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The Emergence and Persistence of the Anglo-Saxon and German Financial Systems*

Abstract

We use a 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 theoetical conditions that favour each system, such as the size and number of firms, with the historical 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.

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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.[2] 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, and similar arguments were used recently in the US to advocate reform of the Glass-Stegal Act.[3] Analyses of Germany sometimes argue that Grossbanken hindered growth, while similar

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[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] See, for example, Schneider-Lenne (1994, p. 284).

[3] 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

complaints are sometimes made of Zaibatsu and Keiretsu in Japan.[4] The debate has also resurfaced in the guise of choosing appropriate financial institutions for Eastern Europe and other emerging markets.

One major difference between the two financial systems was the degree to which creditors monitored firms. In England, creditors preferred a "hands-off" approach. This may have reflected a preference for liquid assets. Collins (1991) argues that English banks were first concerned with liquidity, avoiding long-term industrial loans, preferring to discount bills of exchange. The banks certainly pre-screened such borrowers, helping to overcome adverse-selection problems, but they did not like to get involved in continuous monitoring of the activities of debtor firms. The final holders of such widely traded securities may have been too distant to monitor directly, or too many to internalize the costs of monitoring. Collins believes that bank's already small direct involvement with industry may have actually declined in the late 19th century (especially after the crisis of 1878), at the time when German industrial banking was on the rise. This was "a kind of business that English banks had by this time come to abhor" according to Sayer's (1967a, p. 188) famous banking textbook.[5] For Sayers, liquidity was the central tenet of good English banking practice, whereas industrial loans required hand-on knowledge, and

> "...can be undertaken only by a large group of specialists, each one specializing in one or a few industries. The traditional bank manager is not qualified for such 'industrial consultant' work.... It is this distinction that lies behind the traditional view that a banker should make only 'self-liquidating' loans." (pp. 186-7)

Even when English banks provided direct loans to industry (for example, in the form of short-term overdrafts), 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)

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

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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).

[4] See, for example, Neuburgher & Stokes (1974); Weinstein & Yafeh (1998); and Masuyama (1994).

[5] We thank a referee for bringing this book to our attention.

importance of this has been over-emphasized) was to place bank officers on the supervisory boards of industrial companies.[6] The German financial system has come to be associated with "hands-on", relationship banking.

Section 2 models the choice of different methods of firm finance, focusing on moral hazard and on the trade-offs between monitored and non-monitored (possibly traded) debt. We ignore traded equity since the latter was unimportant as a source of finance in either industrial revolution.[7] The model is fairly standard and simple enough to allow a graphical treatment. Even such a simple model, however, can go some way to 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 and policy consequences. It extends the basic model to allow free entry by firms and lenders. In the extended model, the scale and number of firms (which were exogenous before) are now determined as part of the equilibrium along with the form of financial system. We show that multiple equilibria may exist: in particular, a "German" equilibrium with fewer, larger firms and monitored finance; and an "Anglo-Saxon" equilibrium with more, smaller firms with unmonitored and traded debt. These equilibria may be welfare ranked, and an economy might get stuck in the worse equilibrium. We argue, however, that the Anglo-Saxon equilibrium is only robust when it is Pareto efficient, while a German equilibrium can be sustained even when it is inefficient. This suggests that there is no need for policy interventions to encourage German-style bank finance, but there may be a need for policy aimed at the development of Anglo-Saxon style secondary financial asset markets.

Dewatripont & Maskin (1995) study an adverse selection model and identify a trade off between the ability to finance large projects and the ability to commit not to refinance bad loans. They identify a "German" equilibrium with large *lenders* as well as large firms and

[6] 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 (1997, 1999), 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. For opposing views of the modern situation, see Edwards & Fischer (1994) and Schneider-Lenne (1994).

[7] In the 18th century and for most of the 19th century, English domestic industry (with the exception of the railways) rarely raised capital directly from the London or provincial stock markets: see Collins (1991, pp. 31, 34 & 51), Mirowski (1981) and Neal (1995). As late as 1873, industry and commerce accounted for just 1.4% of quoted London securities: see Michie, (1987, p. 54). Even by 1913, Rajan & Zingales (2001) report the proportion of total GDCF raised by equity at 14% for the UK and 7% for Germany. Early on, this may have been due to legislation such as the Bubble Act and the absence of adequate corporation law: see Patterson and Reiffen (1990). But even once these impediments were removed, the number of limited-liability companies did not take off until the 1880s, and even then equity was often private or narrowly held: see Sayers (1967b, pp. 145-50)). In Germany also, legislation hindered the development of traded equity markets: see Tilly (1986, pp. 125-7), Fohlin (2000) and Guinanne (2001, pp. 53-4).

an "Anglo-Saxon" one with small ones. Holmstrom (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. Holmstrom and Tirole (1997) analyze a model of financial intermediation with moral hazard. They study how capital tightening affects different firms with different amounts of internal capital. Repullo & Suarez (1998) analyze a model of informed and uninformed lending. They take an incomplete-contracts (as against our moral-hazard) approach and do not study multiple equilibria. Pagano (1989) focuses on this last issue, especially on thick-market externalities which we also consider to be important. Scherfke (1993) uses a dynamic model to address similar issues. Aoki (1993) considers repeated moral 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. 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 (1998) 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. See Guinanne (2001) for a recent survey of German banking history.

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 and very standard moral-hazard model, and then add structure. Most of the arguments of this section can be presented using graphs. These graphical intuitions will be useful when we move to the more complex model in section 3.

The Basic Model. Consider the choices facing an entrepreneur who, in period 1, has access to a new project that requires external financing. Both the size of the project and prices are exogenous (we will change this is section 3). If a project is successful, it produces an output q which sells for a price $P > 1$. 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 and 'efforts' taken by an entrepreneur whose participation is essential. These efforts involve private (possibly non-pecuniary) costs for the entrepreneur. Let π denote the probability of success and, for a project of prospective output 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 $c(q)$ units of capital. For now, assume that the entrepreneur has no private wealth to contribute to the project so the capital must be borrowed. Borrowing can be either in the form of a monitored or a non-monitored loan. If loans are not monitored, then the efforts of the entrepreneur are unobservable to lenders and will depend on incentives provided by the loan contract. These incentives will, in general, induce only 'second-best' probabilities of success. If loans are monitored then efforts (and 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.

The cost to the lender of providing a non-monitored loan to finance the project is $tc(q)$, where $t > 1$ reflects the market interest rate. The cost to the lender of providing the corresponding monitored loan is $M + vc(q)$ where M reflects the costs of monitoring. Below we will allow v and t to differ, but for now let $t = v$. All loan contracts specify the amount R paid back to the lender if the project is a success. For simplicity, for now, assume that there is no collateral, so that nothing is paid back if the project fails. Both entrepreneurs and lenders are risk neutral and do not discount future consumption. To begin with, we assume that all the bargaining power resides with the entrepreneur: that is, the financial sector is competitive and lenders make zero expected profit.

