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ABSTRACT

Does Firm Size Matter? Evidence on the Impacts of Liquidity Constraints on Firm Investment Behaviour in Germany*

This paper examines the link between liquidity constraints and investment behaviour on the one hand, and firm size on the other for a large sample of German firms over the time period 1968–85. The results indicate that smaller firms tend to have investment functions which are more sensitive to liquidity constraints than do the larger enterprises. These results support the hypothesis that smaller firms tend to be disadvantaged relative to their larger counterparts in terms of access to finance. Such liquidity constraints are found to exist in Germany only since the mid-1970s, however. Apparently the German model of finance was able to avoid imposing financial constraints on even smaller enterprises prior to the mid-1970s. Since then, however, the evidence suggests that it has not succeeded in avoiding such liquidity constraints, particularly with respect to the finance of smaller enterprises.

JEL Classification: G0, G1, G2, G3, L0
Keywords: Germany, liquidity constraints, investment

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NON-TECHNICAL SUMMARY

That capital markets are inherently distinct from other markets has been observed in the economics literature for a long time. What makes capital markets distinct is the added feature of risk associated with the demand side of the market. Yet it has only been recently that attention has been devoted to one of the main implications of this risk inherent in loaning credit – capital markets do not, in fact, always clear, in that supply equals demand for any given price level.

The purpose of this paper is to explicitly examine the link between firm size and the extent to which liquidity constraints are imposed in Germany. We do this by examining investment behaviour across firm size using the Q theory of investment model. In particular we examine the suggestion of a series of recent studies that the institutional structure of Germany precludes liquidity constraints from occurring. There are two institutional features of the German financial system that sharply contrast with that practised in the United States and the United Kingdom, both of which may affect the extent to which liquidity constraints occur. First, companies in Germany typically rely heavily upon banks for external finance. The external capital market remains relatively undeveloped. Second, not only do the banks represent the major financial intermediary supplying capital to firms, but they are also extensively represented on the supervisory boards of companies. John Cable (1985) refers to this peculiarity of the German financial system which links finance to supervision as a quasi-internal capital market.

While considerable attention has been placed on the role that the Big Three private banks – the Deutsche Bank, Dresdner Bank and the Commerzbank – play in terms of financing the largest manufacturing corporations of Germany, considerably less emphasis has been placed on the other institutions comprising the German financial system. In fact, the *Big Three* German banks account for slightly less than one-tenth of all banking assets. By contrast is the existence of a broad spectrum of financial intermediaries mandated with channelling funds into the German *Mittelstand*, or small- and medium-sized enterprises, which has resulted in the emergence of mechanisms providing smaller banks with access to long-term, fixed rate funds. Such mechanisms do not exist in the United States and the United Kingdom and ensure: (i) special credit institutes which, among other things, issue bonds on national bond markets to refinance long-term fixed rate loans to small firms; (ii) refinancing and risk pooling mechanisms within both the savings bank and cooperative bank sectors; and (iii) mechanisms allowing for the channelling of a high

proportion of long-term savings held at insurance companies to the banks through bank bonds. It is the existence of this infrastructure that supposedly defuses the problem of liquidity constraints confronting smaller enterprises found to exist in the United States and the United Kingdom.

The extent of financial constraints is linked to firm investment behaviour through the lens of the Q theory of investment. The Q framework is based on the assumption that in the absence of capital market imperfections (and taxes), the value-maximizing firm will continue to invest as long as the shadow price of a marginal unit of capital, Q, exceeds unity. The equilibrium level condition for a profit maximizing enterprise is met when the value of a marginal unit of capital is equated to the cost of replacing that capital, ensuring that the marginal value of Q is unity.

One of the greatest impediments to measuring the impact of liquidity constraints on firm investment behaviour in Germany has been the lack of a reliable and comprehensive panel data set. We employ a data base consisting of a collection of financial reports of German industrial corporations quoted on the German stock exchange over a long period of time.

