On the Effects of Banks' Equity Ownership on Credit Markets: An Antitrust Perspective on the Glass-Steagall Act*

Rabah Amir
CORE, UCL, Belgium

Michael Troge
ESCP-EAP, Paris, France

Jan 2004

Abstract

Recent U.S. legislation (Gramm-Leach-Bliley Act) allows commercial banks to enter merchant banking, i.e. hold equity in non-financial firms. A stylised auction-theoretic model is developed to investigate the effects of bank equity stakes in firms on the competition in bank loans. The main finding is that the largest stake confers a competitive advantage to the holding bank and constitutes a barrier to entry in equity acquisition, resulting in high interest rates charged to firms. This finding unearths an antitrust dimension in the controversial debate on the separation of banking and commerce in the U.S., and provides a theoretical basis for recent empirical evidence on the relationship between bank equity holdings and the cost of debt finance in Germany and Japan.

JEL Classification Codes: G21, D44, L40.

Key words and phrases: Banking and commerce, Regulation and antitrust, Glass-Steagall Act, Gramm-Leach-Bliley Act, Auctions.

* *Corresponding author:* Rabah Amir, CORE, 34 voie du Roman Pays, 1348 Louvain-la-neuve, Belgium. (*E-mail:* amir@core.ucl.ac.be)

1 Introduction

The separation of banking and commerce remains one of the most controversial issues in banking regulation. This is reflected in the great diversity of regulatory regimes across OECD countries. In the United States, where the history of regulating non-lending activities of banks dates back to the first bank charters in the 18th century (Shull, 1999), the Gramm-Leach-Bliley Act now allows financial holding companies to invest in equity without significant restrictions[1], repealing much of the Glass-Steagall Act and the earlier National Banking Act. In Germany, where banks have traditionally been free to own equity in non-financial firms, the introduction of restrictions on bank ownership was discussed in the German parliament (Bundestag, 1997). In a recent study, the German antitrust commission (Monopolkommission, 1998) has recommended limiting bank participation to 5% of a firm's capital. [2]. In an international comparison, the United States and Germany lie at the extreme ends of the policy spectrum on this issue. Most countries do limit bank ownership in non-financial firms to some extent. Banks may own up to 50% of a firm's voting stock in Denmark and Norway, 25% in Portugal, 10% in Finland and Ireland, and up to 5% in Belgium, Japan and Sweden. Like Germany, Austria, Greece, Spain and Turkey have no general restrictions on the percentage of a firm that a bank may own (OECD 1992). With Italy having recently abandoned ownership restrictions, Australia is now the only OECD country that does not allow any investment in the equity of non-financial firms[3].

What are the incentives for banks to invest in the equity of their client firms, and are there any reasons for regulatory restrictions on this form of investment? While the separation between lending and underwriting activities has been analyzed extensively (Puri 1994, Kroszner and Rajan 1994, Kroszner 1998), surprisingly few studies have concentrated on the issue of commercial banks investing in the equity of non-financial firms. The dominant view seems to be that ownership restrictions are part of the prudential regulation of banks. On this basis, however, it is clearly not optimal to restrict the bank's stake to a percentage of the firm's capital. On the one hand this

[1]As of January 2001, The Federal Reserve and the Treasury announced the final rule implementing the provisions of the Gramm-Leach-Bliley Act on merchant banking. The rule limits holding periods, restricts the extent of routine management of a firm by a bank, and imposes capital adequacy requirements for investing in equity. The equity stake that a subsidiary of a financial holding company is allowed to own in a firm is not restricted.

[2]A law to this effect was proposed but not passed. Instead of this so-called "Transparency and Competition Law" proposed by the Social Democrats, in 1998 the Bundestag voted for the "KonTrAG" law proposed by the Christian Democrats, which only limited the voting powers of banks.

[3]With an international comparative perspective and case studies, Hall and Soskice (2001) provide a detailed account of the institutional aspects of the financial system in relation to other parts of the economy.

will not prevent small banks from overinvesting in big firms. On the other hand, even a large stake in a small firm should not endanger the stability of a large bank. Indeed, as shown by Santos (1999), it is more reasonable to restrict investments in equity as a function of the bank's capital. For example in Germany, in order to reduce the bank's exposure to firm-specific risk, a bank is not allowed to invest more than 15% of its capital in a single firm's equity. In any case it is not clear how ownership restrictions could prevent a bank from gambling with depositors' money. The modern view of these and similar restrictions is rather that they increase the bank's risk by preventing diversification. This is corroborated by empirical results. For instance, White (1995) has shown that in the pre Glass-Steagall era, equity ownership was not correlated with a bank's probability of failure.

While the beneficial effects of ownership restrictions on the safety and soundness of the financial system remain somewhat controversial, the downside of such regulation from a social welfare standpoint is quite easy to establish. Adapting an agency-theoretic view of financial contracting, it is evident that restricting the scope of feasible financial contracts will reduce welfare. For example a share holding bank is generally held to have more incentives to finance riskier projects, to obtain better information, and to restructure in case of distress. Neuberger and Neumann (1991) and John et al. (1995) present models in this spirit. Sometimes the alleged benefits of close bank-firm relationships have led to quite an enthusiastic view of the German financial system (e.g. Calomiris, 1994). A more systematic treatment of the comparative merits of bank-oriented financial systems (as in Germany and Japan), and market-oriented systems (as in the US and the UK), appears in Allen and Gale (2000).

This paper argues that restrictions on equity ownership of banks should be understood at least in part as antitrust regulation, with the aim of preventing intrinsic market power in the credit market[4]. In order to investigate the effects of an equity stake in a firm on the competition in the market for this firm's credits, oligopolistic competition between banks has to be posited. (It would be inappropriate to address this issue in an agency-theoretic framework, where one typically posits either monopolistic or perfectly competitive banks.) In this paper this is accomplished by developing an auction-theoretic model of bank competition in the tradition of Broecker (1990), Ruckes (1998) and von Thadden (2001). In this setting, it turns out that the ownership of a fraction of a firm's equity gives a bank market power when lending to the firm. The bank will be in a privileged position to provide loans to the firm vis a vis any competing bank, and will therefore increase its profit as well as the cost of debt to the firm.

