Why Do Financial Systems Differ? History Matters.

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Abstract

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Abstract

We describe a dynamic model of financial intermediation in which fundamental characteristics of the economy imply a unique equilibrium path of bank and financial market lending. Yet we also show that economies whose fundamental characteristics have converged may continue to have very different financial structures. Because setting up financial markets is costly in our model, economies that emphasize financial market lending are more likely to continue doing so in the future, all else equal.

1 Introduction

Financial systems vary greatly even among nations at similar stages of economic development.[1] For instance, bank lending is the leading source of funds for most German firms, while financial markets play a larger role in the U.S. (see figure 1 in the appendix). In this paper, we describe a model in which two economies can continue to have very different financial systems long after their fundamental characteristics have converged.

Specifically, we embed the adverse selection model of Bolton and Freixas (2000) in a dynamic, general equilibrium framework. Bolton and Freixas describe a simple static model in which banks and direct intermediation co-exist. One could rely on other models in which different borrowers choose different financial options. The dynamic results we establish in this paper do not depend on the static theory of financial intermediation one has in mind.

We consider an environment where time is discrete and, every period, a continuum of borrowers need to fund a two-stage, risky project. The likelihood of a positive payoff at the end of the first stage is public information, but only the borrower knows the likelihood of a positive payoff at the end of the second stage of his project. Other agents simply know that projects more likely to succeed in the first stage are also more likely to succeed in the second stage. Lenders can make their funds available to borrowers directly on a financial market, or, instead, via a bank. Bank intermediation is costly, but the bank learns the quality of the project at the end of the first stage. In the financial market, lenders discover the quality of the project after funding its second stage. Entry into the financial market carries an initial fixed cost, but no further cost until lenders choose to exit and revert to using the bank.

In competitive equilibrium, agents take the gross surplus lenders can expect on the financial market as given, and the market for each type of financing clears every period. As in Bolton and Freixas, borrowers whose project is too risky receive no funding, while safe projects are funded on the financial market. Projects of intermediate risk level obtain fund-

[1] Allen and Gale (2000) provide a comprehensive survey of financial structures in several developed countries.

ing from the bank. One key result we establish is that given a sequence of fundamental characteristics (that is, for each period, the cost of bank intermediation, the cost of entry on the financial market, and the distribution of project characteristics) and given an initial size of the financial market, a unique equilibrium sequence of financial market sizes exists. Put another way, fundamentals fully explain financial systems. Yet we also establish that convergence in fundamentals does not imply financial convergence. Economies with different initial financial systems may continue to differ even if their fundamental characteristics become forever identical. The intuition for this result is simple. Current fundamentals may not justify entry into the financial market for lenders who have yet to pay the fixed cost, but it may be profitable for incumbent lenders to stay put. The financial market can remain persistently large in an economy where past fundamentals led a high number of lenders to bear the entry cost. It follows that to understand an economy's current financial structure, one needs to take account of past fundamentals. In other words, history matters.

In the appendix, we briefly document the well-known fact that institutional environments used to differ greatly between Germany and the U.S. Our theory suggests that despite the fact that these differences have been fading, the U.S. and German financial systems could continue differing for a long time. That the U.S. developed large financial markets early is not surprising given its institutional history. According to our model, this head-start could explain why the U.S. continues to emphasize financial markets today. Similarly, the fact that banks have played a large role historically in Germany could explain why they are still a prominent form of finance today.

By rationalizing differences in financial structures even in observably similar economies, our theory differs from those of Dewratipont and Maskin (1995), Holmstrom (1996), or Bolton and Freixas (2000), among others. In effect, we show that embedding those theories in a standard framework of firm dynamics can help us understand the persistence of financial structures. Furthermore, we obtain persistence without resorting to multiple equilibria. Baliga and Pollak (2004), for instance, find that their static model of monitored versus non-monitored financing can support both German and Anglo-saxon equilibria that are robust to individual deviations. In our model, the equilibrium is unique and Pareto efficient. As in Allen and Gale (2000), financial outcomes cannot be Pareto ranked. More generally, ours is a step towards thinking about financial systems in the context of a dynamic, general equilibrium environment in which the impact of policy choices can be studied.

2 The environment

Time is discrete and infinite. The economy we study is populated by three classes of risk-neutral agents: borrowers, lenders, and a bank. Lenders have mass $\ell > 1$. They are infinitely lived, discount future flows at rate $\beta \in (0, 1)$, and are endowed with two units of the consumption good at the beginning of each period. A mass one of borrowers are born every period. They live for one period[2] and are not endowed with any consumption good. They are however endowed with a productive technology described by parameters $p_1 \in (0, \bar{p}]$, $p_2 \in \{0, 1\}$ and $R > 0$. This technology transforms one unit of the consumption good invested at the beginning of the period into R units after half a period with probability p_1. With probability $1 - p_1$, this first investment yields nothing. Borrowers can then invest another unit of the consumption good with proceeds R with probability p_2, 0 with probability $1 - p_2$. Borrowers also enjoy non-monetary benefits B for each half-period in which their project is implemented.

While R is common across borrowers, p_1 and p_2 vary. Borrowers know all the characteristics of their own technology, but other agents only know p_1 and R. We will refer to borrowers with $p_2 = 1$ as good borrowers, and to other borrowers as bad borrowers. While lenders do not know p_1, they know that p_1 and p_2 are correlated in the following specific sense: $E[p_2|p_1] = g(p_1)$ where g is a strictly increasing, continuous function such that $g(0) = 0$ and $g(\bar{p}) < 1$. That is, lenders know that fraction $g(p_1)$ of borrowers with initial likelihood of success p_1 are good borrowers.[3] In particular, it is public information that safe projects are

[2] This assumption enables us to study two-stage optimal contracts. Those contracts are easy to characterize. Fully characterizing longer-term contracts is beyond the scope of this paper and should not alter our basic findings.

[3] Notice that we do not make any assumption of independence of outcome across projects. We simply

more likely to be good projects. Like Bolton and Freixas (2000), we restrict parameters so that in an environment with full information bad projects would not be implemented.

