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Hamburgisches Welt-Wirtschafts-Archiv (HWWA)
Hamburg Institute of International Economics
Öffentlichkeitsarbeit
Neuer Jungfernstieg 21 • 20347 Hamburg
Telefon: 040/428 34 355
Telefax: 040/428 34 451
e-mail: hwwa@hwwa.de
Internet: http://www.hwwa.de/

David B. Audretsch
Indiana University, SPEA
Suite 201, Bloomington
IN 47405, USA

Julie Ann Elston
Department of Economics
University of Central Florida, Orlando
FL 32816-1400, USA

Corresponding author is Julie Ann Elston, Dept. of Economics, Box 161400, University of Central Florida, Orlando FL 32816-1400, Email: Julie.Elston@bus.ucf.edu
Tel. (407) 823 2078, Fax. (407) 823 3269.

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Abstract

This paper examines the link between liquidity constraints and investment behavior for German firms of different sizes from 1970 to 1986. Results indicate that medium sized firms appear to be more liquidity constrained in their investment behavior than either the smallest or largest firms in the study, suggesting that the unique German infrastructure designed to assist the small firm has indeed succeeded in alleviating, to some degree, such liquidity constraints. Findings also support the hypothesis that the emerging competition and internationalism which characterized the German financial markets in the 1980's, have been improving access to capital for some groups of firms.

Zusammenfassung

Dieser Beitrag untersucht die Beziehung zwischen Liquiditätsbeschränkungen und Investitionsverhalten deutscher Unternehmen unterschiedlicher Größen im Zeitraum 1970 bis 1986. Die Ergebnisse deuten darauf hin, dass das Investitionsverhalten mittlerer Unternehmen stärker von der Liquiditätsseite her beschränkt ist als das der in der Untersuchung berücksichtigten kleinen und großen Unternehmen. Dies spricht dafür, dass die besondere deutsche Infrastruktur, die auf eine Unterstützung kleiner Unternehmen ausgerichtet ist, derartige Liquiditätsbeschränkungen mit Erfolg in gewissem Maße gelockert hat. Die Ergebnisse unterstützen auch die Hypothese, dass der stärkere Wettbewerb und die Internationalisierung, die die deutschen Finanzmärkte in den achtziger Jahren kennzeichneten, einigen Gruppen von Unternehmen den Zugang zu Kapital verbesserten.

1. Introduction

The notion that capital markets are inherently distinct from other markets has long been noted in the economics literature. What makes capital markets distinct is the added feature of risk associated with the demand side of the market. Yet, it is only 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. 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. For example, Fazzari, Hubbard and Peterson (1988), hereafter FHP, found systematic evidence that liquidity constraints tend to be more binding as firm size decreases. Further, after reviewing the empirical evidence, 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 virtually all of the empirical evidence linking liquidity constraints (inversely) to firm size has been restricted to the United States, the United Kingdom and a few other countries (Chirinko, 1993). Not only is little known about Germany, but there are reasons to believe that liquidity constraints are less binding, or even non-existent for some firms in Germany (Deeg, 1999). This is because the unique institutional structure of the German financial system may alleviate or avoid financing constraints. The German institutional structure has, among other traits, financial intermediaries that have close long-term relations to German firms in a way that do not exist in other countries such as the United States. Based on these institutional differences, the German system has been characterized as being bank-based, while the U.S. and United Kingdom represent prototypical market-based financial systems. Whether liquidity constraints can be avoided or at least mitigated under Germany’s unique system of finance remains an empirical question which is the focus of this paper.

In particular, the purpose of this study 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 behavior across firm size using the Q theory of investment model. In the second section of the paper we introduce theories relating firm size to investment and liquidity constraints and explain why the German institutional 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 a regression model is used to estimate investment behavior for 100 West German firms between 1970 and 1986. In the last section a summary and conclusions are presented. We find considerable evidence suggesting that medium-sized firms tend to experience a greater degree of liquidity constraints than do their smaller or larger counterparts in Germany. This refutes the hypothesis that under the German model of financial institutions the smallest firms tend to be disadvantaged in terms of access to the financial markets.

