Credit Market Constraints and Financial Networks in Late Victorian Britain

Fabio Braggion*
Tilburg University and CentER

November 12, 2005

Abstract

Economic historians have debated whether imperfections in British capital markets caused a delay in adoption of the second industrial revolution technologies in Britain after 1870. Despite numerous studies, the economic history literature has not found a conclusive answer.

Using a data set of over 600 companies quoted on the London stock exchange between 1895 and 1904, this paper tests whether firms operating with second industrial revolution technologies were more financially constrained than other firms. Economic performances of credit market constrained firms should heavily depend on the access to informal sources of capital, and on tight and close relationships with the bank. Close relationships with the bank are proxied by geographical distance between the company and the bank. Access to informal sources of capital is measured by the number of titled people (Lords, Baronets, Knights) on the administration board of the company, and by the number of directorships held by the directors of the companies in the sample. My findings show that economic performances of firms operating with second industrial revolution technologies were strongly and positively affected by shorter distance to a bank, by the number of directorships, and by the number of titled directors serving in their administration board.

*I am indebted to Larry Christiano, Joe Ferrie, Kiminori Matsuyama, Joel Mokyr and Paola Sapienza for help and guidance. I would like to thank Ran Abramitzky, Federico Boffa, Helge Braun, Lou Cain, Bruce Carruthers, Adeline Delavande, Riccardo DiCecio, Bruce Kogut, Nisan Langberg, Deirdre McCloskey, Lyndon Moore, Chiaki Moriguchi, Steven Ongena, Harold Perkin, Enrico Perotti, Marcin Peski, Mitchell Petersen, Ian Savage, Luis Vasconcelos and Luigi Zingales for comments and discussions. I benefited from comments of participants to seminars at University of Amersterdam, University of Antwerp, University Carlos III-Madrid, Cambridge University, European Central Bank, INSEAD, Northwestern University, University Nova-Lisbon, Federal Reserve Bank of St.Louis, Tilburg University, Williams College and the Global Scholars Network/IFRI conference - Paris, June 2005. Financial support of the Global Scholars Research Network-NYU Stern-Aspen Institute-Ford Foundation is gratefully acknowledged.

1 lntroduction

"Did late Victorian capital markets support investment in new technologies?" This question was already posed in 1931 by Keynes in the Macmillan report, and since then the debate has been inflamed by accusers of the British credit market and by tireless defenders. In particular, it was claimed that banks and investors failed to provide long term loans to industrial firms and to establish close, supportive relations with their industrial clients (Kennedy, 1987).[1] As a result, the argument goes, entrepreneurial endeavors in new technologies, such as electricity, chemicals and engineering were discouraged. On the other hand, McCloskey (1970, 1973) took a neoclassical perspective and argued that indeed Britain did not fail. The open, competitive nature of Britain's markets of the period could hardly sustain incompetence on any significant scale.

This debate was particularly important because it was closely related to the issue of British relative decline in the late nineteenth and early twentieth centuries, characterized by a decline in the productivity growth of the country and a slow pace in the adoption of new technologies.[2]

Economic historians have hitherto considered case studies in the bicycle industry (Harrison, 1982), in the electrical industry (Kennedy, 1987), in the brewing industry (Watson, 1996), and in the cotton and iron industries (Cottrell, 1979), presenting arguments in favor or against the successful functioning of British capital markets. But no work has undertaken a formal and comprehensive analysis studying a wide variety of firms and industries.

This paper takes a step forward in understanding how late Victorian capital markets worked, and how effective they were in supporting entrepreneurial endeavors. Using a unique and original data set of over 600 companies quoted on the London Stock Exchange, this study measures credit market constraints on British firms for the period 1895-1904. In particular, it examines whether firms, operating mainly with the new technologies of the second industrial revolution, were more credit market constrained than firms operating in long-established sectors. By doing so, it evaluates the empirical foundations of the credit market hypothesis: if credit markets were responsible for the decline of productivity growth, some firms in key industries must have been financially constrained.

Corporate finance analysis has traditionally measured credit market constraints by analyzing investment sensitivity to cash flow (Fazzari, Hubbard,

[1] Committee on Finance and Industry, *Report* (London: H.M.S.O.).

[2] Landes (1969), Mokyr (1990)

and Petersen, 1988), but recently this methodology has been criticized (Kaplan and Zingales, 1997) on the basis of weak theoretical underpinnings and misleading empirical results. The special conditions of the credit system in Victorian Britain offer a case study to provide an alternative approach to the investment cash flow sensitivity analysis while studying a specific historical context.

If formal capital markets are unable to provide adequate funds to some firms, informal capital sources such as peers, friends and family may become relevant. It follows that a credit market constrained firm should benefit more from access to informal sources than an unconstrained firm. An entrepreneur or a director able to obtain funds through informal channels should help a credit market constrained firm more than a financially unconstrained firm. For a firm that can obtain capital through formal channels, the financial connections of its directors should matter less: the firm can always approach a bank or go to the stock exchange to obtain the funds it needs. More specifically, access to informal sources should help a chemical or an electrical firm (typical second industrial revolution endeavors) more than any other firm.

In the same spirit, the amount granted and the terms applied to a loan depend on the financial position, credit history of the borrower and the soundness of the entrepreneurial projects. All these information are important determinants of the lending decision. Relationships between borrowers and lenders may be conditioned by the way financial markets collect, process and transmit these information. The empirical study by Petersen and Rajan (2002) shows that if most of the information flowing from the borrower to the lender is "soft", i.e. not easily codable or not transmittable in a formal way, physical distance between the borrower and the lender affects lending relationships. Firms that are credit constrained in the formal market may benefit more by being located closer to the bank.

The degree of networking displayed by a certain company is proxied in the paper with the number of Peers and titled individuals in the companies' board. The proximity of a firm to its bank is proxied by the number of branches of the partner bank over population of the county where the firm is located.

The findings of this paper show that an additional titled director added an extra 1% of growth to firms operating with second industrial revolution technologies when compared to the other firms in the sample. On average, firms at the technological frontier increased their growth rate by an extra 2% by being closer to a bank, whereas an extra directorship led to an additional 0.42% of growth.

The analysis undertakes a further step and tries to understand what features of technologies may have influenced their performances on the capital markets. The second industrial revolution technologies were new and capital intensive endeavors. Bank proximity was an important and positive determinant of growth both for new technologies firms and for capital intensive firms. Titled directors helped particularly new technology firms, whereas numbers of directorships played a positive role for capital intensive firms.

2 Banks and Capital Markets

Two particular features have often been claimed to be the source of British capital markets inadequacy: their reluctance to finance fixed capital for a long period of time, and their unwillingness to set up a formal monitoring technology to gather information about the borrower (Kennedy, 1987). The accusations were launched both against banks and against investors operating at the stock exchanges.

Banks did not like to get involved in firms' finances. A central principle that was asserted many times –between headquarters and branches, and between bankers and clients- was that commercial banks did not see their function as that of providing fixed capital (Capie and Collins, 1999). Unlike their German counterparts, British banks did not purchase equity in industrial concerns, nor would they lend formally for long periods for the acquisition of fixed capital (Reisser, 1911). To the degree that English industrial firms had business relationships with banks, they were often in the form of tradable bills of exchange or promissory notes (Collins, 1988).

J. W. Gilbart, former director of the London and Westminster Bank, in a treaty regarding joint stock banking practices, maintained that

> It is contrary to all the sounds principles of banking for a banker to advance money in the form of permanent loans, or as they are called, "dead loans.[3]

Commercial banks saw themselves as credit banks, helping industrial clients finance current business activities, but not sustaining long-term entrepreneurial projects (Capie and Collins, 1999). Loans granted for fixed capital expenditures or to ameliorate plants and premises were for fairly short periods, until the client was in receipt of funds from other sources

[3] Gilbart (1873) p. 132

(Capie and Collins, 1999). Banks wanted to keep a liquid portfolio to address promptly the depositors' need for liquidity and long term entrepreneurial projects were seen as risky and uncertain investments.

Though loans were often renewed, renewal was at the discretion of the bank, and often depended on personal relationships between the borrower and the banker (Collins, 1988; Capie and Collins, 1999). As shown by Baker and Collins, preferences towards investment in liquid assets became more pronounced in the last twenty years of the nineteenth century.[4]

To some extent, the London Stock Exchange exhibited a similar pattern of investment. Investors in the London Stock Exchange did not refuse long-term investments in fixed assets. But commercial and industrial assets were only 10% of the nominal capital traded, with government bonds and domestic and international railways constituting most of floating nominal capital (Michie, 1999). The merchant banks at the Exchange specialized in lending money to foreign governments. Only investment trusts had some industrial concerns in their portfolios (Cassis, 1994).

The second distinctive feature of late Victorian capital markets is monitoring, as investors (both lenders and equity owners) did not set up a formal monitoring technology (Reisser, 1911; Kennedy, 1987; Capie and Collins, 1999). Investors did not establish research committees to evaluate the technical soundness of the projects or send their own representatives to company boards. Banks acquired information regarding business ventures solely through firms' public business papers and informal sources (Capie and Collins, 1999). George Rae, a financial journalist and a banker, in 1881 wrote a short treatise laying down the main rules that a good country banker should abide by. A special section was dedicated on how the banker should obtain information from outside sources.

> For the most part the banker has to rely on hearsay and opinion of others. The banker will consequently have to sift the information which you may gather as to the position of the individual with the utmost care, because on no other subject of daily gossip is there a greater tendency to exaggeration or mischievous credulity.[5]

Nor was monitoring technology developed by financial institutions operating at the Stock Exchange. The main operators in the London Stock

[4] Baker and Collins show that after the 1878 banking crisis culminated with the failure of the City of Glasgow Bank, British banks became more and more cautious accumulating larger amounts of liquid assets.

[5] Rae (1891) p. 54

Exchange were banks, insurance companies, investment trusts and pension funds. Investment trusts developed in the second half of the nineteenth century. At the London Exchange, their business consisted of buying a broad portfolio of financial assets without exerting any control over the companies in which they had equity interests.

Merchant banks were mainly concerned with foreign assets rather than domestic undertakings (Cassis, 1994).The other two operators were insurances and pension funds, but they prefer to have a safe portfolio rather than investing in industrial undertakings. (Cassis, 1994).[6]

This portrait is in contrast to what economic historians have reported about other capital markets, and particularly Germany. Gerschenkron (1962) wrote that German industrial banks "established the closest possible relationships with industrial enterprises".[7] Tilly (1969)reports that German bankers influenced or even controlled strategic decisions within German companies (especially in heavy industries) by holding voting rights over significant blocs of their shares. German banks occupied a large number of directorships in German companies. This allowed bankers to access information that could lower their ex-ante risk assessment on entrepreneurial projects (Tilly, 1991). This practice was particularly desirable when financing new technologies: by having a place in companies' administration board, the banker could better assess the difficulties that the firm encountered in using and implementing new technologies.[8]

3 Possible Effects on Technology Adoption

The technologies of the second industrial revolution were profoundly different from the breakthroughs of the eighteenth century. Electricity and heavy chemicals were large-scale projects that needed stronger connection with formal science (Mokyr, 1990).

[6] Watson (Watson, 1996) reports of few cases of insurance lending money to brewing firms, however.

[7] Gerschenkron, 1962. p.14

[8] The effectiveness and the role of universal banks in financing industrial concerns however still object of debate. Some other studies show that by concentrating on the financing of relatively large-scale projects, the Grossbanken neglected finance to large a quota of the German entrepreneurs. Smaller scales businesses (such as textile) had hard time to collect the necessary funds to operate at an efficient scale. Using data on German banks and German companies, recent research by Fohlin (1998, 2001) shows that interlocking directorships between universal banks and firms were not effective in relaxing credit market constraints.

These technical characteristics had important implications for the way such projects were financed. They required a high up-front fixed cost, and they needed a relatively long time before they started to work properly and deliver revenues. In other words, more than their predecessors, they needed venture capital.

In the earlier stage of British industrialization, these needs has been more modest. As described by François Crouzet:

> At the beginning of the Industrial Revolution, the threshold of entry into "factory" production was relatively low, especially in the textile industry, where even the largest production units were small.[9]

For example, electrical plants were major endeavors requiring money and time before their successful completion. One example is the building of an electric station in Deptford-London in 1887 by the London Electrical Supply Company (LESco) and its most prominent engineer, SZ Ferranti. This plant was proposed to light two millions lamps in London from a station located along the river Thames at Deptford, for that period a major undertaking. Not until, 1890 LESco did supply electric power, and only in 1895 the company could declare a first dividend (Shiman, 1992).

The same was true for the new chemical technologies. The ammonia process was complicated, and its implementation slow and difficult. Brunner and Mond, the successful English company producing alkali with the processes pioneered by Ernst Solvay, took several years before mastering the product even with Solvay's help (Lishcka, 1973; Shiman, 1992).

These technologies needed patient investors committed for a fairly long time to the endeavor. British banks did not want to invest in fixed and granted loans only for short periods of time, and apparently the London Stock Exchange was not particularly interested in investing in industrial assets. This mismatch between industrial needs and capital markets features is at the heart of the capital market hypothesis for the British relative decline.

Economic historians have reported ambiguous evidence. By analyzing a case study of a Frank Hopper & Co., a firm producing bicycles in Coventry, Harrison (Harrison, 1982) argued that the system of loan renewal harmed the possibility of the expansion of the firm in the motorcar business. Byatt (1979) reports similar cases in the electrical manufacturing industry.