Assumption 2.1. $\bar{p}R < 1$

On the other hand, some good projects are profitable in the sense that for p_1 large enough, expected returns exceed the opportunity cost of the funds a project requires:

Assumption 2.2. $\bar{p}R + g(\bar{p})R > 2$

Like lenders, the bank is infinitely lived. It can store deposits on behalf of lenders during the period with a net return normalized to zero.[4] It can also lend funds to borrowers. In that case, the bank incurs a cost $\rho_t \geq 0$ for each unit of good it lends to borrowers at date t, and discovers whether each project is good or bad at the end of the first stage of production.

Instead of depositing their endowment at the bank, lenders can make lend it directly to a borrower. If at date $t-1$ a lender chose the bank option, choosing the direct lending option at date t entails cost $c_t > 0$. Lenders who already chose to lend their endowment directly at date $t-1$ can do so once again at date t at no cost. We will refer to lenders and borrowers who contract directly with each other as *the financial market*. By *size of the financial market* we will mean the mass of projects so funded. Unlike the bank, lenders on the financial market only find out whether a project is good or bad after funding its second stage.

3 Contracts

Consider a borrower who seeks funding from the bank given a current cost $\rho \geq 0$ of intermediation. A contract between the borrower and the bank stipulates a transfer $x_1 \leq R$ from the borrower to the bank if the project succeeds in the first half-period, and a transfer $x_2 \leq R$ at the end of the period if the borrower turns out to be good. Because they enjoy private

assume no aggregate uncertainty.

[4]Alternatively, we could assume that the bank has access to a foreign capital market where a one period risk-free security pays zero interest.

benefit B when and only when their project is financed, bad borrowers want their projects to be implemented in both half-periods. Since bad projects are never profitable (assumption 2.1), bad borrowers have no choice but to mimic the behavior of good borrowers. Therefore, all borrowers of a given publicly observable type p_1 receive the same terms from the bank. We will assume that the bank behaves competitively so that among the contracts that cover the bank's expected costs, the most favorable to good borrowers prevails. That is, the bank offers borrowers of type p_1 a contract x_1, x_2 that solves:

$$\max_{x_1,x_2 \leq R} p_1(R - x_1) + R - x_2 + 2B$$

subject to the following participation constraint:

$$p_1 x_1 + g(p_1)x_2 \geq 1 + \rho + g(p_1)(1 + \rho)$$

Indeed, good borrowers are successful with probability p_1 in the first half-period, in which case their net income is $R - x_1$, and are successful with probability 1 in the second half-period and earn $R - x_2$. They also enjoy non-monetary benefits $2B$ since the project is implemented in both subperiods. The bank's expected return and cost depend on whether the borrower is good or bad. They earn x_1 during the first stage with probability p_1, and x_2 during the second stage if the borrower proves good, which occurs in fraction $g(p_1)$ of the projects. The bank's cost per unit loaned is the sum of the monitoring cost ρ and the gross return, 1, on risk-free investments. The bank's cost, therefore, is $1 + \rho$ for the first half-period, and $1 + \rho$ again for the second half period when the borrower turns out to be good. Note that the bank can cover its expected cost if and only if $p_1 R + g(p_1)R \geq 1 + \rho + g(p_1)(1 + \rho)$. Denote by $\underline{p}^B(\rho)$ the value of p_1 for which this condition holds as an equality. The optimal contract is easy to characterize:

Proposition 3.1. *Optimal bank contracts for borrowers with projects of type $p_1 \geq \underline{p}^B(\rho)$, are $x_1 = R$ and $x_2 = \frac{1+\rho+g(p_1)(1+\rho)-p_1 R}{g(p_1)}$. The bank offers no contract to other borrowers.*

Proof. Write the objective function as $(p_1+1)R-(p_1x_1+g(p_1)x_2)-(1-g(p_1))x_2+2B$. At a solution, the bank's participation constraint is binding since the objective function is strictly decreasing in x_1 and x_2. So we may rewrite the problem as

$$\min_{x_1,x_2\leq R}(1-g(p_1))x_2$$

subject to

$$p_1x_1+g(p_1)x_2=1+\rho+g(p_1)(1+\rho).$$

Since $1-g(p_1)>0$, making x_2 as low as possible is optimal. This implies that $(R,\frac{1+\rho+g(p_1)(1+\rho)-p_1R}{g(p_1)})$ is optimal. Indeed, assumption 2.1 says that setting $x_1=R$ does not suffice to cover the bank's costs. Together with the fact that $p_1\geq\underline{p}^B(\rho)$, it implies that $\frac{1+\rho+g(p_1)(1+\rho)-p_1R}{g(p_1)}\in(0,R]$. To prove the second part of the proposition, simply note that the participation constraint is violated even if $x_1=x_2=R$ if $p_1<\underline{p}(\rho)$. □

Turning now to the financial market, assume that contracts on the financial market currently give gross surplus q^M to lenders. We assume that borrowers and lenders behave competitively in the financial market in the sense that they take this surplus as given. We will refer to q^M as the price of financial market contract. Then the optimal contract for good borrowers with initial success probability p_1 solves:

$$\max p_1(R-x_1)+R-x_2+2B$$

subject to the lenders' participation constraint:

$$p_1x_1+g(p_1)x_2\geq q^M$$

Denote by $\underline{p}^M(q^M)$ the unique value of p_1 such that $p_1R+g(p_1)R=q^M$. Optimal contracts on the financial market are derived as in the case of banking contracts, and the same arguments as in the proof of proposition 3.1 yield:

Proposition 3.2. *Optimal contracts on the financial market for borrowers of type* $p_1 \geq \underline{p}^M(q^M)$ *satisfy* $x_1 = R$, *and* $x_2 = \frac{q^M - p_1 R}{g(p_1)}$. *Other borrowers are not offered a contract on the financial market.*

Notice that since competition prevails on both financial sectors, the surplus borrowers enjoy in each type of contract is a monotonic function of the right hand side of the participation constraint. Borrowers of a given type simply choose the financial option associated with the weakest participation constraint. As a corollary, all the equilibrium results we establish below continue to hold as long as borrowers have preferences representable by a strictly increasing utility function. Assuming that they are risk-averse, for instance, would not change any of our conclusions.

4 Equilibrium

Our goal is to study financial market development in an economy with a given sequence $\{c_t, \rho_t, F_t\}_{t=0}^{+\infty}$ of financial market entry costs, intermediation costs and distributions of observable project characteristics.[5] Like Lucas and Prescott (1971), we will study equilibria in which all agents know and take as given the sequence $\{q_t^M\}_{t=0}^{+\infty}$ of prices of financial market contracts. We will require that when agents behave optimally given those prices, the market for each type of financing clears every period.

