(.0567)	(.0555)
$(k-y)_{t-2}$	-0.1301	-0.1196	-0.1292	-0.1199
	(.0533)	(.0552)	(.0550)	(.0504)
C_t/K_{t-1}	0.0895	0.0824	0.0987	-0.0812
	(.1496)	(.1290)	(.1392)	(.1707)
I[S_i=1]·C_t/K_{t-1}	0.5064	0.2180	0.2927	0.2963
	(.2275)	(.2466)	(.2984)	(.2203)
I[G_{it}=1]·C_t/K_{t-1}	0.1307	0.3691	0.2520	0.4068
	(.1987)	(.1926)	(.2742)	(.2026)
No. Firms	264	264	264	264
Obs.	1559	1559	1559	1559
Df	1541	1541	1541	1541
sc_1	-7.897 [235]	-8.031 [235]	-8.202 [235]	-8.028 [235]
sc_2	-0.437 [207]	-0.788 [207]	-0.733 [207]	-0.805 [207]
Sargan	95.53 [90]	96.84 [90]	96.34 [90]	91.47 [90]
	p=0.325	p=0.292	p=0.305	p=0.437
Wald (cash flow interactions)	5.03 [2] p=0.081	6.57 [2] p=0.037	5.53 [2] p=0.063	7.10 [2] p=0.029

In all the columns the cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

All columns S_{it}=1: the firm is large (above median employment in the first year of observation)

Column (i): G_{it}=1 observations with an above median level of total institutional ownership

Column (ii): G_{it}=1: observations with an above median level of insurance company ownership

Column (iii): G_{it}=1: observations with a below median level of individual ownership

Column (iv): G_{it}=1: observations where either the largest shareholder is not an individual or the largest shareholder owns less than 9.83% of the shares

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1987-1997. Wald is a test of joint significance of the coefficients on the cash flow interactions asymptotically distributed as χ^2[df] under the null. See also notes for Table 4.1.

5. US investment regressions

Ownership information available for the sample of US firms is less detailed than that available for the sample of UK firms. There are two main differences between the two samples. In the first place, information available for the sample of US firms is limited to beneficial owners of more than 5% of the firm's total outstanding equity (5% beneficial owners). In the light of the low degree of ownership concentration amongst listed US companies, this deprives us of some potentially important information on the characteristics and shareholdings of the owners of relatively significant proportions of the firm's equity. As we will see below, this makes it difficult to draw reliable inferences on the effects of ownership structure on the basis of the proportion of the firm's equity owned by different categories of shareholders. Nonetheless, information on 5% beneficial owners still makes it possible to draw some interesting comparisons between firms split according to the degree of ownership concentration and the characteristics of the largest shareholder(s).

Secondly, only ownership information for the last years of observation is available for the US firms. Here we assume that ownership structure in the previous years coincides with ownership structure recorded in the last year. This assumption is not as strong as it may seem, as ownership structure is relatively constant over a ten years period. More importantly, the regression results for our sample of UK firms, presented in Section 4 of this chapter, did not change significantly when we used only ownership information for the last year of observation to define the ownership dummies. This is shown in Table 5.1, where the regression results in columns (i), (ii) and (iii), obtained by splitting firms according to the ownership structure in the last year of observation, should be compared with the results in Table 4.4, column (ii), Table 4.5, column (ii), and Table 4.7, column (i), respectively. Notwithstanding this evidence, any interpretation of the empirical evidence for the sample of US firms should take into due account the shortcomings in our data.

Table 5.2 reports regression results for an error correction model for the sample of 396 US firms with one or more 5% beneficial owners. This is a subset of the sample of US firms analysed in Chapter 6. As for that sample, the preferred estimator is here a system GMM estimator with an instrument set that includes levels of all right-hand side variables dated from t-3 to t-5 for the equations in first differences, and first differences of the dependent variable and the sales growth term dated t-2 for the equations in levels. For this analysis we impose the unit restriction on the long-run elasticity and drop the lagged output term y_{t-2}, which was found to be statistically insignificant in all the GMMSYS estimates. Since in column (i) the estimated coefficient on the lagged cash flow term appears to be insignificant, the preferred specification of the error correction model includes only current cash flow. Column (ii) presents the GMMSYS results for this specification. The estimated coefficients on the error correction term and the lagged output growth are significant at the conventional confidence level (t=2.21 and t=2.23, respectively). The coefficient estimate of current cash flow is also statistically significant (t=2.65), thus suggesting the existence of a positive relationship between US firms' investment expenditures and the availability of internal funds.

In Table 5.2 we also investigate whether this investment-cash flow sensitivity varies with firm size in this US sample. Column (iii) presents estimates for the sample of firms with below median employment. Column (iv) presents estimates for the sample of firms with above median employment. The point estimates of the cash flow coefficients are basically the same for the two samples. In contrast to the UK case, this should exclude the possibility of ownership effects reflecting differential firm size effects on company investment.

We now turn to investigate the effect of ownership structure on the relationship between investment spending and the availability of internal finance. As in Section 4, we first analysed the impact of institutional ownership. The specification of an appropriate measure of institutional ownership is complicated by the fact that information is available only for holdings that are above 5% of the firm's equity. Ideally we would have liked to measure the

proportion of the firm's equity owned by non-banking financial institutions, and investigate whether this affects the sensitivity of investment to cash flow. However, on average we only have ownership data for about 25% of the firm's total equity, and this proportion of identified shareholdings varies considerably between firms in the sample. As expected, this affected the significance of comparisons across firms based on the observed proportion of the firm's equity owned by financial institutions, which were all found to be uninformative. Similar shortcomings apply to sample splits based on the observed proportion of equity owned by other categories of investors, such as individuals and non-financial companies. Also in these cases, differences across samples in the investment sensitivity to cash flow were found to be negligible.

