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Banks Versus Bonds:
The Emergence and Persistence of two Financial Systems

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Abstract

We use a simple graphical moral hazard model to compare monitored (non-traded) bank loans versus traded (non-monitored) bonds as sources of external funds for industry. We contrast the conditions that theoetically favour each system, such as the size and number of firms, with conditions prevailing when these financial systems evolved during the British and German industrial revolutions. Then, to address why different systems have persisted, we consider a larger model with entry so that firm size and number are endogenous. We show that multiple equilibria can exist if financiers take the industrial structure as given and vice versa, and we compare these equilibria in welfare terms. Finally, we argue that with, if bilateral co-ordination is possible, Anglo-Saxon style finance systems can only persist if they are efficient, but an economy can get stuck in an inefficient German style system.

JEL Classification: N20, D82, G20

Keywords: Monitoring, Traded Debt, Anglo-Saxon Financial Institutions, Industialization, Internal and External Economies, Free Entry.

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1 Introduction

Three questions motivate this paper. First, why did different methods of finance emerge from the British and German industrial revolutions? To the degree that the new English industrial firms used external finance at all, it was often in the form of tradeable bills of exchange or promissory notes. Banks (notably, but not only, the *Grossbanken*) played a more prominent role in funding late-19th century German industrialization.[1] Second, why did these two modes of finance not converge more quickly over time? Separate so-called German and Anglo-Saxon financial systems persist today. And third, do these differences matter in terms of welfare?

Each of the three questions above has a good pedigree. For example, it was the power and importance of the German universal banks that led Hilferding (1910) to develop his theory of *Finance Capital*. Later, different methods of finance were among the main contrasts identified by Gerschenkron (1962) in his seminal comparative study of early and late industrial revolutions:

> "The industrialization of England had proceeded without any substantial utilization of banking for ... investment purposes. ... [Whereas] the continental practices in the field of industrial investment banking must be conceived as specific instruments of industrialization in a backward country." (p.14)

More recently, Mokyr (1985, p. 37), in his survey of new thinking on the British industrial revolution, wrote of industrial banks: "why such institutions were relatively unimportant is still an unanswered problem", while Chandler (1990, pp. 415-9) praised the *Grossbanken* for shaping what he calls "German managerial capitalism".

The third question — the pros and cons of the Anglo-Saxon versus the German financial system — has given rise to much heated debate. The grass has often seemed greener on the other side of the fence. Analyses of Anglo-Saxon economies often blame the supposed greater separation of industry from finance for the decline of Britain from the late 19th century onward and of the US today.[2] Analyses of Germany sometimes argue that Grossbanken hindered growth, while similar complaints are sometimes made of Zaibatsu and Keiretsu

[1] See, for example, Anderson (1970), Ashton (1945, 1955 ch. 6), Crouzet (1963), Neal (1994), and Tilly (1992, 1998). Edwards & Ogilvie (1996), however, warn against exaggerating the importance of universal banks in Germany.

[2] For example, Best & Humphries (1986, p. 223) write: "The lack of integration between finance and industry adversely affected the volume and allocation of British industrial investment and the long-term competitive performance of British industry compared with its international rivals." While Calomiris (1995, p. 258) writes of the US: "... large-scale industrial investment was stunted relative to its potential by a faulty financial system." See also, for example, Ingham (1984); and Kennedy (1987 and 1990). For a critiques of the modern UK and US financial systems see Mayer (1991) and Porter (1992).

in Japan.[3] Most recently, the debate has resurfaced in the guise of choosing appropriate financial institutions for Eastern Europe.

One major difference between the two financial systems was the degree to which creditors monitored firms. In England, creditors preferred (and to some extent still prefer) a 'hands-off' approach. This may have reflected a preference for liquid assets. Final holders of widely traded securities may have been too distant to monitor directly, or too many to internalize the costs of monitoring. Lemons problems may have made it difficult to recover monitoring costs when an asset was transferred.. Collins (1991) argues that even banks were first concerned with liquidity, preferring to discount bills of exchange rather than provide direct industrial loans. Even when English banks provided direct loans, their monitoring did not impress Riesser (1909), the self-appointed spokesman for German industrial bankers:

> "the [English] banks have never shown any interest in the newly founded companies or in the securities issued by these companies, while it is a distinct advantage of the German system, that the German banks, even if only in the interests of their own issue credit, have been keeping a continuous watch over the development of the companies, which they founded." (p. 555)

By contrast, German banks saw their role as providing direct credit to industry, not merely as traders of liquid assets. Gerschenkron (1962, p.14) wrote that German industrial banks "established the closest possible relations with industrial enterprises". One form of monitoring (though the importance of this has been over-emphasized) was to place bank officers on the supervisory boards of industrial companies.[4] The German financial system has come to be associated with 'hands-on', relationship banking.

In Section 2, we model the choice of different methods of firm finance, focusing on the trade-offs between monitored (non-traded) loans and tradeable (non-monitored) debt. The model is simple enough to allow a graphical treatment. Even such a simple model, however, can explain the emergence of two different financial systems, given the differences in the 18th century English and 19th century German economies. Section 3 then asks why these different systems persisted and considers the welfare policy consequences.

Hölmström (1996) uses a model similar to that presented in the first part of section 2 to compare the benefits of different types of finance over the life-cycle of the firm. Scherfke (1993) uses a dynamic model to address similar issues. Aoki (1993) considers repeated moral

[3] See, for example, Neuburgher & Stokes (1974); Weinstein & Yafeh (1998); and Masuyama (1991).

[4] Hilferding, (1910, p. 398.) reports that by 1903, the six largest Berlin banks controlled 751 positions on Boards of directors. See also Riesser (1909, pp. 897-920). Fohlin (1996, 1997), however, argues that representation by banks on supervisory boards was much lower before 1900. Edwards & Ogilvie (1996) point out that, anyway, most German firms of the period were not joint stock and hence did not have supervisory boards, and the power of such boards has been exaggerated. See also Edwards & Fischer (1994).

hazard in teams and shows that banks can help by eliminating budget balance. Calomiris (1995) and Calomiris & Raff (1995) stress economies of scope enjoyed by universal banks. Dewatripont & Maskin (1995) emphasize a trade off between the ability to finance large projects and the ability credibly to commit not to refinance. Cantillo (1994), following Diamond (1984), stresses the ability of intermediaries to verify bankruptcy.. Allen & Gale (1995, 1997) compare the ability of financial systems to smooth income intertemporally and diversify individual and aggregate risks. Brecht & Ramirez (1993) and Fohlin (1994) consider whether German banks eases firm's internal liquidity constraints. Da Rin (1997) looks at the effect of economic integration on the choice both of capital specificity and the form of finance.

2 Monitored versus Non-Monitored Loans.

In this section, we consider some of the trade-offs involved in choosing either monitored bank loans or non-monitored (possibly tradeable) debt. Once we have established circumstances such that we would expect to see one or the other system of finance emerge, we compare these with standard accounts of German and English industrialization. We start from a simple moral hazard model, and then add structure.

2.1 The Basic Model.

Consider the choices facing entrepreneurs each of whom has access to a new project that requires external financing in period 1. If a project of size q is successful, it yields revenues of Pq in period 2, where $P > 1$. If it fails, it yields zero. In either case, the project terminates in period 2. Projects are ex ante identical. The probability that each project succeeds depends on actions taken by an entrepreneur (whose participation is essential). Some of the actions and efforts that raise the probability of success involve private (possibly non-pecuniary) costs for the entrepreneur. Let π denote the probability of success and, for a project of size q, let $q\psi(\pi)$ be the associated private cost to the entrepreneur, where $\psi(0) = \psi'(0) = \psi''(0) = 0$, $\psi'(1) = \psi''(1) = \infty$, and $\psi''' > 0$.

A project of size q requires q units of capital. Assume that q is greater than w, the entrepreneur's initial wealth, so that at least part of the capital has to be borrowed. Borrowing can be either in the form of a monitored or a non-monitored loan. If loans are not monitored, then the privately costly actions of the entrepreneur that affect the probabilities of success, π, are unobservable to lenders and will depend on incentives provided by the loan contract. These incentives will, in general, induce only 'second-best' success probability levels. If loans are monitored then such actions, and hence the success probabilities they generate, are contractible.. The advantage of monitoring is that it allows first-best probabilities of success to be enforced. The disadvantage is that monitoring is costly.

Let the subscripts A and G denote the Anglo-Saxon and German financial systems respectively. Accordingly, let the marginal cost, c, to the lender(s) of providing one unit of capital be c_A without monitoring, or c_G with monitoring, where $c_A, c_G > 1$. We will give more structure to these costs below but, for now, assume these are constant marginal costs. For a project of size q, let qR be the amount repaid by the entrepreneur to the lender(s) if the project is successful and qd be the amount paid if it fails. Let L denote the size of the loan and let D denote the amount the entrepreneur deposits in a bank (at zero interest) in period 1 to use or consume the next period.[5] Both entrepreneurs and lenders are risk neutral and do not discount future consumption. In particular, let the entrepreneur's payoff, U and the lenders' (aggregate) payoff, V, be given by:

$$\begin{aligned} U &= q[\pi P - \psi(\pi) - \pi R - (1-\pi)d] + D \\ V &= q[\pi R + (1-\pi)d] - cL. \end{aligned}$$

To begin with, we assume that all the bargaining power resides with the entrepreneur. For example, suppose that the financial sector is competitive and that lenders make zero expected profit. Then, formally, the problem facing the entrepreneur if she chooses a monitored loan is given by

$$\max_{L,D,R,d,\pi} q\left[\pi P - \psi(\pi) - \pi R - (1-\pi)d\right] + D \qquad \text{subject to} \tag{1a}$$

$$q\left[\pi R + (1-\pi)d\right] - c_G L \geq 0; \tag{1b}$$

$$w + L - D - q \geq 0; \tag{1c}$$

$$qP + D - Rq \geq 0; \qquad \text{and} \tag{1d}$$

$$D - dq \geq 0; \tag{1e}$$

where, D, $L \geq 0$ and $\pi \in [0,1]$. Whereas the problem facing the entrepreneur if she chooses a non-monitored loan is given by:

$$\max_{L,D,R,d,\pi} q\left[\pi P - \psi R - (1-\pi)d\right] + D \qquad \text{subject to} \tag{2a}$$

$$q\left[\pi R + (1-\pi)d\right] - c_A L \geq 0; \tag{2b}$$

$$\pi \in \arg\max_{\pi \in [0,1]} q\left[\pi P - \psi(\pi) - \pi R - (1-\pi)d\right]; \qquad \text{and} \tag{2c}$$

conditions (1c) (1d), (1e), where $D, L \geq 0$.

[5] Thus, the entrepreneur could, in principle, borrow more than the cost of the project, though in fact she will never choose to do so.