On the other hand, some scholars have observed that the Stock Exchanges did not welcome the new technologies. Kennedy (Kennedy, 1987)

[9] Crouzet (1972) p. 164

reported how moody and volatile investment in new endeavors was. In 1882, after the excitement of the electrical inventions at the Paris exposition there was a boom in the investment in electricity stocks. After investors realized that this endeavor was not as productive as they originally thought, they sold their equities already in 1883. Electricity stock prices dropped considerably, forcing many companies into liquidation.

In many other circumstances the overdraft renewal system appeared to be an effective instrument to support industrial endeavors. Cottrell (1979) documented how the overdraft system was flexible enough to guarantee medium or long-term financial support to many iron firms in northern England even in period of crisis. Byatt (1979) reported that the electricity supply industry was adequately supported by the London Stock Exchange. Katherine Watson (1996) studied brewing industry between nineteenth and twentieth century. Her analysis shows that brewers turned to bank to finance working capital, but they effectively issued debenture and preference stocks at the London Stock Exchange to finance fixed capital. This system worked effectively over all the period under study. By 1900 more than 200 brewing firms were quoted at the London Stock Exchange.

In view of such a variety of case studies, this work takes an agnostic approach and employs a large data set of companies to test the existence of credit market constraints.

4 Theoretical Underpinnings

The empirical work presented in this paper raises the question of why profitable investment opportunities were forgone by investors. Starting from the seminal study by Stiglitz and Weiss (1981) and Myers and Majluf (1984), many other analysis have explained how asymmetric information problems may have limited the amount of funds for profitable investment.

Some more recent works more explicitly in analyze institutional differences between different credit market systems. In particular, the literature of Soft and Hard budget constraints remarked how the structure of the banking system may offer different solution to problems of adverse selection (Dewatripont and Maskin (1995), Qian and Xu (1998)).

Dewatripont and Maskin emphasize the differences in banking systems as a way to sort out bad entrepreneurial projects from good entrepreneurial projects. Their world is composed by bankers and entrepreneurs, and lasts three periods. Entrepreneurs can either be good or bad. Good entrepreneurs can choose between good projects, i.e. projects that require

only one unit of capital and deliver revenue at the end of the same period, and very good projects, projects that require two units of capital (one on each period) and deliver very high revenue after two periods. On the other hand, bad entrepreneurs can only undertake bad projects: projects that again require a capital injection each period, a deliver the same revenue of good projects after two periods. Bankers cannot distinguish between the typology of projects and the typology of entrepreneurs. The model yields two equilibria: one where investors create "small" banks and good entrepreneurs choose short term project; another where investors manage "big" banks, and good entrepreneurs choose long term projects. Setting up a system of small banks, i.e. banks that do not have enough capital to refinance longer term projects for the second period, is a commitment device that prevents bad entrepreneurs from entering into the market. Threatened by the possibility of early liquidation, bad entrepreneur prefer to stay out from the market. The system incurs in a type two error: the same threat applies to good entrepreneurs choosing longer terms highly profitable projects. Therefore, good entrepreneurs will choose short term projects. The other possible equilibrium is characterized by big banks, i.e. banks that can refinance the second stage entrepreneurial projects: in this case good entrepreneurs choose longer terms projects. However, the system incurs in a type 1 error: also bad entrepreneur have an incentive to enter into the market. For certain parameters values the model displays both equilibria. In this context, the Anglo-Saxon/British system characterized by small banks mainly financed by deposits can be considered a commitment device necessary to prevent bad entrepreneurs from entering into the market. The implication is that longer-term investment should have harder time to be financed in a British system rather than in German system. Moreover, if the returns from the good long term project are very high, the German equilibrium Pareto dominates the British equilibrium and generates a bigger surplus. If the my estimated differences in firms' growth of the firms, are a good proxy of forgone investment opportunities, in the Dewatripont-Maskin's framework, the loss deriving from the British financial system appears to be big.

Similarly, Von Thadden (1995) provides for a model of short-term behavior based on the threat of early termination. Entrepreneurs can be good or bad, and the lender has to sort out their quality. Projects last two periods and have uncertain returns every period. Short term projects are more likely to succeed in the short run, whereas long term projects are more likely to succeed in the longer run. The lender tries to understand entrepreneurial qualities by observing the results delivered by the entrepreneur in first periods of undertakings. The lender has also the option of terminating the

project after the first period if the project delivered bad results. In order to avoid early termination, entrepreneurs may choose short term less profitable projects, that have higher chances of success in the short run.

Baliga and Polak (2004) describe the differences between British and German financial system by relying on the difference between monitored debt and non-monitored debt. In the German system, the lender pays a fixed cost and monitors the borrower. In an Anglo-Saxon system, lenders do not monitor, but enforce an incentive compatibility constraint on the borrower. For certain values of the parameters the model yields multiple equilibria. Their set up predicts that firms in a British should be more numerous but smaller than in the Germany. An Anglo-Saxon system always Pareto dominates a German one but a German system can produce a higher amount of total surplus. The genesis of the two equilibria relies on the thickness of the secondary market for debt. Monitored debt does not have a market, non-monitored debt may be represented by bonds and debenture may have a market. The cost of the latter for the lender depends on the thickness of the secondary market for debenture.[10] The large stock exchange in London made non-monitored debt cheaper in Britain than in Germany.

This class of models predicts that:

1) large scale entrepreneurial projects with cost should have more difficulties to be financed in a British system;

2) entrepreneurial projects with a longer gestation period should have harder times to receive funds in the British system.

Broadly speaking, this work can be interpreted as a test of the implications that these models have for the "British equilibrium". In Appendix 1 I present another mechanism that can induce entrepreneurs to choose short term projects, even though long term projects yields higher revenue. Like Von Thadden, projects differ in their probability of success in different periods: short term projects are more likely to deliver revenue in the short run, longer term projects in the longer run. The lender has the possibility to liquidate the project at the end of every period: for high liquidation values the entrepreneur prefers to undertake the short term project in order to minimize the probability of liquidation.

[10] In particular, as Pagano (1999) points out, the size of the financial market reduces assets volatility, making more attractive to risk averse agents to trade equities and debt, and therefore making the market even thicker.

5 The Methodology

The methodology developed in this paper is derived from Rajan and Zingales (1998). Differently from Rajan and Zingales, the focus is on the firms' level, rather cross-country and cross industry.

In a perfect capital market access to informal sources of capital should not have a big impact on the economic performances of a company. The company can always obtain the funds needed from a bank or the stock exchange at the risk adjusted interest rate, and implement the optimal level of investment. The situation changes when capital markets are imperfect. Some firms are more credit market constrained than others, and access to informal capital sources may have a relevant impact on their economic performances. These firms will have a higher marginal productivity of capital, work at a scale that is below efficiency. In all these circumstances an extra unit of capital obtained through informal channels would encourage their economics growth.

In other words, connections with informal capital sources should be more important for credit market constrained firms than for unconstrained firms.

I use here a broad definition of informal capital markets which consists of loans extended by friends and peers, and loans obtained through banks or investment trusts at better conditions to what is officially stated. In the latter case better terms must be the result of friendship, affiliation to the same brotherhood, or even mutual trust between borrower and lender (see Uzzi, 1999).

In this paper I measure access to informal sources of capital by looking at the type and the size of the social network where the firm, and its directors, belong. Networking should disproportionately help financially constrained firms. By obtaining extra funds through informal channels, such firms should grow more than other constrained firms without access to informal credit. Similarly, networking should not have a big impact on financially unconstrained firms which can obtain the resources they need in the formal market.

The logic works also along another dimension. When studying credit market transactions the information between the two parties can be classified either as soft or hard (Petersen, 2002). Hard information is quantitative, and easy to store and transmit in impersonal ways; its content is independent of the collection process. Soft information is hard to communicate to others and even harder to capture in written documents. More importantly, the quality of its content depends on the way it is collected. As a result, distance between the borrower and the lender may decrease the quality of

the information obtained by the lender about the borrower (Petersen and Rajan, 2002; Degryse and Ongena, 2004). The empirical analysis by Petersen and Rajan shows that in a financial environment characterized by "soft" information, physical distance may affect credit relationships. The lender needs to have local presence and direct contact with the business in order to obtain high quality information about it. Furthermore, Petersen and Rajan (1994), and Uzzi (1999) noticed that in an environment where information is soft, relationship lending matters. The amount offered and the conditions applied to a loan will depend on the degree of trust between the entrepreneur and the lender.

Closer distance to the lender should help firms that are financially constrained. It should reduce the extent of the asymmetric information problem, allowing the firm to increase the amount of external finance available. In the same way, a credit market constrained firm should benefit more from being closer to the source of credit (bank or stock exchange) than an unconstrained firm.

The test for credit market constraints is based on the following equation:

$$\Delta y_i = \alpha_I + \alpha_c + \eta Assets_t + \phi Year_i + \lambda BP_i + \delta TS_I BP_i + \varepsilon_i \qquad (1)$$

$$\Delta y_i = \alpha_I + \alpha_c + \eta Assets_t + \phi Year_i + \beta NW_i + \gamma TS_I NW_i + u_i \qquad (2)$$

Δy_i indicates growth of firm i. α_c is an indicator for the county where the firm is located. α_I is an industry indicator. TS represents a technology score specific to industry I: the higher is TS, the closer is the firm to being a second industrial revolution firm. NW is degree of networking enjoyed by firm i. BP is bank proximity, and it is an index measuring how close a bank is to firm i: the higher it is the closer is the bank. $Assets_t$ represents total value of the assets of firm i at the beginning of the period, and $Year_i$ the year of incorporation of firm i.

In this work, I test whether firms using second industrial revolution technologies were more credit market constrained than other firms. If this hypothesis is true, access to informal capital sources should matter more to an electricity supply company rather than a cotton spinning firm. The latter can always obtain the resources it needs from the formal capital market: its possible access to informal sources becomes less relevant.

If second industrial revolution firms were credit constrained we should expect γ and δ to be positive. If the technological score is big (the firm

belongs to a second industrial revolution sector), both networking and proximity of the bank will have a big impact on the growth rate. If the coefficient on the networking interaction is big, the firm will enjoy a much higher growth rate due the connections provided by its directors. Similarly, if also the coefficient on the bank interaction is big, the firm will display a higher growth rate.

The direct effect of networking is also introduced to prevent the interaction from capturing some networking effects common to all firms. Technological score is industry specific and its effect alone is absorbed by the industry indicator. The proxy of distance from the bank is county and firm specific and it is also enters directly in the regression. Δy_i is measured by taking the first differences in the firms' total assets value. The technology score is either a dummy variable representing second industrial revolution sectors (chemicals, electricity and engineering), or a proxy for the degree of novelty and capital intensity of industry I. Networking is measured by number of titled people in the company boards of company i, and total number of interlocking directorates displayed by the directors of company i. Proximity to the bank is measured by the ratio of the number of branches of the bank trading with firm i to the population of the county where firm i is located.

6 Variables and Data

6.1 The Sample

The data consists of two samples of 271 and 480 British companies for the period 1895-1900 and 1900-04. The samples cover a wide variety of manufacturing sectors: from chemicals to textile, from electricity manufacturing to leather and rubber, from paper and publishing to iron and steel. I also consider three non-manufacturing industries: coal mining, railways and electricity supply. Table 1.1 lists the sectors in the sample and the number of firms in each sector.

The sample is not random: all the firms are public companies quoted on the London Stock Exchange. These companies had relationships with banks, and issued bonds and stock. Since they experienced all possible financing methods, they should suffer less extent problems of credit market constraint than other firms. Thus, the bias arising from sample selection should weaken the channel that is tested in this paper.

The sample appears to be representative of the British industrial structure. Hart and Paris, (Hart and Paris, 1956) provided some estimates of

manufacturing companies listed at the Exchange: there were 60 in 1885 and 571 in 1907. My sample has 180 for 1895 and 322 for 1900. Even if the samples cover different years, it appears that a sizable share of public companies is represented in the sample.

All the major railways companies are in the sample. There were many smaller companies, but they were usually owned by the biggest, and they were excluded. Data for electricity supply companies were taken from *Garcke's Manual of Electrical Undertakings*, a yearly publication where annual reports of electricity undertakings were transcribed. Among the companies reported, I selected companies with private ownership rather than municipal corporations: 20 companies for 1895 and 30 companies for 1900.[11]

Only British companies were selected. Irish companies and foreign companies were excluded. Companies headquartered in the UK, but with works located either in the colonies or abroad are not considered in this study.[12]

The information about the companies was taken from balance sheets, and various annual publications such as the *Stock Exchange Year Book* and the *Stock Exchange Official Intelligence*. The balance sheets of public companies were retrieved from the Guildhall Library, where a large collection of public business papers is preserved. The information displayed on the balance sheets varies from company to company and from year to year. From the accounts it is possible to obtain important data such as total value of assets, revenues and depreciation. The balance sheets also reported the names of the directors with their honorific titles (Lord, Sir, Baronet), the address of the headquarters of the firm and its works. Rarely, did the balance sheet display the name of the banks that had business relationships with the firm, but fortunately, since 1891, the Stock Exchange Official Intelligence reports this information. Table 1.2 presents summary statistics for the main variables used in the analysis.

[11] According to the information presented in the Stock Exchange Official Intelligence, in 1895 only 10 electrical supply companies located in the London area were quoted at the London Stock Exchange. To have a wider variety of locations in this sector I considered also 10 other electrical supply companies not quoted at the Exchange in 1895 but located in other parts of the country. The results are robust to this change.

[12] A coal mining company having its headquarter in the City of London, but exploiting mines in New South Wales, Australia was excluded. Few companies had activities in Britain and outside Britain. In this case, only companies whose majority of physical assets (as indicated by their balance sheet) was located in Britain were taken into the sample.

