Banks as Catalysts for Industrialization

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

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Abstract

Much of the recent growth and development literature is based on the notion that economies may exhibit multiple equilibria, due to coordination failures. Surprisingly, little attention has been given to analyze which economic institutions may solve such failures. We examine the role of banks as 'catalysts' for industrialization. When there are limits to contracting, and complementarities exist among investments of different firms, we derive coordination costs endogenously and show that banks can acts as catalysts provided that: *(i)* they are sufficiently large to mobilize a critical mass of firms, and *(ii)* they possess sufficient market power to make profits from coordination. We also show that the costs of coordination depend critically on the contracting instruments available to banks. In particular, allowing banks to hold equity reduces and sometimes eliminates the cost of coordination. We use our results to interpret the patterns of early industrialization of Belgium, Germany, and Italy in the late 19th century. These countries experienced quick industrialization with the active involvement of large and powerful universal banks, which engaged in both debt and equity finance.

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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 economies to industrialize, however, has called for new approaches. Several strands of the 'new growth' theory have shown how industrialization may fail to occur not (only) because of a scarcity of resources, but because of a lack of investment coordination and investors' confidence. This happens when the economy is stuck in an 'underdevelopment trap' even though there exist higher equilibria. It is natural to ask under what conditions an economy may find itself stuck in an underdevelopment trap. Also, in the absence of spontaneous coordination we would like to know which institutions may remedy such coordination failure. While the former question has been thoroughly analyzed by the literature, the latter has received less attention so far, despite its great importance for theorists and policy makers alike. A typical conclusion is simply that there may be a role for government to coordinate investments. As Murphy, Shleifer and Vishny (1989, p.1019) put it: "The inefficiency of the unindustrialized equilibrium raises the possibility of a government role either in encouraging agents to invest or, alternatively, in discouraging current consumption." This argument does not consider the possibility that private institutions may also induce coordination. Moreover it leaves open the issue of how and under what circumstances coordination is actually achieved.

In this paper we begin to address these questions by focusing on the role of one particular institution: banks. We ask under what circumstances banks may prove instrumental in fostering industrialization. Banks are natural candidates as their lending activities naturally put them in touch with a large variety of firms. They may therefore not only be able to perceive opportunities for coordination, but also to influence - through their lending activities - the investment decisions of many firms.

To examine this problem we provide a theoretical framework, which allows the existence of complementarities among firms' investments. This may lead to multiple, Pareto-rankable equilibria. To model the financial market structure, we use a variant of a Stackelberg price-leadership model. A lead bank can offer loans at sufficiently favorable terms to mobilize a 'critical mass' of firms to invest, thus making investments by others worthwhile. We examine under what conditions a lead bank can act as a 'catalyst' for other banks and firms to invest, thus inducing industrialization. We show that for a bank to take the lead in coordinating (complementary) investments two conditions must be satisfied. First, the bank has to be sufficiently large, *relative to the economy*, so as to be able to finance a critical mass of firms. Second, the bank must find it in its self-interest to induce coordination. We show that if a bank can only use standard debt contracts it always incurs losses in the

process of mobilizing the critical mass of firms. It will therefore act as a catalyst only when it possesses sufficient market power to recoup the cost of coordination by making profits on loans to firms outside the critical mass. But the cost of coordination also depends on the available contracting options. A bank can reduce - and possibly eliminate - the cost of coordination if it is allowed to finance firms through equity, rather than just standard debt contracts. Moreover, if it were possible to make contracts contingent on other firms' investment, then the cost of coordination would always disappear.

Our emphasis on banks emanates from a historical perspective. Even a cursory look at the past suggests that in many countries banks played a significant role in the process of industrialization. We look in particular at the emergence of private 'industrial' credit banks in 19th century continental Europe, and we use our model to interpret the experiences of Belgium, Germany and Italy. In all these countries, a few powerful large banks financed the majority of firms in the high growth sectors of the economy. They pioneered universal banking, providing firms with both debt and equity finance. They dominated their financial markets, also thanks to restrictions to entry. These countries experienced a quick and sustained industrialization as banks became involved with industrial finance. Their experiences contrast sharply with those of countries where the lack of industrialization was accompanied by limitations to industrial banking. Our theory explains the role of banks as catalysts in economies where the underlying obstacle to industrialization is one of coordination. We do not claim to explain all industrialization experiences, and in particular those where the underlying problem to be solved is not one of coordination. The succesful industrialization of England in the 18th century, for example, followed a different path. England was a technological leader, not a 'catch up' economy, so that the underlying problem was risk diversification rather than coordination failure.

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. Matsuyama (1992) extends this model to a dynamic setting, and Fafchamps and Helms (1996) to local pecuniary externalities. Multiple equilibria can also arise due to a second type of pecuniary externality, namely backward and forward linkages in the production of intermediate goods. Ciccone and Matsuyama (1996) and Rodríguez-Clare (1996a) both introduce specialized non-tradable intermediate inputs which induce pecuniary externalities. Okuno-Fujiwara (1980) provides an alternative framework, based on Cournot competition. 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. Azariadis and Drazen (1990), Durlauf (1993), and Matsuyama (1991) also develop models where technical externalities induce multiple equilibria. 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.

We use a very simple model to convey the insights of the paper, and in the appendix we provide a general formulation which accounts for firm heterogeneity and for any type of complementarity in investments, thus encompassing all these notions of pecuniary and technological externalities. The remainder of the paper is as follows. Section 1 develops the model. Section 2 discusses the historical evidence. Section 3 interprets our results and suggests a research agenda.

1 A Model of Bank Coordination

1.1 The Basic Model

Our economy lasts two periods, and there are two technologies available to firms, one 'traditional' and one 'industrial.' The adoption of the industrial technology requires the investment of a sum F in the first period, and allows a firm to produce in the second period. There is no uncertainty in the model about the future outcome of the investment. Each firm 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 firm which borrows has to repay $(1+i)F_b$ in the second period.

There are Q identical firms indexed by $q = 1...Q$. Let $I_q = 1$ if firm q decides to invest, and $I_q = 0$ otherwise. Denote the set of all investment decisions by $K = \{I_q\}_{q \in Q}$, and by $\|K\|$ the corresponding number of investing firms. K forms a sub-lattice.[1] When the

[1] For a definition and discussion of sub-lattices see Milgrom and Shannon (1994). Notice that our model

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 $I_q=1$: Firms which do not invest make no profits. When a firm invests, its return depends not only on its own investment, but also on the investments of all other firms. The fundamental assumption we make is that there are positive externalities between firms' investments. In other words, we assume that $f(K)$ is supermodular in K.[2] Given symmetric firms, this means that $f(K)$ is an increasing function of $\|K\|$. In the appendix we consider the case of heterogeneous firms and use a more general class of complementarities, showing that our results continue to hold.