Constraints (1b) and (2b) ensure lenders at least zero expected profits. Constraint (1c) ensures that there are sufficient funds to undertake the project. Constraints (1d) and (1e) ensure that the payments, R and d, are feasible. The extra incentive compatibility constraint (2c) in the non-monitored loan problem arises because the entrepreneur cannot commit to an effort level at the time the debt contract is signed.

This model is simple enough to illustrate graphically. The appendix provides a more formal treatment. First notice that, in both problems, at the optimum, no money is deposited in the bank in order to make a repayment if the project fails ($D = d = 0$), and, the optimum loan is just sufficient to cover the entrepreneur's shortfall in funding the project ($L = q - w$). The intuition for this is that the cost of borrowing is higher than the interest rate on deposits, so the entrepreneur will never borrow to deposit. We can therefore illustrate optimal contracts in two dimensions, π and R.

Figure 1(a) illustrates problems (1) and (2) for the case where the borrower is roughly indifferent between a German- and an Anglo-Saxon-style loan. The horizontal axis shows π, the probability of project success. The vertical axis shows R, the contract repayment terms after dividing through by the size of the project. All vertical distances are per unit size of the project.

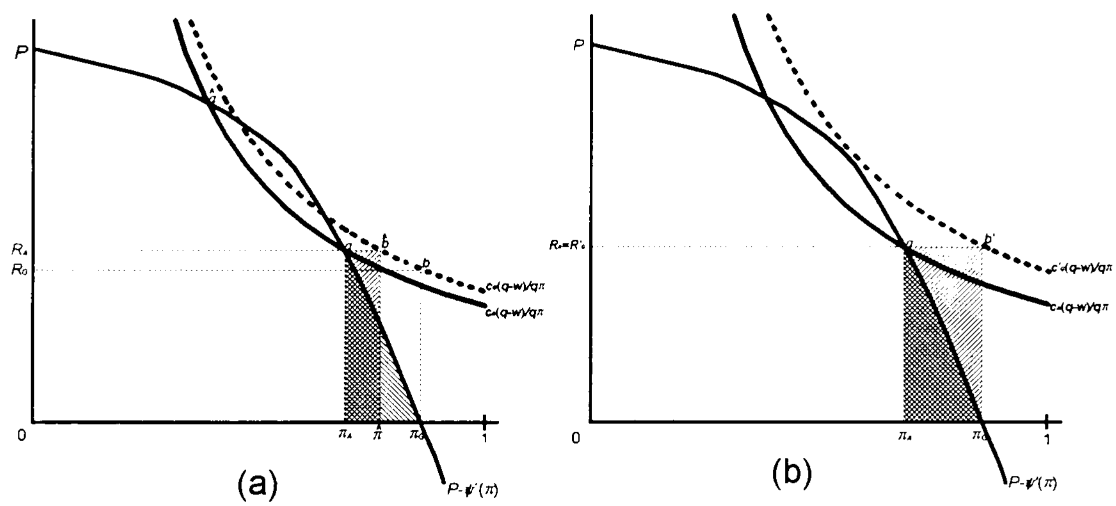

Figure 1: The Basic Model when Borrowers have the Bargaining Power

Consider first the monitored loan problem. The area under the concave curve $P - \psi'(\pi)$ shows the entrepreneur's per unit expected revenue net of his private cost ψ. This is maximized where the curve crosses the horizontal axis, hence the first best probability of success — that stipulated by a monitored loan contract — is given by the equation

$P - \psi'(\pi_G) = 0$. The hyperbola, $R = c_G(q - w)/q\pi$, represents zero expected profits for lenders. That is, the per unit expected repayments to lenders, $\pi_G R_G$, just covers the per unit cost of a monitored loan, $c_G(q - w)/q$. Thus, the net per unit expected profit of an entrepreneur with a German style loan is shown by the net revenue area $0Pa\pi_G$ minus the borrowing-cost rectangle $0R_G b\pi_G$. Exploiting the properties of a hyperbola, the latter rectangle is equal to the area $0R_A\hat{b}\hat{\pi}$.[6]

Next consider the non-monitored loan problem. In this case, once the contract is signed, the entrepreneur does not receive the full benefit of her actions at the margin. The reason is that, if the project fails, the entrepreneur makes no payment to the lender, but if it succeeds, she makes a positive payment, R. Therefore, the entrepreneur only has an incentive to increase the probability of success up to the point where $P - \psi'(\pi) = R$. The concave curve in Figure 1(a) shows all combinations of π and R that satisfy this incentive-compatibility constraint. Similar to before, the hyperbola, $R = c_A(q - w)/q\pi$ represents zero expected profits for lenders. The contract must specify a probability of success π and a repayment R on the incentive-compatibility curve, and on or above this zero-profit hyperbola: that is, for the case shown, between $\hat{a}$ and a.[7] As before, the per unit expected profit net of private costs is given by the area under the concave curve. Given the constraints, this is maximized at a. Thus, the per unit net expected profit of an entrepreneur with an Anglo-Saxon style loan is shown by the net revenue area $0Pa\pi_A$ minus the borrowing-cost rectangle $0R_A a\pi_A$.

The nearly-triangular area $\pi_A a\pi_G$ (shaded downward) represents the per unit dead-weight loss arising from the information asymmetry in a non-monitored loan. On the other hand, the extra per unit cost of a monitored loan is shown by the rectangle $\pi_A a\hat{b}\hat{\pi}$ (shaded upward). To decide between an Anglo-Saxon- or German-style loan, the entrepreneur compares the per unit dead-weight loss of an Anglo-Saxon-style loan with the per unit extra cost of a German-style loan. In our case, these are drawn to be roughly equal.

The above discussion is summarized in the following Proposition which we state without further proof.[8]

Proposition 1 *The entrepreneur will choose an Anglo-Saxon style, non-monitored loan if and only if there exists a $\pi_A \in (0, 1)$ given by*

[6] A necessary condition for the project to be undertaken with a German-style loan is that the expected profit area is non-negative. This requires that $P > R_G$, so constraint (1d) never binds in Problem (1).

[7] At low values of P or high values of c, no pair (π, R) will satisfy both constraints. In these cases, non-monitored loan contracts are infeasible. If such a contract is feasible, $P > R_A$, so again constraint (1d) never binds in Problem (2).

[8] Assume that, where feasible, an entrepreneur always chooses an Anglo-Saxon over a German style loan if indifferent and chooses to undertake the project at zero profit.

(a) $P - \psi'(\pi_A) = c_A(q-w)/q\pi_A$ *and*

(b) $\psi''(\pi_A) \geq c_A(q-w)/q\pi_A^2$

such that

(c) $(\pi_G P - \psi(\pi_G)) - (\pi_A P - \psi(\pi_A)) \leq (c_G - c_A)(q-w)/q,$

where π_G *is given by*

(d) $P - \psi'(\pi_G) = 0.$

Otherwise, the entrepreneur chooses a German style monitored loan, if and only if

(e) $\pi_G P - \psi(\pi_G) - c_G(q-w)/q \geq 0.$

Proposition 1 part (a) is the feasibility condition for a non-monitored loan. Part (b) selects points like a over points like $\hat{a}$. Part (d) defines the first-best probability level. Part (e) states the zero profit condition for a monitored loan. And part (c) states that an Anglo-Saxon loan is preferred if the deadweight loss (the left side) is less than the additional cost of monitoring (the right side).

The model has some immediate implications. First, since dead-weight losses are positive, a necessary condition for an entrepreneur to choose an Anglo-Saxon-style loan over a monitored one is that it have lower cost, $c_A < c_G$. Second, a necessary condition for the entrepreneur to prefer a German-style loan is that monitored 'interest rates' are lower, $R_G < R_A$. The intuition is that the probability of repayment of a monitored loan, π_G, is always higher than that of a non-monitored loan, π_A. If $R_A = R_G$, as shown in Figure 1(b), then the extra cost rectangle, $\pi_A a b' \pi_G$, must be larger than the deadweight loss area $\pi_A a \pi_G$.

Simple comparative statics: (a) Costs of Credit. Suppose that the costs of providing credit, c_A and c_G, were to increase by the same amount (leaving the right side of Proposition 1 part (c) unchanged). Then the dead-weight loss of a non-monitored loan, the left side of part (c), would be increased. That is, the higher is the cost of credit, the more likely is an entrepreneur to choose a German style monitored loan. The intuition for this is that raising the marginal cost of a monitored loan, c_G, has no effect on the first-best success probability level π_G. But, raising the marginal cost of a non-monitored loan, c_A, reduces the success probability level, π_A, induced by the second-best optimal contract, raising the dead-weight loss. In Figure 2(a), raising c_A to $c_A^{'}$ reduces expected revenues net of private costs of the entrepreneur with an Anglo-Saxon style loan by the (almost rectangular) area $\pi'_A a' a \pi_A$. But raising c_G to $c_G^{'}$ has no effect on the expected revenues of the entrepreneur with a German style loan.

The cost of providing either monitored and non-monitored loans is affected by the cost of capital to the financial sector itself. A possible empirical proxy for this could be the real

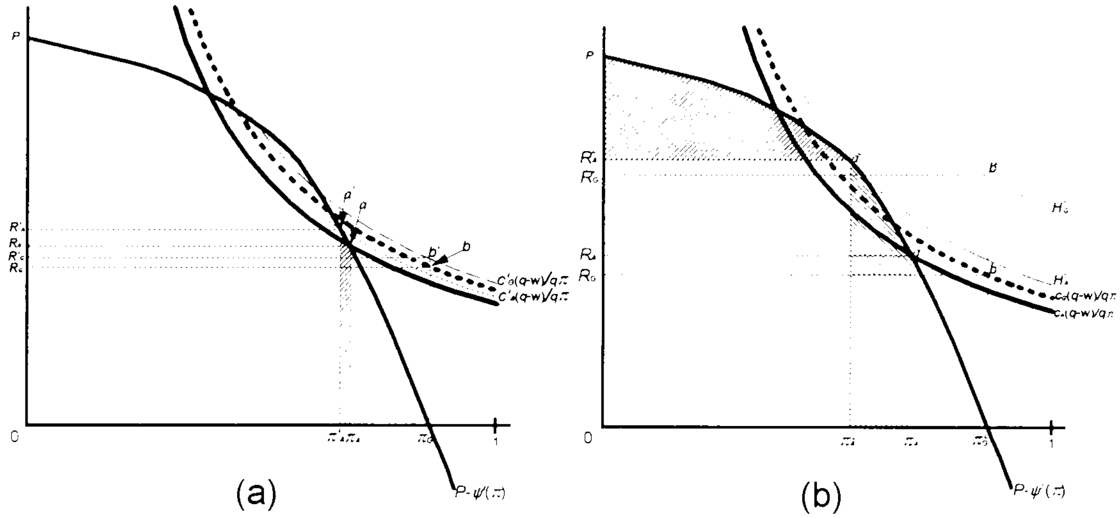

Figure 2: Comparative Statics of the Basic Model

rate of interest on government debt. Homer (1963) provides nominal yields of British consols from the 1750s, of Bavarian and Prussian state bonds before 1869 and of German bonds after 1870. Two things stand out. First, consol rates were lower in the late 19th century than they were at the height of the English industrial revolution a century earlier. This fall in nominal interest rates partly reflects price movements: the late 19th century was period of deflation. It is likely, however, that real interest rates were also lower in the later period. In England, at least, this was a period of low government borrowing. Second, German interest rates were consistently between a half and a whole point above their English equivalents. This could reflect higher risk premiums on less secure governments but it is also consistent with stories of greater capital scarcity in Germany. The second observation counters the effect of the first. The expansion of heavy industry in Germany took place at a time when interest rates were low (favoring non-monitored finance) by historical standards but in a place where interest rates were high (favoring monitored finance) by British standards. From the British perspective, historically and internationally low interest rates may have discouraged a switch to German-style monitored finance in the late 19th century.