6.2 Firms' Growth

Growth is defined as the difference between the book value of the assets between 1895-1900 and 1900-1904. The information is obtained from the balance sheets of the companies in the sample.

Ideally growth of sales would be a better measure of firm's growth, especially when relating specific business performances to the features of the capital market. Unfortunately, only rarely do annual reports indicate sales.[13]

In this analysis I am using total value of the assets as they appear in the balance sheets as indications of firm size. Firms' growth is the difference of this measure between the final years and the initial years of the analysis. There is no correction for depreciation or goodwill, and only retained earnings enter in the definition of the total value of the assets.[14]

It was a widespread practice to register fixed assets at historical costs which raises the problem of how to adjust for price changes value of the assets. I adopt the following procedure: I assume that in the starting year (1895 and 1900) all the assets are evaluated at market price. For the final year, I consider two extreme cases: everything is evaluated at historical cost, so there is no need to deflate the final year assets; or everything is evaluated at market prices, and I deflate the whole amount of the assets by the appropriate price deflator. The truth lies somewhere in the middle of these two measures, and two sets of regressions with the different definition of firms' growth have been performed.[15]

Table 1.3 show average growth rates for the industries in the sample. In both samples electricity supply displays the higher growth rate: total value of the assets grew at about 80% from 1895 to 1900 and 40% from 1900-1904. Metals other than iron, and tobacco have the poorest performances.

[13] In the subset of the sample where sales are available the correlation between sales and total values of assets is positve and equal to about 60%.

[14] Although balance sheets were published by almost every public company and audited, there was still not a dominant accounting procedure. The depreciation indicated in the balance sheets did not represent the true value of the depreciation. In general, depreciation was an instrument to accumulate secret reserves in good times (by setting it at a high value) and to increase the probability of having profits and distribute dividends (by setting it at a low value). Fortunately, the balance sheets display the amount of depreciation: the book value of the assets used in the analysis is the n book value of the assets before depreciation. It is unlikely that arbitrary depreciation affects the results of the analysis. The average depreciation observed is about 2% of the total value of the assets. More importantly, the standard deviation of this figure across firms is low: firms depreciated their capital in the same way. If there is a bias, it appears to be small and equal for every firm.

[15] I use the consumer price index as computed by Feinstein (1972).

6.3 Technology Score

Equations 1 and 2 use a technology score to indicate the type of technology employed by every firm. A natural proxy is an indicator for the second industrial revolution sectors: chemicals, electricity supply, electricity manufacturing and cycles and motorcars[16]. Therefore, the basic test will rely on a dummy variable denoting these endeavors. The result of this regression only suggests whether some industries were more financially constrained than others; however the outcome is not related to specific features of the firm or the industry. A more precise test would relate companies' specific characteristics to their performances on the capital market.

For instance, Kennedy reported that British capital markets had a skeptical approach towards new technologies. It is therefore interesting to study whether the degree of novelty constituted an important factor in investment decisions. I define the degree of novelty of an industry by its employment growth between 1881 and 1891. Younger sectors should experience higher growth rates than more mature industries. Using the 1881 and 1891 population censuses, I computed growth rates of industries at a very disaggregated level.[17] This technology score is presented in Table 1.4. As expected young industries such as cycles, explosives and electricity display high growth rates, whereas more mature sectors such as silk and coal mining experienced a decrease in employment.[18] The possible bias coming from this measure works against the hypothesis tested: if new industries had a hard time developing in Britain, electricity should have grown less than its potential and cotton should have developed overcapacity and grown more. In other words, the score under-weights new industries, and over-weights old industries. In this respect, railways, a mature sector, are noteworthy: they were highly rewarded by capital markets and enjoyed a 30% increase in employment. On the other hand, chemical fertilizers, a mature industry with important technological developments after 1870, experienced a 20% decline in employ-

[16] Particular attention was paid in building this score. I also performed analsys augmenting the score with an additional cateogory called "Various Engineering". The defintion of various engineering relies on the defintion of industries given by the 1907 census of production. The catergory is composed of three sub-categories: heating-ventilating engineering, sanitary engineering, and general engeneering. The latter sub-industry is composed by hydraulic engineering and textile engineering.

[17] Unfortunately, it is not possible to use data before 1881. The occupational categories used in the British Census of Population are not comparable, making it quite difficult to compute meaningful growth rates.

[18] Remarkable are the figures for bicycles: the industry increased of ten times between 1881 and 1891.

ment.

British banks preferred to finance working capital rather than fixed assets. British capital markets did not set up formal monitoring technologies. Potentially, these two features may have harmed more capital-intensive firms, or firms that needed to establish a large plant. Economic theory (Baliga and Polak, 2004) predicts that in a world characterized by asymmetric information, a system of credit relationships where the lender does not monitor leads to a less capital intensive and small scale projects. A natural candidate as second technological score is therefore an index of capital intensity for every firm. Unfortunately, from the available data, it is not possible to compute capital labor ratio at firm level. Only rarely companies' annual reports did indicate the number of workers or the wage bill. In the same way, data on capital labor ratio at the industry level is not available until 1948. An alternative possibility is to use the capital labor ratio for United States industries. Data on the American capital stock and labor force at the end of the nineteenth century and beginning of the twentieth century are available from Cain and Patterson (1981). The technologies used in US and Britain were not identical, but the differences in cotton spinning equipments or the size of metallurgical plants should not make a big impact on the way industries are ranked.[19] The figure of capital labor ratio are presented in table 1.5.

6.4 Bank Proximity

Physical distance between the borrower and the lender becomes relevant in an environment where most of the information in financial transactions is soft.

Were late Victorian Britain financial markets characterized by soft or hard information?

Public companies had to publish balance sheets and annual reports. Banks usually asked also to partnerships to deliver a copy of the balance sheet while applying for a loan. Annual reports and balance sheets were the only public financial statements that firms and companies compiled.

Although these documents displayed a lot of useful information, they were less intelligible than modern balance sheets. By common wisdom a sound financial condition reported in a financial document was only a necessary condition to grant a loan. Other information, not easily coded on

[19] For a survey on the technological differences between cotton spinning firms in Lancashire and New England see Leunig (2003). On Iron and Steel, Landes (1969) and McCloskey (1973).

official documents was needed.

George Rae recommended integrating the information from public reports with hearsay and gossip. The banker should understand "how much a man is worth". Gossip and hearsay should help the banker to obtain this information. Contemporary statements also suggests that physical distance mattered. Gilbart maintained that:

> It is bad policy to take the accounts of parties residing at distance, as their transactions do not come under the notice of the banker; and the fact of their passing by the banks in the neighborhood to go elsewhere, is one that should excite suspicion.[20]

Cottrell (1979) reported that already in 1840 banks were concerned with the location of the potential customer: a distant location was a sufficient reason to turn down an application for a loan.

Relationship banking also mattered. As documented by Capie and Collins, despite being discouraged by the headquarters, branches' officials granted unsecured loans to firms. This phenomenon was more widespread for partnerships, but limited liability companies could also receive unsecured loans. In the latter case, banks demanded personal guarantees to the directors. The practice of granting unsecured loans underlines the extent up to which industrial lending was a matter of personal relations between borrower and lender. (Capie and Collins, 1999)

Using an annual publication called "*London Banks and Kindred Companies*" I reconstructed the population of branches in the Kingdom from 1881 until 1904. This periodical reported general data on banks (both joint stock and private, London and provincial) operating in the UK such as names of directors, headquarter address, location of branches and agencies, nominal capital, and collected deposits. For branches located in metropolitan areas, the precise address was reported. Unfortunately, for branches located in the countryside, the exact address is not available. From the balance sheet, I know what bank had business relationships with the firm. Knowing that a specific firm was located in county x, and traded with bank y, I constructed a proxy of distance taking the ratio of number of branches of bank y in county x over population of country x.[21] The data on population are taken from 1891 UK population census. For the purposes of this work population

[20] Gilbart (1873) p. 215.

[21] While listing the banks' offices, London Banks and Kindred Companies reported both branches and agencies. It is therefore important to establish what offices were allowed to grant loans and were considered the true bank's representative by industrial customers. Branches were allowed to provide loans and negotiate with entrepreneurs. What about

gives a better measure of size than surface area. For instance, Inverness is the largest British county with an area of 2,616,545 acres. Using acreage as measure of size would yield, for every bank, a very low bank proximity index. Inverness was also among the least populous counties with 83,317 inhabitants concentrated in its southern part. Banks and firms were located in the southern part of the county making the size of the "relevant" Sutherland much smaller. On the other hand, London/Middlesex had a size of 149,046 acres but it was the most populous area of the Kingdom with 4,792,130 inhabitants in 1891. Despite being concentrated in a smaller area, development of trust and personal relationships were much more difficult in the impersonal environment of the metropolis than in the country. The index captures this affect: all banks located in Middlesex have a low bank proximity index. In this sense, the index does not only give a proxy of physical distance, but also a proxy of economic distance from the bank. It measures what is the amount of soft information that flowed between the borrower and lender.

Normally, there is a higher concentration of branches in counties where firms have better performances: it is therefore possible that the index measures the relative economic performances of a certain geographical area. This problem is alleviated by the fact that the regression controls for counties fixed effects. The distance between the bank and firm might also be endogenous. Banks capable of understating the good future potentials of the firm may have wanted to be located closer to successful companies. Similarly, good companies may have wanted to signal themselves to the bank by locating closer to one of its branches. In both cases, the bank proximity index is more likely to indicate the quality of the firm, rather than a financial channel. To solve this problem I use a two step procedure. As a first step, I ran a multinomial logit where the dependent variable is 0 1 or 2 if the

agencies? The 1936 edition of Thomson's Dictionary of Banking gives the following definition for agency "*Where a bank is not represented by a branch or sub-branch it occasionally appoints a reputable party, such as a shopkeeper, to act as its agent in receiving credits and paying cheques by arrangement. Such items are remitted daily to the branch under which the agent works.*" Archival records at Lloyds group from 1866 (catalogue reference A/16/b/6.0) and related to the Worcester City and County Banking Co. describe the duties and responsibilities of the agents. An agency covers duties such as "*to receive money for transmission to the Worcester City & County Banking Co Ltd; for the credit of parties keeping current accounts at Head Office and the branches taking deposits of money to earn interest; cashing cheques on the Worcester bank free of charge and to use his discretion whether to make any charge to cash cheques on other banks.*" In both cases, no mention is made about granting loans to entrepreneurs. On the basis of this evidence, in this study, I consider only branches as relevant bank offices for loan purposes.

firm has a bank proximity index in the 33^{th}, 66^{th}or 100^{th} percentile, and as regressors various characteristics of the firms and the country where the firm is located. I then constructed a correction term that should indicate all the unobservable features of the firm, that might be correlated with a certain degree of distance from the bank, and insert it in the growth equation.

The bank proximity index may also be correlated with the size or market power of the bank. Bank that have more branches are more likely to be close to a firm, thus the index may capture also effects related to size, bureaucratization of the bank. For this reason the regression controls for size of the bank alone measured both by the total number of branches and total amount of deposits collected by the bank. The index may also be correlated with the market power of the bank and the degree of banking competition within the county: to correct for these effects I introduce in the regression an Herfindal index that measures how competitive is banking system in a particular county.[22] Beside of being controls for the Bank proximity index, bank size and banking competition may provide an alternative (although less clear-cut) test for credit market constraints. Stein (2002) and Berger, Miller, Petersen, Rajan, and Stein (2004) construct a model and a provide for test where banks, depending of their size and their internal organization, may exploit differently soft information. Smaller banks have a simple organizational structure. Many times the branch manager is among the partners of the bank, and has the autonomy of making decisions about loans. This gives him an incentive to proficiently exploit any sort of information related to the borrower: both soft and hard. In bigger banks, the internal structure is more bureaucratized: often the manager who meets the customer does not make the final decision about the loan, or he has to comply with the rules established by the headquarter. Soft information cannot be easily transmitted from the branch to the headquarter, and therefore the branch manager does not have an incentive to collect it. These observations can have an empirical counterpart in Victorian Britain. After 1881 the British banking sector became more and more concentrated: few big banks absorbed many of the provincial banks. As a result, small banks that were operat-

[22] The higher is the Herfindal index the less competitive is the banking system. The Herfindal index is constructed using the market share of each bank in each county. Market shares are usually measured taking the amount of deposits collected by a particular bank over total deposits collected in the county. Unfortunately, London Banks and Kindred Companies only reported the total amount of deposits collected by each bank at national level, and not county level. To overcome this problem, I compute the market share of each bank using the number of branches of a certain bank in a certain county divided by the total number of branches working in the same county.

ing autonomously became branches of bigger banks. This was a source of compliance of many entrepreneurs: who before was a county banker, after 1881 became a branch manager compelled to comply to the rules defined in the distant headquarter (usually in London). The branch manager did not have the flexibility to grant loans like the county banker had before Collins (1988).

If soft information played a role in the late Victorian Britain credit markets, constrained firms might have been better off by trading with a smaller bank rather than a larger bank despite smaller banks have a limited amount of resources available.

In the same way, the Herfindal index might test if credit market constraint firms benefit or not from being located in a county with a high degree of banking competition. A fiercer competition among banks may give better choices and lower interest rates to companies. On the other hand, as argued and tested by Petersen and Rajan (1995), lower competition may favor credit market constrained firms by promoting long term relationships between borrower and lender. In markets with lower degree of banking competition, the lender can better internalize the benefits of assisting a firm in financial distress. In highly competitive markets the bank does not take into account the future stream of profits that a firm may deliver: it has to break even period after period. In a less competitive market a bank can share in future profits by applying lower interest rates when the firm is young or distressed, and charging higher interest rates in the future when firm will have firmly established its business.