[4]The effect of bank ownership on product market competition between firms is a different issue, analyzed in the literature on financial predation (see e.g. Bolton et al. 2000 for an introduction).

In addition, more precise predictions about the relationship between bank ownership and the equilibrium outcome of the credit market can be derived. If two banks participate in a firm's capital, both banks' profits increase with the level of the high-stake bank and decrease with the level of the low-stake bank. Thus, the loan rate depends on the asymmetry of the banks' stakes. Larger identical stakes by the two banks will lower the lending rate. However, if one bank already owns a sufficiently large stake, no other bank has any incentive to buy equity. For each firm, one would thus expect to see a credit market that is biased in favor of one major share-holding bank. Owning a significant stake in some sense acts as a type of barrier to entry into the firm's equity market. Thus, the structure of the firm's credit market reflects a surprising alignment of banks' incentives, which may be viewed as a form of tacit collusion between them, which is likely to lead to close relationships between one firm and one bank.

These results are driven by a key feature of the payoff structure: A bank that owns shares of a company receives not only interest payments, but also part of the firm's net profits through dividends or increased market value of the shares. Therefore a share owning bank will prefer low interest rates in case a competitor provides the loan and high rates if it itself supplies the loan, as it recovers only a fraction of the cash flows through dividends in the latter case. Auctions with a similar payoff structure have recently been studied by Burkart (1995), Bulow et al. (1999) and Singh (1999) in the context of company takeovers in which bidders already own a fraction of the equity prior to the auction.

The analysis at hand also bears some similarity to well-known results in related settings in industrial organization. Reynolds and Snapp (1986) show that in a linear Cournot market with cross-holdings amongst firms, higher holdings lead to more collusive outcomes and thus higher price and profits. Farrell and Shapiro (1990a-b) provide extensive generalizations of this observation along several dimensions. In a standard Cournot setting with constant unit costs, Salant and Shaffer (1998) establish that a mean-preserving spread of firms' unit costs leads to higher industry profits, with the symmetric case yielding the lowest equilibrium profits, a result reminiscent of our Proposition 2 but in quite a different setting.

The model developed in this paper provides a theoretical foundation for recent empirical evidence on the issues at hand. Starting in 1995, when a new law imposed the disclosure of participation levels in excess of 5% in Germany, several studies have estimated the impact of bank participation on various firm characteristics. Schmid (1996) uses a Herfindahl index to measure the concentration of banks in firms' capital and reports a significant rise in interest due to higher concentration. Similar results were obtained by Weinstein and Yafeh (1998) for Japan.

The results derived here offer a new perspective on the regulatory debate concerning banking and commerce, with a definite antitrust flavor. In view of the "natural monopoly" nature of credit markets uncovered by our simple analysis, each firm will find itself with only one bank as major share-holder. This will have at least two different adverse implications for the firm. The first follows immediately from our analysis: Higher cost of finance, and thus high agency costs of debt. The second is that the common policymakers' fear that led to the Glass-Steagall Act in the US (Cantillo, 1998), or to other limitations on banking and commerce elsewhere – that banks will exploit firms through substantial control of their boards – is more likely to be justified in a one-firm-one-bank world.

The next section of the paper presents the model. In section 3, the equilibrium outcome is derived. In Section 4, the main implications of the analysis are analyzed. Section 5 discusses agency costs and welfare effects. A conclusion forms Section 6. Proofs are all in the Appendix.

2 The Model

Our highly stylised model considers two banks that compete in providing a loan to a non-financial firm. One or both of the banks may own a fraction $\alpha_i \geq 0$, $i = 1, 2$ of the firm's equity. Without loss of generality, it is assumed that $\alpha_2 \geq \alpha_1$. We treat these equity stakes as exogenous and the investment of banks in equity as sunk. The size of the loan is normalized to one, w.l.o.g. The firm has a risky investment project that will yield a payoff $X > 1$ with probability λ. Hence the maximum loan rate a project can support is $X - 1$[5]. In case the project is successful, the credit is paid back and the net profit is distributed to shareholders. In case the project fails, it produces no return and is liquidated.

Banks have different information about the creditworthiness of firms. In the model, this is captured by assuming that with the same probability q, each bank receives additional information about the firm's project, independently of the other bank[6]. Having received this information, a bank knows with certainty whether the firm's project is going to succeed or not. The assumption $\lambda X < 1$ is made, so that even if the banks ask for the highest possible interest rate, it is not profitable for them to lend without additional information. Therefore, banks make an offer only if they know that the project is going to be successful. This offer specifies the repayment b the firm has to make after the project has succeeded. It is supposed that both bids are made simultaneously and

[5] Here, $X - 1$ could also be understood as the highest loan rate the firm is willing to accept, for example beause it can obtain financing at this cost from alternative sources.

[6] Allowing banks to receive information of different qualities q will not change our results.

that neither bank observes its rival's offered interest rate nor the fact that the latter has submitted a bid.

In this form, the model is essentially a simple common value auction. Note however that it lacks some of the typical features. In particular there is no danger of a winner's curse, as each bank bids only in case it has complete information. There are other variations on the present set-up that would share essentially the same structure and solution[7].

3 Equilibrium Characterization

As is common for auctions with discrete values, the game at hand has no equilibrium in pure strategies. If one bank were to bid a given interest rate as a pure strategy, the best response of the other bank would be either to slightly undercut this bid or to bid the highest possible amount. In both cases, the first bank's bid would not be optimal. We establish the existence of a unique mixed-strategy equilibrium.

