Banks as Catalysts for Industrialization

By

Marco Da Rin
and
Thomas Hellmann

DISCUSSION PAPER 343

February 2000

FINANCIAL MARKETS GROUP
AN ESRC RESEARCH CENTRE

LONDON SCHOOL OF ECONOMICS

ISSN 0956-8549-343

Banks as Catalysts for Industrialization

Marco Da Rin*
Università di Torino, IGIER and FMG/LSE
and
Thomas Hellmann
G.S.B. - Stanford University

September 1999
First Version August 1995

Abstract

We provide a theoretical framework to address the historical debate about the role of banks in industrialization. We introduce banks into a model of the big push to examine under what circumstances pro¯t-motivated banks would engage in coordination of investments. We show that banks may act as `catalysts' for industrialization provided that: *(i)* they are su±ciently large to mobilize a `critical mass' of ¯rms, and *(ii)* they possess su±cient market power to make pro¯ts from coordination. Our model also shows that universal banking helps reduce endogenously derived coordination costs. Our results delineate the strengths and limits of Gershenkron's(1962) view of banks in economic development, and help explain a diverse set of historical experiences. We examine both countries where banks were associated with industrialization, showing that our theoretical conditions holds, as well as countries where the failure to industrialize can be related | at least in part | to the absence of our necessary conditions.

JEL Classi¯cation numbers: G21, N2, O14, O16.

*We would like to thank two anonymous referees, Masahiko Aoki, Ashish Arora, Giuseppe Bertola, Marcello De Cecco, Klaus Desmet, Serdar Dinç, Marcel Fafchamps, Avner Greif, Dietmar Harhoff, Ross Levine, Manju Puri, Rafael Repullo, John Roberts, Andrés Rodríguez-Clare, and Javier Suarez for their comments, as well as seminar participants at Bologna, CEMFI (Madrid), the CEPR Alghero Conference on Financial Intermediation (September 1997), FMG/LSE, IGIER (Università Bocconi), NBER, Torino, and Stanford. We gratefully acknowledge financial support from the Financial Markets Group at LSE. All errors remain our own.

Keywords: Endogenous Growth, Coordination Failures, Choice of technology, Financial Institutions, Financial History.

What prevents some economies from industrializing and growing? The neoclassical growth model predicted that less developed countries would naturally catch up with more advanced economies. The failure of many

The analysis of Gerschenkron and its surrounding historical debate leaves many important questions unanswered. What does it mean for banks to promote industrialization? Are banks merely following demand, or are they contributing to the process themselves? Does industrial promotion mean the ¯nancing all of industrialization, or the ¯nancing of some key sectors? What are the limits of the Gerschenkronian view? Under what conditions can private banks play a role of industry promotion, and under what conditions is this not possible?

In answering these questions, the historical debate has received little assistance from economic theory. In this paper we construct a simple theory that allows us to evaluate both the merits of the Gerschenkronian argument and its limits. Our starting point is a big push model, along the lines of the seminal work of Murphy, Schleifer and Vishny (1989). Their model aims to capture the 'catch-up' problem, where a potential failure in the coordination of investments hampers industrialization. Individual ¯rms are not willing to invest unless other ¯rms also invest, and

ots s e whe to a o rdlice o

makes it easier to achieve industrialization. Universal banking makes it possible to have a more competitive financial system, since less market power is necessary to guarantee the lead bank's incentive in acting as a catalyst. Our theory thus shows that allowing universal banking does increase the efficiency with which banks can perform their function of catalyst.

Our model thus provides a conceptualization of the conditions under which banks can promote industrialization. This is a novel and valuable contribution to understand both the strength and the limitations of the Gerschenkronian view of banks. Not only does our theory explain the underlying economic rationale behind the view of banks as catalysts for industrialization, it also provides the boundary conditions for the validity of that argument. Indeed, our theory explains under which circumstances we would expect banks not to play a role as catalysts. We discuss historic evidence not addressed by Gerschenkron, namely the cases of Spain, Russia and Italy before 1890 as examples of countries that failed to industrialize. Interestingly, we find that in these cases the conditions provided by our model are not satisfied and that banks did not engage in industrial promotion.

Finally, our results suggests that there are some major drawbacks to having private banks acting as catalysts and promoting industrialization. In particular, the very need for market power for banks brings with it all the inefficiencies of oligopoly. This insight is fundamental in reconciling Gerschenkron's view of banks with the more recent evidence that questions both the effectiveness and the desirability of large, powerful universal banks as catalysts. If banks invest in industrialization with the expectations of reaping oligopolistic rents, we should not be surprised to find the ills of oligopoly at later stages of industrialization. These have been the focus of the recent historical criticism of the Gerschenkronian view.

Our results contribute to the growth literature based on multiple equilibria. Murphy, Shleifer and Vishny (1989) formalize the idea that investment in industrial production is profitable only when it is simultaneously undertaken by several firms. This is due to the existence of aggregate demand spillovers, a type of pecuniary externality. Multiple equilibria can also arise due to a second type of pecuniary externality, namely backward and forward linkages in the production of intermediate goods, as shown by Ciccone and Matsuyama (1996), Okuno-Fujiwara (1980), and Rodríguez-Clare (1996a). A third possible source of multiple equilibria for an industrializing economy is Marshallian externalities. Helpman and Krugman (1985) formalize this notion in terms of technological externalities. In this case the simultaneous growth of technologically related sectors increases economic growth. An economy where the right mix of sectors takes off will develop smoothly, whereas an uncoordinated start may throw it into a vicious circle of poverty. Matsuyama (1995a)

and Rodríguez-Clare (1996b) give excellent and comprehensive surveys of this literature. Milgrom and Roberts (1994a,b) show that all these models are based on the existence of complementarities. A growing empirical literature, started by King and Levine (1993), suggests that financial variables are not only highly correlated with growth, but that there may well be a causal relationship from financial development to economic growth. See Rajan and Zingales (1998) for a recent methodological appraisal of its results, and Arestis and Demetriades (1997) and Levine (1997) for comprehensive surveys.

The remainder of the paper is organized as follows. Section 1 provides historical evidence from three continental European countries | Belgium, Germany, and Italy | describing the role of banks in industrialization and linking it to the structure of the financial system. Section 2 develops the theoretical model, examining the conditions under which banks can act as a catalyst for industrialization. Section 3 revisits the historical debate in the light of our theoretical insights, examining additional historical evidence from other European countries. It is followed by a brief conclusion in Section 4.

1 Banks and the industrialization of Belgium, Germany and Italy

In his seminal work on economic development, Gerschenkron (1962, p.45) wrote that "[t]he focal role in capital provision in a country like Germany must be assigned not to any original capital accumulation but to the role of credit-creation policies on part of the banking system." Rondo Cameron (1967, p.129) wrote about Belgium: "[S]ubsequently [to 1830] the economy entered a period of explosive growth accompanied by the development of a unique set of banking institutions." Schumpeter (1939, chapter 7) gave German *Kreditbanken* large credit for taking an entrepreneurial attitude and fostering the rise of large industries. These economic historians clearly saw a link between fast industrialization and the financing of industry by private banks.

In this section we examine historical evidence from the three continental European countries that experienced fast industrialization in the nineteenth century, focusing on the initial stage of their industrialization: Belgium (from 1830 to 1850), Germany (from 1850 to 1870), and Italy (from 1894 to 1914). We devote particular attention to the financial market structure, an aspect often alluded to in the debate among historians but rarely linked explicitly to the role of banks as industrial promoters. We thus provide a novel perspective from which to look at well known facts. For each country we show that a few

large private banks ¯nanced the majority of new industrial ¯rms. These banks did not develop as a consequence of industrialization, but pre-existed it. They enjoyed considerable market power in an oligopolistic market that was protected by regulatory barriers to entry. They actively promoted investment in industrial technology, and engaged in coordination of industrial investments. These banks also acted not only as lenders but also as shareholders, thus pioneering universal banking.

Belgium, the ¯rst country to follow Britain in the Industrial Revolution, achieved its industrialization roughly between 1830 and 1850. Over this period, its GNP grew at an yearly 2.5%, well above the 1.4% European average.[1] Industrialization transformed the structure of the economy, which until then was based on small ¯rms engaged in traditional production. Between 1830 and 1860 its industrial capacity grew at an yearly average of 4.4%, more than twice as in the previous thirty years (Bairoch (1982), p.292). Modernization was most intense in the heavy industries. Between 1830 and 1850 coal mining grew at a yearly 5.3%, zinc mining at 20.0%, and steam engines at 7.9%.[2]

Critical to this success was the action of two banks. The Soci¶t¶ G¶n¶rale pour favoriser l'industrie nationale was the world's ¯rst joint-stock investment bank. It had been created in 1822, well before industrialization took o®, and became active in industrial ¯nance from the early 1830s. The Banque de Belgique was founded in 1835 to compete with it, and engaged in industrial ¯nance from the outset.[3] These two banks accounted for about two thirds of the capitalization of all industrial credit banks (Durviaux (1947), p.56),[4] and their assets grew by an average 3.8% between 1834 and 1850 (Chlepner (1926), p.76-8). These two banks ¯nanced themselves mainly with own capital; until 1850 deposits never accounted for more than 25% of the liabilities (Durviaux (1947), p.37). Other industrial banks existed, but were smaller and mostly local.[5] Entry of joint stock-banks into the ¯nancial sector was restricted, since the government had discretionary power in granting banking charters, according to article 7 of the *Code du Commerce* (Neuville [1974], p.109-

[1] Bairoch (1976a), p.281-6. In per capita terms these two figures are 1.6% and 0.8%, respectively.

[2] Cameron (1967), p.148. Railways played a lesser role at thip me

11). Indeed, the Soci¶t¶ G¶n¶rale and the Banque de Belgique faced no competition from incorporated banks.

These two banks assisted and actively encouraged ¯rms in fast growing industries to adopt the corporate form in order to raise large amounts of external ¯nance.[6] Between 1835 and 1838 alone, the Soci¶t¶ G¶n¶rale organized 31 industrial joint-stock companies (*sociétés anonymes*), and the Banque du Belgique 24. They also helped these new ¯rms raise a combined capital of 154 million Francs. (Cameron (1967), p.145). The two banks invested a large share of their capital in industrial equity: 31% for the Soci¶t¶ G¶n¶rale and 26% for the Banque du Belgique in 1847 (Chlepner (1930), p.26). In 1860, the Soci¶t¶ G¶n¶rale controlled about a ¯fth of the country's industrial joint-stock capital, which amounted to 1 billion Francs.[7] As Cameron (1967, p.145) put it, \banks did not respond passively to demand for credit, but actively sought new ¯rms, underwrote their stock issues, ¯nanced potential stockholders, held stock in their own names, placed their o±cers on the board of directors of the companies they promoted, and ministered to the companies' needs for both working capital and new capital for expansion." These investments turned out to be pro¯table. The net income of the Soci¶t¶ G¶n¶rale, for instance, which started at a level around 4% of assets in 1830, increased constantly from 1830 to 1860 (Soci¶t¶ G¶n¶rale (1922), Annexes).

The Soci¶t¶ G¶n¶rale and the Banque du Belgique were the ¯rst examples of universal banks. They identi¯ed industries with high potential for growth, to which they extended credit and in which they bought equity participations.[8] For this purpose they came up with an important innovation: ¯nancial trusts.[9] Financial trusts managed most of the banks' industrial portfolios.[10] This way they also enhanced information circulation, and thus the coordination of investment decisions by otherwise scattered entrepreneurs (Wee (1981), p.6). Bank managers consulted their clients on business strategies, and even acted as their

[6]Six industrial *sociétés anonymes* (joint-stock companies) existed in 1830, which became 150 in 1839, and 200 in 1857, Cameron (1967), p.130. Durviaux (1947), p.53, gives a detailed sectoral breakdown, and Neuville [1974], p.113-5, yearly data. See also Morrison (1967), p.64, and Chlepner (1943), p.8-9.

[7]In the 1840s it controlled mining companies responsible for more than a quarter of the whole coal extraction, Neuville [1974], p.123.

[8]Cfr. Société Générale (1922) for a detailed description of the bank's policy of sectoral investment.