2. Firm Size, Investment, and Financial Constraints

In reviewing the role of financial constraints on investment behavior, Chirinko (1993, p. 1902) observed that, "The investment literature has been schizophrenic concerning the role of financial structure and liquidity constraints." As FHP (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 centralized 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. 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 FHP (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 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 classes of 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 phenomenon 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 resources, issuance of equity, or debt. By contrast, smaller firms are limited in the extent of their internal earnings and the potential for issuing equity.[1] In Germany in particular since 1974, firms have been obligated by law to retain pension funds for employees. These funds, which can run into millions of deutsche marks, have become an important alternative source

1 See Franks and Mayer (1990) and Corbett and Jenkinson (1994) for details on differences and similarities between Anglo-Saxon and bank-based financial systems.

of firm financing, particularly for the larger firms.[2] It is expected that these funds would loosen the impact of liquidity constraints across firms, but particularly for the largest firms. Therefore in this study, any results indicating binding liquidity constraints after 1974 would suggest that the financial market imperfections limiting external finance are quite severe --sufficient to bind despite the new source of financing from employee pension funds.

A series of recent papers have 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. FHP (1988) found that smaller publicly traded firms in the US face liquidity constraints and that such smaller enterprises in particular experience difficulties obtaining capital during periods of macroeconomic downturns. That is, *ceteris paribus*, the likelihood of a firm experiencing a liquidity constraint decreases along with increasing firm size. According to FHP, 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. FHP 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.

But Germany's financial infrastructure is not like other countries. In fact recent studies have suggested that the institutional structure of Germany precludes liquidity constraints

2 We have chosen to include pension holdings as a source of funds, although we recognize that they could, alternatively, be treated as an obligation of the firm. Since there does not seem to be a consistent position in the literature, we have chosen to be consistent with the argument that availability of these funds may loosen liquidity constraints of the 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.

from occurring.[4] There are two institutional features of the German financial system that sharply contrast with practices 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 sources of finance. The external capital market remains relatively under developed. And second, not only do the banks represent the major financial intermediary supplying capital to firms, but they are also extensively represented on the firm's supervisory boards[5]. Cable (1985, p. 119) refers to this peculiarity of the German financial system which links finance to supervision as a "quasi-internal capital market".

Several studies have noted 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 that target as customers the small and medium firms. It is still unclear however, how much this spread in rates affects 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[6] in terms of financing the largest manufacturing corporations of Germany,[7] 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.[8] The bulk of credit from the *Big Three* private banks is channeled 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 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

4 See for example Cable (1985) and Soskice (1992).
5 See Elston (1998) for a more detailed discussion of the scope of German bank influence on firms.
6 The *Big Three* German banks are the Deutsche Bank, Dresdner Bank and the Commerzbank.
7 See for example Cable (1985).
8 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 and 10.6 percent in 1978, to 8.9 percent in 1988.

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 channeling funds into the German *Mittelstand* has resulted in the emergence of 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 absent in the United States and United Kingdom, include (1) special credit institutions 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 channeling 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." According to Deeg (1999), the increasing bank competition has strengthened the long-term relationship between banks and small firms by inducing banks to provide more long-term funds and information to small firms.

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 as found by Evans and Jovanovic (1989) and FHP (1988), among others, to exist for the United States. 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." 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.

3. The Q Theory of Investment Model and Methodology

Q-Theory of Investment

We link the extent of financial constraints to firm investment behavior through the lens of the Q theory of investment.[9] 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 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 capitalizes the impact of some or all finance constraints as well."

Methodology

From Bond et al. (1997) we estimate an investment equation derived from an accelerator specification in the absence of adjustment costs and a constant returns to scale production function. In this model with the investment equation nested within the general dynamic regression model, we include lagged investment, sales, Q, and cash flow. We use the average Q to proxy for the unobservable Tobin's or marginal Q in order to control for the investment opportunities of the firm. As is standard in the investment literature, we use sales as a real proxy for output or productivity, and cash flow as a proxy for the liquidity constraints of the firm.