Let $F_i : [1, X] \rightarrow [0, 1]$ be the equilibrium distribution functions for the bid b_i of bank i in case it has received a positive signal. The expected profit of bank j, conditional on having received a positive signal, bidding b and having an equity participation of $\alpha_j \geq 0$ is:

$$\begin{aligned} \pi_j(b) &= (b-1)\left[q\left(1-F_i(b)\right)+(1-q)\right] \\ &\quad +\alpha_j\left[\int_1^b q(X-x)\,dF_i(x)+\left[q\left(1-F_i(b)\right)+(1-q)\right](X-b)\right]. \end{aligned} \tag{1}$$

The first term is the gain from lending, $(b-1)$, multiplied by the probability of bank j lending. The second line contains the profit bank j will make on its equity participation. The integral term captures the expected dividends in case the competitor lends to the firm, while the other terms equal the dividend payments in case bank j wins the auction.

In a mixed strategy equilibrium, each bidder chooses the distribution of his bids in such a way that the competitor is indifferent among his possible (pure-strategy) bids.

[7] A Bertrand paradox does not emerge here since, when making an offer, a bank does not know whether its competitor will also make an offer, an event that depends on the information it receives about the firm's project. In alternative specifications of the model, there could be other reasons why competitors might not make an offer. For example, banks could, with probability $1-p$, not have sufficient liquidity to provide financing. We would then obtain a simple private (not common) value auction with exactly the same payoff structure as in the present model. Another possibility is that firms may not apply for credit at more than one bank. As Burdett and Judd (1983) show, if search or applying for credit is costly, firms will randomize between applying at one or at two banks. Hence, a bank that has been asked for a loan by a firm does not know whether it is facing a competitor.

It is shown in the appendix how this condition leads to a set of differential equations, characterizing the following unique, mixed-strategy, equilibrium.

Proposition 1 *The following distribution functions F_1, F_2 form the unique equilibrium of the game (here, $b_{\min} := 1 + (1-q)^{\frac{1}{1-\alpha_1}}(X-1)$, $i \neq j$):*

$$F_i(b) = \begin{cases} 0 & \text{for } b < b_{\min}, \\ \frac{1}{q} - \frac{1}{q}\left(\frac{b_{\min}-1}{b-1}\right)^{1-\alpha_j} & \text{for } b \in [b_{\min}, X), \\ 1 & \text{for } b \geqq X. \end{cases} \tag{2}$$

It is easily seen the high-stake bank offer on average a lower loan rate and that in case both banks receive a positive signal, the high-stake bank has a higher probability of winning. Moreover the distribution of the bank with a lower or no stake has a masspoint at $b = X$: it bids the highest possible value with positive probability.

We now examine how the banks' equilibrium bid distributions vary with higher stakes.

Proposition 2 *(i) The bid distribution of the low-stake bank is first-order stochastically decreasing in own stake and increasing rival's stake, and (ii) the bid distribution of the high-stake bank is independent of its own stake and first-order stochastically decreasing in rival's stake.*

Hence the low-stake bank bids more aggressively if its own stake increases and less aggressively if the competitor's stake increases. The high-stake bank becomes more aggressive if the competitor's stake increases but does not react to changes in its own stake (as long as that remains higher than the rival's.)

The underlying intuition is quite simple. When the high-stake bank decreases its bid, it recovers a larger part of the losses on the credit through an increase in dividends. It has thus a competitive advantage over the low-stake bank. The latter reacts to this competitive threat by behaving less aggressively. Instead of trying to outprice the high-stake bank in case it offers a loan, it prefers to extract the maximum profit in case the high-stake bank has not obtained a signal. To that end, it places some probability mass on the highest possible loan rate. Technically, in order to achieve indifference for the high stake bank, which is required for a mixed strategy equilibrium, the low stake bank has to bid with a lower density on the interior of the bidding support. This means that a higher probability mass has to be put on the upper range of the support i.e. at the highest possible loan rate $X - 1$.

4 Equity Stakes and Competitiveness

The fact that the high-stake bank is able to bid more successfully than the bank with a low (or no) stake does not a priori have any clear-cut implications on the overall effect of equity stakes on the expected interest rate and bank profits. Two countervailing forces determine these equilibrium outcomes: On the one hand, the competitive advantage of the bank with higher shareholdings could lead to a lower interest rate. On the other hand, banks with smaller or no shareholdings anticipate this and compete less aggressively, which may increase interest rates. In order to determine which of these effects dominates, one needs to derive the comparative statics of the equilibrium. The first result examines how an increase in the participation of each bank influences the equilibrium outcome.

Proposition 3 *Increasing the equity stake of the high-stake (resp., low-stake) bank increases (resp., decreases) both banks' expected profit from lending.*

The first statement of Proposition 3 captures the incentives banks have to acquire equity in their client firms. Equity ownership has a positive externality on the credit business. In particular, in a situation where no banks own equity, acquiring equity for one bank will always be profitable. Surprisingly, the fact that the bank with the higher stake increases its expected interest income is not accomplished at the expense of the competitor. The latter also strictly benefits from a higher participation of its high-stake rival (provided $\alpha_1 > 0$.)

The second statement of Proposition 3 (in brackets) explains why the low-stake bank does not wish to level the playing field by purchasing more stakes in the firm. One might a priori suspect that if both banks can decide whether to acquire equity in the firm, the outcome will be symmetric and no bank will keep an advantage. This is clearly not the case. Furthermore, the interests of the two rivals are again fully aligned, here in their desire to minimize the low stake.