We find no evidence that the institutional structure of finance in Germany has been able to avoid the impact of liquidity constraints. In particular, we find that the impact of liquidity constraints on investment behaviour tends to increase systematically as firm size decreases. Smaller enterprises tend to be more vulnerable to financing constraints than their larger counterparts, even under the German model of finance where the spread between large- and small-firm lending rates is relatively low. There is, however, evidence that the German model was able to avoid financing constraints on German enterprises prior to the mid-1970s. A particularly striking feature of this era in West Germany was a relative abundance of cheap credit. This era, however, seems to coincide with the *Wirtschaftswunder* in Germany. Since the mid-1970s, there is no evidence that German firms, particularly the smaller enterprises, have been able to avoid finance constraints.

1. Introduction

That capital markets are inherently distinct from other markets has been observed in the economics literature for a long time. And what makes capital markets distinct is the added feature of risk associated with the demand side of the market. Yet, it has only been recently that attention has been devoted to one of the main implications of this risk inherent in loaning credit -- capital markets do not, in fact, always clear, in that supply equals demand for any given price level. This has moved Alan S. Blinder (1988, p. 196) to observe that, "A few years ago, in revising my graduate course reading list, I looked for some modern literature on liquidity constraints and investment. There was none."

Since Blinder's (1988) dismal observation, a wave of studies have been published linking liquidity constraints to capital market conditions. A key theoretical contribution by Stiglitz and Weiss (1981) is that the propensity for an enterprise to be subject to credit rationing is not neutral with respect to firm size. Rather, as a result of adverse selection in a market with asymmetric information the likelihood of credit rationing tends to systematically increase as firm size decreases. In fact, Fazzari, Hubbard and Petersen (1988) found systematic evidence that liquidity constraints do, in fact, tend to be more biding as firm size decreases. Still, after reviewing the empirical evidence gathered by 1993 , Chirinko (1993, p. 1904) concludes that, "While the recently generated evidence points to the importance of financial structure and liquidity constraints, their sources and severity remain open questions." In fact, Edwards and Fischer (1994) have questioned even the existence of liquidity constraints under the German system of finance. They have suggested that while the extent of such liquidity constraints may be shaped by the financial institutions specific to each country; but conclude that the German model of investment financing is effectively no different from the Anglo-Saxon model for the firm. In general the lack of empirical studies on German firm investment behaviour has left many important economic questions unanswered.

The purpose of this paper is to explicitly examine the link between firm size and the extent to which liquidity constraints are imposed in Germany. We do this by examining investment behaviour across firm size using the Q theory of investment model. In the second section of the paper we introduce the theories relating firm size to investment and liquidity

constraints and explain why the German model of finance may produce results different from the Anglo-Saxon model. In the third section we explain the Q theory of investment and how it can be applied to shed light on the extent of liquidity constraints for specific firms. Measurement issues are discussed in the fourth section. In the fifth section *generalised method of moments* (GMM) estimation is used to investigate investment behaviour for 138 West German firms between 1968 and 1985. In the last section a summary and conclusions are presented. We find considerable evidence suggesting that smaller firms tend to experience a greater degree of liquidity constraints than do their larger counterparts in Germany. This supports the hypothesis that smaller firms tend to be disadvantaged in terms of access to the financial markets, even under the German model of financial institutions.

2. Firm Size, Investment, and Financial Constraints

In reviewing the role of financial constraints on investment behaviour, Chirinko (1993, p. 1902) observed that, "The investment literature has been schizophrenic concerning the role of financial structure and liquidity constraints." As Fazzari, Hubbard and Peterson (1988, p. 141) point out, "Empirical models of business investment rely generally on the assumption of a 'representative firm' that responds to prices set in centralised security markets. Indeed, if all firms have equal access to capital markets, firms' responses to changes in the cost of capital or tax-based investment incentives differ only because of differences in investment demand." That is, the financial structure of a firm does not play an important role in investment decisions, since the firm can costlessly substitute external funds for internal capital. Under the assumption of perfect capital markets, then, firm-specific investment decisions are generally independent of the financial condition of that firm.

The assumption of perfect capital markets has, of course, been rigorously challenged. And once it is no longer assumed that capital markets are perfect, it also can no longer be assumed that external capital is a costless substitute for internal capital. An implication of this view is that the availability of internal finance, access to new debt or equity finance, and other financial factors may shape firm investment decisions.