Under the standard application of the Q model of investment, the dependent variable is investment for firm *j* in time *t*. The investment behavior of each firm in each period is shaped primarily by the following variables. Q 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, divided by the value of the adjusted capital stock of the firm plus inventories. From Hall (1991) and others, we recognize the difficulties in empirically implementing

9 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.

the Q model, but feel that it is important to estimate this well known specification within the German context for comparison.[10]

Cash flow is a proxy measure of the degree to which a firm is subjected to liquidity constraints, and is calculated as the net income of the firm in the previous period. Chirinko (1987), among others, have established the importance of including lagged investment in the model specification in order to control for the past level of investment by the firm. This is calculated as the annual change in the plant, property, and equipment for the firm. Finally the firm's net of tax sales is used as a measure of firm output.

Many have argued that Germany's unique system of corporate governance may impact the firm's ability to access capital markets. In order to control for the possible influence that concentrated ownership may have on firm investment and liquidity, we include a measure of the concentration of firm ownership in our investment model.

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

$$\frac{I_{jt}}{K_{jt}} = \beta_0 + \beta_1 \frac{I_{jt-1}}{K_{jt-1}} + \beta_2 Q_{jt-1} + \beta_3 \frac{CF_{jt-1}}{K_{jt-1}} + \beta_4 \frac{Y_{jt-1}}{K_{jt-1}} + \beta_5 Conc_{jt} + \beta_6 \log(Size_{jt}) + \varepsilon_t \quad (1)$$

where $I_{j,\,t-1}$ is investment for firm j in period t-1, $K_{j,\,t-1}$ is the capital stock of firm j in period t-1, $Q_{j,\,t-1}$ is the ratio of market to book value of firm j in period t-1, $CF_{j,\,t-1}$ is the net income of the firm or cash flow proxy for firm j in period t-1 . $Y_{j,\,t-1}$ is the net sales of firm j in period t-1, $Conc_{j\,t}$ is the ownership concentration of firm j in period t, and log ($Size_{j\,t}$) is the log of net sales of firm j in period t.

The regressions for each of the various size classes of firms are estimated with annual dummy variables in order to control for exogenous shocks in the data, such as the oil shocks of 1973, 1974, and 1979, and the move from a fixed to a floating exchange rate regime in 1973. We also used industry dummies to control for industry effects, and sorted the data by year which enabled us to examine the behavior of the firm over time. Nine broad industry dummies are constructed based on the primary specialization of the

10 There are several difficulties in estimating the Q model, including the fact that the unobservable marginal Q is difficult to measure by proxy, even with the best of data, and that the Q model does not always perform well empirically as a predictor of investment.

firm in: chemical, metal and metal goods, mineral and mineral products, mechanical engineering, electrical and instrument engineering, motor vehicles and transportation, food and tobacco, textiles, and “other” manufacturing sectors.

From Arellano and Bond (1998) we estimated the model using a Generalized Method of Moments (GMM) procedure from the DPD98 program in order to provide heteroscedastic-consistent parameter estimates. Estimations were run on first differenced data to remove firm-specific effects, and with instrumental variables of t-2 lagged values of variables $I_{,jt}/K_{jt}$, $Q_{,jt}$, $CF_{,jt}/K_{jt}$ and $Y_{,jt}/K_{j,t}$ to account for endogeniety in the model.[11]

The impact of liquidity constraints on firm investment behavior can be inferred by estimating equation (1) for different years and different size classes of firms 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. The Data

One of the greatest impediments to measuring the impact of liquidity constraints on firm investment behavior 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 719 German firms over from 1961-1989. Much of the firm level data are from annual financial reports of German industrial corporations quoted on the German stock exchange.[12] 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.[13] Data prior to 1970 is not used because much of the data for key variables are missing in this early time period. Because of mergers, bankruptcies, acquisitions, changes in legal status, double listing of consolidated and non-

11 From Bond, et. al. (1997) if the error term in levels is serially uncorrelated, then the error term in first differences is a Moving Average series of order 1, MA(1), and therefore instruments dated t-2 and earlier should be valid in the differenced equations. Under these assumptions, consistent parameter estimates can be obtained.