Overall then, the competitiveness of the credit market does not hinge so much on to the total amount of bank participation in the firm, but rather on its distribution across banks. The intensity of competition decreases if the asymmetry between the stakes owned by different banks increases. This result has far-reaching consequences and policy implications discussed below. Many results in industrial organization have a similar flavor in that competition gets fiercer as the rivals get closer to symmetry.[8]

[8] In addition to the references given at the end of the Introduction, one might add the rich literature on two-stage models of price competition, such as vertical product differentiation, where equal quality choices lead to pure Bertrand competition, and thus zero profits for both firms (see e.g. Gabszewics and Thisse, 1979)

Due to the uniqueness of equilibrium here, the derived comparative statics properties are robust.[9]

We now establish that the higher the size of the high-stake, the more the firm is adversely affected. To this end, observe that in the present setting the generated surplus $S = \left[1-(1-q)^2\right]\lambda\,(X-1)$ is fixed, since the probability of credit being provided does not change. Hence the increased earnings of the banks can only come from an increase in the average interest rate at the disadvantage of the firm's shareholders. More precisely, if Π_1^c and Π_2^c are the expected earnings of bank 1 and 2's credit departments (calculated in the Appendix as equations (8) and (9)), the average interest rate a good firm has to pay, conditional on getting credit, is $\left(\Pi_1^c+\Pi_2^c\right)/\left[1-(1-q)^2\right]\lambda$. As the sum of the banks' earnings increases, we have just established a key result of this paper:

Proposition 4 *The average interest rate paid by the firm increases with the larger equity stake.*

It is not easy to compare the stengths of the two conflicting effects reported in Proposition 3, i.e. to determine what happens if both stakes are increased simultaneously. In fact, an unambiguous effect can be obtained only in the symmetric case.

Proposition 5 *With equal equity stakes, the average interest rate decreases with increasing participation.*

As the equal equity stakes increase, both banks bid more aggressively, thus increasing overall competitiveness in the credit market. Hence, in the symmetric case, the profit-lowering effect of the low-stake increase dominates the profit-enhancing effect of the high-stake increase.

Proposition 3 implies that, if one bank already has a stake in a firm, a second bank will have no incentive to acquire a smaller stake. Only if it acquires a substantially larger stake than the incumbent's could its interest income possibly exceed the level it would earn without any stake. Obviously, if the incumbent owns more than 50% of the firm, no outsider is able to acquire a higher stake. The next corollary states that smaller shareholdings are sufficient to block outsiders from acquiring capital.

Corollary 6 *If one bank owns at least a third of the firm's shares, the other bank cannot increase its expected return on lending by acquiring a stake in the firm.*

[9] In particular, they are not due to the instability of equilibrium (in the sense of Cournot dynamics), which is known to yield "perverse" comparative statics results, e. g. Amir and Lambson (2000).

Even if the outsider buys all remaining shares, his return on lending will remain lower than if he owns no equity. In reality, it would typically be prohibitively difficult for a bank to acquire all the remaining equity of a firm, so that even lower shareholdings should be stable with respect to the entry of a second bank. In some respects, the situation here is similar to a natural monopoly. If one bank initially holds a significant stake in a firm's equity, an "entrant" will make losses and decrease the profits of both competitors by purchasing the same firm's equity.

We now discuss some consequences and policy implications of these conclusions, and relate them to relevant empirical evidence and stylized facts about bank-firm relations. Extrapolating a bit from Proposition 3, assuming equity stakes are endogenously chosen by banks, one would not expect to observe more than one bank owning equity in a given firm. In essence, the largest stake confers a competitive advantage to its holder that serves as a barrier to entry for other banks into the firm's equity. Banks and firms will therefore tend to form matches consisting of one bank and one firm each, but never of one firm and many banks. Nevertheless, the equity holding bank need not be the only lender. In our model non-shareholding banks will provide loans with a small but positive probability. This prediction of the model nicely fits two well-known stylized facts: While most companies do have several lenders in Germany, high participation levels of several banks in the equity of one firm are rarely observed (Monopolkommission, 1998). In the context of our model, these exclusive equity ties between one bank and one firm will increase the cost of debt for the firm, a result that could explain the empirical findings of Schmid (1996), dealing with German data, and Weinstein and Yafeh (1998) with Japanese data.

One should not claim, however, that close relationships offer only disadvantages for the firm. Empirical studies on the effects of bank relationships on firm performance are often controversial and report much less clear-cut conclusions than the literature on interest rates. For instance Gorton and Schmid (2000) observe higher market to book values for German companies with bank ownership. The underlying argument here is that the higher cost of finance that comes with bank ownership may be offset by the advantages of flexible financial contracting and bank monitoring (more on this point in Section 5.).

In privately held companies, shareholders can limit the ownership structure and therefore optimize the trade off between the advantages and disadvantages of bank participation. In case the increased cost of debt outweights the advantages of a close relationship with one bank, they may limit the equity stake that can be acquired by any one bank or promote multi-bank holdings as opposed to single-bank holdings of their equity. On the other hand, public companies are not able to decide about the identity of their owners.[10] This means that banks could buy up shares and impose a close relationship against the will of the shareholders. In particular small quoted companies for which alternative sources of finance are expensive could suffer from the reduced competition in the credit market.

Our results suggest a strong argument in favor of public policies restricting bank participation in the equity of quoted companies, or at least requiring the submission of bank ownership to the approval of shareholders. Restrictions on voting rights for banks or disclosure rules targeted at the reduction of informational asymmetries, as have recently been introduced in Germany, may not be sufficient to ensure competitive credit markets, as the mechanism described in the model does not depend on voting rights nor on an informational advantage of shareholding banks.

To sum up our results: allowing commercial banks to enter merchant banking is likely to lead to credit markets that are biased in favor of one bank, resulting in higher financing costs to firms, and thus potentially in reduced investment and high agency costs. Furthermore, since the incentives at work here indicate that there will be one bank holding a high stake for each firm, this bank may end up in possession of excessive power in firms' boards. Thus, the "exploitation" scenario emerges as relatively more likely. More broadly, the effects uncovered in the present analysis could have important consequences for the development of stock markets. In particular small firms might be reluctant to issue equity if they anticipate that it might be bought up by banks, resulting in higher cost of debt. This could be part of an explanation for the strikingly low stock market capitalization in Germany: 27% of GDP versus 122% in the U. S. and 152% in the UK (Monopolkomission, 1998).