In Table 5.3 we present GMMSYS regression results for the sample of firms where the largest shareholder is a financial institution [column (i)], and the sample of firms where the largest shareholder is not a financial institution [column (ii)]. Column (iii) reports differences of the estimated coefficients across the two samples. The coefficient estimate of the cash flow term appears to be statistically significant (t=3.56) for firms where the largest shareholder is a financial institution, but not otherwise. The difference in the cash flow coefficients across the two samples of firms is also (weakly) significant (t=1.77). In column (iv) we present estimates for the full sample of 396 US firms, where common coefficients are imposed on the non-cash flow variables and only the cash flow coefficient is allowed to vary across firms[27]. The cash flow variable is therefore interacted with two distinct ownership dummy variables for whether the largest shareholder is a non-banking financial institution (I_i=1) or not (I_i=0). Interactions of the cash flow term with the two dummies are also included in the instrument set. The

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[27] In Table 5.3, column (iii), the Wald test of the hypothesis that the differences in the estimated coefficients of the non-cash flow terms are jointly zero has a p-value of 99.3%. Thus the validity of the restriction of common coefficients for the non-cash flow variables cannot be rejected.

estimated cash flow coefficient is statistically significant for firms where the largest shareholder is a financial institution (t=3.30), but not for firms where the largest shareholder is not a financial institution (t=0.77). Again the difference in the cash flow coefficients across the two samples of firms is statistically significant (t=2.13).

One possible problem with the investment regressions in columns (i) to (iv) is that they include in the instrument set interactions of the ownership dummies with (some of) the right-hand side variables. This implicitly assumes that ownership structure is uncorrelated with the unobserved firm-specific effects. To control for the possibility that ownership structure is correlated with the firm-specific effects, Table 5.3, column (v), presents GMMSYS results obtained using an instrument set that includes no interactions of any of the right-hand side variables with the dummy variables that indicate the identity of the largest shareholder. Under this specification, the cash flow effect is still significant (t=2.56) for firms where the largest shareholder is an institution. The cash flow coefficient difference across firms with different categories of largest shareholder is again significant (t=2.21).

Despite the fact that both the results in column (v) and the results in column (iv) of Table 5.3 provide similar evidence for a relationship between company investment and the identity of the largest shareholder, the diagnostics bring into question the assumption that ownership structure is not correlated with the unobserved firm-specific effects. The Sargan difference test between the estimates in columns (iv) and (v) indicates that the interactions of the ownership dummy variables with cash flow are not valid instruments [$\chi^2(21)=37.23$, $p=0.016$]. This rejects the validity of the assumption that ownership structure is exogenous and uncorrelated with the firm-specific effects. Therefore, in the following we will control for endogeneity of the ownership structure and present only GMMSYS results obtained by using an instrument set that includes no interactions with the dummy variables that indicate ownership structure.

In Table 5.4 we investigate the effect of ownership concentration on the relationship between investment and cash flow. Column (i) presents regression results for the sample of 396 firms, where the cash flow coefficient is allowed to vary across firms according to whether the proportion of the firm's equity owned by the largest shareholder is above (O_i=1) or below (O_i=0) the median proportion owned by the largest shareholder[28]. Even though the cash flow term is significant only for firms where ownership is more dispersed (t=2.73), the cash flow coefficient differences across firms are not significant (t=0.68).

Column (ii) of Table 5.4 presents separate cash flow coefficients for the sample firms where the proportion of equity owned by the largest shareholder is greater than 14% (O_i=1), and the sample of firms where the proportion is lower than 14% (O_i=0). The firms in the former (latter) sample comprise one-third (two-thirds) of the 396 firms. The estimated cash flow coefficient is highly significant (t=3.44) when ownership is more dispersed, and insignificant (t=0.56) when ownership is less dispersed. The difference in the cash flow coefficients across firms remains, however, insignificant at the conventional level (t=1.30). A similar result emerges from the analysis in column (iii) of the proportion of the firm's equity owned by the largest three shareholders. The estimated cash flow coefficient is significantly positive only for the sample of firms (comprising two-thirds of the 396 firms) where the largest three shareholders own a low proportion of the firm's total equity, but the difference in the cash flow coefficients across firms is again insignificant at the conventional level (t=1.41). Columns (iv) and (v) replicate the analyses of columns (ii) and (iii) for the larger sample of 451 firms. The regression results confirm the existence of a weakly negative relationship between ownership concentration and the sensitivity of investment spending to the availability of internal finance.

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[28] The median value for the proportion of the firm's equity owned by the largest shareholder is 11.46% for the sample of 396 US companies.

Table 5.5 summarises the empirical evidence of the impact on company investment of different categories of largest shareholder. In column (i) we separate firms where the largest shareholder is an individual (I_i=1) from firms where the largest shareholder is not an individual (I_i=0). The coefficient estimate on the cash flow term is insignificant for the former (t=1.25), but significant for the latter (t=2.98). In column (ii) we distinguish firms where the largest shareholder is either an individual or a non-financial company (I_i=1) from firms where the largest shareholder is neither an individual nor a non-financial company (I_i=0). The estimated coefficient on the cash flow term appears to be statistically significant only when the largest shareholder is neither an individual nor a non-financial company (t=3.07). However, both in column (i) and in column (ii) the differences in the cash flow coefficients across these sub-samples are not significant (t=0.87 and t=1.20, respectively). In column (iii), which reproduces then results presented in column (v) of Table 5.3, the cash flow coefficient varies across firms according to whether the largest shareholder is a non-banking financial institution (I_i=1) or not (I_i=0). The cash flow effect is significant at a 1% confidence level for firms where the largest shareholder is a financial institution, and is not significantly different from zero for firms where the largest shareholder is not a financial institution. Moreover, the difference in the cash flow coefficients across these two samples of firms is statistically significant (t=2.21).