[9]The Société Générale created one subsidiary and three investment trusts. The Banque du Belgique created two subsidiaries and two investment trusts, Morrison (1967), p.64-5. Chlepner (1930), p.10-2 and p.36-7, describes their role.

[10]The banks themselves did retain shareholdings of some corporations, see Lévy-Leboyer (1964), p.641 for the Banque du Belgique, and Société Générale (1922), annex 6, for the Société Générale.

¯nancial managers.[11] Cameron (1961, p.90-1) describes how the Soci§t§ G§n§rale actively encouraged mining companies and foundries to incorporate, obtained Royal charters for them, and provided the necessary ¯nance. Banks thus carried out an intense coordination of industrial activities.

Germany is often cited as the quintessential case of bank-driven development. Between 1850 and 1870 the German economy experienced a quick industrialization which allowed it to become the ¯rst economic power on the continent. In this period its GNP grew at a yearly 2.4%, well above the 1.9% European average and its own 1.6% growth rate of the previous two decades.[12] Between 1860 and 1880 its industrial capacity grew at an yearly 4.6%, up from 1.7% in the previous thirty years, and was concentrated in textiles and heavy industries (Bairoch (1982), p.292). Production of coal increased ¯vefold, and that of pig iron sixfold, also spurred by a threefold expansion of railways (Mitchell (1980), tables E2,E8,G1). The German industrial credit banks, *Kreditbanken*, played an active role in industrial development combining commercial and investment banking activities and nurturing close relations with industry (Da Rin (1996)). Of the 40 *Kreditbanken* founded between 1848 and 1870, four accounted for most of the industrial credit activities: the Schaa®hausen Bankverein, the Disconto Gesellschaft, the Bank für Handel und Industrie and the Berliner Handelsgesellschaft. Their capitalization accounted for nearly half of that of all industrial credit banks, and they were also much larger than the unincorporated industrial credit banks (*Privatbanken*), which operated locally. The average founding capital of these four *Kreditbanken* was 33 million Marks (Riesser (1911), Appendix 3), versus only 1 million for the average Rhenish *Privatbankier*.[13] Own capital was the main source of ¯nance; for these four banks it remained well above 40% until 1870 (Tilly (1966), ch.5 and 8). In Prussia, by far the largest German state, incorporations were granted discretionally by the government, and entry as a *Kreditbank* was restricted. Indeed the government granted a joint-stock charter only to the Schaa®hausen Bankverein (Tilly (1966), p.111). The other three *Kreditbanken* were organized as unincorporated limited liability companies. This constraint seems to have been binding, for when incorporation was liberalized in 1871, there was a °ood of new joint-stock banks.

The credit channeled by *Kreditbanken* increased at an average yearly rate of 19.4%

[11] Cfr Chlepner (1926), p.86-7, and Wee (1981), p.5-6.

[12] Bairoch (1976a), p.281. In per capita terms the growth of GNP was 1.6% in Germany and 0.9% in Europe, p.286.

[13] Tilly (1966), p.66. Rhenish *Privatbankiers* were the earliest and largest to engage in industrial finance in Germany.

between 1852 and 1870, from 20 to 492 million Marks (Ho®man (1965), p.743). Between 1851 and 1870, 259 ¯rms incorporated, up from 102 in the previous 24 years, typically with the help of an industrial credit bank.[14] *Kreditbanken* acted as universal banks, not only providing loans and issuance of securities for their clients, but also retaining equity positions in these ¯rms (Riesser (1911), p.62-6). Their activity concentrated in high growth regions and industries: mining, machinery, textiles, construction, and railways. These industries were concentrated in the Rhineland, Ruhr, Silesia and Saxony.

The emphasis which German banks placed on equity participations and capital market operations was even more pronounced than that of Belgian banks. Riesser (1911, p.339-40) describes in detail the participations taken by *Kreditbanken* in railways and heavy industries in the 1850s. These equity holdings absorbed much of the banks' capital: 13% for the Schaa®hausen Bankverein (p.72) up to 50% for the Bank für Handel und Industrie (p.81). Many equity holdings resulted from illiquid loans during the 1857 economic slump, but with time several of them became pro¯table.

Universal banking was overall pro¯table, though losses were experienced in the early years (Tilly (1966), ch.8). The average dividend in the 1850s and 1860s was 6.7% for the Bank für Handel und Industrie, 7.0% for the Disconto Gesellschaft, 7.2% for the Schaa®hausen Bankverein, and 7.3% For the Berliner Handelsgesellschaft (Riesser (1991), p.68). Moreover each bank accumulated several million marks of surplus reserves.

The personal nature of their business relationships allowed them to elicit and circulate information e®ectively, and to have strong in°uence on investment decisions.[15] As Richard Tilly (1966, p.181) argued: \the contribution of German bankers to the mobilization of capital operated not only on the supply side but on the demand side as well; by organizing and allying themselves so closely with industrial enterprises, bankers strengthened and in part represented the demand for investment funds."

The last case we consider is Italy, which industrialized rapidly between the early 1890s and World War I. Between 1893 and 1913 its industrial output grew at a yearly 4.8%, up from 0.5% in the previous two decades, and GDP grew at 2.5%, up from 0.6%.[16] The yearly

[14] Riesser (1911), p.38. *Kreditbanken* also supported firms that assumed unincorporated limited liability form (*Kommanditgesellschaft auf Aktien*).

[15] Da Rin (1996), p.29-30, provides evidence of such close links and their effect on investing decisions. As the first report of the Bank für Handel und Industrie said: "[the bank] is fitted to assist to the fullest extent of its powers in directing capital and the spirit of enterprise into the channels corresponding to the requirements of the moment," Riesser (1911), p.49.

[16] Fuà (1965), tab.1 and 3. Similar data are in Gerschenkron (1962), p.75. The yearly per capita growth of GNP between 1890 and 1913 was 1.5%, slightly higher than the European average of 1.4%, Bairoch (1976a),

growth rate of manufacturing production (1896-1913) ranged from 4.0 to 6.2% according to di®erent estimates.[17] Between 1894 and 1913 the yearly growth rates were 15% in electricity, 12.9% in chemicals, 10.7% in iron and steel, 7.5% in engineering, and higher than in other European countries (Cohen (1967), p. [illegible]

a major role in planning and ¯nancing these operations. Between 1894 and 1906 the Banca Commerciale took part in 145 capital market operations, and the Credito Italiano in 84.[21] Confalonieri (1976, vol.3) describes in detail the involvement of the Banca Commerciale in the steel, electric and mechanical sectors, and of the Credito Italiano in sugar re¯ning, iron, and chemicals (1976, vol.2). He concludes that investment banking activities favored their role as promoters of industrial undertakings.

Investments in industrial securities (equity and bonds) by the Banca Commerciale and the Credito Italiano ranged from 5% to 10% of their assets between 1895 and 1906, and contributed a corresponding share of the net income of the two banks.[22] Large loans to large industrial ¯rms accounted for another 20-30% of assets and income (Confalonieri (1976), vol.3, p.486). The net income of Banca Commerciale Italiana rose from 1.3 million lira in 1895 to 12.7 millions in 1913, and that of Credito Italiano from 0.9 to 5.4, respectively (Confalonieri (1976 and 1982), statistical annexes). In both cases income growth was steady and accelerating.

Like the Belgian banks with investment trusts, the Italian banks managed their industrial participations through subsidiaries. But unlike their Belgian colleagues, they did so by acquiring control in some industrial companies, which they used as holding companies. This was often the case with fast growing industries: electricity, chemth

circumstances can private banks take such a role, and under which conditions would they actually choose to take it? What are the costs and bene¯ts of such actions? Also, is the historical similarity in ¯nancial market structures across countries a mere coincidence, or is there a de¯nite relationship between bank size, bank market power and bank activity in industrial promotion? Finally, what is the signi¯cance of universal banking for the promotion of industrialization?

To answer these important questions and to make sense of these episodes in economic history, we seek guidance from theory. Theories of the big push have so far focussed on identifying the reasons for the multiplicity of equilibria and for the existence of coordination failures, but little attention has been given to addressing possible remedies. In particular, the role of ¯nancial intermediaries has not been addressed in this literature. This is our starting point for developing a model to examine under what circumstances private pro¯t-motivated banks would act as catalysts for industrialization.

2 A model of bank coordination

2.1 The basic model

Our economy lasts two periods, and there are two technologies available to ¯rms, one `traditional' and one `industrial.' The adoption of the industrial technology requires the investment of a sum F in the ¯rst period, and allows a ¯rm to produce in the second period. There is no uncertainty in the model about the future outcome of the investment, nor asymmetric information between agents. Each ¯rm is endowed with $F_o < F$ of own funds, and thus needs to borrow $F_b = F - F_o$. We denote the lending rate by i, so that a ¯rm which borrows has to repay $(1 + i)F_b$ in the second period.

There are Q identical ¯rms indexed by $q = 1...Q$. Let $I_q = 1$ if ¯rm q decides to invest, and $I_q = 0$ otherwise. Denote the set of all investment decisions by $K = \{I_q\}_{q \in Q}$, which forms a sub-lattice, and by $\|K\|$ the corresponding number of investing ¯rms.[24] When the investment pattern is K, the (gross) return to investment is given by $f(K)$. We assume that $f(K) = 0$ if $I_q = 0$, and $f(K) \geq 0$ if $I_q = 1$. In other words, ¯rms which do not invest make no pro¯ts, and when a ¯rm invests, its return depends not only on its own investment, but also on the investments of all other ¯rms. The fundamental assumption we make is that

[24] For a definition and discussion of sub-lattices see Milgrom and Shannon (1994). Notice that our model could be extended to the more general case where firms also choose the level of investment, so that I_q is distributed over an interval. We only require that the set of firms' investment decisions still forms a sub-lattice.

there are positive externalities between ¯rms' investments. Formally, we assume that $f(K)$ is supermodular in K.[25] Given symmetric ¯rms, this means that $f(K)$ is an increasing function of $\|K\|$. In the appendix we consider the case of heterogeneous ¯rms and use a more general class of complementarities, showing that our results continue to hold. In the main text we adopt a simple symmetric version to convey the main intuitions in the simplest possible fashion.

We also use a simple model of banking, where we start by assuming that only standard debt contracts are feasible. (We will relax this assumption later.) Our assumption can be justi¯ed on several grounds. First, there may be regulatory and legal constraints. Second, there may be problems of veri¯ability or enforceability that make standard debt contracts the only feasible or economical ¯nancial instruments.[26] We also use a simple of model for the liability side of banks, where banks face a constant cost of capital.[27] Let r denote the riskless rate of return, and thus the cost of funds in the economy, and let $\beta = \frac{1}{1+r}$ be the discount rate. The net present value of the pro¯ts of ¯rm q is given by:

$$\pi(K, i) = \beta[f(K) - (1+i)F_b]$$

where $\|K\|$ is the number of ¯rms expected to invest (including q). In order to focus on the possibility of multiple equilibria, we assume that $\beta f(K) < F$ if $\|K\| = 1$, and that $\beta f(K) > F$ if $\|K\| = Q$.

It is clear that the investment decision depends on the interest rate o®ered which, in turn, is determined by the structure of the ¯nancial market. We use a simple price-leadership model that allows for a one-dimensional parameterization of the intensity of competition in the ¯nancial market. In particular, we assume that there exist a competitive fringe of z `small' banks which can ¯nance exactly one ¯rm each. A `lead bank' can then ¯nance up to $(Q - z)$ ¯rms. The ¯nancial market is competitive when $z = Q$, so that the lead bank disappears and the lending rate i equals the deposit rate r. If the fringe is smaller ($0 < z < Q$), the lead bank has some market power. If the fringe disappears ($z = 0$), the lead bank becomes a monopolist.

[25] For a definition and discussion of supermodularity, see Milgrom and Roberts (1990, 1994a) and Milgrom and Shannon (1994).

[26] To keep the model simple we do not model these problems explicitly. See Gale and Hellwig (1985) and Hart and Moore (1995). The problems of weak verifiability and enforcement are likely to be particularly pressing in a state of economic under-development.

[27] We do not derive the existence of banks as financial intermediaries between depositors and borrowers endogenously, since this would considerably complicate the model without adding to our insights. Diamond and Rajan (1999) provide a model where banks as intermediaries are endogenously derived.