Recall that at a given date $t > 0$, a lenders' opportunities to invest his endowment depend on their investment decision at date $t-1$. If at date $t-1$ they supplied their endowment on the financial market, they can choose to do the same at no cost at date t. We will denote by V_t^M the expected present value of future income as of date t for lenders who were in the financial market at date $t-1$. Other lenders must bear cost c_t if they choose to enter the financial market. Let V_t^B be the expected present value of future income as of date t for those lenders. In each period, lenders decide whether to deposit their endowment in the bank, or

[5]By F_t we mean the distribution of borrowers' observable success types. We assume for notational simplicity that R and g are constant across projects and across time.

lend it on the financial market. They choose the option that maximizes their future income. Formally, for all $t \geq 0$,

$$V_t^M = max\left\{q_t^M + \beta V_{t+1}^M; 2 + \beta V_{t+1}^B\right\}. \tag{4.1}$$

Indeed, lending on the financial market yields q_t^M in the current period and expected income V_{t+1}^M as of date $t+1$. Bank deposits on the other hand yield zero net return (since the bank behaves competitively) and give the lender expected income V_{t+1}^B as of period $t+1$. Similar considerations for lenders who were not in the financial market at date $t-1$ yield:

$$V_t^B = max\left\{q_t^M - c_t + \beta V_{t+1}^M; 2 + \beta V_{t+1}^B\right\}. \tag{4.2}$$

Denote by e_t the mass of lenders who enter the financial market at date t while x_t is the fraction of lenders who exit the financial market. Because there are more lenders than borrowers ($\ell > 1$) in each period, it is necessary in equilibrium that $q_t^M - c_t + \beta V_{t+1}^M \leq 2 + \beta V_{t+1}^B$ for all $t > 0$, with equality if $e_t > 0$. But this implies $V_t^B = 2 + \beta V_{t+1}^B$ for all t or, for short and for all t,

$$V_t^B = V^B \equiv \frac{2}{1-\beta}.$$

As for exit, $x_t > 0$ in equilibrium for some t will imply $q_t^M + \beta V_{t+1}^M \leq 2 + \beta V_{t+1}^B$, or more succinctly, $q_t^M + \beta V_{t+1}^M \leq V^B$. In passing, note as a result of these observations, $x_t > 0$ implies $e_t = 0$. Entry into and exit from the financial market cannot coincide in equilibrium.[6]

We now turn to the problem solved by borrowers in equilibrium. We need to calculate the mass of borrowers who obtain funding on the financial market in each period. Recall first that borrowers whose project is too risky, specifically borrowers whose p_1 is such that $p_1 < \underline{p}^M(q_t^M)$ at a given date $t \geq 0$, cannot get any funding on the financial market. Borrowers whose p_1 exceed this threshold expect utility $p_1 R + R + 2B - (1 + \rho_t + g(p_1)(1+\rho_t))$ from the bank, while on the financial market they expect $p_1 R + R + 2B - q_t^M$. Therefore, a borrower's expected utility is higher on the financial market if $q_t^M \leq 1 + \rho_t + g(p_1)(1+\rho_t)$. It follows

[6]This feature is no longer present when we introduce exogenous exit in section 6.

that borrowers on the financial market at date t have mass $1 - F_t(p_1^*(q_t^M, \rho_t))$ where

$$p_1^*(q, \rho) = \max\left\{\underline{p}^M(q); g^{-1}\left(\frac{q-(1+\rho)}{1+\rho}\right)\right\}$$

for all $q, \rho \geq 0$, with the convention that g^{-1} is zero if $\frac{q-(1+\rho)}{1+\rho}$ is negative. It is, in other words, borrowers with relatively safe projects that opt for the financial market. This is because bank monitoring is particularly valuable for good borrowers with a low p_1. Our model inherits this feature from the model of Bolton and Freixas (2000). Note for future reference that p_1^* is continuous, rises with its first argument, and decreases with its second argument.

We can now define an equilibrium from the vantage point of a reference date $t = 0$. All relevant past information is summarized by the mass m_{-1} of lenders who were on the financial market at date -1, that is, the size of the financial market at date -1. Given m_{-1}, a sequence $\{m_t\}_{t=0}^{+\infty}$ of financial market sizes, a sequence $\{q_t^M\}_{t=0}^{+\infty}$ of financial market prices, the associated value functions $\{V_t^M\}_{t=0}^{+\infty}$, and a sequence $\{e_t, x_t\}_{t=0}^{+\infty}$ of entry and exit decisions constitute an equilibrium if:

1. $q_t^M - c_t + \beta V_{t+1}^M \leq V^B$ with equality if $e_t > 0$,
2. $q_t^M + \beta V_{t+1}^M \leq \frac{2}{1-\beta}$ if $x_t > 0$,
3. for all $t \geq 0$, $m_{t+1} = m_t - x_t + e_t$,
4. for all $t \geq 0$, $m_t = 1 - F_t(p_1^*(q_t^M, \rho_t))$.

The key result of this section is that the fundamental characteristics $\{c_t, \rho_t, F_t\}_{t=0}^{+\infty}$ of the economy uniquely determine its financial development.

Proposition 4.1. *Given an initial size m_{-1} of the financial sector, a unique equilibrium sequence $\{m_t^*\}_{t=0}^{+\infty}$ of financial market sizes exists.*

Proof. From a technical standpoint, our economy resembles the framework of Hopenhayn

(1992),[7] and like Hopenhayn, we will adapt the arguments of Lucas and Prescott (1971) to establish that a unique equilibrium exists in our model. For $m \in (0,1)$, define $D_t(m)$ implicitly by

$$1 - F_t(p_1^*(D_t(m), \rho_t)) = m.$$

$D_t(m)$ is therefore the market price for which m lenders are active in the market. To see that D_t is well-defined for all t, recall that F_t is continuous and strictly increasing, and note that for q large enough $p_1^*(q, \rho_t) = 1$, while for q small enough $p_1^*(q, \rho_t) = 0$. Then let $D_t(0) = \lim_{m \downarrow 0} D_t(m)$ and $D_t(1) = \lim_{m \uparrow 1} D_t(m)$. Because $p_1 + g(p_1)$ converges to zero as p_1 falls, we have $D_t(1) = 0$. Furthermore, D_t is strictly decreasing on $[0,1]$ for all t, because F_t is strictly increasing. Now let

$$S(m,t) = \int_0^m D_t(i)di$$

for all $m \in [0,1]$ and $t \geq 0$, and extend S on $[1, \ell]$ by $S(m,t) = S(1,t)$ if $m > 1$. Since $\lim_{m \uparrow 1} S_1(m,t) = D_t(1) = 0$, $S(\bullet, t)$ is differentiable on $[0, \ell]$. Now consider for all t the following *surplus maximization problem*:

$$v(m,t) = \max_{e,x} S(m+e-x,t) - ec_t - 2(m+e-x) + \beta v(m+e-x, t+1)$$

$$\text{subject to :} \quad \begin{aligned} x &\geq 0 \\ x &\leq m \\ e &\geq 0 \\ e &\leq \ell - m \end{aligned}$$