12 The Bonn Database includes annual reports of firms, and information from the *Handbuch der Aktiengesellschaften*, *Wer gehört zu Wem*, and the *Statistisches Jahrbuch*. The database was constructed at the Business and Economics Institute at the University of Bonn.

13 The second legislation that effected accounting rules was the Corporation Act of 1965, under which the rules for the valuation of plant, equipment, and inventories, as well as profits, were tightened. According to Albach (1984), 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.

consolidated information for the same firm groups, only 295 unconsolidated firms remained in 28 industrial branches as of 1986.[14] From this population, a sample of 100 listed firms is used for which complete information was available on the concentration of firm ownership.

Note that we need to use listed firms only, in order to maintain consistency between our Q theory model and our empirical model which demands calculation of the value of the firm from stock price data. The sample we used is fairly representative because in 1980 there were only about 459 listed AG and KgaA (incorporation identities indicating that they are publicly held) firms in Germany.[15]

The data for variables are measured in terms of millions of German deutsche marks. 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 of common stock (E_t) to the market value of preferred stock (S_t). 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. 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, plus changes in the year end reserve holdings for pensions. Gross sales, dividend payment information and retained earnings figures for the firms are taken from the balance sheet of each firm.

14 Data after 1986 is not used because of the substantial changes in German accounting laws, which render the data incomparable without considerable revisions.

15 See Edwards and Fischer (1994, p. 77).

The concentration of firm ownership is measured from one to five, where the Concentration variable is set at 1 if the firms have the highest degree of ownership concentration with a single stockholder holding more than 75% of the firm's shares. If two or three stockholders hold more than 75% or the shares then Concentration is set at 2. Concentration is set at three if a single stockholder hold more than 50% of the shares, and four, if two or three stockholders own more than 50% of the shares. Concentration is set at 5 for all cases in which the concentration level is more dispersed than for category 4.[16]

Firms were placed into four size groups, roughly quartiles, based on the total number of employees in order to determine firm size effects. It was advantageous that by obtaining four groups of roughly equal size we were also able to define Size1 as those firms employing 500 persons or less -this criteria is consistent with the standard definition in the literature for small firms. The second quartile or Size2 firms contains those with more than 500 but 1300 or fewer employees, Size3 contains firms with more than 1300 but 5500 or fewer employees, and Size4 contains firms with more than 5500 employees.[17]

5. Empirical Results

Tables 1 and 2 contain descriptive statistics on the data including the means and variable correlations. The mean of the concentration variable reveals that dispersion in ownership increases monotonically with firm size. Table 2 suggests that Sales (over capital stock) may be the best indicator of investment. In order to explicitly examine the link between liquidity constraints and investment behavior across firm size, we ran regressions on the data sorted by firm size and year.

The results of the estimations of the investment function over the period 1970-1986 are shown in Table 3. Of particular interest is the comparatively larger and statistically significant coefficient of the Cash flow measure for the earlier years of the study. In 8 of the first 11 years of the study Cash flow is significant. From 1981 onward, there is just

16 Note that 25% is a key percentage because it represents a minority blocking vote at shareholders meetings and German law requires disclosure of ownership for any party owning 25% or more of outstanding stock.

17 It should be emphasized that we are not examining very small firms, rather smaller vs medium and larger firms in the context of the largest firms in Germany. While the smallest firm grouping is consistent with Small and Medium Sized Enterprise (SME) definitions in the literature, the general results should be interpreted in the light of examining firm size effects in the data.

one Cash Flow coefficient significant at the 10% level, whereas all the cases before 1980 are significant at the 5% level. This evidence is broadly consistent with the hypothesis that German firms were subject to a lower degree of liquidity constraints during the 1980's in which the increasing competition in the German banking sector helped raise the supply of capital, possibly indicative of a fundamental shift in the financial regime in Germany. Coefficients on Q are positive as expected, and significant in 6 of the 17 years. These findings are consistent with the hypothesis that firms had incentives to invest in many of these years, but there does not appear to be any particular pattern to the incentives to invest over time.

