EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

NO. 407 / NOVEMBER 2004

BANKING CONSOLIDATION AND SMALL BUSINESS LENDING

by Elốd Takáts

EUROPEAN CENTRAL BANK

WORKING PAPER SERIES

NO. 407 / NOVEMBER 2004

BANKING CONSOLIDATION AND SMALL BUSINESS LENDING [1]

by Előd Takáts [2]

In 2004 all publications will carry a motif taken from the €100 banknote.

1 I am indebted to Patrick Bolton, Princeton University for his guidance throughout this paper. I am also thankful to Philipp Hartmann, David Marquez Ibanez, Reint Gropp and Cyril Monnet at the European Central Bank, to Gábor Virág at Princeton University and the participants at the ECB Directorate Monetary Policy and at the Princeton student seminar for their comments and suggestions. All remaining errors are mine. Part of this research was completed while visiting the European Central Bank, Capital Markets and Financial Structures Division. I am grateful to the European Central Bank for hospitality.
2 Department of Economics, Princeton University, Fisher Hall, Princeton, 08544-1021 NJ, USA; e-mail: elod@princeton.edu

Address
Kaiserstrasse 29
60311 Frankfurt am Main, Germany

Postal address
Postfach 16 03 19
60066 Frankfurt am Main, Germany

Telephone
+49 69 1344 0

Internet
http://www.ecb.int

Fax
+49 69 1344 6000

Telex
411 144 ecb d

ISSN 1561-0810 (print)
ISSN 1725-2806 (online)

CONTENTS

Abstract

The paper investigates small business lending as an information problem. It models the effects of information asymmetries within the bank combined with fixed wages. Two kinds of inefficiencies arise in equilibrium: the credit officer either sometimes shirks or he is occasionally fired. In both cases lending falls below the first-best level. The solution, when the bank accepts the information asymmetries, is called the centralized structure. Under decentralized structure the bank employs additional supervisors to mitigate the information asymmetries within its organization. Decentralized banks manage to finance more small firms, but incur higher costs than centralized ones. Small banks are interpreted as a bank with relatively few credit officers, whom can be monitored without information asymmetries. The specification allows for investigating the effects of banking consolidation and technological change on small business lending. The model suggests that not banking size, but organizational structure is decisive in small business lending.

JEL classification: G21, G34, J30

Keywords: corporate governance, banking, small business lending, efficiency wage

Non-technical summary

The paper provides a new perspective on the effects of banking consolidation on small business lending. A theoretical model is developed to understand the internal workings of the bank. The most important conclusion is that not bank size, but rather the bank's organizational structure is crucial for small business lending. Thus, the ongoing banking consolidation is not necessarily bad for small businesses. However, a close attention should be paid to the internal organization of banks as the determinant of small business lending.

The paper is motivated by three basic observations. First, small businesses are vital in the modern economy. Small businesses employ two-thirds of the EU and half of the US workforce. Small businesses are also crucial in the eventual creation of large firms. Second, small businesses crucially depend on bank lending. The share of bank debt to total debt is roughly twice as high in small firms than in large firms. Third, fast-paced banking consolidation leads to a more concentrated banking system. Roughly one-third of Eurozone and US banks have disappeared in the past ten years.

The interaction of the above three factors prompts the question: How banking consolidation affects small business lending? This is the main question investigated in this paper.

The paper builds a theoretical model based on information asymmetries within the bank and the usage of fixed wages. The model formally investigates the consequences of information asymmetries between bank managers or headquarters and the credit officers lending to small businesses. Credit officers are assumed to have more detailed information on their clientele than their supervisors. The second assumption of fixed wage is mainly based on casual industry observations and to a lesser degree on theoretical evidence.

The model shows two equilibria. The first is characterized by no firing, and slack effort. The bank demands low output, which the credit officer can always reach. Consequently, the credit officer is never fired. In this equilibrium the efficiency loss stems from shirking. The credit officer does not provide additional effort when there are higher than prescribed lending opportunities. The first equilibrium resembles to the continental European labor setup and it is called the Frankfurt policy after the continental financial center.

The second equilibrium is characterized by disciplinary firing and disruption. The bank demands high output from the credit officer. The credit officer, however, can not always comply with these demands – and it is fired then. The efficiency loss here stems from disruption of lending. When the credit officer knows that the targets are unattainable, it stops providing effort. The second equilibrium resembles to the workings of the Anglo-Saxon labor markets and is called the London policy.

An extension of the model allows for the bank to decrease the information distance and asymmetry by increasing the number of supervisors. This is called decentralization in the

model. Decentralization eliminates the information asymmetries, and banks can always use all the lending opportunities. Supervisors can receive the same information as credit officers and can write contingent contracts. Decentralization is, however, costly, as the bank has to employ more supervisors. Centralization, on the other hand, implies inefficient lending volumes. Naturally, the bank chooses in equilibrium the organizational form which is more profitable.

Small banks can be interpreted in the model as banks with few credit officers. These few credit officers are always supervised efficiently. However, there is an unused supervising capacity - even a single supervisor could monitor more credit officers. Thus, supervision is wasteful.

The model can allow for investigating the consequences of banking consolidation. Banking consolidation might hurt small business lending, if a centralized large bank acquires a small bank. However, wasteful supervision decreases even in this case. Thus, the aggregate welfare effects are unclear.

Banking consolidation does not affect small business lending if a decentralized large bank acquires the small bank. In this case banking consolidation is clearly welfare improving. Wasteful supervision declines and small business lending remains on the first-best level.

These results are in sharp contrast with the implications of the traditional portfolio theory of lending. The portfolio theory abstracts from the information asymmetries and sees lending as a portfolio allocation problem. As large banks have access to lending to large firms (that small bank do not have because of their size), large banks are able to diversify better than small banks. This better diversification implies that large banks allocate less of their portfolio to small businesses. Consequently, according to the portfolio theory of lending banking consolidation is harmful for small business lending.

This model concludes, that not size, but organizational structure is important. The way how banks handle the information asymmetries within their organization is crucial for the volume of small business lending. The policy implication of the paper calls for a different approach to investigate the effects of banking consolidation. It directs attention towards the corporate governance of banks, rather than the size of banks.

1 Motivation

This paper investigates the effects of banking consolidation on small business lending. It builds a theoretical model, which explicitly focuses on the internal corporate governance of banks. The model investigates the effects of fixed wages and information asymmetries within the bank on efficiency. The paper argues that these building blocks - though relevant in other sectors too - are particularly characteristic of small business bank lending. Extensions of the model are used to allow for the explicit investigation of decentralization and centralization - and also the size of the bank. These extension provide tools to investigate the consequences of banking consolidation. The paper finds that banking consolidation does not necessarily decrease small business lending.

Bank lending to small businesses has an eminent importance in the modern economy for three interrelated factors. First, small businesses are important in the modern economy. SMEs (small and medium sized enterprises) employ roughly half of the US and two-thirds of the EU workforce. Moreover, these small firms are also vital in the eventual creation of large firms. Second, small firms heavily rely on bank financing. The share of bank debt to total debt in small firms is around double than that of the large firms and in some countries exceeds 60% of all debt.[1] Third, a significant portion of these small firms are financed by small banks, whose number is decreasing. The fast-paced consolidation concentrates the banking sector at an unprecedented rate. Small banks are disappearing at an appalling rate. The number of banks has declined by roughly one-third in both the US and the euro-zone in the 1990s.[2]

The policy question is: Should the credit supply of small businesses decrease in proportion with the number of small banks? If the answer is affirmative then traditionally bank dependent SMEs would face troubles from banking consolidation.

Some empirical evidence indeed warns that banking consolidation might be harmful for small businesses. Small banks lend higher proportion of their assets to small firms as it is reviewed in Berger, Demsetz and Strahan (1999). New findings in Hooks (2000), Berger, Klapper and Udell (2001) and Berger, Miller, Peterson, Rajan and Stein (2002) support the earlier results. Berger et al (1998) and Sapienza (2002) find on the US and Italian market respectively that after M&As the new bank reduces financing to small firms compared to the before merger financing level.[3]

Moreover, traditional portfolio theory supports the notion that banking consolidation ad-

[1] Data from G10

[2] US: G10 p407; Eurozone: constructed G10, ECB data

[3] However, the picture is more controversial, if we look at aggregate data. The preliminary results in Berger, Demsetz and Strahan (1999) and Bonaccorsi di Patti and Gobbi (2001) do not seem to warrant the concerns for decreasing aggregate SME financing. Though consolidated banks decrease small business lending, newly established and small banks provide sufficient additional credit.

versely effects small business lending. According to the portfolio theory of lending, large banks are able to finance a wider range of firms, including for instance large enterprises. Consequently, large banks can diversify their portfolio better than small banks, and they lend less to small businesses. As a result, the traditional portfolio theory predicts size to be the most important factor in small business lending: large banks finance small firms less. This implies that banking consolidation adversely effects small business lending.