Our goal is to show that solutions to the surplus maximization problem and competitive equilibrium allocations coincide. A standard appeal to dynamic programming arguments

[7] Our environment differs from Hopenhayn's in one important respect. The demand for funds on the financial market depends not only on the price of the funds, but also on time-varying intermediation and entry costs, and characteristics of the distribution projects.

shows that for all $t \geq 0$, $v(\bullet, t)$ is well-defined, concave, and differentiable on $[0, \ell]$, and that $v_1(m, t) = 0$ if $m \geq 1$ (since exit is free.) Let λ, μ, η and γ be the non-negative multipliers associated with the four constraints, respectively. Necessary and sufficient[8] conditions for a solution to the above maximization program at date t are:

$$-S_1(m + e - x, t) + 2 - \beta v_1(m + e - x, t + 1) + \lambda - \mu = 0 \quad (4.3)$$

$$S_1(m + e - x, t) - c_t - 2 + \beta v_1(m + e - x, t + 1) + \eta - \gamma = 0 \quad (4.4)$$

$$\lambda x = 0 \quad (4.5)$$

$$\mu(m - x) = 0 \quad (4.6)$$

$$\eta e = 0 \quad (4.7)$$

$$\gamma(\ell - m - e) = 0 \quad (4.8)$$

Observe that $e > 0$ implies $x = 0$. Indeed, if $\eta = 0$ then (4.3) and (4.4) imply that $\lambda = c_t + \mu + \gamma > 0$. Conversely, $x > 0$ implies $e = 0$. Also note that $\gamma = 0$. To see this, suppose $\gamma > 0$ so that $e = \ell - m > 0$ by (4.8). Then $x = 0$ (since $e > 0$) and $\mu = 0$ by (4.6). Then, since $S_1(m, t) = 0$ and $v_1(m, t) = 0$ when $m \geq 1$, (4.3) implies that $\lambda < 0$, a contradiction. Now let $\{x_t, e_t\}_{t=0}^{+\infty}$ be a solution to the surplus maximization problem. Then together with

$$m_t = m_{t-1} + e_t - x_t$$

$$V_t^M = v_1(m_t, t) + V^B,$$

and

$$q_t^M = S_1(m_t + e_t - x_t, t),$$

for all t, $(4.3 - 4.8)$ imply that $\{x_t, e_t, m_t\}_{t=0}^{+\infty}$ satisfy the four defining conditions of a competitive equilibrium. We need only check that $\{V_t^M\}_{t=0}^{+\infty}$ so defined satisfies equation (4.1). The

[8]These conditions are sufficient because $S(\bullet, t)$ is strictly concave for all t on $[0, 1]$ since D_t is strictly decreasing.

envelope theorem gives

$$v_1(m_t, t) = S_1(m_t + e_t - x_t, t) - 2 + \beta v_1(m_t + e_t - x_t, t + 1) + \mu_t$$

for all t, where $\mu_t \geq 0$ is the value of the multiplier associated with the second constraint at date t. But then (4.3) implies $v_1(m_t, t) = \lambda_t$. So $v_1(m_t, t) \geq 0$. If λ_t happens to be positive, $x_t = 0$ by (4.5), hence $\mu_t = 0$ by (4.6). Then $\lambda_t = S_1(m+e-x, t) - 2 + \beta v_1(m+e-x, t+1)$, by (4.3), or , $\lambda_t = q_t^M - 2 + \beta(V_{t+1}^M - V^B)$. It follows that,

$$V_t^M - V^B = v_1(m_t, t) = \max \left\{ q_t^M - 2 + \beta(V_{t+1}^M - V^B), 0 \right\},$$

which is equation (4.1) with $V_t^B = V^B = 2/(1-\beta)$ for all t. So we have shown that solutions to the surplus maximization problem are competitive equilibria. That competitive equilibria are solutions to the surplus problem is established similarly.

To see that an equilibrium exists, observe that the surplus maximization problem is the maximization of a continuous function on a compact subset of $I\!R^\infty$ equipped with the product topology. As for uniqueness, note that the set of feasible sequences $\{x_t, e_t\}_{t=0}^{+\infty}$ is convex, and that $S(\bullet, t)$ is strictly concave for all t because D_t is strictly decreasing. This completes the proof. □

Proposition 4.1 is not merely of technical interest. It implies that our theory for why financial structures vary in observably similar economies is not one of multiple equilibria. Given an initial size of the financial sector, economies with the same sequence of fundamental characteristics have the same equilibrium sequence of financial structures. Fundamentals fully explain financial structures. Put another way, if two economies reach two different financial systems, their fundamental characteristics must have differed at some point. This, however, does not imply that two economies whose fundamental characteristics converge will converge to similar financial systems. We now turn to establishing this result.

5 Fundamental vs. financial convergence

In this section we compare the equilibrium sequence of financial structures of economies with different sequences of fundamental characteristics. Formally, let $i \in \{1, 2\}$ index two distinct economies. Denote by (c_t^i, ρ_t^i, F_t^i) the financial market entry cost, the bank intermediation cost, and the distribution of observable project characteristics in economy i at date t. By economy i's fundamental characteristics at date t we mean (c_t^i, ρ_t^i, F_t^i). A sequence $\{c_t^i, \rho_t^i, F_t^i\}_{t=0}^{+\infty}$ of fundamentals together with an initial size m_{-1}^i of the financial market in economy i imply a unique equilibrium sequence $\{m_t^i\}_{t=0}^{+\infty}$ of financial structures, by proposition 4.1. The question we ask in this section is whether convergence (in some sense) of (ρ_t^1, c_t^1, F_t^1) to (ρ_t^2, c_t^2, F_t^2) with t implies that m_t^1 converges to m_t^2, for any pair (m_{-1}^1, m_{-1}^2) of initial conditions.