Which view is correct? According to Fazzari, Hubbard and Peterson (1988, p. 142), "Conventional representative firm models in which financial structure is irrelevant to the investment decision may well apply to mature companies with well-known prospects. For other firms, however, financial factors appear to matter in the sense that external capital is not a perfect substitute for internal funds, particularly in the short run."

There are compelling reasons why liquidity constraints become more severe as firm size decreases. Stiglitz and Weiss (1981) pointed out that, unlike in most markets, the market for credit is exceptional in that the price of the good -- the rate of interest -- is not necessarily at a level that equilibrates the market. They attribute this to the fact that interest rates influence not only demand for capital but also the risk inherent in different borrowers. As the rate of interest rises, so does the riskiness of borrowers, leading suppliers of capital to rationally decide to limit the quantity of loans they make at any particular interest rate. The amount of information about an enterprise is generally not neutral with respect to size. Rather, as Petersen and Rajan (1992, p. 3) observe, "Small and young firms are most likely to face this kind of credit rationing. Most potential lenders have little information on the managerial capabilities or investment opportunities of such firms and are unlikely to be able to screen out poor credit risks or to have control over a borrower's investments." If lenders are unable to identify the quality or risk associated with particular borrowers, Jaffe and Russell (1976) show that credit rationing will occur. This phenomena is analogous to the lemons argument advanced by George Akerloff (1970). The existence of asymmetric information prevents the suppliers of capital from engaging in price discrimination between riskier and less risky borrowers. But, as Diamond (1991) argues, the risk associated with any particular loan is also not neutral with respect to the duration of the relationship. This is because information about the underlying risk inherent in any particular customer is transmitted over time. With experience a lender will condition the risk associated with any class of customers by characteristics associated with the individual customer.

Larger firms can finance capital expenditures from internal earnings, issuance of equity, or debt. By contrast, small firms are limited in the extent of their internal earnings and the

potential for issuing equity.[2] In Germany in particular since 1974, firms have been obligated by law to retain pension funds for employees. These funds, which can run into billions of deustche marks, have become an important alternative source of firm financing, particularly for the larger firms. It is expected that this would loosen the impact of liquidity constraints across firms, but particularly for the largest firms. In terms of the study, any results indicating binding liquidity constraints after 1974 should be strengthened.

A series of recent papers has found that liquidity constraints tend to have a greater impact on smaller enterprises than on their larger counterparts. In particular, small firms are more likely to be unable to obtain capital at market interest rates and therefore subject to credit rationing. Fazzari, Hubbard, and Petersen (1988) found that smaller publicly traded firms face liquidity constraints and that such smaller enterprises in particular experience difficulties obtaining capital during periods of macroeconomic downturns. That is, the likelihood of a firm experiencing a liquidity constraint decreases along with increasing firm size. According to Fazzari, Hubbard and Petersen, smaller firms tend to be more dependent upon internal finance or bank loans than are their larger counterparts.[3] While the large firms in their study issued 99 percent of all new equity shares and 92 percent of all new corporate bonds, they accounted for only 74 percent of total manufacturing assets. Because smaller firms are more dependent upon loans from commercial banks, they are more prone to experiencing a credit crunch, especially during recessions. Fazzari, Hubbard and Petersen find evidence suggesting that the credit sources for smaller firms tend to dry up more rapidly during economic downturns than do the credit sources for larger enterprises.

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[2]For example, Andrews and Eisemann (1984) found that the flotation costs for non convertible notes and debentures offered to the public through security dealers fell from 17.0 percent for issues of between $1 million, and $2 million, to 6.2 percent for issues between $2 million and $5 million, and to 1.0 percent for issues exceeding $50 million. The authors note that when the interest expense is added to the flotation costs, the first-year total cost of raising funds can easily exceed 30 percent for a small firm.

[3]Not surprisingly, small enterprises more frequently turn to commercial banks for funding of capital projects. But, as Stoll (1984) notes, smaller firms typically face higher credit costs than do their larger counterparts. For example, a Federal Reserve Board study of loan rates charged by commercial banks on loans made between November 3 and November 7, 1986 found that short-term loans at a fixed rate had an average rate of 11.2 percent for loans of less than $24,000. However, the rate fell steadily to a mean of 6.8 percent for loans exceeding $1 million. For loans with a floating rate, the differential was not quite as great. The smallest loans had an average rate of 9.7 percent, while the largest loans were for 7.5 percent. Very similar patterns were identified for long-term loans at both fixed and floating rates (United States Small Business Administration, 1987, Table A2.7, p. 91). Thus, the evidence clearly indicates that the cost of capital tends to fall as the size of the loan increases.