The problem facing the entrepreneur if she chooses a monitored loan is then given by

$$\max_{R,\pi} \; q\pi P - q\psi(\pi) - \pi R \quad \text{subject to} \tag{1a}$$

$$\pi R \geq M + vc(q). \tag{1b}$$

And the problem facing the entrepreneur if she chooses a non-monitored loan is given by

$$\max_{R,\pi} \; q\pi P - q\psi(\pi) - \pi R \quad \text{subject to} \tag{2a}$$

$$\pi R \geq tc(q) \quad \text{and} \tag{2b}$$

$$\pi \in \arg\max_{\pi} \; q\pi P - q\psi(\pi) - \pi R. \tag{2c}$$

Conditions (1b) and (2b) are lender-participation constraints: they ensure lenders attain at least zero expected profits. Condition (2c) is the incentive-compatibility constraint that arises in non-monitored loans since the entrepreneur cannot commit to an effort level at the time the contract is signed.

The model is simple enough to illustrate graphically. Figure 1(a) illustrates both the monitored and non-monitored loan problems for the case where the borrower is roughly indifferent between the two types of loan. The horizontal axis shows the probability of project success, π. The vertical axis shows output prices, P, and the contract repayment terms divided through by the output of the project, R/q . All vertical distances are per unit output of the project.

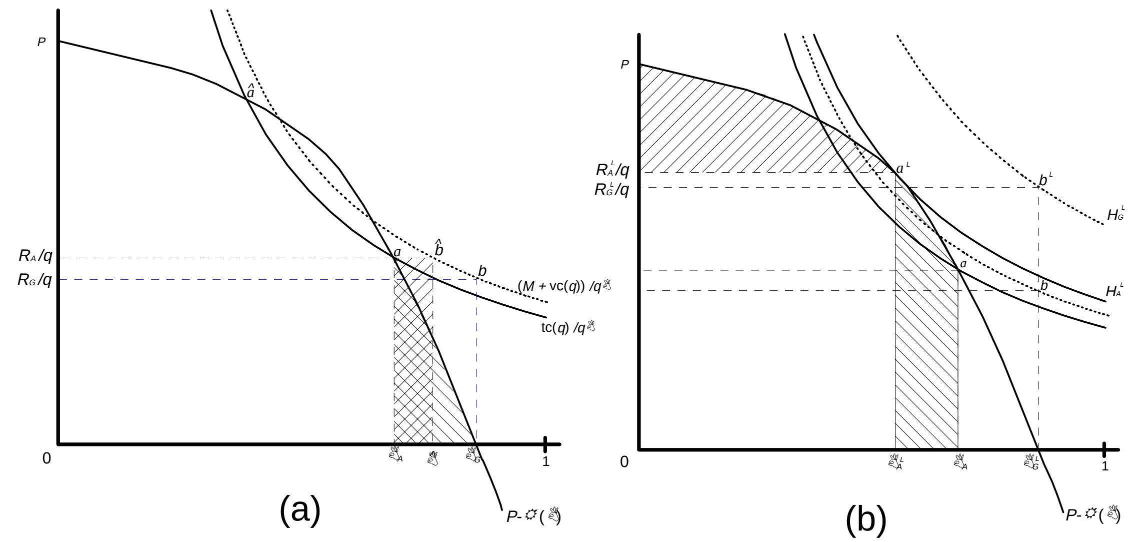

Figure 1: The basic model: bargaining power with (a) borrowers; and (b) lenders

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 her 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 dotted hyperbola, $R/q = (M + vc(q))/q\pi$, represents the boundary of the lender-participation constraint. That is, along this line, the per unit expected repayments to lenders, $\pi_G R_G/q$, just covers the per unit cost of a monitored loan, $(M + vc(q))/q$. 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 $0(R_G/q)b\pi_G$. Exploiting the properties of a hyperbola, the latter rectangle is equal to the area $0(R_A/q)\hat{b}\hat{\pi}$.

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 $P - \psi'(\pi) = R/q$. The concave curve in figure 1(a) shows all combinations of π and R/q that satisfy this incentive-compatibility constraint. Similar to before, the solid hyperbola, $R/q = tc(q)/q\pi$ represents the lender participation constraint. The contract must specify a probability of success π and a repayment

R/q on the incentive-compatibility curve, and on or above this zero-profit hyperbola: that is, for the case shown, between $\hat{a}$ and a. At low values of P or high values of $tc(q)$, no pair (π, R) will satisfy both constraints. In these cases, non-monitored loan contracts are infeasible. Assuming feasibility, 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 $0(R_A/q)a\pi_A$.

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 the case illustrated, these are 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 (a)* $P - \psi'(\pi_A) = tc(q)/q\pi_A$ *and (b)* $\psi''(\pi_A) \geq tc_A(q)/q\pi_A^2$ *such that (c)* $(\pi_G P - \psi(\pi_G)) - (\pi_A P - \psi(\pi_A)) \leq (M + vc(q) - tc(q))/q$*, 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)* $\pi_G P - \psi(\pi_G) - (M + vc(q))/q \geq 0$*.*

Proposition 1 item (a) defines the intersection of the incentive-compatibility and (the boundary of) the lender-participation constraints. Item (b) rules out points like $\hat{a}$ in favor of points like a: it is a second-order condition. Item (d) defines the first-best probability level selected by the monitored loan contract. Item (e) ensures that the entrepreneur is not making losses. The key trade off of the model is shown by item (c). The left side is the deadweight loss associated with a non-monitored loan. The right side is the additional cost of monitoring.

Even this simple model has some immediate implications. For example, a necessary condition for the entrepreneur to prefer a monitored loan (ceteris paribus) is that $R_G < R_A$. That is, if we observe both monitored and non-monitored loans in the same industry in the same economy, despite the additional costs of monitoring, the 'interest rates' on monitored loans should be lower. The intuition is that the probability of repayment of a monitored loan,

[8] For completeness, we assume that, if he is indifferent, the entrepreneur chooses an Anglo-Saxon style loan.

π_G, is higher than that of a non-monitored loan, π_A. In our picture, if $R_G = R_A$ then the extra cost rectangle must be greater than the deadweight loss triangle. The next subsection develops the comparative statics of this model and compares the results with stylized facts about England and Germany during their industrial revolutions.

Simple comparative statics: (a) Costs of Credit. Recall that, for now, we assumed that $t = v$ and that these reflected the underlying opportunity cost of credit to the financier or the market base interest rate. Suppose that the cost of credit were to increase so that both t and v were to rise. There is no change in the right side of Proposition 1(c). But the left side, the deadweight loss of a non-monitored loan, increases. In our picture, as the cost hyperbola moves out, it has no effect on the first-best π_G even though the interest rate on the loan, R_G, rises. But as R_A rises, the induced level of π_A falls: as the hyperbola rises, the solution slides to the north-west along the incentive compatibility curve. This increases the size of the deadweight loss area. Thus, the higher is the opportunity cost of credit to the financial sector, the more likely is an entrepreneur to choose a monitored loan.