The model here aims at understanding the effect of banking consolidation on small business lending. It departs from the portfolio theory by realizing that lending is more than a portfolio allocation choice. It also involves information handling and the motivation of credit officers. Thus the paper is linked to two streams of literatures. First, the corporate finance literature is linked to investigating the internal organization of the bank. Second, the labor economics and the efficiency wage literature is linked to the motivation of the credit officer.

This modeling of banking corporate governance represents a new strand in the corporate finance literature. The literature, with the notable exception of Stein (2002), did not focus on the contracting problem within the bank as it is reviewed for instance in Bolton and Scharfstein (1998). The research explicitly modeling bank lending such as Diamond (1984, 1991) and Bolton and Freixas (2000) focuses on the information asymmetries between the bank and the debtor. The contracting problem within the bank arises only as a question in Diamond (1984): Who monitors the monitor?

Stein (2002) investigates similar problems, though with different tools. His paper originates from the internal capital markets literature and arrives to the contracting problems within the bank from this perspective. He contrasts decentralized and hierarchical firms in terms of handling soft and hard information. Hierarchical firms are better suited to deal with hard information as it as easily passed through their hierarchy. On the other hand, decentralized firms handle soft information better, as these firms do not have to harden it. Stein (2002) also suggests that his model be best used to understand banking consolidation.

The model presented here is, however, significantly different from the Stein (2002) model. Most importantly, it focuses exclusively on soft information handling and contrasts two kinds of corporate governance mechanisms: centralization and decentralization. Nevertheless, the similar focus, that is investigating banking consolidation and small business lending through the contracting problems within the bank, links the two papers.

Through the assumption of fixed wages the model is also linked to the efficiency wage literature originating from Shapiro and Stiglitz (1984). In Shapiro and Stiglitz (1984) fixed wages were imposed exogenously without further theoretical investigation. It can be shown, however, that under certain conditions fixed wages are optimal. Under relational contracting fixed wages might prevail as MacLeod and Malcolmson (1998) show. The relational contracting approach, originating from Bull (1987), focuses on the fact that firms can not be trusted to pay bonuses, if they can renegotiate implicit contracts. This approach is confirmed by numerous anecdotal evidence such as the well-known case of the leaving investment bankers of the First Boston Bank quoted in Stewart (1993).

In the MacLeod and Malcolmson (1998) model firms choose the profit-maximizing form of incentive payment. Employees are aware that firms can not be trusted to pay their bonuses. In industries where vacancies are very costly (like very capital intensive industries) firms must be able to replace workers quickly. If firms are able to replace workers quickly, then the workers must be able to retain rent in the form of high wages. Consequently, effort is provided through the fear of loosing the job, and employees are paid fixed, efficiency wages.[4]

This model does not explicitly model the emergence of fixed wages theoretically. It builds on the above theoretical results and casual industry observations. In small business lending wages are essentially fixed and performance pay is not used to create strong differences across credit officers.

The remainder of the paper is organized as follows. The model is presented in the next section. In section 3 the model is solved and analyzed. Section 4 presents the centralized and decentralized organizational framework. Section 5 discusses the empirical implications and the links to banking consolidation and technological improvements. Section 6 summarizes and concludes.

2 The model setup

The model considers two kinds of players: the unique bank and infinitely many, identical agents.[5]

Both the bank and the agents have von Neumann-Morgenstern type utility function. The bank's discount factor is β and the agent's is δ, where both $\beta, \delta \in (0.1)$ The period utility function both the bank and the agent is linear in terms of their respective payoffs.[6] In the following discussion the bank will be referred in the feminine, and the individual agents in the masculine to ease identification.

The payoffs are obtained from an underlying economy. The economy consists of a continuum of firms whose number is normalized to one. Each firm requires unit volume of financing.

[4] Note, that in those industries where workers are very specific or in short supply firms' renegotiating power is weak. In these sectors performance pay functions well.

[5] The assumption, that agents are identical is crucial exactly as in Shapiro and Stiglitz (1984). This implies, that agents can not signal higher quality nor is any need for screening. The infinite number of agents, on the other hand, is an innocent simplification to allocate all bargaining power to the bank.

[6] Linearity is used to ease calculation as risk neutrality does not play any substantive role in the model.

The firms are of two types: high and low quality. The variable q represents the volume of high quality firms. This q variable is an independently and identically distributed random variable. It can take two values: in the bad state of the world q_B and in the good state q_G, where $q_B < q_G$. The realization of a good or bad state is assumed for simplicity to have equal probability, so $Prob(q_B) = Prob(q_G) = \frac{1}{2}$.

Financing a unit volume of high quality firms yields θ_H profit for the bank, whereas financing a unit volume of low quality firms yields θ_L, where $\theta_L < 0 < \theta_H$. The bank's period payoff (π_{net}) is given by the banking profit from financing (π) minus wage paid (w) that is: $\pi_{net} = \pi - w$. Banking profit from financing depends on the volume of credit granted to high (z_H) and low quality (z_L) firms: $\pi = \theta_H z_H + \theta_L z_L$. Banking profit can not be verified by third parties.

The bank offers a contract to an agent. If the agent accepts the offer, he becomes the credit officer. The credit officer has to exert effort to finance firms. Financing high quality firms requires high effort which yields μ_H disutility of effort on the financing volume. Financing low quality firms requires lower effort, with μ_L. Consequently, $\mu_H < \mu_L < 0$. The credit officer's period payoff, is given by the disutility of the effort plus the wage paid by the bank; formally $u = \mu_H z_H + \mu_L z_L + w$. Effort levels can be observed by both the bank and the credit officer, but can not be verified by a third party.

The disutilities of effort implicitly model a two-tier effort setting. First, the credit officer has to exert a screening effort to learn the quality of firms or to learn the local economy. This is represented by $\mu_L < 0$. Second, the credit officer has to make additional effort to finance high quality firms. This can be interpreted as an effort to close the deal with high quality firms. The additional effort is represented by $\mu_H - \mu_L < 0$. The two efforts are represented in the joint parameter restriction $\mu_H < \mu_L < 0$.

The agent receives $\bar{u}$ period utility, if he declines the contract or does not receive an offer. This $\bar{u}$ is the value of the credit officer's outside option.

The disutility of effort level is assumed to be monetized to allow for welfare comparisons. The utility and profit values are set so that financing high quality firms is optimal from a Pareto perspective, that is $0 < \mu_H + \theta_H$.

The parameter values are also assumed to take values which imply positive financing volumes.[7] This is an innocent technical assumption and greatly simplifies the exposition by eliminating the need to repeatedly exclude the uninteresting corner solution of zero financing.

The bank's action set has three elements $[w, \pi^*, R(z_H, z_L, \pi)]$. The three elements of the contract specify a wage (w), a profit target (π^*) and a retaining/firing rule (R). The bank later observes financing volumes (z_H, z_L) and profit value (π) and decides to retain ($R = 1$) or fire ($R = 0$) the credit officer accordingly.

[7] This implies that either $0 < q_B\theta_H + \frac{q_B\mu_H}{\delta} - \bar{u}$ or $0 < \frac{q_G\theta_H - c}{2} + \frac{q_G\mu_H}{\delta} - \bar{u}$.

The credit officer's action set has three elements: $A(w, \pi^*)$, $z_H(A(w, \pi^*), q)$, $z_L(A(w, \pi^*), q)$. The credit officer at each time period chooses to accept ($A = 1$) or decline ($A = 0$) the contract offered. Conditional on accepting the contract (which depends on the content of it) and the realization of q the credit officer can choose which firms to finance (z_H, z_L) and in particular whether or not to comply with the profit target.

The game consists of infinitely many identical periods. The timing within a period allows the credit officer to learn the state of the world only on the job. Formally the timing is as follows:

1. The bank offers a contract (w, π^*) to an agent.

2. The agent accepts or declines the offer. If he accepts the offer, he will be referred to as the credit officer. If the agent declines the contract, the period ends.

3. If the credit officer has accepted the contract, he observes the state of the world.

4. The credit officer grants credit.

5. The bank observes profit level, credit volume and she decides whether the credit officer has complied with the contract. If she believes, that the credit officer has complied, then he is retained, otherwise he is fired.

The parameter values, the form of the utility functions, and the ex-ante distribution of the state variable are common knowledge among the players. The players also know their own decisions. The bank observes profit level, credit volume of all credit officers employed by her. However, credit officers do not learn about previous credit officers' decisions. The most important information asymmetry is that the bank can never observe the actual realization of the state of the world, while the agents can learn it after accepting the contract.

The model confines attention to a subset of all possible strategies.[8] First, the strategy set is limited to pure strategies. Pure strategies are used to ease the interpretation of the results. Second, the model seeks a stationary solution since the problem is also stationary. All players face essentially the same problem in each period, as the realization of q is identically and independently distributed. Although the individual agent might change across periods, the problem faced by the different agents remains the same. Third, the model confines attention to subgame perfect Nash-equilibria in order to exclude unreasonable threat or promise strategies. Finally, the model assumes that the bank always opts for the grimmest possible punishment strategy. The grimmest punishment means that whenever the bank finds that the credit officer has not complied with the contract, he is fired and the bank will never rehire that particular agent.[9]

[8] In line with restricting the strategies a simple tie-breaking is assumed. The indifferent player chooses a solution such that the other player is better-off.

