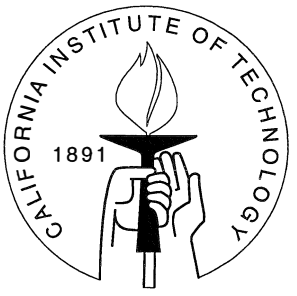
DIVISION OF THE HUMANITIES AND SOCIAL SCIENCES
CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA, CALIFORNIA 91125

RELATIONSHIP BANKING, LIQUIDITY, AND INVESTMENT: LESSONS FROM THE GERMAN INDUSTRIALIZATION

Caroline Fohlin



SOCIAL SCIENCE WORKING PAPER 913

October 1993
Revised July 1996

Relationship Banking, Liquidity, and Investment: Lessons from the German Industrialization

Caroline Fohlin

Abstract

Because of apparently close ties between banks and industry, German-style universal banking is thought by many to improve investment efficiency. This paper presents new evidence to the contrary. Using a panel of firm data from Germany's heavy industrialization period (1903-1913), the analysis shows that investment is more sensitive to internal liquidity for bank-networked firms than unattached firms, and that this effect is only minimally offset in the long run. Furthermore, the paper presents extensive evidence on the characteristics of bank-attached firms and demonstrates through direct tests that the estimated investment equations are free of selection bias.

Relationship Banking, Liquidity, and Investment: Lessons from the German Industrialization

Caroline Fohlin*

Universal banking has received a great deal of attention of late. As banking regulation loosens in the United States and efforts toward industrial redevelopment in eastern Europe intensify, economists have begun to wonder what type of financial system will promote the greatest stability and strongest growth in the economy. Germany and Japan, whose large universal banks are often credited with the post-World War II industrial successes of these economies, have been the starting points for several recent investigations.[1] The current interest in universal banking, however, is more of a revival than an innovation. Economists and historians have long suggested that financial institutions play a vital role in industrial development, and the German universal banks of the pre-World War I era have often been singled out as the prime example.[2] These banks, which combined short-term commercial lending with long-term investment banking, are thought to have fostered long-term relationships with industrial firms; allowing more efficient and stronger investment.

While powerful influence has been attributed to Germany's universal banks, little systematic evidence has been provided to support these assertions. Given the extent to which modern conceptions of relationship banking are based on the received wisdom about pre-war Germany, quantification of the impact of universal banking relationships is in order. This paper presents new evidence on the role of the German universal banks during the period of heavy industrialization in the decade preceding World War I. By investigating the influence of universal banking relationships on the investment patterns

*Division of the Humanities & Social Sciences, California Institute of Technology. This paper is a substantially revised version of Chapters 3 and 7 of my dissertation, Fohlin (1994). I am grateful to Stefano Athanasoulis, Peter Bossaerts, Lance Davis, Jeff Dubin, Barry Eichengreen, Tim Guinnane, David Grether, Bronwyn Hall, Takeo Hoshi, Naomi Lamoreaux, John Latting, Richard Meese, David Romer, Ken Sokoloff, Richard Tilly, Kenneth Train, and Eugene White as well as to workshop participants at Berkeley, UCLA, UCSD, Caltech, Stanford, the NBER, the Universities of Mannheim, Münster and Munich and conference participants at the All-U.C. Group in Economic History (Fall 1994), the Cliometric Society (1995), the Social Science History Association (1995), and the Econometric Society Summer Meetings (1996) for helpful discussions and comments on earlier drafts. Financial support from the Joint Committee on Western Europe of the American Council of Learned Societies and the Social Science Research Council (with funds provided by the Ford and Mellon Foundations), the Center for German and European Studies at U.C. Berkeley, and the Mellon Foundation Area Studies Fellowship Program is gratefully acknowledged.

of industrial firms, this paper measures one component of the hypothesized impact of bank-based financial systems on industrial growth. In contrast to several recent studies on the relative financing constraints of bank-attached and independent firms, this paper demonstrates that bank attachment is not associated with dramatic reductions in firms' liquidity sensitivity of investment. Thus, the findings suggest that the early work of economic historians and the recent work of economists may overstate the importance of relationship banking, particularly in the realm of industrial investment.

The theoretical literature on the role of financial intermediation extends back at least to Gurley and Shaw (1960), Brainard and Tobin (1961), and Tobin (1969); yet this early work provided no comparison of financial institutions and their welfare implications. Recent work has offered both analytical models and qualitative descriptions of financial relationships, but there has been no definitive answer to the question of optimal financial structure.[3]

Most recent theories of financial intermediation, and of relationship banking in particular, are implicitly prefaced by the assumption that asymmetric information between investors and savers leads to capital market failures: excessively-risky uses of outside funds or dishonest reporting of project returns, for example. In order to avoid these moral hazard problems, investors may need to monitor the activities of entrepreneurs.

If oversight is costly, and equally so to all investors, lack of an incentive for individuals to share information creates an economy-wide duplication of effort. Selecting one investor to monitor for all economizes on investment costs and provides static efficiency gains. This process shifts the information gap from the entrepreneur and financier to the financier and depositors. In Diamond's (1984) framework, one investor collects funds from all others and then lends to many different firms, whose activities the delegated monitor observes closely. Diversification by the intermediary insures payment of the risk-free rate to depositors.[4]

Diamond's delegated monitoring framework focuses on the static problem of monitoring, but it may also be the case that corporate financiers experience dynamic economies of scale that give certain investors advantages over others.[5] That is, information about investing and investment targets accrues over time. Efficiency improvements may result from cost reductions in funds provision itself and from refinements in the information investors obtain about specific entrepreneurs and projects. Through both channels, the financier will encounter progressively lower costs. Those who are willing and able to invest early will earn rents: they will gain a cost advantage over late-comers and will sell their accumulated information in the form of deposits.[6] These financial intermediaries will be able to guarantee lower-risk rates of return than would be available to individuals, and depositors will pay for this in the form of relatively low interest rates on their deposits.

The link between theoretical models of financial intermediation and empirical studies of the importance of banking relationships is indirect and is based on the predictions of several models concerning incompleteness of contracts (Greenwald, Stiglitz and

Weiss (1984), Grossman and Hart (1982), Jensen and Meckling (1976), Myers and Majluf (1984), Stiglitz and Weiss (1981), and Stultz (1990) to name a few). These models connect failures in the capital markets (information and incentive problems stemming from separation of ownership and control) to the relative costliness of external finance. If banks act as monitors, they will have better information about their clients' investment opportunities than would individual investors. Others have argued that, because of this attenuation of asymmetric information problems, a firm's investment will depend on the existence of new projects and not on the availability of internal funds. This same asymmetric information problem will cause un-monitored firms–who cannot defend the viability of each project to individual investors–to time investments according to their liquidity. According to this logic, investment should, therefore, be more sensitive to internal funds for unattached firms' than for attached firms.

Previous work on the impact of close banking relationships or industrial group membership has compared liquidity sensitivities of investment to quantify the benefits of monitored corporate finance. Of greatest relevance to German-style universal banking are the studies by Hoshi, Kashyap, and Scharfstein (1991) on post-war Japanese industrial groups; Becht and Ramírez (1993) on pre-World War I German mining firms; Elston (1994) on modern German industrial firms; and Ramírez (1995) on J.P. Morgan's group in the United States at the beginning of this century. These authors have tested the empirical disparity in the investment-liquidity relationship according to *a priori* assumptions about the difference in information problems faced by individual firms.[7] All of these studies have found higher cash-flow sensitivity for the group of firms considered to be unattached to a bank than for firms with bank connections, and this has been taken as evidence of the important role of relationship banking in reducing information asymmetries between investors and savers.

A major problem with comparing the behavior of attached and independent firms is that attachment to a bank may be endogenous. In particular, it may be inappropriate to assign a causal relationship between bank attachment and diminished liquidity sensitivity of investment. The causation may, in fact, run in the opposite direction or the two events may be simultaneous determined by a third factor. While some previous studies have attempted to address selectivity bias on the basis of qualitative arguments or simple comparisons of sample means, none has attempted to model selectivity bias directly. This study takes some steps toward accounting for such problems by linking discrete choice analysis of the characteristics of bank-attached firms to the disturbance terms in the random effects OLS model of investment.

Diminished liquidity constraints for bank-attached firms may be consistent with the delegated monitoring theory, yet it does not reject dynamic theories: the two are not mutually exclusive. Distinguishing between static and dynamic effects requires some refinement of the standard liquidity constraints specification. Since the dynamic economies hypothesis implies an intertemporal efficiency gain it suggests that effects of bank relationships will become more pronounced with time. Attached firms' liquidity sensitivity of investment, while perhaps equal to that of independent firms in the short run, should

be lowered in the long run. By including measures of the length of the bank-firm relationship, the dynamic effects of bank involvement can be tested. Another possibility is to study the investment sensitivity of newly-public firms. If, for example, IPO firms with bank attachments are equally liquidity constrained as those without bank involvement, then it will be difficult to support the static delegated monitoring theory.[8]

While delegated monitoring and dynamic economies of scale may simultaneously describe different characteristics of the same financial system, they seem to imply fundamentally different ways of selecting bank clientele. In Diamond's original formulation of delegated monitoring, the problem of who monitors the monitor is dealt with through diversification by the intermediary. This construction implies that optimal financial intermediaries should be infinitely large and perfectly diversified. Under dynamic economies of scale, however, the greatest rents may accrue to intermediaries that specialize in particular sectors. That is, much of the information relevant to financing investment is industry specific and may relate to specialized technology or even the industrial organization of the sector.[9] Thus, the degree to which financial intermediaries focus their involvement provides a measure of the extent to which learning is important in the dynamic finance production function. In the German case, large, universal banks appear to have been highly specialized. Such lack of diversification hints at gains from specialization that may only be reaped over the course of the banking relationship. Patterns of interlocking directorates are discussed further in the final section.[10]

A simple test of the sensitivity of investment to internal funds may not fully capture the effects of liquidity constraints faced by industrial firms. Indeed, according to the recent work of Kaplan and Zingales (1996), liquidity sensitivity of investment may bear no consistent relationship to financing constraints. Another approach is to investigate the temporal distribution of investment. If investment is concentrated in one year rather than being dispersed throughout the period, there may be evidence of liquidity constraints.[11] Uneven investment patterns alone, however, do not provide evidence of financing constraints. Investment may appear to be clumpy either because of the lumpiness of demand for fixed capital (for example, when a new factory or mine shaft is built) or because of the need on the part of the firm to accumulate internal funds even for smaller investments. In the former case, lumpy investment may cause real or apparent financing constraints, while in the latter case liquidity constraints cause lumpy investment. Sectors that naturally invest in a lumpy manner may exhibit particularly high liquidity sensitivity of investment. Thus, a certain amount of qualitative information, including the industrial branch of the firms, is helpful in gauging the relevance of liquidity sensitivity for financing constraints.

The analysis in this paper begins by testing the hypothesis that close involvement with a universal bank diminishes a firm's liquidity sensitivity of investment and that this effect is intensified over time. The paper continues by investigating the effects of possible selectivity biases among firms involved in financial and industrial networks. The last part of the paper investigates directly the characteristics of firms involved in interlocking directorates. The results show that evidence on the existence and relaxation of liquidity

constraints varies with the type of firms under investigation. In some cases, bank-attached firms experienced higher liquidity sensitivity than unattached firms, but this relationship was mostly diminished for older than average attached firms. A more direct measure of long-term relationships–the existence of attachment in the five years prior to the period investigated–yields weaker results. This study thus emphasizes the dynamic nature of learning in financial intermediation, and it argues for a more conservative interpretation of the role of relationship banking in economic growth and industrial development than that which has been advocated by previous researchers. From a methodological standpoint, this study also suggests that measurement of firms' liquidity sensitivity of investment may provide misleading predictions about financing constraints.

I. Institutional Background

Universal banks are thought of as those financial institutions that concurrently provide several types of financial services–including short-term commercial banking, long-term investment functions, and brokerage services. In this study, the terms credit banks, universal banks, and mixed banks are used interchangeably and all refer to the group of German joint-stock banks that provided a variety of financial services to industry at the turn of the last century. The nine largest of the universal banks became known as the great banks.[12] For the purposes of this study, all other joint-stock universal banks are categorized as small (or provincial) banks.

A. *Universal Banking in the German Context*

The functions performed by the German credit banks extended to many realms of corporate finance and continued to evolve over time.[13] Their credit operations–including several types of short-term credits and loans, payment services, brokerage, and underwriting–set the German universal banks apart from other financial institutions. The consensus in the historical literature indicates that the universal banks offered industrial credit primarily on a short-term, but flexible, basis and often ended up financing the accumulation of fixed capital. Commercial services included facilities for making and receiving payments, undersigning of commercial paper, Giro accounts (payments made and received between customers of one bank), foreign bills of exchange, current account credits, discounting of bills and outstanding business accounts, and information on business connections (including individuals, firms, and foreign markets).

German joint-stock companies used mainly banks as financial intermediaries, rather than raising funds directly from the public. The universal banks were actively involved in transformations and foundings, issuing of industrial securities, syndications and securities holding. Indeed, the post-1870 boom in joint-stock foundings is thought to have been a direct result of the banks' activities, with a majority of new companies being organized by the banks.[14] The large credit banks were also responsible for many other new issues of corporate securities, particularly in the mining, machinery, and electrical industries. For underwriting large or risky projects–such as loans to the Prussian army–banks often combined into syndicates, allowing the banks to offer large amounts of credit

while safeguarding against over-exposure to risk.

As a result of many of their promotional operations, the banks often held–both voluntarily and otherwise–the securities of their client firms, thereby providing further sources of liquidity. Banks were able to undertake the large investments they did because of their sizeable paid-in capitals as well as their close links to the capital market. Some might argue that the universal banks internalized the capital market, since their active role in the promotion and placement of securities apparently reduced the importance of the stock exchange for channeling capital into industry.[15] The German capital market remains underdeveloped relative to its modern counterparts–particularly in Britain and the United States.