As we discussed in the introduction, positive interdependencies or 'complementarities' are at the heart of much recent work in development economics. They can arise for a variety of reasons, including pecuniary externalities, R&D spillovers, externalities in intermediate goods production, or agglomeration economies. They can be symmetrical (as in Murphy, Shleifer and Vishny (1989)) or asymmetrical (as when a few key firms may substantially increase others' profitability but not vice versa). Our more general model in the appendix captures all these possible cases. In the main text we adopt the symmetric version to convey more immediately the intuition of our results.

We also assume that there are limitations on the types of contracts that banks and firms can write. In particular, we start by assuming that only standard debt contracts are feasible and relax this assumption later. Our assumption can be justified on several grounds. First, there may be regulatory and legal constraints. Second, there may be problems of verifiability or enforceability that make standard debt contracts the only feasible or economical financial instruments.[3]

Let r denote the riskless rate of return, and thus the costs of funds in the economy, and let $\beta=\frac{1}{1+r}$ be the discount rate. The net present value of the profits of firm q is given by:

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

where $\|K\|-1$ is the number of firms expected to invest. 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 $\|K\|=Q$.

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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.

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

[3] 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.

It is immediately clear that the investment decision depends on the interest rate offered. This, in turn, is determined by the structure of the financial market. We use a simple price-leadership model that allows for a one-dimensional parameterization of the intensity of competition in the financial market. We will later discuss the generality of our approach. In particular we assume that there exist a competitive fringe of z 'small' banks which can finance exactly one firm each. A 'lead bank' can then finance up to $(Q-z)$ firms. The financial market is competitive when the fringe is very large $(z=Q)$, such that the lead bank disappears. Then the lending rate i always equals the deposit rate r. If the fringe is smaller (intermediate values of z), the lead bank has some market power, although it is constrained in its action by the fringe. If the fringe disappears $(z=0)$, the lead bank becomes a monopolist.

The sequence of actions is as follows. The lead bank moves first and makes loan offers to firms. The fringe banks observe the lead bank's offers, and then make their loan offers to firms. Finally firms simultaneously decide whether to invest and which offers to accept. Notice that there are no information asymmetries.

1.2 Multiple Competitive Equilibria and the Need for Coordination

In this section we examine the rational expectations equilibria when financial markets are competitive. In this case $z=Q$, and there is no lead bank but only a competitive fringe. A set of investing firms 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 $q \in Q \backslash K$. The main Proposition of this section is then:

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 firms investing (here Q) then complementarities make it worthwhile to invest for all firms. Likewise, when only 'few' firms (here none) invest, it is not profitable for others to invest, due to the lack of a sufficiently strong complementarities effect. We name the equilibrium with no firms investing the BE ('Backward Equilibrium') and the equilibrium with all firms investing the IE ('Industrialization Equilibrium').

In the appendix we show that with firm 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 firms invest, there are (weakly) fewer firms investing than is socially desirable.

The existence of multiple equilibria is a coordination failure. In the BE the belief that no firm is industrializing is self-fulfilling, i.e. it implies that indeed no firm does actually undertake the costly investment to industrialize. Likewise, in the IE the belief that many firms are investing does justify investment by many firms. Such multiplicity of equilibria is determined by beliefs, not by exogenous parameters or past values of the variables.[4] Coordination of beliefs occurs spontaneously, so that the IE arises effortlessly, and to get out of the BE the economy must rely on spontaneous changes in beliefs. In many economic situations it is hard to see why firms would independently change their beliefs on others' investment decisions.[5]

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*. This is different from a pure signaling effect. Any publicly observable signal, even if without content—like a 'sunspot'—*could* indeed induce coordination. But there is no particular reason to believe it *would*, since the BE still remains a possible equilibrium. 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. Put differently, in order not to rely on a somewhat implausible spontaneous coordination of beliefs, we focus on the case where agents do not rely on it at all.

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. First, the availability and terms of bank financing directly influence firms' decisions to invest. Second, banks provide funds, which are a necessary input for a large number of firms. A bank potentially interacts with many firms and thus has a unique opportunity to induce coordination. Third, banks may have a self-interest in industrialization if their profits increase as a result of industrialization. While we emphasize the role of banks, we do not claim that they are the *only* possible coordination mechanism. Indeed we later discuss

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

[5]This would be particularly true in a dynamic interpretation of the model, where the economy has been using the traditional mode of production for a long time.

alternative institutions that may also induce coordination.

1.3 Coordination with a Lead Bank

We now examine how a lead bank can induce coordination. A lead bank can induce firms to invest through the terms of the financing 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 sufficiently large number of firms to invest, this constitutes a 'critical mass': Other firms recognize that their investments are now profitable. They are willing to invest, and they are able to convince any bank that their investment is worth financing. 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 one equilibrium of the game, the IE.[6] But in the process of convincing firms in the critical mass to invest, we show that the lead bank takes losses on all their loans. This means that two conditions need to be satisfied for the lead bank to engage in coordination. First, it has to be large enough to finance all the firms in the 'critical mass.' Second, in order to recoup the costs of coordination, it needs enough market power to make profits on the firms it finances outside of the critical mass. These two conditions are directly related to the structure of the financial markets.

In order to achieve this unique equilibrium it is necessary for all firms to believe that a critical mass of firms will invest. Once the firms in this critical mass invest, other firms will find it profitable to invest as well. The critical mass is thus defined as the smallest number of firms which make investing the only equilibrium strategy for all other firms. Formally, $1<M<Q$ is the critical mass if $\pi(M,r)<F_o$ and $\pi(M+1,r)\geq F_o$.

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

Proposition 2 *(i) Coordination by a lead bank is costly: $\chi<0$;*
(ii) There exists a critical value $\hat{z}$ such that the lead bank induces coordination if and only if the fringe has size $z<\hat{z}$.

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

Proof. (i) Since all firms are identical, consider any arbitrary index of them: $q=1,....Q$, and notice that debt contracts can differ only for the interest rate, as each firm needs to borrow the same amount of capital. Suppose the lead bank offers a set of standard debt contracts $\{i_q\}$ to firms $q=1,...M$, that satisfies $\pi(q,i_q)=F_o$. The interest rate on each contract i_q is chosen so that if all firms with a lower q invest, then q also finds it worthwhile to invest. Thus each firm in the critical mass is offered a different contract. Then firm $q=1$ always invests, irrespective of other firms' decisions. Firm $q=2$ knows this and invests irrespective of what firms $q=3,....Q$ do, and so on. From this inductive chain we can conclude that all firms $q=1,....,M$ invest.[7] But once M firms invest, all other firms - by definition - find it worthwhile to invest as well. Therefore the *only* equilibrium left is the IE, where all firms, $q=1,.....Q$ do invest. Lead bank coordination has induced industrialization. Consider now any other set of contracts that has exactly one interest rate higher than in the set $\{i_q\}$. Denote the different contract i'_q, for it is offered to firm q'. We know that $\{i'_q\}$ is such that all firms with $q<q'$ always invest. Now firm q' will invest only if at least some other firms with $q>q'$ do - as the interest rate i'_q is too high to make investment attractive otherwise. This implies multiple equilibria. If all firms with $q>q'$ expect firm q' *not* to invest, they will not invest either. This creates a negative self-fulfilling 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 firms with $q>q'$ expect q' to invest, they will form a positive self-fulfilling belief, which makes it optimal for q' to invest. In this case industrialization occurs. Thus, 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. Thus $\{i_q\}$ is the most profitable set of contracts the lead bank is able to offer 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 profit 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 offer the contract $\{i_q\}$, it must be overall profitable to do so. Formally: $\rho \geq 0$, i.e. $\nu \geq -\chi < 0$. The value of ν is determined by market clearing. The interest rate charged to firms outside the critical mass, say i_z, is the same whether the lender is the lead bank or one of the banks in the competitive fringe. It is determined by