Not only is considerably less known about the extent of liquidity constraints in other countries, such as Germany, but in fact there has been a series of recent studies suggesting that the institutional structure of Germany precludes liquidity constraints from occurring.[4] There are two institutional features of the German financial system that sharply contrast to that practised in the United States and the United Kingdom, both of which may impact the extent to which liquidity constraints occur. First, companies in Germany typically rely almost exclusively upon banks for external finance. The external capital market remains relatively undeveloped. Second, not only do the banks represent the major financial intermediary supplying capital to firms, but they are also extensively represented on the supervisory boards of companies. Cable (1985, p. 119) refers to this peculiarity of the German financial system which links finance to supervision as a "quasi-internal capital market".

Some studies have mentioned that the spread in lending rates between the largest and the smallest firms is lower in Germany than in the UK or the US. This is due in part to the effect of strong local and regional bank networks who target as customers the small and medium firms. It is still unclear however, how much this spread in rates effects German firm investment behavior between different sizes of firms.

While considerable attention has been placed on the role that the *Big Three* private banks play[5] in terms of financing the largest manufacturing corporations of Germany,[6]considerably less emphasis has been placed on the other institutions comprising the German financial system. Vitols (1994) points out that, in fact, the *Big Three* German banks only account for slightly less than one-tenth of all banking assets.[7] The bulk of credit from the *Big Three* private banks is channelled into the largest German firms. According to Vitols (1994, p. 7), "These banks have traditionally confined their industrial lending activities to larger corporate accounts." The largest financial institutions are the *Sparkassen*, which are essentially public savings banks, and the *Genossenschaftsbanken*, which essentially are co-operative banks. While the *Sparkassen* account for around 40 percent of all banking assets, the *Genossenschaftsbanken* account for

[4]See for example Allen (1990), Cable (1985), and Soskice (1992)
[5]The *Big Three* German banks are the Deutsche Bank, Dresdner Bank and the Commerzbank.
[6]See for example Cable (1985).
[7]The Monthly Report of the Deutsche Bundesbank (April 1989, p. 15, Table 4.1) points out that the market share of the *Big Three* fell from 10.2 percent in 1970 to 10.6 percent in 1978 to 8.9 percent in 1988.

about 15 percent of total banking assets (Deeg, 1992). These financial institutions are generally oriented towards financing the *German Mittelstand*, or small- and medium-sized firms in Germany. While the economic and political power of the *Big Three* German banks, particularly in terms of providing finance and direction to the largest firms of Germany, has tended to pre-empt the attention from overseas, what must be one of the better kept secrets of Germany is the magnitude and role that these other institutions play in shaping the overall financial landscape of Germany -- particularly in providing finance to smaller enterprises.

The existence of these financial intermediaries channelling funds into the German *Mittelstand* has resulted in the emergence mechanisms providing smaller banks access to long-term, fixed rate funds. As Vitols (1994, p. 12) points out, "These mechanisms, which are less developed or less absent in the United States and United Kingdom, include (1) special credit institutes which among other things issue bonds on national bond markets to refinance long-term fixed-rate loans to small firms, (2) refinancing and risk pooling mechanisms within both the savings bank and co-operative bank sectors, and (3) mechanisms allowing for the channelling of a high proportion of long-term savings held at insurance companies to the banks through bank bonds. Roughly two-thirds of long-term bank lending to small companies is refinanced through these three mechanisms."

It is the existence of this infrastructure of financial institutions mandated with providing the German *Mittelstand* with finance that supposedly defuses the problem of liquidity constraints confronting smaller enterprises found by Evans and Jovanovic (1989) and Fazzari, Hubbard and Petersen (1988), among others, to exist for the United States. Whether, of course, whether the financial institutions under the German model are, in fact, able to avoid financial constraints imposed upon firms, and particularly smaller sized firms, is an empirical question which will be answered in the following sections. As Petersen and Rajan (1992, p. 1) point out, "One way to overcome frictions is for firms to build close relationships with the suppliers of capital. These relationships allow the lender to collect information about the borrower and their investments and to monitor the actions of the borrower."