We will show that convergence in fundamentals does not imply convergence in financial structures unless entry into the financial market is free. To emphasize the key role of entry costs, we first show that if, eventually, $c_t^1 = c_t^2 = 0$, then convergence in fundamentals imply financial convergence. In this case, financial market entry is eventually costless and lenders solve a static problem as past financial decisions do not matter. The supply of funds on the financial market, therefore, only depends on current fundamental characteristics. If those characteristics converge, so must the size of the financial sector. For concreteness, we will say that two economies converge in fundamentals if $\rho_t^1 - \rho_t^2$ and $c_t^1 - c_t^2$ converge to zero with t in the usual sense, while $F_t^1 - F_t^2$ converges to zero uniformly on $[0, 1]$. To avoid the usual convergence technicalities, we will also assume that $\{F_t^1 - F_t^2\}_{t=0}^{+\infty}$ is a *normal family of functions*:[9]

Assumption 5.1. $\{F_t^1 - F_t^2\}_{t=0}^{+\infty}$ *is equicontinuous on* $[0, 1]$.

Under that assumption, we obtain:

Proposition 5.2. *If* $c_t^1 = c_t^2 = 0$ *for* t *large enough, convergence in fundamentals implies convergence in financial structures.*

[9] To obtain a generic convergence result assuming that $\{F_t^1 - F_t^2\}_{t=0}^{+\infty}$ has a small Julia set suffices. Potential problems only arise in the proof of proposition 5.2 if p_1^* lands in the Julia set of $\{F_t^1 - F_t^2\}_{t=0}^{+\infty}$ infinitely often.

Proof. When $c_t^1 = c_t^2 = 0$ from t on, $V_s^M = V^B$ for all $s \geq t$ in both economies and the supply of funds on the financial market in a given period is independent of the previous size of the financial sector. Specifically, when $q_s = 2$ at date $s \geq t$, lenders are indifferent between the bank and the financial market. The supply of fund, in that case, is any number in $[0, \ell]$. Demand, on the other side is $1 - F_s^i(p_1^*(2, \rho_s^i))$ in economy i, which is contained is $[0, 1]$. Therefore $q_s = 2$ clears markets for all $s \geq t$. Since the equilibrium sequence of market sizes is unique, we must have $m_s^i = 1 - F_s^i(p_1^*(2, \rho_s^i))$ for $i = 1$, 2 and $s \geq t$. To complete the argument, note that we can assume without loss of generality that $\{\rho_t^1, \rho_t^2\}_{t=0}^{+\infty}$ is bounded. Indeed, whenever $\rho > 1$, $p_1^*(2, \rho) = p_1^*(2, 1)$. Therefore, p_1^* is uniformly continuous. Because $\{F_t^1 - F_t^2\}_{t=0}^{+\infty}$ is equicontinuous, $m_t^1 - m_t^2$ converges to zero in the standard sense as t rises, as claimed. □

But, in general, fundamental convergence does not imply financial convergence. To see this, we consider an extreme case of fundamental convergence by assuming that, for both $i \in \{1, 2\}$, $(c_t^i, \rho_t^i, F_t^i) = (c, \rho, F)$ for all t. We further restrict parameters so that if $c = 0$ the financial sector is active in every period. Without such an assumption, the two economies would jump to the same degenerate (banks only) financial structure immediately. Formally,

Assumption 5.3. $1 - F(p_1^*(2, \rho)) > 0$.

When, as is now the case, fundamentals are constant, it is natural to inquire about invariant values for the size of the financial sector, that is, set of initial conditions m^* such that if $m_{-1} = m^*$, $m_t = m^*$ for all t in equilibrium. Let Γ be the set of such initial values. A necessary condition for economies with the same sequence of constant fundamentals to always converge to the same financial structure is that Γ be a singleton. Otherwise, two economies whose initial conditions are two distinct points of the invariant set would remain at those distinct points at all dates. The following remark records the fact that Γ is a singleton when entry into the financial market is costless.

Remark 5.4. *If $c = 0$, Γ is a singleton.*

Proof. When $c = 0$, $m_t = 1 - F(p_1^*(2, \rho))$ for all t in equilibrium, regardless of m_{-1}. ☐

In fact, when $c = 0$ and all fundamentals are identical in the two economies, both economies jump to the unique invariant size of the financial sector immediately and remain there. They trivially converge to the same financial structure. When $c > 0$ however, there are many invariant distributions and, therefore, convergence in fundamentals in any sense does not imply convergence in financial structures.

Proposition 5.5. *If $c > 0$, Γ is a closed interval of strictly positive diameter.*

Proof. Let $m^* = 1 - F(p_1^*(2, \rho))$ and assume that $c > 0$. If $q_t = 2$ for all t then $e_t = 0$ for all t. (Indeed, lenders are just willing to enter markets if $q_t = 2$ for all t when $c = 0$.) In particular, m^* remains invariant when $c > 0$. Now choose q' so that if $q_t = q'$ for all t, $V_t^M - c = V^B$ for all t. Then $q' > 2$ (because $c > 0$) and for all $q \in (2, q')$, $q_t = q$ for all t implies $V_t^M - c < V^B$ for all t so that $e_t = 0$ for all t. But since $q > 2$ we also have $x_t = 0$ for all t. It follows that for $q \in [2, q']$, $m = 1 - F(p_1^*(q, \rho))$ is invariant. Because F is strictly increasing and continuous, the set of invariant sizes of the financial market is a closed interval of positive mass. ☐

The intuition for this result is simple. Fundamentals imply a unique sequence of prices of financial contracts. Those prices can be such that it is profitable for lenders who have borne the entry cost to remain on the financial market, but not high enough to cover the entry cost for lenders who have yet to bear it. If c is high, many such price sequences exist and so, therefore, do many invariant sizes of the financial market. The fact that the upper bound of the set of invariant distribution is the unique element ($m^* = 1 - F(p_1^*(2, \rho))$) of Γ in economies where entry costs are zero should also be intuitive. It is finally easy to see that for c large enough or ρ low enough, $\Gamma = [0, m^*]$ so that, in that case, economies that did not develop a financial market in the past never will.