5 Agency Costs and Welfare

So far, we focused on credit market competition and the cost of debt, abstracting from other, possibly beneficial, effects of bank ownership. In particular, the model neglects agency costs of financial contracting. Welfare or total surplus is constant, as interest rates only determine its allocation between the bank and the firm. In reality, there are clearly a number of reasons why higher interest rates may affect welfare. For instance, if the firm's demand for loans is elastic, a high interest rate will lead to an inefficiently low amount of finance. In addition, if there is a residual bankruptcy risk for projects that have passed the creditworthiness test, moral hazard, adverse selection effects (Stiglitz and Weiss, 1981) or bankruptcy costs (Williamson, 1987) may create agency costs that

[10]Most European shares are still traded as bearer shares. Markets trading in registered shares like the NYSE do not allow companies to restrict ownership in their corporate charters.

will increase with the lending rate.

It could be suspected that agency costs might reverse the results of the previous section. A bank owning a stake in the firm should internalize the welfare losses inflicted by high interest rates and therefore be willing to offer lower interest rates. In order to formalize this argument, we postulate a function specifying how the expected surplus of a project that has successfully passed the creditworthiness test decreases as the bank extracts higher rents through the loan. For tractability, this function is assumed linear: $X(b) = X - c(b-1)$ with $c > 0$, if the bank asks for a risk-adjusted repayment $b \geq 1$. The highest surplus a bank is able to extract under these circumstances is $b_{\max} = \frac{X+c}{1+c}$.

The following corollary summarizes the Properties of the equilibrium in case the surplus produced by the firm depends on the interest rate:

Corollary 7 *If the success payoff decreases with the lending rate as* $X(b) = X - c(b-1)$,
i) for $\alpha_1, \alpha_2 < \frac{1}{c+1}$ *Propositions 3, 4 and 5 and Corollary 6 remain true.*
ii) for $\alpha_2 \geq \frac{1}{c+1} > \alpha_1$ *bank 2 offers the break even interest rate* $b = 1$ *and bank 1 asks for the maximum repayment* $b_{\max}$.
iii) for $\alpha_2, \alpha_1 \geq \frac{1}{c+1}$, *both banks offer* $b = 1$.

Hence, even in the presence of agency costs of high interest rates, an equity owning bank will extract rents from the credit market. Only if the bank owns a very large stake or if agency costs are important will the bank find it more profitable to provide financing at efficient rates.

The intuition for these results is straightforward. If higher interest rates create agency costs, extracting an additional dollar through the lending rate will not decrease the bank's dividends by the fraction α as in the previous paragraph, but rather by $(1+c)\alpha$ dollars. Hence, the banks' payoff is identical to a situation where $c = 0$, but where banks own stakes $(1+c)\alpha_i$ instead of α_i and can ask for a highest bid $b_{\max}$ instead of X. All the results of the preceding section remain valid. Only if $(1+c)\alpha > 1$ will the equilibrium change qualitatively. Then the dividend loss will exceed the gain in interest, and therefore the bank owning the large stake will prefer to offer the lowest possible interest rate $b = 1$. The competitor will bid his best response, $b_{\max}$, if his stake is below $\frac{1}{c+1}$ and $b = 1$ if he owns more than $\frac{1}{c+1}$ shares.

As welfare losses are proportional to the expected interest rate, Corollaries 7 and 4 yield:

Corollary 8 *i) As long as* $\alpha_1, \alpha_2 < \frac{1}{c+1}$, *increasing the equity stake of the bank with the higher stake decreases welfare.*
ii) If $\alpha_2 > \frac{1}{c+1}$, *welfare exceeds the level for* $\alpha_1 = \alpha_2 = 0$.

The predictions of Corollary 7 nicely fit existing empirical results. For example Schmid (1996) documents a U-shaped relationship between bank ownership and return on equity in a sample of German firms. Morck et al (2000) find that in Japan, at low levels of bank ownership, firm value falls as ownership rises, while at higher level of ownership, this relationship is inverted.

6 Conclusion

The paper has shown that allowing banks to own equity stakes in firms will reduce competition in the credit market and drive up the cost of debt for firms. This provides a theoretical foundation for recent empirical results obtained for Germany and Japan, where banks constitute important block holders in firms. While the prudential motivation for restricting equity ownership remains controversial, the anti-competitive effects identified in this paper provide a novel argument favoring limitations on merchant banking, thereby vindicating the Glass-Steagall Act and similar restrictions on equity ownership.

The ongoing liberalization of share ownership in the U.S. will provide an interesting experiment for the theory developed in this paper. Whether the benefits of flexible financial contracting will outweigh the costs of reduced competition remains an open question at the present time.

Appendix

The proofs of all our results are provided here, with additional intermediate results added as needed. We begin with four lemmas building up to the proof of Proposition 1.

The support of a density f is the closed set $\overline{\{x|f(x) > 0\}}$. Bidders have to be indifferent between bids on the support.[11] Using this condition, several preliminary requirements of any equilibrium bid distribution will be derived before existence and uniqueness can be proved[12]:

Lemma 9 *The supports of both banks' bid distributions have to be identical.*

Proof. Suppose one of the bidders bids in a open region where the competitor does not place bids. Then this region contains two disjunct ε balls between which the bidder cannot be indifferent. Bidding in the higher one would increase the profit in case he wins but not decrease his probability of winning. ■

Lemma 10 *One of the equilibrium distribution functions may be discontinuous at the highest possible bid. Elsewhere both distribution functions are continuous.*

Proof. Suppose one distribution function is discontinuous, i.e. one bank bids with positive probability $b \in (1, X)$. Then we can choose $\varepsilon > 0$, so small that the loss in interest from bidding $b - \varepsilon$ instead of $b + \varepsilon$ is outweighed by the increased probability of winning against the competitor, and hence the bank cannot be indifferent between bidding in $(b - \varepsilon, b)$ and $(b, b + \varepsilon)$. If both banks were to bid X with positive probability, then one of them would be better off by bidding $X - \varepsilon$ and avoiding ties. ■

Lemma 11 *The bidding supports have to be single intervals including the highest possible bid.*

Proof. Suppose there is an open region U in $[1, X]$ in which bank j places no bids, but below which it places bids. Define $x := \sup\{z|z < U \text{ and } z \in \textit{Support}\}$. Then the profit for bidding in U must be bigger than bidding x, because the interest rate increases, but the winning probability does not change. As the other bank i has no mass points in the inside of the support, bank j's profit changes continuously in its bid and is

[11] More precisely, this must hold away from a set of measure zero on which they may earn lower profits than on the rest of the support. This will not change the bid distributions since the probability of bidding exactly those points is zero. If however, on a set of measure zero, profits are bigger, the bidders will deviate to those bids.