Simple comparative statics: (b) Cartelization and Protection. A feature of late 19th century Germany that has attracted much attention is the degree to which some industries were both protected and cartelized.[9] It has been suggested that there is a connection to German-style financing. We can use our model to explore at least one such connection. Pro-

[9] See, for example, Borchardt (1973) or Webb (1980).

tection and cartelization presumably raised industrial output prices. In our model, increasing the price P, has no effect on the costs on the right of Proposition 1(c) . But, increasing P has two affects on the deadweight losses on the left of this condition:

$$(\pi_G - \pi_A) - \frac{R_A}{[\psi''(\pi_A) - (c_A(q-w)/q\pi_A^2)]}$$

The direct effect, $(\pi_G - \pi_A) > 0$, increases deadweight loss. Monitored firms get to enjoy higher prices more often since they have a higher probability of succeeding. The indirect effect is the second term above. As prices rise, entrepreneurial effort (hence π) increases. For monitored loans, π was already at the first best, so there is only a second-order gain. For unmonitored loans, however, π was below the first best, so there is a first-order gain. The marginal return to increasing π is the height of point a from the horizontal axis, hence R_A in the numerator. The increase in π_A as we increase P depends on the relative slopes of the incentive-compatibility and zero-profit curves at point a, hence the denominator. This indirect effect is similar (but opposite) to the effect of increasing the costs of credit.

Thus, the model suggests that the effects of monopoly and protection on the choice of financing are ambiguous. On the one hand, higher prices increase the cost of any given loss of production from moral hazard. On the other hand, they diminish the loss of production from moral hazard. There may, however, have been other connections between cartelization and German-style finance. For example, it is possible that the monitoring of several firms by the same banks both helped keep cartel interests aligned and alleviated intra-cartel information problems.

Simple comparative statics: (c) Bargaining power. During the British industrial revolution, it is unclear whether bargaining power lay with borrowers or lenders. For late 19th century Germany, however, Hilferding (1910) regarded the power of finance important enough to require adjusting orthodox Marxist theory. Gerschenkron (1962, p.14 and p.21) argued that banks "acquired a formidable degree of ascendancy over industrial enterprises", describing this as "master-servant" relationship. Edwards & Ogilvie (1996) argue that the power of banks has been exaggerated, especially as the relative size of industrial firms grew. But banks grew too. In 1913, 17 of the 25 largest enterprises in Germany (measured by paid up capital) were banks.[10] Moreover, banks essentially controlled access to the Berlin securities exchange.[11]

While we cannot resolve this historical debate, we can ask what is the effect of shifting

[10] Tilly (1986 pp. 113-4). For increased concentration in banking, see Tilly (1992), Riesser (1909), and especially Da Rin (1996).

[11] See Tilly (1995).

bargaining power from borrowers to lenders on the choice of type of loan. So far, we have assumed that the all the bargaining power lies with the borrower. Consider, next, the opposite case where all the bargaining power lies with the lenders. The problem faced by such lenders if they choose a monitored loan is given by:

$$Max_{L,D,r,d,\pi} q(\pi R + (1-\pi)d) - c_G L \qquad \text{subject to :} \tag{3a}$$

$$q(\pi P - \psi(\pi) - \pi R - (1-\pi)d) + D \geq 0 \tag{3b}$$

and constraints (1c), (1d) and (1e), where $D \geq 0$, $L \geq 0$ and $\pi \in [0,1]$. If the lenders chose a non-monitored loan, the problem becomes

$$Max_{L,D,r,d,\pi} q(\pi R - (1-\pi)d) - c_A L \ \text{ subject to} \tag{4}$$

constraints (3b), (1c), (1d), (1e), and (2c), where $D \geq 0, L \geq 0$ and $\pi \in [0,1]$. Condition(3b) is the zero profit constraint for the entrepreneurs. The other constraints have the same interpretation as before.

Let (π_G^L, R_G^L) denote the solution to Problem (3) and let (π_A^L, R_A^L) denote the solution to Problem (4). For completeness, the following proposition states formally (but without proof) the conditions under which the lenders choose Anglo-Saxon- or German-style loans.[12] The intuition is similar to that for Proposition 1

Proposition 2 *The lenders will choose an Anglo-Saxon style, non-monitored loan if and only if*

(a) $\pi_G^L R_G^L - \pi_A^L R_A^L \leq (c_G - c_A)(q-w)/q$ *and,*
(b) $\pi_A^L R_A^L - c_A(q-w)/q \geq 0$.

Otherwise, the lenders choose a German style, monitored loan if and only if
(c) $\pi_G^L R_G^L - c_G(q-w)/q \geq 0$.

The left side of Proposition 2 part (a) is the difference in lenders' per unit expected revenues across loan types. The right side is the same as the right side of Proposition 1(c), the difference in per unit costs. Parts (b) and (c) are both zero expected profit conditions.

We claim that, if the bargaining power is moved from entrepreneurs to the suppliers of capital, then we are more likely to see a German financial system emerge. The formal argument in the appendix compares the conditions in Propositions 1(c) and 2(a). The intuition, however, can be seen in Figure 2(b).

[12] As before, assume that the lenders choose non-monitored over monitored loans if they are indifferent and that they choose to undertake the project at zero profit.

Monitored loans, whether bargaining lies with borrowers or lenders, induce the efficient probability of success: where the curve $P - \psi'(\pi_G)$ crosses the axis. Thus, π_G in Figure 1(a) equals π_G^L in Figure 2(b). Moreover, the ultimate cost of supplying the monitored loan is the same: area $OR_G b\pi_G$ in Figure 1(a) and $OR_G b\pi_G^L$ in Figure 2(b). Therefore, the total surplus available from a monitored loan is the same regardless of where bargaining power lies. Switching bargaining power from borrower to lender merely transfers this same surplus from one to the other. It is the borrower now who makes zero profit. In Figure 2(b), the hyperbola H_G^L represents the lender's per unit expected revenues ($\pi \times R$) equal to the borrower's per unit expected revenue (net of his private cost). That is, area $0R_g^L b^L \pi_G^L$ equals area $0Pa\pi_G^L$.

For non-monitored loans, however, switching the bargaining power from borrowers to lenders affects the size of the available surplus. Moreover, not all the surplus can be transferred to the lender. Non-monitored loan contracts must still satisfy the incentive constraint, $P - \psi'(\pi) = R$, represented as before by the concave curve. Therefore, the highest per unit expected revenue the lender can attain is that represented by the hyperbola, H_A^L, tangent to the constraint at a^L. These revenues are represented by the rectangle $0R_A^L a^L \pi_A^L$. This is smaller than the area $0Pa\pi_A$, the borrower's expected revenue net of his private costs in problem (2). The difference is made up of two areas: extra dead-weight loss (shaded downward), and expected surplus retained by entrepreneurs (shaded upward). The former is the result of the higher interest rate, R, charged by lenders to extract surplus now that they have the bargaining power. This results in lower efforts by borrowers and hence a lower probability that the project is successful. The latter is analogous to the surplus retained by workers in efficiency wage contracts. The entrepreneurs have to retain some surplus if they are to supply any effort at all.

In short, with monitored loans, the surplus to lenders when they have the bargaining power is the same as that borrowers when they have that power. With non-monitored loans, the surplus to lenders is smaller. Therefore, lender bargaining power tends to favor monitored loans, consistent with the Anglo-Saxon German comparison.

2.2 Internal and external economies in debt provision

So far, we have taken the costs of Anglo-Saxon and German style loans as exogenous. Here, we consider factors that might have affected these costs. We already know that if monitored loans are cheaper than non-monitored loans then they are always preferred..[13] Monitoring, however, is costly. In addition (following, for example, Diamond (1984)), we assume that

[13] We showed this when borrowers have the bargaining power, and switching bargaining power to lenders further favors monitored loans.

it is impossible to both trade and monitor debt. This is a reasonable first approximation: for example, there are free rider problems in monitoring widely held debt. If tradeable debt provides lenders with liquid securities, it will be cheaper for borrowers.

The key idea in this section is that there are internal economies of scale in monitoring, but external economies of scale in trading debt. The cost of monitoring one large loan is probably less than the cost of monitoring two small loans.[14] We assume (though this is not essential) that part of monitoring costs are fixed with respect to the scale of the loan. On the other hand, the degree to which tradeable securities are liquid, depends on market thickness. Many trading costs — staffing discount houses, maintaining the exchange, or publishing price lists in financial broad sheets — are approximately fixed with respect to the size of the entire market. Tradeable debt may also be cheaper, the greater the variety of assets traded on the capital market since this offers greater opportunities for lenders to diversify.[15]

In this section we explicitly model these internal and external economies, taking as given (for now) both the size and number of industrial firms. We then consider comparative statics relevant to the English and German cases.

The size and number of firms.

Start from our basic model with all the bargaining power assigned to borrowers. For heuristic purposes, assume that all industrial projects are the same size, and that there is one project per firm so we can use the term firm and project interchangeably. Regardless of the existence of monitors or of a secondary asset market, we assume that it is always possible for a lender to issue a non-monitored, non-tradeable loan. Think of these as ordinary bank loans. Such debt has constant marginal cost, $v > 1$: so the cost of a non-monitored, non-tradeable loan of size $(q - w)$ is $v(q - w)$. The cost of a monitored loan of size $(q - w)$ is given by $M + mq + v(q - w)$, where $M > 0$ is the fixed cost of monitoring and mq is the variable cost of monitoring a project of size q.

Let $\tilde{N}$ represent the number of securities traded on the secondary asset market. A security could be debt from one of the projects under consideration or it could be a liability from some other part of the economy that uses the secondary asset market. Let s represent the

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[14] Tim Guinnane (1997) has used the idea that there are scale economies in monitoring to examine the policies of German agricultural credit cooperatives in the late 19th century.