The sequence of actions in the ensuing game is as follows. The lead bank moves ¯rst and makes loan o®ers to ¯rms. The fringe banks observe the lead bank's o®ers, and then make their loan o®ers to ¯rms. Finally ¯rms simultaneously decide whether to invest and which o®ers to accept. Notice that unlike much of the recent banking literature, this model does not rely on any asymmetries of information. Instead, it focuses on the coordination problem, which in our reading of history, is more central to an understanding of the role of banks in industrialization.

2.2 Multiple competitive equilibria and the need for coordination

In this section we examine the rational expectations equilibria when ¯nancial markets are competitive. In this case $z = Q$, and there is no lead bank but only a competitive fringe. We say that a set of investing ¯rms K is a competitive equilibrium if $\pi(K, r) \geq F_o$ for all $q \in K$ and $\pi(K, r) < F_o$ for all $q \in Q \backslash K$. It follows that:

Proposition 1 *With a competitive financial market, $i = r$, and there exist two Pareto-rankable competitive equilibria, one where all firms invest, and one where no firms invest.*

Proposition 1 follows immediately from $i = r$ and the assumption that $\beta f(K) < F$ if $\|K\| = 1$ and $\beta f(K) > F$ if $\|K\| = Q$. The intuition is that whenever there is a `large' number of ¯rms investing (here $Q$), then complementarities make it worthwhile to invest for all ¯rms. Likewise, when only `few' ¯rms (here none) invest, it is not pro¯table for others to invest, due to the lack of a su±ciently strong complementarities e®ect. We name the equilibrium with no ¯rms investing the BE (`Backward Equilibrium') and the equilibrium with all ¯rms investing the $IE$ (`Industrialization Equilibrium').

In the appendix we show that with ¯rm heterogeneity and general complementarities there may be more than two equilibria, but there always exist a `maximal' and a `minimal' equilibrium. Moreover, in the `maximal' equilibrium, where the largest number of ¯rms invest, there are (weakly) fewer ¯rms investing than it is socially desirable.

The existence of multiple equilibria is a coordination failure. In the BE the belief that no ¯rm is industrializing is self-ful¯lling, i.e. it implies that no ¯rm does actually undertake the costly investment to industrialize. Likewise, in the IE the belief that many ¯rms are investing does justify investment by many ¯rms. Such multiplicity of equilibria is determined by beliefs, not by exogenous parameters or past values of the variables.[28]

[28] See Krugman (1991) on the role of history and beliefs in models with multiple equilibria.

Previous work, which we surveyed in the introduction, has shown the possible existence of a coordination failure and characterized the conditions under which either equilibrium may attain. The focus of our paper is on how to eliminate the BE. To break the beliefs that sustain the BE requires that agents know that the BE cannot be an equilibrium any longer. We therefore argue that coordination has been achieved *if and only if the BE is no longer an equilibrium*. In explaining industrialization we thus do not rely on a spontaneous coordination of beliefs, which would assume rather than explain industrialization.[29]

The question we ask is what economic institutions may be able to perform coordination. This is in general a costly activity, which implies that an agent must possess not only the ability but also the appropriate incentives to engage in it. We submit that banks are a natural candidate as a `coordination mechanism' for at least three reasons.[30] First, the availability and terms of bank ¯nancing directly in°uence ¯rms' decisions to invest. Second, banks provide funds, which are a necessary input for a large number of ¯rms. A bank potentially interacts with many ¯rms and thus has a unique opportunity to induce coordination. Third, banks may have a self-interest in industrialization if their pro¯ts increase as a result of industrialization.[31]

2.3 Coordination with a lead bank

We now examine how a lead bank can induce coordination. A lead bank can induce ¯rms to invest through the terms of the ¯nancing it provides. Firms need not communicate with each other, but instead the lead bank interacts with each of them individually. Once the lead bank convinces a su±ciently large number of ¯rms to invest, this constitutes a `critical mass': Other ¯rms recognize that their investments are now pro¯table. They are willing to invest, and they are able to convince any bank that their investment is worth ¯nancing. In this sense the lead bank acts as a `catalyst' for industrialization, eliminating the BE as an equilibrium. We will say that the lead bank achieves coordination whenever there is only

[29] Publicly observable signals, even if without content—like a 'sunspot'—have similar problems than spontaneous coordination. They *could* indeed induce coordination, but there is no particular reason to believe they *would*. As long as the BE remains a possible equilibrium, there is reason to believe that it may also be the chosen equilibrium, especially if we think of beliefs as being inherently sluggish. Our requirement eliminates this possibility, since the BE is no longer an equilibrium.

[30] Notice that the possibility for firms to obtain direct finance from savers is not an option, since Proposition 1 proves that if financiers are small a coordination failure exists.

[31] While we emphasize the role of banks, we do not claim that they are the *only* possible coordination mechanism. Indeed in Sectio 3 we discuss alternative institutions that may also induce coordination.

one equilibrium of the game, the IE.[32] But in the process of convincing ¯rms in the critical mass to invest, we show that the lead bank necessarily takes losses on all their loans. This means that two conditions need to be satis¯ed for the lead bank to engage in coordination. First, it has to be large enough to ¯nance all the ¯rms in the `critical mass.' Second, in order to recoup the cost of coordination, it needs enough market power to make pro¯ts on the ¯rms it ¯nances outside of the critical mass. These two conditions are directly related to the structure of the ¯nancial markets.

In order to achieve coordination it is necessary for all ¯rms to believe that a critical mass of ¯rms will invest. The critical mass M is de¯ned as the smallest number of ¯rms which make investing the only equilibrium strategy for all other ¯rms. Formally, $1<M<Q$ is the critical mass if $\pi(M,r)<F_o$ and $\pi(M+1,r)\geq F_o$. In other words, M is the smallest number of ¯rms which, if they all invest, makes it worth for other ¯rms to invest as well.

It is useful to break down the pro¯ts of the lead bank into two parts: Those pro¯ts which result from mobilizing the critical mass, and those made on all other ¯rms. Let lead bank's pro¯ts be $\rho = \nu + \chi$, where χ are the pro¯ts made on (M) ¯rms within the critical mass, and ν those on ¯rms outside it (i.e. ($Q-M$) ¯rms, some of which are ¯nanced by the fringe banks). We can now state our main result:

Proposition 2 *(i) Coordination by a lead bank is feasible but costly: $\chi<0$;*
(ii) There exists a critical value $\hat{z}$ such that the lead bank induces coordination if and only if the competitive fringe has size $z<\hat{z}$;
(iii) The average cost of capital to firms is higher than the riskless interest rate r.

Proof. (i) Since all ¯rms are identical, consider any arbitrary index of them: $q = 1, ...Q$, and notice that debt contracts can di®er only for the interest rate, as each ¯rm needs to borrow the same amount of capital. Suppose the lead bank o®ers a set of standard debt contracts $\{i_q\}$ to ¯rms $q = 1, ...M$, that satis¯es $\pi(q, i_q) = F_o$. The interest rate on each contract i_q is chosen so that if all ¯rms with a lower q invest, then ¯rm q also ¯nds it worthwhile to invest. Thus each ¯rm in the critical mass is o®ered a di®erent contract. Then ¯rm $q = 1$ always invests, irrespective of other ¯rms' decisions. Firm $q = 2$ knows this and invests irrespective of what ¯rms $q = 3, ...Q$ do, and so on. From this inductive chain we can conclude that all ¯rms $q = 1, ..., M$ invest.[33] But once M ¯rms invest, all other ¯rms - by de¯nition - ¯nd it worthwhile to invest as well. Therefore the *only* equilibrium left is the IE, where all ¯rms,

[32] In the appendix we show that in the general case the equilibrium induced by the lead bank needs not coincide with the competitive equilibrium.

[33] Note, however, that this is a *simultaneous* move game. We do not rely on sequential moves.

$q = 1, ...Q$ do invest. Lead bank coordination has induced industrialization. We now show that it is however costly to do so. Consider now any other set of contracts that has exactly one interest rate higher than in the set $\{i_q\}$. Denote the di®erent contract i'_q, for it is o®ered to ¯rm q'. We know that $\{i'_q\}$ is such that all ¯rms with $q < q'$ always invest. Now ¯rm q' will invest only if at least some other ¯rms with $q > q'$ do | as the interest rate i'_q is too high to make investment attractive otherwise. This implies multiple equilibria. If all ¯rms with $q > q'$ expect ¯rm q' not to invest, they will not invest either. This creates a negative self-ful¯lling belief, which makes it optimal for q' not to invest itself. Thus industrialization does not occur, and the economy remains stuck at the BE. On the contrary, if all ¯rms with $q > q'$ expect ¯rm q' to invest, they will form a positive self-ful¯lling belief, which makes it optimal for q' to invest. In this case industrialization occurs. Therefore, if the lead bank raises the interest rates it charges on even only one contract, not investing remains a possibility, and bank coordination cannot be achieved. This shows that $\{i_q\}$ is the most pro¯table set of contracts the lead bank is able to o®er in order to induce coordination. But since $\pi(M, r) < F_o$, $i_q \leq r$ for all $q = 1, ..., M$, the inequality must be strict for at least one q. Therefore, the lead bank does not earn a pro¯t on any of these loans, and takes a loss on at least one of them. Formally:

$$\chi \equiv \sum_{q=1}^{M} (i_q - r) F_b = \sum_{q=1}^{M} f(q) - (1+r)F < 0$$

(ii) In order for the lead bank to o®er the contract $\{i_q\}$, it must be overall pro¯table to do so: $\rho = \nu + \chi \geq 0$. The value of ν is determined by market clearing. The interest rate charged to ¯rms outside the critical mass, say i_z, is determined by the condition $\pi(Q, i_z) = F_o$, and it is the same whether the lender is the lead bank or one of the banks in the competitive fringe. In this simple model with homogeneous ¯rms banks extract all rents from ¯rms, as long as $z < Q - M$. Since $\pi(Q, r) > F_o$ by assumption, it follows that $i_z > r$, and $\nu = (i_z - r)(Q - M - z)F_b = (Q - M - z)[f(Q) - (1+r)F]$. It follows that there exists a critical level $\hat{z}$, with $\hat{z} < Q - M$, such that the lead bank o®ers $\{i_q\}$ if and only if $z < \hat{z}$.

(iii) Firms in the critical mass all pay a cost of capital lower than the market rate $I_q < r$, but outside the critical mass ¯rms face a cost of capital higher than the market rate $i_z > r$. Since the lead bank makes non-negative pro¯ts ρ by lending F_b to $(Q - z)$ ¯rms, the ¯rms it ¯nances face an average cost of capital equal to $r + \rho/(Q - z)F_b \geq r$. Moreover, the ¯rms ¯nanced by banks in the competitive fringe pay a cost of capital equal to $i_z > r$. Therefore the average cost of capital to ¯rms is strictly higher than r. □

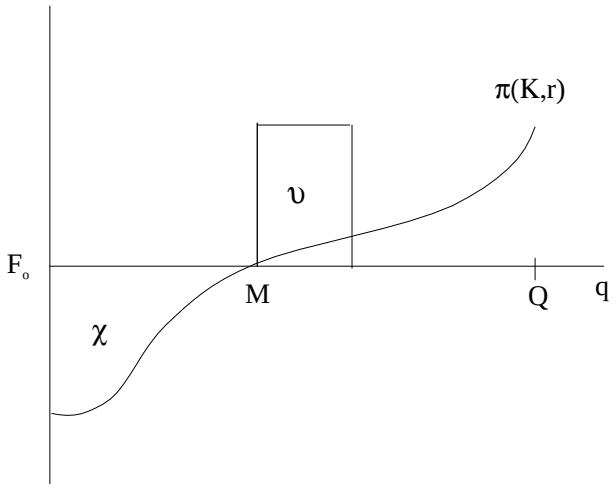

Figure 1:

We illustrate the intuition behind Proposition 2 with the help of Figure 1, where we draw $\pi(K, r)$ as a continuous function only for sake of simplicity. The lead bank needs to convince the ¯rms in M to invest despite their pessimistic beliefs. It can do so by o®ering them loans whose interest rate is low enough to make them willing to invest. Notice that the lead bank cannot raise the interest rate on these loans, otherwise ¯rms in the critical mass M would not invest. The lead bank takes a loss on on these loans since $f(1) < (1+r)F$. Area χ in Figure 1 indicates the lead bank's losses. Once the ¯rms in the critical mass have been o®ered the subsidized loan, and have decided to invest, all other ¯rms become also willing to invest. Thus the lead bank sets the interest rate for other ¯rms at the level i_z, so as to maximize its pro¯ts ρ. The larger the competitive fringe the fewer ¯rms the lead bank is left with to ¯nance.