[9] Note that the grimmest punishment promotes the strongest incentives to the agent to comply with the

3 Solving the model

The bank designs the contract so that the agent accepts it, and later in his role as the credit officer complies with it. This condition implies the two usual types of conditions.

First, the Individual Rationality constraint (IR) has to be satisfied. Through this condition, the agent has an incentive to accept the contract, as the lifetime expected utility of accepting a contract (U_A) is weakly higher than the lifetime expected utility of declining it (U_D).

Second, the Incentive Compatibility constraints, denoted as IC_B and IC_G, have to be satisfied. The agent has an incentive to comply with the contract (as the bank defines compliance), if the lifetime expected utility of compliance is weakly higher than that of non-compliance. Utility of compliance is denoted (U_{CB}, U_{CG}) in the bad and good state of the world respectively. Similarly, the utility of non-compliance is denoted as (U_{NB}, U_{NG}).

The incentive conditions are stated concisely using the above notations as follows:

$$\begin{aligned} U_D &\leq U_A && (IR) \\ U_{NB} &\leq U_{CB} && (IC_B) \\ U_{NG} &\leq U_{CG} && (IC_G) \end{aligned}$$

3.1 The utility Bellman equations

The lifetime expected utilities can be determined by Bellman equations in a stationary context. The lifetime expected utility of accepting the contract (U_A) is given by the expectation on the two lifetime expected utilities of compliance (U_{CB}, U_{CG}). Agents who reject the contract are never offered a contract again, because the grimmest punishment strategy is used. So the utility of rejecting the contract (U_D) is given by the discounted sum of the outside option payment stream.

The lifetime expected utilities of complying with the contract (U_{CB}, U_{CG}) can be determined in a similar manner. They have two main components: the period utility derived from complying to the contract (u_{CB}, u_{CG}) and the continuation value of the contract. By the IR constraint the agent accepts the contract whenever offered, so the continuation value is the discounted value of the lifetime expected utility of accepting the contract (U_A). Similarly, the value of non-compliance is given by the period utility (u_{NB}, u_{NG}) and the discounted value of non-continuation. The value of non-continuation is the discounted sum of the outside option payment stream, which is the same as the lifetime expected utility of rejecting the contract

contract. Not rehiring a particular agent, however, incurs no cost on the bank as there are infinitely many, identical agents. Consequently, grimmest punishment is optimal from the bank's point of view.

(U_D). Collecting terms gives:

$$U_A = \frac{U_{CB} + U_{CG}}{2} \qquad U_D = \frac{\bar{u}}{1-\delta}$$
$$U_{CB} = u_{CB} + \delta U_A \qquad U_{NB} = u_{NB} + \delta U_D$$
$$U_{CG} = u_{CG} + \delta U_A \qquad U_{NG} = u_{NG} + \delta U_D$$

The above system of equations can be solved after specifying the utility values in a single period (u_{CB}, u_{NB}, u_{CG} and u_{NG}).

3.2 Solving the Bellman equations

The period utility values can be found through finding the profit maximizing compliance rules within each periods. This is achieved by solving the stationary incentive problem backward. Note also that solving the model backward ensures subgame perfection. The solution is as follows:

1) The last decision is whether the bank retains the credit officer or not. The only basis for this decision is how much profit has been delivered by the credit officer.[10] Consequently, the bank sets a profit threshold level and if the realized profit level reaches or exceeds it, the credit officer is considered to have complied.[11] This unique threshold level can be the carefully set profit target π^*.[12] Thus, the bank retains the credit officer if he met or exceeded the profit target and fires him else. Consequently, the profit target (π^*) entails the retaining decision.

2) Given that financing high quality firms requires effort, the profit constraint is binding for the credit officer. This means that the credit officer does not exert more effort than what is strictly necessary to meet with the profit target.

The credit officer also does not finance low quality firms, as doing so only reduces the profit level, and still requires effort. Formally $z_L = 0$.

The period utility levels are determined differently depending on whether the credit officer complies with the profit target or not. Formally the credit officer solves the following problem:

$$\max_{z_L, z_H} z_L \mu_L + z_H \mu_H + w \tag{1}$$

[10] It is easy to see that targeting on credit volume is not efficient from the banks point of view. The credit officer can easily comply with any credit volume expectations when the profit expectation is not binding by expanding the credit lines to low quality firms. This is clearly not optimal for the bank.

[11] Note that, there is no reason to identify more compliance regions in terms of realized profit. The agent would always choose the compliance level which requires the lowest effort level. As it will be clear from the subsequent discussion, this is the lowest profit threshold level.

[12] Other threshold levels, determined differently in terms of the profit target, are also possible. The bank could set, for instance, compliance to 1/2 of the target. Nevertheless, the effect is the same as requiring a properly defined profiy target to be satisfied.

$$\begin{aligned} z_L &\leq 1 - q_{true} \\ z_H &\leq q_{true} \\ z_L\theta_L + z_H\theta_H &\geq \pi^* \qquad\qquad \text{Compliance constraint} \\ q_{true} &\in \{q_B, q_G\} \end{aligned}$$

The credit officer satisfies the compliance constraint, only if he intends to do so.

2a) If the credit officer complies, that is he reaches or exceeds the profit target, then he tries to finance as few high quality firms as it is possible. The the solution to 1 yields:

$$z_L = 0 \qquad z_H = \frac{\pi^*}{\theta_H}$$

The period utility is:

$$u = w + \mu_H \frac{\pi^*}{\theta_H}$$

2b) If the credit officer does not comply, he exerts as little effort as it is possible. Consequently, the trivial solution to 1 is that he does not provide financing to any firms:

$$z_L = z_H = 0$$

which yields the period utility:

$$u = w$$

3) Because the IR constraint is satisfied, the credit officer accepts the employment contract offered by the bank.

4) The bank has to decide on the (w, π^*) pair on the basis of the above.

The above allows for computing the period utility values (u_{CB}, u_{NB}, u_{CG} and u_{NG}) given the employment contract (w, π^*). Thus the Bellman equation values can be derived from the (w, π^*) pair.

3.3 The contract offered

The results derived above are used as a shortcut from the (w, π^*) offer pair to the period payoffs. The bank can foresee the expected profit of the contract given his offer pair, and offers wage and profit target accordingly. This is sufficient to determine the (w, π^*) offer.

In order to determine the optimal profit target level the bank has to consider two contradicting effects of raising profit target. On one hand, while a higher profit target requires higher effort level and thus higher wages, the wage increase is slower than the revenue increase. This points towards higher profit target. On the other hand, the higher the profit target is, the less likely that the credit officer is able to meet it. If he can not comply, then he shirks and eventually gets fired. Thus he produces zero revenue, but receives salary. This second effect points toward a lower profit target.

The positive effects apply continuously in the wage increase, while the negative effects appear only at two profit target threshold level. If the bank increases the profit target from zero the credit officer is able to comply in all states of the world until it reaches $q_B\theta_H$. After exceeding this level, the expected profit level drops as the credit officer can comply only in the good state. Further increasing the profit target starts to increase the profit level again. This effect lasts until the profit target reaches $q_G\theta_H$. Exceeding this threshold, the credit officer can not comply anymore, not even in the good state of the world. Consequently, revenue level drops to zero which is clearly suboptimal.

This trade-off can also be understood as an effort-incentive Laffer-curve. Increasing target thresholds (or incentives) initially raises expected output (and effort). Nevertheless output peaks, and eventually incentive increases lead to collapsing effort level. This is fairly similar to the original tax rate - revenue Laffer curve.

Figure 1 gives a qualitative view of the two contradicting effects with taking $q_B\theta_H = 5$, $q_G\theta_H = 8$. Of course, the fact that one peak is higher is than the other on the graph is simply the artefact of parameter choice. Theoretically, either peak can be the higher one.