[15] There may also be internal scale economies in issuing new tradeable securities (such as equity) directly on the stock market. English industry in the 18th century almost never raised capital directly from London's stock market. See, for example, Mirowski (1981) and Neal (1995). One reason for this was that legislation such as the Bubble Act made it difficult to issue shares. See, Patterson and Reiffen (1990). It is likely that the fixed costs of a London floatation would anyway have discouraged most textile firms. In 1721, there were only 8 shares regularly quoted on the London exchange and 3 of these were essentially companies for holding government debt. We therefore ignore direct equity issues.

average amount per security traded: so the total volume of capital in the market is $\tilde{N}s$. The marginal cost of a tradeable (non-monitored) loan is given by: $t(\tilde{N}, s) := l + F/\tilde{N}s + f(\tilde{N})$, where l $(1 < l < v)$ represents a lower bound on the cost of tradeable debt; $F > 0$, represents the fixed costs of the market; and $f(.) > 0$, $f' < 0$, represents the gain from having more diverse assets traded on the capital market. If the existing secondary market size is large in relation to the size of an individual firm, the entrepreneur faces an approximately constant marginal cost of tradeable debt. Thus, the cost of a tradeable loan of size $(q - w)$ is $t(\tilde{N}, s)(q - w)$.

Figure 3(a) illustrates the different possible equilibria as we vary the number and size of industrial firms[16] The vertical axis represents the number of industrial firms, N, in the economy. The horizontal axis represents the size, q, of these firms. Figure 3 is drawn for the case where entrepreneurs have no initial private wealth $(w = 0)$, and where the number of different securities traded in the secondary asset market is bounded by the number of firms $(\tilde{N} \leq N)$.

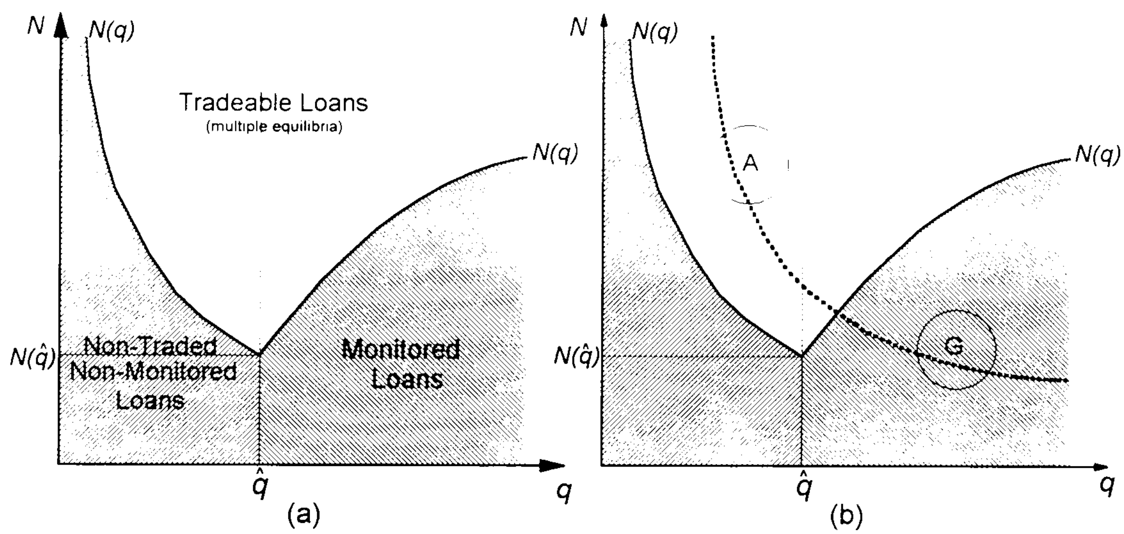

Figure 3: Equilibrium Regions at Different Sizes and Numbers of Firms

There are three (or, depending on how you count, four) regions in Figure 3. There exists a size $\hat{q}$ >0 such that monitored loans are strictly preferred to non-monitored, non-tradeable loans, if and only if $q > \hat{q}$. And for every uniform firm size, q, there is a number of firms, $N(q)$, below which it is not possible to sustain a secondary asset market even if all the firms

[16] Again, a more formal treatment is in the appendix.

issued tradeable debt.[17]

When there are relatively few, small firms, the unique equilibrium is for all the firms to choose non-monitored, non-traded loans of the kind associated with English banks. First, these firms are too small to warrant the fixed costs of monitoring, even after allowing for deadweight losses. Second, even if all firms were to choose tradeable debt, the secondary asset market would still be too small for such debt to be cheaper than bank loans.

When there are relatively few, large firms, the unique equilibrium is for all the entrepreneurs to choose monitored loans of the type associated with German banks. The costs of monitoring are now spread thinly enough to warrant monitoring in order to avoid the dead-weight losses associated with Anglo-Saxon loan contracts. Moreover, even if all firms issued tradeable debt, its cost (plus the associated deadweight losses) would outweigh the costs of monitoring.

When there are relatively many firms of medium size, there is an equilibrium in which all entrepreneurs choose tradeable non-monitored loans. In this case, the size of the secondary asset market is such that tradeable debt costs less than non-monitored bank loans. Moreover, the cost saving from not monitoring is enough to overcome the associated deadweight losses. But this is not the only equilibrium in this region. For example, if all firms were to choose non-monitored bank loans then no entrepreneur would want to issue tradeable debt since it would have to bear the full fixed costs of the market on its own. Thus, if the size of firms is small, there is also an equilibrium in which all entrepreneurs choose non-monitored non-tradeable loans. Similarly, if the size of firms is large, there is an equilibrium in which all entrepreneurs choose monitored non-tradeable loans as, again, the fixed costs of trading debt are too large for it to be worthwhile for just one firm to do.[18]

How does this simple picture compare to the experience of the British and German industrial revolutions? In Gerschenkron's famous comparison of early and late industrializers, alongside his observations on the different roles of banks, he also noted (1962, p. 354) that "the more backward a country's economy, the more pronounced was the stress in its industrialization on bigness of both plant and enterprise". The size and capital requirements of the typical industrial firms in late 18th century Britain were quite small. Landes, for example, writes (1969 pp. 64-5):

> "The early machines, complicated though they were to contemporaries, were nevertheless modest, rudimentary, wooden contrivances which could be built for sur-

[17] The exact shape of the function $N(\cdot)$ above $\hat{q}$ need not be as shown. See the appendix for details.

[18] There are still other equilibria in this region. For example, if $q < \hat{q}$, we can construct an equilibrium in which just enough entrepreneurs choose tradeable, non-monitored loans for each entrepreneur to be indifferent between these and non-tradeable, non-monitored loans.

> prisingly small sums. A forty-spindle jenny cost perhaps £6 in 1792; .... The only really costly items of fixed investment in this period were buildings and power, but here the historian must remember that the large, many-storeyed mill that awed contemporaries was the exception. Most so-called factories were no more than glorified workshops: a dozen workers or less; one or two jennies, perhaps, or mules; and a carding machine to prepare the rovings."

As late as 1841, Gatrell (1977) found that the median Lancashire cotton primary processing firm had just over 100 employees while the median firm in subsidiary textile production had fewer than 50 employees. The same study identified over 1000 separate firms in the cotton textile industry in Lancashire alone.

The size of the typical German firm by the 1870s was much larger. First, whereas textiles were the "leading sector" of the first industrial revolution, the second industrial revolution was dominated by heavy industries such as steel and chemicals with larger fixed capital requirements and larger optimal plant sizes. Second, even in the by-now older sectors, firm sizes generally increased after 1850. Third, German firms may have been larger than their English counterparts.. The number of spindles per firm in the British spinning industry increased by 50% from 1850 to 1870. In Germany, it increased by 600%. In steel smelting, by the turn of the century, the median member of the German steel cartel was four times bigger than its equivalent firm in Britain.[19]

Not only were German firms probably larger but, within Germany, the *Grossbanken* appear to have favored larger firms. As early as 1853, the stated policy of the Bank of Darmstadt was to concentrate on firms with a turnover of 50,000 Guilders. Tilly (1986) has called this "Development Assistance for the strong,"[20] while Gerschenkron (1962 p. 10) argued that this later resulted in a sectorial bias:

> "until the outbreak of World War I, it was essentially coal mining, iron and steel making, electrical and general engineering, and heavy chemical output which became the sphere of activity of German banks. The textile industry, the leather industry, and the foodstuff producing industries remained on the fringes of bank interest ... it was heavy rather than light industry to which the attention was devoted."

One way to contrast industrial revolutions is to compare different economies at the same given stage of development as measured by the size of their industrial sector. Figure 3(b) represents a particular volume of capital invested in an industrial sector by a hyperbola superimposed on the previous diagram. The late 18th century British economy was represented

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[19] Landes (1969, pp. 223-4. and p. 263). Borchardt (1973, p. 133).

[20] Landes (1969, p. 208) argues that the Grossbanken "sought out the largest possible clientele." Fohlin (1997) finds that firm size strongly affects the probability of finding bank directors on the supervisory board, but this may be driven by large firms need to be listed on the Berlin stock exchange. See also Tilly & Fremling (1976) especially p. 420, and Tilly (1982).

by an area like A in the figure: with relatively many, relatively small industrial firms. Late 19th century Germany looked more like the area G in the figure. In Britain, external finance was generally unmonitored, sometimes from small local banks and sometimes in tradeable forms such as bills of exchange.[21] In Germany, monitored loans provided by industrial banks was more important than in England.

Simple comparative statics: (a) Other Traded Securities. If the secondary asset market includes securities other than those issued by industrial companies, such as government debt instruments and merchant paper, then this relaxes the constraint $\tilde{N} \leq N$. The effect is shown in Figure 4(a). The area in which there are equilibria involving tradeable debt is increased: its lower boundary shifts down from $N(q)$ to $\hat{N}(q)$. Intuitively, any fixed costs of the market are spread more thinly. Thus, an entrepreneur in an economy with an active secondary market in non-industrial debt is more likely to choose tradeable forms of debt.