The results in Table 5.5 provide evidence for a significant impact of ownership structure on the relationship between investment and cash flow. Investment spending appears to be strongly related to the availability of internal finance only when the largest shareholder is a financial institution. When compared to the results in Table 5.4, these findings seem to suggest that firm performance and investment behaviour are more likely to be affected by the characteristics of the firm's largest shareholder(s) rather than by the proportion of the firm's equity owned by its largest shareholders.

In contrast to the UK data set, the US data set also contains information on the overall proportion of the firm's equity owned by officers and directors as a group. This information allows us to investigate the impact of managerial share ownership on the sensitivity of investment to cash flow. To do so, we divide the US panel into quartiles by managerial share ownership. We then estimate the error correction model of investment for the full sample of 451 firms, where the cash flow coefficient is allowed to vary across the different groups of firms. The regression results presented in Table 5.6, column (i), show that the estimated coefficient on cash flow is equal to zero for the quartile of firms with the lowest level of managerial ownership, positive but insignificant (t=0.75) for the second quartile of firms, highly significant (t=3.50) for the third quartile, and close to zero (t=0.68) for the highest managerial ownership firms. Column (ii) reports differences in the cash flow terms between the third quartile and the other quartiles of firms. These cash flow differences are statistically significant when comparing the cash flow coefficient for the third quartile of firms with both the cash flow coefficient for the lowest managerial ownership firms (t=2.05) and the cash flow coefficient for the highest managerial ownership firms (t=2.16). In column (iii) we group together firms with a below median level of total insider ownership. As expected, the estimated cash flow coefficient is insignificant for this sample of firms (t=0.59), and significantly different from the estimated coefficient for the third quartile of firms.

Our findings seem to suggest the existence of a non-monotonic relationship between managerial share ownership and investment-cash flow sensitivity. As managerial shareholdings increase from an initial point of zero, investment becomes more sensitive to cash flow. However, at relatively high levels of managerial ownership, the sensitivity of investment to cash flow decreases with insider holdings. Hadlock (1998) finds a similar non-monotonic relationship when analysing a panel of US firms from the 1970s. This also reflects the empirical evidence provided by Morck *et al.* (1988) and McConnell and Servaes (1990)

that the relationship between insider holdings and the alignment of interests between managers and shareholders is not monotonic.

The finding that at relatively low levels of managerial share ownership the investment sensitivity to cash flow increases with insider holdings is consistent with alternative interpretations. Hadlock (1998) interprets this evidence as reflecting financing constraints becoming more severe as managers' interests become more aligned with those of shareholders. Intuitively, if capital market imperfections raise the cost premium on external funds and result in firms passing up some projects with positive net present value, managers should internalise more of the mis-pricing on external funds as their holdings increase. Thus, managers holding a relatively high proportion of the firm's equity will be more hesitant to raise external funds. This should in turn increase the firm's reliance on internal funds when making investment decisions, thus resulting in a significant positive effect from cash flow on investment expenditures.

An alternative interpretation would consider the relationship between investment and cash flow as reflecting free-cash flow problems, and stress the disciplinary role played by takeovers on managers' behaviour. For very low levels of managerial ownership, there is no significant relationship between investment and internal funds because the takeover threat prevents managers from overspending internal funds in unprofitable projects. As insider holdings increase, the investment sensitivity to cash flow increases, since takeover bids are less likely and managers can therefore overinvest free-cash flow funds.

Both interpretations are not easily reconcilable with the finding that at relatively high levels of managerial share ownership the investment-cash flow sensitivity decreases with managerial holdings. This effect is commonly attributed to the entrenchment properties of high levels of insider holdings (see Hadlock, 1998, and Morck *et al.*, 1988, among the others).

Overall, the regression results for the sample of US firms suggest that investment spending is strongly related to the availability of internal funds when a) the largest shareholder is a

financial institution, and b) managers as a group own a relatively high proportion of the firm's equity (more than 3.6% but less than 10.2%). As a final test we try to ascertain which of these two ownership measures has the greatest impact on the investment sensitivity to cash flow. In Table 5.7 we present regression results for the sample of 396 US firms[29], which include two additional interactions between the cash flow variable and two distinct ownership dummies, $I[I_i=1]$ and $I[M3_i=1]$. These dummies are, respectively, equal to one when the largest shareholder is a financial institution, and when total managerial ownership is higher than 3.6% and lower than 10.2%. The estimated coefficients of the cash flow interactions with the two ownership dummies are jointly significant (p=0.058), but individually insignificant (t=1.45 and t=1.21, respectively). Hence, on the basis of this evidence we cannot establish which factor (whether institutional or managerial ownership) has the greatest impact on the relationship between investment spending and cash flow.

[29] Since information on the identity of the largest shareholder is not available for those firms where no beneficial owner holds more than 5% of the firm's equity, in Table 5.7 we report results for the sample of 396 firms, and not for the sample of 451 firms.