3. The Q Theory of Investment Model

We link the extent of financial constraints to firm investment behaviour through the lens of the Q theory of investment.[8]The Q framework is based on the assumption that, in the absence of capital market imperfections (and taxes), the value-maximising firm will continue to invest as long as the shadow price of a marginal unit of capital, Q, exceeds unity. The equilibrium level condition for a profit maximising enterprise is met when the value of a marginal unit of capital is equated to the cost of replacement of that capital, ensuring that the marginal value of Q is unity. This measure of Q effectively controls for the assessment by the market of the investment opportunities available to the firm. As Chirinko (1993, p. 1903) points out, "Even though financial market frictions impinge on the firm, Q is a forward-looking variable capturing the ramifications of these constraints on all the firm's decisions. Not only does Q reflect profitable opportunities in physical investment, but, depending on circumstances, Q capitalises the impact of some or all finance constraints as well."

Under the standard application of the Q model of investment behaviour, the dependent variable is investment for firm j in time period t. The investment behaviour of each firm in each period is shaped by the following variables:

1. The marginal incentive of the firm to invest, measured by Q_{jt}. More specifically, Q_{jt} is defined as the market value of the firm over the replacement cost. This is calculated as the total market value of the firm's equity plus the market value of debt, for firm j in period t, divided by the value of the adjusted capital stock of the firm including inventories.

2. Cash flow, or CF, is a proxy measure of the degree to which a firm is subjected to a liquidity constraints.

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[8]The Q theory of investment was introduced by Brainard and Tobin (1968) and Tobin (1969). Their studies focused on linking the financial sector of the economy to the real sector of the economy, where it was assumed that assets in the economy consist solely of money and capital.

3. Lagged investment, I_{t-1}. Chirinko (1987), among others, have established the importance of including lagged investment in the Q model specification in order to control for the past level of investment by the firm.

4. Y is is a measure of the firm's net of tax Sales, which can be structurally interpreted as a measure of the productivity of the firm.

Thus, the model, stated in terms of first differences, to be estimated is specified as:

$$\frac{I_{jt}}{K_{jt}} = \beta_0 + \beta_1 \frac{I_{jt-1}}{K_{jt-1}} + \beta_2 Q_{jt} + \beta_3 Q_{jt-1} + \beta_4 \frac{CF_{jt}}{K_{jt}} + \beta_5 \frac{Y_{jt}}{K_{jt}} + \varepsilon_{jt} \quad (1)$$

The impact of liquidity constraints on firm investment behaviour can be inferred by estimating Equation (1) unconstrained and omitting CF to estimate a constrained regression. The significance and impact of liquidity constraints is then gauged by constructing a *J-Jcf* statistic based on the constrained and unconstrained estimated regressions. The importance of firm size affects can then be determined by comparing the results of the specification tests, where the *J* statistic is distributed asymptotically χ^2 with *m-k* degrees of freedom.[9] Calculating this test statistic will enable us to infer, "Is cash flow a significant determinant of investment in Germany?" In addition, estimating Equation (1) separately for different size classes of firms enables us to shed light on the question, "Are there any differences in terms of the investment sensitivity to liquidity constraints based on firm size in Germany?"

4. Measurement

One of the greatest impediments to measuring the impact of liquidity constraints on firm investment behaviour in Germany has been the lack of a reliable and comprehensive panel data set. The Bonn Database is a new source of data tracking the financial performance of a comprehensive set of German firms over a long period of time, 1961-1985. The Bonn Database is a collection of financial reports of German industrial corporations quoted on the

[9]M represents the number of instruments or orthogonality conditions in the model and k represents the number of parameters to be estimated.

German stock exchange.[10] The initial year in the data base is 1961, because this was the first year that firms were required to publish sales data according to the 1959 Accounting Reform Act. This led to the listing of over 700 firms. Because of mergers, bankruptcies, acquisitions, changes in legal status, double listing of consolidated and non-consolidated information, only 295 firms remained in 28 industrial branches as of 1980. From this population, a sample of 139 firms for which complete information was available was formed. This sample accounts for more than 70 percent of total German manufacturing activity in 1980.