A possible empirical proxy for the opportunity cost of capital could be the real 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, nominal consol rates in England were lower in the late 19th century than they were at the height of the industrial revolution a century earlier. This fall in nominal rates, however, partly reflects price movements. In England, the late 18th century saw great price instability and possibly some inflation associated with the Napoleonic wars. The late 19th century saw first a period of deflation and then (from about 1896) a period of inflation associated in both cases with monetary movements that also affected Germany.[9] The second thing that stands out is that 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. It seems possible, therefore, that German industrialization occured in a place (and perhaps also at a time) of relatively high real interest rates. If so, this may have favored the adoption of monitored finance.

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.[10] It has often been suggested that the German-style

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[9] See, for example, Solomou (1994). We thank a referee for stressing the importance of these price movements.

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

finance affected the growth of protected cartels. Large banks lobbied for industrial protection and encouraged the formation of cartels among their clients, and that the monitoring of several firms by the same bank helped alleviate intra-cartel information problems. Here we explore the opposite (less discussed) direction of causation: could protection and cartelization have affected the choice of German-style financing?

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

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

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/q 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 due to moral hazard. On the other hand, they diminish the actual loss of production due to moral hazard.

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.[11] Moreover, banks had considerable control of access to the Berlin

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

securities exchange.[12]

While we cannot resolve this historical debate, we can ask what is the effect of shifting bargaining power from borrowers to lenders on the choice of type of loan. So far, we have assumed that 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:

$$\max_{R,\pi} q\pi R - (M + vc(q)) \quad \text{subject to} \tag{3a}$$

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

If the lenders chose a non-monitored loan, the problem becomes

$$\max_{R,\pi} q\pi R - tc(q) \quad \text{subject to} \tag{4a}$$

$$q\pi P - q\psi(\pi) - \pi R \geq 0 \quad \text{and} \tag{4b}$$

$$\pi \in \arg\max_{\pi} q\pi P - q\psi(\pi) - \pi R. \tag{4c}$$

Conditions (3b) and (4b) are borrower-participation constraints: they ensure the entrepreneur attains at least zero expected profits. Condition (4c) is the incentive compatibility constraint that arises in non-monitored loans since the entrepreneur cannot commit to an effort level at the time the contract is signed.

Once again, we can illustrate the solution graphically. As before, a monitored loan contract will specify the efficient effort level, where the curve $P - \psi'(\pi)$ crosses the x-axis. Thus, π_G in figure 1(a) equals π_G^L in figure 1(b). The (per unit) cost of supplying the monitored loan is the same: $(M + vc(q))/q$ or the rectangles under the dotted hyperbolae through b in figure 1(a) and (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 1(b), the new dotted hyperbola H_G^L represents the lender's per unit expected revenues $(\pi_G^L R_G^L/q)$ equal to the borrower's per unit expected revenue (net of her private cost). That is, area $0(R_G^L/q)b^L\pi_G^L$ 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, $P - \psi'(\pi) = R/q$, represented as before by the concave curve. Therefore, the highest per unit expected revenue the lender can attain is that represented by the solid hyperbola, H_A^L, tangent to the constraint at a^L. These revenues are represented by the rectangle $0(R_A^L/q)a^L\pi_A^L$.

[12] See Tilly (1995) and Fohlin (2000).

This is smaller than the area $0Pa\pi_A$, the borrower's expected revenue net of her private costs when the borrower had the bargaining power. 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_A^L, 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.

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, switching bargaining power from the borrower to the lender tends to favor monitored loans. This is consistent with the comparison of the Germans and English industrial revolutions.

Simple comparative statics: (d) Internal versus external economies — the size and number of firms. Up to now, we have assumed that the cost of capital for monitored and non-monitored loans, t and v, is the same. It is likely, however, that the cost of providing a loan depends in part on whether the financier can trade the debt instrument on a secondary asset market. Following Diamond (1984), we assume that it is impossible to trade monitored debt. Recall that the monitoring here is of actions taken by the entrepreneur in the course of production, it is not just pre-screening of the loan. When debt is widely held, no individual investor has sufficient incentive monitor the on-going project.[13] The close holding of debt by German banks gave them an incentive to monitor, while their large scale and wide portfolios reduced the moral hazard between the "delegated monitor" and its depositors.

For non-monitored debt, the degree to which tradeable securities are liquid depends on the thickness of the secondary asset market. As Pagano (1989) points out (albeit in the context of equity rather than debt) the size and diversity of the market reduce asset volatility. There may also be fixed costs in establishing market infrastructure. Thus there are external scale economies in trading debt. In contrast, there are internal scale economies in monitoring: it is cheaper to monitor one large loan than two small loans.[14]

In our model, since we assumed the fixed cost M, we already implicitly assumed internal economies of scale in monitoring. We can model the external economies of traded debt as

[13] Grossman & Hart (1980) make the same point for a public firm with many, small shareholders. This view also underlies the modern debate on banking in the UK and Germany: see, for example, Prevesa & Ricketts (1994).

[14] Guinanne (forthcoming) uses the idea that there are scale economies in monitoring to examine the lending policies of nineteenth-century German agricultural-credit cooperatives.

follows. If the non monitored loan is not traded then $t = v$ as before. If the debt instrument is traded, however, then t depends on the thickness of the secondary asset market which, in turn, depends on the size and number of firms in the economy that have tradeable non-monitored loan contracts. When such markets are thin, assume that $t \geq v$. When such markets are thick, assume $t < v$. We can now consider comparative statics on the types of industries prevalent in the economy. As in our initial model, assume that borrowers have all the bargaining power.[15]

We can divide the possibilities into three parameter regions that depend on the size and number of firms. When there are relatively few, small firms, entrepreneurs will choose non-monitored loans and the debt instruments will not be traded. Such small firms are too small to warrant the fixed costs of monitoring even after allowing for deadweight losses, and the secondary asset market would still be thin even if all debt was traded. When there are relatively few, large firms, entrepreneurs will choose monitored loans. The fixed cost M is now spread thinly enough to warrant monitoring to avoid dead-weight losses, but the secondary asset market would still be thin even if all firms issued tradeable debt.

When there are relatively many firms of medium size, All entrepreneurs could choose non-monitored loans that are then traded. The secondary asset market would then be thick (that is, $t < v$) and hence the savings from not monitoring would outweigh the deadweight losses. But this is not the only equilibrium in this region. For example, if firms are medium-small, all entrepreneurs might still choose non-monitored loans but none would be traded. No-one would want to deviate and issue tradeable debt since the secondary-asset market would be thin. Similarly, if firms are medium large, all entrepreneurs might choose monitored loans even though, were they all to issue traded debt, they would be better off. This is a coordination failure.

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 surprisingly 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,

[15] The conclusions are the same for the other case.

> 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 (and most important), 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.[16]

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,"[17] 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."

In short, the late 18th century British economy was typified by relatively many, relatively small industrial firms. Late 19th century Germany was typified by larger (and possibly fewer) firms. In Britain, external finance was generally unmonitored, sometimes from small local

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

[17] 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).

banks and sometimes in tradeable forms such as bills of exchange.[18] In Germany, monitored loans provided by industrial banks was more important than in England.