6 Discussion of our key assumptions

Many of the simplifying assumptions we have made heretofore are easy to relax. For instance, assuming that borrowers also face a cost when they choose to participate in financial markets (say, for the sake of symmetry with lenders), or assuming that exit from financial markets is costly, would add notation without altering any of our results. Similarly assuming more general monotonic preferences for borrowers would not affect our results. Two critical assumptions we make however are that 1) no exogenous exit from financial markets ever occurs and, 2) that lenders cannot fund more than one project with bounded size. The purpose of this section is to discuss the role of those two key assumptions.

6.1 Exogenous exit

So far we have assumed that there is no exit from the financial market for exogenous reasons. Lenders exit when and only when it is profit maximizing for them to do so. Lenders who entered the financial market in the past because fundamental characteristics justified it may choose to stay put in equilibrium while given current and future fundamentals lenders who have yet to pay the fixed cost maximize their income by staying out of the financial market.

To highlight the importance of this feature of our model, we now introduce exogenous exit by assuming that a fraction $\delta > 0$ of lenders die every period and are immediately replaced by newly born lenders. Furthermore, *all* newly born lenders have to pay the fixed cost if they choose to enter the financial market. For clarity, we state here the equations which the value functions of lenders must solve when death occurs with positive likelihood. From the point of view of risk-neutral lenders, this only means that they discount future flows at rate $\beta\delta$, instead of β:

$$V_t^M = max\left\{q_t^M + \beta\delta V_{t+1}^M; 2 + \beta\delta V_{t+1}^B\right\},$$

while, for lenders who were not in the financial market at date $t-1$,

$$V_t^B = max\left\{q_t^M - c_t + \beta\delta V_{t+1}^M; 2 + \beta\delta V_{t+1}^B\right\} = \frac{2}{1-\beta\delta}.$$

Our definition of an equilibrium changes little. The main difference is that condition 3 becomes, for all $t \geq 0$, $m_{t+1} = m_t(1-\delta) - x_t + e_t$, where x_t is the mass of surviving lenders who choose to exit the financial market in period t. One can replicate the arguments behind proposition 4.1 to show that equilibria continue to exist and that the equilibrium path of financial market sizes continues to be unique. More importantly, we can also show:

Proposition 6.1. *If $\delta > 0$, then Γ is a singleton. Furthermore, if for $i \in \{1,2\}$ and for all $t \geq 0$ $(c_t^t, \rho_t^i, F_t^i) = (c, \rho, F)$, then $m_t^1 - m_t^2$ is zero after a finite number of periods.*

Proof. Let m^* be an element of Γ. (Γ is not empty because it always contains at least the unique invariant distribution that prevails when $c = 0$.) If $m^* > 0$, then there must be some entry in invariant equilibrium in all periods since $x_t + \delta m^* > 0$ for all t. This implies that $q_t = \bar{q}$ for all t where $\frac{\bar{q}}{1-\beta\delta} - c = V^B$ or, $\bar{q} = 2 + (1-\beta\delta)c$. That is, $\bar{q}$ is the unique constant price of financial market contracts such that lenders are just willing to enter the financial market in each period. But then $m^* = 1 - F(p_1^*(\bar{q}, \rho))$ is the only possible element of Γ. Note that if (and only if) $1 - F(p_1^*(\bar{q}, \rho)) = 0$, $m^* = 0$ is the only element of Γ.

To see that both economies converge to Γ's unique element, assume that $m^* > 0$ and that $m_t^1 < m^*$ for some t. Then $q_t > \bar{q}$ for otherwise we would have too many borrowers on the financial market in economy 1 since $1 - F(p_1^*(\bar{q}, \rho)) = m^* > m_t^1$. If $q_s > \bar{q}$ for all $s > t$ then all lenders would enter the financial market at date t since $\bar{q}$ is such that, if maintained for ever, lenders are just willing to enter the financial market. This is incompatible with equilibrium. So we must have $q_s < \bar{q}$ for some $s > t$ so that, at some s, $m_s \geq m^*$. If $m_s = m^*$, we are done. So without loss of generality we can assume that $m_{-1}^i > m^*$ for $i \in \{1,2\}$, that is start both economies above the invariant size of financial market. We will construct a continuation equilibrium from that point that converges to m^* in a finite number of period. Because equilibria are unique from any initial size, the result will then be established.

Let $\tilde{m}_t^i = m_{-1}^i(1-\delta)^{t+1}$ for all t. If, at date t, $\tilde{m}_t^i < m^*$ let $q_t(m_{-1}^i) = \bar{q}$. Otherwise, let $q_t(m_{-1}^i)$ be such that the financial market clears at size $\tilde{m}_t^i$, i.e. the unique solution to $1 - F(p_1^*(q,\rho)) = \tilde{m}_t^i$. Let V_t^M be the corresponding value function for lenders on the financial market. Note that $q_t(m_{-1}^i) \leq \bar{q}$ for all t. Therefore, at those prices, $V_t^M \leq V^B + c$. Define

$$\bar{m}_{-1} = \max\left\{ m_{-1} \in [\frac{m^*}{1-\delta}, 1] : V_0^M \geq V^B \text{ given prices } \{q_t(m_{-1})\}_{t=0}^{+\infty} \right\}.$$

In words, $\bar{m}_{-1}$ is the largest initial size of the financial market such that the resulting future prices induce no endogenous exit. If $m_{-1}^i > \bar{m}_{-1}$ then $V_0^M < V^B$ given prices $\{q_t(m_{-1}^i)\}_{t=0}^{+\infty}$. In that case, set $\tilde{m}_t^i = \bar{m}(1-\delta)^{t+1}$ for all t and construct prices as before. To complete our construction of an equilibrium, we need to describe a path for entry and exit from the financial market. If $m_{-1}^i \leq \bar{m}$, set $x_t = 0$ for all t. If $m_{-1}^i > \bar{m}$, then set $x_0 = (1-\delta)(m_{-1}^i - \bar{m})$ and $x_t = 0$ for all $t > 0$. As for entry, set $e_t = 0$ if $\tilde{m}_t^i > m^*$, $e_t = m^* - (1-\delta)\tilde{m}_t^i$ the first time that $(1-\delta)\tilde{m}_t^i < m^*$, and $e_t = \delta m^*$ after that. One easily checks that we have constructed an equilibrium from initial condition m_{-1}^i. What's more, $m_t^i = m^*$ after at most $\lfloor \frac{\log(m^*)}{\log(1-\delta)} \rfloor$ periods in both economies. In particular, $m_t^1 - m_t^2 = 0$ after a finite number of periods, as claimed. □

Obtaining convergence, therefore, requires that exit occurs exogenously sufficiently enough, *and* that the lenders who replace lenders on the financial market do not inherit their opportunities. Note however that convergence occurs at a rate that depends on the rate of exogenous exit. While not permanent, differences in financial market can be arbitrarily persistent if the rate of exogenous exit is low.