In Table 4 we have regression results on quartiles of firms divided by size based on number of employees. We observe that Size2 and 3 groups have relatively larger and more statistically significant cash flow coefficients compared to the smallest and largest firms, suggesting the impact of the liquidity constraints tends to be the greatest for the medium sized firms. The positive and significant coefficients on Q for Size1 suggests strong incentives to invest for the smallest firms, while negative and significant results for Size3 firms may suggest an incentive to disinvest.[18] The difference in the impact of liquidity constraints on the investment behavior of the smallest and largest firms, compared with the two medium sized firm groups, suggest that financial institutions of Germany do provide a system of finance that is different from the Anglo-Saxon model, specifically in that liquidity constraints could be attenuated for the smallest firms.

The findings are consistent with predictions by Deeg (1999) that the German financial system is becoming increasingly characterized as one consisting of several intertwined models of industrial finance. That is, as Germany's financial sector has became more acutely international and competitive, closer to the Anglo-Saxon model, larger firms have had an easier time gaining access to capital. While smaller firms have found that the market share for small business lending has shifted substantially from the commercial banking sector to the savings and credit cooperative sectors where they "…continue to enjoy access to long-term and competitively priced capital".[19] At the same time, this has largely left medium-sized firms as odd man out in the German financial system.

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18 The negative and non-significant coefficients on Q may be indicative, among other things, of the weakness of empirical performance of Q as discussed in the Q literature.

19 Deeg (1999) notes that over the last two and a half decades, all of the conditions in the market for business loans have changed in favor of greater firm independence from banks. This trend is particularly true for the largest firms, which presumably have better access to both internal and external capital.

Table 1

MEANS OF INVESTMENT VARIABLES

Means of key variables from 1970 - 1986 are listed below, with standard deviations in parenthesis. Means were calculated for each firm size group as follows: the first quartile1 or Size1 is composed of firms with 500 <= employees, Size 2 or quartile2 is defined (500 < quartile2 <= 1300) Size3 or quartile3 is defined (1300 <quartile3 <= 5500), and Size4 or quartile4 > 5500.

Variables	**(smallest) Size1**	**Size2**	**Size3**	**(largest) Size4**
Y_{t-1} / K_{t-1}	-1.4485	1.1930	21.52	373.32
	(11.254)	(14.867)	(79.005)	(1681.3)
Q_{t-1}	-0.0289	0.0886	-0.0591	-0.0463
	(0.5197)	(0.5709)	(0.4696)	(0.3727)
CF_{t-1} / K_{t-1}	-4.3791	-2.7944	-1.0375	0.5518
	(8.9264)	(9.5978)	(9.6091)	(8.9360)
Log ($Size_t$)	310.18	867.04	2179.00	34014.00
	(124.81)	(226.22)	(1256.6)	(42899)
$Concentration_t$	2.8534	2.8649	2.9815	3.5542
	(1.4452)	(1.5757)	(1.6129)	(1.5880)
$Employees_t$	310.1800	867.04	2719.00	34014.00
	(124.81)	(226.21)	(1256.6)	(42899)
Observations	392	444	423	424

Table 2

CORRELATION ANALYSIS

Correlations of key variables are listed below. The correlation measures the strength of the relationship between variables, and the probability that the coefficient is zero is reported in parenthesis below.
Total observations are 1683.

VARIABLE	**I_{t-1} / K_{t-1}**	**Y_{t-1} / K_{t-1}**	**Q_{t-1}**	**CF_{t-1} / K_{t-1}**	**Log ($Size_t$)**	**$Concentration_t$**
I_{t-1} / K_{t-1}	1.000					
	(0.000)					
Y_{t-1} / K_{t-1}	0.596	1.000				
	(0.000)	(0.000)				
Q_{t-1}	0.000	-0.005	1.000			
	(0.991)	(0.834)	(0.000)			
CF_{t-1} / K_{t-1}	0.040	0.013	-0.076	1.000		
	(0.116)	(0.613)	(0.004)	(0.000)		
Log ($Size_t$)	0.051	0.101	0.005	-0.004	1.000	
	(0.034)	(0.000)	(0.832)	(0.851)	(0.000)	
$Concentration_t$	0.004	0.079	-0.011	0.001	0.293	1.000
	(0.842)	(0.001)	(0.644)	(0.946)	(0.000)	(0.000)