It is important to remark that any result related to bank distance does not imply irrationality of the firm when taking a location decision. Being close to a source of credit was an important factor, but not the only one. Crafts and Mulatu (2004) show how the localization of firms and industries followed a factor proportion/Heckscher-Ohlin logic: firms located in areas where the necessary resources were more abundant. For instance, chemical companies were situated close to nitrate caves and iron and steel factories close to mines. John Brunner and Ludwig Mond decided to locate their factory in Winnington, Cheshire because of the numerous salt works in the area and the availability of limestone and coal.[23] Electrical companies preferred to be located near water streams. It is reasonable to think that firms maximized their expected revenue by taking the geographical distribution of banks as given. But is it possible that the geographical distribution of branches may have affected the firms' growth? In a perfect capital market

[23] Lischka pp 92-93.

the location of the bank should not matter. But if capital markets are imperfect, relocating a branch a bit closer to a firm may have altered firms' investment possibility and firms' profitability. The distribution of the bank proximity index per industry is reported on Table 1.6.

6.5 Networking

The importance of social connections as means in obtaining financial capital has been previously recognized.[24] Several works have studied informal capital flows in other countries and other historical contexts.[25] To the best of my knowledge, no study has estimated the amount of capital flowing through informal channels during the late Victorian period. Nevertheless, there is a lot of anecdotal evidence in this regard. Especially when a business endeavor was established, the founding partners were particularly careful to look for new partners not generally interested in the management of the business, but with a sufficient availability of financial resources and a lot of important friends.

Charles Holland, a civil engineer from Manchester and long-time friend of John Brunner's, had agreed to help Ludwig Mond and John Brunner himself to find mortgage money and then promised to purchase the land for the factory if it should be needed.

Ludwig Mond commented in a letter dated 1873: "I found a third, sleeping partner, with sufficient capital under rather favorable conditions for myself... a nice man, a bit older than us; a man of means, intelligence and enterprise."[26]

But what were the main channels in operation? One possibility is the connections with the wealthy upper class of the late Victorian period. As documented by Harold Perkin (Perkin, 1989), after 1850 British society became increasingly segmented. The Great Depression reduced agricultural prices and rents. Landed gentry started to look at industrial and financial business as way to diversify their investments. As a result, a new rich and powerful "Plutocracy" came into existence formed by the union of the City financial business, the landowners and important members of the professions such as judges or barristers[27]. They constituted the peak of the wealth and

[24] Cassis (1994) p.202.

[25] Lamoreaux (1994) for Industrial New England, Hanley (2004) for Brazil, La Porta, López-de Silanes, and Zamarripa (2003) for contemporary Mexico and Maurer and Haber (2004) for late nineteenth and early twentieth centuries Mexico.

[26] Quoted by Lishcka p. 94.

[27] Perkin (1989).

income pyramid and brought together political power, financial capital, and social prestige.

At the same time the old aristocracy became increasingly involved in industrial business. In the late Victorian period aristocrats were more often found on the administration boards of industrial companies. At the same time, members of professions such as judges and barristers were recruited onto the committees. Having a member of the upper class in the company board meant having social connections with men of net worth well known in the London financial market.[28]

The way the company and the titled director matched were different. Many times the Peers themselves sought to differentiate their business and became increasingly concerned in industrial endeavors. Lord Verulam for instance became increasingly involved in entrepreneurial business. In 1894, he was directors of two companies, in 1896, six companies, and by 1913 was director of thirteen companies. In addition to diversifying the investment they could receive an honorarium. The sum differed from company to company. In the case of Lord Verulam, the director's fee varied considerably, from the £.50 of the Colchester Brewery Co. to the £.500 of Accles Borneo Rubber, and in aggregate it yield a substantial income. Many other times the companies looked for a titled director, and usually the company promoter had a leading role in placing puppet titled directors on company boards.[29] It is premature to say that there was a well defined market for titled directors, but in the last years of the nineteenth century, businessmen were increasingly realizing the importance of acquiring respectability to their business by placing good sounding names on the annual reports.[30]

It is important to remark that this men represent more than anything else good relationships with the important financial centers of the late nineteenth century and early twentieth century Britain. They did not have any

[28] Until the 1880s is was not unusual for peers to become directors of any sort of company. Again, as effect of the agricultural depression, by 1896 there were 167 noblemen, over a quarter of the peerage, holding directorships, most of them more than in one company Thompson (1963).

[29] John Hooley was the most famous company promoter of that time. Hooley's successful technique was the use of members of the aristocracy as puppet directors. To give respectability to his companies he paid members of the aristocracy to sit on the boards: the prevailing tariff was 10,000 pounds for a duke; 5,000 pounds for a baron, and so on down through Debrett's.

[30] May quoted an ad appeared on the October 4, 1932's *Daily Telegraph* that, although corresponding to a leter period, is still quite suggestive. "*A titled gentleman is wanted to communicate with progressive company with a view to installing him as director. Write A,. Box 10,161.*"

particular business ability; their main function was the acquisition of the financial capital necessary to maintain sound business activities.

While describing British capital markets in the early twentieth century May (1939) reported,:

> "Sometimes a man with good name, knowing nothing about the business and even without residence in the country, is set up as chairman with the principal duty of reading the annual speech, which has been written out for him, to shareholders".

The senior official receiver. H.E. Burgess, provided evidence along the same lines:

> "I so frequently find [directors] are expert in nothing at all. The merely get a nice-sounding name to put on the prospectus. They can offer nothing but that name or the acquaintances they have who can be induced to put up capital".[31]

The challenge is to have a quantitative measure capable of capturing such social connections. I propose two measures: the number of titled people (Lords, Baronets, Knights, MPs) in the directors' committee and the number of interlocking directorships displayed by the directors on the boards of companies in the sample.

Most of the individuals belonging to the new upper class had either hereditary or not-hereditary titles; they were member of the House of Commons. In 1913-14 there were about 1,500 peers and baronets and another 1700 non-hereditary knights (Perkin, 1989).

I consider a definition of title that takes into account Peers, Judges (Justice of Peace) and Members of the Parliament . I do not consider purely professional titles related to the business of the firm (such as Master in Engineering, Fellow of the Royal Scientific Society) since they can correlate with professional abilities. In the company's annual report the names of the directors and their titles are usually indicated. As supplementary sources, I use the information reported on the Stock Exchange Year book and the Stock Exchange Official intelligence. They were both annual publications giving general and financial information on the companies quoted at the London Stock Exchange. Table 1.7 displays the distribution of titled directors per sector

[31] Ibid q. 479. Wilfred May also reports that companies actively searched for titled people to appoint as directors.

The number of titled people in the administration board may have depended on the performances of the company during the period considered. Companies that had been very successful between 1895 and 1904 may have recruited a larger number of titled directors. To avoid this problem I use the number of titled directors at the beginning of the period. The results of the empirical analysis have to be interpreted in the following way: how ex-ante networking affected ex-post firms' performances.

Reverse causality issues may still arise through another channel. It is possible that a titled person knew the future potential of the company and chose to be member of its administration board. Having a titled director may have been indicative of a better organization, better technical skills, or better reputation in the market. In this case, we would observe high growth associated with titled directors not because the directors could obtain capital through informal sources, but just because they decided to be part of the most profitable companies. To alleviate this problem I use a Heckman two-step procedure to correct for selectivity bias. In the first step I run a probit regression where the dependent variable is one if the company has at least a titled directors and zero otherwise. As regressors I use different features of the firms such as its size, age and the industry of which it was part. Using the results coming from the first stage, I construct a correction term for selection bias and insert it as new regressor in the firms' growth equation. This term should capture firms' unobservable features related to the number of titled members on the administration board.

Another proxy for networking relies on the number of interlocking directorships, directors positions held in other companies by the directors of the companies in the sample, enjoyed by each firm. Rubinstein (Rubinstein, 1981) noticed that for the post-1880 professional entrepreneurs did not hold more than three directorships in companies. Only 10% held more than three. Members of the aristocracy, however, generally held many directorships.[32] This measure should capture under another angle to what extent the company belonged to the "right network". Information about interlocking directorships can be obtained by the *Directory of Directors*, an annual publication listing the names of the directors of public companies quoted in London. Together with the names, they were indicated the names of the companies where these gentlemen were serving as directors. It is therefore possible to learn in how many and which company boards a single individual was participating. The distribution of interlocking directorships across industries is shown in Table 1.8. Railways have in averages the larger

[32] Thompson (1963) p. 307

number of title people in the company board.

Also with this networking proxy, reverse causality problems may affect the analysis. I therefore run a multinomial logit as a first step to create a correction variable that measures all the unobservable firm's characteristics that might be associated with a certain number of interlocking directorships.

7 Empirical Results

7.1 Evidence from Dividends Policies

In this section, before presenting the results of the main test, I introduce some descriptive statistics that should give an indication about the existence (and the extent) of financial constraints.

Firms that are more financially constrained should retain more earnings. Being the cost of external finance particularly high, these firms should have a higher incentive to use their own profits to finance entrepreneurial projects. Similarly, financially constrained firms should pay positive dividends more rarely when compared to financially unconstrained firms.

Using data available on the companies' annual reports, I computed the dividend payout ratio for electricity and railways for the year 1895 and for all the companies in the sample for the year 1900. In addition, I present evidence about the percent of years, between 1896 and 1900 in which a positive dividend was paid by a company. The dividend payout ratio is defined as the proportion of profits distributed in both preference and ordinary dividends.

Results are presented in table 2.1. Railways and textile had a dividend payout ratio above one. Companies in these industries took money from previous undistributed dividends to pay out current dividends. This ratio was particularly low for electricity supply and chemicals, two industries in the new sectors. Interestingly, the evidence on this figure reveals that the sectors that have been considered the most likely to be financially constrained were also those retaining more earnings.

One finding is quite interesting: companies in this sample had a much higher dividend payout ratio than present times companies. In the Fazzari, Hubbard and Petersen sample companies in average have a dividend payout ratio of 35%.

The evidence on dividends payout (table 2.2) contrasts to what we see in the case percentage of year when the dividend was paid between 1895 and 1900. Railways is the industry that by and large paid less dividends between 1895 and 1900: about 64% of the years. Electricity supply the industry that paid dividends more often more than 90% of the times. Further

inspection of the data reveals that nine railways companies never distributed profits between 1896 and 1900. Out of the thirty-four railways companies considered in the sample, eight ran losses or barely broke even in the period considered. Notwithstanding the negative profits, these companies continued to issue debenture and receive financing from banks. If we exclude these companies the percent of years for railways becomes much higher, also approaching 90%.[33]

Alone this evidence cannot be considered conclusive. For instance, Kaplan and Zingales show for present times companies, that many companies with low dividend payout ratio, are indeed not financially constrained, and they could exploit investment opportunities if they wanted.

7.2 The Basic Test

Tables 3 presents the findings of the basic test where the technological score is the dummy for second industrial revolution firms. The regression has county and industry fixed effects to alleviate problems deriving from omitted variables. Standard errors are presented in parenthesis below the coefficients. The dependent variable is the growth of the firm.

Table 3.1 displays the results with bank proximity for the sample in the period 1895-1900. Columns 1 and 2 show the findings using the dummy second industrial revolution as a technological score, and distance from the bank measured with the branch intensity index. The branch intensity index may be correlated with market power and size of the bank. To capture the effect due only to branch proximity, the regression controls for size of the bank both measured with number of branches (column 1) and total deposits collected in 1895 (column 2). Moreover, an Herfindal index controls for the degree of banking competition within the county.

The coefficient on the interaction term (Second Industrial Revolution * Bank Distance) is positive and significant with both controls for the bank size. The coefficients on the interaction terms with bank size are small. On the other hand, the interaction term with the Herfindal index is positive and statistically significant. In all the specifications number of branches and amount of deposits display a small and not statistically significant coefficient. We observe a similar pattern for the year of incorporation of the firm. The proximity index alone is not significant as well.

[33]The railway companies running losses were Brecon & Merthyr Tyndfill Junction Railway, Cambrian Railway, Colne Valley Railway, Gargstang and Knot End Railway, Manchester and Milford Railway, Neath and Brecon Railway, Somerset and Dorset Railway, Port Talbot Railway.

The coefficient associated with the bank proximity interaction is equal to 8.084 when size of the bank is measured with number of branches. Does it mean that bank proximity played an important role in lending relationships? The answer to this question lies in the interpretation of the coefficient itself. The 75^{th} percentile of the bank proximity index in the 1895 sample is Consolidated Banks in Lancashire. The 25^{th} percentile of the bank index is Martin's bank in the metropolitan area of London. The econometric result tells that a second industrial revolution firm located in Lancashire and trading with Consolidated Banks grew 1.12% more per year than a new technology firms located in London and trading with Martin's Bank. In other words, it was more likely to be closer to Consolidated Banks' branch in Lancashire that to a Martin's branch in London, and this affected firms' economic performance.[34]

Some other examples can provide further clarification. A second industrial revolution firm located in Hertfordshire and trading with Lloyds Bank is not considered "close to a bank": Lloyds did not have any branch in Hertfordshire and the firm would have not gained any additional growth from being there. A firm located in Northamptonshire, where Lloyds had one branch for a population of 638,830, would have gained an additional 0.76% of growth per year when compared to Hertfordshire. A firm located in Sussex, where Lloyds had four branches for a population of 330,883, would have attained an extra 1.14% of annual growth when again compared to a similar company located in Hertfordshire. Since the average growth rate of

[34] This result suggests that even within a geographical area a firm should have chosen the bank with the largest number of branches because it was more likely to be the closest. If there were such large gains, why didn't they do it? It is possible that some new technology firms prefer to have business relationships with private banks rather than larger joint stock banks. Private banks were less bureaucratic and more flexible in setting terms of loans. On the other hand, private banks (especially in the London area) had only one branch and were on average more distant: this resulted in a cost for the firm. Notice that, by controlling for the size of the bank, the regression controls for possible benefits deriving from trading with private banks. It is also possible that a new branch of a competing bank opened an office in the neighborhood of the firm, but the firm did not want to switch from the old to the new bank. For the period observed, and in the majority of cases, firms traded only with one bank and never changed bank. Modern corporate finance shows that long lasting business relationships between a bank and a firm yield benefits to the company. It is possible that firms preferred to exploit long lasting business relationships with a more distant bank, rather than starting a new business with a closer bank. Since firms did not change banks, the age of the firm is a good approximation of the length of the business relationship with the bank: the regression controls for this possible effect. As noted before, what really matters is that bank proximity played a role in determining companies' performance. If capital markets were perfect, bank proximity should not have any influence.

the firms in the 1895 sample is 5.2% per year the effect related to the bank index is quite sizable.