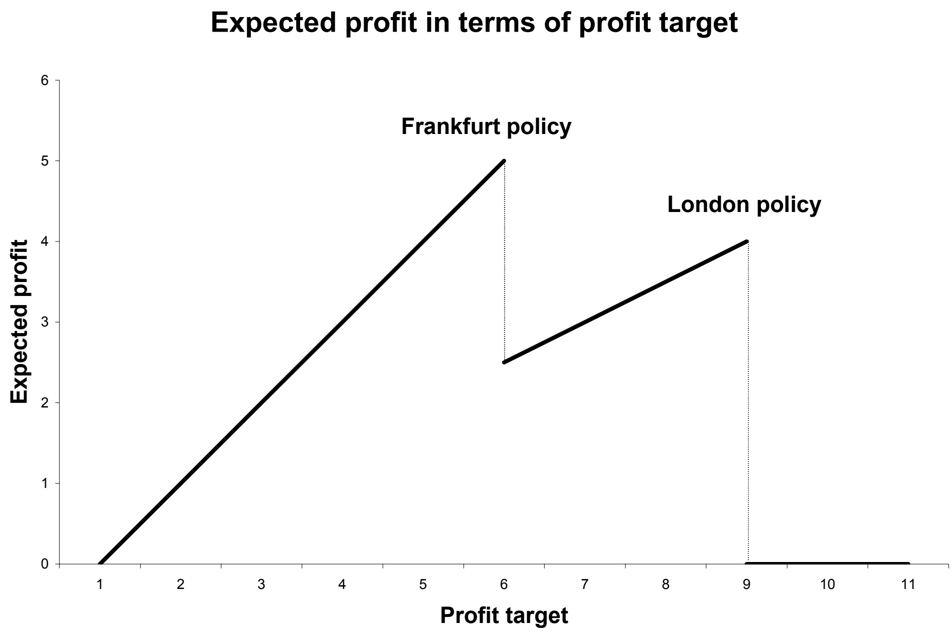

Figure 1: Expected profit as a function of profit target

The first peak, requiring $q_B\theta_H$ profit, is called the Frankfurt policy. The second one, requiring $q_G\theta_H$ profit is called the London policy.

These names are used to invoke the fundamentally different labor market conditions in the two cities. They are meant to provide an intuition on firing and labor market regulations. There is a caveat, however. This model is not built around labor market regulations. It emphasizes that banks choose between the two policies on the basis of the underlying market conditions, captured by parameter values.

The following proposition summarizes the results:

Proposition 1 (Contract Offered) *In equilibrium the bank offers either the Frankfurt policy ($\pi^* = q_B\theta_H$) or the London policy ($\pi^* = q_G\theta_H$). The choice between the two equilibria depends on which one provides the highest expected payoff to the bank. In terms of parameters:*

$$\begin{aligned} &\text{If } q_G\theta_H + \frac{2(q_B - q_G)\mu_H}{\delta} \leq 2q_B\theta_H \text{ then the Frankfurt policy;} \\ &\text{If } q_G\theta_H + \frac{2(q_B - q_G)\mu_H}{\delta} > 2q_B\theta_H \text{ then the London policy is offered.} \end{aligned}$$

In the following the Frankfurt and London policies are characterized in detail.

3.3.1 The Frankfurt policy

In the Frankfurt policy the bank offers the pair:

$$\pi^* = q_B\theta_H \qquad\qquad w = \bar{u} - \frac{q_B\mu_H}{\delta}$$

The credit officer is clearly able to comply and consequently complies in every period. He always grants q_B credit to high quality firms. The originally hired credit officer is never fired. The bank's expected period payoff is as follows:

$$\pi_{net} = q_B\theta_H - w_{Frankfurt} = q_B\theta_H + \frac{q_B\mu_H}{\delta} - \bar{u}$$

Figure 2 illustrates the Frankfurt policy graphically. For the graphical representation consecutive good and bad states are picked with setting $q_B = 4$ and $q_G = 5$. The Frankfurt financing is contrasted to the first-best benchmark solution. The first-best solution is to finance all high quality firms in all states of the world and only those ones.

The Frankfurt financing is stable. The financing volume is optimal in the bad state of the world, but it is insufficient in the good state. The solution can be interpreted as the bank being unable to spot certain business opportunities or more precisely, the bank is not able to force the credit officer to exert effort to use these opportunities. The amount of financing is thus suboptimal in expected terms. Intuitively, the bank mitigates the losses of the information problem by concentrating on a secure niche and forces the credit officer to exert effort on this small niche continuously.

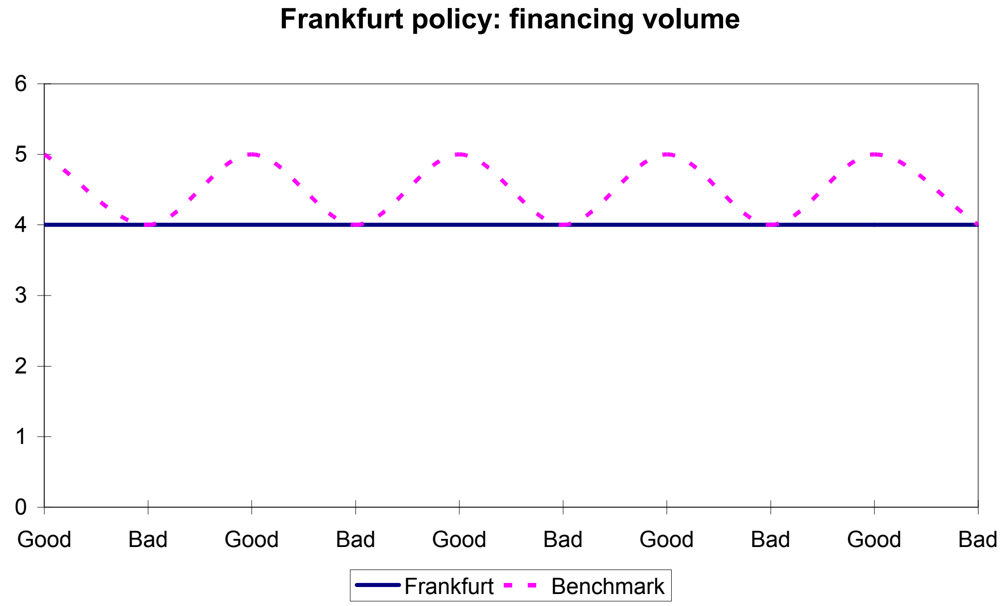

Figure 2: Frankfurt policy

3.3.2 The London policy

In the London policy the bank offers:

$$\pi^* = q_G \theta_H \qquad\qquad w = \bar{u} - \frac{q_G \mu_H}{\delta}$$

Now, the credit officer complies only in the good state of the world. In the good state he produces $q_G \theta_H$ banking profit. Conversely, in the bad state he can not meet the profit target. Knowing this he stops all financing activities, producing zero profit. He still receives wages and the bank fires him at the end of the period. Then the banks expected period payoff is as follows:

$$\pi_{net} = \frac{q_G \theta_H}{2} - w_{London} = \frac{q_G \theta_H}{2} + \frac{q_G \mu_H}{\delta} - \bar{u}$$

Figure 3 illustrates the result as before with consecutive good and bad states, setting $q_B = 4$ and $q_G = 5$ using the first-best benchmark as a contrast, exactly as in the illustration of the Frankfurt policy solution.

The London policy provides zero financing in the bad state of the world and optimal financing in the good state. The solution still provides underfinancing in expected terms. However, it fundamentally differs from the Frankfurt solution in its volatility. The bank aims at high effort level in the good state and in exchange accepts firing and slack in the bad state of the world. The intuition behind the London policy is that the bank values the good state high effort level so much that she accepts the loss incurred in the bad state.

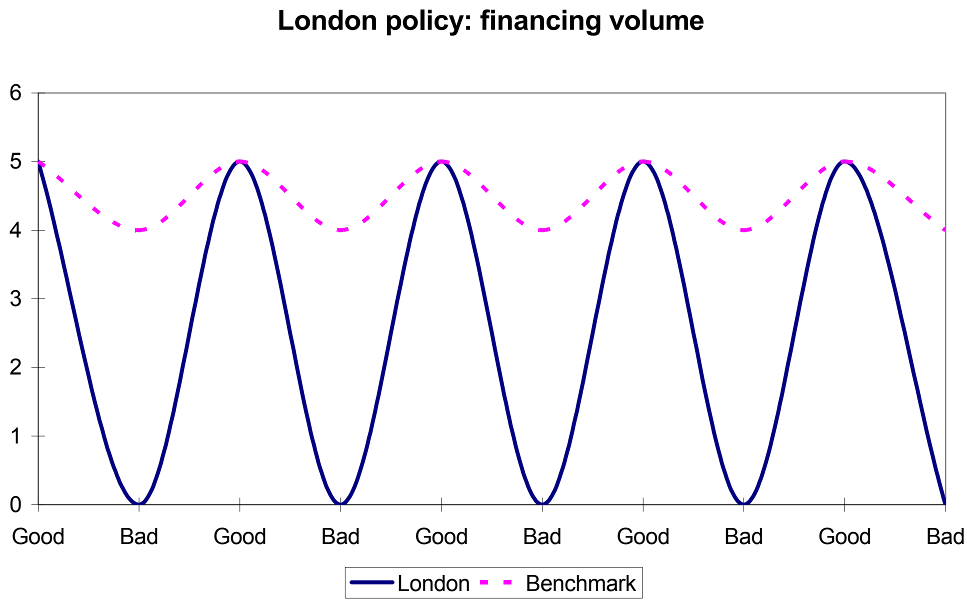

Figure 3: London policy

The London policy might be especially interesting if there are large differences between the two states of the world, or when the good state of the world is much more likely. Acquiring an important market segment, or lending in a booming sector might provide such circumstances.