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

the condition $\pi(Q, i_z) = F_o$. In this simple model with homogeneous firms banks extract all rents from firms, 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 offers $\{i_q\}$ if and only if $z < \hat{z}$. □

We illustrate the intuition behind Proposition 2 with the help of Figure 1. Notice that we draw $\pi(K, r)$ as a continuous function only for sake of simplicity. The lead bank needs to mobilize the firms in M despite their pessimistic beliefs. It can do so by offering them 'subsidized' 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 firms in the critical mass M would not invest. The lead bank takes a loss on these loans as $f(1) < (1 + r)F$. Area χ in Figure 1 indicates the lead bank's losses. Once the firms in the critical mass have been offered the subsidized loan, and have decided to invest, all other firms become also willing to invest. Thus the lead bank sets the interest rate for other firms at the level i_z, so as to maximize its profits ρ. The larger the competitive fringe the fewer firms the lead bank is left with to finance.

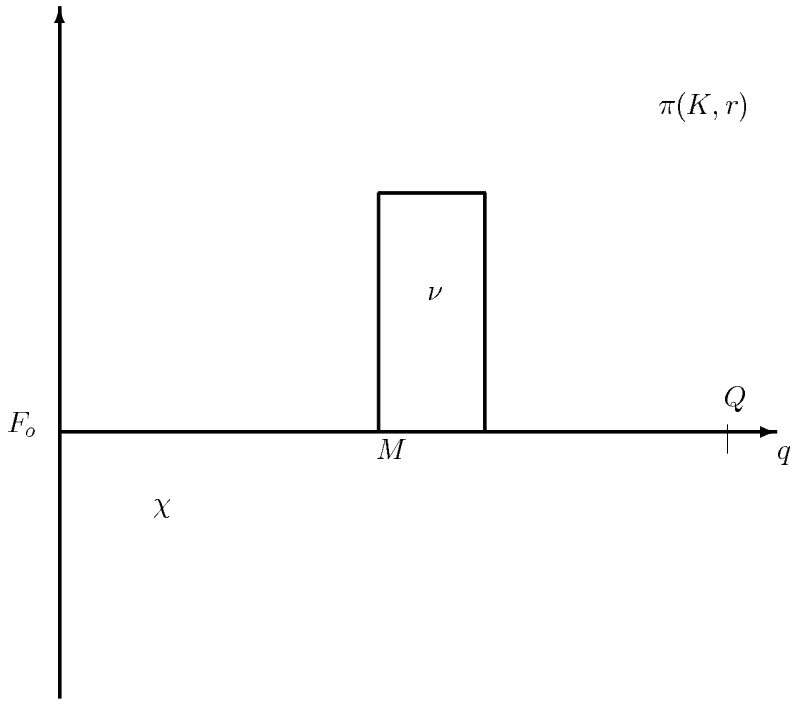

Figure 1

How general is our result? In the appendix we show that with heterogeneous firms and general complementarities the same logic continues to apply. In this case banks cannot extract all rents from firms, and the interest rate i_z for firms outside the critical mass becomes a decreasing function of z. Moreover, in the general model the above conditions are necessary, but not always sufficient to achieve the 'highest' possible equilibrium (i.e. with most firms). This is because with more than two equilibria banks may sometimes choose a 'higher,' but not the 'highest,' equilibrium. In the appendix we show that in this case lead bank coordination increases social welfare with respect to the competitive equilibrium. However this does not constitute a Pareto improvement. In particular we show that some firms face higher interest rates in a lead bank induced equilibrium.

1.4 Relaxing the contracting constraints

So far we restricted banks to providing finance 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 offer more sophisticated financial contracts. The simplest case is to allow the lead bank to hold equity in the firms it finances. Proposition 3 states the implication of this:

Proposition 3 *If banks can offer firms equity finance, by holding a stake α, then:*
(i) χ is a decreasing function of α;
(ii) $\hat{z}$ is a decreasing function of α;
(iii) if banks can hold an unrestricted amount of equity, 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 finances a firm q by holding a share α of its equity in addition to a loan, then the firm's return - when K firms invest - is given by:

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

and the bank's (gross) return by:

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

As with pure debt contracts, the bank needs to offer a set of contracts $\{i_q, \alpha\}$ that will induce all firms in the critical mass to invest, i.e. $\pi(q, i_q, \alpha) = F_o$ for all $q = 1, ..., M$. As in the case of pure debt contracts, this eliminates the BE. 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 first (negative) term represents the loss the bank suffers from financing firms in the critical mass. The second (positive) term represents the profit it makes by holding equity and sharing in the value appreciation 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 χ, the lower $\hat{z}$.

(iii) If the bank finances firms only through equity, the amount of equity it will hold in each firm 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 coordination costs became zero, i.e. $\chi \geq 0$. □

The intuition for Proposition 3 is straightforward. When the bank is allowed to finance the firm also through equity, it shares in the profits which obtain in the IE. This reduces the cost of subsidizing firms in the critical mass and makes coordination easier. The decrease in coordination costs also means that a larger competitive fringe is compatible with lead bank coordination. Part *(iii)* of Proposition 3 says that coordination costs may even disappear when a bank owns a sufficiently large share of equity. If, however, firms only need a small portion of outside finance, 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 finance firms through debt or equity. One can think of yet more sophisticated contracts. Indeed, greater financial sophistication can further reduce coordination costs:

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

Proof. The lead bank can simply offer to (at least) M firms a contract with interest rate i_K, such that $\pi(K, i_K) = F_o$ for all $\|K\|$. In other words, the lead bank offers these firms an interest rate that is contingent on $\|K\|$, that is the number of firms which will actually invest. Then each firm is willing to invest, and the BE is no longer an equilibrium. Coordination is 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 different 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.

1.5 Robustness of the Model

We have presented our results with the simplest possible model. In this section we briefly discuss how they would change in a more general model. In the appendix we provide a generalization to the case of heterogeneous firms and a general class of complementarities. Our basic insights continue to apply.

The main point of the model is that, in order to act as a catalyst for industrialization, a bank which can only offer finance through standard debt contracts needs to be large enough to mobilize a critical mass of firms, as well as possess enough market power to make profits on the other firms which invest, so as to recoup the costs of coordination. When banks are allowed to finance firms not only with standard debt contracts but also with equity, the costs of coordination can be substantially reduced.