B. *Quantifying Bank-Firm Relationships*

German corporate governance forms, which differ significantly from the Anglo-American board of directors, have changed little over the last century. Joint-stock companies are governed by two separate bodies: the executive board (*Vorstand*) is made up of firm managers, while the supervisory board (*Aufsichtsrat*) is comprised of shareholders' representatives. At the turn of the last century, members of the supervisory board did not play an active role in firms' day-to-day operations, but they are thought to have wielded considerable influence in long-run investment and strategic planning. In addition to direct power through voting rights, positions on firms' boards are thought to have allowed banks access to the inner workings of the firms they financed and apparently functioned as a commitment mechanism between the two entities.

The placement of bank directors on firms' boards of directors is commonly perceived to have been the most powerful expression of a firm-bank relationship, and the institution of interlocking directorates has become a trademark of German-style universal banking. In 1905, Otto Jeidels maintained that "...the power of the Great Banks is exercised via the legal institution of the Aufsichtsrat, rather than through direct influence of financial strength."[16] In his influential 1962 treatment of European industrialization, Alexander Gerschenkron echoed Jeidel's claim, saying that "...through development of the institution of the supervisory boards to the position of most powerful organs within corporate organizations, the banks acquired a formidable degree of ascendancy over industrial enterprises, which extended far beyond the sphere of financial control into that of entrepreneurial and managerial decisions."[17]

The means by which banks or firms could have initiated interlocking directorates were varied. The bank may have obtained proxy votes from depositors or may have ended up holding shares from new industrial promotions or bailouts of troubled firms. Alternatively, firms may have pursued bankers as board members for reputational reasons, or the two (or more) parties could have swapped shares and engaged in communities of interest. Equity ownership, it should be noted, was not a prerequisite for membership in the supervisory board. Unfortunately, since firms were not required to report

lists of shareholders or their holdings (in the pre-war period), no comprehensive data on ownership structure exists.

Bank involvement with an industrial firm normally began with the extension by the bank of current account privileges and progressed from the granting of various other forms of credit ultimately to the underwriting, and often holding, of the firm's securities. The range of universal banking operations suggests two additional ways to identify involvement between a bank and an industrial firm: the extension of current account privileges to the firm and the holding of the firm's securities.

A current account with a credit bank provided a firm with many services and opportunities for short-term credit and often led to the provision of other services. The current account may have also provided the bank with a window into the financial status of its client firms. A stronger link might be inferred if there were evidence that a bank issued or held substantial quantities of a firm's securities. The banks' active role in joint-stock company transformations and foundings often led to the issuing of stocks and bonds by the bank. Participation in the promotional process gave the banks' access to proprietary information about firms, and the inclusion of clients' securities in the banks' portfolios offered banks some measure of direct control.

Yet the existence of a current account or involvement in securities issues fails to discriminate between firms that had only a loose bank connection and those with a close, ongoing one. Credit bank current accounts were widespread–particularly among joint-stock companies–and the banks' insight could easily be impaired if, as they often did, client firms held such accounts with more than one bank. Furthermore, a simple current account relationship would not have allowed monitoring of firms' investment projects. The relationship resulting from promotional activities was almost certainly closer than that suggested by a current account. Nonetheless, since any firm wishing to issue securities did so through a universal bank, the holding of firm securities by such banks was common and could easily have been transitory.

Ideally, all three indicators of bank attachment–current accounts, securities issues and holdings, and interlocking directorates–could be used to measure gradations of bank involvement. Due to the paucity of firm-level data on current accounts and securities holdings, though, the investigation must be limited to interlocking directorates. While this criterion may overlook firms with weak or informal connections to a bank, it will not falsely categorize unattached firms as attached. Furthermore, since the three types of interaction normally occurred as steps towards increased involvement, it is likely that firms involved in bank networks had already progressed through the current account and securities issue stages. Whether or not the bank successfully exerted influence through firms' boards of directors remains to be determined, but the presence of bank representatives on company directorates still offers the strongest quantifiable evidence of bank connections. Identification of interlocking directorates for the firms studied in this paper is discussed in the next section.

II. Data

A. *Sources*

The data for this study were compiled from Part II of *Saling's Börsen-Jahrbuch*, a stock market annual that began publishing in 1876 and was targeted toward bankers and investors. *Saling's* Part II contains entries on joint-stock companies traded at the Berlin stock exchange and includes balance sheet summaries, profit and loss statements, listings of supervisory and executive board members, as well as share capital history, ratios of market-to-par value of shares, and dividends. While *Saling's* provides little discussion of underlying sources, the data appear to derive from the annual reports (*Jahresberichte*) of the firms. Since firms without stock market listings are excluded, samples taken from *Saling's* are almost certainly biased toward larger, more established firms. Such firms, however, comprise the major clientele of the universal banks.[18] One other limitation of the data–namely, the concentration on firms with the joint-stock form–should be recognized. While many firms converted to the joint-stock form in the early years of the twentieth century, a large portion of industrial firms maintained limited liability partnership (G.m.b.H.) or private status. The bias toward larger firms appears to be more pronounced prior to 1900, when the average size of newly-listed firms was significantly larger than in ensuing years.[19] In any case, since joint-stock companies were the only class of firm required to publish an annual report, balance sheet data are only widely available for these firms.

The data sample in this paper comprises 75 firms of two basic types–long-lived firms and newly-public firms. The first group includes 50 firms covering the period 1903 to 1913. Selection, with one exception, was limited to those firms in continuous existence from 1880 to 1913. Given these constraints, there is no entry or exit into or out of the sample, and thus, the panel is nearly balanced. Exceptions arise when variables are missing for a given firm-year, but these cases are rare. The long-lived firms were chosen and the firms' financial data was collected by Rudi Rettig.[20] The data were sampled from the 1900 volume of *Saling's* and reflect the sectoral distribution of joint-stock companies reported there. The sample was also structured to represent size and geographical variation of reported (Berlin-listed) firms. The long-lived firms are on average 2 to 4 times larger than corresponding sectoral means for all joint-stock firms, but this discrepancy stems largely from the selection bias toward larger firms in the data source.

Because of the constraints imposed on the selection of long-lived firms, I augmented the data with a random sample of newly-public firms. This group is comprised of a panel of 25 firms whose initial public offerings (IPO's) fell between 1880 and 1899. Like the first group of firms, the new firms were selected from those with entries published in the 1900 issue of *Saling's*. Since firms were permitted to exit the sample at any time after the sampling date, the resulting panel is somewhat unbalanced. The IPO firms represent a random cross-section of joint-stock firms founded between 1880 and 1900 that were listed in Berlin in 1900.[21]

Some IPO firms may have operated under alternate corporate forms before becoming joint-stock companies. Such firms were eliminated from consideration to the extent that

they were identifiable, however, the source is unclear in most cases.[22] Nonetheless, transformation into the joint-stock form was often associated with an increase in capital and other significant changes in operations, and thus can be seen as the beginning of a new stage in the life of the firm. It is, therefore, plausible that IPO firms would have experienced greater difficulty in obtaining finance than established joint-stock firms, even with prior existence under alternative corporate forms. T

he two groups of firms complement one another by providing a comparison of effects during early and later stages of the firm's development. Because of widely varying criteria, the samples are quite distinct from one another. The descriptive statistics presented at the end of this section summarize the differences between the samples for a range of variables. Since the samples appear to derive from fundamentally different populations, the analysis is performed separately for the two panels, though the results are compared at several stages.

B. *Measuring Interlocking Directorates*

Categorizing industrial firms as attached or unattached to a universal bank is more complicated in practice than in theory. There are four ways in which a firm might be considered to have interlocking directorates with a bank: executive board to executive board, executive board to supervisory board (either bank to firm or firm to bank), or supervisory board to supervisory board. Since the executive board is comprised of firm managers, presence in that body denotes a degree of day-to-day involvement not indicated by membership in the supervisory board. Thus, attempting to narrow the investigation to bank representation at firms would suggest looking for members of a bank executive board sitting concurrently on a firm's supervisory board. Such a restriction, however, eliminates firms whose supervisory boards were interlocked with a bank's–a potentially important conduit for information and oversight. Since I am interested in information flows between the bank and firm, and since the importance and power of the supervisory and executive boards varied from firm to firm, I include all possible conduits of joint membership in my measure of interlocking directorates.[23] It seems preferable to include some firms in the attached category whose bank relationships were weak than to include firms with strong bank connections in the unattached category. The former, at least, would bias the results against finding significant differences between attached and independent firms.

While it might be desirable to establish whether an individual found on multiple supervisory boards was a representative from the bank to the firm or vice versa, it is difficult to make such a distinction due to the equivalent stature of jointly-held positions. Furthermore, since few of the concurrent supervisory board members in the current samples were also members of the sampled firms' executive boards, the problem remains. The chair and vice-chair of the supervisory board are indicated in *Saling's*, but it is not clear that these positions indicate primary allegiance either.

The data source, since it contains information on firms listed at the Berlin stock exchange, includes entries on all of the principal universal banks as well as many of

the smaller joint-stock credit banks. The firm reports include a listing of executive and supervisory board members, and from this, I compiled an alphabetical directory of all board members of all (Berlin-listed) universal banks. By cross-referencing the executive and supervisory board members of the firms in the samples with this bank board member directory, I determined which firms were engaged in interlocking directorates with a bank and what proportion of each firm board was interlocked (that is, the share of the firm's board members having seats on both a bank and firm board). Four natural categories of bank attachment emerge: small (provincial)-bank only, great (berlin)-bank only, combination of small and great banks, and no bank.

I checked for attachment in 1900, 1905, and 1910 and assumed that attachment status in the intermediate years was the same as the endpoints. In the cases in which the endpoints were different, I assumed that the status changed mid-way through the period. For example, although I assumed that board membership in 1905 indicated strong bank attachment as early as 1903, I was not prepared to make more radical assumptions. A firm with no bank attachment in 1900, but with several bank representatives in 1905, would therefore be categorized as unattached through 1902, but attached after 1902. Attachment was nearly constant between 1905 and 1910, however, there was a distinct shift toward attachment between 1900 and 1905. Since the purpose of this study is to evaluate the possible benefits from membership in a banking network, the analysis is constrained to 1903-1913–the period in which bank-firm relationships stabilized.[24]

C. *Descriptive Statistics*

The firms' financial variables are defined as follows: fixed capital includes land, property, plant, equipment, patents, and permits (for example, the right to open a new mine shaft) and excludes inventories (since inventories are likely to decline when production increases); investment is the first difference of gross fixed capital; short-term liquidity is the sum of assets available on short notice, such as cash, notes, bank deposits, and accounts receivable; stock liquidity is the sum of short-term liquidity and longer-term financial wealth such as securities and participations in other firms; revenues and profits are as reported in the profit and loss statements of the firms; and inside finance (alternatively, net worth) is share capital plus reserves (in thousands of Marks). Investment, liquidity, profits, and revenues are all normalized by the yearly stock of fixed capital.

In nearly all cases it is impossible to disaggregate long-term assets into finer gradations of liquidity. Thus, holding companies, to the extent that they existed in the first part of this century, are indistinguishable from subsidiaries or from bonds or other securities the firm may have held. Since all such financial investments are reported together for most of the firms, such aggregation is carried through for all firms in order to avoid measuring different quantities depending on reporting procedure. Such inconsistency underscores the reality that accounting practices were considerably less regulated in Germany in the pre-war period than they are today. Thus, balance sheet posts vary from firm to firm and from year to year. Since this paper focuses on comparing attached and independent firms, the biases introduced by over-aggregation of liquidity, for example, would have

to be systematically different for the various types of firms. In the current sample, long-term securities and participations comprise a small portion of the stock of liquid assets, regardless of bank-attachment status. In addition, the correlation between short- and long-term financial assets is very high and varies little (between 89 and 93 percent) between categories of banking relationships.

Tobin's q cannot be measured directly from the available data, since some components of the measure are not documented for the sampled firms. *Saling's* does report the ratio of market to par value of common stocks (called the *Kurs*), and this provides a proxy for marginal, common-equity q.

Table IA compares sample means for the four sub-populations of firms: firms with attachment only to small banks, firms with attachment only to the great banks, firms with attachments to both great banks and other banks, and firms with no attachment to a bank.[25] Data for IPO firms and long-lived firms are given separately, and t-test results for comparisons between sub-sample pairs are provided in Table IB. Since logit models of the characteristics correlated with the various types of bank attachment are analyzed in the final section of the paper, I discuss the sample means only briefly to warn of several significant differences among the sampled firms. As Table IB demonstrates, several means that appear to be different are insignificantly so due to high standard deviations. Means are calculated by firm-years, so that firms that change status mid-period fall into the appropriate categories in each year. In practice, since within-firm variation is smaller than between-firm variation, the time series component adds little information.

Table IA here.

Table IB here.

Perhaps of greatest interest for this study is the similarity in investment rates among different categories of bank attachment and between IPO and long-lived firms. Indeed, only the difference of means between great-bank and combined-bank firms within the long-lived sample obtains statistical significance. Nonetheless, the large apparent differences in investment rates suggest variation in the distribution of normalized investment according to sub-group. The final section of the paper pursues this issue further.

Fixed capital and net worth provide two measures of firm size, and Table IA reveals a striking difference in these variables between attached and independent firms as well as between IPO and long-lived firms. On average, long-lived, great-bank firms maintained over twice the net worth of their counterparts without great-bank connections, and firms with both great- and small-bank attachment had almost ten times the inside finance of unattached and small-bank-only firms. Similar relationships arise for fixed capital. Among IPO firms, firms with great-bank attachments are also the largest, however, the combined-bank firms tend to have less fixed capital than great-bank-only firms. Not surprisingly, the long-lived firms are larger overall by both measures.

Another obvious difference among types of firms is age, or more accurately, years from founding as a joint-stock firm. Naturally, given the sampling criterion, the greatest disparity lies between IPO and long-lived firms, however, there is also some variation within these subsets of firms. Unattached firms are youngest on average in both samples, though the difference obtains greater statistical significance among long-lived firms. Within the IPO sample, firms without bank attachment are of similar vintage as those with combined-bank attachments.

Relative to their fixed capital, small-bank firms lie at the high end of the distribution for several measures of liquidity: short-term and total financial assets, revenues, and net profits. This difference cannot be attributed to sectoral bias, since the sectors in which small-bank firms predominate–textiles and chemicals–show insignificant differences in average normalized short-term assets, revenues, and profits. Only the mean of total financial assets differs between these two sectors and all others, and in this case the average is lower for textiles and chemicals than for other sectors. IPO firms as a group have higher (normalized) revenues and short-term liquid assets, yet they have profits and total financial assets on par with long-lived firms.