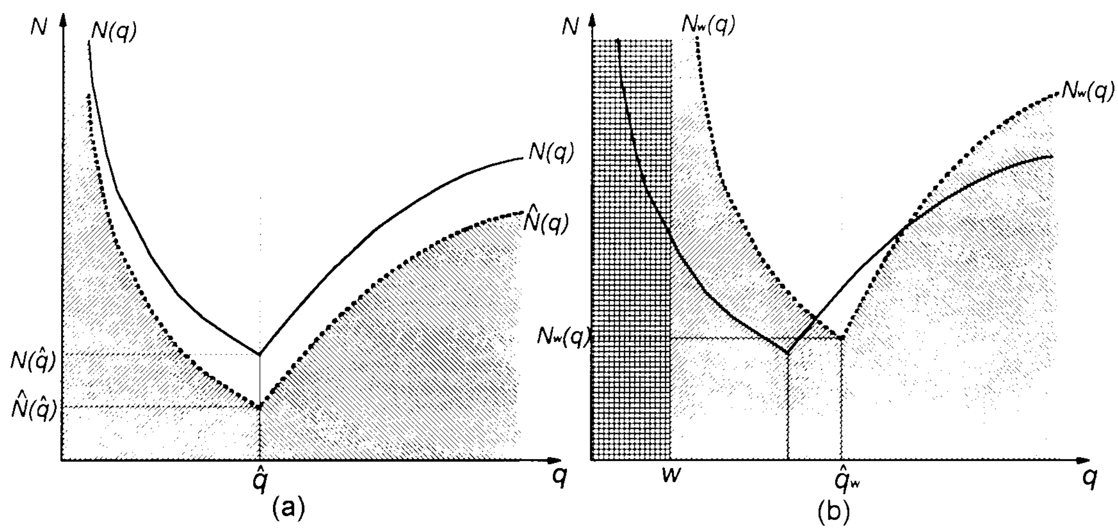

Figure 4: Comparative Statics: Other Securities and Wealth

The use of tradeable debt by industrial firms in Britain would itself have helped develop the market and encouraged others to follow. But this process was probably aided by the early existence of a secondary asset market in Britain trading in government and merchant debt. Landes (1969, p.74) writes that

[21] Collins & Hudson (1979, p. 78) found that, although there were personal links between local banks and industry, banks were not closely involved with management unless a firm defaulted. For the use of bills of exchange, see Ashton (1945 and 1955, ch. 6); and Anderson (1970).

> "in no country in Europe in the 18th century was the financial structure so advanced and the public so habituated to paper instruments as in Britain .... The development of a national network of discount and payment enabled the capital hungry industrial areas to draw ... on the capital rich agricultural districts."

The secondary market in government paper was particularly well developed, having recovered from crises in the 1720s. There is evidence consistent with integration between this market and investment in the industrial north by at least the last quarter of the century.[22] England's 18th century internal capital markets were probably more developed than those of newly united Germany a century later. German regulation (such as the 1884 imposition of taxes on transfers of securities) probably hindered the development of secondary asset markets.[23] Our model suggests that early, well developed secondary asset markets in England may have influenced the form of loans chosen during the industrial revolution.

Simple comparative statics: (b) Private Wealth. Given the importance of self-finance in the British industrial revolution, we would like our model to be robust to changes in the initial private wealth of entrepreneurs. The effect of increasing entrepreneurs' wealth, w, are shown in Figure 4(b). If $q \leq w$, entrepreneurs will entirely self-finance their projects as shown by the cross hatched region on the left of the figure. If $q > w$, they will only borrow their shortfall, $(q - w)$, so, as we increase w, the amount borrowed is reduced.

There are two effects on the trade-off between non-monitored non-tradeable debt and monitored (non-tradeable) debt. First, the fixed costs of monitoring are spread over a smaller loan. Second, while the efficient success probability level, π_G, is unchanged, that chosen by entrepreneurs with non-monitored loans, π_A, is increased. Since less is borrowed, less needs be repaid if the firm is successful. The entrepreneur receives a larger share of the marginal return, and so works harder. Both these effects favor non-monitored over monitored loans, so the critical size $\hat{q}$ is unambiguously shifted to the right in Figure 4(b).

Next consider the effect of increasing private wealth, w, on tradeable loans. In addition to the above effects favoring not monitoring, there are two additional effects.[24] First, if the wealth of all entrepreneurs is increased simultaneously, then the volume of assets in the secondary market will be reduced (borrowing is decreased). This will increase the cost of tradeable loans. Second, suppose that tradeable loans are strictly preferred to non-monitored, non-tradeable loans, but are indifferent to monitored loans (as occurs along the border $N(q)$

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[22] See, for example, Buchinsky & Polak (1993), and Hoppitt (1986).

[23] Riesser (1909) argues that this legislation reduced competition to banking. See also Tilly (1986, pp. 125-7).

[24] Here, we provide only an intuition. Details are given in the appendix.

when $q > \hat{q}$). Then $t < v$. That is, the marginal saving, t, to a tradeable loan as personal wealth increases is smaller than the marginal saving, v, to a monitored, non-tradeable loan. From the first of these extra effects, it follows that increasing personal wealth favors non-tradeable non-monitored loans over tradeable loans. But, we cannot say whether or not increasing wealth favors tradeable loans over monitored loans. Here the effects conflict. This is illustrated in Figure 4(b).

Overall, the main effect of increasing wealth is to increase the proportion of self-finance, and to shift the non-monitored non-traded loan region to the right. Under plausible assumptions, the border between the other two regions twists as shown. Then, at least for lower N, increasing the initial wealth of entrepreneurs generally raises the minimum size at which monitored loans are chosen.

This picture is roughly consistent with the British experience. To use Landes as our authority again, "a good many of the early mill owners were men of substance", often with wealth built up from merchant activities, putting out or even artisanal production within the sectors they later revolutionized.. For example, almost 3/4 of the cotton spinning mills established in the Midlands from 1769 to 1800, were set up by people already established in some part of the textile industry. Not only was the scale of the new industries small, but "18th century Britain enjoyed ... more wealth and income per head than the unindustrialized countries of today."[25] Crouzet's (1963) study of how industrialization was funded in Britain concluded that the "simple answer to this question is the overwhelming predominance of self-finance." Germany's industrialization, though later, started from a lower base in terms of accumulated industrial wealth. As the model predicts, early industrial entrepreneurs in Britain borrowed less overall and their relatively small external capital requirements were met by local bank loans, promissory notes and bills of exchange. The larger requirements of their counterparts in Germany were met, at least in part, by the direct involvement of the industrial banks.

It may be that as wealth increased our stylized British industrial sector was pushed into the region where non-monitored bank loans predominate over tradeable loans. Interestingly, the high period of bank loans to industry in Britain appears to have been the middle decades of the 19th century, after a generation of industrial growth and accumulation.[26] Increasing personal wealth may also help explain why Britain did not converge to a German style financial system as the size of her firms increased in the 19th century. Since the critical size $\hat{q}$ is increased with private wealth w, the British economy was less likely to be pushed into

[25] Landes (1969 pp. 65-6, and p. 78). See also Pollard (1964 p. 300).

[26] See, for example, Collins & Hudson (1979); and Collins (1990, 1991).

the region where monitored loans form part of the equilibrium.

3 Entry, Persistence and Welfare

In the previous section, we tried to explain the emergence of two different financial systems in 18th century England and 19th century Germany. We considered the choice between monitored and tradeable loans, taking as given the structure of the new industries (for example, the size and number of firms) in these two industrial revolutions. In this section, we ask why these financial systems persisted, and we consider the welfare consequences of that persistence. In particular, we allow free entry into industry and finance so that both the size and number of firms and the financial system are endogenous. The idea we want to capture is that industrial entrepreneurs may take financial institutions as given when they organize firms. Similarly, lenders may take the organization of firms as given when they choose what type of financial institutions to form.[27] An economy may then find itself with German style banks and German style firms, each designed taking the other as given; or with Anglo-Saxon style secondary asset markets and Anglo-Saxon style firms. We loosely describe these as G- and A-types of equilibrium. We first describe these equilibria, then show that multiple equilibria can arise and discuss the welfare implications.

3.1 The Entry Model

To allow the number of projects to be endogenous, assume there are a large number of potential entrepreneurs each with an identical project, producing an identical product. Project risks are independent. There are a similarly large number of potential lenders and the supply of capital is infinitely elastic. To allow choice of scale to be endogenous, let $k(q)$ be the capital required to fund a project of size q, where k, k', $k'' > 0$ and there exists a unique $q^* > 0$ that minimizes $k(q)/q$; that is, average capital requirements are U-shaped. To keep things simple, assume that no potential entrepreneurs have any private wealth, and that there are no other traded assets except the traded debt of the projects concerned.

If a project of size q is funded by a monitored loan then the average cost of the loan are $(vk(q) + mq + M)/q$. Since, $k'' > 0$ and there are fixed costs to monitoring, the efficient scale for a project funded by such a loan, q_G^*, is greater than q^*. The average capital cost of a non-monitored, non-traded loan is just $vk(q)/q$ so the efficient project scale given such

[27] Here, we use project scale as our example of an organisational choice of firms, but the general idea could be extended. The organisation of firms could refer to types of machinery or to administrative forms. For example, firms set up to be run by family members who have special knowledge of the business may not easily be adapted to allow for external monitoring.

a loan q_B^* equals q^*. For simplicity, we assume that the marginal capital cost of a tradeable loan can only take two values: high ($\hat{t}$) when the asset market is thin, and low (t) when the asset market is thick. Formally, if the set of firms issuing tradeable assets is Θ and if the sizes of those firms are given by the vector $(q_i)_{i\in\Theta}$, then let

$$t(\Theta,(q_i)_{i\in\Theta}) = \begin{cases} t & \text{if } \sum_{i\in\Theta} k(q_i) \geq V \\ \hat{t} & \text{otherwise} \end{cases}$$

be the marginal cost of a tradeable loan, where $\hat{t} > v > t$. Assume that the critical market thickness V and thin market marginal costs $\hat{t}$ are sufficiently large that it is never profitable for one firm to shoulder the entire costs of the market. The total cost of a tradeable loan of size q when the market is thick is then $tk(q)$ and the efficient project size given such a loan q_A^* equals q^*.

We are interested in equilibria that arise in competitive financial and product markets. Let each potential borrower i choose the size of his project, q_i. Each potential lender chooses either to set up an industrial bank that can handle monitored (non-tradeable) loans, or a discount house that can handle tradeable (non-monitored) loans. Either type of financial institution can offer basic loans that are neither monitored or tradeable. Think of these choices as simultaneous, so that in equilibrium it is as if borrowers takes the available types of loans as fixed when they choose scale, and lenders take the available scale of projects as given when they choose what kinds of loans to offer. If an entrepreneur obtains a non-monitored loan, he privately chooses the probability of success π_i. If he obtains a monitored loan then this probability is specified in the contract.