In the absence of a standard theory of bank competition, we have chosen to model the financial market with a particular Stackelberg model where a lead bank is a first mover and a fixed-size fringe of perfectly competitive banks are followers. The important part of this assumption is that the lead bank is a first mover, and so can gain some market power. By financing a critical mass, it acts as a catalysts for the investment of all other banks and firms. 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, undifferentiated Bertrand competition between the lead bank and (at least) another bank would not do, as it would destroy any rent accruing to the lead bank, which would no longer engage in costly coordination in the first place. But if there is enough differentiation, 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 costs of coordination unless it is assured enough rents. The implication is that restriction of entry into banking may be warranted if the financial market is inherently too competitive.[8]

We have modeled the costs of coordination endogenously as the loss from making 'cheap' loans to the critical mass. Other costs could also be thought of. For instance, we assumed

[8]See Hellmann, Murdock, and Stiglitz (1997a,b) for a more extensive discussion of these issues.

perfect information: all agents know the exact nature of complementarities and the level of productivity of each firm, and therefore know what it takes to achieve coordination. In real economic situations information may not be freely available. There may be costs of identifying what firms have strong complementarities, and of ascertaining the profitability of each firm. The main insight of our model is strengthened if we account for such costs. Should a bank incur additional costs to identify complementary investments, it would need even more market power to recoup them.

The presence of information asymmetries raises other issues. There are agency costs associated with financing firms.[9] For instance, if the bank assumes much equity it may significantly reduce the incentives of the firm's managers to provide effort.[10] This would affect the extent to which banks use equity. The message of our model, however, still remains. Holding constant any other trade-offs, there is a benefit to allowing banks to finance through equity, since this allows them to share in the value created by coordination.[11]

2 Banks and the Industrialization of Belgium, Germany and Italy

A recurrent theme in economic history is the association between episodes of fast industrialization and the presence of large, powerful, banks. 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, ch.7, section 7) gave German *Kreditbanken* large credit for taking an entrepreneurial attitude and fostering the rise of large industries. Not only have economic historians noticed the frequent association of 'big banks' with fast industrialization, they have also documented in detail the active role that banks often undertook in spurring industrialization and coordinating investments.

[9] See Harris and Raviv (1991) for a survey on this topic.

[10] We have not discussed the several trade-offs between debt and equity based bank finance. See Benston (1994) for a discussion of the costs and benefits of universal banking.

[11] Asymmetric information also means that the lead bank needs to beware of adverse selection. By offering favorable terms to the firms in the critical mass, the lead bank may attract 'lemons' (impostors and unprofitable firms) that will be unable to repay their debt. In an earlier version of this paper, Da Rin and Hellmann (1996), we show that if it has to offer the same interest rate to all firms, the lead bank may invest in fewer firms than in the competitive industrialization equilibrium.

In this section we use the results of our model to interpret the industrialization of three European countries in the 19th century: Belgium, Germany, and Italy. For each case we show how large banks emerged before industrialization and started engaging in industrial finance, operating in oligopolistic financial markets. We describe how such banks coordinated the investment activities of industrial firms, focusing their attention on high growth sectors. These banks also acted as both lenders and shareholders, thus pioneering universal banking. In these countries banks were in fact allowed to invest in equity capital. In other countries banks were instead constrained to loans by regulations or by economic convenience. As for contractual freedom, commercial codes restricted the terms of loans. Interest had to be fixed to comply with usury laws, and so had the amount of principal to be lent out.

Belgium, the first 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.[12] Industrialization transformed the structure of the economy, which until then was based on small firms 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%.[13]

Critical to this success was the action of two banks. The Société Générale pour favoriser l'industrie nationale was the world's first joint-stock investment bank, created in 1822, well before industrialization took off. It became active in industrial finance beginning in the early 1830s. The Banque de Belgique was founded in 1835 to compete with it, and engaged in industrial finance from the outset.[14] These two banks dominated the banking sector from the outset, their capitalization accounting for about two thirds of all industrial credit banks (Durviaux (1947), p.56).[15] Other industrial banks existed, but were smaller and mostly local.[16] Entry of joint stock-banks into the financial sector was restricted. Incorporation

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

[13]Cameron (1967), p.148. Railways played a lesser role at this stage of the Belgian industrialization, though in these two decades 850 km were built, Mitchell (1980), tab G1.

[14]On the development of the Belgian financial sector cfr. Cameron (1967), Chlepner (1926,1930,1943), Morrison (1967), Société Générale de Belgique (1922), and Wee (1981).

[15]The initial capital of the Société Générale was 33 million Francs, which was doubled in 1837; the initial capital of the Banque fu Belgique was 20 million Francs, Durviaux (1937), p.11.

[16]See Cameron (1967), p.134-6, and Chlepner (1930), p.21-24. At least seven such banks appeared in the late 1830s: the Banque Liégeoise, the Banque Commerciale d'Anvers, the Banque d'Industrie, the Banque de Flandre, the Banque Foncière, the Caisse Hypotécaire, and the Caisse de Propriétaires, Chlepner (1930), p.61-3.

was not free, as the government could grant charters at their discretion, according to article 7 of the *Code du Commerce* (Neuville [1974], p.109-11). Incorporation charters were granted very sparingly, incorporating only the Société Générale and the Banque de Belgique.

Both banks assisted and actively encouraged firms in fast growing industries to adopt the corporate form in order to raise large amounts of external finance.[17] Between 1835 and 1838 alone the Société Générale organized 31 industrial *sociétés anonymes*, and the Banque du Belgique 24, helping them to raise a combined capital of 154 million Francs. (Cameron (1967), p.145). They invested a large part of their capital in industrial equity: in 1847 this was 31% for the Société Générale and 26% for the Banque du Belgique (Chlepner (1930), p.26). In 1860, the Société Générale controlled about 20% of the 1 billion Francs of industrial joint-stock capital.[18] These participations turned out to be profitable. The net income of the Société Générale, for instance, increased almost constantly over the 1830-1860 period. From the mid 1840s it reached double digit figures.[19] The assets of the two banks grew by an average 3.8% between 1834 and 1850 (Chlepner (1926), p.76-8.). As Cameron (1967, p.145) put it, "banks did not respond passively to demand for credit, but actively sought new firms, underwrote their stock issues, financed potential stockholders, held stock in their own names, placed their officers 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."

The Société Générale and the Banque du Belgique were the first examples of universal banks. They identified industries with high potential for growth, to which they extended credit and in which they bought equity participations.[20] For this purpose they came up with an important innovation: financial trusts.[21] Financial trusts managed most of banks' industrial portfolios.[22] 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

[17]. 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.

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

[19]Société Générale (1922). Annexes 6 and 8.

[20]Cfr. Société Générale (1922) for a detailed description of the bank's sectors.

[21]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.