Finally, the sample means and t-tests indicate that long-lived firms had substantially higher values of Tobin's q than IPO firms. Differences according to bank-attachment status within the two sub-populations are less pronounced, though they are significant in some cases. Among long-lived firms, for example, small-bank firms have a higher value of q than independents, while among IPO firms, the greatest split falls between firms with and without great-bank attachment (regardless of attachment to a smaller bank).

The descriptive statistics and significance tests indicate a variety of differences among the sample populations, but it is not immediately clear whether the variation in individual firm characteristics across categories provides a robust indicator of different types of bank attachment. It does warn of possible selectivity biases that should be, and are, accounted for in the econometric analysis that follows.

III. Fixed Effects Specifications and Results

Tobin's Q theory of investment, and Hayashi's (1982) interpretation thereof, provides the theoretical framework behind several recent empirical studies of firm investment behavior. In this framework, internal funds play no role in firms' investment decisions; only expected future profitability of investment enters consideration. Such models require strong assumptions. In particular, markets and firm competition must be perfect–two assumptions that are clearly violated for the present case. Liquidity constraints may, therefore, be a real problem, and this motivates the inclusion of inside funds in the investment regression equation.

A. *The Fixed Effects Model*

The empirical implementation of the Tobin's Q model encounters several difficulties. Even in the case of modern data, Tobin's Q is notoriously difficult to measure.[26]

Dependence on stock market data may present a further complication in the German case. Since it is widely believed that the universal banks internalized the capital market through their distribution and brokerage networks, both par values and market values of shares could well be distorted. For example, the banks are thought to have propped up share prices occasionally, in order to unload their shares of issues they no longer wanted to hold. If this were the case, then the *Kurs* would give the false impression that the firm in question had particularly good future investment prospects. Unfortunately, there is no practical solution to this problem at present, but the pervasiveness of such activities by the bank deserves further attention.

Another potential ambiguity in the interpretation of inside funds in the investment equations arises from the possibility that liquidity proxies for production. High levels of production in one period may lead to the need for more capacity in the next period. To control for this potential accelerator effect, lagged production or production growth is often included among the exogenous variables despite the lack of strong theoretical motivation. Since production data is not generally available for my sample, I use revenue growth as the nearest alternative. The reduced form investment equation to be estimated is the following.

$$\begin{aligned}\frac{I_{it}}{K_{it}} &= b_1\frac{I_{it-1}}{K_{it-1}} + b_2\frac{SL_{it-1}}{K_{it-1}} + b_3 Y_{it-1} + b_{4j}Q_{it-1} \\ &+ b_{5j}B_{jt}\frac{SL_{it-1}}{K_{it-1}} + b_{6j}B_{jt}Y_{it-1} + b_{7j}B_{jt}Q_{it-1} + b_{8t}T_t + \epsilon_{it} \qquad (1)\end{aligned}$$

Thus, I regress investment on lagged (beginning of period) investment (I), stock liquidity (SL), revenue growth (Y), and Tobin's q (Q); indicator variables for attachment to a small bank, a great bank, and a combination of small and great banks (B_j) interacted with each exogenous variable; and annual indicator variables (T_t). Investment, stock liquidity, Tobin's q, and revenue growth are as previously defined, and all level variables are normalized by the firms' yearly stock of fixed capital to reduce the possibility of heteroskedasticity and to control for size effects. The interaction terms allow a comparison of slopes between bank-attached and independent firms within the same regression equation.[27]

This basic specification is essentially the same as those used in other recent studies, though some adjustments have been made. The regression equation includes only the total stock of financial assets (at the beginning of each period) as the liquidity variable, because I consider it a more sensible representation of a firm's available finance than cash flow. In addition, since cash flow and stock liquidity are approximately 80 percent correlated in this sample, and since they are thought to measure similar financial characteristics, inclusion of both variables creates the potential for collinearity problems.[28]

The introductory section suggested that dynamic economies of scale may yield significant reductions in the cost of external finance for firms that remain attached to the same

banks for several years. The data currently available permit no explicit measurement of the length of attachment to a particular bank. Since attachment status was checked for 1900, 1905, and 1910, an alternative means of controlling for the length of attachment is to create an indicator variable for firms that were attached in the preceding period. The resulting long-term relationship indicator variable takes the value one for firms attached as of 1900 and zero otherwise. The interaction of this variable with the other exogenous variables permits a comparison between firms that were attached in 1900 as well as in 1905 and 1910 and firms that gained bank attachments in 1905 or 1910 (or not at all).

A third specification incorporates the effects of age. In place of the LTR variable, this specification adds an indicator variable for whether the firm was older than average and interacts this variable with liquidity and each of the bank-attachment indicator variables. This is a second, broader attempt to capture the dynamic effects of bank-firm relationships. Though this is certainly an imperfect indicator of the tenure of the banking relationship, age may play an important role in financing constraints. Older firms might be expected, on average, to have easier access to external capital than young firms, and should, therefore, exhibit less sensitivity to liquidity. That is, firms that are both attached and relatively far along in their life cycles should be the least liquidity constrained. It is interesting to investigate whether an age effect exists in general, and whether bank attachment has any effect on the process. The age test is less useful for the IPO firms, since all the firms were selected to be young, and thus the life spans captured in that sub-sample are much shorter. Nonetheless, since the IPO firms are younger than the long-lived firms they already provide some insight into the age question. Thus, the first specification is repeated for the full sample, and an indicator variable for IPO status (and the interaction of this variable with the other exogenous variables) is included.

The panel structure of the data leads to regression equations of the form $Y_{it} = X_{it}\beta + \epsilon_{it}$, for $i = 1, 2, ...N$ and $t = 1, 2, ...T_i$, where $\epsilon_{it} = \alpha_i + \eta_{it}$. This specification allows insights into the dynamics of firm investment, but in doing so, it introduces the possibility of correlation over time. Accordingly, I make the standard panel assumptions about the error distributions: 1. the expected values of the error components (α_i and η_{it}) are zero; 2. the components are uncorrelated ($E(\alpha_i \eta_{it}) = 0$); 3. the firm-specific errors are uncorrelated ($E(\epsilon_{it}\epsilon_{jt}) = 0, i \neq j$); 4. There is no serial correlation within individual cases' error terms ($E(\eta_{it}\eta_{it'}) = 0, t \neq t'$); 5. η_{it} is i.i.d. within groups; and 6. α_i is i.i.d.

To estimate the investment equations just described, I first use the standard within groups (fixed effects) method and then, in the next section, employ a generalized least squares (random effects) framework. The within groups estimation runs OLS on the variables minus their time averages and is equivalent to a pooled regression in which indicator variables are included for each cross-sectional unit (firms, in the current case).

A major concern in estimating the differences in liquidity sensitivity of investment according to bank-attachment status is that there is endogeneity in the right hand side variables. In particular, selectivity bias in the choice of bank attachments may drive the apparent differences in coefficient estimates: characteristics that cause firms to become

involved with banks may simultaneously lead to diminished liquidity sensitivity.[29] Since it is constant across time, the error component sensitive to endogeneity, α_i, is removed in the case of the within groups estimator. If biases arise at the firm level, the fixed effects model ameliorates the selectivity problem. Direct tests of selectivity bias are provided in the following section.

B. *Results*

Table II gives the results for the first two of the three investment equation specifications just described. The first two columns include only long-lived firms, whereas, the second two cover all firms. Columns one and three include only the variables of the base specification–that is lagged investment, stock liquidity, revenue growth, and Tobin's q, along with the interaction terms for the various bank-attachment categories and annual indicator variables.[30]

The coefficient on stock liquidity in column one is negative but insignificantly different from zero, and thus, on average there is little liquidity sensitivity of investment among the long-lived firms as a group. In contrast, the coefficients on the interaction of liquidity with bank-attachment indicators are positive and significant–suggesting a strong relationship between investment and internal funds for bank-attached firms. The baseline coefficient on the Tobin's q proxy is positive and significant (in contrast to that on liquidity), yet–as evidenced by the significant negative estimates on the interaction of bank indicators with q–the corresponding coefficients for the bank-attached firms are positive but significantly lower. Together, then, the estimates indicate that unattached firms' investment responds to expected future profitability, while attached firms' investment moves with internal funds.

This finding contrasts with those of the majority of recent studies and suggests, on the face of it, that close involvement with a bank yields no easing of liquidity constraints. Hoshi, Kashyap, and Scharfstein (1991) on modern Japan and Ramírez (1995) on J.P. Morgan at the turn of the last century, for example, find that bank-attached firms enjoyed substantially lower liquidity sensitivity than their unattached counterparts.[31] Assuming previous studies have correctly estimated relative liquidity sensitivities, the current results show, at a minimum, that the effects of bank attachment are not generalizable. Implicitly, however, Ramírez (1995) lends support to the findings in this paper. Since Ramírez compares J.P. Morgan firms to all others, and since several other investment and commercial banks engaged in similar practices to the German universal banks, there must be firms in the unattached category that had attachments to banks other than Morgan's. Since the Morgan firms nonetheless demonstrate lower liquidity sensitivity than these other bank-attached firms, clearly the majority of bank-attached firms did, on average, show sensitivity to their inside funds. It would be necessary to identify and measure liquidity sensitivity for the sub-sample of non-Morgan firms in order to compare the results of Ramírez's investment regressions to those in this study.

The results of the Hoshi, Kashyap, and Scharfstein (1991) study may also be inap-

propriate as a comparison to the current case. While group membership was assumed to be exogenous in that study, it may not have been. Since many of the bank-attached firms they studied subsequently freed themselves of group ties (see Hoshi, Kashyap, and Scharfstein (1993)), clearly the group-attached category contained a large proportion of financially secure firms. Furthermore, even though group membership was stable throughout the period of their investigation, it must have arisen at some point. At that point, certainly the attachment process was, if not systematic, at least not completely random. While it may be unable to explain the liquidity sensitivity results in their earlier paper, a discrete choice analysis of the characteristics correlated with group membership would aid in understanding the differences in the process of formation of industrial groups in Germany and Japan.

Table II here.

The specification in column two of Table II adds the previously-described indicator variable for attachment in the previous period (LTR) as well as the interaction of LTR with liquidity. Coefficients on the interaction of these variables with liquidity are negative as expected, but they are statistically insignificant. This is likely due to the small number of firms fitting the criterion and suggests that further work on long-term relationships is warranted. For example, the sample might be extended to later years in order to capture more firms with long-term relationships with banks. The inclusion of the LTR variables causes little movement in the coefficient estimates on the variables from the original specification.

Columns three and four of Table II repeat the first two specifications for the full sample and include an indicator variable for membership in the IPO sub-sample. Coefficients on the IPO indicator variables, and the interaction of these variables with stock liquidity, suggest qualitatively similar results as those for long-lived firms taken separately. When the indicator for long-term relationships is included, along with its interaction with stock liquidity (column four), the baseline coefficients are nearly unchanged. The coefficient on stock liquidity for great-bank firms, however, leaps to over nine, and that on liquidity for great-bank firms with long-term relationships turns nearly as large and negative. These estimates of liquidity sensitivity suggest that, on average, firms with great-bank attachment increased investment by nine units for every additional unit of financial assets, but that those firms that had been attached to a great bank continuously in the five years preceding the period in question enjoyed much lower sensitivity to their inside funds. While there is some intuitive appeal to the notion that banks attach to firms with naturally tighter liquidity constraints and that they are only able to ameliorate such problems after several years of involvement, the sheer size of the coefficient estimates is suspect.

Closer inspection of the data reveals that such doubts are well-founded. Indeed, one IPO firm seems to drive the reported results, and the firm's financial situation provides a good example of the potential weaknesses of this methodology for measuring firms' liquidity constraints. The firm in question, Rostocker Strassenbahn Aktiengesellschaft,

was a light rail company operating in Rostock. Having decided during the general meeting of shareholders in 1897 that they would undertake the electrification of the railway, the company spent six years negotiating the deal with the city in which they operated.[32] In 1903, the shareholders finalized the municipal contract and voted to raise 800,000 Marks to finance the project. Thus, the company raised its share capital from M. 370,500 to M. 670,500 and issued M. 500,000 in bonds. In addition, in the following year, the firm borrowed M. 261,033 from the electrical firm Lahmeyer & Co. in Hamburg. As a result of this investment, fixed capital rose from 371 to 1,196 thousand Marks between the close of 1903 and the close of 1904. During the same period, revenues from its newly-electrified lines increased from 97 to 146 thousand Marks. Since the lines were only opened halfway through 1904, these returns are all the more remarkable.

Through the early stages of these investment decisions, Rostocker Strassenbahn A.G. apparently had no interlocking directorates with a bank.[33] By 1905, the firm had interlocking directorates with one of the so-called great banks, but the top positions remained independent of bank involvement. Since the stock of liquid assets, or cash flow, was relatively small in the period preceding the surge in investment, the estimated regression line is extremely steep. Since this firm is categorized as attached to a great bank, the resulting high level of sensitivity is attributed to that category of firm. Furthermore, since the firm was without previous bank attachment, the coefficient on liquidity for bank-attached, LTR firms fully offsets that on liquidity for attached firms overall. Taken together, these effects present what may be misleading results. Without similar investigation of the other firms, however, it is impossible to know how unusual this firm was. In the case of the light rail sector, it is more likely that it was the exceptional firm that did not undergo electrification in the decade or so around the turn of the twentieth century. Likewise, new technologies were developed and applied in many other sectors of the economy, and such firms would have also undertaken major investment projects. Other researchers have discarded firms with investment over certain limits, apparently for statistical reasons. On the contrary, it seems that these are exactly the firms that should be investigated the most closely.[34]

The case of Rostocker Strassenbahn supports the point made in Kaplan and Zingales (1996) that, in general, liquidity constraints and investment-cash flow sensitivities have no monotonic relationship to one another. In particular, this case points to certain conditions under which the least constrained firms will appear to have the greatest liquidity sensitivity. For example, long delays between the decision to invest and the beginning of investment, due to protracted negotiations with the municipal government, create the appearance of liquidity constraints. Such delays might occur in many situations, and the accumulation of internal funds might therefore be an accidental (or at least, unneeded) by-product of delays. In fact, Rostocker Strassenbahn did not accrue internal funds during the six years of negotiations. This behavior only supports the notion that this firm was unconstrained, since it suggests confidence that the substantial new investment could be efficiently financed through outside funds. Cases in which internal funds reached relatively high levels in the period before investment can actually produce lower estimates of liquidity sensitivity than cases in which internal funds do not accrue at a rapid rate.