Potential lenders and borrowers are free not to participate and therefore must not make expected losses in equilibrium. Interest rates can depend on the type of loan. Given free entry, equilibrium interest rates must be such that lenders make zero expected profits. Prices depend on the total quantity produced. If the set of active firms is $\mathcal{A}$ and $(q_i,\pi_i)_{i\in\mathcal{A}}$ are the associated scales and success probabilities, then let the equilibrium output price be given by $P = \alpha - \beta\sum_{i\in\mathcal{A}} q_i\pi_i$, where α, $\beta > 0$. That is, prices clear the output market in expectation.[28]

An Anglo-Saxon equilibrium is one where all potential entrepreneurs choose small scale projects and all potential lenders form discount houses that can offer tradeable (hence non-monitored) loans. More formally, an A-equilibrium involves a number of firms N_A^* of size

[28] Since P is implicitly set before the resolution of uncertainty, strictly speaking this is a futures price. Alternatively, we could let prices form later, and let agents make decisions based on the expected price.

q_A^*, an output price P_A^*, an interest rate R_A^*, and a probability of success π_A^*, such that the following conditions are satisfied:

(A1) Entrepreneur incentive compatibility: $P_A^* - \psi'(\pi_A^*) = R_A^*$;

(A2) Lender zero profit: $R_A^* = tk(q_A^*)/q_A^*\pi_A^*$;

(A3) Tangency: $\psi''(\pi_A^*) = tk(q_A^*)/q_A^*(\pi_A^*)^2$;

(A4) Output market clearing: $P_A^* = \alpha - \beta q_A^*\pi_A^* N_A^*$;

(A5) No profitable monitored loans: $q_A^*\left(\pi P_A^* - \psi(\pi)\right) - [vk(q_A^*) + q_A^* m + M] \leq 0$ for all $\pi \in [0,1]$.

Compare Figures 1 and 5(a). As before, non-monitored loan contracts must satisfy an incentive compatibility condition (condition (A1)) shown by the concave curve. Free entry into the finance keeps interest rates down so contracts must also lie on the lender zero expected profit hyperbola (condition (A2)). Free entry into production drives output prices down, shifting the incentive compatibility curve down to the point where it is just tangent to the zero profit hyperbola (condition (A3)). These three conditions thus give us R_A^*, π_A^* and P_A^*, as illustrated. Output demand (condition (A4)) then given us N_A^*.[29] Despite free entry, the active firms make strictly positive expected profits in equilibrium; shown by the area $P_A^* a^* \pi_A^* R_A^*$. The reason, again, is analogous to efficiency wage models. Excluded entrepreneurs would like to enter production, borrowing at (or even above) the prevailing interest rate, R_A^*. But lenders will not accept these additional loan applications, since the resultant lowering of output prices would undermine incentive compatibility. At lower output prices (or higher interest rates), entrepreneurs would not work hard enough to justify the costs of supplying the capital.[30]

Provided no lender can offer a monitored loan, there is no incentive for an entrepreneur to deviate by choosing a large scale project. But we also need there to be no incentive for a lender to deviate by forming an industrial bank and offering a monitored loan, taking as given the scale of available projects. Condition (A5) ensures that, at the equilibrium price P_A^*, no firm of size q_A^* can generate enough expected surplus with a monitored loan to provide positive expected profits for the deviant lender and non-negative expected profits for the borrower. In Figure 5(a), this condition is met since area $0P_A^* a^* \tilde{\pi}$ (the maximum net per unit expected revenues of the entrepreneur at this price) is less than rectangle $O\tilde{R}\tilde{b}\tilde{\pi}$ (the

[29] We are implicitly assuming here that $N_A^* k(q_A^*) > V$ so that the secondary asset market is thick if all firms choose tradeable loans. This is achieved, for example, if α is large and β small.

[30] This is informal. In our working paper, Baliga & Polak (1995), we provide a formal model, and show how these equilibria arise as competative limits of subgame perfect equilibria of a non-cooperative 'entry' game.

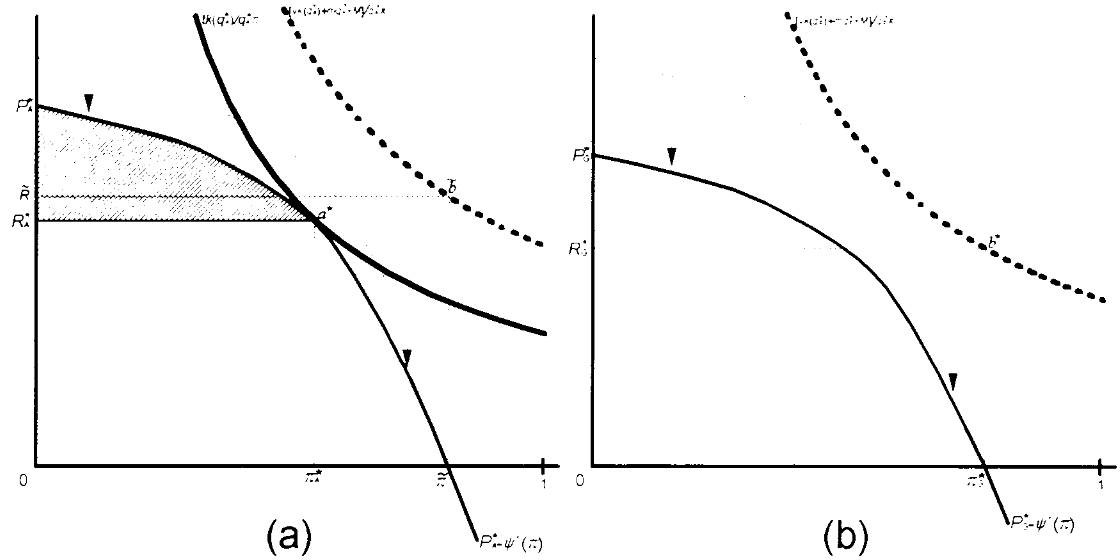

Figure 5: Equilibria in the Entry Model

expected average costs of a monitored loan at scale q_A^*). In general, this condition will be met, for example, if monitoring costs (M and m) are high; or if tradeable loan costs (t), and hence A-equilibrium prices (P_A^*), are low.

Next, for a moment, consider basic (non-monitored, non-traded) loans. As above, there is a minimum output price, P_B^*, below which such basic contracts must violate the lender participation, or the entrepreneur incentive compatibility constraints, or both. This minimum price is given by:

(B1) Entrepreneur incentive compatibility: $P_B^* - \psi'(\pi_B^*) = R_B^*$;

(B2) Lender zero profit: $R_B^* = vk(q_B^*)/q_B^*\pi_B^*$;

(B3) Tangency: $\psi''(\pi_B^*) = vk(q_B^*)/q_B^*(\pi_B^*)^2$

These conditions are analogous to conditions (A1)-(A3), except that (when asset markets are thick) the marginal cost of a basic loan, v, is higher than that of a tradeable loan, t. It follows that $P_B^* > P_A^*$.

Now, consider a German equilibrium where all potential entrepreneurs choose large scale projects and all potential lenders form investment banks that can offer monitored (hence non-tradeable loans). More formally, an G-equilibrium involves a number of firms N_G^* of size q_G^*, an output price P_G^*, an interest rate R_G^*, and a probability of success π_G^*, such that the following conditions are satisfied:

(G1) Entrepreneur efficient effort: $P_G^* - \psi'(\pi_A^*) = 0$;

(G2) Lender zero profit: $R_G^* = [vk(q_G^*) + M + mq_G^*]/q_G^*\pi_G^*$;

(G3) Entrepreneur zero profit: $\pi_G^* P_G^* - \psi'(\pi_G^*) = R_G^* \pi_G^*$;

(G4) Output market clearing: $P_G^* = \alpha - \beta q_G^* \pi_G^* N_G^*$;

(G5) No profitable basic loans: $P_G^* < P_B^*$.

Compare Figures 1 and 5(b). As before, monitored loan contracts will specify the efficient success probability, where the downward concave curve crosses the axis (condition (G1). Free entry into the finance keeps interest rates down so contracts must also lie on the lender zero expected profit hyperbola (condition (G2)). Free entry into production drives output prices down, shifting the return to π down to the point where active entrepreneurs also make zero expected profits (condition G3). In Figure 5(b), this is shown by the equality between the area $0P_G^*\pi_G^*$ (the entrepreneurs net per unit expected revenues) and rectangle $0R_G^*b^*\pi_G^*$ (the expected average costs of a monitored loan at scale q_G^*). These three conditions thus give us R_G^*, π_G^* and P_G^*. Output demand (condition (G4)) then given us N_G^*.[31]

Provided all active firms are funded by non-tradeable loans, the market for secondary assets will be thin and there will be no incentive for a lender to deviate and by forming a discount house and offering a tradeable loan. But we also need there to be no incentive for an excluded entrepreneur to deviate by choosing a project of small scale, q_B^*, and applying for a basic loan. Condition (G5) says that the output price in this equilibrium are below the minimum price such that a basic loan is feasible. In Figure 5, this condition is met since $P_G^* < P_A^*$ (compare parts (a) and (b) of the figure) which is less than P_B^*. In general, the condition will be met, for example, if monitoring costs (M and m), and hence G-equilibrium prices (P_G^*), are low.

3.2 Multiple Equilibria and Welfare Analysis

In the model above, there are parameter values at which both types of equilibria can arise. Indeed, Figure 5 shows such a case. To see this more generally, consider fixing all parameters except M, the fixed cost of monitoring. Let $P_G^*(M)$ be the price, described by conditions (G1)-(G3) as a function of M. Since $P_G^*(M)$ is the price that just yields zero expected profit, we can think of $P_G^*(\cdot)$ as a cost function. As such, we know that it is strictly increasing (and concave). Now, let $\underline{M}$ be the lowest fixed cost of monitoring such that it is possible to sustain an A-equilibrium. That is, condition (A5) applies if and only if and only if $M \geq \underline{M}$. Let

[31] Once again, we are implicitly assuming that demand is thick so that at least one monitored firm would be viable.

$\overline{M}$ be the highest fixed cost at which a G-equilibrium can be sustained. That is, $P_G^*(\overline{M}) = P_B^*$.[32] And let M^* be such that $P_G^*(M^*) = P_A^*$.

We want to show that $\overline{M} > \underline{M}$ so that there is a non-empty interval of fixed costs over which both G- and the A-equilibria can be sustained. Since $P_G^*(\overline{M}) = P_B^*$ and $P_B^* > P_A^*$, we know that $\overline{M} > M^*$. By definition, at $\underline{M}$, a entrepreneur with a small scale (q_A^*) project, who accepts a deviant monitored loan contract would just be able to make zero expected profit after paying back the costs of the loan, taking the output price P_A^* as given. But, if the project was the optimal scale (q_G^*) for a monitored loan, it could make strictly positive expected profit at these prices. Also by definition, $P(\underline{M})$ is such that a project of scale q_G^* makes (at most) zero expected profit from a monitored loan contract. Thus, $P(\underline{M}) < P_A^*(= P_G^*(M^*))$, implying $M^* > \underline{M}$, as desired.