[22]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.

financial managers.[23] Cameron (1961, p.90-1) describes how the Société Générale actively encouraged mining and foundries companies to incorporate, obtained Royal charters for them, and provided the necessary finance. 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 first 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.[24] 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 fivefold, and that of pig iron, spurred by a threefold expansion of railways, increased sixfold (Mitchell (1980), tables E2,E8,G1). The German industrial credit banks, *Kreditbanken*, played a similar role in industrial development as Belgian banks, 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 Schaaffhausen Bankverein, the Disconto Gesellschaft, the Bank für Handel und Industrie and the Berliner Handelsgesellschaft. They were all founded by 1856, and their capitalization accounted for nearly half of industrial credit banks' total. They were much larger than the smaller 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*.[25] Until 1871 incorporations in Prussia were subject to discretionary governmental approval, and entry as a large *Kreditbank* was restricted. The government granted a joint-stock charter only to the Schaaffhausen Bankverein.[26] 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 flood of new *Kreditbanken*.

The credit channeled by *Kreditbanken* increased 25-fold between 1852 and 1870, from 20 to 492 million Marks, at an average of 19.4% a year (Hoffman (1965), p.743). Between 1851 and 1870, 259 firms incorporated (up from 102 in the previous 24 years), almost always

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

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

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

[26]Tilly (1966), p.111.

with the help of an industrial credit bank.[27] *Kreditbanken* acted as universal banks. They not only provided loans and floated the securities of their clients, but also retained equity positions in these firms (Riesser (1911), p.62-6). Their activity concentrated in high growth regions and industries: mining, machinery, textiles, construction, and above all railways. These industries were centred in the regions of Rhineland, Ruhr, Silesia and Saxony.

The emphasis which German banks placed on equity participations and capital market operations was even more pronounced than that for Belgian banks. Riesser (1911, p.339-40) describes in detail the participations taken by *Kreditbanken* in railways and heavy industries in the 1850s. Such participations absorbed amounts of bank capital, from 13% for the Schaaffhausen Bankverein (p.72), up to 50% for the Bank für Handel und Industrie (p.81). Many participations resulted also from illiquid loans during the 1857 economic slump, but with time many of these became profitable.

Universal banking was profitable. The average dividends 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 Schaaffhausen Bankverein, and 7.3% For the Berliner Handelsgesellschaft. Moreover each bank accumulated several million marks of surplus reserves.

The personal nature of their business relationships allowed them to elicit and circulate information among industrial leaders effectively, and to have strong influence on investment decisions.[28] 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%.[29] The yearly growth rate of manufacturing production (1896-1913) ranged from 4.0 to 6.2% according to different estimates.[30] Between 1894 and 1913 the yearly growth rates were 15% in

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

[28] 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.

[29] 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), p.286.

[30] Federico and Toniolo (1988), discuss the reliability of different estimates.

electricity, 12.9% in chemicals, 10.7% in iron and steel, 7.5% in engineering, all higher than in other European countries (Cohen (1967), p.364). The share of producers' goods of total production rose from 28% to 47% (Romeo (1972), p.68). Private industrial credit banks (*'banche di credito ordinario'*) played a key role in channeling savings towards industrial high growth sectors and in influencing the direction and timing of investments. The Banca Commerciale was founded in 1894 and the Credito Italiano in 1895, before the economy made its 'big leap.' They controlled nearly 60% of the assets of all industrial credit banks, the others being few and smaller.[31] The assets of all industrial banks increased 2.5 times over the two decades, or 4.9% per year.[32] They spurred investment in electricity, mechanical engineering, metals, and automobiles, while overlooking traditional industries like textiles.[33] Also, they focused their efforts towards firms in the Northern 'triangle' between Genova, Torino and Milano (Aleotti (1990), p.58-60).

In the case of Italy sheer size seems to have been enough to deter entry by other large industrial credit banks. Indeed the Banca Commerciale and the Credito Italiano were successful in imposing exclusive relationships to most of their clients (Confalonieri (1980, vol.2), p.329).

As in Belgium and Germany, Italian industrial credit banks were another example of universal banking, engaging in both commercial and investment banking activities. Between 1894 and 1906 the Banca Commerciale took part in 145 capital market operations, and the Credito Italiano in 84.[34] This way they encouraged firms to undertake incorporation and raise funds on the stock market. Between 1900 and 1913 Italian joint stock companies grew from 848 to 3,069, and between 1900 and 1907 they raised about 2.7 billion lire, mostly on the stock exchange (Aleotti (1990), p.61-7). In 1897 there were 30 listed companies in the Milano Stock Exchange, which grew to 169 by 1908.[35] Both the Banca Commerciale and the Credito Italiano played a major role in planning and financing these operations. Confalonieri (1980, 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 refining, iron, and chemicals (1980, vol.2). He concludes that investment banking activities favored their

[31] Cfr Confalonieri (1980), vol.3. Most of these banks operated in Northern Italy.

[32] Cohen, (1972), p.78. Confalonieri (1980), vol.3, provides a thorough discussion of the evolution of the Italian financial system.

[33] As we can read in the early reports of the Banca Commerciale, the bank strived to be 'active part ... in all the major and worthy signs of the economic development in our country' (Confalonieri (1980),vol.3, p.42, our translation).

[34] These operations were flotations, mergers and acquisitions, capital increases, debt conversions, cfr. Confalonieri (1980), vol.2, p.341-5.

[35] Most of these were in electricity, transportation, and textiles, Aleotti (1990), p.62.

role as catalysts 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. They contributed 5% to 10% of the income of the two banks.[36] Loans to large industrial firms accounted for another 20-30% of assets and income (Confalonieri (1980), vol.3, p.486).

Like the Belgian banks with investment trusts, the Italian banks managed their industrial participations through subsidiaries. They acquired control in some industrial companies, which they used as holding companies. This was especially the case with fast growing industries: electricity, chemicals, iron and steel.[37] Gerschenkron (1962, p.88) noticed that in Italy "[a]s in Germany, not only capital, but a good deal of entrepreneurial guidance was channeled to the nascent and expanding industrial enterprises. As in Germany, the policy was to maintain an intimate connection with an industrial enterprise and to nurse it for a long time before introducing it to the capital market."

These experiences share several features, which are in accordance with the conclusions of our model. Each country went through a period of fast industrialization, where a few large universal banks financed the majority of industrial firms through loans, equity, and by floating industrial securities. These banks did not develop as a consequence of industrialization, but pre-existed it. They managed to retain considerable market power with the aid of regulations and legal barriers to entry. They actively promoted investment in industrial technology, and engaged in coordination of industrial investments. Finally they were all private institutions motivated by profits.

The importance of universal industrial credit banks becomes even more compelling when we consider cases where their absence coincided with protracted difficulties in catching up with industrialization. In some cases the small size of banks or their lack of market power seem to have failed to satisfy our conditions for bank led coordination. Such has been the experience of Russia and Spain, for instance.

As shown by Crisp (1967), Russian industrial credit banks developed slowly and re-

[36] Confalonieri (1980), vol.2, p.322, and vol.3, p.476. The Banca Commerciale had larger participations but also a larger balance sheet than the Credito Italiano. Both banks invested substantial amounts in public bonds and in short term loans.