Table 3
INVESTMENT EQUATION BY YEAR

Investment equation was estimated using t-2 lagged values of I /K , CF/K and Y/K as instruments. The sample is comprised of 100 unconsolidated German firms from 1970 to 1986. T-values are reported in parenthesis below coefficients. Concentration is a measure of the ownership concentration of the firm, and Log ($Size_t$) is the log of total firm assets. Table reports p-values for the Sargan test - the probability of generating the calculated Sargan statistic under the null hypothesis of valid instruments. Reported M1 values can be used to test the null hypothesis of no autocorrelation. Regressions were estimated using nine industry dummies covering the German manufacturing sector.

Variables **Year**	I_{t-1} / K_{t-1}	Y_{t-1} / K_{t-1}	Q_{t-1}	CF_{t-1} / K_{t-1}	**Log ($Size_t$)**	**Concentration$_t$**	**M1[a]**	**Sargan[b]**
1970	0.0008	0.0540*	0.6919*	0.0214	-0.0211	-0.1131	-6.02	0.214
	(0.260)	(4.172)	(2.341)	(1.168)	(-0.149)	(-1.450)		
1971	0.0003	0.1539*	0.0481	0.0075*	-0.0015	0.0090	-5.68	0.427
	(0.289)	(43.971)	(1.040)	(-3.437)	(-0.169)	(1.077)		
1972	0.0010	0.0166	0.8041	0.2330*	0.2936	-0.0026	-5.89	0.362
	(0.081)	(0.304)	(0.842)	(3.385)	(-0.696)	(-0.008)		
1973	-0.0008	0.0457**	0.1222	0.0767*	-0.0016	-0.1053	-5.99	0.805
	(-0.133)	(1.849)	(-0.276)	(3.052)	(-0.009)	(-0.721)		
1974	-0.0016	0.1007*	0.0317	0.0445	0.2697	-0.178	-6.00	0.477
	(-0.190)	(3.037)	(0.046)	(1.329)	(1.170)	(-1.043)		
1975	-0.0071	0.0910*	0.2893*	0.0412	0.2745	-0.1323	-5.87	0.452
	(-1.204)	(2.874)	(2.424)	(1.162)	(1.309)	(-0.833)		
1976	-0.0084	0.0131	0.0849**	0.1132*	0.1908	0.0202	-5.67	0.635
	(-1.026)	(0.459)	(1.846)	(4.490)	(0.778)	(0.110)		
1977	-0.0106	0.0329	-0.6387	0.1060*	0.3297	-0.2800	-5.73	0.123
	(-1.219)	(0.882)	(-0.609)	(3.732)	(1.119)	(-1.407)		
1978	-0.0018	0.0122	0.2935	0.1208*	-0.1128	-0.0547	-5.76	0.321
	(-0.159)	(0.628)	(1.338)	(3.060)	(-0.378)	(-0.264)		
1979	-0.0051	0.0689*	0.2323**	0.0774*	-0.0427	-0.1561	-5.81	0.527
	(-0.521)	(2.132)	(1.676)	(3.190)	(-0.245)	(-1.093)		
1980	0.0015	0.0558*	0.1418	0.0787*	-0.4164	0.0865	-5.66	0.459
	(0.108)	(2.755)	(1.157)	(2.779)	(-1.493)	(0.438)		
1981	0.0071	0.0660*	0.1752	0.0294	-0.0120	-0.1528	-6.01	0.243
	(-0.745)	(4.789)	(1.385)	(1.199)	(-0.077)	(-1.251)		
1982	-0.0067	0.8983*	0.0741	0.0056	0.0753	-0.1189	-6.21	0.382
	(-0.714)	(5.413)	(1.171)	(-0.233)	(0.464)	(-1.049)		
1983	-0.0028	0.0680*	0.0434	0.0367	-0.1889	0.0413	-6.03	0.651
	(-0.252)	(5.698)	(0.078)	(1.471)	(-1.052)	(0.288)		
1984	-0.0043	0.0457*	0.3538**	0.0338	-0.1217	-0.1219	-6.21	0.756
	(-0.418)	(3.977)	(1.738)	(1.560)	(-0.619)	(-1.014)		
1985	-0.0236	0.0496*	0.0445	0.0471	-0.0043	-0.0225	-6.10	0.434
	(-0.846)	(2.467)	(1.033)	(0.739)	(-0.013)	(-0.096)		
1986	0.0032	0.1805*	1.245*	0.0521**	-0.2105	-0.0022	-6.03	0.672
	(0.483)	(8.274)	(2.453)	(1.732)	(-0.845)	(-0.013)		