How general is our result? In the more general model we develop in the appendix we show that with heterogeneous ¯rms and general complementarities the same logic continues to apply. However, in this more general case banks cannot extract all rents from ¯rms, and the interest rate i_z for ¯rms outside the critical mass becomes a decreasing function of z. Moreover, in the general model the above conditions are necessary, but not always su±cient to achieve the `highest' possible equilibrium (i.e. that with most ¯rms). This is

because with more than two equilibria banks may sometimes choose a `higher,' but not the `highest,' equilibrium. We show that in this case lead bank coordination increases social welfare with respect to the competitive equilibrium, but this does not constitute a Pareto improvement because we show that some ¯rms face higher interest rates in a lead bank induced equilibrium.

2.4 Relaxing the contracting constraints

So far we restricted banks to providing ¯nance with standard debt contracts. In this section we show that the cost of coordination can be reduced, and possibly eliminated, if the lead bank is allowed to o®er more sophisticated ¯nancial contracts. The simplest case is to allow the lead bank to hold equity in the ¯rms it ¯nances, which has some interesting implications:

Proposition 3 *If banks can offer firms equity finance, by holding an equity stake α, then:*
(i) χ is a decreasing function of α;
(ii) $\hat{z}$ is a decreasing function of α;
(iii) if there is no limit to the extent of equity that banks can hold, then there exists $\hat{F}_o$ such that $\chi \geq 0$ if and only if $F_o < \hat{F}_o$.

Proof. $(i) - (ii)$ If the bank ¯nances a ¯rm q by holding a share α of its equity in addition to a loan, then the ¯rm's return | when K ¯rms invest | is given by:

$$\pi(K, i, \alpha) = \beta(1-\alpha)[(f(K)-(1+i)F_b]$$

and the bank's (gross) return by:

$$\beta\alpha[(f(K)-(1+i)F_b] + (1+i)F_b$$

As in the case with pure debt contracts, in order to achieve coordination, the bank needs to o®er a set of contracts $\{i_q, \alpha\}$ that will induce all ¯rms in the critical mass to invest, i.e. $\pi(q, i_q, \alpha) = F_o$ for all $q = 1, ..., M$. The proof that bank coordination is feasible is as in the case with pure debt contracts. Notice that $\beta(1-\alpha)(1+i_q)F_b = \beta(1-\alpha)f(q) - F_o$, so that we can write the lead bank's (gross) return as $\beta\alpha f(Q) + \beta(1-\alpha)f(q) - F_o$, which corresponds to a net return of $\beta[f(q)-F] + \alpha\beta[f(Q)-f(q)]$. The ¯rst term (negative) represents the loss the bank su®ers from ¯nancing ¯rms in the critical mass. The second term (positive) represents the pro¯t it makes by holding equity and sharing in the appreciation of ¯rms' value as coordination shifts beliefs from pessimistic ($K = q$) to optimistic ($K = Q$). It is immediately clear that the larger α the larger is this second term, and so the lower is the

cost of coordination, χ. In turn, the lower the coordination cost χ, the lower $\hat{z}$ | the largest size of the competitive fringe which allows lead bank coordination to be feasible.

(iii) If there is no limit to the extent of equity that banks can hold, then from (i) the lead bank will ¯nance ¯rms only with equity. In this case, the amount of equity a bank holds in each ¯rm in the critical mass is given by $\beta(1-\alpha)f(q) = F_o$, that is $\alpha = 1-\frac{F_o}{\beta f(q)}$. The bank's net return is given by $\beta f(Q) - F - F_o\frac{f(Q)-f(q)}{f(q)}$, which is larger the smaller is F_o. Thus there exists a critical level $\hat{F}_o = \frac{M(\beta f(Q)-F)}{\sum_{q=1}^{M}(f(Q)-f(q)/f(q))}$ below which the cost of coordination becames zero, i.e. $\chi \geq 0$. □

The intuition for Proposition 3 is the following. When the bank is allowed to ¯nance ¯rms also through equity, it shares in the pro¯ts which obtain in the IE. In other words, the lead bank internalizes the externality at the roots of the coordination problem. This reduces the cost of subsidizing ¯rms in the critical mass and makes coordination easier. The decrease in the coordination cost also means that a larger competitive fringe is compatible with lead bank coordination. Part (iii) of Proposition 3 says that coordination cost may even disappear when a bank owns a su±ciently large share of equity. If, however, ¯rms only need a small portion of outside ¯nance, it may be that the bank cannot acquire a large enough portion of equity, so that coordination remains costly.

We have so far restricted banks to ¯nance ¯rms through debt or equity. One can think of yet more sophisticated contracts. Indeed, greater ¯nancial sophistication can further reduce the cost of coordination:

Proposition 4 *If banks can write financing contracts contingent on the number of firms investing, then:*
(i) the cost of coordination disappears: $\chi \geq 0$*;*
(ii) the size of the competitive fringe becomes larger: $\hat{z} = Q - M$

Proof. The lead bank can simply o®er to (at least) M ¯rms a contract with interest rate i_K, such that $\pi(K, i_K) = F_o$ for all $\|K\|$. In other words, the lead bank o®ers ¯rms in M an interest rate that is contingent on $\|K\|$, that is the number of ¯rms which will actually invest. This is su±cient to make each ¯rm willing to invest, and the BE is no longer an equilibrium. Coordination is thereofere achieved costlessly, which proves part (i). Part (ii) follows from the fact that the lead bank can induce coordination for any size of the competitive fringe (weakly) smaller than $Q-M$. □

The intuition for this result is that sophisticated contracts can reduce the cost of coordination since they allow the lead bank to charge di®erent terms depending on whether or

not coordination is achieved. This makes coordination a costless task, as the lead bank's return to coordination increases with the success of inducing investment.

In this section we have presented our results with the simplest possible model. In the appendix we provide a generalization to the case of heterogeneous ¯rms and to a general class of complementarities, and we show that our basic insights continue to apply.

The main point of our model is that, in order to act as a catalyst for industrialization, a bank which can only o®er ¯nance through standard debt contracts needs to be large enough to mobilize a critical mass of ¯rms, as well as possess enough market power to make pro¯ts on the other ¯rms which invest, so as to recoup the cost of coordination. When banks are allowed to ¯nance ¯rms not only with standard debt contracts but also with equity, the cost of coordination can be substantially reduced.[34] To express our results in the simplest possible fashion, we have chosen to model the ¯nancial market with a standard Stackelberg model where a lead bank is a ¯rst mover and a ¯xed-size fringe of perfectly competitive banks are followers. The important part of this assumption is that the lead bank is a ¯rst mover, and so can gain some market power. By ¯nancing a critical mass, it acts as a catalysts for the investment of all other banks and ¯rms. The way we model the fringe is not as important. All that matters is that second-mover banks do not compete away all the rents that the lead bank needs to compensate for the cost of coordination. For example, undi®erentiated Bertrand competition between the lead bank and one or several other banks would destroy any rent accruing to the lead bank, which would no longer engage in costly coordination in the ¯rst place. But if there is enough di®erentiation, then the lead bank would engage in coordination. The key point is that imperfect competition among banks is necessary to allow for lead bank coordination: The lead bank is not willing to incur the cost of coordination unless it is assured enough rents.[35]

[34]The model considers how coordination is achieved by a private profit-oriented lead bank. The model could be also used to look at how a public, government-owned, bank could engage in coordination. In an 'ideal case' scenario, our necessary conditions for cordination might be relaxed. It is in fact immediate that if the (public) lead bank did not have to make profits, it would only have to be large enough to finance a critical mass of firms—with no need to finance additional firms. The main problem with this approach is that there may be distortion resulting from the government having to finance the losses of the lead bank. A second problem is that the goals of a government-owned lead bank are unclear, and potentially prone to inefficient pressure from lobbies. The large number of problems with many so-called development banks, and their often dismal performance, suggest that these political economy issues are very important in understanding the role of government as a coordinating agent.

[35]Another possible implication is that restriction of entry into banking may be warranted if the financial market is inherently too competitive, see Hellmann, Murdock, and Stiglitz (1997a,b) for a more extensive discussion of these issues.

3 Insights from the model: the limits of Gerschenkron's view

The fundamental insight from our model is that for banks to play a role as a catalyst, they need to be sufficiently large and to have sufficient market power in order to be willing to incur the cost of coordination. The power of the theory is thus to identify the conditions under which we can or cannot expect banks to take the role of catalyst for industrialization. Our theory is consistent with the evidence from Section 1, which focussed on the success stories of Belgium, Germany and Italy, where a few large universal banks played a significant role in promoting industrialization.

In this section we take the theory one step further by confronting it with additional historic evidence not considered by Gerschenkron's analysis. Indeed, if the theory is useful in identifying the conditions under which the Gerschenkronian argument holds, we now want to concern ourselves with the limits of that argument, thus providing a tighter connection between theory and history. We structure this analysis in three parts. First, we consider historic evidence from some countries that failed to industrialize. Second, we confront the model with the recent empirical questioning of the Gerschenkronian view. This will helps us to delineate the limits to the desirability of banks acting as a catalyst for industrialization. Finally, we discuss the experience of countries that developed relying on mechanisms other than coordination by private banks.

3.1 Violating the necessary conditions: evidence from countries that failed to industrialize

Our theory establishes the necessary conditions for a bank to be able to act as a catalyst for industrialization. We now look at what happens when these conditions are violated, and examine the experience of some countries that failed to industrialize: Russia, Spain, and Italy before 1890. While the failure to industrialize can clearly be attributed to multiple causes, what we want to emphasize is that the necessary conditions for bank coordination were not satisfied in each of these countries.

As shown by Crisp (1967), Russian industrial credit banks developed slowly and remained small and dispersed over an immense country. The discretionary power of the state in granting corporate charters, its policy of limiting the growth of banks, and its tight grip on new economic activities were behind banks' passive attitude.[36] Moreover, the government considered as usury any activity which took the form of compensation for risk-taking.

[36] For instance, an attempt to set up a large joint-stock industrial credit bank in Moscow in the 1860s failed because investors feared to 'offend the authorities.'

This strongly limited how much banks could charge their borrowers, and therefore their market power. Only from the 1890s did banks based in St. Petersburg start engaging in some industrial credit, but they were many (ten in 1900 and thirteen in 1914), and so there was much competition. [37] Furthermore, these banks were relatively small. The result was a pattern of economic growth which owed more to the rationalization of agriculture than to industrialization.

Another case which illustrates the consequences of repressing the activity of industrial banks is Spain in the second half of last century, where several banks which engaged in industrial credit emerged. While incorporation was initially subject to governmental approval, it was liberalized after 1856. By 1870 about 30 credit companies and issue banks had appeared, which also engaged in commercial banking (Tortella (1972), p.93). Four of these became quite large, but shunned investment in manufacturing firms. This was due to the fact that the government posed several constraints on their actions, curtailing their ability to invest in manufacturing and encouraging purely speculative investment in railroads and mining companies. Tortella (1972) argues that the repression of manufacturing companies impeded a rapid and stable economic growth, as it prevented banks from effectively coordinating complementary activities. For instance, the government subsidisation of railways with the corresponding curtailment of manufacturing meant that there were not enough goods to transport, and therefore too little business for the railways to be profitable. In this environment, banks had not enough power, nor incentives, to engage in investment coordination.

Interestingly, the Italian experience in the decades before industrialization also lends support to our interpretation. Polsi (1996) describes how a large number of small banks competed for financing industry since the 1860s. They extended little equity finance, and were competing also with six banks of issue, which lent to commercial and industrial firms as well. The situation changed drastically by the mid 1890s. The Banca d'Italia was created in 1894, and was conferred a monopoly over note issuing. Existing industrial credit banks collapsed, and they were substituted by Banca Commerciale and Credito Italiano, both much larger than any previous industrial credit bank.