Also banking competition displays a quite important effect. The coefficient on the interaction with the Herfindal index is equal to 3.47. The induced effect is the very big: a second industrial revolution firm located in a county at the 75^{th} percentile (Kent extrametropolitan or Pembrokeshire) of banking competition would have grown at a 5% per year higher than a similar firm located at the 25^{th} (Staffordshire).

Table 3.2, Column 1 reports the results of the basic test with number of titled people in the company board. The coefficient on the interaction variable is positive and statistically significant. A firm operating with second industrial revolution technologies and an additional titled director enjoyed an extra 2.6% of growth per year. Column 2 shows the results when controlled for selection bias. The coefficient on the interaction second industrial revolution/titled directors is still positive and significant, and its magnitude is not altered. On the other hand, the correction term has a negative sign and is not statistically significant. Column 3 displays the results when the networking variable is "Interlocking Directorships". The coefficient on the interaction is positive and significant. An additional interlocking directorships to the firm would have yielded 0.9% of extra growth per year to the firm. Column 4, displays the results with the correction term: sign and magnitude of the relevant coefficients are unchanged.

Table 3.3 presents the results with banks for the 1900-1904 sample. The interaction between the second industrial revolution score and bank proximity index is positive and significant. The result is robust after controlling for bank size both measured by the number of branches and the amount of deposits. The coefficient on year of registration of the company is now statistically significant and positive.

The difference between the 75^{th} percentile of bank proximity index and the 25% is now 2% of growth per year. In other words, an new technology firms trading with a bank in the 75^{th} percentile of distance would grow 2% faster than a firm trading with a bank in the 25^{th} percentile. Following the previous example, trading now with Lloyds in Sussex yielded an additional 1.1% of growth per year when compared to any other country where Lloyds does not have branches. The effect on a firm's growth is still quite big when we notice that the average growth rate of firms in this period is 2.1% per year. Interestingly, all firms operating with bigger banks were growing at a lower rate than other firms. However, the coefficient is quite small.

The coefficient on the interaction with banking competition is still positive, but not statistically significant and much smaller. Interestingly, when

controlling for deposits, the correction for selection term becomes statistically significant, maintaining a negative sing.

Table 3.4 column 1 shows the results of the basic test with titled directors for the 1900-1904 sample. The interaction variable is significant and positive. An extra titled person yielded an additional 1.47% of growth per year. Again the coefficient on age of the firm is positive and significant. Column 4 displays the outcome with self-selection correction. The coefficient on the interaction term does not change sign and magnitude and it is still significant. The selection correction term is positive, but not statistically significant. Column 2 presents the results for the interlocking directorships. The coefficient on the interaction term is still positive, but no longer significant. Moreover, it is smaller than the same coefficient for the 1895 sample regression. The result does not change when the regression is corrected for self selection.

Table 3.6 reports the results for the probit first step needed to construct the selection correction variable. In the 1895 sample having an administration board composed of many members increased the probability of having a titled director.[35] Moreover, electricity supply, chemicals and engineering companies were more likely to have a titled director in the administration board.

In the 1900 sample, the age of the firm and its size (measured by total value of the assets) made a firm more likely to have a titled person in the administration board. On the other hand, the industry where the firm belonged did not have an important impact on the likelihood of having a titled director. Also the number of members of the administration board did not have a significant impact.

Table 3.7 presents the results of the multinomial logit related to the interlocking directorships. The 33^{th} percentile is the reference category. Being a firm in Iron and Steel in 1895 increased the probability of being in the 33^{th} and 66^{th} and decreased the probability of being in the $66^{th}$and 100^{th} percentile. Total value of the assets at the beginning of the period increased the likelihood of having many interlocking directorships in the 1895 sample, but decrease the same likelihood in the 1900 sample. Apparently bigger firms were less "interlocked" in 1895, and they became more in 1900. Textile and clothing and paper and publishing were in general less interlocked.

[35] The number of directors is a proxy of the degree of bureaucratization of a company. A company with an administration board composed of many members is more likely to have a hierachical structure of managers and deputy managers. The biggest railways companies are examples.

7.3 Technological Features and Credit Market Constraints

This section formally evaluates the possible characteristics that may have prevented capital markets from financing new technologies. There are at least two features that should be considered: degree of novelty and capital intensity.

The results with the score indicating the degree of novelty are presented in Table 4.1 for 1895-1900. In columns 1 and 2 the specification with log of occupation growth interacted with bank proximity index is used. The coefficient on the interaction term is positive and statistically significant. A way to get a sense of the magnitude of the effect is as follows. Gunpowder and explosives is among the industries that displayed the highest occupation growth. Silk experienced a decrease in occupation. Again, the 75^{th} percentile of the bank proximity index for 1895 is Consolidated Banks in Lancashire whereas the 25^{th} percentile is Martin's Bank in London metropolitan area. A chemical explosive firm trading with Martin's Bank in London would have grown at a 0.2% per year higher than a silk firm located in London and also trading with Martin's. On the other hand, a chemical explosive firm trading with Consolidated bank in Lancashire would have grown at a 0.9% per year higher than a silk firms in the same conditions. Again, proximity to the bank is a more important determinant of growth for a second industrial revolution firm than a traditional firm.

Also the interaction with banking competition index is positive and significant. A chemical explosives firm located in a county at the 25^{th} percentile of banking competition would have grown an additional 3% in comparison to a silk firm located in the same county. The differential in economic performances becomes bigger in a county with a lower degree of banking competition (at the 75^{th} percentile): the explosives firm would outperform the silk company by 5% per year. In the specification with titled people (column 3) and interlocking directorships (column 4) the coefficient is positive, but not statistically significant. Apparently, titled people and interlocking directorships did not a play an important role in determining economic performance of firms operating with new technologies.

The results are somewhat different in the 1900-1904 sample (Table 4.2). The interaction of the bank proximity index with occupation growth yields a positive and statistically significant coefficient. The interaction on the Herfindal index is still positive, but not statistically significant. In 1900, Bank proximity mattered also for firms operating new technologies.

Turning to networking variables measured with titled directors and interlocking directorships: both of them display a positive coefficient. The

interaction with titled directors is also significant.

When the technology score is capital intensity of the industry (Table 4.3), in the 1895 sample, the interaction with the bank proximity index is positive but no longer statistically significant. The interaction with Herfindal index is still positive and significant. It appears that a lower degree of banking competition helped capital intensive firms.

Interestingly, while titled directors does not have an effect on firm's growth, the interaction with interlocking directorships displays a positive and significant coefficient.

In the 1900 sample (Table 4.4), the coefficient on the interaction with bank proximity index results again positive and not significant. However, this outcome is mainly driven by railways. When a new regression is run without considering railways, the coefficient is still positive and statistically significant. Railways are typical example of capital intensive old technology. The interactions with titled directors is still positive, but not significant. The interaction with interlocking directorships is negative and not significant.

In both samples, banking variables appear to be an important determinant of growth for new technologies and capital intensive firms. The evidence on the other proxies is more mixed. Interlocking directorships appear to matter for capital intensive firms between 1895 and 1900, whereas titled directors mattered for new technologies firms between 1900 and 1904. It is important to notice that in all the specifications but one the sign of the coefficient is always positive, and magnitude quite important.

7.4 Other Tests

7.4.1 Political Connections

Titled people may measure not only a financial channel, but also political connections that helped firms to achieve higher growth rates. This can be particularly true for electricity supply. Hannah (Hannah, 1979) reports how the allocation of the electricity franchises in the various districts of London was the result of political struggles between different vested interests. In many instances private electrical enterprises needed the authorization of the local government to expand their activities and open new power stations.[36] Having a member of House of Commons or the House of Lords on the administration board may have helped electrical firms win such political struggles and obtain better working terms.

[36] Hannah, 1976 p. 44

This fact can also be true in older industries. A sector where Peers had long lasting interests was railways. The tracks needed to pass over the land, and the old aristocracy was the owner of the land. Like railways, coal and iron mining were activities intrinsically related to the ownership of land: a Peer on the administration board may have permitted the company to pay lower royalties and have easier access to the mines. In these two sectors the effect of having a titled person on the board works against the hypothesis tested in this work: the problem arises for electricity supply. To see if possible effects of political connections are biasing the analysis in an important way, I dropped electricity supply from both samples and again ran the experiment with titled directors. The results are presented in table 5.1. The coefficients on the interaction dummy are still positive and statistically significant on both samples.

7.4.2 Age of Companies and the 1903-1907 recession.

It is also useful to study whether the effects of bank proximity and titled directors are stronger for younger firms rather than old firms. Younger firms should be more constrained than older firms, thus requiring a larger amount of external finance. The age of the firm is proxied with the year of incorporation.[37] A way to observe this effect is to split the sample into old and young companies and run the same set of regressions on the two samples. Unfortunately, this experiment is not possible for the 1895-1900 sample. Most of the second industrial revolution firms were young firms. Splitting the sample on the median age, 1885, would leave more than 80% of new technology companies in the sub-sample of young firms, and less than 20% in the sub-sample composed of older firms.

This experiment is possible for the 1900-1904 firms. Here companies operating with second industrial revolution technologies start to be more mature, and the division of the sample becomes more meaningful. I split the sample with firms incorporated before 1892 and after 1892 and run separate regressions on each sample.[38] Fifty percent of the new technology firms are classified as "Young" and fifty percent are classified as "Old". Results are reported in Table 5.2.

Interestingly, it appears that bank distance had a greater impact on older

[37] It is difficult to establish with precision the age of the firm since its foundation. The Stock Exchange Official Intelligence reports only the incorporation date. Many times, before becoming joint stock limited liability companies, firms were partnerships or private companies. However, incorporation date can still be considered a good proxy.

[38] Similar splits made for 1894, 1896 and 1897 do not yield different results.

firms than on younger firms. The coefficient of the interaction term with the bank proximity index is positive and significant for firms registered before 1895 and still positive but not statistically significant for firms registered after. At a first glance this results seems surprising: usually younger firms are more in need of external finance. A closer inspection of the data reveals that much of the result on bank distance is driven by electricity firms. All these firms are considered as middle aged being incorporated between 1885 and 1892. Running the regression on the growth equation (on the whole sample) and creating a score that attributes a value of one only to electricity firms yields a positive, high valued and statistical significant coefficient on the interaction variable (Table 5.3). Between 1903 and 1907 the electricity industry was in a period of crisis. The industry faced difficult times as domestic investment fell by a third between 1903-1908. (Kennedy, p.137 and Byatt p. 151).[39] Industries in distress needs more external support than other industries. Overdraft may need to be rolled over, banks may grant longer period of time for the repayment of the loans.

The results on the Titled people in the administration board is presented on column 3 and column 6 of Table 4.4. Here titled people have a stronger effect on younger companies: an additional titled director produce an extra 3% of growth per year to the firm over an average growth of 3.1% for young firms. The effect on older companies despite having a positive sign, smaller magnitude and it is not statistically significant.

Interestingly the coefficient on the interaction with interlocking directorships is now positive and statistically significant. Interlocking directorships had an effect, although not very big, on younger companies. An extra interlocking directorship gave an additional 0.01% of growth to the firm.

8 Conclusions

This paper developed an analysis useful to measure the impact of credit market constraints on British companies for the period 1895-1904.

The historical literature has pointed out the inability of British capital markets to finance the technologies of the second industrial revolution. This paper tests this hypothesis by looking at two samples of about 270 companies, for the period 1895-1900 and about 430 companies for the period 1900-04.

[39] Byatt attributes the recession in the sector to the excess of capacity generated in the previous years. Kennedy describes it as a phenomenon related to business cycle: demand for electrical equipments and electricity decreased as the aggregate investment decreased.

The test is based on the capability of financially constrained firms to access informal capital sources. A financially constrained firm should grow more if it is closer to a bank: in this way information between borrower and lender can flow more easily. Similarly, a company financially constrained on the formal capital market should grow more than a financially unconstrained firm if its directors enjoy a large financial network and are hence able to obtain capital from informal sources. The proximity of a firm to its bank is proxied by the number of branches of the partner bank over population of the county where the firm is located. Networking is proxied by the number of titled individuals (Lords, Baronets, MPs) in the company board and the number of directorates held by the chairman of the company.

The analysis shows that an additional titled director in the company board yielded an extra 2.6% of growth between 1895-1900 and an extra 1% between 1900-1904 to firms engaged in second industrial revolution technologies. Interlocking directorships added an extra 0.42% of growth per year to a second industrial revolution firm between 1895-1900. They did not play an important role between 1900 and 1904. Trading with a closer bank yielded on average an extra 4% of growth per year between 1895 and 1900 and an extra 2% per year between 1900 and 1904.