Simple comparative statics: (e) 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 adds to market thickness and makes it cheaper for firms to issue traded non-monitored debt. 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

> "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.[19] There is evidence consistent with integration between this market and investment in the industrial north by at least the last quarter of the century.[20] 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 imposition of taxes on transfers of securities in the 1880s) probably hindered the development of secondary asset markets.[21] 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: (f) Private Wealth and Collateral. Suppose now that the entrepreneur has available some private wealth w. There are two cases of interest. Either this wealth is liquid and can be invested directly in the project, or it is too illiquid for this purpose but can serve as collateral. In the first case, the actual amount borrowed is reduced, hence less has to be repaid if the project is a success. Thus, the entrepreneur with a non-monitored loan has a greater incentive to work for the projects success. In contrast, for a

[18] 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).

[19] See, for example, Dickson (1967) and Neal (1990).

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

[21] Riesser (1909) argues that this legislation reduced the competition to banks from secondary asset markets. See also Tilly (1986, pp. 125-7), Guinanne (2001) pp. 53-4, and Fohlin (2000).

monitored loan since the efficient effort level was already specified in the contract. Thus, the presence of private wealth liquid enough to allow a degree self finance, reduces deadweight losses and makes it more likely that external finance (if any is still required) will be in the form of non-monitored loans.

The case where the entrepreneur's private is not directly invested but can be used as collateral is similar. Collateral reduces the difference between the amount paid back to the lender when the project succeeds and when it fails. This increases the incentive for the non-monitored entrepreneur to provide effort and so increases π_A and reduces deadweight loss.[22] Thus, even if the private wealth is only used as collateral, rather than directly invested, it favors the use of non-monitored loans.

Once again, 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."[23] 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. Indeed, this was a major reason why Gerschenkron thought that such late industrializers would need alternate financial institutions in order to concentrate sufficient capital. 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.

On the other hand, private wealth can have a negative external effect on tradable debt. As self finance increases, it can cause secondary asset markets to become thin. This may have happened in Britain towards the end of the nineteenth century. The high period of bank loans to industry in Britain appears to have been the middle decades of the 19th century.[24]

[22] For a more detailed discussion of the comparative statics in moral hazard models with explicit bankruptcy-collateral rules, see Adler, Polak & Schwartz (2000).

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

Thereafter, after a generation of industrial growth and accumulation, self finance may have undermined the traditional role of English banks, not as monitors but as intermediaries to secondary markets. This may have led to what some critics see as increased separation between financial and industrial capital.[25]

We summarize the main comparative statics results from above as follows:

Proposition 2 *Non-monitored loans are relatively more likely to be chosen where: the underlying cost of credit is low; bargaining power favors borrowers over lenders; the scale of projects is smaller; there are more firms requiring capital; there are pre-existing thick secondary asset markets; and the entrepreneurs have more private wealth.*

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 in these two industrial revolutions. For example, we argued that the English financial system emerged to cope with an industry consisting of many, small firms such textiles, whereas the German system emerged to cope with an industry consisting of fewer, larger firms such as steel. To some extent, this was an argument where industrial technology determined the response of the financial sector. In this section, we ask why these different financial systems persisted into the 20th century even though entrepreneurs in both counties presumably had access to the same set of technologies (indeed, both economies contained both steel and textiles sectors).

To examine this question, we develop a model with free entry into both industry and finance. All entrepreneurs face the same technology and can choose the scale of their projects. All lenders can choose whether to establish an investment bank with the technology and personnel to monitor firms, or just a regular bank. The size and number of firms, and the type of the financial system are determined in equilibrium. 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.[26] An economy may then find itself with German-style

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

[25] See, for example, Best & Humphreys (1986).

[26] Here, we use project scale as our example of an organizational choice of firms, but the general idea could

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 first describe these 'German' and Anglo-Saxon' types of equilibria, then show that multiple equilibria can arise and discuss whether the persistence of different financial systems might have welfare implications. Throughout, we will consider only pure-strategy equilibria and will ignore integer constraints.

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. We assume that no entrepreneur has access to any private capital, all project risks are independent, and the product faces a downward sloping demand curve. There are a similarly large number of (potential) lenders. The model has three stages. First, each entrepreneur chooses a scale q_i. This is the quantity of output that her proposed project will produce if it is funded and if it is successful. Simultaneously, each financier chooses whether to form an investment bank or a regular bank. Only investment banks are equipped to monitor loans. Each financier is matched with exactly one entrepreneur. Then, either the entrepreneur and financier agree on a loan contract and the project is funded, or the project is abandoned. Since we are assuming free entry, the relative bargaining power of the lender and the borrower does not matter.

Similar to before, a project that would (if successful) produce quantity q requires a capital investment of $c(q)$. Assume that $c(q)/q$ has the standard U-shape with fixed costs: that is, c, c', $c'' > 0$ for all $q > 0$; there is a $q^* > 0$ such that $c'(q^*) = c(q^*)/q^*$; and $\lim_{q \to 0} c(q)/q = \infty$. Monitoring is costly. If a loan is to be monitored (which presupposes that the lender formed an investment bank) then the cost to the financier of supplying the loan is $M + vc(q)$. Either type of financial institution can offer a non-monitored loan. The cost of such a loan depends on whether or not it is traded and, if it is traded, on the thickness of the secondary asset market. If a loan is non-monitored and not traded, the cost to the financier of supplying the loan is $vc(q)$. If the loan is to be traded then the cost of the financier of supplying the loan is $tc(q)$. To keep things simple, we assume that t can take on only two values: $\tau < v$ when secondary-asset markets are thick; or v when secondary asset markets are thin.[27] We assume that the output market is large enough such that if, in equilibrium, all active firms used tradeable debt then the secondary asset market would be thick.

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.

[27] While we identify each project with a separate firm and a thick market with many project/firms, we could also allow for the possibility that one firm has many different projects and let market thickness depend on the number of projects not the number of firms. We do not pursue this extension in greater detail here, but see Subrahmanyam (1991) and Gorton & Pennacchi (1993).

All loan contracts specify the amount to be paid back, R, in the event that a funded project is successful. For a monitored loan, the contract also specifies the effort level (or probability of success) π_i of the ensuing project. For a non-monitored loan, efforts are unobservable so the probability of success π_i will be that induced by the incentives implicit in the contract. Define efficient scale to be the scale that minimizes average costs. For a non-monitored loan the efficient scale q_A^* is simply q^* defined above. For a monitored loan, the efficient scale q_G^* is larger since monitoring involves an extra fixed costs M.