[37] Some such cases were: Società Edison (BCI), Vizzola (BCI), and Società Industrie Elettro-Chimiche (CI); Unione Italiana Concimi (CI) and Montecatini (CI); Ferriere Italiane (CI), Società Elba and Acciaierie Terni (BCI), and Acciaierie Savona (BCI). Confalonieri (1980), vol.3, chapter 3, details their history, as do Cohen (1967), p.378-80, and Romeo (1972), p.77-8, and p.83 ff. To a lesser extent holding companies were used to coordinate bank activities in the mechanical industry, through Officine Meccaniche (BCI and CI) and Pattison (CI), and in steamship, through the Società Generale di Navigazione Marittima (BCI), Confalonieri (1980), vol.2, chapter 6.4.

mained 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.[38] Moreover, the government considered as usury any activity which took the form of compensation for risk-taking. 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 (10 in 1900 and 13 in 1914), and so there was much competition. Furthermore, these banks were also relatively small. Overall they represented only about 15% of the commercial banking sector.[39] 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. Several banks also engaging 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 engaged in commercial banking as well.[40] 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

[38]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.'

[39]Total joint-stock Russian banks were 40 in 1893, and 50 in 1914, Crisp (1967), p.197.

[40]Tortella (1972), p.93.

much larger than any previous industrial credit bank.

3 Discussion and Research Agenda

The model we have developed captures some of the fundamental traits of the fast industrialization of the countries whose experience we have examined in Section 2. In these cases a small number of industrial banks channeled their resources to a few high growth sectors. These banks not only took large debt and equity positions in the firms they financed, they were also large relative to the economy. They were set up as large banks since their inception, at the beginning of the catch-up period, and remained large as the economy grew. This suggests that their size was not merely the result of industrialization. Moreover, they were motivated primarily by profits, rather than by 'developmental' concerns. These large banks competed with a number of smaller banks that could partly free-ride on some of their activities, but managed to retain a substantial market power throughout the period. Finally, all these banks benefitted from being universal banks, as they could take equity positions in the firms they financed.

The Belgian Société Générale and Banque du Belgique, the German Schaaffhausen Bankverein, Disconto Gesellschaft, Bank für Handel und Industrie, Berliner Handelsgesellschaft, and the Italian Banca Commerciale and Credito Italiano all engaged in financing activities which closely resemble the ones of our model. In Belgium these large banks focused on mining and metal processing. In Germany they focused on mining, railways, and mechanical engineering, and in Italy on chemistry, electricity, iron and steel.[41]

Moreover, the universal nature of these banks meant that they faced a lower cost of inducing coordination than they would have with pure debt contracts.[42]

Our model applies to economies where the problem hampering development is a lack of coordination of investments.[43] We consider banks as one economic institution which may be able to internalize the externalities that create such coordination problems. We do not attempt to provide a general theory of industrialization, though. Banks need not

[41] These banks actively selected these sectors and solicited firms within them. Indeed, the ability of industrial banks to pick promising sectors and firms has been credited by historians as an important contribution to their countries' economic growth. The model we develop in the appendix allows us to capture this aspect through the presence of heterogenous firms. This implies that the lead bank finances firms not haphazardly, but in order to exploit complementarities among them.

[42] Bertero (1995) makes a similar argument for France after world war II. Bhatt (1995) discusses further 20th century examples along these lines.

[43] Thus coordination is likely to be most important for 'catch-up' economies. Matsuyama (1995b), for instance, forcefully argues that coordination becomes less important as the economy approaches the 'technological frontier.'

be the only institutions to achieve coordination, and coordination may not even always be the problem hampering industrialization. This caveat seems to apply, for example, to the industrialization experiences of England or the United States, which we do not try to explain here. Acemoglu and Zilibotti (1997), for instance, argue that experimentation and risk diversification were the crucial problems Britain had to solve to become the first country to industrialize. They show that the fragmented British banking sector was indeed instrumental for sustaining experimentation and diversification. Similarly, coordination may have been provided by institutions other than banks, as Chandler (1977) argued it was the case with railways in the creation of a unified market in the United States. Indeed, an interesting question for future research is what other institutions can achieve coordination and how their coordination activities may differ from those of banks. To us, history suggest at least two other important alternatives.

First, large industrial groups - conglomerates - can 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 more on the exploitation of technological complementarities across sectors. Moreover in Japan regulation forced banks to limit their action to short-term lending and also limited their size and power (Patrick (1967)). This brings up the question whether conglomerates arose as mere substitutes to industrial banks or as real alternatives, as explored by Da Rin (1998).

A second alternative to banks is coordination by a government. A country which exemplifies this view 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). Interestingly, 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).

It is sometimes argued that the costs of achieving coordination through large banks which enjoy market power is that they slow down growth, especially at later stages of development. Tilly (1993) for instance, argues that *Kreditbanken* developed a vested interest in maintaining a stable, oligopolistic industrial structure. A related criticism is that industrial credit banks have insufficient incentives to introduce financial innovations. Simi-

larly, it is frequently argued that conglomerates soon become an obstacle to innovation and entrepreneurship.[44] However, this does not imply that large banks or conglomerates are not desirable *per se*. Without their coordination activity industrialization may come later, or not at all. An interesting question for future research is then to examine which forces or policies may counterbalance the 'ossification' of these institutions once the economy achieves industrialization.

As for government coordination, there may also be inefficiencies. While a government can typically satisfy our size condition for coordination, it may not have the correct incentives to do so. Private banks and conglomerates have a clear objective: maximize profits. A government may not even have a well defined objective. Instead government officials may be exposed to the influence activities of various interest groups.[45] As a consequence they may be tempted or forced to allocate subsidized loans on the basis of political rather than economic merit.[46]

As some of these examples already suggest, there can be complex interrelationships among the institutions which induce coordination. 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)).

All these issues open up a rich agenda for future research. Should we think of conglomerates as a mere substitute to industrial banks or do they have a fundamentally different approach to achieving coordination? How much does the distinction of public versus private institutions matter for achieving coordination? Moreover, none of these institutions operates in isolation. How do they interact with each other? How do the costs of coordination change when several institutions are involved? And what are the dynamic welfare

[44] For instance Korean *'Chaebols'*, which were favored by the government during the industrialization phase, are believed of have become dysfunctional (The Economist (1996)).

[45] Milgrom and Roberts (1990b) discuss the importance of influence activities in government.

[46] Another problem with government coordination relates to their control over development banks. These banks are typically set up with the explicit purpose of making pioneering investments that stimulate subsequent private investment. As shown in our model such 'catalytic' investment by themselves are typically not profitable for banks. If development banks are allowed to take losses, it is much harder to assess their performance, especially since their contribution to the economy at large is difficult to measure. The lack of a performance measure then creates a moral hazard problem: Bank managers may run operations inefficiently or pursue their own political agendas.

properties of these mechanisms? We hope to have contributed a useful starting point for such analysis.