Table 5.1

Sample of UK firms: ownership structure based on last year of observation

I_t/K_{t-1}	(i) Insurance company ownership	(ii) Largest shareholder's equity-holdings	(iii) The largest shareholder is (not) an individual AND ownership is (not) concentrated
I_{t-1}/K_{t-2}	-0.1154 (.0642)	-0.0857 (.0536)	-0.0999 (.0584)
Δy_t	0.1968 (.0922)	0.1755 (.0848)	0.1804 (.0868)
Δy_{t-1}	0.1454 (.0642)	0.1131 (.0551)	0.1239 (.0576)
$(k-y)_{t-2}$	-0.1462 (.0626)	-0.1090 (.0486)	-0.1185 (.0566)
$I[G_i=1]\cdot C_t/K_{t-1}$	0.5893 (.1912)	0.1928 (.1360)	-0.0797 (.1641)
$I[G_i=0]\cdot C_t/K_{t-1}$	-0.1379 (.2037)	0.3162 (.1478)	0.4368 (.1240)
(C_t/K_{t-1}) difference	*-0.7273* *(.2918)*	*0.1233* *(.1871)*	*0.5165* *(.1915)*
No. Firms	264	264	264
Obs.	1559	1559	1559
Df	1542	1542	1542
sc_1	-7.800 [235]	-8.191 [235]	-7.966 [235]
sc_2	-0.974 [207]	-0.615 [207]	-1.102 [207]
Sargan	91.32 [91] p=0.471	93.40 [91] p=0.411	101.39 [91] p=0.214

In all the columns the cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

Column (i): $G_i=1$: above median level of insurance company ownership
$G_i=0$: below median level of insurance company ownership

Column (ii): $G_i=1$: the largest shareholder owns more than 13.6% of the firm's equity (two-third of firms)
$G_i=0$: the largest shareholder owns less than 13.6% of the firm's equity (one-third of firms)

Column (iii): $G_i=1$: the largest shareholder is an individual AND owns more than 10% of the firm's equity
$G_i=0$: the largest shareholder is not an individual OR owns less than 10% of the firm's equity

The term (C_t/K_{t-1}) *difference* is the difference in the cash flow coefficients across firms with different ownership structure.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-2}/K_{t-3} to I_{t-3}/K_{t-4}, Δy_{t-2} to Δy_{t-3}, $(k-y)_{t-2}$ to $(k-y)_{t-3}$, and C_{t-2}/K_{t-3} to C_{t-3}/K_{t-4}; levels equations: $\Delta(I_{t-1}/K_{t-2})$ and $\Delta(\Delta y_{t-1})$.

Notes. Sample period: 1987-1997. See also notes for Table 4.1.

Table 5.2

Error correction model: sample of US firms with 5% ownership information

I_t/K_{t-1}	(i)	(ii)	(iii)	(iv)
	Full sample	Full sample	Small firms	Large firms
I_{t-1}/K_{t-2}	-0.0010	-0.0007	-0.1468	0.1958
	(.0907)	(.0878)	(.0937)	(.0875)
Δy_t	0.0601	0.0599	0.0769	0.0644
	(.0508)	(.0502)	(.0630)	(.0291)
Δy_{t-1}	0.1250	0.1252	0.2052	0.1037
	(.0580)	(.0562)	(.0695)	(.0456)
$(k-y)_{t-2}$	-0.1159	-0.1162	-0.1790	-0.0743
	(.0545)	(.0526)	(.0860)	(.0330)
C_t/K_{t-1}	0.1861	0.1868	0.1724	0.1572
	(.0788)	(.0706)	(.1000)	(.0698)
C_{t-1}/K_{t-2}	0.0013	-	-	-
	(.0702)			
No. Firms	396	396	198	198
Obs.	2897	2897	1327	1570
Df	2881	2882	1312	1555
sc_1	-3.632 [373]	-3.766 [373]	-2.605 [181]	-4.716 [192]
sc_2	-2.998 [354]	-2.997 [354]	-2.897 [169]	-1.903 [185]
z_1	62.51 [6]	37.37 [5]	33.73 [5]	151.60 [5]
z_2	10.91 [9]	27.78 [9]	10.55 [9]	33.27 [9]
Sargan	101.05 [97]	100.98 [98]	99.97 [98]	96.41 [98]
	p=0.369	p=0.398	p=0.426	p=0.526
Wald	7.00 [2]	-	-	-
(cash flow terms)	p=0.030			

Small firms are firms with below median employment in the initial year of observation.
Large firms are firms with above median employment in the initial year of observation.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: $I_{t-3}K_{t-4}$ to $I_{t-5}K_{t-6}$ Δy_{t-3} to Δy_{t-5} $(k-y)_{t-3}$ to $(k-y)_{t-5}$ and $C_{t-3}K_{t-4}$ to $C_{t-5}K_{t-6}$; levels equations: $\Delta(I_{t-2}K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1988-1997. Wald is a test of joint significance of the coefficients on the cash flow terms asymptotically distributed as χ^2[df] under the null. See also notes for Table 4.1.

Table 5.3

I_t/K_{t-1}	(i) The largest shareholder is an institution	(ii) The largest shareholder is not an institution	(iii) Difference (ii) - (i)	(iv) Full sample	(v) Full sample (no interactions)
I_{t-1}/K_{t-2}	0.0139 (.1082)	-0.0073 (.1102)	-0.0212 (.1545)	-0.0270 (.0805)	-0.0145 (.0890)
Δy_t	0.0873 (.0657)	0.0974 (.0454)	0.0101 (.0798)	0.0779 (.0493)	0.0409 (.0549)
Δy_{t-1}	0.1050 (.0631)	0.0930 (.0555)	-0.0120 (.0840)	0.1274 (.0557)	0.1015 (.0587)
$(k-y)_{t-2}$	-0.1405 (.0565)	-0.1255 (.0539)	0.0149 (.0781)	-0.1308 (.0513)	-0.1156 (.0579)
C_t/K_{t-1}	0.2478 (.0695)	0.0657 (.0755)	-0.1822 (.1026)	-	-
$I[I_i=1]\cdot C_t/K_{t-1}$	-	-	-	0.2929 (.0888)	0.4071 (.1037)
$I[I_i=0]\cdot C_t/K_{t-1}$	-	-	-	0.0642 (.0833)	0.0654 (.1018)
(C_t/K_{t-1}) difference	-	-	-	*-0.2287* *(.1074)*	*-0.3416* *(.1543)*
No. Firms	211	185	396	396	396
Obs.	1555	1342	2897	2897	2897
Df	1540	1327	2867	2871	2881
sc_1	-2.805 [200]	-2.951 [173]	-4.014 [373]	-3.726 [373]	-3.544 [373]
sc_2	-2.228 [191]	-2.124 [163]	-3.076 [354]	-3.102 [354]	-3.194 [354]
Sargan	101.33 [98] p=0.389	108.66 [98] p=0.217	210.00 [196] p=0.234	129.95 [118] p=0.213	92.66 [97] p=0.606
Wald	-	-	0.24 [4] p=0.993	-	-