Let $\mathcal{N}$ denote the set of firms that are funded in the first stage, and let N be the number of such firms. In the second stage, each entrepreneur whose project has been funded chooses the probability π_i that it will succeed. For those with monitored loans, this must be the level specified in the contract. As before, let $q\psi(\pi)$ be the associated private cost to the entrepreneur, where ψ has the same properties as before. The entrepreneurs cannot observe the number of competitors N, their competitors' prospective outputs $(q_j)_{j\in\mathcal{N}\backslash i}$, or their contracts and probabilities of success $(R_j,\pi_j)_{j\in\mathcal{N}\backslash i}$.[28] In the third stage, firms either succeed or fail. The successful firms sell their output at price $P=\alpha-\beta Q$, where Q is realized aggregate output. Our assumption that the output market is large is equivalent to assuming that α is large and β is small. Each firm i whose project is a success repays the amount R_i specified in its contract, while firms whose projects fail default on their loans.[29]

German Equilibrium. We first consider equilibria in which all loans are monitored. To start, we will ignore deviations to non-monitored loan contracts, and then return to these later. We construct an equilibrium in which all financiers form investment banks (equipped to monitor loans), all firms choose the same prospective output q_G, and all the firms that are funded have the same monitored loan contract (R_G,π_G). Let N_G be the number of these active firms, and let P_G be the expected output price. These five variables are defined by the following five equations.[30]

$$q_G\pi_G\left[\alpha-\beta\left(N_G-1\right)\pi_G q_G-\beta q_G\right] = \pi_G R_G+q_G\psi(\pi_G) \tag{5a}$$

$$\pi_G R_G = M+vc(q_G) \tag{5b}$$

$$q_G\left[\alpha-\beta\left(N_G-1\right)\pi_G q_G-\beta q_G\right] = q_G\psi'(\pi_G) \tag{5c}$$

[28] An earlier version of this model reversed this assumption. The analysis was more complicated but the results and intuitions were qualitatively the same.

[29] We assume that, in equilibrium, the output market is thick enough for us to ignore defaults caused by ex post price risk. Again, this assumption is not essential.

[30] A solution to these equations exists (for some range of M) under our maintained assumption that α is large and β is small.

$$\pi_G \left[\alpha - \beta \left(N_G - 1\right) \pi_G q_G - 2\beta q_G\right] = vc'(q_G) + \psi(\pi_G) \tag{5d}$$

$$\alpha - \beta N_G \pi_G q_G = P_G. \tag{5e}$$

Notice that this is similar to a standard Cournot-entry equilibrium. Equation (5a) is the zero-profit condition for firms. The term in brackets is the output price that firm i expects to get for its product if it is successful, so the left side is just expected revenue. The right side is expected costs: the expected repayment to the lender plus 'effort cost'. Equation (5b) is the zero-profit condition for lenders. The left side is the expected repayment. The right side is the cost of financing the monitored loan. Equation (5c) selects the optimal level of π for the firm, taking as given the outputs and probabilities of success of the other active firms. The left side is the revenue the firm gets if it is successful. This is the marginal benefit of increasing π. The right side is the marginal cost. Therefore, equations (5b) and (5c) correspond to the model in section 2. Fixing q_G and writing L_G for $\alpha - \beta \left(N_G - 1\right) \pi_G q_G$, the intercept of the residual demand curve, figure 2(a) shows the solution to these three equations. The zero-profit condition (5a) is shown by the marked equal areas. Equation (5d) selects the prospective quantity. The left side is like the standard Cournot marginal revenue (taking as given the actions of the other firms) except that this marginal revenue is only attained with probability π_G. The right side is the marginal cost of increasing the prospective quantity.[31] Equation (5e) defines the expected equilibrium price.

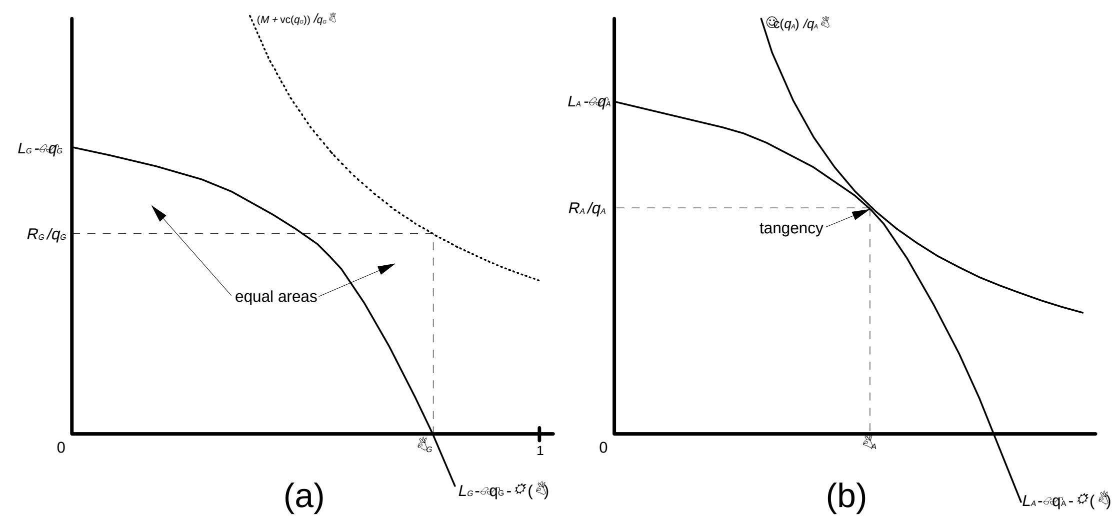

Figure 2: The model with entry: (a) German and (b) Anglo-Saxon equilibrium.

[31] Notice that the repayment term, R, adjusts to account for changes in the financing cost of the loan as q increases.

We can think of $AC_G(q) := (M + vc(q))/q$ as the average-financing-cost function for a monitored loan. Then, from equations (5a), (5b) and (5d), we obtain:

$$AC'_G(q_G) = -\pi_G \beta. \tag{6}$$

This corresponds to the standard Cournot-entry (or monopolistic competition) result that the demand curve and the average cost curve are tangent.[32]

It remains to consider the possibility that one of the firms chooses a non-monitored loan (and possibly a different level of prospective output). Without loss of generality, we can assume that this loan is not traded. If not, the deviant contract would be the only tradeable debt instrument so $t = v$. Suppose the deviant firm is active in the proposed equilibrium, that it instead chooses prospective output q, and that it proposes a non-monitored loan contract that specifies a repayment of R if the project is successful. If the contract is accepted, the deviant firm will choose π such that:

$$q\left(\alpha - \beta\left(N_G - 1\right)\pi_G q_G - \beta q\right) - q\psi'(\pi) = R.$$

For this contract to be accepted by the lender, it must satisfy her participation constraint:

$$vc(q) = \pi R.$$

Combining these two equations yields

$$\left(\alpha - \beta\left(N_G - 1\right)\pi_G q_G - \beta q\right) - \psi'(\pi) = vc(q)/q\pi \tag{7}$$

This is analogous to the analysis of non-monitored loans in section 2 except that the output price is now affected by the prospective quantity. The left side is analogous to the concave downward-sloping curve representing the incentive-compatibility constraint. The right side is analogous to the hyperbola representing the lender-participation constraint. If prices are low enough — more specifically, if $\beta\left(N_G - 1\right)\pi_G q_G$ is high enough — then there will be no intersection of these two curves; that is, there will be no q and π that satisfies equation (7). In this case, there will be no profitable feasible deviations to non-monitored loan contracts.[33]

More formally, define

$$g_G(q, \pi) := \left(\alpha - \beta\left(N_G - 1\right)\pi_G q_G\right) - \beta q - \psi'(\pi) - vc(q)/q\pi. \tag{8}$$

[32] The π_G in condition (6) corrects for the fact that the firm only obtains revenue when it succeeds. The relevant tangency here is between (expected) demand and the full average costs including the average cost of effort $\psi(\pi)$. The latter does affect the derivative in condition (6) since it is a constant.