The mean value of the 1968 capital stock of the 138 German firms in the sample is DM 373.41 million, with a standard deviation of DM 1, 045.54 million. The minimum value of the capital stock is DM 1.73 million and the maximum value is 6,576.61 million. The mean employment of the sample is 8,211.23 employees, with a standard deviation of 22,736.26 employees. The minimum number of employees is 65, and the maximum number of employees is 192, 988. There are two points to be emphasised concerning the data sample. First, as evidenced by the range and the mean, there is considerable variation across firm size within this sample of German firms. Second, virtually all of the firms included in the sample are large. The firms in the data base comprise the largest 2 percent of the German enterprise population. Because of the importance of this sample, in terms of its contribution to economic activity in Germany, it is important to understand how firm size and liquidity constraints impact investment behaviour. It should be pointed out that the spectrum of firm size is roughly equivalent to that used by Fazzari, Hubbard and Peterson (1988)[11] to examine the link between liquidity constraints and firm size in the United States. Further, we believe that any evidence linking liquidity constraints to firm size within this sample of the largest German firms would suggest the existence of such a relationship for the entire population of German firms.

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[10]Sources for the Bonn Database include annual business reports of firms, the *Handbuch der Aktiengesellschaften*, *Wer gehört zu Wem*, and the *Statistisches Jahrbuch*. The data base was constructed under the direction of Professor Horst Albach at the Business and Economics Institute of the University of Bonn.

[11]Fazzari, Hubbard and Peterson (1988) point out for their sample consisting of four classes that, "While class 1 firms are small relative to firms in class 4, they are still large relative to U.S. manufacturing corporations in general; 85 percent of manufacturing corporations had smaller capital stocks than the average class 1 firm...we deal with fairly large firms even in class 1."

Since 1961 there have been two major reporting standards revisions which have affected the contents of the database. The first of these was the Corporations Act of 1959, which compelled firms to publish sales data. The second was the Corporation Act of 1965, under which the accounting rules for the valuation of plant, equipment, and inventories, as well as profits, were tightened. For example, if BASF's 1981 equity was valued under U.S. SEC rules rather than under German law, the valuation would be 40 percent higher than reported according to the new German rules.[12]

The data for each variable included in Equation (1) are measured in terms of German deutsche marks and are adjusted for inflation using 1985 as the base year. The market value of firm equity at time t, or V_t, is calculated by adding the end of year closing prices on stocks (P_t) times the number of outstanding shares (E_t) to the market value of preferred stock (S_t), plus the market value of the firm's debt.

$$V_t = pE_t + S_t + B_t \qquad (2)$$

The market value of debt B_t is calculated by adding the adjusted book value of long-germ, medium-term, and short-term debt. For example, long-term debt is calculated as the sum of reserve holdings for pensions, bonds with a term in excess of four years, loans from banks with terms in excess of four years, miscellaneous accounts payable with terms in excess of four years, the German equalisation levy, liabilities to shareholders, minus any amount due on the above items before the end of the four-year term. Medium-debt is calculated using a discount factor for accrued liability portions of one-third, and short-term debt is calculated using a discount factor for accrued liability of two-thirds.

The replacement cost of the firm was calculated as the adjusted total tangible fixed assets of the firm plus inventories. This includes the total tangible assets of the firm minus accumulated depreciation to property and current assets, undeclared valuation reserves, net losses, and capital stock subscriptions receivable. The valuation of inventories is based on

[12]For further explanations see Albach (1984).

moving averages and added to capital stock in the denominator of the tax adjusted Q equation. The standard *Fifo* and *Lifo* measures typically applied in the United States cannot be used for taxation purposes in Germany; instead firms use the same valuation method for inventories in their financial reports as they do in their tax returns. Adjusted definitions of capital and sales are based on the balance sheet format as prescribed by German law, which corresponds roughly to the historical cost. Capital stock was adjusted with a depreciation factor constructed from the index of actual to replacement cost of capital in each manufacturing sector from the German Statistical Yearbook. Unfortunately, calculation of assets does not include data from the firm's research and development activities because firms are not required by law to publish this information.