* Indicates t-statistic is significant at the 0.05 and ** at the 0.10 levels.

a DPD98 reports tests for the absence of first-order and second-order serial correlation in the differenced residuals. Under this models particular assumptions about the form of the error term, we expect evidence of significant negative first order serial correction in the differenced residuals, which is confirmed by the M1 values. b Reported p-values generally indicate valid instruments.

Table 4
INVESTMENT MODEL BY FIRM SIZE GROUPS

Investment equation was estimated using t-2 lagged values of I /K , CF/K and Y/K as instruments. The sample is comprised of 100 unconsolidated German firms from 1970 to 1986. T-values are reported in parenthesis below coefficients.
Concentration is a measure of the ownership concentration of the firm, and Log ($Size_t$) is the log of total firm assets.
Reported p-values of the Sargan statistics tests the probability of generating the calculated Sargan statistics under the null hypothesis of valid instruments. M1 values are tests for first order (M1) serial correlation in the differenced residuals.
Regressions were estimated using annual time dummies and nine industry dummies covering the German manufacturing sector.

Variables	**(smallest) Size1**	**Size2**	**Size3**	**(largest) Size4**
I_{t-1} / K_{t-1}	-0.0128*	-0.0050	-0.0048**	-0.0007
	(-4.891)	(-1.289)	(-1.703)	(-0.329)
Y_{t-1} / K_{t-1}	0.0086	0.0343*	0.0691*	0.1628*
	(1.061)	(3.710)	(7.378)	(19.574)
Q_{t-1}	0.1860*	0.2095	-0.8808*	-0.3780
	(2.248)	(0.931)	(-1.989)	(-1.375)
CF_{t-1} / K_{t-1}	0.0047	0.0798*	0.1187*	-0.0216**
	(1.111)	(7.173)	(6.481)	(-1.892)
Log ($Size_t$)	0.5474*	-0.3457	-1.0537*	0.9345*
	(7.356)	(-0.755)	(-2.366)	(5.552)
$Concentration_t$	0.0323	0.0244	-0.1522	-0.0152
	(1.000)	(0.351)	(-1.504)	(-0.241)
Sargan[b]	0.364	0.062	0.247	0.526
M1[a]	-6.32	-5.81	-6.71	-7.40

* Indicates t-statistic is significant at the 0.05 and ** at the 0.10 levels.

a DPD98 reports tests for the absence of first-order and second-order serial correlation in the differenced residuals. Under this models particular assumptions about the form of the error term, we expect evidence of significant negative first order serial correction in the differenced residuals, which is confirmed by the M1 values.
b Reported p-values generally indicate valid instrument set.

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 results presented in this paper suggest that may be true only for some firms, indicating a more complex relationship between firm size and liquidity constraints.

Smaller firms have relatively fewer liquidity constraints, apparently benefiting from the specialized institutional structure in Germany, which provides long-term and competitively priced capital to the SME. However, evidence does not support the hypothesis that the institutional structure of finance in Germany is able to avoid the impact of liquidity constraints for medium-sized firms, which had the most severe liquidity constraints in the study. Finally, the largest firms, not surprisingly, did not appear to be particularly liquidity constrained, consistent with their ability to easily access internal and external sources of funds.

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