[33] Here, we have only argued that such deviations by active firms are infeasible. Our condition, however, is (a fortiori) sufficient for non-active firms since there are then N non-deviant firms pushing down the price.

Then

Proposition 3 *If $g_G(q, \pi) < 0$ for all $q > 0$ and all π in $[0, 1]$, then equations (5a)-(5e) describe a German equilibrium.*

Anglo-Saxon Equilibrium. Next, we consider equilibria in which all loans are non-monitored and traded. To start, we will ignore deviations to monitored loan contracts, and then return to these later. We construct an equilibrium in which all financiers form regular banks (not equipped to monitor loans), all firms choose the same prospective output q_G, all the firms that are funded have the same non-monitored loan contract R_A, and these contracts are then traded on the (thick) secondary asset market. All the active firms choose the same probability of success π_A. Let N_A be the number of these active firms, and let P_A be the expected output price. These five variables are defined by the following five equations:[34]

$$\tau c(q_A)/q_A \pi_A^2 = \psi''(\pi_A) \tag{9a}$$

$$\pi_A R_A = \tau c(q_A) \tag{9b}$$

$$q_A (\alpha - \beta (N_A - 1) \pi_A q_A - \beta q_A) = q_A \psi'(\pi_A) + R_A \tag{9c}$$

$$(c'(q_A) - c(q)/q_A) \tau / q_A = -\pi_A \beta \tag{9d}$$

$$\alpha - \beta N_A \pi_A q_A = P_A. \tag{9e}$$

Unlike the German equilibrium, this is not a standard Cournot-entry equilibrium. For example, equation (9a) is not a zero-profit condition. With moral hazard, entry cannot drive the firms' expected profits to zero. The intuition is that, if prices were driven too low, it would be impossible to satisfy both the lender's zero-profit constraint and the borrower's incentive-compatibility constraint.

These two constraints are given by equations (9b) and 9c). Combining yields:

$$(\alpha - \beta (N_A - 1) \pi_A q_A - \beta q_A) - \psi'(\pi_A) = \frac{\tau c(q_A)}{q_A \pi_A} \tag{10}$$

Fixing q_A and writing L_A for $\alpha - \beta (N_A - 1) \pi_A q_A$, the intercept of the residual demand curve, the left side of expression (10) is represented by the downward-sloping concave curve in figure 2(b). The right side is represented by the hyperbola. The first condition above, equation (9a), describes the tangency between these two curves. Therefore, the first three conditions taken together ensure that no further entry can occur. If any further firms were

[34] Again, a solution to these equations exists under our maintained assumption that α is large and β is small.

to enter, the intercept of the first curve (and hence entire curve) would shift down, leaving no intercept. Thus, in equilibrium, no further firm will be funded. The shaded area in the figure represents the (per unit) expected profits of the firm. As in the model of section 2, the entrepreneurs have to retain this surplus if they are to supply any effort.

Equation (9d), selects the prospective quantity. We can think of $AC_A(q) := \tau c(q))/q$ as the average-financing-cost function for a traded non-monitored loan. Using this, we can rewrite equation (9d) as:

$$AC'_A(q_A) = -\pi_A \beta. \tag{11}$$

Like equation (6), this equation says that the slope of the average cost curve is equal to the slope of the (expected) demand curve. Unlike equation (6), however, the two curves are not tangent: indeed, as we have seen, profits are not zero. Instead, an intuition for this condition is that no active firm should be able to improve its (expected) price-cost margin by altering its prospective quantity.

More formally, consider a deviation in the prospective quantity chosen by one of the firms that is active in the putative equilibrium (holding fixed the choices of the other firms). To rule out such a deviation, it is enough to show that the deviant firm will not be funded. Define

$$g_A(q,\pi) := (\alpha - \beta\,(N_A - 1)\,\pi_A q_A) - \beta q - \psi'(\pi) - AC_A(q)/\pi. \tag{12}$$

>From equation (10), we know that $g(q_A, \pi_A) = 0$; that is, the incentive-compatibility and lender-participation constraints are met (exactly) at (q_A, π_A). Thus, a sufficient condition for no such deviant firm to be funded is that $g(q,\pi) < 0$ for all $(q,\pi) \neq (q_A, \pi_A)$. This is equivalent to saying that the function $g(q,\pi)$ achieves its maximum at (q_A, π_A). The first-order condition of this maximization problem with respect to π is

$$AC_A(q_A) = \pi_A^2 \psi''(\pi_A) \tag{13}$$

which is just a rewriting of equation (9a). The first-order condition with respect to q yields equation (9d). In the appendix, we provide a condition under which these first-order conditions are sufficient and we show that the sufficiency condition is always satisfied when β is small: that is, when the market is large. Also in the appendix, we show that there always exists a pair (q_A, π_A) that satisfies both equation (11) and (13).

It remains to consider the possibility that one of the financiers deviates to form an investment bank equipped to monitor loans. First consider the case where the deviant financier is matched with a firm that is not active in the proposed equilibrium. Suppose that this pair agree on a monitored-loan contract specifying π. The joint surplus of the deviant lender and her partner firm is then given by:

$$V_1(\pi) := q_A \pi \left(\alpha - \beta N_A \pi_A q_A - \beta q_A\right) - q_A \psi(\pi) - M - vc(q_A). \tag{14}$$

Therefore, a necessary condition for equilibrium is $V_1(\pi) \le 0$ for all π in $[0, 1]$.

Next consider the case where the deviant financier is matched with a firm that is active in the proposed equilibrium. Again, suppose that this pair agree on a monitored-loan contract specifying π. The joint surplus of the deviant lender and her partner firm is then given by:

$$V_2(\pi) := q_A \pi \left(\alpha - \beta(N_A - 1)\pi_A q_A - \beta q_A\right) - q_A \psi(\pi) - M - vc(q_A).$$

We do not need $V_2(\pi)$ to be negative for all π since the deviant active firm would anyway make positive expected profits in the putative equilibrium. These positive expected profits are given by

$$V_A := q_A \pi_A \left(\alpha - \beta \left(N_A - 1\right) \pi_A q_A - \beta q_A\right) - q_A \psi(\pi_A) - \tau c(q_A). \tag{15}$$

Therefore, the last necessary condition for equilibrium is $V_2(\pi) \le V_A$ for all π in $[0, 1]$. Notice however that the functions V_1 and V_2 only differ by an extra $\beta \pi_A q_A$ in the expected price. If the market is large, that is β is small, then this term will be small. In this case, the constraint that excludes entry by an extra monitored firm will imply the constraint that excludes an active (already profitable) firm switching to monitoring.