In columns (i) and (ii), all right-hand side variables in the equation for the full sample of firms are interacted with two distinct dummy variables, identified by the indicator function I[·], which are equal to one when the conditions in brackets are verified, and zero otherwise. $I_i=1$ ($I_i=0$) identifies observations where the largest shareholder is (not) a financial institution. A full set of time dummies interacted with the dummy variables is included in the estimation.
Column (iii) presents the coefficient differences across observations, obtained by interacting all right-hand side variables in the equation for the full sample of firms with a dummy variable which is one (zero) for observations where the largest shareholder is (not) a financial institution. Interactions of the dummy variable with time dummies are also included. Wald is a test for differences in the non-cash flow variables across regimes.
In columns (iv) and (v) the cash flow coefficient is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. $I_i=1$ ($I_i=0$) identifies observations where the largest shareholder is (not) a financial institution.
The term (C_t/K_{t-1}) *difference* in column (iv) and (v) is the difference in the cash flow coefficients across observations where the largest shareholder is not a financial institution, and firms where the largest shareholder is a financial institution.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in columns (i), (ii), and (iii) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. Time dummies interacted with the dummy variables included as instruments in all equations.
Instruments used in columns (iv) and (v) are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$. In column (iv) interactions of the dummy variables with cash flow are also included in the instrument set.

Table 5.4

I_t/K_{t-1}	(i) Largest shareholder's equity-holdings (396 firms)	(ii) Largest shareholder's equity-holdings (396 firms)	(iii) Largest three shareholders' equity-holdings (396 firms)	(iv) Largest shareholder's equity-holdings (451 firms)	(v) Largest three shareholders' equity-holdings (451 firms)
I_{t-1}/K_{t-2}	0.0019	0.0026	-0.0079	-0.0116	-0.0017
	(.0863)	(.0862)	(.0857)	(.0891)	(.0880)
Δy_t	0.0582	0.0591	0.0718	0.0992	0.1101
	(.0509)	(.0521)	(.0496)	(.0564)	(.0546)
Δy_{t-1}	0.1227	0.1188	0.1332	0.1633	0.1622
	(.0548)	(.0549)	(.0570)	(.0608)	(.0604)
$(k-y)_{t-2}$	-0.1167	-0.1152	-0.1185	-0.1381	-0.1264
	(.0530)	(.0528)	(.0545)	(.0590)	(.0578)
$I[O_i=1]\cdot C_t/K_{t-1}$	0.1421	0.0711	0.0292	0.0244	0.0248
	(.1145)	(.1263)	(.1389)	(.1297)	(.1259)
$I[O_i=0]\cdot C_t/K_{t-1}$	0.2528	0.2545	0.2639	0.2206	0.1959
	(.0927)	(.0740)	(.0824)	(.0804)	(.0760)
(C_t/K_{t-1}) *difference*	*0.1107*	*0.1834*	*0.2347*	*0.1962*	*0.1710*
	(.1624)	*(.1412)*	*(.1663)*	*(.1545)*	*(.1437)*
No. Firms	396	396	396	451	451
Obs.	2897	2897	2897	3331	3331
Df	2881	2881	2881	3315	3315
sc_1	-3.845 [373]	-3.884 [373]	-3.741 [373]	-3.905 [428]	-3.936 [428]
sc_2	-2.980 [354]	-3.022 [354]	-3.071 [354]	-2.793 [407]	-2.757 [407]
z_1 [6]	63.91	64.50	60.21	59.41	61.69
z_2 [9]	11.40	11.29	11.15	10.70	10.91
Sargan	98.20 [97]	96.22 [97]	98.01 [97]	97.50 [97]	99.40 [97]
	p=0.447	p=0.503	p=0.452	p=0.467	p=0.413

In all the columns the cash flow coefficient is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

Column (i): O_i=1 (O_i=0): the largest shareholder owns more (less) than 11.46% of the firm's equity

Column (ii): O_i=1 (O_i=0): the largest shareholder owns more (less) than 14% of the firm's equity

Column (iii): O_i=1 (O_i=0): the largest three shareholders own more (less) than 28.68% of the firm's equity

Column (iv): O_i=1 (O_i=0): the largest shareholder owns more (less) than 13.6% of the firm's equity

Column (v): O_i=1 (O_i=0): the largest three shareholders own more (less) than 27.8% of the firm's equity

The term (C_t/K_{t-1}) *difference* is the difference in the cash flow coefficients across observations with different ownership structure.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1988-1997. See also notes for Table 4.1.