The London policy case is also interesting because it produces equilibrium firing. The solution introduces the firing or relocation of perfectly able and hard working agents as a way of motivating agents in a fixed wage contract. This firing is an efficient, albeit second-best measure which provides optimal solution with certain parameter values.

3.4 Constrained optimal contract

The question arises whether the contract proposed is the constrained optimal contract. Informally, the question is whether the proposed contract is the best for the bank in the game. Formally, the constrained optimal contract is defined below.

Definition: Constrained optimal contract is defined to be a stationary, fixed wage and pure strategy Nash-equilibria contract that yields the highest expected profit for the bank, given the bank's action and information set.

The Frankfurt or London policy contracts are indeed constrained optimal. The intuition is that the bank can not compensate the credit officer in a stationary context to exert two different effort levels such that the agent would comply in both states. Consequently, the contract boils down to offering a single (w, π^*) pair to the agent, as the agent contemplates only one pair, namely the one with the lowest effort level. The problem of finding the unique (w, π^*) pair was analyzed in the Contract Offered proposition, consequently the same result arises in the constrained optimal contract. The following proposition formally summarizes the result:

Proposition 2 (Constrained Optimal Contract) *The solution outlined in the Contract Offered proposition is the constrained optimal contract. Consequently, either the Frankfurt or the London policy arises as the constrained optimal contract.*

This result implies that the earlier described inefficiencies do not stem from poorly-designed contracts. The bank, so long as she is confined to using fixed wages and stationary contracts, can not achieve higher profits. Thus the proposed contract is robust and the underlying reason for suboptimal financing rests in the information and action structure.

4 An extension: centralization vs. decentralization

Banking organization can be captured by slightly extending the basic model. Assume that the bank can employ K credit officers, the number of whom is determined by the exogenous market position. The bank can employ supervisors who monitor the credit officers and it is assumed that the bank has to employ at least one supervisor. If the supervisor monitors weakly less than L credit officers, then the supervisor can observe the true state of the world for each credit officer. The cost of employing a supervisor is W. Parameter L and W can be interpreted as the technology of supervision.

We can assume that banks choose the form of operation given the parameter values. They choose to become either centralized or decentralized banks based on profit expectations.

4.1 Centralized bank

If only a single supervisor is employed and the bank is large enough ($K > L$) such that the supervisor can not observe the true state of the world, then the bank is called centralized. In this case either the Frankfurt or the London policy results as in the basic model. Similarly the appropriate Frankfurt or London wage applies for each credit officer.

Proposition 3 (Centralized Bank) *The centralized bank implements either the Frankfurt or London policy for each credit officer.*

The profit level differs from the base model in two trivial ways. First, there are many credit officers and net payoffs accrue for each. In order to ease comparison, profit data is computed on a per credit officer basis. The second difference is that now the bank has to pay for the supervisor. Consequently, the per credit officer profit is decreased by the supervision cost W/K. Thus the per credit officer profit levels are as follows:

$$\begin{aligned}\pi_{Frankfurt} &= q_B\theta_H + \frac{q_B\mu_H}{\delta} - \bar{u} - \frac{W}{K} \\ \pi_{London} &= \frac{q_G\theta_H}{2} + \frac{q_G\mu_H}{\delta} - \bar{u} - \frac{W}{K}\end{aligned}$$

The centralized banks chooses the more profitable policy out of the two as in the base model.

4.2 Decentralized bank

If K/L supervisors are employed with $K = nL$,[13] then the bank is called decentralized. The cost of supervision in the decentralized bank is W/L per credit officer. The decentralized bank can achieve the first-best financing volume as it is shown below.

The decentralized bank makes use of the fact, that both the bank and the credit officer will observe the state of the world during the contract. If the credit officer does not provide the first-best effort level, he is fired and otherwise retained. The following proposition formalizes the argument.

Proposition 4 (Decentralized Bank) *The decentralized bank achieves first-best financing volume. Formally, the local bank offers the employment contract that the credit officer is retained if* $\pi = q_{true}\theta_H$ *and fired else.*

The contract gives the credit officer the proper incentives to exert effort efficiently. It means that he finances all good firms and only good firms, so in the bad state he finances q_B volume of high quality firms and in the good state he finances q_G volume of them. If compliance is assured and the grimmest punishment strategy is used, then the utility values can be determined in the same manner as in the base model.

The wage is:

$$w_{Decentralized} = \bar{u} - \frac{(1-\delta)q_G\mu_H}{\delta} + \frac{(q_B + q_G)\mu_H}{2}$$

The decentralized bank's expected per credit officer payoff is:

$$\begin{aligned}\pi_{Decentralized} &= \frac{q_B\theta_H + q_G\theta_H}{2} - w_{Decentralized} - \frac{W}{L} \quad \text{or} \\ \pi_{Decentralized} &= \frac{q_B\theta_H + q_G\theta_H - (q_B + q_G)\mu_H}{2} + \frac{(1-\delta)q_G\mu_H}{\delta} - \bar{u} - \frac{W}{L}\end{aligned}$$

[13] Assume in the following discussion of the decentralized bank that n is a natural number. Any other number would not change the conclusions, but would make the analysis unnecessarily cumbersome.

The profit level of the decentralized bank exceeds that of the centralized bank if the supervision cost W/L is sufficiently low or the efficiency gain from the first best financing volume is high.

The decentralized bank policy focuses attention on information division within the firm. The bank as a whole has the same information both in the centralized and in the decentralized bank case, since the credit officer perfectly observes the firms. However, the decentralized bank is more efficient in lending, because the management can tailor the incentive scheme of credit officers to the state of the economy.

4.3 Small bank

Finally, it is worth to consider the case of small banks. If the number of all credit officers is small enough $K < L$, then the bank is called small bank. Here the single supervisor is necessarily close to the local market. Then the bank implements the decentralized bank's employment contract with her credit officers. The following proposition formalizes the argument.

Proposition 5 (Small Bank) *The small bank offers the same employment contract as the decentralized bank and achieves the first-best financing level.*

Thus a small bank achieves first-best financing level. The problem is, however, that first best financing level does not come along with necessarily high profitability. The per credit officer profit levels are similar to that of the decentralized bank, but here the cost of supervision is higher: W/K.

$$\pi_{Decentralized} = \frac{q_B\theta_H + q_G\theta_H - (q_B + q_G)\mu_H}{2} + \frac{(1-\delta)q_G\mu_H}{\delta} - \bar{u} - \frac{W}{K}$$

The existence of the small bank is the consequence of size constraints. She would always prefers to expand her activities and utilize the supervisor better as there is wasteful supervision. Thus there are economies of scales for small banks, irrespective of the fact whether centralized or decentralized banks are more profitable.

5 Discussion

5.1 Comparative Statics

The model offers a wide range of interesting comparative statics. Here, the two most interesting ones are analyzed in detail: banking consolidation and technological change. One should bear in mind that the model uses a partial setup: consequently the parameter values are set for each bank individually. There can be small and large, centralized and decentralized bank in the economy - while each operating optimally under their respective parameter constraints.

5.1.1 Banking consolidation

Banking consolidation can be understood in the model as a large bank buying one or more several small banks. The consequences of this banking consolidation are ambiguous. One can identify two subcases for the analysis. The two subcases are summarized on Figure 4.

Optimal form of corporate governance		centralized	decentralized
Effects of consolidation on	cost efficiency	positive	positive
	lending volume	negative	none

Figure 4: Effects of banking consolidation

The first case is, when centralized banks are more efficient then decentralized banks. In this case the welfare effects of banking consolidation are unclear. The following trade-off emerges: On the one hand, centralized banks buying small banks improves welfare as wasteful supervising declines. On the other hand, this consolidation reduces small business lending, which decreases welfare as efficient financing is not realized.

The second case is, when decentralized banks are more efficient. In this case banking consolidation is unambiguously welfare improving. Banking consolidation only leads to declining wasteful supervision, while small business lending remains at the first-best level.

5.1.2 Technological improvements

The information technological improvements (captured by increasing parameter L) offers interesting insights. There are two effects. First, decentralized banks become relatively more profitable than centralized banks as their supervision costs are decreased. Second, small banks become less profitable relative to decentralized banks, as they waste even more supervisory effort.

Technological change has important implications in two dimensions: small business lending and banking profits. The effects of technological improvements are weakly positive in both dimension. There are three subcases,[14] summarized on Figure 5.

First, if before and after the technological improvement centralized governance is optimal, then small business lending does not change. Moreover, in this case technological improvement does not even change banking profitability. Second, if before and after the improvement decentralized governance is optimal, then small business lending does not change with technology. In this case, however, banking profits increase as a heavily used technology becomes cheaper.

[14] The fourth case, when before the technological improvement decentralized, after it centralized banking structure is optimal, is clearly impossible.