To summarize:

Proposition 4 *When β is small, if $V_1(\pi) \le 0$ for all π in $[0, 1]$ then equations (9a)-(9e) describe an Anglo-Saxon equilibrium.*

Comparing Equilibria. We are interested in studying the nature of German and Anglo-Saxon equilibria when competition between firms is intense. Therefore, we will focus on the case where the market is large; that is, β is small.

First, consider the scale of firms. Recall that in the German equilibrium, $AC'_G(q_G) = -\pi_G \beta$. Therefore, as β becomes small, the equilibrium scale q_G converges to the efficient scale q^*_G (i.e., where $AC'_G(q)$ is zero). Again, this is similar to monopolistic competition: as the demand curve becomes flatter, production becomes more efficient. Similarly in the Anglo-Saxon equilibrium, from (11), as β becomes small, the equilibrium scale q_A converges to the efficient scale q^*_A. Since $q^*_A < q^*_G$, we can conclude that, when the market is large (i.e., β is small), the scale of firms in an Anglo-Saxon equilibrium is smaller than that of firms in a German equilibrium.

Next, consider the case when equilibrium output prices are the same, $P_A = P_G$, as might arise if there was open trade in goods but not in direct financial services. The expressions (5c) and (10) determine the probabilities of success in the two equilibria. After dividing by q_G, the left side of equation (5c) is equal to $P_G - \beta q_G(1 - \pi_G)$. The probability of success π_G is bounded, and as β becomes small, q_G converges to q_G^* which is also bounded. Therefore, as β becomes small, this left-side term converges to P_G. Similarly, the first term in brackets in equation (10) converges to P_A as β becomes small. Therefore, comparing (5c) and (10), if $P_A = P_G$, we see that $\pi_A < \pi_G$. Looking now at the expressions for the equilibrium prices, (5e) and (9e), since prices are assumed to be equal and $\pi_A q_A < \pi_G q_G$, we have $N_A > N_G$.

To summarize:

Proposition 5 *If the output market is large (i.e., β is small) then firms are larger in the German than in the Anglo-Saxon equilibrium. If, in addition, output prices are equal, then the German equilibrium involves fewer firms and these firms have a lower probability of failure.*

This seems a reasonable approximation of stylized facts about the German and English economies as they persisted in the early and mid 20th century. English firms are thought to have been smaller and more numerous than their German counterparts, and to have had fewer direct links to industrial banks. Some writers have also claimed that firms "fail" less often in the German financial system, but this is hard to assess empirically given that bankruptcy laws differed in two economies.[35]

Multiple Equilibria. We next turn to which equilibrium will prevail. There are parameter values at which both types of equilibrium can arise. To see this, consider fixing all parameters except M, the fixed cost of monitoring. We will show that there is a range of M such that the economy could either be in a German or an Anglo-Saxon equilibrium. Moreover, when markets are large, this range contains the parameter level at which output prices are the equal.

To do this, as before, let $L_A := \alpha - \beta\,(N_A - 1)\,\pi_A q_A$. This is as the intercept of the residual (expected) demand curve for each firm in an Anglo-Saxon equilibrium. Similarly, let $L_G := \alpha - \beta\,(N_G - 1)\,\pi_G q_G$. Clearly, the L_G depends on M, the cost of monitoring. More formally, using the zero profit conditions for the German equilibrium, let $L_G(M)$ be defined by:

$$\max_{q,\pi}\; q\pi\,[L_G(M) - \beta q] - q\psi(\pi) - M - vc(q) = 0. \tag{16}$$

[35] See, for example, Dyson (1986). For a discussion of German bankruptcy law, see Edwards & Fischer (1994, pp. 159-164)

By the envelope theorem, $L_G(M)$ is increasing in M. Thus, by appropriate choice of M in expression (16), $L_G(M)$ can take on any value between 0 and α.[36] We can now re-write the necessary and sufficient condition from Proposition 3 for a German equilibrium to be sustainable (that is, $\max_{q,\pi} g_G(q,\pi) < 0$) simply as $M < \overline{M}$ where the latter is defined by

$$\max_{q,\pi} \left(L_G(\overline{M}) - \beta q - \psi'(\pi) - vc(q)/q\pi \right) = 0 \tag{17}$$

Similarly, we can rewrite the necessary and sufficient condition from Proposition 4 for an Anglo-Saxon equilibrium to be sustainable, (that is, $\max_\pi V_1(\pi) \leq 0$) simply as $M \geq \underline{M}$ where the latter is defined by

$$\max_{\pi} \left(q_A \pi \left[(L_A - \beta \pi_A q_A) - \beta q_A \right] - q_A \psi(\pi) - \underline{M} - vc(q_A) \right) = 0. \tag{18}$$

Notice that $V_1(\pi_A) = V_A - \beta \pi_A q_A - M - (v - \tau)\, c(q_A)$. But the profits made by an incumbent firm V_A is always positive. Thus, if β is small and τ is close to v, then $\underline{M} > 0$.

It remains to show that $\overline{M} > \underline{M}$. Since $0 < L_A < \alpha$, there exists an M^* such that $L_G(M^*) = L_A$. We will show that $\underline{M} < M^* < \bar{M}$. By the definition of L_A, we know that $g_A(q,\pi) = L_A - \beta q - \psi'(\pi) - \tau c(q)/q\pi$, and that the maximum of this function is zero. Thus, if $M = M^*$, then $g_G(q,\pi) = L_G(M^*) - \beta q - \psi'(\pi) - vc(q)/q\pi < 0$ for all (q,π) since $v > \tau$. Intuitively, the deviant does not have access to a thick secondary asset market on which to trade debt. Therefore, by the definition of $\overline{M}$, expression (17), $\overline{M} > M^*$.

Next, we show that $M^* > \underline{M}$. In the definition of $\underline{M}$, expression (18), the maximization is only with respect to π (the scale of the deviant entrant is fixed at q_A). Intuitively, the entrant firm does not have the optimal scale for monitored loan. Allowing scale to adjust would raise profit. That is,

$$\max_{q,\pi} q\pi \left((L_A - \beta \pi_A q_A) - \beta q \right) - q\psi(\pi) - \underline{M} - vc(q) \geq 0. \tag{19}$$

But setting $M = \underline{M}$ in expression (16), the zero-profit condition for the German equilibrium, and comparing it with expression (19) implies $L_G(\underline{M}) \leq L_A - \beta \pi_A q_A$ or $L_G(\underline{M}) < L_A = L_G(M^*)$. Therefore, $\underline{M} < M^*$.