Table 5.5

I_t/K_{t-1}	(i)	(ii)	(iii)
	The largest shareholder is (not) an individual	The largest shareholder is (not) either an individual or a company	The largest shareholder is (not) a financial institution
I_{t-1}/K_{t-2}	-0.0037	0.0019	-0.0145
	(.0880)	(.0874)	(.0890)
Δy_t	0.0512	0.0487	0.0409
	(.0516)	(.0525)	(.0549)
Δy_{t-1}	0.1148	0.1073	0.1015
	(.0560)	(.0564)	(.0587)
$(k-y)_{t-2}$	-0.1167	-0.1108	-0.1156
	(.0537)	(.0540)	(.0579)
$I[I_i=1]\cdot C_t/K_{t-1}$	0.1335	0.1282	0.4071
	(.1070)	(.0956)	(.1037)
$I[I_i=0]\cdot C_t/K_{t-1}$	0.2557	0.3021	0.0654
	(.0859)	(.0985)	(.1018)
(C_t/K_{t-1}) *difference*	*0.1221*	*0.1738*	*-0.3416*
	(.1408)	*(.1450)*	*(.1543)*
No. Firms	396	396	396
Obs.	2897	2897	2897
Df	2881	2881	2881
sc_1	-3.658 [373]	-3.729 [373]	-3.544 [373]
sc_2	-3.056 [354]	-3.063 [354]	-3.194 [354]
z_1 [6]	66.49	70.54	70.91
z_2 [9]	7.95	8.41	8.11
Sargan	98.12 [97]	97.16 [97]	92.66 [97]
	p=0.449	p=0.476	p=0.606

In all the columns the cash flow coefficient is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

Column (i): I_i=1: the largest shareholder is an individual
I_i=0: the largest shareholder is not an individual

Column (ii): I_i=1: the largest shareholder is either an individual or a non-financial company
I_i=0: the largest shareholder is neither an individual nor a non-financial company

Column (iii): I_i=1: the largest shareholder is a financial institution
I_i=0: the largest shareholder is not a financial institution

The term (C_t/K_{t-1}) *difference* is the difference in the cash flow coefficients across observations with different ownership structure.

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in all columns are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1988-1997. See also notes for Table 4.1.

Table 5.6

I_t/K_{t-1}	(i) Managerial share ownership	(ii) *Differences*	(iii) Managerial share ownership	(iv) *Differences*
I_{t-1}/K_{t-2}	-0.0170 (.0853)	-	-0.0033 (.0850)	-
Δy_t	0.0723 (.0567)	-	0.0747 (.0558)	-
Δy_{t-1}	0.1239 (.0584)	-	0.1228 (.0585)	-
$(k\text{-}y)_{t-2}$	-0.1119 (.0557)	-	-0.1099 (.0559)	-
$I[M1_i=1]\cdot C_t/K_{t-1}$	0.0102 (.1580)	*-0.4087* *(.1995)*	-	-
$I[M2_i=1]\cdot C_t/K_{t-1}$	0.1311 (.1736)	*-0.2877* *(.1999)*	-	-
$I[M12_i=1]\cdot C_t/K_{t-1}$	-	-	0.0650 (.1105)	*-0.3436* *(.1557)*
$I[M3_i=1]\cdot C_t/K_{t-1}$	0.4189 (.1195)	-	0.4089 (.1181)	-
$I[M4_i=1]\cdot C_t/K_{t-1}$	0.0727 (.1073)	*-0.3462* *(.1602)*	0.0758 (.1065)	*-0.3328* *(.1594)*
No. Firms	451	-	451	-
Obs.	3331	-	3331	-
Df	3313	-	3314	-
sc_1	-3.882 [428]	-	-3.871 [428]	-
sc_2	-3.070 [407]	-	-3.109 [407]	-
Sargan	88.09 [95] p=0.679	-	89.01 [96] p=0.680	-

In columns (i) and (iii) the cash flow coefficient is interacted with dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise. Columns (ii) and (iv) present cash flow coefficient differences between firms interacted with the dummy variable $I[M3_i=1]$ and firms interacted with the other dummy variables.

$M1_i=1$: managerial ownership of the firm's equity is lower than 1.7% (1st quartile)
$M2_i=1$: managerial ownership of the firm's equity is greater than 1.7% and lower than 3.6% (2nd quartile)
$M12_i=1$: managerial ownership of the firm's equity is lower than 3.6%
$M3_i=1$: managerial ownership of the firm's equity is greater than 3.6% and lower than 10.2% (3rd quartile)
$M4_i=1$: managerial ownership of the firm's equity is greater than 10.2% (4th quartile)

GMMSYS estimates.
Time dummies included as instruments in all equations.
Instruments used in are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k\text{-}y)_{t-3}$ to $(k\text{-}y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1988-1997. See also notes for Table 4.1.

Table 5.7

Horse Race - Institutional ownership vs. managerial ownership

I_t/K_{t-1}	I[I_i=1]: The largest shareholder is a financial institution I[$M3_i$=1]: 3.6 < managerial ownership < 10.2
I_{t-1}/K_{t-2}	-0.0099 (.0860)
Δy_t	0.0312 (.0552)
Δy_{t-1}	0.0847 (.0573)
$(k-y)_{t-2}$	-0.1048 (.0554)
C_t/K_{t-1}	0.0641 (.0984)
I[I_i=1]$\cdot C_t/K_{t-1}$	0.2364 (.1630)
I[$M3_i$=1]$\cdot C_t/K_{t-1}$	0.1921 (.1585)
No. Firms	396
Obs.	2897
Df	2880
sc_1	-3.560 [373]
sc_2	-3.376 [354]
Sargan	90.08 [96] p=0.651
Wald (cash flow interactions)	5.698 [2] p=0.058

The cash flow term is interacted with two distinct dummy variables, identified by the indicator function I[.], which are equal to one when the conditions in brackets are verified, and zero otherwise.

I_i=1: the largest shareholder is a financial institution
$M3_i$=1: managerial ownership of the firm's equity is greater than 3.6% and lower than 10.2%

GMMSYS estimates.
Time dummies included as instruments.
Instruments used in are: differenced equations: I_{t-3}/K_{t-4} to I_{t-5}/K_{t-6}, Δy_{t-3} to Δy_{t-5}, $(k-y)_{t-3}$ to $(k-y)_{t-5}$, and C_{t-3}/K_{t-4} to C_{t-5}/K_{t-6}; levels equations: $\Delta(I_{t-2}/K_{t-3})$ and $\Delta(\Delta y_{t-2})$.