The study also analyzes which features of the second revolution technologies are at the root of these results. These technologies are typically new and capital intensive endeavors. Bank proximity was an important determinant of growth both for capital intensive firms and firms using the new technologies. Networking measured as number of titled directors helped new technology firms, whereas interlocking directorships positively affected the economic performance of capital intensive firms.

Young companies and financially distressed companies should rely more heavily on external finance and be more sensitive to the access to informal sources of capital. This paper finds that titled directors and interlocking directorships have a big and positive impact on the growth of young companies. On the other hand, bank proximity was a very important determinant of the performance of second industrial revolution companies in financial distress, especially in the electricity sector.

This paper is part of a larger research project that studies the effect of credit market imperfections on the diffusion of new technologies between the nineteenth and the twentieth century. The next step consists of an evaluation of the macroeconomic impact of credit market constraints in relation to the diffusion of new technologies in late Victorian Britain.

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Table 1.1
Number of Companies per Sector

	1895	1900
Brewing	15	20
Tobacco	3	6
Textile, Clothing and Leather	38	65
Coal, Iron, Clay and Stone Mines	36	46
Iron, Steel and other Metal manufacturers	21	35
General and Electric Engineering	49	69
Bicycles and Motorcars	9	37
Paper and Publishing	14	31
Railways	35	35
Chemicals	37	61
Electricity Supply	19	29
All Sample	276	434

Table 1.2

Summary Statistics 1895 Sample

Growth of the firm is measured as variation in book value of the assets, as presented in the companiies' annual reports, between 1895 and 1900, and 1900 and 1904. Year of Registration is the year when the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence* . Total value of the assets is the book value of the assets at the beginning of each period (1895 and 1900). Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Banks deposits stands for total amount of deposits collected by the bank trading with the firm. Banking competition is an Herfindal index computed at county level using the share of branches that a bank has in respect to the total number of bank branches working in the county. Titled directors are the numbers of directors with honorific titles in the administration board of the company. Interlocking directoriships are the total number of directorates held by the member of the boards of a particular company.
The information on banking were retrieved from *London Banks and Kindred Companies* , the information on Directors from companies' annual reports and the *Stock Exchange Official Intelligence* and the *Directory of Directors* .

Summary Statistics 1895 Sample

Variable	Number of Observations	Mean	Standard Deviation	Min	Max
Growth of the Firm	276	0.259	0.458	-0.69	2.393
Year of Registration	275	1,879	14.11	1832	1895
Total Value of the Assets	276	3,285	13,124	5.537	111,201
Bank Proximity index	255	0.0142	0.0186	0	0.1102
Number of Branches	255	62.91	58.79	1	175
Amount of Deposits	247	13.607	11.99	0.678	42.74
Banking Competition (Herfindal Index)	276	0.129	0.058	0.061	0.414
Titled Directors	274	1.2	1.724	0	11
Interlocking Directorships	272	7.8	9.27	0	56

Summary Statistics 1900 Sample

Variable	Number of Observations	Mean	Standard Deviation	Min	Max
Growth of the Firm	434	0.084	0.262	-0.64	1.694
Year of Registration	426	1,887	13.98	1832	1900
Total Value of the Assets	434	2385	11355	6.03	116582
Bank distance index	404	0.02	0.0224	0	0.1386
Number of Branches	404	97.84	63	1	182
Amount of Deposits	398	20.51	14.18	0.633	49.28
Banking Competition (Herfindal Index)	434	0.134	0.065	0.062	0.5
Titled Directors	434	1.08	1.69	0	13
Interlocking Directorships	422	6.81	7.73	0	60

Table 1.3
Growth Rates by Sector

Growth rates are measured as first difference between book value of the assets between 1895 and 1900, and 1900 and 1904. Information retrieved from Companies' Annual Reports.

1895

	Mean	S.D.	Min	Max
Brewing	0.4	0.327	-0.004	1.189
Tobacco	0.017	0.2147	-0.406	0.294
Textile, Clothing and Leather	0.090	0.275	-0.316	1.207
Coal, Iron, Clay and Stone Mines	0.246	0.476	-0.254	2.394
Iron, Steel and other Metal manufacturers	0.311	0.588	-0.544	1.795
General and Electric Engineering	0.266	0.472	-0.691	2.213
Bicycles and Motorcars	0.231	0.398	-0.422	0.745
Paper and Publishing	0.054	0.201	-0.388	0.395
Railways	0.108	0.212	-0.300	1.020
Chemicals	0.208	0.396	-0.536	1.724
Electricity Supply	0.968	0.579	0.183	2.316

1900

	Mean	S.D.	Min	Max
Brewing	0.037	0.122	-0.247	0.28
Tobacco	-0.445	0.201	-0.443	0.215
Textile, Clothing and Leather	0.141	0.120	-0.240	0.448
Coal, Iron, Clay and Stone Mines	0.063	0.322	-0.435	1.486
Iron, Steel and other Metal manufacturers	0.012	0.170	-0.221	0.610
General and Electric Engineering	0.097	0.315	-0.064	1.230
Bicycles and Motorcars	0.089	0.329	-0.520	1.690
Paper and Publishing	0.036	0.091	-0.277	0.214
Railways	0.087	0.122	-0.006	0.633
Chemicals	0.051	0.173	-0.360	0.846
Electricity Supply	0.481	0.390	-0.063	1.55

Table 1.4

Employment Growth by Industry 1881-1891

Nail Manufacture	0.53	Clay	1.24
Ironstone Miner	0.58	Bolt, Nut, Rivet, Screw, Staple maker	1.24
Manure Manufacture	0.78	Anchor, Chain, Manufacture	1.27
Button Maker	0.79	Carpet and Rug Manufacturer	1.28
Agricultural Machines and Implement Makers	0.80	Sum Coal and Iron	1.30
Silk	0.87	Engineers and Machine Makes	1.30
Brick and Tile	0.89	Stone Quarries	1.31
Slate Quarrier	0.93	Spinning and Weaving Machine Maker	1.31
Tallow Chandler, Candles, Oil	0.94	Brass, Bronze	1.31
Millwright	0.95	Publisher, Bookseller, Librarian	1.31
Bleacher, Printer, Dyer	0.95	Ironmonger, Harware Dealer, Merchants	1.34
Lead	0.99	Shipbuilding	1.34
Salt Maker/Dealer	1.00	Railway	1.35
Other Iron and Steel	1.01	Plaster, Cement Manufacturer	1.35
Tanner Fellmonger	1.02	Coal Miner	1.36
Wool Cloth Manufacture	1.07	Boiler Maker	1.36
Brewer	1.08	Indiarubber, Waterproof	1.37
Cotton, Cotton Good Manufacture	1.08	Floor Cloth, Oil Cloth	1.38
Wool	1.08	Printer	1.40
Paper Manufacture	1.10	Stationer	1.44
Worsted, Stuff Manufacture	1.10	Tobacco Manufacturer	1.47
Clothing	1.12	Manufacturing Chemist & Alkali	1.50
Shoe, Boot maker	1.12	Mineral Water	1.53
Balcksmith, Whitesmith	1.15	Zinc, Zinc goods	1.61
Arms	1.17	Soap Boiler Maker	1.61
Copper	1.18	Hemp, Jute	1.70
Chemist Druggist	1.19	Newspaper agent, news room keeper	1.80
Coach, Carriage maker	1.21	Paper Bags, Paper Box Makers	1.91
Wire Maker	1.21	Gunpowder, Guncotton, Explosive	1.96
Leather Goods	1.21	Dye Paint, Manufacturer	2.16
Glue, Size, Gelatine, Isinglass	1.22	Mineral Oil Workers	2.56
Tin, Tin Plate, Tin Good Manufacture	1.23	Electrical Apparatus Makers	5.16
		Bicycle, Tricycle -Maker, Dealer	10.75

(Source: 1881 and 1891 UK Population Census)

Table 1.5 **Capital Labor Ratio at 1890**

Apparel	0.74
Tobacco	0.78
Coal Mining	0.83
Lumber_wood	0.98
Other non metals	0.98
Stone_Clay_Glass	0.98
Furniture	1.15
Leather	1.16
Printing	1.37
Miscellaneous	1.42
Textile	1.48
Instruments	1.56
Mining: Petroleum	1.59
Machinery	1.67
Transportation Equipment	1.71
Rubber	1.90
Fabricated Metal	1.93
Paper	1.96
Primary Metals	2.32
Food and Kindred Products	2.77
Chemical	3.07
Mining: Total Metals	5.18
Railways	7.34
Electricity Supply	9.53
Petroleum and Coal Product	11.02

(Source: Cain and Patterson, 1981)

Table 1.6
Bank Proximity Index per Industry

Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. The information on branches is taken from *London Banks and Kindred Companies.* The data on Population from the 1891 UK Census of Population.

	1895			
	Mean	S.D.	Min	Max
Brewing	0.021	0.02	0.000	0.059
Tobacco	0.006	0.007	0.002	0.013
Textile, Clothing and Leather	0.0121	0.0166	0.000	0.0684
Coal, Iron, Clay and Stone Mines	0.015	0.0138	0.000	0.059
Iron, Steel and other Metal manufacturers	0.014	0.021	0.000	0.068
General and Electric Engineering	0.013	0.0199	0.000	0.065
Bicycles and Motorcars	0.021	0.029	0.000	0.068
Paper and Publishing	0.02	0.033	0.000	0.11
Railways	0.015	0.0171	0.000	0.052
Chemicals	0.013	0.016	0.000	0.065
Electricity Supply	0.011	0.013	0.000	0.041

	1900			
	Mean	S.D.	Min	Max
Brewing	0.021	0.021	0.000	0.068
Tobacco	0.013	0.01	0.002	0.026
Textile, Clothing and Leather	0.017	0.018	0.000	0.081
Coal, Iron, Clay and Stone Mines	0.015	0.014	0.000	0.05
Iron, Steel and other Metal manufacturers	0.023	0.027	0.000	0.081
General and Electric Engineering	0.017	0.021	0.000	0.081
Bicycles and Motorcars	0.045	0.033	0.000	0.138
Paper and Publishing	0.012	0.019	0.000	0.081
Railways	0.017	0.023	0.000	0.11
Chemicals	0.0147	0.016	0.000	0.081
Electricity Supply	0.0142	0.0156	0.000	0.0594

Table 1.7
Number of Titled People on Company Boards

Titled directors are the numbers of members of the administration board with honorific titles (Lords, Sirs, Baronets, Knights, MPs, JPs). The information is obtained from Companies' annual reports and the *Stock Exchange Official Intelligence.*

	1895			
	Mean	S.D.	Min	Max
Brewing	0.267	0.456	0	1
Tobacco	0.333	0.577	0	1
Textile, Clothing and Leather	0.815	1.291	0	5
Coal, Iron, Clay and Stone Mines	0.889	1.165	0	4
Iron, Steel and other Metal manufacturers	0.714	1.05	0	4
General and Electric Engineering	1.145	1.237	0	4
Bicycles and Motorcars	0.778	0.971	0	2
Paper and Publishing	0.428	0.851	0	2
Railways	2.97	3.139	0	11
Chemicals	1.222	1.375	0	5
Electricity Supply	1.5	1.387	0	4

	1900			
	Mean	S.D.	Min	Max
Brewing	0.6	0.94	0	3
Tobacco	0.111	0.333	0	1
Textile, Clothing and Leather	0.723	1.352	0	5
Coal, Iron, Clay and Stone Mines	1.020	1.180	0	4
Iron, Steel and other Metal manufacturers	0.800	1.270	0	4
General and Electric Engineering	0.913	1.067	0	3
Bicycles and Motorcars	0.730	0.961	0	3
Paper and Publishing	0.580	0.764	0	3
Railways	3.910	3.420	0	13
Chemicals	0.786	1.050	0	4
Electricity Supply	1.517	1.617	0	6

Table 1.8
Interlocking Directorships

Interlocking directoriships are total number of directorates held by the member of the boards of a particular company. The information is obtained from the *Directory of Directors*.

	1895			
	Mean	S.D.	Min	Max
Brewing	4.46	6.32	0	20
Tobacco	2	1.73	1	4
Textile, Clothing and Leather	3	3.58	0	13
Coal, Iron, Clay and Stone Mines	7.67	5.2	0	18
Iron, Steel and other Metal manufacturers	3.8	2.98	0	11
General and Electric Engineering	6.7	6.16	0	25
Bicycles and Motorcars	4.67	3.42	0	10
Paper and Publishing	2.92	3.4	0	12
Railways	22.28	13.83	0	56
Chemicals	5.83	8.13	0	36
Electricity Supply	9.94	6.97	0	26

	1900			
	Mean	S.D.	Min	Max
Brewing	5.05	5.82	0	21
Tobacco	4.57	5.22	0	15
Textile, Clothing and Leather	3.306	4.586	0	22
Coal, Iron, Clay and Stone Mines	7.41	5.96	0	19
Iron, Steel and other Metal manufacturers	5.85	4.71	0	19
General and Electric Engineering	7.72	7.16	0	34
Bicycles and Motorcars	4.82	4.04	0	14
Paper and Publishing	2.72	2.76	0	9
Railways	19.27	14.03	0	60
Chemicals	4.475	5.53	0	22
Electricity Supply	11.35	5.474	1	22

Table 2.1 **Dividends Payout ratios in various sectors, 1895 and 1900**

Divindends Payout Ratios are computed as dividends paid in various class of ordinary and preference shares divided by total profits. Information retrieved from companies' annual reports.

