A joint Initiative of Ludwig-Maximilians-Universität and Ifo Institute for Economic Research

Working Papers

FINANCIAL INTERMEDIATION AND THE CREATION OF MACROECONOMIC RISKS

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CESifo Working Paper No. 695 (6)

April 2002

Category 6: Monetary Policy and International Finance

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ISSN 1617-9595

* I would like to thank Volker Hahn, Eva Terberger-Stoy, Achim Schniewind, Jan Wenzelburger and seminar participants in Bielefeld, Heidelberg and conference participants at the annual meeting of the German Economic Association in Rostock 1998 and at the meeting of the European Economic Association (EEA) in Santiago de Compostela 1999 for helpful comments.

CESifo *Working Paper No. 695*
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Abstract

We examine financial intermediation when banks can offer deposit or loan contracts contingent on macroeconomic shocks. We show that the risk allocation is efficient if there is no workout of banking crises. In this case, banks will shift part of the risk to depositors. In contrast, under a workout of banking crises, depositors receive non-contingent contracts with high interest rates while entrepreneurs obtain loan contracts that demand a high repayment in good times and little in bad times. As a result, the present generation overinvests and banks create large macroeconomic risks for future generations, even if the underlying risk is small or zero. This provides a new justification for capital requirements.

JEL Classification: D41, E4, G2.

Keywords: financial intermediation, macroeconomic risks, state contingent contracts, banking regulation.

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1 Introduction

It is a widely held view that traditional contractual arrangements in banking leave banks subject to the risks associated with systematic or macroeconomic[1] shocks and that this may be inefficient. The recent financial crisis in Asia renewed the attention to the impact of macroeconomic risks on banks since a large number of banks became insolvent. In this paper, we examine the incidence of macroeconomic risks in the presence of financial intermediation under different regulatory schemes to solve banking crises when banks can write deposit or loan contracts contingent on macroeconomic events.

We consider an overlapping generations model in which financial intermediaries such as banks can alleviate agency problems in financial contracting. Banks compete for funds and offer credit contracts to potential borrowers. We allow for macroeconomic shocks affecting the average productivity of investment projects.

We distinguish between workout and failure depending on whether the whole banking system faces default. We show that financial intermediation yields a Pareto efficient risk allocation for each generation if the regulator commits to bankruptcy or failure of insolvent banks. If macroeconomic shocks are small, depositors and entrepreneurs are offered non-contingent deposit and loan contracts. All macroeconomic risk is borne by entrepreneurs. The inside funds of entrepreneurs act as a buffer to macroeconomic risks. If macroeconomic shocks are larger, banks write state contingent contracts for both market sides and part of the macroeconomic risk is shifted to consumers, since entrepreneurs cannot bear the entire risk.

The risk allocation changes completely if banking crises are worked out and, hence, future generations provide funds to pay back the banks' obligations to the previous generation in order to prevent banks from becoming insolvent. Competing banks under workout try to generate a profitable (positive intermediation margin) and a non-profitable (negative intermediation margin) state of the world. In the good state with high productivity of investment projects (upturn), they request high loan interests from entrepreneurs in order to achieve a positive intermediation margin. In order to moti-

1 We use the terms systematic and macroeconomic shocks as synonyms.

vate entrepreneurs to invest rather than to save, banks request very low repayments in the bad state with low productivity of investment projects (downturn) which leads to a negative intermediation margin. Deposit rates are non-contingent since banking crises are worked out. Competition of banks for the creation of a profitable state pushes deposit rates up to the high repayment of entrepreneurs in the good state. As a result, banks create a state of the world with high repayment obligations to depositors, but very low pay-back requirements from entrepreneurs. The present generation receives higher interest rates on savings than under bank failures. This induces overinvestment of the current generation at the expense of future generations.

Allowing for equity issuing does not alleviate the incentives of banks to create profitable and non-profitable states under the workout regime. In competition, banks are unable to raise equity. Shareholders would demand at least the same expected returns on equity as depositors receive. This is, however, infeasible since future generations pay back deposits but not equity. Thus, a bank trying to issue equity cannot attract savings. Capital adequacy rules are necessary to overcome the equity rising dilemma.