It should be pointed out that relative to the IPO firms, the long-lived sample contains more firm-years, even controlling for sample size, in which investment exceeded the stock of fixed capital in the base year. Such firm-years also fall into one of the bank-attachment categories. The absence of comparatively low cash flow or liquidity in these cases, however, means that none of these high-investment cases produces apparent outliers among the long-lived firms. Thus, the long-lived sample yields more moderate (and probably more generalizable) estimates of liquidity sensitivity for attached firms than does the IPO sample.

Table III gives the results for the third specification, in which an indicator variable is included for older-than-average firms. Column one repeats the results for the original specification. Column two shows that, as in the base specification, the coefficients on liquidity interacted only with bank attachment dummies are positive. This suggests that younger-than-average attached firms experienced tighter liquidity constraints than similar unattached firms. Coefficients on the simultaneous interaction of liquidity with bank attachment and OLD are negative. These results indicate that firms that had great-bank or combined attachments and were older than average had lower liquidity sensitivity of investment than other great-bank firms, but they still had higher sensitivity than independent firms in all categories. This finding is qualitatively the same as those for the LTR variable presented in Table II, but the statistical power is now greater. Nonetheless, it is not clear that bank attachment lessened firms' liquidity sensitivity over time, since older firms should have experienced looser liquidity constraints than their younger counterparts. Even the oldest of the attached firms had higher liquidity sensitivity than the unattached firms overall.

Given the findings on liquidity sensitivity, there is good reason to question the role of bank attachment in firms' liquidity sensitivity of investment. To the extent that banks eased financing constraints, they therefore seem to have yielded only small, long-term benefits.

Table III here.

A causal relationship cannot necessarily be inferred from the finding that only bank-attached firms had positive liquidity sensitivity of investment. The findings heighten worries about selectivity bias, and thus the following two sections provide both a direct attempt to control for such influences as well as deeper analysis of the characteristics associated with bank-attachment. As I pointed out in the previous section, however, the fixed effects specification should mitigate selectivity problems, since it eliminates firm-specific effects. Nonetheless, if biases are systematically related to characteristics other than firm identity, then improvements may be possible.

IV. The Random Effects Model with Selectivity Corrections

In contrast to the fixed effects estimator described in the previous section, the random effects estimator runs OLS on a weighted value of the exogenous variables ($X - \Theta\overline{X}$). The weight, theta, is based on the ratio of variances from the within and between (OLS on time

averages of the variables) groups estimators. In the case of a balanced panel, Hausman and Taylor (1981) show that GLS estimation is equivalent to a weighted average of these two estimators. When a panel is unbalanced, which is the case with the current data, there are two places where some adjustments may be necessary: the variance components (s_α^2 and s_η^2) and theta (directly via the variation in the number of time periods across cases and indirectly via the variance components). If the panel is unbalanced, theta should be calculated separately for each case depending on the number of time periods available.

Individual effects remain in the GLS random effects estimates. To control for potential selectivity bias in the random effects model, I use the method described by Dubin and McFadden (1984), in which a Heckman-type selectivity correction term is included as an independent variable for all but one choice category. The first step is to run a logit regression on the multinomial choice variable for bank attachment. The errors calculated in the logit regressions are correlated with the firm-specific effects that are of concern in the investment regressions. Correction terms are then formed using the predicted probabilities from the logit estimates and are included as exogenous variables in the investment regressions. The coefficients on these selectivity terms measure the correlations between unobserved firm effects and unobserved factors that influence the probability of attachment. In the fixed effects regressions, the attached firms had significantly higher liquidity sensitivity than independent firms, yet this sensitivity may be related to other factors that tend to go hand in hand with attachment. Thus, if the logit equation can be specified to capture the major characteristics influencing the choice of interlocking directorates, the resulting selectivity terms will minimize the influence of these factors in the estimation of the investment equation. The logit results are reported in Table V in the following section, and the correction terms for the four-choice case are derived in the appendix.

Table IV presents the results of the random effects procedure, and the four columns correspond to those in Table II. Changes arise in the estimation procedure, the addition of the selectivity correction terms, and the restriction of the sample in columns three and four to the IPO firms alone.[35] All of these changes can have effects on the coefficient estimates. The statistical tests at the bottom of Table IV reveal that the investment behavior of IPO firms is better described by the random effects model than the fixed effects model. On the other hand, the extremely low P-values for the Hausman Chi-square test suggest that the fixed effects model better suits the case of the long-lived firms. Nonetheless, it is useful to examine the effects of the newly-introduced selectivity correction terms for both sub-samples.

The selectivity correction terms are statistically significant in only about one third of the cases. Among long-lived firms, the combined-bank firms show a significant, negative *a priori* effect on investment, while great-bank-only firms exhibit a positive, and only weak, relationship. The results for the great-bank and combined-bank firms are essentially reversed in the IPO sample, though the negative coefficients on the great-bank-only correction term are substantially larger in absolute value than any of the other coefficients.

This effect is likely due to the same outlier discussed previously. In both sub-samples, it is the category that contains the largest firms that obtains negative coefficients on the corrections term. As is demonstrated in the next section, size is probably the strongest selection criterion for great-bank or combined-bank attachment.

Among long-lived firms, the biggest effect on the coefficient estimates for liquidity derives from the change to the random effects model. Exclusion of the selectivity correction terms produces almost no effect on the coefficient estimates or robustness tests. Indeed, the coefficients on liquidity for all categories of bank attachment are actually higher when the corrections terms are included. This suggests that, if anything, the selectivity bias causes underestimation of liquidity sensitivity for attached firms.

The correction terms do wield considerable statistical influence among the IPO firms. The exclusion of these terms yields more extreme estimates of liquidity sensitivity–in the positive direction for great-bank firms overall and in a negative direction for great-bank firms with long-term relationships. While this suggests that selectivity bias accounts for part of the extreme values of liquidity sensitivity of great-bank firms, the majority of the effect can still be attributed to the one outlier firm-year described in the previous section. In the absence of this outlier, the regression results for the IPO firms alone are statistically insignificant. Clearly, much of the poor statistical performance of the IPO sub-sample taken alone stems from the small number of observations, and this a problem that can only be addressed through expansion of the sample.

Table IV here.

V. Selectivity Bias: A Closer Look

The random effects models just reported suggest that selectivity bias plays only a limited role in the findings on liquidity sensitivity. To the extent that the logit analysis fails to capture selection effects, however, the selectivity corrections in the random effects model will fail to fully account for such bias. Furthermore, the logit analysis may turn up systematic differences among the various types of firms that provide valuable insights into the process of interlocking directorates, but that cause little change in the estimation of firms' liquidity sensitivity. Thus, the first part of this section presents the results of the logit analysis used in forming the selectivity correction terms.

The second part of this section examines the sectoral distribution of bank-firm interlocking directorates. Such evidence provides further insight into the patterns of interlocking directorates between banks and industrial firms in Germany. At the same time, the sectoral distribution of bank involvement also helps to distinguish between the dynamic economies of scale and static delegated monitoring frameworks of financial intermediation. The introductory section suggested that dynamic economies of scale favor specialization by financial intermediaries, while static delegated monitoring requires diversification to guarantee viability. The data reveal that specialization is clearly evident in the current case.

A. *Discrete Choice Analysis*

The GLS specification and selection correction model, though theoretically appealing, require several assumptions about the underlying properties of the data–some of which the current case likely violates. In particular, the power of the GLS-selectivity correction model hinges on the proper specification of the discrete choice model in the first step. To the extent that the first step fails to capture the effects of group selection bias, the random effects model retains selection bias. Since the descriptive statistics exposed several areas of potential divergence among the categories of firms, the logit analysis from the first step of the selection model are of particular interest. Table V gives the results of this procedure. The long-lived and IPO firms are treated separately, since they were shown in Tables IA and IB to have substantially different characteristics from one another.

The dependent variable in the logit equation is the four-choice attachment variable that takes the value zero for no bank connection and one through three for small-, great-, and combined-bank attachment, respectively. The independent variables include the variables involved in the investment equation–investment, stock liquidity, revenue growth, and Tobin's marginal q–as well as a vector of control variables–fixed assets (to measure size), age, capital intensity (the ratio of fixed capital to revenues), leverage (the ratio of outside to inside finance), profit margin (the ratio of profits to revenues), and dividends (in the case of long-lived firms). The capital intensity variable proxies for a capital-output ratio and uses revenues in the denominator due the lack of output data. The first three columns of Table V cover the long-lived firms, while the last three cover the IPO firms. Within each sub-sample, the columns give the results for small-bank, great-bank, and combined-bank attachment.

Perhaps the most notable result is the lack of any systematic difference in the rates of investment among the various groups of firms. This confirms the findings of the ANOVA and t-tests given in Table IB. Like investment, revenue growth is statistically indistinguishable across bank-attachment categories. These two variables measure the rate of growth of a firm, and by either metric, bank-attached firms grew no faster than unattached firms. From the point of view of development and economic growth, this finding casts some doubt on the importance of the banks for promoting industrialization through their involvement in industrial networks.

Other variables do reveal significant differences between attached and independent firms, though the results are somewhat different for long-lived and IPO firms. For example, among long-lived firms, bank-attached firms in general accumulated higher levels of stock liquidity (relative to fixed assets) than unattached firms. Whether this phenomenon caused or was a reaction to bank attachment cannot be determined directly from the current data. There are logical explanations for either interpretation. Banks may have been attracted to firms with relatively strong financial positions for security reasons, or bank-connected firms may have held higher levels of liquidity to maintain independence from bankers.

Among IPO firms, the pattern is different. Only small-bank firms held significantly higher levels of liquidity than unattached firms, and great-bank firms actually held lower levels. Much of the magnitude and statistical significance of the coefficient on great-bank liquidity derives from the outlier firm discussed in the previous section. When that firm is dropped from the sample, the coefficient rises to negative two, and the p-value of the t-statistic falls to 17 percent. Combined-bank firms in the IPO sample held approximately the same level of liquid assets as unattached firms. The difference in liquidity coefficients between the IPO and long-lived firms suggests that liquidity was not a consistent criterion for forming interlocking directorates.

Tobin's marginal q provides a clearer indication of bank attachment. Regardless of bank type or firm age, this measure obtains positive coefficients. These estimates are significant for great-bank and combined-bank firms in the long-lived sub-sample and are significant only for combined-bank firms in the IPO sub-sample. The introductory section mentioned the possibility that Tobin's q could easily be mismeasured due to the thinness of the capital market and the supposed influence of the universal banks in setting prices and par-values of securities. Such activities would have extended to unattached firms as well as attached, since the universal banks were virtually the only route to the capital market. The banks may have selected only the best-performing firms with which to engage in interlocking directorates (*ex ante* monitoring in the sense of Aoki (1995)), or, conversely, high values of q may have followed from the benefits of bank oversight and advice. It is also possible that the existence of interlocking directorates with a bank increased a firm's share price due to the signal it sent to the market (as in James (1987)). As with stock liquidity, without further data on the characteristics of firms before they engaged in interlocking directorates, it is difficult to assess causality.

Age and size appear as two strong indicators of bank attachment. Among long-lived firms, the largest firms were most often attached to several banks, while the smallest firms tended to be attached to the provincial banks. Among IPO firms, great-bank attachment is also correlated with size. The coefficient on fixed assets is also positive for combined-bank firms, but the statistical relationship is weaker. Generally, then, it appears that only larger firms gained interlocking directorates with the largest banks. Such a result makes intuitive sense for two reasons. Only the largest banks would have been able to provide for the needs of extremely large firms, and only the largest firms would have yielded the high commissions that would be required for the profitability of large banks. Since firms with great-bank attachments were not growing particularly fast, it seems likely that the causality runs from size to attachment and not vice versa.

Likewise, age is not a variable that can be caused by bank attachment, and it therefore offers interesting insight into the process of selecting firms for interlocking directorates. Among the long-lived firms, firms with more exclusive banking relationships–those with great-bank-only or small-bank-only attachment–were significantly older than unattached firms. Firms that were relatively old during this period are likely to have been fairly secure investments for the banks, but were also less likely to have required the kind of new, large-scale securities issues that likely resulted in board positions for a variety of

banks in the case of younger firms. Thus, among IPO firms, the youngest of the young tended to have the most bank connections.

Attached firms appear to have had similar debt-equity ratios as unattached firms. Only small-bank firms in the IPO sample had statistically higher leverage, and in that case, the effect is small. Indeed, great-bank firms in the long-lived sub-sample had significantly lower leverage than unattached firms. These results may stem from the high inside liquidity and lack of particularly vibrant growth on the part of bank-attached firms. If a firm were not growing and investing at a high rate, and if internal liquidity were simultaneously relatively high, then there would be little call for issuing new debt. It may also have been the case that attached firms were not growing and investing at higher rates because bank attachments constrained their ability to do so–either directly through voting rights in the supervisory board, or indirectly through control of financing options.[36]

Capital intensity provides less information about bank attachments than might be expected. The historical literature on Germany emphasizes the involvement of the large universal banks in heavy industry, and, as the next section shows, the current sample supports this view. Nonetheless, great-bank firms apparently had higher capital intensity among the long-lived firms, but lower capital intensity among the IPO firms. In all other sub-populations the coefficients on capital intensity are small and statistically insignificant. One possibility is that revenues overstates output, and that this leads to underestimation of capital intensity. For this to lower disproportionately attached firms' capital intensity, however, revenues would have to exaggerate output to a greater extent for attached firms than for unattached firms.