In all of the cases we thus note that one common reason why these countries experienced difficulties of industrialization: a financial market structure which was not conducive to bank coordination. The example of Italy is also particularly interesting since it uses 'time-series-like' reasoning as opposed to 'cross-section-like' reasoning to confirm the insights from

[37] Joint-stock Russian banks totalled 40 in 1893, and 50 in 1914, Crisp (1967), p.197.

our model. Soon after Italy changed its ¯nancial structure, its banks started engaging in coordination, as we discussed in Section 1.

3.2 The limited desirability of banks as catalysts for industrialization

An important insight from our model is that the oligopolistic structure of ¯nancial markets implies possible ine±ciencies, and in particular an elevated cost of capital for ¯rms. [38] If we relate the model back to the historic evidence, we notice that a number of historians have pointed out problems stemming from the oligopolistic structure of ¯nancial markets. Tilly (1982)) and Riesser (1911, chapter 5) note for Germany (after 1880) that in the later stages of the industrialization the power of those banks that had helped industrialize also led to a certain 'ossi¯cation' of both the industrial and banking market structures. Confalonieri (1982) makes a similar point for Italy (after 1907). These large and powerful banks were particularly concerned with protecting from competition the ¯rms they ¯nanced. Banks came to play a less active role in ¯nancing new ¯rms, and actively encouraged the cartelization of several industries in order to protect existing ¯rms and the stability of their pro¯ts. Moreover, it is argued, these banks were also concerned with maintaining the oligopoly among industrial ¯nanciers, possibly at the cost of slowing down growth and innovation in the industrial banking sector itself.

This skeptical view of the role of banks in industrialization has been developed further in recent empirical work on the role of German *Kreditbanken*, neatly summarized by Edwards and Ogilvie (1996). Intriguingly, this work focuses on the later stages of the German industrialization, mostly between 1880 and 1914. A ¯rst interesting point made by Edwards and Ogilvie (1996) is that while *Kreditbanken* had a large share in industrial ¯nance, their share in the overall ¯nancial sector was relative small by the end of the nineteenth century. These banks indeed accounted for only 10% of the ¯nancial sector in 1880 and 17% in 1900 (Goldsmith (1969), p.514). As the German economy grew, *Kreditbanken* remained heavily specialized in industrial ¯nance and did not branch out into other fast growing segments of the ¯nancial market (such as, for example, private mortgages). Edwards and Ogilvie (1996) also noted that *Kreditbanken* focussed mostly on joint stock companies (*Aktiengesellschaften*), but that these companies constituted only a relatively small share in overall industrial capital: 10% in 1880 and 16% in 1900 (Ho®man (1965, p.785)). This evidence suggests that *Kreditbanken* were mainly preoccupied with maintaining their domi-

[38] Our simple model of oligopoly only emphasizes one key problem with oligopolies, namely too high prices. Obviously, there are many other inefficiencies related to market power. See Hart (1983) or Aghion, Dewatripont and Rey (1997) for more elaborate arguments of the ills of market power.

nant position in their existing business. It also further underlines the important point that *Kreditbanken* cannot be said to have '¯nanced' industrialization, but instead their role is better understood as one of a catalyst | an agent that creates the impetus necessary to allow many other agents to participate in new investment opportunities.

Some of the most interesting new evidence relates to the relationship between *Kreditbanken* and the ¯rms they ¯nanced. Fohlin (1997) notes that *Aktiengesellschaften* which were the main clients of *Kreditbanken*, became less dependent on external ¯nance with time. Her evidence shows that the ratio of liquid to ¯xed assets of established joint-stock companies rose from below 30% in the 1880s to 60% in 1912 (and from less than 10% to 50% for recently listed ones). These ¯ndings are con¯rmed by Wellhäner's (1989) case study of nine large companies and by Feldenkirchen's (1982, 1985) studies of heavy industries. Moreover, Fohlin (1998a) shows that joint-stock ¯rms which borrowed from banks did not bene¯t from lower liquidity constraints than other ¯rms. Using a sample of 75 ¯rms listed on the Berlin stock exchange between 1880 and 1913, she ¯nds that bank-attached ¯rms were at times even more dependent on cash °ow for the ¯nancing of their investment than bank-independent ¯rms.[39]

These empirical results might at ¯rst seem to contradict the evidence we presented in Section 1. But our theoretical framework actually helps to understand them at a deeper level. Indeed, these results show precisely the limits of banks acting as catalysts for industrialization. Once industrialization was on its way, banks became more interested in preserving monopoly power than in nurturing economic growth. After having acted as catalyst, these banks wanted to reap the bene¯ts of their privileged market position. As a consequence, they became an increasingly less attractive source of funds for industrial ¯rms | especially those that were successful enough to be able to rely on internal funds for investment.

The work of Fohlin also puts into question the notion that *Kreditbanken* derived informational advantages as part of their relationships with ¯rms.[40] Our theory is consistent with this perspective. It might be very tempting to interpret the role of banks which act as catalysts as one of alleviating asymmetric information. In our theoretical modeling, however, we deliberately focus on a coordination problem, without relying on asymmetric information.[41] While an asymmetric information model would typically predict that a re-

[39] Fohlin (1998b) finds similar results for a sample of 170 Italian firms financed by the Banca Commerciale Italiana between 1903 and 1911.

[40] This theme is developed in Fohlin (1997), which questions the importance of interlocking directorates as a means to overcome asymmetric information and enforce bank control over firms.

[41] A close reading of Gerschenkron (1962) reveals that asymmetric information does not play a large role in his thinking, which is centred on complementarities and indivisibilities (see for instance p.10).

lationship with a bank would be valuable to reduce the cost of capital, our model does not predict such advantages to bank ¯nancing. More speci¯cally, in our model some ¯rms enjoy a cost of capital lower than the market interest rate, but there must be other ¯rms that pay a cost higher than the market interest rate. Indeed, the average ¯rm faces a higher cost of capital than the market interest rate, a prediction that appears to be borne out in the historical evidence.[42]

In summary, the historic evidence on the role of the *Kreditbanken* in the later stages of the German industrialization is an extremely useful reminder of the costs of having private banks as promoters of industrialization. The very conditions that enabled banks to act as catalysts and engage in coordination (size and market power) also imply the existence of an ine±ciency, since the very attainment of industrialization brings banks to enjoy oligopoly rents. Our model makes it clear that banks are then a double-edged instrument: catalysts and rent-extractors, a feature which in due course may retard rather than promote economic progress.

3.3 Alternative ways to industrialization

To round o® our discussion of the Gerschenkronian analysis, it is worthwhile to brie°y mention two further limitations of the argument, a full development of which is beyond the scope of this paper. First, private banks are one possible solution to the coordination problem, but they are by no means the only possible one. Second, coordination may not even be the problem hampering industrialization.

We have seen that the main argument of Gerschenkron revolves around the successful

[42] A natural empirical test of our model would be to examine the distribution of interest rates across different types of banks and borrowers. Unfortunately, historic evidence about interest rates that banks charged to their clients is not available. Then, as today, banks have always been very secretive about interest rates, and carefully avoided to make such evidence available. We researched extensively the available historic evidence, and only found that other historians had also noted the lack of any interest rate data. For Belgium—to the best of our knowledge—there is no available archival or secondary information about loan prices. For Germany, contemporary authors such as Jeidels (1905), Motschmann (1915), and Riesser (1911) comment on the difficulties of collecting systematic evidence on interest rates for loans. More recently Wellhöner (1989, p.) explicitly states that he could not find any data on interest rates charged on loans. For Italy we accessed the minutes of both the board of directors and the 'credit committees' of both Banca Commerciale Italiana and Credito Italiano. In several hundred pages of minutes we could find just a handful of references to rates charged on loans, whereas these two banks extended loans to over 3,000 industrial firms, a clear indication of the confidentiality of such information. In Section 1, however, we report evidence on the long-term profitability of banks which acted as catalysts, which also provides support-albeit indirectly—to our findings.

industrialization of a number of continental European countries with the assistance of few large universal banks with market power. We have also seen that in some other countries the absence of such banks coincides with protracted delays of industrialization. In a number of other important countries, however, institutional mechanisms other than private banks have been used for the coordination of investments.

First, large firms or industrial groups | conglomerates | may exploit complementarities internally. Probably the most interesting case in this respect is Japan before World War II. Fruin (1992) and Morikawa (1992), among others, document the role of $Zaibatsu$ in fostering and coordinating industrialization. $Zaibatsu$ were family-dominated conglomerates centered around a trading company. They grew by focusing on `trading' complementarities among their own companies. Their pattern of development contrasted with the European cases of bank coordinated growth, which relied heavily on the exploitation of technological complementarities across sectors. Interestingly, in the pre-war period Japanese regulation forced banks to limit their action to short-term lending and it also limited the size and power of its bank institutions (Patrick (1967)).

A second alternative is government coordination. A country that exempli¯es this well is Korea. The Korean government of General Park implemented a coordinated allocation of resources for industrialization which led to quick and sustained industrialization during the 1960s and 1970s, as described by Cho (1989) and Wade (1986). To implement the coordination of investment a government obviously still needs some implementing agent. In the case of Korea, the government nationalized all banks and used them as an instrument of economic policy, especially in connection with subsidized credit directed to target sectors, as examined by Cho and Hellmann (1994).

The other limit of Gerschenkron's argument is that, by de¯nition, it applies only to economies that su®er from a coordination problem. Coordination is likely to be most important for `catch-up' economies, and, as argued forcefully by Matsuyama (1995b), it becomes less important as the economy approaches the `technological frontier.' Our theoretical model is therefore explicitly targeted at examining the problems of coordination of investments. The best example of an economy that is believed to have industrialized near the technological frontier is, of course, Britain, which led the ¯rst Industrial Revolution. Acemoglu and Zilibotti (1997), for instance, convincingly argue that experimentation and risk diversi¯cation were the crucial problems Britain had to solve to become the ¯rst country to industrialize. They argue that the fragmented British banking sector was actually instrumental for sustaining experimentation and diversi¯cation. Clearly, this fragmented structure also implied that our necessary conditions for bank coordination were not satis¯ed.

4 Conclusion

In this paper we provide a theoretical framework to address the debate about the role of banks in industrialization. We introduce banks into a model of the big push to examine under what circumstances pro¯t-motivated banks would engage in coordination of investments. The model establishes a theoretical link between the role of banks as catalysts for industrialization and the necessity of market power for these banks. It also shows why universal banking helps to reduce the (endogenously determined) coordination cost, thus improving the e±ciency of banks as catalysts. We use the model to explain a diverse set of historical observations on the role of banks in industrialization. First we show that in those countries and times where banks took an active role in promoting industrialization we also ¯nd the necessary conditions derived form theory - most notably the existence of market power in banking. Second, we provide a number of examples where the lack of industrialization seems at least in part related to a violation of these conditions. Finally, we can also explain seemingly contrary evidence on the declining usefulness of banks at later stages of industrialization.

The ongoing debate about the role of banks in industrialization is obviously not merely a historical debate. Indeed, our historic understanding of how countries industrialize has direct implications for development policies, including the most recent debates about the desirability of ¯nancial liberalization. By examining both the validity and limitations of the Gerschenkronian argument of large powerful universal banks as catalysts to industrialization, the paper illuminates what we consider the central trade-o® in this debate: the very conditions necessary to allow private banks to promote coordinated investments{namely size and market power{also imply signi¯cant drawbacks of an ine±cient oligopolistic market structure, once coordination has been achieved.