Notes. Sample period: 1988-1997. Wald is a test of joint significance of the coefficients on the cash flow interactions asymptotically distributed as χ^2[df] under the null. See also notes for Table 4.1.

6. Conclusions

The hypothesis that modern corporations are characterised by the separation of ownership and control, as first proposed by Berle and Means (1932), has led to a large, if controversial, literature investigating the link between ownership structure and corporate value. Few empirical studies have, however, analysed the relationship between ownership structure and company investment.

In this chapter we have investigated this relationship by providing some preliminary evidence on the influence of ownership structure on the sensitivity of investment to the availability of internal finance. The analysis has been based on two different samples of UK and US firms for which company accounts data have been matched with detailed information on beneficial share ownership. In spite of the differences in the available ownership information, both data sets allowed us to estimate the impact of different degrees of ownership concentration and of different types of shareholders on the investment-cash flow relationship.

A result common to both the UK and the US samples is that cash flow has a significant and positive impact on investment spending when the free-rider problems associated with monitoring management performance are likely to be most severe; that is, when ownership is dispersed and/or the largest shareholders are passive shareholders (e.g., non-banking financial institutions). In contrast, cash flow has no impact on investment when managers' interests are either more likely to be aligned with shareholders' interests or when shareholders have a greater incentive to monitor managerial behaviour; that is, when ownership is concentrated and/or the largest shareholders are individuals. For the sample of UK firms, where the data allowed us to break down institutional ownership into different categories of financial institutions, cash flow appears to have a particularly strong impact on the investment expenditures of firms with a high level of total insurance company ownership.

Information on shareholdings by managers and directors of US firms also allowed us to investigate the impact of total managerial ownership on company investment behaviour. Regression results from an error correction model provide evidence of a non-monotonic relationship between managerial shareholdings and the sensitivity of investment to cash flow. Thus, as insider holdings increase from an initial point of zero, investment becomes more sensitive to cash flow. At higher levels of insider ownership, investment-cash flow then sensitivities decrease with insider holdings.

Although suggestive, the findings of this chapter represent only a first step towards a better understanding of the impact of ownership structure on company investment behaviour. Hence, at this initial stage it is not possible to discern whether the positive relationship between internal finance and investment spending when ownership is dispersed and/or the main shareholders are passive shareholders reflects the impact of financial constraints on investment, or free cash problems due to the separation of ownership and control. Both effects may plausibly be argued to be greater in cases where managers have more discretion to deviate from value-maximising investment policies. In future research we will focus on the investigation of this and related issues.

APPENDIX D

Securities Exchange Act, 1934

VI. Rule 13d-3. Determination of Beneficial Owner

(a) For the purposes of Sections 13(d) and 13(g) of the [Securities Exchange] Act a beneficial owner of a security includes any person who, directly or indirectly, through any contract, arrangement, understanding, relationship, or otherwise has or shares:

(1) Voting power which includes the power to vote, or to direct the voting of, such security; and/or

(2) Investment power which includes the power to dispose, or to direct the disposition of, such security.

(b) Any person who, directly or indirectly, creates or uses a trust, proxy, power of attorney, pooling arrangement or any other contract, arrangement, or device with the purpose or effect of divesting such person of beneficial ownership of a security or preventing the vesting of such beneficial ownership as part of a plan or scheme to evade the reporting requirements of Section 13(d) or 13(g) of the Act shall be deemed for purposes of such sections to be the beneficial owner of such security.

(c) All securities of the same class beneficially owned by a person, regardless of the form which such beneficial ownership takes, shall be aggregated in calculating the number of shares beneficially owned by such person.

Chapter 8

Summary and Conclusions

1. Summary

In this thesis we have investigated whether capital market imperfections affect company investment expenditures. Firm-level panel data have been used to estimate two different models of company investment in physical capital that test for the importance of financial market imperfections on firms' investment decisions. These models are an error correction specification augmented with a cash flow term (proxying for the change in internal net worth), and an Euler equation model derived from dynamic optimisation in the presence of symmetric, quadratic costs of adjustment. Our preferred econometric results have been obtained using a system Generalised Method of Moments (GMM) estimator, proposed by Arellano and Bover (1995), which uses lagged differences of the regressors as instruments for the equations in levels, in addition to lagged levels of the regressors as instruments for the equations in first differences.

The main findings of the empirical analysis are summarised below.

Chapter 4

In Chapter 4 an unbalanced panel of 710 individual, legally independent, Italian companies for the period 1986 to 1996 has been used to investigate the impact of financial variables on the investment decisions of Italian manufacturing firms. For the full sample of firms, we found evidence of a significant relationship between financial variables and investment spending. On

the one hand, the estimated coefficient on the cash flow term in the error correction specification was found to be significantly positive. On the other hand, the Euler equation model derived under the null of financial constraints was rejected. Although the dynamics implied by the adjustment cost model were not rejected by the data and we allowed for imperfect competition, the diagnostics provided some evidence of mis-specification of the model, and the estimated coefficient on the gross operating profits term had the wrong sign for the Euler equation interpretation of the model.

Following Fazzari, Hubbard and Petersen (1988), we also employed a split-sample approach, dividing the full sample of firms according to size and form of control. In the estimates for the error correction model, no cash flow effect was found for the firms that are in a position to credibly communicate private information to outside investors and/or are able to increase the supply of low cost internal finance (either large or group firms). In contrast, a strong effect from cash flow was found for firms in a weak informational and liquidity position (small and independent firms). At the same time, regression results from the Euler equation model suggest that there are important departures from the perfect-capital-market specification for the latter firms.