Appendix

A General Model of Complementarities

In this appendix we present a model with heterogenous firms 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.[47]

We modify the model of the main text by allowing each firm to have a different profitability, and its investment to have a different impact on other firms' profitability. When the investment pattern is K, the (gross) return to investment for firm 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 firm invests, its return depends not only on its own investment, but also on the investments of all other firms. 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 firm q are such that: $f(K_1,q)\leq f(K_2,q)$.[48] The only modification in the financial sector is that, with firm heterogeneity, a loan that is offered to a particular firm may not be available to another firm, i.e. we allow for price-discrimination. The present value of the profits of firm q is given by:

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

where firm q expects the set $K\cup q$ to invest.[49] Firm q invests whenever $\pi(K,q,i)\geq F_o$. A set of investing firms 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 firms 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.

(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.

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

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

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

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 simplificatory assumptions of identical firms 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 definition 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 firms 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 profits, the largest number of firms are investing, and the investment by one firm can only have a positive externalities on all other firms.

(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 $\emptyset \subseteq K^{\mathbf{0}} \subseteq (K^i \cap K^j)$ such that $\pi(K^{\mathbf{0}}, q, r) \leq \pi[K^i \cap K^j, q, r) < F_o$ for all $q \in (K^{ij} \cup K^{ji})$, $\pi(K^{\mathbf{0}}, q, r) < F_o$ for all $q \in Q \backslash K^{\mathbf{0}}$, and $\pi(K^{\mathbf{0}}, q, r) \geq F_o$ for all $q \in K^{\mathbf{0}}$. This shows that for any two non-nested equilibria there exists an equilibrium (possibly empty) where no firm 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 firms investing.

(iv) There cannot be too many firms investing in K^{IE} since every firm is individually profitable, and can only have positive externalities on all other firms. Suppose next a firm $q' \in Q \backslash K^{IE}$ were to invest as well. The definition 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 effect, captured by the function $f(.)$, it may be socially efficient to have more firms 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 definitions and two lemmata. We have to use a more sophisticated definition 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 firms 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 definition of critical mass, valid for any equilibrium.[50]

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 firms in K find it profitable to invest. Moreover, $M(K)$ is the smallest set that contains no redundant firms, i.e. the above property fails to hold if any one firm is dropped from $M(K)$. For any K there may be several critical masses $M_s(K)$, $s=1,...,S$. There is no definite 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 firms 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 satisfies 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 satisfies property *(i)*.
Let $M_s(K)$, $s=1,...,S$ be all the critical masses for K. We define $M_{min}(K)$ 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 firms in $M(K)$ when they hold 'pessimistic' beliefs that all firms outside of $M(K)$ and K^{BE} are not investing. We denote a 'catalytic loan set' by $\xi(M)$. The definition of BE implies that firms with pessimistic beliefs always assume that all firms in K^{BE} do invest. Note also that the above definition does not require all firms in $M(K)$ to have the belief that nobody in $M(K)$ is investing, but instead asks for an equilibrium of beliefs for all firms in $M(K)$. Whenever it is not confusing, we will write M instead of $M(K)$.

Our definition of critical mass ensures that even if firms 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 firms in K invest, while there may be more firms investing,

[50] 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.

either as part of M or not.[51] The definition 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 firms in K^{IE} investing) whenever it mobilizes some critical mass $M(K^{IE})$ for the IE.[52] 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 sufficient–condition for a set of interest rates to form a catalytic loan set $\xi(M)$ is to make it worth the investment by all firms 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 profits 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 firms 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 firms in M' invest, also all firms in M, and so all firms 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. □

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

[51] 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.

[52] 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.

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 profits should it choose to compete away some of the most profitable firms from the fringe banks. For each $q \in K\backslash M$ define 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 financing of the z most profitable firms to the banks in the competitive fringe. These banks will maximize their profits by charging the same interest rate i_z defined by: $\beta[f(K,\varphi_z) - (1+i_z)F_b] = F_o$ to firms φ_n, $n = 1, ..., z$. The lead bank maximizes its own profits by charging $i_l(q)$ such that $\beta[f(K,\varphi_n) - (1+i_l(\varphi_n))F_b] = F_o$ to firms $n = z+1, ..., \|K\backslash M\|$. Suppose next the lead bank decides to compete for *one single* firm $\varphi_{n'}$, with $n' \leq z$. In this case the lead bank has to offer firm $\varphi_{n'}$ the same interest rate (or ϵ less) than the fringe banks, or else its offer will be refused. The fringe banks now charge i_z defined by $\beta[f(K,\varphi_{z+1}) - (1+i_z)F_b] = F_o$ to firms 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 firms φ_n, $n = z+2, ..., \|K\backslash M\|$. Thus the lead bank gets the same return on firms $n = z+2, ..., \|K\backslash M\|$, and finances firm $\varphi_{n'}$ instead of firm φ_{z+1}, making zero profits in both cases. As a consequence the lead bank is indifferent between competing away *one* firm 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* firms $\varphi_{n'}$ and $\varphi_{n''}$, with $n' < n'' \leq z$. The lead bank must offer these two firms the same interest rates (or ϵ less) than the fringe bank, or else its offers will be refused. The fringe banks now charge i_z defined by $\beta[f(K,\varphi_{z+2}) - (1+i_z)F_b] = F_o$ to all firms 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 firms φ_n, $n = z+3, ..., \|K\backslash M\|$. We now ask whether the lead bank increases its profits by financing firms n' and n'' instead of leaving them to the fringe. By competing, the lead bank gets the same return on all firms φ_n, $n = z+3, ..., \|K\backslash M\|$, and finances firms n' and n'' instead of firms $z+1$ and $z+2$. In the former case it receives on both firms an interest rate $i_l(z+2)$ defined by $\beta[f(K,\varphi_{z+2}) - (1+i_l(z+2))F_b] = F_o$. In the latter case it receives a rate $i_l(z+1)$ defined by $\beta[f(K,\varphi_{z+1}) - (1+i_l(z+1))F_b] = F_o$ on firm n', plus a rate $i_l(z+2)$ defined 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 off when it tries to compete the better firms away

from the fringe. The same argument applies, *a fortiori*, should the lead bank choose to compete away from the fringe more than two firms. Without loss of generality we thus conclude that the lead bank leaves all the z most profitable firms 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 financing a critical mass, the lead bank may also finance some more firms. We denote the set of these firms by L which satisfies $L \equiv K_z^* \backslash \{M(K_z^*) \cup Z\}$. The lead bank makes an overall profit 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* $z \leq \tilde{z} \equiv Q - \left|M_{min}(K^{IE})\right|$.