We believe our theory is the ¯rst to model under what circumstances a particular institution{banks in our case{can induce coordination for a big push. This provides a useful starting point for several lines of future research. One natural question is which economic agents other than banks might be able to achieve coordination, and how they di®er from banks. Another is how the negative consequences of ine±cient oligopolistic market structures can be minimized without undermining the incentives for coordination in the ¯rst place. Finally, it is important to better understand the political economy of how a private institution engaging in industrial promotion interacts with government in the process of industrialization.[43]

[43]On this final point, it is interesting to note that in the countries where bank played a significant role

Appendix
A General Model of Complementarities

In this appendix we present a model with heterogenous ¯rms which allows for a wide variety of complementarities. We show how the insights of the basic model we used in the main text carry over to a much more general setting.[44]

We modify the model of the main text by allowing each ¯rm to have a di®erent profitability, and its investment to have a di®erent impact on other ¯rms' pro¯tability. When the investment pattern is K, the (gross) return to investment for ¯rm q is then given by $f(K,q)$. We assume that $f(K,q) = 0$ if $I_q = 0$, and $f(K,q) \geq 0$ if $I_q = 1$. That is, when a ¯rm invests, its return depends not only on its own investment, but also on the investments of all other ¯rms. K forms a sub-lattice, and $f(K,q)$ is supermodular in K. This implies that for any $K_1 \subseteq K_2$ the returns to ¯rm q are such that: $f(K_1,q) \leq f(K_2,q)$.[45] The only modi¯cation in the ¯nancial sector is that, with ¯rm heterogeneity, a loan that is o®ered to a particular ¯rm may not be available to another ¯rm, i.e. we allow for price-discrimination. The present value of the pro¯ts of ¯rm q is given by:

$$\pi(K,q,i) = \beta[f(K,q) - (1+i)F_b]$$

where ¯rm q expects the set $K \cup q$ to invest.[46] Firm q invests whenever $\pi(K,q,i) \geq F_o$. A set of investing ¯rms K is a competitive equilibrium if $\pi(K,q,r) \geq F_o$ for all $q \in K$ and $\pi(K,q,r) < F_o$ for all $q \in Q \backslash K$. We denote the equilibrium sets of investing ¯rms by K^n, $n = 1, ..., N$, where N is the number of competitive equilibria.

Proposition 1 *(i) With a competitive financial market there may exist multiple equilibria.*

(ii) There always exists a 'maximal' equilibrium in which all the firms that invest in at least one equilibrium K^n do invest. It Pareto dominates all other equilibria.

---

in promoting industrialization, there also was close communication between the banks and the government. In Belgium, for instance, the Société Générale faced many attempts of political parties to influence its decisions. As a result it had to accept representatives from both main political parties on its board of directors (Chlepner (1930)). In Germany *Kreditbanken* exerted pressure on the government, asking for protection and support for their clients. They pursued favorable charter conditions for clients who wanted to incorporate, and diplomatic assistance to their clients in the export sector (Riesser (1911)).

[44] In an earlier version of this paper, Da Rin and Hellmann (1996), we also allow for asymmetric information between firms and banks.

[45] Notice that the inequality is trivially satisfied with $I_q = 0$, so we only focus on the cases where $I_q = 1$.

[46] This reflects the fact that firms are not 'atomistic,' and take into consideration the indirect effect of their own investment on profitability.

(iii) There always exists a 'minimal' equilibrium in which all firms that do not invest in at least one equilibrium K^n do not invest. It is Pareto dominated by all other equilibria.

(iv) In the 'maximal' equilibrium there are (weakly) less firms investing than in an utilitarian social welfare optimum.

Proof. (i) The possibility of multiple equilibria is established by the example in the main text, and trivially extends to the general case when the simpli¯catory assumptions of identical ¯rms and simple complementarity we use in the main text are dropped. The equivalent result is also derived in Milgrom and Roberts (1990a, 1994a, 1994b).

(ii) Consider any two equilibria K^i and K^j, $i \neq j$ which are not nested, i.e. $K^{ij} \equiv K^i \backslash K^j \neq \emptyset$, and $K^{ji} \equiv K^j \backslash K^i \neq \emptyset$. By the de¯nition of equilibrium, for all $q \in K^i$ we have $\pi(K^i, q, r) \geq F_o$ so that $\pi(K^i \cup K^j, q, r) \geq F_o$. Similarly, for all $q \in K^j$ we have $\pi(K^j, q, r) \geq F_o$ so that $\pi(K^j \cup K^j, q, r) \geq F_o$. Then there exists some set $K^n \supseteq (K^i \cup K^j)$ such that $\pi(K^n, q, r) \geq \pi(K^i \cup K^j, q, r) \geq F_o$ for all $q \in (K^i \cup K^j)$, and $\pi(K^n, q, r) \geq F_o$ for all $q \in K^n$, and $\pi(K^n, q, r) < F_o$ for all $q \in Q \backslash K^n$. This shows that for any non-nested equilibria there exists an equilibrium (K^n) where all ¯rms investing in either equilibrium do invest as well. We denote the largest such equilibrium by K^{IE}, or simply IE. The IE Pareto dominates all other equilibria since banks make zero pro¯ts, the largest number of ¯rms are investing, and the investment by one ¯rm can only have a positive externalities on all other ¯rms.

(iii) Consider any two equilibria K^i and K^j, $i \neq j$ which are not nested, i.e. $K^{ij} \equiv K^i \backslash K^j \neq \emptyset$, and $K^{ji} \equiv K^j \backslash K^i \neq \emptyset$. For all $q \in K^{ij}$ we have $\pi(K^j, q, r) < F_o$. Similarly, for all $q \in K^{ji}$ we have $\pi(K^i, q, r) < F_o$. Thus , for all $q \in K^{ij} \cup K^{ji}$ we have $\pi(K^i \cap K^j, q, r) < F_o$. The above inequalities imply that there exists some set $\emptyset \subseteq K^0 \subseteq (K^i \cap K^j)$ such that $\pi(K^0, q, r) \leq \pi[K^i \cap K^j, q, r) < F_o$ for all $q \in (K^{ij} \cup K^{ji})$, $\pi(K^0, q, r) < F_o$ for all $q \in Q \backslash K^0$, and $\pi(K^0, q, r) \geq F_o$ for all $q \in K^0$. This shows that for any two non-nested equilibria there exists an equilibrium (possibly empty) where no ¯rm in their non-overlapping subsets is included. We denote the smallest such equilibrium by K^{BE}, or simply BE. The BE is Pareto inferior to all other equilibria since it is the one with the fewest ¯rms investing.

(iv) There cannot be too many ¯rms investing in K^{IE} since every ¯rm is individually pro¯table, and can only have positive externalities on all other ¯rms. Suppose next a ¯rm $q' \in Q \backslash K^{IE}$ were to invest as well. The de¯nition of K^{IE} implies that q' takes a loss. But by assumption 1 the investment by q' (weakly) raises $f(K^{IE}, q, r)$ to $f(K^{IE} \cup q', q, r)$ for all $q \in K^{IE}$. Depending on the strength of the complementarity e®ect, captured by the function $f(.)$, it may be socially e±cient to have more ¯rms investing than in K^{IE}. □

Proposition 2 gives the conditions under which the lead bank will engage in coordination. In order to prove it we introduce a few de¯nitions and two lemmata. We have to use a more sophisticated de¯nition of what it means to achieve coordination and of what constitutes a critical mass than in the simpler model of the main text. As now there are more than just two equilibria, we focus on the case where - in the absence of coordination - the `minimal' one would always attain. In this more general model there may be more than two equilibria. We have to use a more sophisticated notion of what it means to achieve cordination. A reasonable notion of `achieving coordination' is that at least all ¯rms in the `maximal' equilibrium invest (and possibly more, for reasons we explain below). This requires us to employ a critical mass which is such relative to the `maximal' equilibrium. Below, however, we give a more general de¯nition of critical mass, valid for any equilibrium.[47]

Critical Mass. A critical mass M relative to some set K is a set $M(K)$ such that *conditional on all firms in* $M(K)$ *investing*, all ¯rms in K ¯nd it pro¯table to invest. Moreover, $M(K)$ is the smallest set that contains no redundant ¯rms, i.e. the above property fails to hold if any one ¯rm is dropped from $M(K)$. For any K there may be several critical masses $M_s(K)$, $s = 1, ..., S$. There is no de¯nite relationship between K and $M(K)$. $M_s(K)$ may be a subset of K, or contain some elements outside K, and it may even be the case that all elements of $M_s(K)$ are outside of K. Moreover, since the ¯rms in K^{BE} always invest, $M(K)$ never contains any $q \in K^{BE}$.

More formally, $M(K)$ is a critical mass for K if it satis¯es the following two conditions:
(i) For any set $K' \supseteq M(K)$ with $\pi(K', q, r) \geq F_o$ for all $q \in M(K)$ and $\pi(K', q, r) < F_o$ for all $q \in Q \backslash K'$, then $K' \supseteq K$.
(ii) There does not exist any $M'(K) \subset M(K)$ that satis¯es property *(i)*.
Let $M_s(K)$, $s = 1, ..., S$ be all the critical masses for K. We de¯ne $M_{min}(K)$ as the one with fewest elements.

Catalytic Loan Set. A catalytic loan set for $M(K)$ is a set of interest rates $\{i_m(q)\}_{q \in M(K)}$, such that $I_q = 1$ for all $q \in M(K)$ is the *only* equilibrium investment decision of all ¯rms in $M(K)$ when they hold `pessimistic' beliefs that all ¯rms outside of $M(K)$ and $K^{BE}$ are not investing. We denote a `catalytic loan set' by $\xi(M)$. The de¯nition of BE implies that ¯rms with pessimistic beliefs always assume that all ¯rms in K^{BE} do invest. Note also that the above de¯nition does not require all ¯rms in $M(K)$ to have the belief that nobody in $M(K)$ is investing, but instead asks for an equilibrium of beliefs for all ¯rms in $M(K)$.

[47] Indeed, Propositions 2 and 3 could be readily extended to achieving any of the equilibria other than the 'maximal' one, precisely by using this more general definition of critical mass.

Whenever it is not confusing, we will write M instead of $M(K)$.

Our de¯nition of critical mass ensures that even if ¯rms initially have beliefs consistent with the BE, the critical mass can break these beliefs as it forces all remaining equilibria to have the property that at least all ¯rms in K invest, while there may be more ¯rms investing, either as part of M or not.[48] The de¯nition of the critical mass is obviously directly related to the notion of inducing coordination. In particular, a lead bank can induce coordination (in the sense of achieving an equilibrium that has all ¯rms in K^{IE} investing) whenever it mobilizes some critical mass $M(K^{IE})$ for the IE.[49] We are now ready to state our two lemmata.

Lemma 1 *For any critical mass $M(K)$ and any catalytic loan set $\xi(M)$ the lead bank takes losses on all firms in $M(K)$.*

Proof. Since we are dealing with the critical mass for any set K we simply write M instead of $M(K)$. First notice that a necessary{but not su±cient{condition for a set of interest rates to form a catalytic loan set $\xi(M)$ is to make it worth the investment by all ¯rms in M. Formally, we need that $\beta[f(K^{BE} \cup M, q) - (1 + i_m(q))F_b] \geq F_o$ for all $q \in M$. We prove the lemma by contradiction. Suppose that the lead bank makes pro¯ts on some $q' \in M$, i.e. $i_m(q') > r$. Then:

$$\beta[f(K^{BE} \cup M, q') - (1 + i_m(q')F_b] \geq F_o \Leftrightarrow f(K^{BE} \cup M, q') \geq (1 + i_m(q'))F_b + (1 + r)F_o > (1 + r)F$$

consider the set $M' = M \backslash q'$, and suppose that all ¯rms in M' invest. Then q' will also have an incentive to invest, since $f(K^{BE} \cup M', q') = f(K^{BE} \cup M), q') > (1 + r)F$. But this means that when all ¯rms in M' invest, also all ¯rms in M, and so all ¯rms in K, do invest. In other words, M' is a critical mass for K. Since $M' \subset M$, this contradicts the claim that M is a critical mass. □

[48] The definition of a critical mass is demanding. Starting from the most pessimistic belief, it must be that K is the only equilibrium. If everybody in the economy had an initial belief that some intermediate equilibrium between the BE and the IE was being played, then a smaller critical mass would suffice to induce the IE. The point we make is that this smaller mass would indeed only work if the initial belief is this intermediate equilibrium. But if it turns out that the initial belief was the BE, then any "smaller critical mass" will fail to induce coordination to the IE. By contrast, our critical mass will induce K irrespective of the initial expectations.

[49] If we were to use a weaker notion of achieving coordination in the sense of achieving an equilibrium that has all firms in some K^n other than the K^{BE} investing, then the lead bank would equivalently have to mobilize a critical mass $M(K^n)$ for that K^n.