Efficient governance	before the improvement:	centralized	decentralized	centralized
	after the improvement:	centralized	decentralized	decentralized
Effect on small business lending		none	none	positive
Effect on banking profits		none	positive	positive

Figure 5: Effects of supervision technology improvements

The third case is the most interesting. If before the technological change centralized banks are optimal, but increasing L makes decentralized banks more profitable, then the effects of technological change are positive in both dimension: both small business lending and banking profitability increase. The improving technology fosters the centralized bank to decentralize and the new decentralized bank reaches first-best lending level. Note, that for the decentralization the bank has to employ new supervisors, thus employment also increases. This also gives an example of job-creating technological advances.

Last, technological changes might make banking consolidation more desirable. With improving technology wasteful supervision of small banks becomes increasingly costly in terms of opportunity costs. Moreover, this consolidation is more likely not to reduce small business lending, as technological improvements make decentralized banks more profitable.

5.2 Empirically testable implications

The model offers four major, empirically testable implications. First, the most important empirical implication allows to contrast the conclusions of this model to that of the traditional portfolio theory. Both theories predict that on average large banks finance small firms less than small banks. In this model this is due to the potential heterogeneity of centralized and decentralized large banks in the economy. In the portfolio theory lending differences directly stem from the size of the bank - that is from the better diversification options of large banks. These predictions correspond to the findings of the empirical literature as it was reviewed earlier: small banks finance small firms more than large banks.

The model, however, predicts significant heterogeneity among large banks - a feature missing from the portfolio theory of lending. According to the model the crucial difference is not the size of the bank, but rather its organizational structure. This is a testable implication that can distinguish this model from the portfolio theory model.

There is some additional empirical evidence supporting the theoretical findings of this paper. Corporate governance seems to affect bank lending to small businesses. De Young, Goldberg and White (1997) disentangle corporate governance effects from size. They show that after controlling for size, corporate governance variables, such as the number of branches or participation in a bank holding, affect small business lending. Peek and Rosengreen (1998) find that when banks merge the acquiring bank tend to recast the target to its own image. Thus, small business lending seems to be more related to banking governance than to size. Nevertheless, further specific empirical research is needed to test this prediction more precisely.

The second testable implication is, that the model predicts small banks to be less profitable than large banks. Small banks wastefully supervise, consequently they are less profitable, even though they produce first-best financing volume. In line with these findings the empirical studies such as Berger, Demsetz and Strahan (1999) show strong economies of scales for the smallest banks - and only for them.

Third, the wage in the decentralized or in the small bank is between the Frankfurt and London policy wage rate. As the internal structure of banking was not traditionally in the focus of research, the wage implications are not yet analyzed. Such an analysis could provide, nevertheless, a strong test for the model.

Finally, the model also has a few implications for the economies of scales of large banks. If the centralized solution is the most profitable, then there are economies of scales at all sizes. Though these economies of scales decline with size they are present at every operational level. If, however, the decentralized solution is optimal, then economies of scales are not present. The larger bank implies also proportionally more supervisors thus the per credit officer profit level remains are the same. Thus the model links small business lending to economies of scales through banking corporate governance.

6 Conclusion

This paper explores the effects of fixed wages on effort exertion in case of information asymmetries. Two equilibria, namely the Frankfurt and the London policy emerge, which resemble to the stylized workings of the continental European and respectively the Anglo-Saxon labor markets. The model's implications are thus fairly general. The main building blocks of the model (fixed wages and information asymmetries) are indeed relevant in a wide range of sectors in the modern economy. Consequently, the model can be used to understand many institutions and problems besides banking. The lifetime employment in public administration for instance, resembles what occurs under the Frankfurt policy, while the "up-or-out" career path in consulting looks like what happens under the London policy.

The paper nevertheless concentrates on the implications in banking. It argues that fixed wages and information asymmetries are especially important in small business lending and uses the findings of the model to investigate the consequences of banking consolidation. The most important theoretical finding of the paper is that banking corporate governance might be more important in small business lending than mere size of banks.

Two main policy implications can be derived. First, banking consolidation does not necessarily hurt small business lending. Larger banks do not necessarily abandon small business lending and small businesses are not per se endangered by banking consolidation. Decentralized banks can take the role of small local banks. In this case, consolidation is socially optimal as wasteful supervision in small banks is eliminated.

Second, the model highlights the need for increased scrutiny on banking corporate governance. As small business lending is potentially threatened by centralization tendencies, supervisory authorities should pay adequate attention to changes in banking governance. Even absent consolidation, changes in banking governance at several large banks might contribute to a credit crunch for small businesses.

The paper is one of the first papers to explicitly investigate the corporate governance of banks. Consequently, it represents at its best a new, fresh look on banking consolidation and banking corporate governance. There is some empirical support for the main findings, but many theoretical and empirical implications are unclear or untested. There is much left to do for future research. A particularly interesting avenue is building a general equilibrium model to fully understand the economy wide implications of banking consolidation. The paper sincerely hopes to elicit further empirical and theoretical research to better understand the role and implications of banking corporate governance.

7 Appendix

7.1 Proofs

Proof of the Contract Offered proposition. The proof can be divided into seven parts:

(1) By the profitability assumption the bank can expect positive profits in equilibrium, that is: $\pi^* > 0$

(2) The credit officer complies at least in one state. Else zero revenue is provided and the profitability assumption is violated. Moreover, if the credit officer complies in the bad state, then he is also able to comply in the good state.

(3) Expected profit is linear in financing volume.

If the credit officer can comply in both states of the world then

$$\pi = z_H \theta_H$$

If the credit officer can comply only in the good state, then:

$$\pi = \frac{z_H \theta_H}{2}$$

(4) Wage paid is linear or declining in financing volume as

$$w = \bar{u} - \frac{z_H \mu_H}{\delta}$$

and $\bar{u} \geq 0$

Derivation follows from the IR/IC constraints.

If the credit officer can comply in both states:

$$\begin{aligned} \frac{\bar{u}}{1-\delta} &\leq \frac{w + z_H \mu_H}{1-\delta} \Longrightarrow w_{IR} \geq \bar{u} - z_H \mu_H && IR \\ w + \frac{\delta \bar{u}}{1-\delta} &\leq \frac{w + z_H \mu_H}{1-\delta} \Longrightarrow w_{IC} \geq \bar{u} - \frac{z_H \mu_H}{\delta} && IC \end{aligned}$$

If he can comply only in the good state:

$$\begin{aligned} \frac{\bar{u}}{1-\delta} &\leq \frac{2w + z_H \mu_H + \frac{\delta \bar{u}}{1-\delta}}{2-\delta} \Longrightarrow w_{IR} \geq \bar{u} - \frac{z_H \mu_H}{2} && IR \\ w + \frac{\delta \bar{u}}{1-\delta} &\leq \frac{(2+\delta) w + 2 z_H \mu_H}{2-\delta} \Longrightarrow w_{IC} \geq \bar{u} - \frac{z_H \mu_H}{\delta} && IC \end{aligned}$$

So,

$$w = w_{IC} = \bar{u} - \frac{z_H \mu_H}{\delta}$$

(5) Consequently, as financing is profitable in both states, then the bank would like to implement the maximum financing volume

$$(w = \bar{u} - \frac{q_B \mu_H}{\delta}, \pi^* = q_B \theta_H)$$

as it provides the highest level financing among those contracts with which the credit officer can comply in both states. (This solution is called Frankfurt policy.)

Similarly, if financing is profitable when the credit officer complies only in the good state of the world, then the bank would like to implement

$$(w = \bar{u} - \frac{q_G \mu_H}{\delta}, \pi^* = q_G \theta_H)$$

as it provides the highest level financing among those contracts with which the credit officer can comply only in the good state of the world. (This solution is called the London policy.)

(6) The bank chooses the solution which is more profitable. The bank's payoff in the Frankfurt policy is:

$$q_B \theta_H - \bar{u} + \frac{q_B \mu_H}{\delta}$$

The bank's expected payoff in the London policy is:

$$\frac{q_G \theta_H}{2} - \bar{u} + \frac{q_G \mu_H}{\delta}$$

The Frankfurt policy has higher expected payoff, if

$$q_G \theta_H + \frac{2(q_B - q_G)\mu_H}{\delta} < 2 q_B \theta_H$$

and if the inequality is reversed, then the London policy has higher payoffs.

(7) In case of profit tie the solution yielding higher utility for the credit officer is chosen. It is straightforward to see that the utility derived from the Frankfurt policy is higher than the utility derived from the London policy.

$$\frac{\bar{u} - \frac{q_G \mu_H}{\delta} + q_B \mu_H}{1 - \delta} > \frac{2\left(\bar{u} - \frac{q_G \mu_H}{\delta}\right) + q_G \mu_H + \frac{\delta \bar{u}}{1-\delta}}{2 - \delta} \iff q_G > q_B$$

This means that the credit officer's utility in the Frankfurt case is always higher. So, in case of profit tie, the Frankfurt policy is chosen. ■

Proof of the Optimal Contract proposition. The proof can be divided into six parts, which are outlined as follows:

(1) Using the grimmest punishment is optimal from the bank's point of view, as it was explained at the introduction of this assumption.