The cash flow of each firm is calculated as the net income (or loss) to the firm, plus depreciation and valuation reserves on fixed assets, intangible properties, and financial assets, minus changes in the year end reserve holdings for pensions. Gross sales, dividend payment information and retrained earnings figures for the firm are taken from the balance sheet of each firm.

5. Empirical Results

In order to explicitly examine the link between liquidity constraints and investment behaviour on the one hand, and firm size on the other, the original sample of 138 firms was decomposed into three size groups of 46 firms, comprising the lowest, middle, and highest values of total capital stock at market value.[13]Because of the oil shocks of 1973, 1974, and 1979, and due to changes in the exchange rate regime in 1973 from a fixed to a floating rate the data are estimated in two nine year waves, 1968-1976, and 1977-1985.

Equation (1) is estimated using the *Generalised Method of Moments* (GMM) procedure, which essentially is an instrumental variable estimation technique estimating the parameters by

[13]While a few firms changed groups between years, there is actually very little movement in the firms across the firm size classes. This is consistent with the fact that the data base consists of older, more stable firms, whose capital stock and investment growth do not vary greatly between periods.

first fitting sample moments to population moments.[14] The estimations were run on first differenced data to remove firm specific effects. In addition, annual dummy variables were included in the regressions in order to control for exogenous shocks in the data, such as the oil shocks of 1973, 1974, and 1979. The results of the GMM estimation of the investment function over the period 1968-1976 are shown in Table 1. Of particular interest is the relatively small and statistically insignificant coefficient of the cash flow measure, not just for the largest enterprises, but also for the smallest enterprises during this period. There does not appear to be evidence that enterprises, regardless of size, were subject to liquidity constraints prior to 1976.

By contrast, the results of the GMM estimation of the investment function over the later period, 1977-1985, shown in Table 2, do provide evidence that German firms are subject to liquidity constraints. The positive and statistically significant coefficients of the measure of cash flow in both the smallest firm group and largest firm group suggest a shift in the fundamental financial regime in Germany before and after the mid-1977s. In fact, as the higher value for the J coefficient, comparing constrained (with the cash flow measure omitted) and unconstrained regressions suggests, the impact of the liquidity constraints tends to be the greatest for the smallest firms.[15] By contrast, the values of the J statistic for the largest enterprises and medium-sized firms is too small to be considered to be statistically significant.

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[14]The GMM method of estimation was first popularised by Hansen and Singleton (1982) in the context of estimating the first order conditions of dynamic optimisation problems.

[15]The J function is given by: $J = N\left(\frac{\varepsilon' X}{N}\right)V^{-1}\left(\frac{X'\varepsilon}{N}\right) \equiv \chi^2_{(m-n)}$, where N is the sample size and ε is the stacked error vector. The J statistic is asymptotically distributed as a χ^2 with $(m\text{-}n)$ degrees of freedom, where m is the total number of instruments or orthogonality conditions and n is the number of parameters. The J statistic can then be used to test the set of over-identifying restrictions that there are more orthogonality conditions than parameters.

Table 1: GMM Estimation of Investment for German Firms, 1968-1976

	$\frac{I_t}{K_t}$	Q_t	Q_{t-1}	$\frac{CF_t}{K_t}$	$\frac{Y_t}{K_t}$	J (prob.)	*J-Jcf*
Smallest Firms	0.171 (0.058	-0.097 (0.02	-0.0056 (0.021)	0.0245 (0.149)	0.0077 (0.006)	30.95 (0.320)	0.17
	0.181 (0.035	-0.071 (0.02	-0.0177 (0.017)	--	0.0085* (0.005)	30.778 (0.375)	--
Medium-Size Firms	0.036 (0.040	0.02 (0.01	0.0239* (0.006)	0.5545* (0.055)	-0.0616* (0.007)	25.06 (0.625)	0.18
	0.040 (0.044	0.03 (0.01	0.0251* (0.005)	--	-0.0429* (0.006)	25.24 (0.666)	--
Large Firms	0.063 (0.049	-0.075 (0.02	-0.0671* (0.034)	0.1854 (0.106)	-0.0231 (0.016)	26.90 (0.524)	1.30
	0.119 (0.051	-0.070 (0.02	-0.0302 (0.027)	--	-0.0035 (0.010)	28.20 (0.507)	--

Notes: J tests the H_0: Overidentifying Restrictions, with m-k degrees of freedom.
J-Jcf tests H_0: CF=0, with 1 degree of freedom.
*indicates that the coefficient is statistically significant for an asymptotic t-test at the 95 percent level of confidence.