(ii) There exists a critical value $\hat{z} < \tilde{z}$*, 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 $\tilde{z} \equiv Q - \|M_{min}\|$, the lead bank is too small to finance 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 finance those firms that were financed 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 finance some other additional firms. And since fringe banks make non-negative

profits, the lead bank cannot decrease its profits 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 define $\hat{z}$ 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 firms 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 definition $K_z^* \supseteq K^{IE}$. Since all firms and banks are making non-negative profits 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 firms in L and Z pay a higher interest rate than in the competitive equilibrium. □

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

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* $z \leq \overline{\overline{z}}$;

(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 firm 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 firm 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 profits on all the firms 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 firms in M. If F_o is small enough, then α may be quite large, implying that the lead bank is making large profits on

some of the firms 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 profitable firms, which may now include some of the firms in the critical mass. This, however, does not contradict the analysis since the lead bank simply makes neither profit nor loss on these firms. This completes the proof for part (ii).

Let $\hat{\hat{z}}$ be the maximum size of the competitive fringe when equity financing is possible. It must be that $\hat{\hat{z}} \geq \hat{z}$, otherwise the lead bank could offer 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 firms in M. It may therefore afford to finance fewer firms 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 finance any critical mass, and the BE remains an equilibrium. Thus $\hat{\hat{z}} \leq Q - \|M_{min}\|$, Moreover, if M_{min} is not profitable 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 firms. Moreover, if the above inequality is strict, then there exists a neighborhood of F_o in which the lead bank still makes non-negative profits on all firms in the critical mass. But if the lead bank incurs no costs of coordination, then it always induces coordination, since this can only increase its profits. The sufficient condition becomes that it is large enough to finance 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] Acemoglu, Daron, and Fabrizio Zilibotti [1997], 'Was Prometeus Unbound by Chance? Risk, Diversification and Growth,' *Journal of Political Economy*, **105** (4), 709-52.

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

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

[4] Azariadis, Costas, and Allan Drazen [1990], 'Threshold Externalities in Economic Development,' *Quarterly Journal of Economics*, **105** (2), 501-26.

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

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

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

[8] Benston, George [1994], 'Universal Banking,' *Journal of Economic Perspectives*, **8** (3), 121-43.

[9] Bhatt, Vinayak [1995], *Financial Systems, Innovation and Development*, New Dehli, Sage Publications.

[10] Bertero, Elisabetta [1995], 'Restructuring Financial Systems in Transition and Developing Economies: An Approach Based on the French Financial System,' Special Paper n.80, LSE Financial Markets Group.

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

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

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

[14] Chandler, Alfred [1977], *The Visible Hand: The Managerial Revolution in American Business*, Cambridge, MA, The Belknap Press.

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

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

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

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

[19] 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.

[20] 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.

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

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

[23] Confalonieri, Antonio [1980], *Banca e Industria in Italia, 1894-1906*, Bologna, Il Mulino.

[24] 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.

[25] 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.

[26] Da Rin, Marco [1998], 'Catalysts for Industrialization: Banks vs Conglomerates,' mimeo, IGIER.

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

[28] Durlauf, Steven [1993], 'Nonergodic Economic Growth,' *Review of Economic Studies*, **60** (2), 349-66.

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

[30] The Economist [1996], 'In the Shadow of the Chaebol,' July 6th 1996.

[31] Fafchamps, Marcel, and Brigit Helms [1996], 'Local Demand, Investment Multipliers, and Industrialization,' *Journal of Development Economics*, **49** (1), 61-92.

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

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

[34] Fuà, Giorgio [1965], *Notes on Italian Economic Growth, 1861-1964*, Milano, Giuffrè.

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

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

[37] Harris, Milton and Arthur Raviv [1991], 'The Theory of Capital Structure,' *Journal of Finance*, **46** (1), 297-356.

[38] Hart, Oliver, and John Moore [1995], 'Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management,' *American Economic Review*, **85** (3), 567-85.

[39] Hellmann, Thomas, Kevin Murdock and Joseph Stiglitz [1997a], 'Financial Restraint: Toward a New Paradigm,' in Masahiko Aoki, Masahiro Okuno-Fujiwara and Hyung-Ki Kim (eds.) *The Role of Government in East Asian Economic Development: Comparative Institutional Analsysis*, Oxford, Oxford University Press.

[40] Hellmann, Thomas, Kevin Murdock and Joseph Stiglitz [1997b], 'Financial Sector Development Policy: The Importance of Reputational Capital and Governance,' in

Richard Sabot and Istvan Skékely (eds.) *Development Strategy and Management of the Market Economy*, Oxford, Oxford University Press.

[41] Helpman, Helhanan, and Paul Krugman [1985], *Market Structure and Foreign Trade*, Cambridge, MIT University Press.

[42] Hoffmann, Walter [1965], *Die Wachstum der Deutschen Wirtschaft seit der Mitte des 19.Jahrhunderts*, Berlin, Springer Verlag.

[43] King, Robert, and Ross Levine [1993], 'Finance and Growth: Schumpeter Might be Right,' *Quarterly Journal of Economics*, **108** (3), 681-737.

[44] Krugman, Paul [1991], 'History versus Expectations,' *Quarterly Journal of Economics*, **106** (3), 651-67.

[45] Levine, Ross [1997], 'Financial Development and Economic Growth: Views and Agenda,' *Journal of Economic Literature*, **35** (2), 688-726.

[46] Lévy-Leboyer, [1964], *Les Banque Europèenes et l'Industrialization Internationale dans la Première Moitié du XIX Siècle*, Paris, Presse Universitaire de France.

[47] Matsuyama, Kiminori [1991], 'Increasing Returns, Industrialization and Indeterminacy of Equilibria,' *Quarterly Journal of Economics*, **106** (3), 617-50.

[48] Matsuyama, Kiminori [1992], 'Making Monopolistic Competition More Useful', Working Paper E-92-18, Hoover Institution, Stanford University.

[49] Matsuyama, Kiminori [1995a], 'Complementarities and Cumulative Processes in Models of Monopolistic Competition,' *Journal of Economic Literature*, **33** (2), 701-29.

[50] Matsuyama, Kiminori [1995b], 'New Goods, Market Formations, and Pitfalls of System Design,' *Journal of the Japanese and International Economies*, **9** (3), 376-402.

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

[52] Milgrom, Paul, and John Roberts [1990b], 'Bargaining Costs, Influence Costs, and the Organization of Economic Activity,' in James Alt and Kenneth Shepsle (eds), *Perspectives on Positive Political Economy*, Cambridge, Cambridge University Press.

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

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

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

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

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

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

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

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

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

[62] 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.

[63] Pohl, Manfred [1992], *Konzentrazion im deutschen Bankwesen*, Frankfurt, Fritz Knapp Verlag.

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

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

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

[67] Rodríguez-Clàre, Andrés, [1996a], 'The Big Push in a Small Open Economy', *Journal of Development Economics,* **49** (1), p.33-2.

[68] Rodríguez-Clàre, Andrés, [1996b], 'Positive Feedback Mechanisms in Economic Development: A Review of Recent Contributions,' mimeo, University of Chicago.

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

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

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

[72] Société Générale de Belgique [1922], *Le Centenaire de la Société Générale*, Bruxelles, Société Générale.

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

[74] 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.

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

[76] 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.

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

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

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