6.2 Project size

In our model, participation in the financial market allows lenders to manage exactly one project for any number of periods after bearing a cost of entry. However, they cannot fund more than one project. Relaxing this assumption enables lenders to mitigate entry costs. For instance, lenders could pool resources and delegate a representative in the financial market, dividing the proceeds equally among members of the coalition.[10] If the entry cost borne by the coalition does not increase with its size, the entry cost per project can be made arbitrarily small. As a consequence, the set of invariant financial market sizes will shrink. One key assumption we are making, therefore, is that the total cost of setting up projects rises with the number of projects, even if the same lender is involved in all projects.

A related assumption we are making is that project size is unique. Under the alternative assumption that lenders can fund project of various sizes, and that set-up costs increase less than linearly with size, large projects would be funded first on the financial market. But, again, as long as funding more projects carries an initial cost, channelling more resources to the financial market will be more costly. Then, as in our basic model, economies who have created a large financial market in the past will remain more likely to have a large financial market in the future, making financial structure persistent. In short, as long as making the financial market bigger from one period to the next is costly, history will continue to matter.

7 Conclusion

We have presented a dynamic, general equilibrium model in which financial structure differences between two economies can persist even after fundamental characteristics have converged. In simple terms, this occurs in our theory because channelling funds through the financial market is cheaper in economies that have borne the cost of building large financial markets in the past.

A possible illustration of these forces at play are the economic histories of Germany and the United States. Germany used to impose significant legal barriers to entry into financial markets. Meanwhile, federal laws discouraged bank intermediation in the U.S. As a consequence, early on, banks became heavily involved in corporate lending in Germany, while U.S.

[10]Lenders could also choose to accumulate resources in order to fund several projects. Wealth accumulation introduces additional technical complications since the evolution of the economy now depends on another state variable. But as long as setting up more projects is costly for lenders, financial systems should be persistent.

firms learned to rely on other sources of funds. Even though the legal frameworks of the two nations no longer differ much, the U.S. has a longer history of financial market lending than Germany, and financial markets remain a more cost-effective source of funds for U.S. firms than for German firms.

Quite importantly, equilibria are unique and Pareto optimal in our model. Financial structures are efficient *given* the fundamental characteristics of each economy. While current fundamentals may not suffice to explain a nation's current financial structure, together with past fundamentals they fully explain, and justify it. More generally, our model suggests that basic industrial organization principles could help us understand why financial structures vary so markedly across nations.

A Historical Motivation

One motivation for this paper is the fact that, historically, institutional environments have differed markedly in Germany and the United States. In the U.S., banking activities have been regulated by states since the end of the Second Bank of the U.S. in 1836. The fear of concentration in the banking sector prompted most states to impose restrictions on branching. The National Banking System introduced after the Civil War in 1863 further limited the scale and scope of banks by restricting their holdings of equities and imposing minimum capital requirement (see Sylla, 1969). The importance of local banks, the absence of nationwide banks and the absence of a central bank created an environment propitious to banking panics.[11] In response, the Federal Reserve System was created in 1913. The poor functioning of the banking sector until then favored the development of alternative sources of finance, and the growing role of financial markets. Davis (1965) writes that "a series of new financial institutions capable of surmounting the barriers raised by distance and by the lack of adequate branch-banking legislation was innovated. In the period 1870 to 1914, barriers to short-term mobility were overcome by direct solicitation of interregional funds, by commercial bank rediscounting, and most important, by the evolution of a national market for commercial paper." Unlike the banking sector, financial markets were subject to little regulation in the U.S. (see Smith and Werner, 1991). Incumbent financial market participants managed to erect some barriers to entry,[12] but the presence of many competing institutions and large broking firms mitigated the impact of these barriers. Michie (1986) points out for instance

[11] Panics occurred in 1837, 1857, 1873, 1884, 1893 and 1907.

[12] Davis and Neal (1998) and Michie (1986) review the history of the New York Stock Exchange. The exchange started operating in 1792 with 24 members and was formally established in 1817. The number of

that "the most serious challenge [to the New York Stock Exchange] came in 1885, when a number of rival exchanges merged to form the Consolidated Stock Exchange, with 2403 members", which competed with the New York Stock Exchange until World War I.

While the relative importance of banks declined in the U.S. in the XIXth century, they became the dominant source of funds for firms in Germany. According to Guinnane (2002), several institutional factors explain the historical dominance of bank financing in Germany. Prior to 1871, Germany was a constellation of independent states with local control over financial regulations. Most states restricted the number of limited liability firms, as they feared the separation of firm's ownership and firm's liabilities would allow entrepreneurs to escape their debts and because they wanted to extract rents from granting this privilege. The right to set up a joint stock firm was seldom granted. In 1857, only 203 joint stock firms existed in Germany. Despite high demand and an improved legal framework under the 1861 Business Code, very few additional firms had obtained joint stock status by 1870. Banks thus remained the main providers of funds for most industrial firms' funds in Germany. Guinnane (2002) and Tilly (1998) also argue that the presence of a lender of last resort made banks more willing to engage in industrial lending. The Bank of Prussia, founded in 1847, "acted, to some degree at least, like a lender of last resort. Banks that were in trouble could sell bills out of their own portfolio to the Bank of Prussia" (Tilly, 1998). The Bank of Prussia later became the Reichsbank, and continued to serve this role. In contrast, no lender of last resort existed in the United States until the Federal Reserve was founded in 1913.