Table 2: GMM Estimation of Investment for German Firms, 1977-1985

	$\frac{I_{t-1}}{K_{t-1}}$	Q_t	Q_{t-1}	$\frac{CF_t}{K_t}$	$\frac{Y_t}{K_t}$	J (prob.)	J-J_{cf}
Small Firms	0.02 (0.09	0.0079 (0.015)	0.0079 (0.018)	0.0838* (0.044)	-0.0243 (0.004)	26.790 (0.530)	2.71
	0.04 (0.06	0.0212 (0.016)	0.0232 (0.019)	--	-0.0198 (0.003)	24.070 (0.685)	--
Medium-Sized Firms	0.26 (0.04	0.1325* (0.021)	-0.0101* (0.001)	-0.0494 (0.040)	0.0534* (0.009)	26.520 (0.544)	0.39
	0.25 (0.04	0.1301* (0.019)	-0.0101* (0.001)	--	-0.0498* (0.007)	26.910 (0.577)	--
Large Firms	0.08 (0.04	0.1110* (0.029)	-0.0945* (0.024)	0.1702* (0.055)	-0.1402* (0.011)	27.920 (0.468)	0.27
	0.09 (0.04	0.1359* (0.025)	-0.1001* (0.022)	--	-0.1271 (0.027)	28.19 (0.508)	--

Notes: J tests the H_0: Overidentifying Restrictions, with m-k degrees of freedom.
J-Jcf tests H_0: CF=0, with 1 degree of freedom.
*indicates that the coefficient is statistically significant for an asymptotic t-test at the 95 percent level of confidence.

The difference in the impact of liquidity constraints on the investment behaviour of smaller firms between the earlier period, prior to the mid-1970s and the later period, subsequent to the mid-1970s is striking. Apparently these firms were not subject to significant liquidity constraints prior to the mid-1970s but became subject to liquidity constraints subsequent to 1970s. Consistent with these results were the changes in the West German discount lending rates which rose substantially from a mean rate of 4.7% between 1968 and 1973 to 5.1% between 1974 and 1980, then down slightly to 4.9% on the average between 1981 and 1992. It may be that the financial institutions of Germany did provide a system of finance that was different from the Anglo-Saxon model, in that liquidity constraints could be avoided -- but only prior to the mid-1970s. Since then, there is no evidence suggesting that the German model of finance has managed to mitigate the impact of liquidity constraints. Rather, the evidence here suggests that not only are liquidity constraints imposed upon firms, but they tend to become more severe as firm size falls.

6. Conclusions

A wave of studies has recently emerged suggesting that the German model of finance is distinct from its Anglo-Saxon counterpart, in that the institutional structure is able to provide adequate liquidity to meet the long-term investment needs of enterprises (Corbett and Jenkinson, 1994; and Cable, 1985). The evidence presented in this paper does not support the hypothesis that the institutional structure of finance in Germany is able to avoid the impact of liquidity constraints. In particular, we find that the impact of liquidity constraints on investment behaviour tends to increase systematically as firm size decreases. As Stiglitz and Weiss (1981) and others have predicted, typically for the United States, smaller enterprises tend to be more vulnerable to financing constraints than their larger counterparts, even under the German model of finance where the spread in large vs small firm lending rates is relatively low.

There is, however, evidence that the German model of finance was able to avoid financing constraints on German enterprises prior to the mid-1970s. We find no evidence that

firms, either large or small, were subjected to liquidity constraints prior to the mid-1970s. A particularly striking feature of this era in West Germany was a relative abundance of cheap credit. This era, however, seems to coincide with the *Wirtschaftswunder* in Germany. Since the mid-1970s there is no evidence that German firms, particularly the smaller enterprises, have been able to avoid finance constraints.

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