Profit margins seem to play a role only among long-lived firms–lending support to the notion that banks and firms formed relationships for a variety of reasons. Long-lived firms with great-bank attachment, with or without additional connections, enjoyed substantially higher profit margins than all other firms. Given that IPO firms with similar connections did not experience similarly high margins, it seems likely that the causality runs from profitability to bank attachment. At a minimum, it is safe to say that bank-attachment caused no uniform improvement in profitability. Together with the data on liquidity, marginal q, and fixed capital, the profit margin findings paint a picture of successful *ex ante* monitoring by the large banks when it came to older firms. In the case of IPO firms, the fact that great-bank firms had higher q values despite their relative youth and, if anything, lower liquidity and profit margins, suggests that bankers may have wielded significant control over share prices for younger firms. Such influence is likely to have been direct (through manipulation of share prices), but may have also resulted from the positive signal that bank attachment relayed to the capital market. While the latter explanation is more palatable from an economic standpoint, the historical literature lends more credence to the former.[37]

Table V here.

Despite higher profitability among long-lived, great-bank firms, dividends appear to have been relatively low for these firms. At the same time, internal liquidity was shown to be significantly higher for these firms. Together, these findings suggest that attached firms retained a relatively high share of their profits to hold in the form of financial assets rather than distributing dividends. Without knowing the results of the investment regressions, this would seem like a surprising result, since it suggests that bank-attached firms were subject to greater liquidity constraints than were unattached firms. Indeed, Fazzari, Hubbard, and Petersen (1988) used low dividend payouts as their indicator of liquidity constraints. The payment of lower dividends by attached firms only reinforces the finding that bank-attached firms' investment was more sensitive to liquidity than was unattached firms'.

Table A1 in appendix B gives the results of the investment regression for long-lived firms when the sample is divided into low- and high-dividend groups. The specification is the same as the first specification in Table II, except for the sorting criterion. The high-dividend indicator variable takes the value one when dividends are higher than the median and zero otherwise. Thus, the specification is similar to that used in Fazzari, Hubbard, and Petersen (1988). The coefficient on baseline stock liquidity is positive and strongly significant (0.32), while that on liquidity for high-dividend firms is significantly lower (0.13). The overall significance and explanatory power of the regression are approximately the same as in the bank-sorted specifications.

The logit analysis indicated that attached firms payed lower dividends on average than unattached firms, controlling for other characteristics. Nonetheless, bank-attached firms are no more likely to fall into the low-dividend category. Thus, the dividend sorting is not equivalent to bank-attachment sorting. This suggests that dividend policy is a distinct and equally good indicator of firms' liquidity sensitivity as bank attachment. This finding might diminish the strength of the conclusion that bank-attached firms experienced greater liquidity sensitivity than independent firms. It is important, however, to recall that the selectivity correction terms for long-lived firms included the influence of the dividend variable as measured in the logit regression. For these firms, however, the selectivity correction terms caused no significant reduction in the liquidity sensitivity of bank-attached firms as estimated in the random effects model. Thus, these findings bolster the contention that relationship banking caused no substantial improvement in firm's liquidity constraints.

One variable that is omitted from the logit estimation deserves mention. Industrial sector likely played an important role in the formation of bank attachments. Indeed, certain sectors provide nearly perfect indication of bank attachment. Furthermore, sectoral identification is constant over time. From a statistical standpoint, therefore, sectoral indicator variables are inappropriate for estimating the logit equation. In terms of measuring selectivity bias, the underlying characteristics of firms in particular branches of industry are presumably more important than the sector itself. Thus, variables such as investment rates, revenue growth, liquidity, profitability, and capital intensity should capture many of the important economic differences among sectors. Nonetheless, indus-

trial branch remains an important component of the choice of bank attachment, and, therefore the next part of this section takes up that question directly.

B. *Sectoral Distribution of Bank Attachments*

There are three reasons to investigate the sectoral distribution of bank attachments in the current sample. One motivation is historical. The historical literature emphasizes the concentration of large, universal banks on specific sectors of the economy.[38] If this were not the case in the current sample, then further investigation would be required. Either the received wisdom would be faulty or the current data would be unrepresentative of the underlying population. As the following data show, the findings reject both of these scenarios.

In addition, if bank-attached firms are unevenly distributed by sectoral affiliation, then the investment regression may capture sectoral effects rather than the influence of bank-attachment. While the results shown anything but a uniform distribution of bank networks, the findings suggest no clear direction of bias for the investment estimates.

Finally, the sectoral distribution of bank involvement offers insight into the dynamic character of the production of financial services. The introductory section noted that dynamic economies of scale may lead to specialization by financial intermediaries, while static delegated monitoring favors diversification. While the two theories are closely related, they imply divergent outcomes in the structure of financing relationships. The makeup of bank clientele may have broader implications for financial stability in the economy at large. If specialization leads to greater fragility of the banking system, then the potential benefits of dynamic learning may be offset.[39]

Table VI gives the sectoral breakdown of bank attachments in the current sample. The numbers in the table represent the percentage of firms in each sector that engaged in interlocking directorates with the given type of bank (including no bank). The first four columns present the data for the long-lived firms, while the last four columns cover the IPO firms. The distributions are given for 1910, though the shares changed only marginally throughout the period. The percentages indicate that mining, electrical, and transportation firms were the most likely to have interlocking directorates with the largest of the universal banks. Furthermore, such firms were highly likely to involve themselves with multiple banks. Textile and chemical firms appear to have been mainly involved with the smaller, provincial banks, while firms in construction and food products (including beer) tended to be unattached. The sectoral breakdown, thus supports the traditional notion that the great banks concentrated their efforts in a small number of industries.[40]

Table VII presents further evidence of the sectoral concentration by universal banks. The first column gives the average percentage of board seats that were held simultaneously by a bank board member. The second column presents the average number of banks represented on the firms' boards, while the third column calculates the percentage

of firms whose supervisory board chair or vice chair was held by a concurrent great-bank board member. The three columns are repeated for IPO firms.

Again, electrical, mining, and transport firms rise to the top in the measures of the extent of bank involvement. Certainly part of the high rates of overlap and great-bank chair stems from the firms' membership in bank boards. Nonetheless, the data indicate a high degree of networking among banks and these firms. In contrast, textile, construction, food product, and chemical firms generally fall at the lower end of the spectrum on these measures. Thus, bank attachment (particularly with great banks) was not only less frequent among these firms, it was also less extensive.

Table VI here.

Table VII here.

Together, these pieces of evidence strongly support, and lend some quantification to, the commonly-perceived focus of the great banks. In addition, these data offer some insight into the clientele of the less-researched provincial banks–showing that these banks serviced different sectors than those financed by the great banks. If securities holdings by the banks represented a subset of the firms with which they engaged in interlocking directorates, then the banks clearly held a minimally diversified portfolio. This finding therefore lends support to the dynamic economies of scale argument but suggests that overall financial stability may have been a problem. Indeed, the move toward concentration in the banking sector, the great part of which derived from the takeover of private and provincial banks by the great banks, may have been prompted by the desire for greater diversification following the economic crises of the early 1890's and 1900-01.

The banks clearly focused their attention on particular sectors, yet the findings here indicate no systematic manner in which bank effects might be proxying for sectoral effects. First, the sectors that are most heavily bank involved, electrical, transport, and mining, are similar in industrial organization, but are quite different from one another in age and technological advancement (the types of factors that influence investment most significantly). For example, all three sectors are oligopolistic: a small number of large firms dominate the industry, but an army of smaller firms fill smaller niches in the sector. Differences, however, may be more pronounced. The mining industry was one of the oldest and arose long before universal banking.[41] The electrical branch, in contrast, arose in the early 1880's with the immediate involvement of the universal banks. Transportation falls somewhere in the middle, since it was an older sector of the economy but underwent significant technological advances relating to electrification.

It might be reasonable to assume that bank-attachment status proxies for sectoral influences if none of the unattached firms belonged to the bank-dominated sectors, or if the largely-independent sectors could be expected to exhibit significantly different investment patterns than those with heavy bank involvement. Neither of these criteria seems to be fulfilled in the current data. First, one fifth to one third of mining companies

engaged in interlocking directorates with no bank or only with a provincial bank. Second, metal and machinery companies were distributed fairly evenly across the banking spectrum. Third, chemical firms, many of which represented equally new and advanced technology as electrical firms, were largely without great-bank attachments. Finally, beer brewing, an industry that enjoyed substantial economies of scale, was a sector that was largely independent of bank involvement. Thus, greater parallels arise between attached and independent sectors than among the bank-networked sectors. There exists, at least, no clear direction of bias based on sectoral identification of bank-attached firms, and, therefore, the liquidity effects attributed to bank-attached firms seem warranted.

VI. Concluding Remarks

This paper has presented new evidence on the operations of the German credit banks and their impact on industrial investment before World War I, while also offering insight into the role of relationship banking more generally.

On the first count, the results indicate that German-style banks do not seem to have had large, static effects on firms' liquidity constraints during the period of rapid economic growth before World War I. Bank relationships do, however, seem to have reduced firms' liquidity sensitivity of investment over time in some cases. These conclusions are hardly those that would be expected, given the abundant qualitative literature on universal banks and their influence in the German industrialization. While a new story of the role of the universal banks does not f ully emerge from the current analysis, I can speculate on a couple of explanations for the contrarian findings.

First, most investigations into the practices of German banks have been based on the experiences of a small number of high-profile firms–Siemens, Krupp, and Deutch-Lux, for example–and an elite group of industrialists and bankers–Stinnes, Rathenau, Hansemann, and others.[42] It is unclear how well their experiences generalize to the remainder of the population, and it is also undetermined how great an impact these special cases may have had on economy-wide aggregates. In addition, many accounts of bank-firm relationships arise out of post-World War I events. Industrial concentration accelerated during this period, and thus, bank influence concurrently became more apparent (if not more real). It is erroneous to assume that banking and corporate governance relations during and after the first world war aptly describe the pre-war situation.

Second, modern notions of the importance of universal banking have been heavily influenced by a small, and probably biased, body of literature. The historiographical lineage can be traced back through Gerschenkron (1962) and Schumpeter (1939) to Riesser (1910). Jakob Riesser was a well- known Great Bank director, and his 1910 work was translated into English by the U.S. National Monetary Commission in 1911. Thus, his work has heavily influenced several generations of economists and historians–particularly in the United States. While his analysis is certainly accurate for a portion of German firms in particular sectors over a limited period of time, his conclusions may no longer hold when extrapolated, as they have been, to cover a wide assortment firms and industries since the middle of the nineteenth century. Furthermore, repeated quotation and

interpretation has tended to broaden and exaggerate Riesser's original theses.

The essence of both explanations is the same: past investigations have been narrow in scope, and their conclusions have been interpreted too generally. If the biases of past work are considered, the implications of this paper become less surprising or controversial.

The second goal of this work has been to provide empirical evidence on more general questions of the importance of relationship formation on the part of financial intermediaries, and in this respect the results are mixed. Three general conclusions should be taken from this analysis.

First, while the purpose of this work has not been to explain the phenomenon of interlocking directorates, the analysis here has revealed a need for such research in the future. Full comprehension of the nature of bank-firm attachments and their importance in industrial development may hinge on a clearer understanding of the process that creates these relationships. Thus far, work on banking relationships and firm liquidity sensitivity has neglected the subject of the process of attachment. The logit analysis and selectivity corrections in this paper represent a first step in providing some insight on the subject. Clearly, further research should grapple with the causality issue, and one way to do so would be to investigate the properties of firms before and after becoming involved in close banking relationships.

Second, the analysis shows that the existence of high liquidity sensitivity provides an inconsistent measure of liquidity constraints. While the results for the long-lived firms appear to be free of outlier influence, the findings of extremely high liquidity sensitivity among great-bank attached, IPO firms clearly stemmed from the influence of one firm. The case study presented for that firm showed that this firm suffered from no apparent liquidity constraints, yet it had radically higher estimated liquidity sensitivity than other firms. These findings warn of the potential for misleading conclusions when liquidity sensitivity is assumed to measure liquidity constraints.

Finally, if liquidity sensitivity does provide some indication of liquidity constraints, then the findings in this paper suggest that there is good reason to question the general ability of relationship banking to produce dramatic results. The estimated differences in liquidity constraints for attached and unattached firms, for firms with and without long-term relationships, and, in the case of long-lived firms, for old, attached and young, attached firms provides evidence in favor of a dynamic economies of scale hypothesis and against a static interpretation of the viability of financial intermediaries. The demonstrated specialization of universal banks in certain branches of industry further substantiates such conclusions. These results undermine widely-held beliefs about the benefits of universal banking and also raise questions about the German banks' industrial policies and the extent and intimacy of their relations with firms. More generally, the findings in this paper contradict several recent papers that find that bank-attached firms encounter lower liquidity sensitivity of investment than do unattached firms. In addition, the specification that sorts firms by dividend payouts, reported in Table AI, finds analogous results to those in Fazzari, Hubbard, and Petersen (1988). This finding only underscores

the limited effects of bank attachment, since bank attached firms appear in nearly equal numbers in the high-dividend and low-dividend categories.

Clearly, further empirical studies of both the costs and benefits of universal banking are necessary. In the mean time–and until the potential costs are fully understood–circumspection should be recommended in drawing policy conclusions in favor of increasing relationship formation between banks and the firms they finance.

Appendix 1

The selectivity correction terms are derived according to Dubin and McFadden (1984). The expected value of the disturbance conditional on a particular choice i having been made is

$$E(\eta \mid i) = \sum_{j \neq i}^{m} \left[\frac{\sigma\sqrt{6}R_J}{\pi} \right] \left[\frac{P_j \ln P_j}{1 - P_j} + \ln P_i \right] \tag{2}$$

where R_i is the correlation between η and ϵ_i, m is the number of mutually exclusive and exhaustive choice alternatives, p_j is the multinomial logit estimate of the probability of choosing category j versus the base category, and δ_j is an indicator variable that takes the value one if an individual chooses category j and zero otherwise. It follows that

$$\sum_{i=1}^{m} E\left[\eta \mid i\right] \delta_i =$$

$$\sum_{j=2}^{m} \left[\frac{\sigma\sqrt{6}R_j}{\pi} \right] \left[\frac{(P_j - \delta_j) \ln P_j}{1 - P_j} - \frac{(P_1 - \delta_1) \ln P_1}{1 - P_1} \right] = \sum_{j=2}^{m} Q_j H_j \tag{3}$$

and H_j is the correction term. In the m-choice case, there will be $m - 1$ such terms of the following form: $H_j = ((p_j - \delta_j) \times log(p_j)/(1 - p_j)) - ((p_1 - \delta_1) \times log(p_1)/(1 - p_1))$, for $j = 2, 3, \ldots, m$.