Despite the many institutional barriers they faced, financial markets experienced a short-lived growth spurt after Prussia defeated Austria in the 1866 war and the new North German Confederation was founded. All trade barriers were abolished and a single currency was established. An economic boom ensued marked by large capital-intensive projects such as railroad expansion. The Berlin Stock Exchange expanded briskly for a few years, but was severely hit by the 1873 crash. As a response to the ensuing instability, Germany decided to restrict the Berlin Stock Exchange's activities in a process that culminated with the 1884 and 1896 company Laws. Although some debate the effects of the companies laws on firms' finance (see Fohlin 2001), these laws imposed new constraints on financial markets activities. For instance Tilly (1982) reports that "only larger firms having a stock exchange listing could tap in that market for capital without delay and only large firms would not find the minimum issue volume of one million marks and minimum share size of one thousand marks inconvenient. This gap must have benefited banks who did have access to the stock exchange, but it also must have excluded many potential users of the capital market." As far as investors are concerned, the 1885 stock exchange laws restricted access to the Berlin Stock Exchange. Entrance tick-

members reached 1,100 in 1879 and remained there until 1914. Then, a new member had to buy the seat of an existing member and pay a substantial entry fee ranging between $64,000 and $94,000 in 1910. The fact that existing members owned the stock exchange enabled them to levy a minimum commission for each trade and restrict the type of securities they wished to trade. As a result, the average size of each issue from quoted industrial and commercial companies was $24.7 million by 1914. Minimum commissions and restricted access created inefficiencies and fragmented the New York securities market.

ets ("Eintrittskarte") were only granted to members of the "Korporation der Kaufmannschaft von Berlin" and owners of firms or corporations that were registered in Berlin.[13] Importantly, it is barriers to access to the stock market, rather than its malfunctioning, that seem to have limited its development. Fohlin and Gehrig (2004) argue that the Berlin Stock Exchange was surprisingly efficient for the time.

Although legal differences between Germany, the U.S. and other nations (see e.g Allen and Gale, 2000) still exist, they are fading. In the U.S. for instance, the Riegel-Neal Interstate Banking and Branching Efficiency Act of 1994 set up a timetable for relaxing the restrictions on interstate banking. Also, the restrictions imposed by The Glass-Steagall Act of 1933 on securities underwriting have been gradually relaxed.[14]

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[13] We thank to Martin Uebele and Stefan Volk for providing this information to us. Unfortunately, we could not obtain the price of these tickets.

[14] A firewall preventing the flow of information between subsidiaries and other parts of the banks remains mandated however. In Germany the underwriting of securities is unrestricted and can be undertaken directly by the bank. Germany does not mandate any firewalls.

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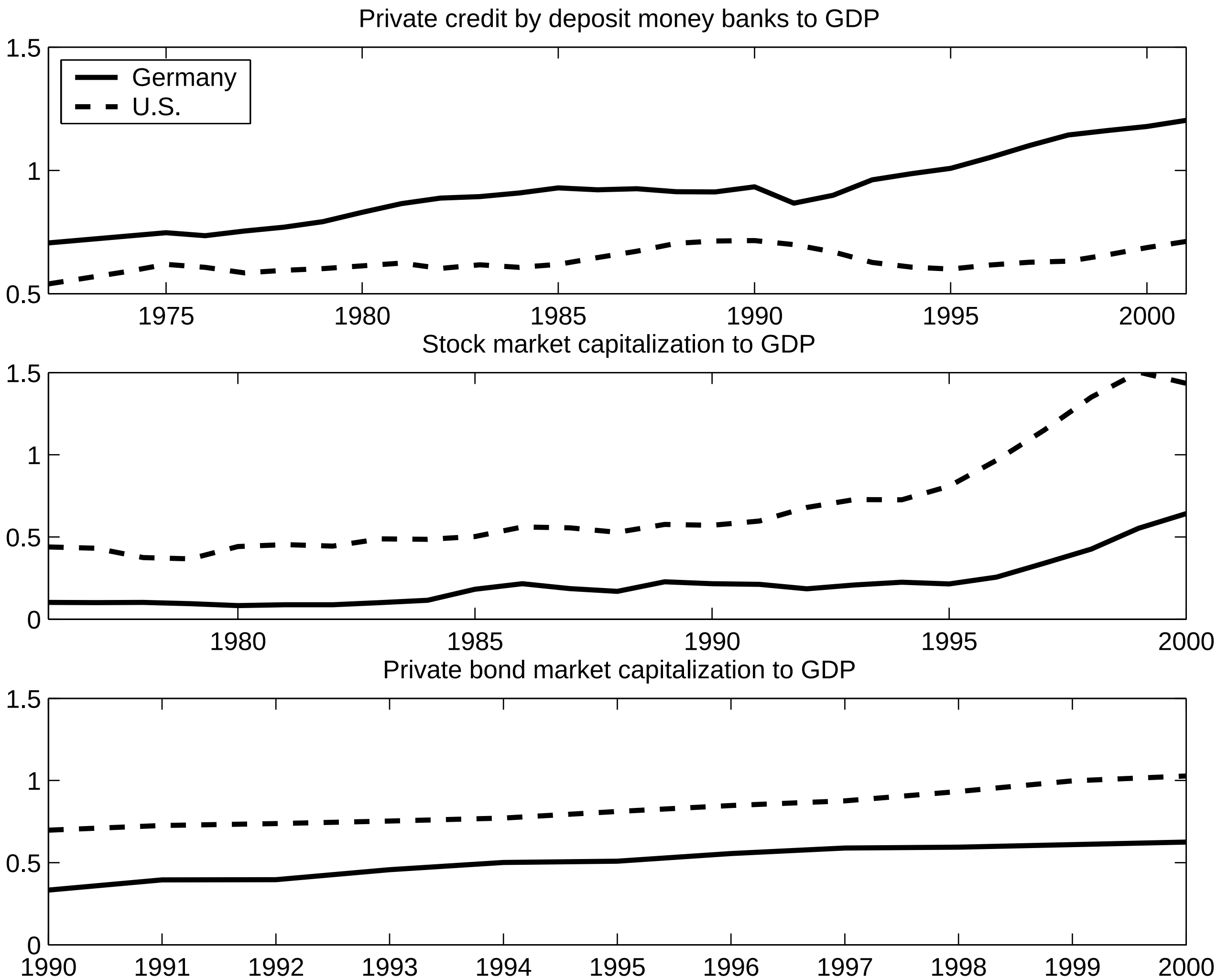
Figure 1: **Bank Lending and Financial Markets in Germany and the U.S.**



Source: Demirguc-Kunt and Levine, 2001.