Since both types of equilibria can arise, there is scope for coordination failures. How are the equilibria welfare ranked? Active entrepreneurs always prefer the A-equilibrium since they make positive profits. Lenders are indifferent since they make zero profits in either case. Consumers prefer lower output prices. Thus, over the interval $[\underline{M}, M^*]$, the A-equilibrium path Pareto dominates the G-equilibria path. However, over the interval, $(M^*, \overline{M}]$, the equilibria are not Pareto ranked, consumers preferring G- and entrepreneurs preferring A-equilibria. At least toward the bottom of this range, the gains to consumers probably outweigh the losses to entrepreneurs. That is, for some parameter values, the A-type equilibrium is Pareto dominant but, for others, the G-type results in greater social surplus.

The possible coordination failures are not, however, symmetric. It is possible for the economy to get stuck in a G-equilibrium when an A-equilibrium Pareto dominates. To establish a thick market for tradeable assets requires the coordination of many agents. But bilateral coordination between just one lender and one borrower can be sufficient to break down an A-equilibrium. In particular, an A-equilibrium is only robust to such bilateral deviations when it is Pareto dominant; that is, when $P_A^* \leq P_G^*$. Recall that condition (A5) only checks that no unilateral deviation by a lender is profitable. Taking the scale of projects (q_A^*) as given, no monitored loan can make money at P_A^*. But suppose that a lender and an entrepreneur can get together, forming an industrial bank offering a monitored loan and designing a project of appropriate size q_G^*. By definition, at P_G^*, firms of size q_G^* with monitored loan contracts make zero expected profits for both lenders and borrowers. Thus, if $P_A^* > P_G^*$, monitored firms can generate positive expected profits for both deviating parties. This is the case shown in Figure 5. But if $P_A^* \leq P_G^*$, such joint deviations are not profitable.

[32] Strictly, this is the supremum of such costs. Provided m is small, $\overline{M} > 0$.

There are important historical examples that seem to correspond to this type of bilateral deviations. Conditions in the late 19th century USA look a lot like those we have said favor the adoption of monitored loan finance: relatively large scale industrial firms and powerful banks operating a "money-trust". Sure enough, something like German-style banking started to emerge. Hilferding (1910) suggested that J.P. Morgan represented the American counterpart to German Finance Capitalism, and a modern version of this view is supported by Carosso (1970), De Long (1991) and Ramirez (1995). This development was hindered, however, by regulation, first limiting bank size and geographical scope, then with the Clayton and Glass-Stegal acts, directly restricting bank-industry relationships.[33] It is too simple, however, to argue that such regulation trapped the US in a inappropriate, costly A-equilibrium. In the mid-20th century, large M-form firms and holding companies developed internal capital markets. They monitored their divisions and subsidiaries much as banks might have monitored clients in the absence of regulation.[34] These institutional responses look a lot like the bilateral deviations that our model suggests will emerge if an A-equilibrium is inefficient. The M-form firm plays both lender (center) and borrower (division). Recent financial deregulation and the re-emergence of "universal banking" in the US, might even undermine the need for such bank-substitute corporations..[35]

The results also have policy implications. Dewatripont & Maskin (1995) argued that equilibria with German-style (large) banks and German-style (long-term) projects can persist only when they are efficient. Their Anglo-Saxon equilibria with small banks and short-term projects can persist even when inefficient. Our model (with bilateral deviations) reverses this conclusion. Anglo-Saxon equilibria, with small firms funded by traded debt, can persist if and only if they Pareto-dominate German-style equilibria. German-style equilibria, with fewer larger firms funded by monitored loans, can persist even when inefficient. Thus, contemporary calls for government intervention to encourage German-style bank-based financial systems may be misguided. Indeed, it is possible that the German economy is stuck in a path-dependent, inefficient equilibrium. There are cases where government should restrict monitored bank loans or promote secondary markets, for example by issuing government debt though the same channels. In 18th century Britain, tradeable industrial debt benefited from the pre-existing markets in government and merchant bonds, while bank lending may have been hindered by restrictions to joint stock banking. In the late 19th century US, networks that developed to place large issues of government debt in the civil war were later used

[33] See, for example, Calomiris & Ramirez (1996).

[34] See, for example, Baker's (1992) study of Beatrice.

[35] See Calomiris (1998).

to distribute commercial paper, while monitored bank lending may have been hindered by restrictions to bank branching and scale. Similarly, some have advocated the use of government debt issue to encourage the development of secondary asset markets in Eastern Europe today.

4 Appendix

Problem (2). The Kuhn-Tucker conditions for the entrepreneur's non-monitored loan problem are as follows:

(λ)	$q\,[\pi R + (1-\pi)d \geq c_A L]$	where $\lambda \geq 0$, with equality if $\lambda > 0$
(γ_0)	$w + L - D - q \geq 0$	where $\gamma_0 \geq 0$, with equality if $\gamma_0 > 0$
(γ_R)	$qP + D - Rq \geq 0$	where $\gamma_R \geq 0$, with equality if $\gamma_R > 0$
(γ_d)	$D - qd \geq 0$	where $\gamma_d \geq 0$, with equality if $\gamma_d > 0$
(L)	$\gamma_0 - \lambda c_A \leq 0$	with equality if $L > 0$
(D)	$1 - \gamma_0 + (\gamma_R + \gamma_d) \leq 0$	with equality if $D > 0$
(R)	$q\,[(\lambda-1)\pi - \gamma_R - \mu] = 0$	
(d)	$q\,[(\lambda-1)(1-\pi) - \gamma_d + \mu] = 0$	

$$(\pi) \qquad q\,[\lambda[R-d] - \mu\psi''(\pi)] \left\{ \begin{array}{c} \geq \\ = \\ \leq \end{array} \right\} 0 \text{ as } \pi \left\{ \begin{array}{cc} = & 1 \\ \in & (0,1) \\ = & 0 \end{array} \right.$$

Since $q > w$ and $D \geq 0$, condition (γ_0) implies that $L > 0$. Thus, condition (L) holds with equality. Adding conditions (R) and (d) yields

$$(\lambda - 1) = (\gamma_R + \gamma_d) = 0. \tag{Ap1}$$

Thus $\lambda > 0$ and condition (λ) binds. Since $c_A > 1$, condition (L) implies that $\gamma_0 > \lambda$. This implies both that condition (γ_0) binds, and from (Ap1) that $\gamma_0 > 1 + (\gamma_R + \gamma_d)$. So, condition (D) holds with strict inequality, implying $D = 0$. That is, no money is placed into the bank. Condition (γ_0) then gives $L = q - w$; that is, there is no over-borrowing. And condition (γ_d) gives $d \leq 0$; there is no positive repayment if the project fails.

Condition (λ) now reads $q[\pi R + (1-\pi)d] = c_A(q-w)$. Since the right side is positive and $d \leq 0$, this implies that $R > 0$ and $\pi \neq 0$. Recall that $\psi'(1) = \infty$. Therefore, Condition (μ) implies that if $\pi = 1$ then $R < d$: a contradiction. That is, $\pi \in (0,1)$. Since $R > d$, Condition (π) implies that $\mu > 0$. Therefore, Condition (d) implies that $\gamma_d > 0$; that is, $q = 0$.

Rewriting obtains

$$R = c_A(q - w)/q\pi \tag{Ap2}$$

the hyperbola shown in Figure 1. And Condition (μ) now reads

$$P - \psi'(\pi) = R \tag{Ap3}$$

Since $\psi'(1) = \infty$, this implies $\pi < 1$. Condition (π) is thus an equality and, since $\psi''(\pi) > 0$ for $\pi > 0$, it implies that $\mu > 0$. Condition (d) and (Ap1) then gives $\gamma_d > 0$, hence $\lambda > 1$. From (Ap3), we have $R < P$, hence condition (γ_R) does not bind: $\gamma_R = 0$. Condition (R) then gives

$$\mu = (\lambda - 1)\pi, \tag{Ap4}$$

and condition (d) gives

$$\gamma_d = (\lambda - 1). \tag{Ap5}$$

We can now rewrite condition (π) as $(\lambda - 1)\pi\psi''(\pi) = \lambda R$. Combining this with (Ap1) and the fact that $(\lambda - 1) > 0$ and using subscripts to indicate solutions, we get:

$$P - \psi'(\pi_A = R_A = c_A(q - w)/q\pi_A \qquad \text{(Prop. 1(a))}$$

$$\psi''(\pi_A) \geq R_A/\pi_A = c_A(q - w)/q\pi_A^2. \qquad \text{(Prop 1(b))}$$

(The weak inequality in (b) comes from taking λ to ∞. This occurs when costs are such that there is only one feasible non-monitored contract).

Problem (1). The Kuhn-Tucker conditions for the entrepreneur'sss monitored loan problem are similar except that, since there is no IC constraint, we can ignore constraint (μ) (set $\mu = 0$ in the other conditions), and replace condition (π) by

$$(\pi)' \quad P - \psi'(\pi) + (\lambda - 1)(R - d) \begin{Bmatrix} \geq \\ = \\ \leq \end{Bmatrix} 0 \text{ as } \pi \begin{cases} = & 1 \\ \in & (0,1) \\ = & 0 \end{cases}$$

Again we assume that a solution to the problem exists. The arguments to show that $\lambda \geq 1$, $D = 0$, $L = q - w$, $d \leq 0$, $R > 0$ and $\pi \neq 0$ are similar to before. It is easy to show that if $\pi = 1$ then the entrepreneur makes negative expected net profits. Hence $\pi \in (0, 1)$.

Let π^* be given by $P - \psi'(\pi^*) = 0$. From Condition $(\pi)'$, we know that $\pi \geq \pi^*$ and that, if $\pi > \pi^*$ then $(\lambda - 1) > 0$. But Conditions (r) and (d) would then imply that $\gamma_R, \gamma_d > 0$; and hence that $R = P$ and that $d = 0$. Condition (λ) then implies that $\pi P = \pi R = c_G(q - w)$, but this again implies that the entrepreneur makes expected net losses.

Therefore, $\pi_G = \pi^*$ as in Proposition 1(d). Condition $(\pi)'$ now implies that $(\lambda - 1) = 1$; hence that $\gamma_R = \gamma_d = 0$ and $\gamma_0 = 1$. Notice that R and d are not uniquely determined in this problem but if $d \geq 0$ then $\pi_G R_G = c_G(q - w)/q$.

Comparative Statics (a): c_A and c_G. The argument that raising base rates favors monitored loans at the margin is shown formally by noting that $\lambda_A > 1 = \lambda_G$.

Comparative Statics (b): P. The argument that raising prices has an ambiguous effect is shown formally by differentiating Proposition 1 part (c) using parts (a) and (d).