[12] As the arguments here are standard, the proofs are given in summary form, skipping over technical details.

therefore also smaller on the open interval $(x-\varepsilon, x)$, which contradicts the indifference condition. Hence the support has to be a single interval including the highest possible bid. ■

Lemma 12 *On their open support, the distribution functions are differentiable.*

Proof. Integrating by parts the equilibrium condition (reflecting equal payoffs to all pure strategies in the support), $\pi_i(b) = K$ (some constant), and rearranging yields:

$$F_i(b) = \frac{\alpha_j \left[q \left(F_i(1)(X-1) - (X-b) - \int_1^b F_i(x)\,dx \right) - (1-q)(X-b) \right] - (b-1) + K}{\left[\alpha_j q (X-b) - (b-1) q - \alpha_j q (X-b) \right]}. \tag{3}$$

The right hand side of this equation is differentiable on the open support, hence so is $F_i(b)$.

Proof of Proposition 1. From Lemma 11, the support of both bidders' distribution functions must have the form $[l, X]$. The indifference condition for bank j can be written as $\frac{\partial}{\partial b}\pi_j(b) = 0$ for all $b \in (l, X)$. Using a bank's profit from equation (1), this leads to the differential equations

$$(\alpha_j - 1)\left[qF_i(b) - 1\right] - (b-1)\,qF_i'(b) = 0,\ \ i = 1,2 \tag{4}$$

Since on the open support, the distribution functions are differentiable, they have to be a solution of this differential equation. The unique solution of (4) for the boundary value $F(X) = 1$ is:

$$F_i(b) = \frac{1}{q} - \frac{1-q}{q}\left(\frac{X-1}{b-1}\right)^{1-\alpha_j}. \tag{5}$$

$F_i(b)$ is positive for

$$b \in \left(1 + (X-1)(1-q)^{\frac{1}{1-\alpha_j}}, X\right]. \tag{6}$$

From (4) it can be seen that for higher α_j the bid distribution of bank i becomes flatter. Both banks have to randomize over the same support and only one distribution function may be discontinuous at the highest bid. As $\alpha_2 > \alpha_1$ this must be F_1. Since its bidding function has to be zero at the lower bound of the support, it can be found by solving (4) with $i = 1, j = 2$ and the initial condition $F_1\left(1 + (X-1)(1-q)^{\frac{1}{1-\alpha_2}}\right) = 0$. The unique solution[13] of this differential equation is easily seen to be given by (2) ■

[13]It can be formally shown that the one-point singularity at $b = 1$ does not create any problems with uniqueness.

Proof of Proposition 2. Differentiating the distribution functions, we obtain

(i) $\frac{\partial}{\partial \alpha_1} F_1(b) = -\left(\frac{(X-1)}{q(b-1)}\right)^{1-\alpha_2} \ln(1-q)(1-q)^{\frac{1-\alpha_2}{1-\alpha_1}} \frac{(1-\alpha_2)}{(-1+\alpha_1)^2} > 0$,

$\frac{\partial}{\partial \alpha_2} F_1(b) = \frac{1}{q} \ln\left(\frac{(1-q)^{\frac{1}{1-\alpha_1}}(X-1)}{b-1}\right)\left(\frac{(1-q)^{\frac{1}{1-\alpha_1}}(X-1)}{b-1}\right)^{1-\alpha_2} < 0$ since $(1-q)^{\frac{1}{1-\alpha_1}}(X-1) = b_{\min} - 1 < b-1$,

(ii) $\frac{\partial}{\partial \alpha_1} F_2(b) = \frac{1}{q}(1-q)\left(\frac{(X-1)}{(b-1)}\right)^{1-\alpha_1} \ln\left(\frac{(X-1)}{(b-1)}\right) > 0$ and $\frac{\partial}{\partial \alpha_2} F_2(b) = 0$ ■

For the proof of Propositions 3 and 5, we need to evaluate the expected profit function of bank i from the credit business *only*. This is given by

$$\pi_i^c(b) = q\lambda(b-1)\left[1 - qF_j(b)\right]. \tag{7}$$

While the overall equilibrium profit of a bank is independent of b, the equilibrium profit from the credit business is not. The latter is obtained by integrating over the equilibrium distribution of bank $i's$ bids (taking into account the mass points). For bank 1, the result is:

$$\Pi_1^c = \int_{b_{\min}}^{X} \pi_1^c(b)\, dF_1 = \frac{\lambda(X-1)(1-q)^2}{1-\alpha_1-\alpha_2}\left[\alpha_1\left(1-(1-q)^{\frac{\alpha_1-\alpha_2}{1-\alpha_1}}\right) - (1-\alpha_2)\left(1-(1-q)^{\frac{2\alpha_1-1}{1-\alpha_1}}\right)\right]. \tag{8}$$

Similarly, the expected profit of bank 2's credit department is

$$\Pi_2^c = \int_{b_{\min}}^{X} \pi_2^c(b)\, dF_2 = \frac{\lambda(X-1)(1-\alpha_1)}{1-\alpha_1-\alpha_2}\left[(1-q)^{\frac{1}{1-\alpha_1}}\left(1-(1-q)^{\frac{1-\alpha 1-\alpha 2}{1-\alpha_1}}\right)\right]. \tag{9}$$