(2) Given the bank's information and action set the bank can set (w, π^*) pairs and base her firing/retaining decision about z_H, z_L and π.

(3) The bank can not observe the state of the world and can not provide compensation for additional effort. Consequently, the credit officer will choose the contract that requires the minimum effort to comply. If he can not comply with the contract he does not grant credit to anybody.

(4) There are no two financing volumes such that the credit officer would be indifferent between the two, given that the wage associated with them is the same.

i) If the credit officer can not comply no credit is granted.

ii) If he can comply he gives credit only to high quality firms.

If two solutions yield the same effort level, then they are identical. This follows from the fact that financing volume to low quality firms is always zero. Consequently, if the effort level is the same, then financing to high quality firms is also the same.

(5) The unique effort level implies unique payoff levels in each state.

(6) The unique payoff level implies that the contract design is reduced to finding the highest payoff (w, π^*) pairs as in the Contract Offered proposition. ■

Proof of the Centralized Bank proposition. The proof is straightforward. The bank can not observe the state of the world, consequently she offers the same contract to each agent as in the Contract Offered proposition. Thus the results of the proposition apply and either the Frankfurt or the London policy applies. ■

Proof of the Decentralized Bank proposition. Given that the bank is decentralized, the contract offered is optimal. As the wage is sufficiently high and compliance is always possible, the agent complies with the contract. The bank does not have any incentives to deviate and offer a different contract either. The proof follows similar steps as the Contract Offered and Optimal Contract proposition and left to the reader.

The main intuition again is that the wage is linear in expected profits, so if financing is profitable (as it is assumed) than the maximum potential expected financing volume is optimal, which is the first-best financing level. ■

Proof of the Small Bank proposition. The proof follows straightforwardly from the Decentralized Bank proposition. ■

7.2 Deriving utility levels and wages

Frankfurt policy

The agent's utility levels are as follows.

$$\begin{aligned} U_A &= \frac{w + q_B \mu_H}{1-\delta} & \qquad U_D &= \frac{\bar{u}}{1-\delta} \\ U_{CB} &= \frac{w + q_B \mu_H}{1-\delta} & \qquad U_{NB} &= w + \frac{\delta \bar{u}}{1-\delta} \\ U_{CG} &= \frac{w + q_B \mu_H}{1-\delta} & \qquad U_{NG} &= w + \frac{\delta \bar{u}}{1-\delta} \end{aligned}$$

Then wage calculation is:

$$IR: \frac{\bar{u}}{1-\delta} \leq \frac{w + q_B \mu_H}{1-\delta} \Longrightarrow w_{IR} \geq \bar{u} - q_B \mu_H$$

Notice that $IC_B = IC_G$, these imply:

$$IC_B, IC_G : w + \frac{\delta \bar{u}}{1-\delta} \leq \frac{w + q_B \mu_H}{1-\delta} \Longrightarrow w_{ICB} = w_{ICG} \geq \bar{u} - \frac{q_B \mu_H}{\delta}$$

Notice that $w_{ICB} = w_{ICG} > w_{IR}$ as $\delta < 1$

$$w = w_{ICB} = w_{ICG} = \bar{u} - \frac{q_B \mu_H}{\delta}$$

London policy

The agent's utility levels are as follows.

$$U_A = \frac{2w + q_G \mu_H + \frac{\delta \bar{u}}{1-\delta}}{2-\delta} \qquad U_D = \frac{\bar{u}}{1-\delta}$$

$$U_{CB} = U_{NB} \qquad U_{NB} = w + \frac{\delta \bar{u}}{1-\delta}$$

$$U_{CG} = \frac{(2+\delta)w + 2q_G \mu_H + \frac{\delta^2 \bar{u}}{1-\delta}}{2-\delta} \qquad U_{NG} = w + \frac{\delta \bar{u}}{1-\delta}$$

Then wage calculation is:

$$IR : \frac{\bar{u}}{1-\delta} \leq \frac{2w + q_G \mu_H + \frac{\delta \bar{u}}{1-\delta}}{2-\delta} \Longrightarrow w_{IR} \geq \bar{u} - \frac{q_G \mu_H}{2}$$

In the bad state it is impossible to deliver the expected profit. Consequently, the compliance decision yields the same payoffs as the non-compliance and the credit officer is fired. IC_B is technically always satisfied. The credit officer is, nevertheless, fired at the end of the period.

$$IC_G : w + \frac{\delta \bar{u}}{1-\delta} \leq \frac{(2+\delta)w + 2q_G \mu_H + \frac{\delta^2 \bar{u}}{1-\delta}}{2-\delta} \Longrightarrow w_{ICG} \geq \bar{u} - \frac{q_G \mu_H}{\delta}$$

Notice that $w_{ICG} > w_{IR}$ as $\delta < 2$, consequently:

$$w = w_{ICG} = \bar{u} - \frac{q_G \mu_H}{\delta}$$

Decentralized Bank

The equilibrium is characterized by the following utility figures:

$$U_A = \frac{2w + q_B \mu_H + q_G \mu_H}{2(1-\delta)} \qquad U_D = \frac{\bar{u}}{1-\delta}$$

$$U_{CB} = w + q_B \mu_H + \delta \frac{2w + q_B \mu_H + q_G \mu_H}{2(1-\delta)} \qquad U_{NB} = w + q_G \mu_L + \frac{\delta \bar{u}}{1-\delta}$$

$$U_{CG} = w + q_G \mu_H + \delta \frac{2w + (q_B + q_G)\mu_H}{2(1-\delta)} \qquad U_{NG} = w + q_G \mu_L + \frac{\delta \bar{u}}{1-\delta}$$

Then wage calculation is:

$$IR : \frac{\bar{u}}{1-\delta} \leq \frac{(q_B + q_G)\mu_H}{2} + w + \delta \frac{2w + (q_B + q_G)\mu_H}{2(1-\delta)}$$

$$\Longrightarrow w_{IRB} \geq \bar{u} - \frac{(q_B + q_G)\mu_H}{2}$$

The IC constraints are as follows:

$$\begin{aligned} IC_B \quad &: \quad w + \frac{\delta \bar{u}}{1-\delta} \leq q_B\mu_H + w + \delta \frac{2w + (q_B + q_G)\mu_H}{2(1-\delta)} \\ &\Longrightarrow \quad w_{ICB} \geq \bar{u} - \frac{(1-\delta)q_B\mu_H}{\delta} - \frac{(q_B+q_G)\mu_H}{2} \end{aligned}$$

$$\begin{aligned} IC_G \quad &: \quad w + \frac{\delta \bar{u}}{1-\delta} \leq q_G\mu_H + w + \delta \frac{2w + (q_B + q_G)\mu_H}{2(1-\delta)} \\ &\Longrightarrow \quad w_{ICG} \geq \bar{u} - \frac{(1-\delta)q_G\mu_H}{\delta} - \frac{(q_B+q_G)\mu_H}{2} \end{aligned}$$

Notice that $w_{ICG} > w_{ICB}$, as $q_G\mu_H < q_B\mu_H$

Also: $w_{ICG} > w_{IR}$ as $\frac{(1-\delta)q_G\mu_H}{\delta} < 0$

Concluding:

$$w = w_{ICG} \leq \bar{u} - \frac{(1-\delta)q_G\mu_H}{\delta} - \frac{(q_B+q_G)\mu_H}{2}$$

Wage comparison

(1) Frankfurt - Decentralized Bank wage comparison

$$\bar{u} - \frac{q_B\mu_H}{\delta} < \bar{u} - \frac{(1-\delta)q_G\mu_H}{\delta} - \frac{(q_B+q_G)\mu_H}{2}$$

(2) Decentralized Bank - London wage comparison

$$\bar{u} - \frac{(1-\delta)q_G\mu_H}{\delta} - \frac{(q_B+q_G)\mu_H}{2} < \bar{u} - \frac{q_G\mu_H}{\delta}$$

Both of these comparisons boil down to:

$$q_B < q_G$$

which is always satisfied by assumption.

References

[1] **Aghion, Philippe and Bolton, Patrick**, 1992, An incomplete contracts approach to financial contracting, Review of Economic Studies, 77, pp 473-494.

[2] **Berger, Allen N., Bonime, Seth D., Goldberg, Lawrence G. and White, Lawrence J.**, 1999, The dynamics of market entry: The effects of mergers and acquisitions on de novo entry and small business lending in the banking industry, Working Paper, Economics Department, Stern NYU

[3] **Berger, Allen N., Demsetz, Rebecca S. and Strahan, Philip E.,** 1999, The consolidation of the financial services industry: Causes, consequences, and implications for the future, Journal of Banking and Finance, 23, pp 135-194.

[4] **Berger, Allen N., Klapper, Leora F. and Udell, Gregory F.**, 2001, The ability of banks to lend to informationally opaque small business, Journal of Banking and Finance, Volume 25, Issue 12, pp 2127-2167.