Appendix 2

Table AI here.

References

Aoki, Masahiko, 1995, Controlling insider control: Issues of corporate governance in transition economies. In M. Aoki and H.K. Kim, eds.: *Corporate Governance in Transitional Economies.* Washington, D.C.: The World Bank, 3-29.

Baliga, Sandeep and Ben Polak, 1994, Why aren't universal banks universal? Cambridge University and Harvard University mimeo.

Becht, Marco and Carlos Ramírez, 1993, Finance capitalism in pre-World War I Germany: The role of the universal banks in the financing of German mining companies 1906-1912, Harvard University, mimeo.

Bhattacharya, Sudipto and Anjan Thakor, 1993, Contemporary banking theory, *Journal of Financial Intermediation* 3, 2-50.

Bosenick, Alfred, 1912, *Neudeutsche Gemischte Bankwirtschaft*, Berlin: J. Schweitzer Verlag.

Brainard, William and James Tobin, 1961, Financial intermediaries and the effectiveness of monetary controls, in D. Hester and J. Tobin, eds.: *Financial Markets and Economic Activity*, Cowles Foundation Monograph 21, New Haven: Yale University Press.

Buchwald, Bruno, 1909, *Die Technik Des Bankbetriebs*, fifth edition, Berlin: Springer Verlag.

Calomiris, Charles, 1995, The costs of rejecting universal banking: American finance in the German mirror, 1870-1914, in N. Lamoreaux and D. Raff, eds.: *Coordination and Information*, Chicago: University of Chicago Press.

Chan, Y., Stuart I. Greenbaum, and Anjan V. Thakor, 1986, Information reusability, competition and bank asset quality, *Journal of Banking Finance* 10, 243-253.

Chirinko, Robert, 1995, Finance constraints, liquidity, and investment spending: Cross country evidence, Emory University, mimeo.

Da Rin, Marco, 1996, Understanding the development of the German *Kreditbanken*, 1850-1914: An approach from the economics of information, *Financial History Review*, 3, 29-47.

Diamond, Douglas, 1984, Financial intermediation and delegated monitoring, *Review of Economic Studies* 51, 393-414.

Dubin, Jeffrey and Daniel McFadden, 1984, An econometric analysis of residential electric appliance holdings and consumption, *Econometrica* 52, 345-362.

Eistert, Eckehard, 1970, *Die Beeinflussung des Wirtschaftswachstum in Deutschland von 1883-1913 durch das Banksystem* Berlin.

Elston, Julie Ann, 1995, Firm ownership structure and investment: Theory and evidence from German panel data," WZB Discussion Paper No. FSIV 93-28.

Fazzari, Steven, R. Glenn Hubbard, and Bruce Petersen, 1988, Investment and Finance Reconsidered, *Brookings Papers on Economic Activity*, 141-195.

Fischer, Klaus, 1990, *Hausbankbeziehungen als Instrument der Bindung zwischen Banken und Unternehmen: Eine theoretische und empirische Analyse,* Doctoral Dissertation, University of Bonn.

Fohlin, Caroline, 1994, *Financial Intermediation, Investment, and Industrial Development: Universal Banking in Germany and Italy from Unification to World War I,* Doctoral Dissertation, University of California Berkeley.

Fohlin, Caroline, 1995, The rise of interlocking directorates in Imperial Germany, Social Science Working Paper No. 931, California Institute of Technology.

Fohlin, Caroline, 1996a, *Fiduciari* and firm liquidity constraints: The Italian experience with Germany-style universal banking, Social Science Working Paper No. 948, California Institute of Technology.

Fohlin, Caroline, 1996b forthcoming, Universal bank clientele in the German industrialization: Microeconomic characteristics and their macroeconomic implications, California Institute of Technology, mimeo.

Fohlin, Caroline, 1996c, forthcoming, What caused the proliferation of corporate networks in pre-war Germany?: Evidence from firm financial data, California Institute of Technology, mimeo.

Gerschenkron, Alexander, 1962, *Economic Backwardness in Historical Perspective.* Cambridge, MA: Harvard University Press.

Gertler, Mark and Simon Gilchrist, 1994, Monetary policy, business cycles, and the behavior of small manufacturing firms, *Quarterly Journal of Economics*, 59, 309-340.

Greenwald, Bruce, Joseph Stiglitz, and Andrew Weiss, 1984, Information imperfections and macroeconomic fluctuations, *American Economic Review* 74, 194-199.

Grossman, Sanford and Oliver Hart, 1982, Corporate financial structure and managerial incentives, in J.J. McCall, ed.: *The Economics of Information and Uncertainty.* Chicago, IL: University of Chicago Press.

Gurley, John and Edward Shaw, 1960, *Money in a Theory of Finance*, Washington, D.C.: Brookings.

Hall, Bronwyn, 1991, Firm-level investment with liquidity constraints: What can the Euler equations tell us? University of California Berkeley, mimeo.

Hausman, Jerry and William Taylor, 1981, Panel data and unobservable individual effects, *Econometrica* 49, 1377-1398.

Hayashi, Fumio, 1982, Tobin's marginal q and average q: A neoclassical interpretation, *Econometrica* 50, 213-224.

Hilferding, Rudolf, 1910 *Das Finanzkapital*, Vienna: Wiener Volksbuchhandlung (English translation [*Finance Capital*] Tom Bottomore (ed.), Boston: Routledge and Kegan Paul, 1981).

Hoshi, Takeo, Anil Kashyap, and David Scharfstein, 1991, Corporate structure, liquidity, and investment, *Quarterly Journal of Economics* 106, 1, 33-60.

Hoshi, Takeo, Anil Kashyap, and David Scharfstein, 1993, The choice between public and private debt: An analysis of post-deregulation corporate financing in Japan, NBER Working Paper No. 4421.

Houston, Joel F. and Christopher M. James, 1996, Banking relationships, financial constraints, and investment: Are bank-dependent borrowers more financially constrained? University of Florida, mimeo.

Huber, Peter J., 1973, Robust regression: Asymptotics, conjectures, and Monte Carlo. *Annals of Statistics* 1.

Huber, Peter J., 1977, Robust methods of estimation of regression coefficients. *Math. Operationsforschung Statist. Ser. Statist.* 8.

James, Christopher, 1987, Some evidence on the uniqueness of bank loans. *Journal of Financial Economics* 16, 217-236.

Jeidels, Otto, 1905, *Das Verhältnis der Deutschen Großbanken zur Industrie*, Leipzig: Duncker und Humblot.

Jensen, Michael and William Meckling, 1976, The theory of the firm: Managerial behavior, agency costs, and ownership structure, *Journal of Financial Economics* 3, 305-360.

Kaplan, Steven N. and Luigi Zingales, 1996, Do investment-cash flow sensitivities provide useful measures of financing constraints? University of Chicago, mimeo.

Kuh, Edwin, 1963, *Capital Stock Growth: A Micro-Econometric Approach,* Amsterdam: North-Holland.

Lansburgh, Alfred, 1909, *Das Deutsche Bankwesen*, Berlin-Charlottenburg: Bank Verlag.

Mayer, Colin, 1988, New issues in corporate finance, *European Economic Review* 32, 1167-1188.

Meyer, John and Edwin Kuh, 1957, *The Investment Decision.* Cambridge, MA: Harvard University Press.

Millon, M. and Thakor, Anjan V., 1985, Moral hazard and information sharing: A model of financial information gathering agencies, *Journal of Finance* 40, 1403-1422.

Motschmann, Gustav, 1915, *Das Depositengeschäft der Berliner Großbanken*, Leipzig: Verlag von Duncker und Humblot.

Myers, Stewart and Nicholas Majluf, 1984, Corporate financing and investment decisions when firms have information that investors do not have, *Journal of Financial Economics* 13, 187-221.

Neuberger, Hugh and Houston Stokes, 1974, German banks and German growth 1883-1913: An empirical view, *Journal of Economic History* 34, 710-31.

Ospina, Sandra P., 1994, Firm heterogeneity, liquidity variables, and investment decisions: The Columbian case." University of Illinois, mimeo.

Passow, Richard, 1905, Die Bedeutung des Aufsichtsrats für die Aktiengesellschaft, in R. Ehrenberg, ed.: Thünen-Archiv, vol. 1, no. 5, Jena: Verlag von Gustav Fischer.

Petersen, Bruce and Raghuram Rajan, 1994, The benefits of lending relationships: Evidence from small business data, *Journal of Finance* 49, 1, 3-37.

Rajan, Raghuram, 1992, Insiders and outsiders: The choice between informed and arm's length debt, *Journal of Finance* 47, 1367-1400.

Ramírez, Carlos, 1995, Did J.P. Morgan's men add liquidity? corporate investment, cash flow and financial structure at the turn of the twentieth century, *Journal of Finance* 50, 661-678.

Rettig, Rudi, 1978, *Das Investitions- und Finanzierungsverhalten Deutscher Großunternehmen 1880-1911*, Doctoral Dissertation, University of Münster.

Riesser, Jakob, 1910, *Die deutschen Großbanken und ihre Konzentration*, Jena: Verlag von Gustav Fischer. English translation (The German Great Banks and their Concentration) published by The National Monetary Commission (Washington: Government Printing Office), 1911.

Sattler, Heinrich, 1977 [1890], *Die Effektenbanken*, Vaduz, Liechtenstein: Topos Verlag.

Schumpeter, Joseph, 1939, *Business Cycles*, New York: McGraw-Hill.

Sharpe, Steven, 1990, Asymmetric information, bank lending, and implicit contracts: A stylized model of customer relationships, *Journal of Finance* 45, 1069-1087.

Sombart, Werner, 1909, 1913, *Die Deutshce Volkswirtschaft im Neunzehnten Jahrhundert*, second and third editions, Berlin: Georg Bondi.

Stiglitz, Joseph E. and Andrew Weiss, 1981, Credit rationing in markets with imperfect information, *American Economic Review* 71, 393-410.

Stürmer, Michael, Gabriele Teichmann, and Wilhelm Treue, 1994, *Striking the Balance: Sal. Oppenheim jr. & Cie., a Family and a Bank.* London: Weidenfeld and Nicolson.

Stulz, René, 1990, Managerial discretion and capital structure, *Journal of Financial Economics* 26, 3-28.

Tilly, Richard, 1965, Germany (1815-1870), in Cameron, R., ed.: *Banking in the Early Stages of Industrialization*, 151-182.

Tilly, Richard, 1991, An overview of the role of the large German banks up to 1914, in Cassier, ed.: Cambridge: Cambridge University Press, 94-112.

Tobin, James, 1969, A general equilibrium approach to monetary theory, *Journal of Money, Credit, and Banking*, 1, 15-29.

Verlag für Börsen- und Finanzliteratur A.-G. (various years) *Saling's Bösen-jahrbuch*, Leipzig.

Wellhöner, Volker, 1989 *Grossbanken und Grossindustrie im Kaiserreich*, Göttingen: Vandenhoek- Ruprecht.

Whale, P. Barrett, 1930, *Joint-Stock Banking in Germany*, London: MacMillan and Co.

White, Eugene N., 1986 Before the Glass-Steagall Act: An analysis of of the investment banking activities of national banks, *Explorations in Economic History*, 23, 33-55.

Whited, Toni M., 1992, Debt, liquidity constraints, and corporate investment: Evidence from panel data, *Journal of Finance*, 47, 4, 1425-1460.

Endnotes

1 See Baliga and Polak (1994), Becht and Ramirez (1994), Calomiris (1995), Da Rin (1994), Elston (1995), and Hoshi, Kashyap, and Scharfstein (1991), for example.

2 Schumpeter (1939) and Gerschenkron (1962) popularized general notions about the importance of universal banking in industrialization. Tilly (1965, 1991) espouses a more moderate view. Some recent research has challenged the traditional notion of German bank influence. See for example Neuberger and Stokes (1974) and Wellhöner (1989).

3 See Baliga and Polak (1994), Fischer (1990), and Mayer (1988); or the review by Bhattacharya and Thakor (1993).

4 Diamond (1984) sets out the conditions for the viability of a financial intermediary. The model also implies that the optimal size of the intermediary is infinite. Gale and Hellwig (1985) also develop a model of financial intermediation employing a debt contract framework with costly, *ex post* monitoring.

5 Related theories are discussed in Rajan (1992), Sharpe (1990), and von Thadden (1990). Gorton and Pennacchi (1990), on the other hand, rationalize financial intermediaries as the providers of liquid securities or deposits for uninformed investors. The advantage of the intermediary over investors, in this case, is static.

6 The actual duration of the advantage is an empirical question.

7 This approach was suggested by Fazzari, Hubbard, and Petersen (1988). See Chirinko (1995), Gertler and Gilchrist (1994), Houston and James (1996), and Petersen and Rajan (1994) for related work. Fundamentally, these studies are based on a long-standing literature on the determinants of industrial investment in general. See Kuh (1963), and Meyer and Kuh (1957).

8 See Fohlin (1994, 1996a) for more on IPO firms, especially in the case of Italy.

9 Millon and Thakor (1985) eliminate the result of infinitely large intermediaries by assuming economies of scope from information reusability. The tradeoff between such economies and free riding problems within the intermediary permits imperfect diversification and finite size. It does not suggest specialization. Other related theories include Chan, Greenbaum, and Thakor (1986), employing a public goods framework, and Allen (1990), modeling an information broker.

10 See Fohlin (1994, 1996b (forthcoming)) for further investigation of the sectoral breakdown of bank attachments and factors leading to involvement in banking and industrial networks.

11 In a recent study of Columbian firms, Ospina (1994) demonstrates that smaller firms have particularly clumpy investment patterns, and this is seen as evidence that

11 In a recent study of Columbian firms, Ospina (1994) demonstrates that smaller firms have particularly clumpy investment patterns, and this is seen as evidence that lack of access to capital markets by such firms leads to tighter financing constraints than those faced by medium and large companies.

12 These included Berliner Handelsgesellschaft, Bank für Handel und Industrie, Commerz- und Discontobank, Deutsche Bank, Discontogesellschaft, Dresdner Bank, Mitteldeutsche Creditbank, Nationalbank für Deutschland, and A. Schaaffhausen'scher Bankverein.