Proof of Proposition 3. We make repeated use below of the obvious inequality:

$$\ln(x) < x - 1 \text{ for } x > 0.$$

The derivative of (8) with respect to α_2 is:

$$\frac{\partial}{\partial \alpha_2}\Pi_1^c = \alpha_1 \frac{\lambda(X-1)(1-q)^{\frac{2-\alpha 1-\alpha 2}{1-\alpha_1}}}{(1-\alpha_1-\alpha_2)^2}\left[(1-q)^{-\frac{1-\alpha 1-\alpha 2}{1-\alpha_1}} - 1 + \ln\left((1-q)^{\frac{1-\alpha 1-\alpha 2}{1-\alpha_1}}\right)\right] > 0 \text{ (if } \alpha_1 > 0)$$

The derivative of (9) with respect to α_2 is:

$$\frac{\partial}{\partial \alpha_2}\Pi_2^c = (1-\alpha_1)\frac{\lambda(X-1)(1-q)^{\frac{2-\alpha 1-\alpha 2}{1-\alpha_1}}}{(1-\alpha_1-\alpha_2)^2}\left[(1-q)^{-\frac{1-\alpha 1-\alpha 2}{1-\alpha_1}} - 1 + \ln\left((1-q)^{\frac{1-\alpha 1-\alpha 2}{1-\alpha_1}}\right)\right] > 0 \text{ ■}$$

The derivative of (8) with respect to α_1 is:

$$\begin{aligned}
\frac{\partial}{\partial\alpha_1}\Pi_1^c &= \frac{(1-\alpha_2)}{(1-\alpha_1)}\frac{\lambda(X-1)(1-q)^{\frac{1}{1-\alpha_1}}}{(1-\alpha_1-\alpha_2)^2}\left[(1-\alpha_1)\left[1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right]+\right.\\
&\quad \left.+\left(1-\alpha_1(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)\frac{(1-\alpha_1-\alpha_2)}{(1-\alpha1)}\ln(1-q)\right]\\
&< K\left[(1-\alpha_1)\left[1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right]-\left[1-\alpha_1(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right]\left(1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)\right]\\
&= K(-\alpha_1)\left(1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)^2<0.
\end{aligned}$$

The derivative of (9) with respect to α_1 is:

$$\begin{aligned}
\frac{\partial}{\partial\alpha_1}\Pi_2^c &= \frac{\lambda(X-1)(1-q)^{\frac{1}{1-\alpha_1}}}{(1-\alpha_1-\alpha_2)^2}\left[\alpha_2\left(1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)+\right.\\
&\quad \left.+\left[1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}+\alpha_2(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right]\ln\left((1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)\right]\\
&< K'\left[\alpha_2\left(1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)\right.\\
&\quad \left.-\left[1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}+\alpha_2(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right]\left(1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)\right]\\
&= K'\left(1-(1-q)^{\frac{1-\alpha1-\alpha2}{1-\alpha_1}}\right)^2(\alpha_2-1)<0\ \blacksquare
\end{aligned}$$

Proof of Proposition 5. For $\alpha_1=\alpha_2=\alpha$, the profit of both banks are identical, so we can use either (8) or (9). Then

$$\begin{aligned}
\frac{\partial}{\partial\alpha}\Pi &= \frac{\partial}{\partial\alpha}\frac{\lambda(X-1)(1-\alpha)}{1-2\alpha}\left[(1-q)^{\frac{1}{1-\alpha}}\left(1-(1-q)^{\frac{1-2\alpha}{1-\alpha}}\right)\right]\\
&= \frac{\lambda(X-1)(1-q)^{\frac{1}{1-\alpha}}}{(1-2\alpha)^2}\left[1-(1-q)^{\frac{1-2\alpha}{1-\alpha}}+\frac{1-2\alpha}{1-\alpha}\ln(1-q)\right]<0\ \blacksquare
\end{aligned}$$

Proof of Corollary 6. If the incumbent has a stake of α the highest stake an outsider can acquire is $1-\alpha$. The outsiders profit with a stake of $1-\alpha$ can be calculated from (9) as $\Pi_2(\alpha,1-\alpha)=\lim_{\alpha_2\to1-\alpha}\Pi_2(\alpha,\alpha_2)=\lambda(X-1)(1-q)^{\frac{1}{1-\alpha}}\ln(1-q)$. His profit with no stake is $\Pi_1(0,\alpha)=\lambda(X-1)(1-q)q$. Solving $\Pi_2(\alpha,1-\alpha)=\Pi_1(0,\alpha)$, yields $\alpha=1-\frac{\ln(1-q)}{\ln(q(1-q))-\ln(-\ln(1-q))}$. The maximum value of this term for $q\in[0,1]$ is $\frac{1}{3}$. $\blacksquare$

Proof of Corollary 7. i) If the banks' stakes α_1' and α_2' are smaller than $\frac{1}{(1+c)}$, replacing X by $X-c(b-1)$ in the indifference condition (1) and deriving leads to the system of differential equations (4) with $\alpha_i=\alpha_i'(1+c)$. Solving it on under the conditions $F_2(b_{\max})=1$ and $F_1\left(F_2^{-1}(0)\right)=0$ yields equilibrium distributions (2) as well as profits (8) and (9) with X replaced by $b_{\max}$ and $\alpha_i'(1+c)$ instead of α_i. The profit formulas (8) and (9) are not defined for $(\alpha_1'+\alpha_2')(1+c)=1$, but can be differentiably

continued because $\lim_{x \to 0} \frac{1}{x} \ln(1 - a^x) = \ln(\ln(a))$. The signs of the derivatives do not change as long as $\alpha_i'(1 + c) < 1$, therefore the original proofs of Propositions 1 to 5 remain valid.
ii) If $\alpha_i'(1 + c) > 1$,dividends will decrease faster than interest rate income. As decreasing the interest below the competitive rate will not further increase welfare, bank i offers $b = 1$. ■

Proof of Corollary 8. i) Clear from Corollary 4 and Proposition 7.
ii) If bank 1 always bids $b_{\max}$ it gets a profit $(1 - q) q\lambda (b_{\max} - 1)$, which is also the profit it would get if $\alpha_1' = 0$. However if $\alpha_2'(1 + c) > 1$, bank 2 offers the competitive interest rate, so the average interest rate must be lower than the average interest for $\alpha_1' = \alpha_2' = 0$, and hence welfare must be higher. ■

References

[1] Allen, F. and D. Gale (2000), *Comparing Financial Systems*, M.I.T Press, Cambridge, MA.