When the market is large (β small), the intercept terms $L_G(M)$ and L_A are approximately equal to the prices P_G and P_A respectively. Hence, when the cost of monitoring is M^*, output prices are approximately equal. To summarize:

Proposition 6 *When β is small, there is a non-empty range of monitoring costs $[\underline{M}, \overline{M})$ such that both Anglo-Saxon and German equilibria are sustainable. This range contains the*

[36] The case $L_G(M) = \alpha$, is when M is so large that there are no other active firms. To get $L_G(M) = 0$ may require $M < 0$, but we give a condition such that $\underline{M} > 0$ below.

level of monitoring cost at which output prices are approximately equal in the two equilibria. When M is above this range, only Anglo-Saxon equilibria can be sustained. If v is close to τ, then $\underline{M} > 0$, so there is also a range in which only German equilibria can be sustained.

Welfare comparison. Since both types of equilibria can arise, there is scope for coordination failures. How are the equilibria welfare ranked? Active entrepreneurs always prefer the Anglo–Saxon equilibrium since they make positive profits. Lenders are indifferent since they make zero profits in either case. Consumers prefer lower output prices.

Suppose the costs of monitoring are M^* so $L_G(M) = L_A$, and $P_A = P_G$ approximately. In the appendix, we show that P_G (like L_G) increases in M when β is small. Hence, when $M > M^*$, the Anglo-Saxon equilibrium Pareto dominates the German equilibrium: consumers prefer the lower prices and entrepreneurs prefer positive profits. When $M < M^*$, however, the equilibria are not Pareto ranked: consumers prefer the lower prices in the German equilibrium while entrepreneurs prefer Anglo-Saxon equilibrium profits. At least when monitoring costs are low, the gains to consumers probably outweigh the losses to entrepreneurs. That is, for some parameter values, the Anglo-Saxon equilibrium is Pareto dominant but, for others, the German results in greater social surplus. To summarize.

Proposition 7 *For β small (up to our approximation between intercepts and prices), when $M > M^*$, the Anglo-Saxon equilibrium Pareto dominates the German equilibrium; when $M < M^*$, entrepreneurs prefer the former but consumers prefer the latter.*

The possible coordination failures are not, however, symmetric. It is possible for the economy to get stuck in a German equilibrium when an Anglo-Saxon 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 Anglo-Saxon equilibrium.

Up till now, we have only considered deviations from a Anglo-Saxon equilibrium in which a lender unilaterally sets up an investment bank equipped to monitor loans taking as given the scale of all potential projects. Since, in equilibrium, this scale is not chosen to be the optimal scale for a monitored loan, it is harder for the deviant lender to make a profit. Suppose now, however, that a lender and an entrepreneur can get together in forming an industrial bank to monitor a loan and designing a project of appropriate scale. In this case, by the argument used in Proposition 6 using expressions (16) and (19) above, we know the deviation will be profitable if $L_G(M) < L_A - \beta\pi_A q_A$. If we make our usual assumption that β is small, then this is close so saying that $P_G < P_A$. That is, an Anglo-Saxon equilibrium is only robust to such bilateral deviations when it would result in lower prices: that is, when it is Pareto dominant.

Proposition 8 *For β small (up to our approximation between intercepts and prices), if bilateral deviations involving one lender and one entrepreneur are possible, then an Anglo-Saxon equilibrium is sustainable if and only if it Pareto dominates a German equilibrium. A German equilibrium can be sustained even when it is Pareto inefficient.*

In fact, 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.[37] 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.[38] 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.[39]

The results also have policy implications. Since bilateral deviations seem plausible and seem to have occurred in practice, the model suggests that we should worry more about the possibility of getting stuck in an inefficient German equilibrium (without thick secondary asset markets) than getting stuck in an inefficient Anglo-Saxon equilibrium (without monitoring investment banks).[40] That is, contemporary calls for government intervention to

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

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

[39] See Calomiris (1998).

[40] This is the opposite conclusion to that of Dewatripont & Maskin (1995). They 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.

encourage German-style bank-based financial systems may be misguided. On the other hand, it is possible that the German economy is stuck in a path-dependent, inefficient equilibrium. These 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 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

Showing that (q_A, π_A) is the unique argmax of g_A. First, notice that $g_A(q,\pi) < (\alpha - \beta(N_A - 1)\pi_A q_A) - AC_A(q^*)/\pi$. Thus, if $\underline{\pi} := [\alpha - \beta(N_A - 1)\pi_A q_A]/AC_A(q^*)$, then $g_A(.,\pi) < 0$ for all $\pi < \underline{\pi}$. Since $\alpha - \beta(N_A - 1)\pi_A q_A > 0$, we know that $\underline{\pi} > 0$. Since $g_A(q_A, \pi_A) = 0$, we know that $\underline{\pi} < 1$. Therefore, we can restrict attention to π in $[\underline{\pi}, 1]$.

It is enough to show, therefore, that the function g is strictly locally concave for all critical values (q,π) such that $\pi > \underline{\pi}$. The local concavity conditions are

$$\begin{aligned} -\psi'''(\pi) - 2AC_A(q)/\pi^3 &< 0 \\ -AC''_A(q)/\pi &< 0 \\ \left(AC''_A(q)/\pi\right)\left(\psi'''(\pi) + 2AC_A(q)/\pi^3\right) - \left(AC'(q)/\pi^2\right)^2 &> 0. \end{aligned}$$

The first two of these are met by our assumptions on the functions ψ and c. Since we only require quasi-concavity, the last condition need only hold at critical values. Substituting in the first-order conditions for critical values and re-arranging yields:

$$AC''(q)\left(\pi^2\psi'''(\pi) + 2\pi\psi''(\pi)\right) - \beta^2 > 0.$$

We require this condition to hold for all critical values such that $\pi > \underline{\pi}$. Notice that, since $\underline{\pi} > 0$, this condition is met as β approaches zero; that is, if the market gets large.

Showing that there exists a solution to equations (11) and (13). Let $q_1(\pi)$ be defined by $AC_A(q_1(\pi)) = \pi^2\psi''(\pi)$, and let $q_2(\pi)$ be defined by $AC'(q_2(\pi)) = \beta\pi$. By construction $q_2(0) = q^*$, $q_2(1) > 0$ and $q_2'(\pi) < 0$ on $[0,1]$. Similarly, $q_1^{-1}(q^*) > 0$, and $q_1(\pi) \to 0$ as $\pi \to 1$. Thus, continuity assures a solution.

Showing that P_G is increasing in M. Recall that $P_G = L_G + \beta q_G(1-\pi_G)$. Differentiating with respect to M, we get

$$\frac{dP_G}{dM} = \frac{dL_G}{dM} + \beta\frac{dq_G}{dM}(1-\pi_G) - \beta q_G\frac{d\pi_G}{dM}$$

We know that $dq_G/dM > 0$, $dL_G/dM > 0$**,** and, from expression (5c), we know that $d\pi_G/dM = (dL_G/dM)/\psi''$. Therefore $dP_G/dM > dL_G/dM(1-\beta q_G/\psi'')$. Since $\psi'' > 0$ for all $\pi > 0$, the term in parentheses **is positive for small** β.

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