13 There is an enormous literature describing both debit and credit operations. See, for example, Bosenick (1912), Buchwald (1909), Jeidels (1905), Motschmann (1915), Riesser (1910, 11), and Whale (1930).

14 Strenuous criticisms were launched at the credit banks during the ensuing depression, with many blaming the banks for engaging in and fomenting stock-market speculation. For a range of polemics see Glagau (1876), Lansburgh (1909), and Sattler (1890). Even Riesser, a great-bank director, acknowledged some bank culpability.

15 The banks' near internalization of the capital market may have stemmed from bourse taxes and membership regulations. The regulatory framework is beyond the scope of this paper but is a topic deserving of closer scrutiny.

16 Jeidels (1905), p. 145, author's translation.

17 Gerschenkron (1962), p. 14.

18 See Fohlin (1995) for a lengthier discussion of *Saling's* and its potential biases.

19 For data on this and lengthier discussion, see Whale (1930).

20 See Rettig (1978). I thank Richard Tilly, who was Rettig's thesis advisor, for providing me with the data.

21 The firms in *Saling's* are reported alphabetically within each sector. In order to arrive at a representative cross section of sectors, I divided the number of pages in the 1900 volume of *Saling's* by the number of firms to be sampled. I then used this quotient to count the number of pages between firms to accept for the sample. I included the first firm whose entry fell on or after the assigned page while also fitting the IPO date criterion. The dating of IPO's was chosen to partly offset the bias introduced into the first group of firms by the criterion of pre-1880 founding. The firms in both samples are aggregated into nine sectors: mining and smelting, metal and machinery, textiles, chemicals, electrical, construction, transportation and shipping, food products, and miscellaneous (firms not fitting the other eight sectors).

22 The source gives a separate founding and incorporation date or indicates previous corporate forms for a few firms. All such firms were excluded. It is possible that all

transformed firms are indicated, but the source does not explicitly state that this is the case.

23 See Passow (1905) on the wide variation in the importance of the supervisory board between firms.

24 The period of transition and factors leading to the growth of banking and industrial networks is analyzed in Fohlin (1996c, forthcoming).

25 The Great Banks are listed in the previous section. All other banks are considered small (provincial) banks.

26 Hall (1991), Kaplan and Zingales (1996), and Whited (1992) all employ an alternative approach based on estimating Euler equations of investment dynamics. This method avoids the often-troublesome issue of measuring q.

27 This approach is analogous to running separate regressions for each category of firm, but using one regression spares degrees of freedom.

28 Econometric results confirm this idea. Cash flow alone yields similar, though larger, coefficient estimates as stock liquidity alone. When the two variables are included together, one variable obtains coefficient estimates that have the opposite signs as those found in specifications in which the variables appear independent of one another.

29 Selectivity bias could go in either direction. If banks pursue attachment in order to facilitate ex-post monitoring of investment outcomes of riskier firms, then the firms with bank-attachments are likely to have a tendency toward tighter liquidity constraints. If firms pursue attachments to banks in order to signal their creditworthiness to investors, then attached firms might not be those with the greatest tendency toward financing constraints. Finally, if bank attachment has little to do with monitoring, and in reality is a means of earning profits off of firms known to be successful, then attached firms might be among the least liquidity constrained.

30 Recall that the data is mean-differenced, and thus the model does not include firm indicator variables. Though coefficients for the annual indicator variables are not reported, some of them are statistically significant–suggesting, not surprisingly, that investment has a cyclical component. The period under study was generally expansionary. The sharp downturn of 1907 was brief and created no long-term, recessionary effects.

31 Houston and James (1996) actually find similar effects to those in the current study, yet the authors interpret them in line with other studies.

32 The details of this case are laid out in *Saling's*, Part II (1904/5), pp. 1760-1 and (1905/6), pp. 1605-6.

33 Given the possible under reporting of the supervisory board membership prior to 1901, it is possible that a bank director sat on the firm's board, but was not in one of the

top positions (chair or vice chair). Fohlin (1995) describes the possible under-reporting in the source.

34 It would be possible to use a limited influence estimator, such as the one proposed by Huber (1973, 1977), but that method seems only slightly less arbitrary than deleting the apparent outlier. The Huber estimator is less arbitrary, because it down weights uniformly all observations exceeding a given tolerance level. This estimator is implemented in Fohlin (1994) in the case of Italian industrial finance, and an alternative solution to the same problem is offered in Fohlin (1996a). Though they do not report the results, an apparently similar estimator is used in Kaplan and Zingales (1996). If, as in the current case, the underlying data are generated by a logical, plausible process, then it seems preferable to retain the observation and clarify the situation that created it.

35 In addition, the random effects model includes intercept terms (the indicator variables) for each category of attachment. Since there was almost no change in category over the period, these terms were excluded from the fixed effects model.

36 Jeidels (1905), as quoted in section II, claimed that bank control was maintained via voting rights, though Wellhöner (1989) has demonstrated only limited control in the few, prominent cases he studied.

37 This phenomenon is mentioned in Jeidels (1905) and Riesser (1910, 1911) as well as the more recent work of Stürmer, Teichmann, and Treue (1994). While these sources are somewhat biased in favor of the banks, it is likely that in the case of stock price manipulation, the stories hold some validity.

38 Such studies range from complimentary to agnostic to critical. See, for example, Eistert (1970), Neuberger and Stokes (1974), and Riesser (1910, 1911).

39 On the subject of financial systems and real fluctuation see Bernanke and Gertler (1989). Also see Temin (1994) and White (1986) for empirical studies questioning the relative susceptibility of universal banking systems.

40 Fohlin (1994) gives a table covering all great-bank board positions in 1910 (the data for which derives from Sombart (1909, 1913)). The overall patterns correspond closely to those arising in the current samples.

41 Private banks existed long before universal banks, and they are thought to have financed mining companies earlier on. Nonetheless, the mining industry was highly developed well before interlocking directorates became widespread.

42 The narrowness of previous work stems partly from the fact that a great deal of primary source material was lost during World War II. The most complete records exist for the largest firms, and for many firms, stock market yearbooks contain the only remaining record of the firm's existence. War damage and absence of published records explains why privately-held firms are nearly impossible to study in any systematic or comprehensive fashion.

Table IA
Sample Means by Firm Type

Figures are calculated for all firm-years fitting the criteria. Long-lived firms are those in continuous existence between 1880 and 1913. IPO firms are those whose initial public offering ocurred in or after 1880. See text for detailed explanation of the data source, sampling procedure, and splitting criteria for bank attachment. Investment, liquid assets, revenues, and profits are normalized by the stock of fixed assets at the beginning of the period. Net worth (share capital plus reserves) and fixed assets are given in thousands of Marks. Standard errors are in parentheses. Means comparison tests are provided in Table IB.

	Long-lived Firms				IPO Firms			
Variable	Attachment with:							
	No bank	Small bank	Great bank	Combined banks	No bank	Small bank	Great bank	Combined banks
Investment	0.02	0.05	0.02	0.06	0.00	0.00	0.11	0.03
	(0.13)	(0.28)	(0.10)	(0.21)	(0.04)	(0.10)	(0.41)	(0.16)
Short-term liquid assets	0.42	0.83	0.47	0.50	0.59	1.95	0.21	0.63
	(0.63)	(1.02)	(0.30)	(0.65)	(0.26)	(2.83)	(0.22)	(1.35)
Total liquid assets	0.50	1.30	0.68	0.75	1.05	2.29	0.22	0.73
	(0.65)	(2.14)	(0.52)	(0.95)	(0.73)	(2.96)	(0.22)	(1.40)
Revenues	0.43	0.62	0.26	0.28	0.32	2.07	0.24	0.39
	(0.33)	(0.54)	(0.18)	(0.22)	(0.16)	(4.04)	(0.14)	(0.31)
Profits	0.13	0.26	0.12	0.13	0.02	0.20	0.06	0.18
	(0.16)	(0.31)	(0.10)	(0.11)	(0.16)	(0.25)	(0.05)	(0.25)
Debt/Equity ratio	0.59	0.59	0.55	0.61	0.55	0.96	0.88	0.57
	(0.40)	(0.34)	(0.25)	(0.52)	(0.33)	(0.91)	(0.56)	(0.50)
Tobin's marginal q	1.66	2.12	1.84	2.01	1.00	1.18	1.45	1.83
	(0.86)	(1.35)	(0.95)	(0.74)	(0.36)	(0.39)	(0.21)	(0.75)
Net Worth	5,033	4,749	10,708	39,809	3,103	3,219	8,650	6,285
	(4,940)	(4,467)	(8,305)	(43,186)	(1,343)	(2,150)	(7,506)	(7,583)
Fixed assets	5,940	4,159	7,505	40,838	2,216	2,712	15,080	7,327
	(6,771)	(6,635)	(4,381)	(50,838)	(1,214)	(2,747)	(15,286)	(7,815)
Age (years)	37.6	41.0	42.3	42.3	13.5	16.2	17.7	14.3
	(6.3)	(7.1)	(7.14)	(11.3)	(6.7)	(7.3)	(7.1)	(5.8)
Number of firms	15	18	7	15	5	9	5	15

Table IB
P-values for Significance Tests: Difference of Sample Means

Differences are calculated for all firm-years. LL denotes long-lived firms. Long-lived firms include those in continual existence between 1880 and 1913, while IPO firms comprise those whose IPO fell in or after 1880. Investment, liquid assets, revenues and profits are normalized by yearly stock of fixed assets. Net worth and fixed assets are given in thousands of Marks. Columns two and three report p-values of a oneway ANOVA on the differences among the four bank-attachment categories for long-lived and IPO firms, respectively. All other columns report p-values of t-tests arising from the direct means comparison tests. NOB, SMB, GB, and SMGB denote no bank, small-bank, great-bank, and combined-bank attachment, respectively.

Variable	IPO vs. LL	oneway LL	oneway IPO	Long-lived Firms: GB vs. NOB	NOB vs. SMB	SMB vs. GB	GB vs. SMGB	IPO Firms: GB vs. NOB	NOB vs. SMB	SMB vs. GB	GB vs. SMGB
Investment	0.65	0.26	0.22	0.94	0.26	0.25	0.03	0.18	0.91	0.19	0.34
Short-term liquid assets	0.04	0.00	0.00	0.48	0.00	0.00	0.62	0.00	0.01	0.00	0.02
Total liquid assets	0.19	0.00	0.00	0.07	0.00	0.00	0.50	0.00	0.02	0.00	0.00
Revenues	0.04	0.00	0.00	0.00	0.00	0.00	0.51	0.09	0.01	0.01	0.00
Profits	0.28	0.00	0.00	0.90	0.00	0.00	0.62	0.36	0.00	0.00	0.00
Debt/Equity ratio	0.02	0.83	0.00	0.42	0.91	0.43	0.24	0.02	0.02	0.67	0.01
Tobin's marginal q	0.00	0.00	0.00	0.25	0.00	0.12	0.25	0.00	0.13	0.00	0.00
Net Worth	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.81	0.00	0.16
Fixed assets	0.00	0.00	0.00	0.08	0.04	0.00	0.00	0.00	0.36	0.00	0.01
Age (years)	0.00	0.00	0.07	0.00	0.00	0.26	0.99	0.06	0.20	0.40	0.03
Number of observations	643	491	152	159	249	190	242	46	56	67	97

Table II
Fixed Effects Estimates of the Investment Equation

Dependent Variable is gross investment normalized by base-year fixed assets. Standard errors are in parentheses. Investment and liquidity are normalized by fixed assets. Annual indicator variables are included as exogenous variables, but their coefficient estimates are omitted from the table. See text for model specifications and variable definitions. P-values for F-test of joint-significance of regressors and for Hausman Chi-square test of fixed versus random effects are given at the end of the table.

	Long-lived Firms:		All Firms:	
Constant	−0.25***	−0.24***	−0.21***	−0.21***
	(0.07)	(0.07)	(0.06)	(0.06)
Lagged investment	0.09*	0.09*	−0.01	0.02
	(0.05)	(0.05)	(0.04)	(0.04)
Liquid assets	−0.12*	−0.11	−0.12	−0.09
	(0.07)	(0.07)	(0.08)	(0.07)
Revenue growth	−0.02	−0.02	−0.02	−0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Tobin's marginal q	0.19***	0.19***	0.17***	0.16***
	(0.05)	(0.04)	(0.05)	(0.04)
Small bank × stock liquidity	0.26***	0.25***	0.26***	0.23***
	(0.07)	(0.07)	(0.08)	(0.07)
Great bank × stock liquidity	0.28***	0.35***	0.27***	0.36***
	(0.10)	(0.11)	(0.11)	(0.10)
Combined banks × stock liquidity	0.38***	0.48***	0.37***	0.45***
	(0.08)	(0.09)	(0.08)	(0.08)
Small bank × revenue growth	0.17***	0.17***	0.02	0.02
	(0.05)	(0.05)	(0.02)	(0.02)
Great bank × revenue growth	0.03	0.02	0.02	0.02
	(0.03)	(0.03)	(0.03)	(0.03)
Combined banks × revenue growth	0.01	0.02	−0.02	0.00
	(0.07)	(0.06)	(0.06)	(0.06)

* Coefficient significant at 10 percent or better.
** Coefficient significant at 5 percent or better.
*** Coefficient significant at 1 percent or better.

Table II, *continued*
Fixed Effects Estimates of the Investment Equation

	Long-lived Firms:		All Firms:	
Small bank × marginal q	−0.07**	−0.06*	−0.07**	−0.04
	(0.03)	(0.04)	(0.03)	(0.04)
Great bank × marginal q	−0.11**	−0.11*	−0.07	−0.13**
	(0.05)	(0.07)	(0.05)	(0.05)
Combined banks × marginal q	−0.15***	−0.16***	−0.09**	−0.11***
	(0.05)	(0.06)	(0.04)	(0.04)
LTR × liquid assets	–	0.20	–	0.18
		(0.32)		(0.31)
LTR × liquid assets (small banks)	–	−0.29	–	−0.28
		(0.29)		(0.28)
LTR × liquid assets (great banks)	–	−0.48	–	−0.22
		(0.39)		(0.36)
LTR × liquid assets (combined banks)	–	−0.44	–	−0.41
		(0.33)		(0.32)
IPO Firms × stock liquidity	–	–	−0.03	−0.11
			(0.24)	(0.23)
IPO × stock liquidity (small banks)	–	–	−0.05	−0.12
			(0.23)	(0.23)
IPO × stock liquidity (great banks)	–	–	0.40	9.73***
			(0.36)	(1.03)
IPO × stock liquidity (combined banks)	–	–	−0.13	−0.22
			(0.24)	(0.22)
LTR & IPO × stock liquidity (small banks)	–	–	–	0.26*
				(0.14)
LTR & IPO × stock liquidity (great banks)	–	–	–	−9.74***
				(1.05)
LTR & IPO × stock liquidity (combined banks)	–	–	–	0.29**
				(0.15)
P-value (F) [Joint significance of X_j]	0.00	0.00	0.00	0.00
P-value (Chi-squared) [Hausman Test]	0.00	0.00	0.00	0.00
Adjusted R^2	0.25	0.28	0.19	0.33
N	478	478	619	619

* Coefficient significant at 10 percent or better.
** Coefficient significant at 5 percent or better.
*** Coefficient significant at 1 percent or better.