Comparative Statics (c): Problem (4). The Kuhn-Tucker conditions for the lenders non-monitored problem are as follows:

$$
\begin{array}{lll}
(\lambda) & q\,[\pi P - \psi(\pi) - \pi R - (1-\pi)d + D] \geq 0 & \text{where } \lambda \geq 0\text{, with equality if } \lambda > 0 \\
(\gamma_0) & w + L - D - q \geq 0 & \text{where } \gamma_0 \geq 0\text{, with equality if } \gamma_0 > 0 \\
(\gamma_R) & qP + D - Rq \geq 0 & \text{where } \gamma_R \geq 0\text{, with equality if } \gamma_R > 0 \\
(\gamma_d) & D - qd \geq 0 & \text{where } \gamma_d \geq 0\text{, with equality if } \gamma_d > 0 \\
(L) & \gamma_0 - c_A \leq 0 & \text{with equality if } L > 0 \\
(D) & 1 - \gamma_0 + (\gamma_R + \gamma_d) \leq 0 & \text{with equality if } D > 0 \\
(\mu) & q\,[P - \psi'(\pi) - [R - d]] = 0 & \\
(R) & q[(1-\lambda)\pi - \gamma_R - \mu] = 0 & \\
(d) & q[(1-\lambda)(1-\pi) - \gamma_d + \mu] = 0 & \\
(\pi) & q\,[[R-d] - \mu\psi''(\pi)] \left\{ \begin{array}{c} \geq \\ = \\ \leq \end{array} \right\} 0 \text{ as } \pi \left\{ \begin{array}{cc} = & 1 \\ \in & (0,1) \\ = & 0 \end{array} \right. &
\end{array}
$$

We assume a solution exists. Since $q > w$ and $D \geq 0$, Condition (γ_0) implies that $L > 0$. Thus Condition (L) holds with equality. Adding Conditions (R) and (d) yields $(1-\lambda) = (\gamma_R + \gamma_d) \geq 0$. Hence $\lambda \leq 1$. Substitution in Condition (D) yields $1 - \gamma_0 \leq 0$. Using Condition (L), $1 - c_A \leq 0$ but this inequality is strict by assumption. Hence $D = 0$. Condition γ_0 then gives $L = q - w$; that is, there is no over-borrowing. And condition γ_d gives $d \leq 0$; there is no positive repayment if the project fails. For the lender to make expected profit thus implies $R > 0$.

If $\pi_A = 0$, then since $d \leq 0$, the lender makes expected losses: a contradiction. If $\pi = 1$, then Condition (μ) implies $R < 0$ and again the lender would make expected losses. Therefore, $\pi \in (0,1)$. Condition (π) then implies that $\mu > 0$. This, in turn, implies by Condition (d) that $\gamma_d > 0$ and hence that $d = 0$.

Next we show that Condition (λ) does not bind. Suppose (contra-hypothesis) that $\pi P - \psi(\pi) - \pi R = 0$. By condition (μ), $P - \psi'(\pi) = R$. Substitution gives $\pi P - \psi(\pi) - \pi[P - \psi'(\pi)] = 0$. Rearranging gives $\pi\psi'(\pi) = \psi(\pi)$ which contradicts $\pi > 0$, $\psi(0) = 0$ and $\psi'' > 0$. Hence $\lambda = 0$.

Since $P - \psi'(\pi) = R$, and $\pi > 0$, $P > R$. Hence $\gamma_R = 0$. Condition (R) now implies that $\mu = \pi$. So Condition (π) reduces to: $R_A^L/\pi_A^L = \psi''(\pi_A^L)$. But this is just the tangency illustrated in Figure 2(b).

We claim that $R_A^L \geq R_A$ or, equivalently, $\pi_A^L \leq \pi_A$. We know from above that: $P - \psi'(\pi_A) = R_A$ and $\pi_A\psi''(\pi_A) \geq R_A$. And we now also know that: $P - \psi'(\pi_A^L) = R_A^L$ and $R_A^L = \pi_A^L\psi''(\pi_A^L)$. Suppose (contra-hypothesis) that $R_A^L < R_A$. This is equivalent to $\pi_A^L > \pi_A$. Then, since $\psi''' > 0$,

$$R_A^L = \pi_A^L\psi''(\pi_A^L) > \pi_A\psi''(\pi_A) \geq R_A$$

which is a contradiction. This formally shows that the deadweight loss is no smaller in Problem 4 than Problem 2.

Problem (3). The Kuhn-Tucker conditions are the same except that Condition (μ) does not apply. $\mu = 0$ in all other conditions: the costs are c_G; and Condition (π) becomes

$$(\pi)' \quad q\,[[(1-\lambda)(R-d)+\lambda(P-\psi(\pi))] \left\{ \begin{array}{c} \geq \\ = \\ \leq \end{array} \right\} 0 \text{ as } \pi \left\{ \begin{array}{cc} = & 1 \\ \in & (0,1) \\ = & 0 \end{array} \right. .$$

Again, we assume a solution exists. The arguments to show that $\lambda \leq 1$, $D = 0$, $L = q - w$, $d \leq 0$, $R > 0$ and $\pi \neq 0$ are similar to before. If $\pi = 1$ then Condition (λ) is violated. Hence $\pi \in (0, 1)$.

Suppose (contra-hypothesis) $\lambda = 0$. The, from Conditions (R) and (d), we know that $\gamma_R, \gamma_d > 0$. This would imply $P = R$ and $d = 0$. But then substitution into Condition (λ) obtains a contradiction.

Let π^* be given by $P - \psi'(\pi^*) = 0$. From Condition $(\pi)'$, we know that $\pi \geq \pi^*$ and that, if $\pi > \pi^*$ then $(1-\lambda) > 0$. But Conditions (R) and (d) would then imply that $\gamma_R, \gamma_d > 0$; and hence that $R = P$ and that $d = 0$. Then Condition (λ) will again yield a contradiction. Hence $\pi_G^L = \pi_G = \pi^*$ (and $\lambda_G^L = \lambda_G = 1$) as shown in Figure 2(b).

Section 2.2. Let $\pi(c, w)$ be the optimal non-monitored loan probability of success when the marginal cost of such a loan is c and the wealth of the entrepreneur is w. Let $z(c_A, w) := [\pi_G P - \psi(\pi_G)] - [\pi(c, w)P - \psi(\pi(c, w))]$ be the associated deadweight loss. Recall that we assume all projects are the same size.

Figure 3: By assumption, there are no other securities traded on the capital market except those issued by firms and borrowers have no private wealth of their own. Let $\hat{q}(0)$ be the project size such that the firm is indifferent between a monitored and non-traded, non-monitored loan. $M + m\hat{q}(0) = z(v, 0)\hat{q}(0)$. The boundary where non-monitored tradeable loans are just indifferent to non-monitored, non-tradeable loans is given by: $f(N) + F/Nq + l = v$.

For $q \geq \hat{q}(0)$, let $N(q, 0)$ denote the number of firms trading on the capital market such that borrowers of size q are indifferent between taking out a tradeable, non-monitored loan and a monitored bank loan. That is, $N(., 0)$ represents the combinations of N and q where borrowers are just indifferent between monitored and non-monitored tradeable loans. Therefore, $N(q, 0)$ solves $M + mq + vq = q[z(t(N, q)) + t(N, q)]$. Differentiating the function $N(q, 0)$ and rearranging yields

$$N_q[f' - F/(Nq^2)](1 + z_c) = -[M - (1 + z_c)F/Nq]/q^2.$$

Notice that at $\hat{q}(0)$, $t(N(\hat{q}(0)), \hat{q}(0)) = v$. Hence the condition for the slope of $N(q, 0)$ to be positive at $\hat{q}(0)$ is just:

$$M > ((1 + z_c(v, 0))F/N(\hat{q}(0), 0)\hat{q}(0). \tag{Ap6}$$

This assumption holds if fixed costs in monitoring are sufficiently greater than those in capital markets. We now show that this condition is sufficient for the slope to continue to be positive above $\hat{q}(0)$.

We first show that $z_c, z_{cc} > 0$. From the definition of z,

$$\begin{aligned} z_c &= -[P - \psi'(\pi)]\pi_c \text{ and} \\ z_{cc} &= -[-\psi'(\pi)(\pi_c)^2 + (P - \psi'(\pi))\pi_{cc}. \end{aligned}$$

From the Kuhn-Tucker conditions for the non-monitored loan problem (with $w = 0$), we have $\pi(P - \psi'(\pi)) = c$ which implies $\pi_c[P - \psi(\pi) - \pi\psi''(\pi)] = 1$. And from the second order condition. $P - \psi'(\pi) - \pi\psi''(\pi) < 0$, implying that $\pi < 0$ and $z_c > 0$. Differentiating again yields

$$\pi_{cc} = [2\psi''(\pi) + \pi\psi'''(\pi)]/P - \psi'(\pi) - \pi\psi''(\pi)] < 0.$$

It follows that $z_{cc} > 0$. That is, assuming (Ap6) holds, N rises initially as we increase q from $\hat{q}$. Therefore, $t(N, q)$ falls and so does z_c. Thus, as we raise q, the right side of condition (Ap6) falls, and the slope continues to be upward.

Comparative Statics (a) $\tilde{N}$. Including traded assets other than those of the firms simply reduces the cost of traded loans at every (N, q). Therefore, the border $N(q, 0)$ and that between traded and non-traded non-monitored loans are lowered everywhere.

Comparative Statics (b) w. Suppose entrepreneurs have private wealth, w. As before, let $\hat{q}(w)$ be the project size such that the firm is indifferent between a monitored and a non-traded, non-monitored loan: $M + m\hat{q}(w) = z(v, w)\hat{q}(w)$. Since $z_w < 0$ (as long as $w < q$), it follows that $\hat{q}_w(w) > 0$. Similarly, the border between traded and non-traded non-monitored loans is given by $t(N, (q - w)) = f(N) + F/N(q - w) + l = v$, so it is clear that it is shifted upward as we increase w.

The difficult case is the border $N(q, w)$ between traded and monitored loans; that is the solution to $mq + v(q - w) + M = qz[t(N, (q - w))] + t(N, (q - w)$ for $q \geq \hat{q}(w)$. Differentiating yields

$$N_w[((q - w) + qz_c)t_N] = (t - v) - qz_w - (\alpha(q - w) + qz_c)t_w.$$

Since $z_c > 0$ and $t_N < 0$, the sign of N_w is opposite to the sign of the right side. For $q > \hat{q}(w)$, and $N = N(q, w)$, we know that traded loans are preferred to non-monitored non-traded loans, hence $(t - v) < 0$. That is, the direct cost of borrowing less as we increase w favors monitored loans. Similarly, $t_w > 0$: increasing wealth makes secondary markets thinner and hence traded loans more costly. But $z_w < 0$; that is, borrowing less reduces the deadweight loss of non-monitored loans favoring non-monitored loans. The total effect is thus ambiguous.

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