The intuition of Lemma 1 is that if the lead bank were to make pro¯ts on any ¯rm in M, *and still induce* K, then it could let it be ¯nanced by the fringe banks. Note, however, that for the lead bank to induce coordination to K it needs to ¯nance *all* ¯rms in $M(K)$, despite making losses on them. If it invested in fewer ¯rms, then not investing would remain an equilibrium for at least some ¯rms in K, and coordination to K would fail to be achieved.

Lemma 2 *Consider any lead-bank equilibrium* K *for which the lead bank finances* $M(K)$ *with a catalytic loan set* $\xi(M(K))$. *Then the banks in the competitive fringe finance the* z *most profitable firms of* $K\backslash M(K)$.

Proof. For sake of simplicity we keep writing M instead of $M(K)$, as we are deriving the lemma for a generic K. The proof consists of showing that the lead bank would indeed make lower pro¯ts should it choose to compete away some of the most pro¯table ¯rms from the fringe banks. For each $q \in K\backslash M$ de¯ne a mapping from q to φ such that $f(K,\varphi_1) \geq f(K,\varphi_2) \geq ... \geq f(K,\varphi_{\|K\backslash M\|})$, where $n = 1,...,\|K\backslash M\|$. First suppose that the lead bank leaves the ¯nancing of the z most pro¯table ¯rms to the banks in the competitive fringe. These banks will maximize their pro¯ts by charging the same interest rate i_z de¯ned by: $\beta[f(K,\varphi_z)-(1+i_z)F_b] = F_o$ to ¯rms φ_n, $n = 1,...,z$. The lead bank maximizes its own pro¯ts by charging $i_l(q)$ such that $\beta[f(K,\varphi_n) - (1 + i_l(\varphi_n))F_b] = F_o$ to ¯rms $n = z + 1,...,\|K\backslash M\|$. Suppose next the lead bank decides to compete for *one single* ¯rm $\varphi_{n'}$, with $n' \leq z$. In this case the lead bank has to o®er ¯rm $\varphi_{n'}$ the same interest rate (or ϵ less) than the fringe banks, or else its o®er will be refused. The fringe banks now charge i_z de¯ned by $\beta[f(K,\varphi_{z+1}) - (1 + i_z)F_b] = F_o$ to ¯rms φ_n, $n = 1,...,n'-1,n'+1,....z+1$. The lead bank charges $i_l(q)$ satisfying $\beta[f(K,\varphi_n) + (1 + i_l(\varphi_n)F_b] = F_o$ to ¯rms φ_n, $n = z + 2,...,\|K\backslash M\|$. Thus the lead bank gets the same return on ¯rms $n = z + 2,...,\|K\backslash M\|$, and ¯nances ¯rm $\varphi_{n'}$ instead of ¯rm φ_{z+1}, making zero pro¯ts in both cases. As a consequence the lead bank is indi®erent between competing away *one* ¯rm from the fringe or not. Without loss of generality we assume it does not. Finally, suppose the lead bank decides to compete for exactly *two* ¯rms $\varphi_{n'}$ and $\varphi_{n''}$, with $n' < n'' \leq z$. The lead bank must o®er these two ¯rms the same interest rates (or ϵ less) than the fringe bank, or else its o®ers will be refused. The fringe banks now charge i_z de¯ned by $\beta[f(K,\varphi_{z+2}) - (1 + i_z)F_b] = F_o$ to all ¯rms φ_n, $n = 1,..,n'-1,n'+1,....n''-1,n''+1,...,z+2$. The lead bank charges $i_l(q)$ satisfying $\beta[f(K,\varphi_n) + (1 + i_l(\varphi_n)F_b] = F_o$ to all ¯rms φ_n, $n = z + 3,...,\|K\backslash M\|$. We now ask whether the lead bank increases its pro¯ts by ¯nancing ¯rms n' and n'' instead of leaving them to the fringe. By competing, the lead bank gets the same return on all ¯rms φ_n, $n = z + 3,...,\|K\backslash M\|$, and ¯nances ¯rms n' and n'' instead of ¯rms $z + 1$ and

z + 2. In the former case it receives on both ¯rms an interest rate $i_l(z + 2)$ de¯ned by $\beta[f(K, \varphi_{z+2}) - (1 + i_l(z + 2))F_b] = F_o$. In the latter case it receives a rate $i_l(z + 1)$ de¯ned by $\beta[f(K, \varphi_{z+1}) - (1 + i_l(z + 1))F_b] = F_o$ on ¯rm n', plus a rate $i_l(z + 2)$ de¯ned by $\beta[f(K, \varphi_{z+2}) - (1 + i_l(z + 2))F_b] = F_o$ on n''.

The lead bank is then clearly worse o® when it tries to compete the better ¯rms away from the fringe. The same argument applies, *a fortiori*, should the lead bank choose to compete away from the fringe more than two ¯rms. Without loss of generality we thus conclude that the lead bank leaves all the z most pro¯table ¯rms to the fringe. □

Suppose now that the lead bank is commited to achieving coordination. Denote the equilibrium that results from its optimal choice of a critical mass, given a fringe of size z, by K_z^*. Beyond ¯nancing a critical mass, the lead bank may also ¯nance some more ¯rms. We denote the set of these ¯rms by L which satis¯es $L \equiv K_z^* \backslash \{M(K_z^*) \cup Z\}$. The lead bank makes an overall pro¯t on L by charging an interest rate $i_l(q)$) satisfying $\beta[f(K_z^*, q)$–$(1+i_l(q))F_b] = F_o$. Assuming the lead bank wants to achieve coordination it will maximize:

$$\rho(z) = \sum_{q \in M} (i_m(q) - r)F_b + \sum_{q \in L} (i_l(q) - r)F_b$$

by choosing $M(K^{IE}), L, i_m(q)$, and $i_l(q)$, where $i_m(q) \in \xi(M)$.

Proposition 2 *(i) Coordination is feasible if and only if* $z \leq \bar{z} \equiv Q - \left|M_{min}(K^{IE})\right|$.

(ii) There exists a critical value $\hat{z} < \bar{z}$*, such that a necessary condition for the lead bank to make profits, and so to induce coordination, is that* $z \leq \hat{z}$*. If the lead bank induces coordination:*

(iii) it always makes losses on any critical mass $M(K^{IE})$*;*

(iv) the fringe banks finance the z most profitable firms in the set $K_z^* \backslash M(K^{IE})$*, charging them a uniform interest rate* i_z*;*

(v) the lead bank makes profits on the firms in the set L, charging them an interest rate $i_l(q)$*;*

(vi) (weakly) more firms invest than in the competitive equilibrium. This increases social welfare relative to the competitive equilibrium, although it does not constitute a Pareto-improvement.

Proof. (*i*) If z is larger than $\bar{z} \equiv Q - \|M_{min}\|$, the lead bank is too small to ¯nance a critical mass, and thus cannot induce coordination.

(*ii*) The optimal value of $\rho(z)$, denoted by $\rho^*(z)$, is a non-increasing function of z. This can be seen as follows. Suppose we start with a fringe of size z_1 and decrease it to $z_2 < z_1$.

The lead bank can ¯nance those ¯rms that were ¯nanced by the `departed' banks $z_1 - z_2$ at the same terms. For the lead bank this is feasible, but it may not be optimal. For example, it may manage to charge its new borrowers higher rates than the fringe banks, or it may prefer to ¯nance some other additional ¯rms. And since fringe banks make non-negative pro¯ts, the lead bank cannot decrease its pro¯ts by taking over those loans from them. It follows that $\rho^*(z_1) \geq \rho^*(z_2)$, which proves our claim.

At $z = \left\| K^{IE} \right\| - \|M_{min}\|$ we have $\|L\| = 0$, and so $\rho^*(z) < 0$ from Lemma 1. We then de¯ne $\hat{z}$ as the largest (integer) z such that $\rho(z) \geq 0$. Clearly, must be that $\hat{z} < \left\| K^{IE} \right\| - \|M_{min}\|$. $\rho(z) \geq 0$ is however only a necessary condition, since the lead bank may prefer to induce some other equilibrium that has not all ¯rms in K^{IE} investing. Notice also that it may be that $\rho(0) < 0$, in which case the lead bank never achieves coordination.

(iii) Follows directly from Lemma 1.

$(iv) - (v)$ Follow directly from Lemma 2.

(vi) If the lead bank achieves coordination, then by de¯nition $K_z^* \supseteq K^{IE}$. Since all ¯rms and banks are making non-negative pro¯ts and since there are no negative externalitites, it follows immediately that the lead bank induces a (weakly) higher level of social welfare than the competitive equilibrium. However this does not constitute a Pareto-improvement because ¯rms in L and Z pay a higher interest rate than in the competitive equilibrium. □

We ¯nally turn to Propostion 3, which examines how the necessary conditions for bank coordination change when the lead bank can extend equity ¯nance.

Proposition 3 *If, in addition to debt, banks can provide finance by taking equity positions:*

(i) there exists $\hat{\hat{z}}$ with $\hat{z} \leq \hat{\hat{z}} \leq Q - \left\| M_{\min}(K^{IE}) \right\|$, so that the necessary condition for the lead bank to induce coordination can be relaxed to $z \leq \bar{\bar{z}}$;

(ii) the cost of financing any critical mass M is reduced;

(iii) for sufficiently small values of F_o there always exists a critical mass M which a lead bank can mobilize without loss. A sufficient condition to induce coordination becomes for the lead bank to be at least as large as M.

Proof. $(i) - (ii)$ Consider any critical mass M and a catalytic loan $\xi(M)$. We can write $D_m(q) = (1 + i_m(q))F_b$ so that $\beta[f(K^p(q), q) - D_m(q)] \geq F_o$ for all $q \in M$ and some pessimistic belief K^p. The pessimistic belief may depend on ¯rm q, in the same manner we described for the chain of expectations in the example of the main text. Then consider any `catalytic pure equity contract' $\alpha_m(q)$ which gives each ¯rm in M the same return under the pessimistic belief: $\beta(1 - \alpha_m(q)) f(K^p(q), q) = \beta[f(K^p(q), q) - D_m(q)]$. Once coordination is achieved we

have $f(K_z^*, q) \geq f(K^p(q), q)$, so that $\beta(1-\alpha_m(q))f(K_z^*, q) \leq \beta[f(K_z^*, q) - D_m(q)]$, and thus $\beta\alpha_m f(K_z^*, q) \geq \beta D_m(q)$. Consequently, the lead bank makes higher pro¯ts on all the ¯rms in M, as it can now participate in the value created by its coordination activity.

In equilibrium the fringe banks may undercut the lead bank on ¯rms in M. If F_o is small enough, then α may be quite large, implying that the lead bank is making large pro¯ts on some of the ¯rms in the critical mass. But as we have seen in the previous section, the lead bank prefers not to compete with the fringe for the most pro¯table ¯rms, which may now include some of the ¯rms in the critical mass. This, however, does not contradict the analysis since the lead bank simply makes neither pro¯t nor loss on these ¯rms. This completes the proof for part (ii).

Let $\hat{\hat{z}}$ be the maximum size of the competitive fringe when equity ¯nancing is possible. It must be that $\hat{\hat{z}} \geq \hat{z}$, otherwise the lead bank could o®er the standard debt contract and still induce coordination at $z = \hat{z} > \hat{\hat{z}}$. To see that $\hat{\hat{z}} > \hat{z}$ is possible note that from part (ii) the lead bank makes fewer losses on the ¯rms in M. It may therefore a®ord to ¯nance fewer ¯rms in L than before, and still have $\rho^*(q) \geq 0$. Finally suppose $\hat{\hat{z}} > Q - \|M_{min}\|$. Then the lead bank is too small to ¯nance any critical mass, and the BE remains an equilibrium. Thus $\hat{\hat{z}} \leq Q - \|M_{min}\|$, Moreover, if M_{min} is not pro¯table on its own once coordination is achieved then $\hat{\hat{z}} < Q - \|M_{min}\|$. This completes the proof for part (i).