[5] **Berger, Allen N., Miller, Nathan H., Peterson Mitchell A., Rajan, Raghuram G. and Stein, Jeremy C.**, 2002, Does function follow organizational form? Evidence from the lending practices of large and small banks, NBER Working Paper 8752

[6] **Berger, Allen N., Saunders, Anthony, Scalise, Joseph M. and Udell, Gregory F.**, 1998, The effects of bank mergers and acquisitions on small business lending, Journal of Financial Economics, 50

[7] **Berger, Allen N. and Udell, Gregory F.**, 1996, Universal banking and the future of small business lending, in A. Saunders and I. Walter, eds.: *Financial systems design: The case for universal banking* (Irwin, Burr Bridge, IL)

[8] **Black, Sandra E. and Strahan, Philip E.,** 2002, Entrepreneurship and bank credit availability, Journal of Finance, December 2002, Vol. 57, no. 6 pp 2807-2833.

[9] **Bolton, Patrick and Freixas, Xavier**, 2000, Equity, bonds, and bank debt: Capital structure and financial market equilibrium under asymmetric information, The Journal of Political Economy, 108, pp 324-351.

[10] **Bolton, Patrick and Scharfstein, David C.**, 1990, A theory of predation based on agency problems in financial contracting, American Economic Review, 80, pp 93-106.

[11] **Bolton, Patrick and Scharfstein, David C.**, 1998, Corporate finance, the theory of the firm, and organizations, Journal of Economic Perspectives, Vol. 12, No. 4, pp 95-114.

[12] **Bonaccorsi di Patti, Emilia and Gobbi, Giorgio**, 2001, The changing structure of local credit markets: Are small businesses special?, Journal of Banking and Finance, 25, pp 2127-2167.

[13] **Bull, Clive**, 1987, The existence of self-enforcing implicit contracts, Quarterly Journal of Economics, 102 (1), pp 147-159

[14] **Cole, Rebel A., Goldberg, Lawrence G. and White, Lawrence J.**, 1997, Cookie-cutters vs. character: The microstructure of small business lending by large and small banks, Working Paper, New York University

[15] **De Yound, Robert, Goldberg, Lawrence G. and White, Lawrence J.**, 1997, Youth, adolescence and maturity of banks: credit availability to small business in an era of bank consolidation, Working Paper, New York University

[16] **Diamond, Douglas W.**, 1984, Financial intermediation and delegated monitoring, Review of Economic Studies, 51, pp 45-67.

[17] **Diamond, Douglas W.**, 1991, Monitoring and reputation: The choice between bank loans and directly placed debt, Journal of Political Economy, 99, pp 689-721.

[18] **Finance for small firms,** Business and household finance, -Finance for small firms, Annual Report on Finance for small firms 1-10, Bank of England, 1994-2003

[19] **G10:** *Report on consolidation in the financial sector*, 2001, January

[20] **Hart, Oliver D.**, 2001, Financial contracting, Journal of Economic Literature, pp 1079-1100.

[21] **Hooks, Linda M.**, 2000, The impact of firm size on bank debt use, Review of Financial Economics, 12, pp 173-189.

[22] **Keeton, William R.,** 2002, The transformation of banking and its impact on consumers and small businesses, Federal Reserve Bank of Kansas City, Economic Review, First quarter 2002, pp 25-53.

[23] **MacLeod, W. Bentley and Malcolmson, James M.,** 1998, Motivation and markets, American Economic Review, 88 (3), pp 388-411.

[24] **Meyer, Margaret, Milgrom, Paul and Roberts, John**, 1992, Organizational prospects, influence costs, and ownership changes, Journal of Economics and Management Strategy, 1, pp 9-35.

[25] **Peek, Joe and Rosengren, Eric S.**, 1998, Bank consolidation and small business lending: It's not just bank size that matters, Journal of Banking and Finance, Vol. 22, pp 799-819.

[26] **Petersen, Mitchell A. and Rajan, Raghuram G.**, 1995, The effect of credit market competition on lending relationships, The Quarterly Journal of Economics, 110, pp 407-443.

[27] **Petersen, Mitchell A. and Rajan, Raghuram G.**, 2002, Does distance still matter? The information revolution in small business lending, The Journal of Finance, December 2002, vol 57, no. 6., pp 2553-2570.

[28] **Sapienza, Paola,** 2002, The effects of banking mergers on loan contracts, Journal of Finance, Vol. 57, no. 1, pp 329-367.

[29] **Scharfstein, David and Stein, Jeremy C.**, 2000, The dark side of internal capital markets: Divisional rent-seeking and inefficient investment, Journal of Finance, 52, pp 111-133.

[30] **Shapiro, Carl and Stiglitz, Joseph E.**, 1984, Equilibrium unemployment as a worker discipline device, American Economic Review, Vol. 74, pp 433-444.

[31] **Stein, Jeremy C.**, 1997, Internal capital markets and the competition for corporate resources, Journal of Finance, 1997, 52, pp 111-134.

[32] **Stein, Jeremy C.**, 2002, Information production and capital allocation: decentralized versus hierarchical firms, Journal of Finance, 2002 No 5, pp 1891-1921.

[33] **Stewart, James B.**, 1993, Taking the dare, New Yorker, July 26, pp. 34-39.

European Central Bank working paper series

For a complete list of Working Papers published by the ECB, please visit the ECB's website (http://www.ecb.int)

380 "Optimal monetary policy under discretion with a zero bound on nominal interest rates" by K. Adam and R. M. Billi, August 2004.

381 "Fiscal rules and sustainability of public finances in an endogenous growth model" by B. Annicchiarico and N. Giammarioli, August 2004.

382 "Longer-term effects of monetary growth on real and nominal variables, major industrial countries, 1880-2001" by A. A. Haug and W. G. Dewald, August 2004.

383 "Explicit inflation objectives and macroeconomic outcomes" by A. T. Levin, F. M. Natalucci and J. M. Piger, August 2004.

384 "Price rigidity. Evidence from the French CPI micro-data" by L. Baudry, H. Le Bihan, P. Sevestre and S. Tarrieu, August 2004.

385 "Euro area sovereign yield dynamics: the role of order imbalance" by A. J. Menkveld, Y. C. Cheung and F. de Jong, August 2004.

386 "Intergenerational altruism and neoclassical growth models" by P. Michel, E. Thibault and J.-P. Vidal, August 2004.

387 "Horizontal and vertical integration in securities trading and settlement" by J. Tapking and J. Yang, August 2004.

388 "Euro area inflation differentials" by I. Angeloni and M. Ehrmann, September 2004.

389 "Forecasting with a Bayesian DSGE model: an application to the euro area" by F. Smets and R. Wouters, September 2004.

390 "Financial markets' behavior around episodes of large changes in the fiscal stance" by S. Ardagna, September 2004.

391 "Comparing shocks and frictions in US and euro area business cycles: a Bayesian DSGE approach" by F. Smets and R. Wouters, September 2004.

392 "The role of central bank capital revisited" by U. Bindseil, A. Manzanares and B. Weller, September 2004.

393 "The determinants of the overnight interest rate in the euro area" by J. Moschitz, September 2004.

394 "Liquidity, money creation and destruction, and the returns to banking" by Ricardo de O. Cavalcanti, A. Erosa and T. Temzelides, September 2004.

395 "Fiscal sustainability and public debt in an endogenous growth model" by J. Fernández-Huertas Moraga and J.-P. Vidal, October 2004.

396 "The short-term impact of government budgets on prices: evidence from macroeconomic models" by J. Henry, P. Hernández de Cos and S. Momigliano, October 2004.

397 "Determinants of euro term structure of credit spreads" by A. Van Landschoot, October 2004.

398 "Mergers and acquisitions and bank performance in Europe: the role of strategic similarities" by Y. Altunbas and D. Marqués Ibáñez, October 2004.

399 "Sporadic manipulation in money markets with central bank standing facilities" by C. Ewerhart, N. Cassola, S. Ejerskov and N. Valla, October 2004.

400 "Cross-country differences in monetary policy transmission" by R.-P. Berben, A. Locarno, J. Morgan and J. Valles, October 2004.

401 "Foreign direct investment and international business cycle comovement" by W. J. Jansen and A. C. J. Stokman, October 2004.

402 "Forecasting euro area inflation using dynamic factor measures of underlying inflation" by G. Camba-Méndez and G. Kapetanios, November 2004.

403 "Financial market integration and loan competition: when is entry deregulation socially beneficial?" by L. Kaas, November 2004.

404 "An analysis of systemic risk in alternative securities settlement architectures" by G. Iori, November 2004.

405 "A joint econometric model of macroeconomic and term structure dynamics" by P. Hördahl, O. Tristani and D. Vestin, November 2004.

406 "Labour market reform and the sustainability of exchange rate pegs" by O. Castrén, T. Takalo and G. Wood, November 2004.

407 "Banking consolidation and small business lending" by E. Takáts, November 2004.