[2] Amir, R. and V. Lambson (2000), On the Effects of Entry in Cournot Markets, *Review of Economic Studies*, 67, 235-254.

[3] Broecker, T. (1990), Credit-Worthiness Tests and Interbank Competition, *Econometrica, 58*, 429-52.

[4] Bolton, P., J. Brodley, and M. H. Riordan (2000), Predatory Pricing: Strategic Theory and Legal Policy, *Georgetown Law Journal,* 88: 2239-330.

[5] Bulow, M., J. Huang and P. Klemperer (1999), Toeholds and Takeovers, *Journal of Political Economy*, 107(3) 427-54.

[6] Bundestag (1997), "Protokoll der 74. Sitzung des Rechtsausschusses," Rechtsausschuß, Deutscher Bundestag, Bonn.

[7] Burdett, K., and K. Judd (1983), Equilibrium Price Dispersion, *Econometrica*, 51, 955-69.

[8] Burkart, M. (1995), Initial Shareholdings and Overbidding in a Takeover Contest, *Journal of Finance, 50*, 1491-1515.

[9] Cantillo, M. (1998). The Rise and Fall of Bank Control in the United States: 1890-1939. *American Economic Review,* 88(5), 1077-1093.

[10] Calomiris, C. (1994), The Cost of Rejecting Universal Banking: American Finance in the German Mirror, in: N. Lamoreaux and D. Raff (eds), Coordination and information: Historical perspectives on the organization mirror, 1870-1914. University of Chicago Press.

[11] Farrell, J. and C. Shapiro (1990a), Horizontal Mergers: An Equilibrium Analysis, *American Economic Review*, 80, 107-26.

[12] Farrell, J. and C. Shapiro (1990b), Asset Ownership and Market Structure in Oligopoly, *Rand Journal of Economics*, 21, 275-292.

[13] Gabszewicz, J. and J. Thisse (1979), Price Competition, Quality and Income Disparities, *Journal of Economic Theory*, 12, 340-359.

[14] Gorton, G. and F.A. Schmid (2000), Universal Banking and the Perfomance of German Firms, forthcoming in *Journal of Financial Economics*.

[15] Hall, P. and D. Soskice, eds. (2001), *Varieties of Capitalism: The Institutional Foundations of Comparative Advantage*, Oxford University Press, vols. 1 and 2.

[16] John, K., T.A. John and A. Saunders, (1994), Universal Banking and Firm Risk-Taking, *Journal of Banking and Finance*.18:307 - 323.

[17] Kroszner, R. and R. Rajan (1994), Is the Glass Steagall Act justified? A Study of the US Experience with Universal Banking Before 1933, *American Economic Review 84,* 810-823.

[18] Kroszner, R.S. (1998), Rethinking Bank Regulation: A Review of the Historical Evidence, Working Paper, University of Chicago.

[19] Morck, R., M. Nakamura, and A. Shivdasani, (2000), Banks, Ownership Structure and Firm Value in Japan, *Journal of Business*, 73, 539-567.

[20] Neuberger, D. and M. Neumann (1991), Banking and Antitrust: Limiting Industrial Ownership by Banks, *Journal of Institutional and Theoretical Economics*, 188-206.

[21] Economist (2000), Germany Unlocked, *The Economist,* January 8th, 62-63.

[22] OECD (1992), Banks under Stress, Report, Paris.

[23] Petersen, M. and R. Rajan (1995), The Effect of Credit Market Competition on Lending Relationships, *Quarterly Journal of Economics,* 110, 407-443.

[24] Puri, M. (1994), The Long Term Default Performance of Bank Underwritten Securities Issues, *The Journal of Banking and Finance, 18*, 397-418.

[25] Reynolds, R. and B. Snapp (1986), The Competitive Effects of Partial Equity Interests and Joint Ventures, *International Journal of Industrial Organization*, 4, 141-153.

[26] Ruckes, M. (1998), Bank Competition, Credit Standards and Corporate Conservatism,"Working Paper, University of Wisconsin-Madison.

[27] Salant, S. and G. Shaffer (1999): Unequal Treatment of Identical Agents in Cournot Equilibrium, *American Economic Review,* 89, 585-604.

[28] Santos, J.A.C. (1999), Bank Capital and Equity Investment Regulations, *Journal of Banking and Finance* 23, 1095-1120.

[29] Schmid, F.A. (1996), Beteiligungen deutscher Geschäftsbanken und Corporate Performance, *Zeitschrift für Wirtschaft und Sozialwissenschaften, 116*, 273-310.

[30] Shull, B. (1999), The Separation of Banking and Commerce in the United States: An Examination of Principal Issues, Working Paper, Office of the Comptroller of the Currency.

[31] Stiglitz, J. and A. Weiss (1981), Credit Rationing with Imperfect Information, *American Economic Review 71,* 393-410.

[32] Weinstein, D. and Yafeh, Y. (1998). On the Cost of a Bank-Centered Financial System: Evidence from the Changing Main Bank Relations in Japan. *Journal of Finance,* Vol. LIII, No. 2, 635-672.

[33] White, E., 1986, Before the Glass-Steagall Act: An Analysis of the Investment Banking Activities of National Banks, *Explorations in Economic History, 23, 33-55.*

[34] Williamson, S.D., 1987, Costly Monitoring, Equilibrium Loan Contracts and Equilibrium Credit Rationing, *Quarterly Journal of Economics, 102, 135-45.*