(iii) Consider any critical mass $M(K^{IE}) \subset K^{IE}$. For each $q \in M(K^{IE})$ we have $f(K_z^*, q) \geq f(K^{IE}, q) \geq (1+r)F$. At $F_o = 0$ we have that $\alpha_m(q) = 1$, so that $\beta\alpha_m(q)f(K_z^{IE}, q) \geq F = F_b$, i.e. the lead bank does not make losses on these ¯rms. Moreover, if the above inequality is strict, then there exists a neighborhood of F_o in which the lead bank still makes non-negative pro¯ts on all ¯rms in the critical mass. But if the lead bank incurs no cost of coordination, then it always induces coordination, since this can only increase its pro¯ts. The su±cient condition becomes that it is large enough to ¯nance the above critical mass $M(K^{IE})$. □

The statement and proof of Proposition 4 are identical to the one in the main text.

References

[1]

[2] Acemoglu, Daron, and Fabrizio Zilibotti [1997], `Was Prometeus Unbound by Chance? Risk, Diversi¯cation and Growth,' *Journal of Political Economy*, 105 (4), 709-52.

[3] Aghion, Philippe, Mathias Dewatripont, and Patrick Rey [1999], `Agency Costs, Firm Behavior and the Nature of Competition,' CEPR Discussion Paper n.2130.

[4] Aleotti, Alessandro [1990], *Borsa e Industria: 1861-1989*, Milano, Edizioni di Comunita.

[5] Arestis, Philip, and Panicos Demetriades [1997], `Financial Development and Economic Growth: Assessing the Evidence,'*Economic Journal*, 107 (3), 783-99.

[6] Bairoch, Paul [1976a], `Europe's Gross National Product: 1800- 1975,' *Journal of European Economic History*, 5 (2) 273-40.

[7] Bairoch, Paul [1976b], *Commerce extérieur et développement économique de l'Europe au XIX siècle*, Paris, Ecole des Hautes Etudes en Science Sociales.

[8] Bairoch, Paul [1982], `International Industrialization Levels from 1750 to 1980,' *Journal of European Economic History*, 11 (1) 269-333.

[9] Cameron, Rondo [1961], *France and the Economic Development of Europe*, Princeton, Princeton University Press.

[10] Cameron, Rondo (ed.) [1967], *Banking in the Early Stages of Industrialization: A Study in Comparative Economic History*, Oxford, Oxford University Press.

[11] Cameron, Rondo (ed.) [1972], *Banking and Economic Development*, New York, Oxford University Press.

[12] Chlepner, Bernard [1926], *La Banque en Belgique: étude historique et économique*, Bruxelles, Lamertin.

[13] Chlepner, Bernard [1930], *Le marché financier belge depuis cent ans*, Bruxelles, Falk.

[14] Chlepner, Bernard [1943], *Belgian Banking and Banking Theory*, Washington D.C., The Brookings Institution.

[15] Cho, Yoon Je [1989], `Finance and Development: The Korean Approach,' *Oxford Review of Economic Policy,* 5 (4), 221-37.

[16] Cho, Yoon Je, and Thomas Hellmann [1994], `The Government's Role in Japanese and Korean Credit Markets: A New Institutional Economic Perspective,' *Seoul Journal of Economics,* 7 (4), 383-415.

[17] Ciccone, Antonio and Kiminori Matsuyama [1996], `Start-up Costs and Pecuniary Externalities as Barriers to Economic Development,' *Journal of Development Economics*, 49 (1), 33-60.

[18] Cohen, Jon [1967], `Financing Industrialization in Italy, 1894-1914: The Partial Transformation of a Late-Comer,' *Journal of Economic History*, 27 (3), 363-82.

[19] Cohen, Jon [1972], `Italy 1861-1914', in Rondo Cameron (ed.) *Banking and Economic Development*, New York, Oxford University Press, p.58-91.

[20] Confalonieri, Antonio [1976], *Banca e Industria in Italia, 1894-1906*, Milano, Banca Commerciale Italiana.

[21] Confalonieri, Antonio [1982], *Banca e Industria in Italia dalla crisi del 1907 all'agosto 1914*, Milano, Banca Commerciale Italiana.

[22] Crisp, Olga [1967], `Russia,' in Rondo Cameron (ed.) *Banking in the Early Stages of Industrialization: A Study in Comparative Economic History*, Oxford, Oxford University Press, p.183-238.

[23] Da Rin, Marco [1996], `Understanding the Development of German Kreditbanken, 1850-1914: an Approach from the Economics of Information,' *Financial History Review*, 3 (1) 29-47.

[24] Da Rin, Marco, and Thomas Hellmann [1996], `Banks as Catalysts for the Big Push,' IGIER Working Paper n.98.

[25] Diamond, Douglas, and Philip Dybvig [1983] `Bank Runs, Deposit Insurance and Liquidity,' *Journal of Political Economy*, 91 (3), 450-77.

[26] Diamond, Douglas, and Raghuram Rajan [1999]`A Theory of Bank Capital,' mimeo, University of Chicago.

[27] Durviaux, Roland [1947], *La banque mixte, origine et soutien de l'expansion économique de la Belgique*, Bruxelles, Bruylant.

[28] Edwards, Jeremy, and Sheilagh Ogilvie [1996], `Universal Banks and German Industrialization: A Reappraisal,' *Economic History Review,* 49 (3), 427-46.

[29] Federico, Giovanni, and Gianni Toniolo [1991], `Italy,' in Richard Sylla and Gianni Toniolo (eds.) *Patterns of European Industrialization*, London, Routledge.

[30] Feldenkirchen, Wilfried [1982], *Die Eisen- und Stahlindustrie des Ruhrgebiets, 1879-1914: Wachstum, Finanzierung und Struktur ihrer Grossunternehmen*, Wiesbaden.

[31] Feldenkirchen, Wilfried [1985], `Zur Finanzierung von Grossunternehmen in der chemischen un elektrotechnischen Industrie Deutschlands vor dem Ersten Weltkrieg,' in Richard Tilly (ed.) *Beiträge zur quantitativen vergleichenden Unternehmengeschichte*, Stuttgart, 94-125.

[32] Fohlin, Caroline [1999], `The Universal Banks and the Mobilization of Capital in Imperial Germany,' *fortcoming* in Philip Cottrell, Gerald Feldman and Jamie Reis (eds.) *Finance and the Making of Modern Capitalism*, Scolar Press.

[33] Fohlin, Caroline [1998a], `Relationship Banking, Liquidity, and Investment in the German Industrialization,' *Journal of Finance,* 53 (5), 1737-58

[34] Fohlin, Caroline [1998b], `Fiduciari and Firm Liquidity Constraints: The Italian Experience with German-style Universal Banking,' *Explorations in Economic History,* 35 (1), 83-107.

[35] Fruin, Mark [1992], *The Japanese Enterprise System*, Oxford, Clarendon Press.

[36] Fua, Giorgio [1965], *Notes on Italian Economic Growth, 1861-1964*, Milano, Giu®ra.

[37] Gale, Douglas, and Marting Hellwig [1985], `Incentive-Compatible Debt Contracts: The One-Period Problem,' *Review of Economic Studies*, 52 (3), 647-63.

[38] Gerschenkron, Alexander [1962], *Economic Backwardness in Historical Perspective*, Cambridge, Harvard University Press.

[39] Goldsmith, Raymond [1969], *Financial Structure and Development*, New Haven, Yale University Press.

[40] Hart, Oliver [1983], `The Market Mechanism as an Incentive Scheme,' *Bell Journal of Economics,* 14 366-82.

[41] Hart, Oliver, and John Moore [1995], `Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management,' $Americ$

[53] Milgrom, Paul, and John Roberts [1990], `The Economics of Modern Manufacturing: Technology, Strategy and Organization,' *American Economic Review*, 80 (3), 511-28.

[54] Milgrom, Paul, and John Roberts [1994a], `Complementarities and Systems: Understanding Japanese Economic Organization,' *Estudios Económicos,* 9 (1), 3-42.

[55] Milgrom, Paul, and John Roberts [1994b], `Comparing Equilibria,' *American Economic Review*, 84 (3), 441-59.

[56] Milgrom, Paul, and Chris Shannon [1994], `Monotone Comparative Statics,' *Econometrica*, 62 (1), 157-180.

[57] Mitchell, Brian [1980], *European Historical Statistics*, London, Macmillan

[58] Morikawa, Idemasa [1992], *Zaibatsus*, Tokyo, Tokyo University Press.

[59] Morrison, Rodney [1967], `Financial Intermediaries and Economic Development: The Belgian Case,' *Scandinavian Economic History Review,* 19 (1), 56-70.

[60] Motschmann, Gustav [1915] *Das Depositengeschaft Der Berliner Grossbanken*, München, Duncker & Humblot.

[61] Murphy, Kevin, Andrei Shleifer and Robert Vishny [1989], `Industrialization and the Big Push,' *Journal of Political Economy*, 97 (5), 1003-1026.

[62] Neuville, Jean [1974], *L'évolution des Rélations Industrielles en Belgique*, Bruxelles, Editions Vie d`Ouvrier.

[63] Okuno-Fujiwara, Masahiro [1988], `Interdependence of Industries, Coordination Failure and Strategic Promotion of an Industry,' *Journal of International Economics*, 25 (1), 25-43.

[64] Patrick, Hugh [1967], `Japan,' in Rondo Cameron (ed.) [1967], *Banking in the Early Stages of Industrialization: A Study in Comparative Economic History*, Oxford, Oxford University Press, p.239-89.

[65] Pohl, Manfred [1982],'Die Entwicklung des Deutschen Bankenwesens zwischen 1848 und 1870,' in G. Ashauer (ed.) *Deutsche Bankengeschichte*, Band 2, Fritz Knapp Verlag, Frankfurt a.M..

[66] Polsi, Alessandro [1996], `Financial Institutions in Nineteenth Century Italy: The Rise of a Banking System,' *Financial History Review*, 3 (2), 117-38.

[67] Riesser, Jacob [1911], *The Great German Banks*, Washington, D.C., National Monetary Commission.

[68] Rajan, Raghuram, and Luigi Zingales [1998], `Financial Dependence and Growth,' *American Economic Review*, 88 (3), 559-86.

[69] Rodr¶guez-Clare, Andr¶s, [1996a], `The Big Push in a Small Open Economy', *Journal of Development Economics,* 49 (1), p.33-2.

[70] Rodr¶guez-Clare, Andr¶s, [1996b], `Positive Feedback Mechanisms in Economic Development: A Review of Recent Contributions,' mimeo, University of Chicago.

[71] Romeo, Rosario [1972], *Breve storia della grande industria in Italia*, Bologna, Cappelli.

[72] Schumpeter, Joseph [1939], *Business Cycles*, New York, McGraw-Hill.

[73] Shleifer, Andrei, and Robert Vishny [1988], `The E±ciency of Investment in the Presence of Aggregate Demand Spillovers,' *Journal of Political Economy*, 96 (6), 1221-31.

[74] Soci¶t¶ G¶n¶rale de Belgique [1922], *Le Centenaire de la Société Générale*, Bruxelles, Soci¶t¶ G¶n¶rale.

[75] Stiglitz, Joseph [1989], *The Economic Role of the State*, Oxford, Blackwell.

[76] Tilly, Richard [1966], `Germany, 1815-70' in Rondo Cameron, Rondo (ed.) *Banking in the Early Stages of Industrialization: A Study in Comparative Economic History*, Oxford, Oxford University Press.

[77] Tilly, Richard [1966] *Financial Institutions and Industrialization in the Rhineland 1815-1870*, Madison, The University of Wisconsin Press.

[78] Tilly, Richard [1983], `Mergers, External Growth, and Finance in the Development of Large Scale Enterprise in Germany, 1880-1913,' *jeh,* 42 (3), 629-58.

[79] Tilly, Richard [1993], `On the Development of German Big Banks as Universal Banks in the 19th and 20th Century: Engine of Growth or Power Block?,' *German Yearbook of Business History*, 109-30.

[80] Toniolo, Gianni [1988], *Storia economica dell'Italia liberale*, Bologna, Il Mulino.

[81] Tortella, Gabriel [1972], `Spain,' in Rondo Cameron (ed.) *Banking and Economic Development*, New York, Oxford University Press, p.91-121.

[82] Wee, Herman van der [1981], `La strategie d'investissement des entreprises belges et son in°uence sur le developpement ¶economique de l'Europe,' *International Review of the History of Banking,* 22 (1), 1-22.

[83] Wellhäner, Werner [1989], *Grossbanken und Grossindustrie im Kaiserrich,* Göttingen, Vandenhoeck & Ruprecht.