Table III
Fixed Effects Estimates of the Investment Equation
Long-lived Firms with OLD indicator

Dependent Variable is gross investment normalized by base-year fixed assets. Standard errors are in parentheses. Investment and liquidity are normalized by fixed assets. Annual indicator variables are included as exogenous variables, but their coefficient estimates are omitted from the table. See text for model specifications and variable definitions. P-values for F-test of joint-significance of regressors and for Hausman Chi-square test of fixed versus random effects are given at the end of the table.

Constant	−0.25***	−0.27***
	(0.07)	(0.08)
Lagged investment	0.09*	0.09*
	(0.05)	(0.05)
Stock liquidity	−0.12*	−0.16*
	(0.07)	(0.08)
Revenue growth	−0.02	−0.02
	(0.02)	(0.02)
Common equity q	0.19***	0.20***
	(0.05)	(0.05)
Small bank × stock liquidity	0.26***	0.30***
	(0.07)	(0.08)
Great bank × stock liquidity	0.28***	0.42***
	(0.10)	(0.12)
Combined banks × stock liquidity	0.38***	0.45***
	(0.08)	(0.09)
Small bank × revenue growth	0.17***	0.17***
	(0.05)	(0.05)
Great bank × revenue growth	0.03	0.02
	(0.03)	(0.03)
Combined banks × revenue growth	0.01	0.00
	(0.07)	(0.07)

* Coefficient significant at 10 percent or better.
** Coefficient significant at 5 percent or better.
*** Coefficient significant at 1 percent or better.

Table III, *continued*
Fixed Effects Estimates of the Investment Equation

Small bank × common-equity q	−0.07**	−0.08**
	(0.03)	(0.03)
Great bank × common-equity q	−0.11**	−0.12**
	(0.05)	(0.05)
Combined banks × common-equity q	−0.15***	−0.15***
	(0.05)	(0.05)
OLD	–	0.05
		0.06
OLD × liquid assets	–	0.03
		(0.07)
OLD × liquid assets (small banks)	–	−0.10
		(0.10)
OLD × liquid assets (great banks)	–	−0.22**
		(0.11)
OLD × liquid assets (combined banks)	–	−0.17**
		(0.09)
P-value (F) [joint-significance of X_j]	0.00	0.00
P-value (Chi-squared) [Hausman test]	0.00	0.00
Adjusted R^2	0.25	0.27
N	478	478

* Coefficient significant at 10 percent or better.
** Coefficient significant at 5 percent or better.
*** Coefficient significant at 1 percent or better.

Table IV
Random Effects Estimates of the Investment Equation

Dependent Variable is gross investment normalized by base-year fixed assets. Standard errors are in parentheses. Investment and liquidity are normalized by fixed assets. Annual indicator variables are included as exogenous variables, but their coefficient estimates are omitted from the table. See text for model specifications and variable definitions. P-values for Chi-squared test of joint-significance of regressors and for Hausman Chi-square test of fixed versus random effects are given at the end of the table.

	Long-lived Firms:		IPO Firms:	
Constant	0.03	−0.04	0.02	−0.35
	(0.06)	(0.06)	(0.58)	(0.70)
Correction term (small banks)	−0.02	−0.01	0.02	0.03
	(0.02)	(0.02)	(0.07)	(0.06)
Correction term (great banks)	0.02	0.04	−0.54***	−0.27***
	(0.02)	(0.02)	(0.10)	(0.09)
Correction term (combined banks)	−0.05***	−0.06***	0.09	0.07
	(0.02)	(0.02)	(0.06)	(0.05)
Lagged investment	0.05	0.04	−0.09	0.01
	(0.05)	(0.05)	(0.09)	(0.07)
Liquid assets	−0.04	−0.05	−0.22	−0.02
	(0.04)	(0.04)	(0.19)	(0.17)
Revenue growth	−0.01	−0.01	−0.18***	−0.12**
	(0.02)	(0.02)	(0.06)	(0.06)
Tobin's marginal q	0.01	0.02	−0.37	0.15
	(0.03)	(0.03)	(0.40)	(0.57)
Small bank	0.08	0.07	−0.07	0.33
	(0.08)	(0.08)	(0.64)	(0.77)
Great bank	−0.03	−0.08	0.43	0.44
	(0.11)	(0.11)	(0.66)	(0.74)
Combined banks	0.14*	0.11	−0.13	0.10
	(0.07)	(0.07)	(0.61)	(0.72)

* Coefficient significant at 10 percent or better.
** Coefficient significant at 5 percent or better.
*** Coefficient significant at 1 percent or better.

Table IV, *continued*
Random Effects Estimates of the Investment Equation

	Long-lived Firms:		IPO Firms:	
Small bank × stock liquidity	0.07**	0.08*	0.22	0.04
	(0.04)	(0.04)	(0.18)	(0.19)
Great bank × stock liquidity	0.13**	0.15**	−0.33	9.20***
	(0.07)	(0.07)	(0.27)	(1.08)
Combined banks × stock liquidity	0.12***	0.23***	0.23	0.09
	(0.04)	(0.05)	(0.18)	(0.18)
Small bank × revenue growth	0.14***	0.14***	0.18***	0.12
	(0.05)	(0.05)	(0.06)	(0.06)
Great bank × revenue growth	0.01	0.02	−0.14	0.00
	(0.03)	(0.03)	(0.10)	(0.09)
Combined banks × revenue growth	0.03	0.04	0.12	0.06
	(0.07)	(0.07)	(0.17)	(0.14)
Small bank × marginal q	−0.01	−0.02	0.44	−0.20
	(0.03)	(0.04)	(0.41)	(0.58)
Great bank × marginal q	−0.02	−0.01	1.17***	−0.06
	(0.04)	(0.05)	(0.48)	(0.60)
Combined banks × marginal q	−0.04	−0.04	0.41	−0.10
	(0.04)	(0.04)	(0.40)	(0.57)
LTR	–	0.01	–	0.11**
		(0.03)		(0.05)
LTR × liquid assets	–	−0.22	–	−3.20
		(0.22)		(2.97)
LTR × liquid assets (small banks)	–	0.16	–	3.16
		(0.22)		(2.97)
LTR × liquid assets (great banks)	–	0.16	–	−5.74*
		(0.23)		(3.15)
LTR × liquid assets (combined banks)	–	0.10	–	3.12
		(0.22)		(2.96)
P(Chi-square) [joint significance of X_j]	0.00	0.00	0.00	0.00
P(Chi-squared) [fixed vs. random effects]	0.00	0.00	0.00	0.84
Adjusted R^2	0.14	0.18	0.29	0.62
N	478	478	141	141

* Coefficient significant at 10 percent or better.
** Coefficient significant at 5 percent or better.
*** Coefficient significant at 1 percent or better.

Table V
Logit Estimates: Firm Characteristics Associated with Bank Attachment

The dependent variable–a discrete attachment-choice variable–takes the values zero through three for interlocking directorates with no bank, small bank, great bank, and a combination of banks, respectively. Standard errors are in parentheses. Investment and liquidity are normalized by fixed assets. Annual indicator variables are included as exogenous variables, but their coefficient estimates are omitted from the table. See text for model specifications and variable definitions. P-values for Chi-squared test of joint-significance of regressors is given at the end of the table.

	Long-Lived Firms:			IPO Firms:		
Independent variables	Small bank vs. no bank	Great bank vs. no bank	Combination vs. no bank	Small bank vs. no bank	Great bank vs. no bank	Combination vs. no bank
Constant	−4.69***	−7.19***	−2.87**	−3.37*	−2.94	−3.00
	(1.08)	(1.42)	(1.17)	(1.96)	(2.44)	(1.98)
Investment	0.56	−0.03	1.04	2.28	4.28	3.05
	(0.95)	(1.37)	(0.99)	(4.25)	(4.54)	(4.50)
Stock liquidity	0.86***	0.64*	0.66**	0.40**	−3.22**	−0.10
	(0.29)	(0.36)	(0.30)	(0.21)	(1.45)	(0.24)
Revenue growth	−0.49	0.31	−0.31	0.02	−0.56	−1.04
	(0.39)	(0.21)	(0.47)	(0.06)	(1.76)	(0.96)
Tobin's Marginal q	0.15	2.46***	0.93*	1.67	2.74	4.09***
	(0.46)	(0.58)	(0.50)	(1.51)	(1.74)	(1.47)
Fixed assets	−0.09**	0.01	0.15***	0.04	0.38**	0.24
	(0.04)	(0.04)	(0.03)	(0.16)	(0.16)	(0.16)
Age	0.14***	0.10***	0.03	0.03	0.02	−0.14**
	(0.03)	(0.04)	(0.03)	(0.07)	(0.08)	(0.07)
Capital intensity	0.01	0.15***	−0.07	0.08	0.41*	−0.03*
	(0.03)	(0.03)	(0.07)	(0.07)	(0.21)	(0.07)
Leverage	−0.01	−0.02***	−0.01	0.01*	0.01	−0.01
	(0.00)	(0.01)	(0.00)	(0.01)	(0.01)	(0.01)
Profit margin	0.50	2.62***	3.25***	0.09	−0.78	−0.05
	(0.53)	(0.53)	(0.80)	(1.29)	(3.32)	(1.53)
Dividends	−0.04	−0.42***	−0.19**	–	–	–
	(0.07)	(0.09)	(0.08)			
P-value of (Chi-square)	0.00	0.00	0.00	0.00	0.00	0.00
Pseudo R^2	0.33	0.33	0.33	0.44	0.44	0.44
N	478	478	478	141	141	141

*Coefficient significant at 10 percent or better
**Coefficient significant at 5 percent or better
***Coefficient significant at 1 percent or better

Table VI
Sectoral Distribution of Bank Attachments, 1910

Figures represent the share of sampled firms falling into the given bank-attachment categories, by sector. See text for detailed explanation of sorting criteria. Means are calculated for 1910 only.

Sector	Long-lived Firms:				IPO Firms:			
	no bank	small bank	great bank	combined bank	no bank	small bank	great bank	combined bank
Mining	0.11	0.22	0.11	0.56	0.00	0.20	0.20	0.60
Metal/machinery	0.20	0.20	0.30	0.30	0.17	0.33	0.00	0.50
Textiles	0.00	0.50	0.25	0.25	0.00	1.00	0.00	0.00
Chemical	0.00	0.83	0.17	0.00	0.00	0.00	0.00	1.00
Electric	0.00	0.00	0.00	1.00	0.00	0.00	0.50	0.50
Construction	0.60	0.00	0.40	0.00	0.33	0.00	0.33	0.33
Transportation	0.00	0.00	0.00	1.00	0.00	0.67	0.00	0.33
Food products	0.50	0.33	0.00	0.17	0.33	0.33	0.00	0.33
Miscellaneous	0.25	0.50	0.00	0.25	0.00	0.00	0.00	1.00

Table VII
Bank penetration variables, 1910

Board overlap is the average share of firms' supervisory and executive board seats held concurrently by a bank board member. Average number of banks represented includes firms with no bank representation. Share with GB chair is the proportion of firms in each sector whose supervisory board chair or vice-chair was occupied by a concurrent bank supervisory or executive board member. Variables are calculated for 1910 only.

Sector	Long-lived Firms:			IPO Firms:		
	board overlap	number of banks represented	share with GB chair	board overlap	number of banks represented	share with GB chair
Mining	0.314	3.22	0.33	0.247	2.80	0.40
Metal/machinery	0.278	2.30	0.50	0.206	1.33	0.50
Textiles	0.394	2.25	0.25	0.125	1.00	0.00
Chemical	0.173	1.17	0.17	0.182	3.00	1.00
Electrical	0.538	7.00	1.00	0.461	4.50	1.00
Construction	0.169	0.60	0.20	0.229	0.60	0.33
Transportation	0.437	4.50	0.50	0.228	1.67	0.67
Food products	0.091	0.83	0.00	0.137	1.33	0.33
Miscellaneous	0.333	1.75	0.25	0.167	2.00	1.00

Table AI
Fixed Effects Estimates of the Investment Equation
Firms Sorted by Dividend Payout

Dependent Variable is gross investment normalized by base-year fixed assets. HIDIV takes the value one if dividends exceed the median in the given year and zero otherwise. Standard errors are in parentheses. Investment and liquidity are normalized by fixed assets. Annual indicator variables are included as exogenous variables, but their coefficient estimates are omitted from the table. See text for model specifications and variable definitions. P-values for F-test of joint-significance of regressors and for Hausman Chi-square test of fixed versus random effects are given at the end of the table.

Constant	−0.21***
	(0.09)
HIDIV	−0.05
(constant for high-dividend firms)	(0.10)
Lagged investment	0.08*
	(0.05)
Stock of liquid assets	0.32***
	(0.03)
Revenue growth	0.03
	(0.02)
Tobin's marginal q	0.02
	(0.05)
HIDIV × stock liquidity	−0.19***
	(0.03)
HIDIV × revenue growth	−0.05*
	(0.03)
HIDIV × marginal q	0.09*
	(0.06)
P-value (F) [Joint significance of X_j]	0.00
P-value (Chi-squared) [Hausman test]	0.00
Adjusted R^2	0.26
N	478

* Coefficient significant at 10 percent or better.
** Coefficient significant at 5 percent or better.
*** Coefficient significant at 1 percent or better.