Chapter 5

In Chapter 5 we analysed the impact of capital market imperfections on investment in R&D by Italian firms. Since for our sample of Italian manufacturing firms information on R&D investment was available only for the period 1992 to 1994, and not for the whole period 1986 to 1996, it was not possible to estimate dynamic models of R&D investment. In order to investigate whether financial variables have a significant impact on innovative behaviour, we then examined the relationship between fixed investment and internal finance over the period 1986 to 1996 for samples of R&D performing and non-R&D performing firms (based on the R&D spending information for the period 1992-94). The rationale for this exercise was the

observation that firms that expect to be able to finance a larger share of their investment from internal funds are both more likely to undertake long-term R&D investment and less likely to encounter binding financing constraints that affect their fixed investment spending.

Regression results from both an error correction specification and the more structural approach of the Euler equation provided evidence that only for the non-R&D performing firms is physical investment spending sensitive to the availability of internal finance. This suggests that firms in a strong liquidity position are more likely to undertake long-run commitments to R&D investment projects. The basic finding held up when subjected to a number of robustness tests, which included the estimation of R&D status probits and of fixed investment equations for subsets of companies split according to either the firm's information position or the characteristics of its R&D activity.

Chapter 6

In Chapter 6 we investigated the impact of financial variables on the investment expenditures of UK, US and Italian firms in a comparative study. The empirical analysis was based on company accounts covering the period 1986 to 1997 for the UK and the US firms, and the period 1986 to 1996 for the Italian firms. Since UK and US firm-level data are typically based on consolidated company accounts data, the Italian data set used here contained the consolidated accounts of corporate groups, instead of the unconsolidated accounts for legally independent companies used in Chapters 4 and 5. Since consolidated financial statements were available exclusively for the largest corporate groups and, in the majority of the cases, only from the beginning of the 1990s, the number of firms in the Italian data set (118 firms) was relatively lower than in the UK and US data sets (466 and 457 firms, respectively).

Despite these differences in the sample size, the comparison across countries provided interesting evidence on the different impact of financial variables on firms' investment spending. In accord with theoretical predictions that suggest that *outsider control* financial

systems may perform less well in channelling investment funds to firms with profitable investment opportunities than do *insider control* systems, financial variables were found to play a significant role in the investment equations only for the samples of UK and US firms, and not in the investment equations for the sample of Italian firms. These results were found to be robust to using both different specifications of the error correction models and the more structural approach of the Euler equations. Moreover, a number of robustness tests suggested that evidence of a strong investment-cash flow sensitivity in the UK and the US cannot be explained away on the grounds of differences across countries in the ability of current cash flow to forecast future real sales growth, or as reflecting differences in the composition of our samples by firm size.

Chapter 7

Chapter 7 presented some preliminary evidence on the influence of ownership structure on the sensitivity of investment to cash flow in Britain and the United States. For this purpose we obtained detailed data on beneficial share ownership for two samples of listed UK and US companies. This ownership information, matched with company accounts data, allowed us to test whether a high level of total institutional ownership is associated with a greater sensitivity of investment to the availability of internal finance. Evidence of a strong link between investment expenditure and cash flow was found for the sample of UK firms where insurance companies hold a high proportion of the firm's outstanding equity. Likewise, both for the UK and the US samples, investment spending was found to be strongly related to cash flow for firms where the largest shareholder is a non-banking financial institution. In contrast, no relationship between internal finance and investment was found for firms where the largest shareholder is an individual. The econometric analysis also provided some weak evidence both for the UK and the US firms, that the more dispersed is the ownership structure the greater is the sensitivity of investment spending to the availability of internal finance.

Information on shareholdings by managers and directors of US firms also allowed us to investigate the impact of total managerial ownership on company investment behaviour. Regression results from an error correction model provided evidence of a non-monotonic relationship between managerial shareholdings and the sensitivity of investment to cash flow. Thus, as insider holdings increase from an initial point of zero, investment becomes more sensitive to cash flow. However, at high levels of insider ownership, investment-cash flow sensitivities then decrease with insider holdings.

2. Concluding remarks

The empirical findings of this thesis are consistent with the hypothesis that capital market imperfections have a significant impact on company investment behaviour. Investment expenditures by a significant fraction of the firms analysed appear to be positively related to the availability of internal funds. A positive relationship between internal finance and investment spending is found for Italian firms in a weak informational and/or liquidity position (small and independent firms, non-R&D performing firms) and for firms that raise their finance in countries characterised by outsider control, market-based financial systems (UK and US firms). This relationship is not found for Italian firms in a strong informational and/or liquidity position (either large or group firms, and R&D performing firms), and in the consolidated accounts of large Italian corporate groups more generally. This evidence is interpreted as reflecting important imperfections in the financial markets, which lead to a wedge between the cost of external and internal finance.

The significance of the cash flow coefficients in the reduced form error correction model for the samples of firms classified as financially constrained could in principle reflect information relevant for expectations of future profitability rather than the impact of financial constraints on investment, although if this is the correct interpretation it is surprising that no

cash flow effect is observed for the samples of firms classified as financially unconstrained. This interpretation is also less appealing in the context of the more structural Euler equation model, where the model derived under the null hypothesis of perfect capital markets is usually rejected in the former samples, but not in the latter samples.

Most of the existing literature on capital market imperfections focuses on the relationship between internal finance and investment expenditures as arising from conflicts of interests between informed firm insiders (existing shareholders and managers) and relatively uninformed outside investors. Our last empirical chapter suggested a different corporate control perspective by considering the impact on company investment of passive insiders (small shareholders, non-banking financial institutions) and of potentially active insiders (large individual shareholders and managers). Although preliminary, the results of this investigation indicate that the identity of the principal shareholders and the degree of ownership concentration affect the relationship between investment and cash flow. Whether this relationship reflects financial constraints on investment or "free cash flow" problems due to the separation between ownership and control will be an important question for future research.

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