Dividends Payout Ratios 1895	
Electricity Supply	0.72
Railways	0.91

Dividends Payout Ratios 1900	
Brewing	0.81
Tobacco	1.78
Textile, Clothing and Leather	1.19
Coal, Iron, Clay and Stone Mines	0.69
Iron, Steel and other Metal manufacturers	0.9
General and Electric Engineering	0.75
Bicycles and Motorcars	0.69
Paper and Publishing	0.99
Railways	1.18
Chemicals	0.75
Electricity Supply	0.73
All Sample	0.87

Table 2.2 **Percent of Year with Positive Dividends 1896-1900**

	Firms living for 5 years	Firms living for at least 3 years
Brewing	0.95	0.95
Tobacco	1	1
Textile, Clothing and Leather	0.91	0.88
Coal, Iron, Clay and Stone Mines	0.72	0.72
Iron, Steel and other Metal manufacturers	0.75	0.78
General and Electric Engineering	0.8	0.79
Bicycles and Motorcars	0.76	0.69
Paper and Publishing	0.86	0.86
Railways	0.64	0.64
Chemicals	0.69	0.77
Electricity Supply	0.91	0.9
All Sample	0.78	0.79

(Source: *Stock Exchange Official Intelligence*)

Table 3.1 Results from the Basic Test - Bank Proximity 1895-1900

The dependent variable is growth of the firm between 1895 and 1900 measured as variation in book value of the assets. Year of Registration is the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence* . Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Bank deposits stands for total amount of deposits collected in 1895 by the bank trading with the firm. Banking competition is an Herfindal index computed at county level using the share of branches displayed by the bank in the county. The data on banks and branches were taken from *London Banks and Kindred Companies.* Second Industrial Revolution is a dummy variable that assigns one to companies in the electricity supply, electricity manufacturing, bicyles and motorcycles and chemicals sector and zero otherwise. Correction for selection obtained by running a multinomial logit that as dependent variable has the 0-33th, 33th-66th, 66th-100th percentile of the bank proximity index and several firms characteristices as regressors.
The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Control Number of Branches	Control Deposits	Branches & Selection	Deposits & Selection
	1	**2**	**3**	**4**
Year of Registration	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)
Bank Proximity	-1.286	-0.916	-1.458	-0.965
	(1.554)	(1.662)	(1.532)	(1.622)
Number of Branches	0.0003		0.0004	
	(0.0007)		(0.0006)	
Bank Deposits		0.004		0.004
		(0.003)		(0.003)
Bank Proximity * Second Revolution	8.084***	6.306**	7.901***	6.082**
	(3.049)	(3.147)	(3.010)	(3.047)
Number of Branches * Second Revolution	-0.002**		-0.002**	
	(0.001)		(0.001)	
Bank Deposits * Second Revolution		-0.01*		-0.09*
		(0.005)		(0.005)
Banking Competition * Second Revolution	3.47***	3.832***	3.652***	3.818***
	(1.22)	(1.23)	(1.218)	(1.23)
Selection Correction Term			-0.149	0.181
			(0.270)	(0.177)
R-Squared	0.31	0.32	0.34	0.34
Observations	251	245	251	245

Table 3.2 **Results from the Basic Test - Titled Directors and Interlocking Directorships 1895-1900**

The dependent variable is growth of the firm between 1895 and 1900 measured as variation in book value of the assets. Year of Registration is the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence* . Titled directors are the numbers of directors with honorific titles in the administration board of the company. The titles of the directors are indicated both on the companies' annual reports and on the *Stock Exchange Official Intelligence* . Interlocking directoriships are total number of directorates held by the members of the boards of a particular company. The data is obtained from the *Directory of Directors* . Second Industrial Revolution is a dummy variable that gives one for companies in the electricity supply, electricity manufacturing, bicyles and motorcycles and chemicals sector and zero otherwise. Correction for selection obtained by running an Heckman two step method. The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Titled Directors		Interlocking Directorships	
	Basic Specification	Correction for Selection	Basic Specification	Correction for Selection
	1	**2**	**3**	**4**
Year of Registration	0.0001	0.0001	-0.0005	-0.0006
	(0.002)	(0.002)	(0.002)	(0.002)
Titled Directors	-0.069	-0.080*		
	(0.043)	(0.047)		
Interlocking Directorships			-0.050	-0.05
			(0.032)	(0.032)
Titled Directors*Second Industrial Revolution	0.192**	0.187**		
	(0.094)	(0.095)		
Interolcking Directorships*Second Industrial Revolution			0.070*	0.069*
			(0.041)	(0.042)
Correction Term		-0.639		0.044
		(0.467)		(0.101)
R-Squared	0.29	0.29	0.28	0.28
Observations	273	273	273	273

Table 3.3 Results from the Basic Test - Bank Proximity 1900-1904

The dependent variable is growth of the firm between 1900 and 1904 measured as variation in book value of the assets. Year of Registration is the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence* . Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Bank deposits stands for total amount of deposits collected in 1900 by the bank trading with the firm. The data on banks and branches were taken from *London Banks and Kindred Companies.* Banking competition is an Herfindal index computed at county level using the share of branches displayed by a bank in the county. Second Industrial Revolution is a dummy variable that assigns one to companies in the electricity supply, electricity manufacturing, bicyles and motorcycles and chemicals sector and zero otherwise. Correction for selection obtained by running a multinomial logit that as dependent variable has the 0-33th, 33th-66th, 66th-100th percentile of the bank proximity index and several firms characteristices as regressors.
The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Control Number of Branches	Control Deposits	Branches & Selection	Deposits & Selection
	1	**2**	**3**	**4**
Year of Registration	0.003***	0.002**	0.003***	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
Bank Proximity	-0.158	-0.382	-0.075	-0.274
	(0.747)	(0.719)	(0.744)	(0.719)
Number of Branches	-0.0003		-0.0003	
	(0.0002)		(0.0002)	
Bank Deposits		-0.001*		-0.001*
		(0.0008)		(0.0008)
Bank Proximity * Second Revolution	3.110**	3.089**	2.964**	2.936**
	(1.531)	(1.489)	(1.481)	(1.439)
Number of Branches * Second Revolution	-0.0004		-0.0004	
	(0.0004)		(0.0004)	
Bank Deposits * Second Revolution		-0.0001		0.0003
		(0.001)		(0.002)
Banking Competition * Second Revolution	0.234	-0.051	0.160	-0.142
	(0.276)	(0.261)	(0.291)	(0.273)
Selection Correction Term			-0.146	-0.188*
			(0.107)	(0.111)
R-Squared	0.26	0.25	0.26	0.25
Observations	401	394	401	394

Table 3.4 **Results from the Basic Test - Titled Directors and Interlocking Directorships 1900-1904**

The dependent variable is growth of the firm between 1900 and 1904 measured as variation in book value of the assets. Year of Registration is the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence*. Titled directors are the numbers of directors with honorific titles in the administration board of the company. The titles of the directors are indicated both on the companies' annual reports and on the *Stock Exchange Official Intelligence*. Interlocking directoriships are total number of directorates held by the members of the boards of a particular company. The data is obtained from the *Directory of Directors*. Second Industrial Revolution is a dummy variable that gives one for companies in the electricity supply, electricity manufacturing, bicyles and motorcycles and chemicals sector and zero otherwise. Correction for selection obtained by running an Heckman two step method. The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Titled Directors		Interlocking Directorships	
	Basic Specification	Correction for Selection	Basic Specification	Correction for Selection
	1	**2**	**3**	**4**
Year of Registration	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Titled Directors	-0.016	-0.011		
	(0.021)	(0.022)		
Interlocking Directorships			-0.003	-0.002
			(0.013)	(0.014)
Titled Directors*Second Industrial Revolution	0.085**	0.086**		
	(0.042)	(0.043)		
Interolcking Directorships*Second Industrial Revolution			0.024	0.023
			(0.019)	(0.019)
Correction Term		0.399		-0.014
		(0.269)		(0.026)
R-Squared	0.21	0.22	0.20	0.20
Observations	430	430	419	419

Table 3.5
Bank Proximity **Multinomial Logit Analysis: Marginal Effects**

Dependent Variable: 0 if the bank proximity index is between the 0 and the 33th percentile of its sample distribution; 1 if the if the bank proximity index is between the 33th and the 66th percentile and 2 if it is between the 66th and the 100th percentile. Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the bank trading with the firm. The information on banks was retrieved from *London Banks and Kindred Companies.* Assets at the beggining of the period indicates the book value of the assets, as presented in the annual report, in 1895 and 1900 respectively. Year of Registration is the year in which a company was registered as limited liability. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	1895		**1900**	
	33th - 66th Percentile	66th- 100th Percentile	33th - 66th Percentile	66th- 100th Percentile
Iron, Steel and other Metals Manufacturing	0.208	-0.232	-0.028	0.125
	(0.144)	(0.173)	(0.131)	(0.119)
Textile and Clothing	0.295**	-0.242*	0.144	0.073
	(0.135)	(0.131)	(0.109)	(0.099)
Brewing and Tobacco	0.052	0.067	0.040	0.147
	(0.152)	(0.189)	(0.133)	(0.127)
Paper	0.128	0.189	0.007	0.003
	(0.157)	(0.176)	(0.126)	(0.131)
General and Electrical Engineering	0.014	-0.146	-0.073	0.047
	(0.132)	(0.129)	(0.112)	(0.109)
Cycles	-0.154	-0.155	0.225*	0.252
	(0.271)	(0.180)	(0.156)	(0.191)
Chemical	0.115	-0.069	-0.006	0.091
	(0.125)	(0.129)	(0.107)	(0.099)
Electricity Supply	0.035	0.257	-0.004	0.182
	(0.158)	(0.197)	(0.149)	(0.167)
Railways	0.126	0.095	-0.160	0.102
	(0.157)	(0.137)	(0.155)	(0.130)
London and sorrounding counties	4.015	-2.443	0.224	-0.568***
	(5.594)	(2.620)	(0.158)	(0.152)
South Western Counties	3.892	-1.389	0.015	-0.081
	(5.643)	(2.444)	(0.205)	(0.190)
Western Counties and Wales	3.754	-1.951	0.025	0.113
	(5.66)	(2.574)	(0.167)	(0.147)
Warwickshire	3.808	-1.389	-0.502*	0.671***
	(5.656)	(2.444)	(0.300)	(0.226)
Northern Counties	3.766	-1.936	0.021	-0.050
	(5.649)	(2.573)	(0.153)	(0.139)
Scotland	3.730	-1.617	-0.038	0.250*
	(5.660)	(2.253)	(0.182)	(0.155)
Year of Registration	0.002	0.001	-0.002	0.003
	(0.003)	(0.002)	(0.002)	(0.002)
Number of Members in the Administration Board	-0.017	-0.006	0.001	-0.0001
	(0.012)	(0.015)	(0.006)	(0.0005)
Pseudo R-squared	0.19		0.24	
Obs.	251		401	

Table 3.6
Titled Direcotrs **Probit Analysis: Marginal Effects**

Dependent variable: 1 if the company had at least a titled director in the administration board and zero otherwise. The data on titled directors were retrieved from companies' annual reports and the *Stock Exchange Official Intelligence.* Year of Registration is the year when a company was registered as limited liability. Assets at the beggining of the period indicates the book value of the assets, as presented in the annual report, in 1895 and 1900 respectively. Number of members of the adminstration board is the number of directors serving in the administration board of the company. The regression also controls for industry fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	1895	**1900**
Iron, Steel and other Metals Manufacturing	-0.117	-0.160
	(0.141)	(0.114)
Textile and Clothing	-0.228*	-0.182*
	(0.117)	(0.099)
Tobacco and Brewing	-0.281*	-0.288**
	(0.137)	(0.128)
Paper	-0.364**	-0.059
	(0.121)	(0.111)
General and Electrical Engineering	-0.007	0.131
	(0.117)	(0.084)
Cycles	-0.044	0.004
	(0.216)	(0.084)
Chemical	-0.087	-0.054
	(0.131)	(0.093)
Electricity Supply	0.105	0.131
	(0.156)	(0.084)
Railways	0.116	0.034
	(0.142)	(0.134)
Registration Year	0.004	-0.005**
	(0.003)	(0.002)
Assets at the beginning of the period	0.0003	0.0001***
	(0.0004)	(0.00002)
Number of Members in the Administration Board	0.075***	-0.007
	(0.016)	(0.006)
Pseudo R-squared	0.13	0.11
Obs.	273	430

Table 3.7
Interlocking Directorships **Multinomial Logit Analysis: Marginal Effects**

Dependent variable: 0 if the number of interlocking directorships displayed by the company is between the 0 and the 33th percentile of its distribution in the sample; 1 if the if the number of interlocking directorships is between the 33th and the 66th percentile and 2 if it is between the 66th and the 100th percentile. The data on interlocking directorships were retrieved from the *Directory of Directors.* Year of Registration is the year when a company was registered as limited liability. Assets at the beggining of the period indicates the book value of the assets, as presented in the annual report, in 1895 and 1900 respectively. Number of members of the adminstration board is the number of directors serving in the administration board of the company. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	1895		**1900**	
	33th - 66th Percentile	66th- 100th Percentile	33th - 66th Percentile	66th- 100th Percentile
Iron, Steel and other Metals Manufacturing	0.324*	-0.391**	0.152	-0.037
	(0.180)	(0.192)	(0.654)	(0.656)
Textile and Clothing	0.193	-0.313**	-1.025*	-1.647***
	(0.148)	(0.167)	(0.531)	(0.571)
Brewing and Tobacco	0.234	-0.316*	-0.766	-1.14*
	(0.173)	(0.189)	(0.639)	(0.685)
Paper	0.281	-0.356	-0.298	-1.838**
	(0.205)	(0.222)	(0.591)	(0.784)
General and Electrical Engineering	0.064	-0.060	-0.025	0.286
	(0.113)	(0.118)	(0.559)	(0.536)
Cycles	0.191	-0.231	0.034	-0.208
	(0.198)	(0.212)	(0.629)	(0.640)
Chemical	0.178	-0.243	-1.683***	-1.354**
	(0.145)	(0.155)	(0.554)	(0.535)
Electricity Supply	-0.037	0.135	0.836	2.724**
	(0.152)	(0.158)	(1.216)	(1.124)
Railways	-0.097	0.170	-0.176	-0.025
	(0.178)	(0.177)	(0.960)	(0.922)
Registration Year	0.002	-0.003	-0.027*	-0.038***
	(0.003)	(0.004)	(0.015)	(0.015)
Assets at the beginning of the period	-0.002	0.006	0.0001	0.0003*
	(0.004)	(0.004)	(0.002)	(0.0002)
Number of Members in the Administration Board	-0.011	0.017	0.023	-0.014
	(0.020)	(0.021)	(0.038)	(0.031)
Pseudo R-squared	0.17		0.14	
Obs.	271		419	

Table 4.1 Employment Growth as Technology Score 1895-1900

The dependent variable is growth of the firm between 1895 and 1900 measured as variation in book value of the assets. Year of Registration represents the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence* . Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Banks deposits stands for total amount of deposits collected by the bank trading with the firm. The data on banks and branches were taken from *London Banks and Kindred Companies* . Titled directors is the number of directors with honorific titles in the administration board of the company. The titles of the directors are indicated both on the companies' annual reports and on the *Stock Exchange Official Intelligence* .

Interlocking directoriships is total number of directorates held by the member of the boards of a particular company. Employment growth in each industry is computed using figures from the 1881 and 1891 UK Census of Population. The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Distance from the Bank		Titled Directors	Interlocking Directorships
	Control Number of Branches	Control Deposits	Basic Specification	Basic Specification
	1	**2**	**3**	**4**
Year of Registration	-0.002	-0.002	-0.0003	-0.0006
	(0.002)	(0.002)	(0.002)	(0.002)
Bank Proximity	-12.375**	-12.24**		
	(5.936)	(7.266)		
Number of Branches	0.001			
	(0.001)			
Bank Deposits		0.010		
		(0.006)		
Titled Directors			-0.151	
			(0.125)	
Interlocking Directorships				-0.054
				(0.051)
Bank Proximity * Employment Growth	11.686*	11.231*		
	(7.088)	(7.266)		
Number of Branches* Employment Growth	-0.002			
	(0.0014)			
Bank Deposits* Employment Growth		-0.011*		
		(0.007)		
Banking Competition*Employment Growth	1.961**	2.01***		
	(0.779)	(0.769)		
Titled Directors*Employment Growth			0.146	
			(0.135)	
Interlocking Directorships*Employment Growth				0.032
				(0.049)
R-Squared	0.33	0.33	0.28	0.28
Observations	251	245	273	273

Table 4.2 Employment Growth as Technology Score 1900-1904

The dependent variable is growth of the firm between 1900 and 1904 measured as variation in book value of the assets. Year of Registration represents the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence* . Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Banks deposits stands for total amount of deposits collected by the bank trading with the firm. The data on banks and branches were taken from *London Banks and Kindred Companies* . Titled directors is the number of directors with honorific titles in the administration board of the company. The titles of the directors are indicated both on the companies' annual reports and on the *Stock Exchange Official Intelligence* .
Interlocking directoriships is total number of directorates held by the member of the boards of a particular company. The data is obtained from the Directory of Directors. Employment growth in each industry is computed using figures from the 1881 and 1891 UK Census of Population. The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Bank Proximity		Titled Directors	Interlocking Directorships
	Control Number of Branches	Control Deposits	Basic Specification	Basic Specification
	1	**2**	**3**	**4**
Year of Registration	0.003***	0.003***	0.003***	0.003***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Bank Proximity	-1.649	-1.771		
	(1.256)	(1.211)		
Number of Branches	0.0005			
	(0.0006)			
Bank Deposits		0.002		
		(0.002)		
Titled Directors			-0.122*	
			(0.062)	
Interlocking Directorships				0.026
				(0.030)
Bank Proximity * Employment Growth	2.261*	2.223*		
	(1.354)	(1.348)		
Number of Branches* Employment Growth	-0.001			
	(0.001)			
Bank Deposits* Employment Growth				
Banking Competition*Employment Growth	0.107	-0.100		
	(0.181)	(0.193)		
Titled Directors*Employment Growth			0.135**	
			(0.067)	
Interlocking Directorships*Employment Growth				-0.021
				(0.030)
R-Squared	0.26	0.25	0.23	0.21
Observations	397	390	426	426

Table 4.3 **Capital Labor Ratio as Technology Score 1895-1900**

The Dependent variable is growth of the firm between 1895 and 1900 measured as variation in book value of the assets. Year of Registration represents the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence* . Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Banks deposits stands for total amount of deposits collected by the bank trading with the firm. The data on banks and branches were taken from *London Banks and Kindred Companies* . Titled directors are the numbers of directors with honorific titles in the administration board of the company. The titles of the directors are indicated both on the companies' annual reports and on the *Stock Exchange Official Intelligence* .
Interlocking directoriships are total number of directorates held by the member of the administration board of a particular company. The data is obtained from the Directory of Directors.Capital Labor ratio is computed using American figures for 1890 obtained from Cain and Patterson (1981). The regression also controls for industry and location fixed efffects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Distance from the Bank		Titled Directors	Interlocking Directorships
	Control Number of Branches	Control Deposits	Basic Specification	Basic Specification
	1	**2**	**3**	**4**
Year of Registration	-0.001	-0.001	-0.0007	-0.0006
	(0.002)	(0.002)	(0.002)	(0.002)
Bank Proximity	-0.158	0.397		
	(2.102)	(2.385)		
Number of Branches	0.0005			
	(0.001)			
Bank Deposits		0.005		
		(0.004)		
Titled Directors			0.051	
			(0.076)	
Interlocking Directorships				-0.066
				(0.041)
Bank Proximity * Capital Labor Ratio	-0.605	-0.801		
	(0.615)	(0.670)		
Number of Branches* Capital Labor Ratio	-0.0002			
	(0.0002)			
Bank Deposits* Capital Labor Ratio		-0.001		
		(0.0007)		
Banking Competition*Capital Labor Ratio	0.407*	0.431*		
	(0.219)	(0.227)		
Titled Directors*Capital Labor Ratio			-0.01	
			(0.014)	
Interlocking Directorships*Capital Labor Ratio				0.017*
				(0.009)
R-Squared	0.26	0.26	0.24	0.29
Observations	251	245	272	272

Table 4.4 **Capital Labor Ratio as Technology Score 1900-1904**

The Dependent variable is growth of the firm between 1900 and 1904 measured as variation in book value of the assets. Year of Registration represents the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence*. Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Banks deposits stands for total amount of deposits collected by the bank trading with the firm. The data on banks and branches were taken from *London Banks and Kindred Companies*. Titled directors are the numbers of directors with honorific titles in the administration board of the company. The titles of the directors are indicated both on the companies' annual reports and on the *Stock Exchange Official Intelligence*. Interlocking directoriships are total number of directorates held by the member of the boards of a particular company. The data is obtained from the *Directory of Directors*. Capital Labor ratio is computed using American figures for 1890 obtained from Cain and Patterson (1981).
The regression also controls for industry and location fixed efffects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Distance from the Bank		Titled Directors	Interlocking Directorships
	Control Number of Branches	Control Deposits	Basic Specification	Basic Specification
	1	**2**	**3**	**4**
Year of Registration	0.003***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
Bank Proximity	-1.523	-1.389		
	(1.695)	(1.498)		
Number of Branches	-0.0004			
	(0.0003)			
Bank Deposits		-0.002*		
		(0.001)		
Titled Directors			0.023	
			(0.035)	
Interlocking Directorships				0.016
				(0.016)
Bank Proximity * Capital Labor Ratio	0.698	0.703		
	(0.516)	(0.485)		
Number of Branches* Capital Labor Ratio	0.0001			
	(0.001)			
Bank Deposits* Capital Labor Ratio		0.0004		
		(0.0004)		
Banking Competition*Capital Labor Ratio	-0.090	-0.094		
	(0.077)	(0.067)		
Titled Directors*Capital Labor Ratio			0.0001	
			(0.01)	
Interlocking Directorships*Capital Labor Ratio				0.003
				(0.005)
R-Squared	0.25	0.25	0.2	0.2
Observations	401	394	430	419

Table 5.1 **Empirical Results without considering Electricity Supply**

The Dependent Variable is Growth of the firm between 1895 and 1900 (column 1) and between 1900 and 1904 (column 2) measured as variation in book value of the assets. Year of Registration is the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence*. Titled directors are the numbers of directors with honorific titles in the administration board of the company. The titles of the directors are indicated both on the companies' annual reports and on the *Stock Exchange Official Intelligence*. Second Industrial Revolution is a dummy variable that assigns one to companies in the electricity manufacturing, bicyles and motorcycles and chemicals sector and zero otherwise. Correction for selection obtained by running an Heckman two step method. The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1895. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	1895 Sample	1900 Sample
	1	**2**
Year of Registration	-0.0006 (0.002)	0.003 (0.001)
Titled Directors	-0.008 (0.029)	-0.007 (0.008)
Titled Directors*Second Industrial Revolution	0.090* (0.054)	0.048* (0.025)
R-Squared	0.125	0.06
Observations	184	411

Table 5.2 **Sample split on the median year of registration 1900-1904**

The Dependent Variable is Growth of the firm between 1900 and 1904 measured as variation in book value of the assets. Year of Registration represents the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence*. Titled directors are the numbers of directors with honorific titles in the administration board of the company. Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Banks deposits stands for total amount of deposits collected by the bank trading with the firm. The data on banks and branches were taken from *London Banks and Kindred Companies*. The titles of the directors are indicated both on the companies' annual reports and on the Stock Exchange Official Intelligence. Interlocking directoriships are total number of directorates held by the member of the boards of a particular company. The data is obtained from the Directory of Directors. Second industrial Revolution is a dummy variable that assigns value one to firms in the Electricity Supply, Electricity Manufacturing, Chemicals, Bicyles and Motorcycles sectors, and zero otherwise.
The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900. Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Registration before 1891:				**Registration after 1891:**			
	Distance from the Bank		Titled Directors	Interlocking Directorships	Distance from the Bank		Titled Directors	Interlocking Directorships
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Year of Registration	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.0006
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.008)	(0.008)
Bank Proximity	-0.014	-0.134			0.110	-0.107		
	(0.872)	(0.863)			(1.820)	(1.738)		
Number of Branches	-0.0008				-0.0001			
	(0.003)				(0.0005)			
Bank Deposits		-0.001				-0.002		
		(0.001)				(0.001)		
Titled Directors			-0.023				-0.005	
			(0.028)				(0.034)	
Interlocking Directorships				0.007				-0.021
				(0.02)				(0.022)
Bank Proximity * Second Revolution	6.409	6.290			0.819	0.692		
	(4.139)	(4.171)			(1.674)	(1.627)		
Number of Branches * Second Revolution	-0.001*				-0.0001			
	(0.0006)				(0.0005)			
Bank Depostis * Second Revolution		-0.002				0.001		
		(0.002)				(0.002)		
Banking Competition*Second Revolution	0.391	-0.020			0.595	0.448		
	(0.370)	(0.366)			(0.475)	(0.443)		
Titled Directors*Second Revolution			0.098				0.117*	
			(0.049)				(0.068)	
Interlocking Directorships* Second Revolution				0.005				0.057*
				(0.03)				(0.030)
R-Squared	0.21	0.20	0.15	0.14	0.36	0.36	0.30	0.29
Observations	202	195	218	211	199	199	212	208

Table 5.3 **Interaction on Electricity**

The Dependent variable is growth of the firm between 1900 and 1904 measured as variation in book value of the assets. Year of Registration is the year in which the company was registered as limited liability as indicated by the *Stock Exchange Official Intelligence*. Bank proximity is computed as number of branches of the bank trading with the firm divided by population of the county where the firm is located. Number of branches indicates the total number of branches of the banks trading with the firm. Banks deposits stands for total amount of deposits collected by the bank trading with the firm. Banking competition is an Herfindal index computed at county level using the share of branches that a bank has in respect to the total number of bank branches working in the county. The data on banks and branches was taken from *London Banks and Kindred Companies.* Electricity is a dummy variable that gives one for companies in the Electricity Supply and zero otherwise.
The regression also controls for industry and location fixed effects, and size of the firm measured by book value of the assets in 1900.
Robust standard errors are indicated in parenthesis. *** indicates 1% significant, ** 5% significant, *10% significant.

	Distance from the Bank	
	1	**2**
Year of Registration	0.003***	0.003***
	(0.0008)	(0.0009)
Bank Proximity	0.081	-0.15
	(0.811)	(0.804)
Number of Branches	-0.0004**	
	(0.0001)	
Bank Deposits		-0.001*
		(0.0007)
Bank Proximity * Electricity	11.504**	11.320**
	(5.274)	(5.440)
Number of Branches * Electricity	-0.0003	0.001
	(0.001)	(0.005)
Bank Depostis * Electricity		
Banking Competition * Electricity	-0.014	-0.24
	(0.735)	(0.726)
R-Squared	0.27	0.26
Observations	401	394