Our paper is related to recent discussions of regulatory issues regarding financial intermediaries. First, our model can explain that competition of financial intermediaries under a workout regime increases the underlying aggregate risk, since banks compete to create profitable states of the world. While the usual regulatory discussion has focused on the behavior of single institutions (see Dewatripont and Tirole 1995) or on the incidence of aggregate risk on the banking system without contingent contracts (Blum and Hellwig 1995 and also Gehrig 1997), our model suggests that the usual risk-taking incentives of bank managers must be complemented by the risk-generating motive when banks compete with contingent deposit and loan contracts. Even if the underlying productivity risk is small, competition of banks under a workout approach yield large macroeconomic risks for future generations.

Second, it has been pointed out by Hellwig (1995a, 1998) that it is unclear why the terms of the deposit contracts cannot be made contingent on aggregate events, such as productivity shocks or fluctuations in the gross domestic product. Hellwig [1998] offers three explanations of this phenomenon: lack of awareness, moral hazard of banks or deposit insurance, transaction costs and the market making role of financial intermediaries. Our model indicates that workouts of banking crises or explicit deposit insurance will not lead to contingent deposit contracts but to contingent loan contracts with very large differences in state dependent repayments. State dependent deposit contracts only occur for large productivity shocks and a regulatory scheme that induces bankruptcy of insolvent banks. Our analysis indicates that making deposit and loan contracts contingent on variations in aggregate income under a workout approach is inefficient and should even be prevented by regulatory action.

Third, our model may explain why banks are unable or unwilling to raise sufficient equity without capital adequacy requirements. Competition of banks in conjunction with workouts of banking crises impedes the possibility of banks to raise equity. Capital requirements are traditionally viewed as a form of prudential regulation that induce banks to internalize the risk of their investment decisions. Our model provides a new justification of capital adequacy rules as they can be justified by the need to solve the equity raising dilemma.[2]

Since we focus on stage contingent loan contracts, our analysis abstracts from many other issues in the design of bank loan contracts which deliver unique characteristics of bank loans. Recent work by Gorton and Kahn (2000) and Repullo and Suarez (1988) and Hege (1997) has shown that unique characteristics of bank loans emerge endogenously in bank/borrower relationships. While it will be important to take into account bank loan design considerations in future work, the incentive to create macroeconomic risk is likely to remain if deposit and loan contracts can be conditioned on macroeconomic events.

The model in the paper builds on the concepts how financial intermediation with adverse selection and moral hazard can be integrated into general equilibrium frameworks as first developed by Uhlig (1995) and extended by Gersbach (1999). The novel elements of this paper are the introduction and the examination of the impact of macroeconomic shocks in conjunction with state contingent deposit and loan contracts.

The paper is organized as follows. The next section describes the model. In the third

2 Capital adequacy rules can solve equity raising problems, but may reinforce future macroeconomic fluctuations as shown by Blum and Hellwig 1995.

section, we derive the equilibrium in the intermediation market when no macroeconomic shocks are present. In section four we introduce temporary productivity shocks, state contingent deposit and loan contracts and regulatory schemes. In section five and six, we examine small and large productivity shocks under different regulatory schemes. In section seven, we consider the equity raising dilemma. Section eight concludes.

2 Model

We consider a standard overlapping generations (OG) model with financial intermediation. Time is infinite in the forward direction and is divided into periods indexed by t. There are overlapping generations of agents living for two periods. For most of our analyses, it will be sufficient to look at one particular generation. However, regulatory policies such as workouts will require the existence of more than one generation.

Each generation consists of a continuum of agents, indexed by [0,1]. There are two classes of agents in each generation. A fraction η of individuals are potential entrepreneurs. The rest $1-\eta$ of the population are consumers. Potential entrepreneurs and consumers differ in the fact that only the former have access to investment technologies. There is one physical good that can be used for consumption or investment. The good is perishable. Each individual in each generation receives an endowment e of the good when young, and none when old.

Each entrepreneur has access to a production project that converts time t goods into time $t+1$ goods. The required funds for an investment project are $F := e+I$. Hence, an entrepreneur must borrow I units of the goods in order to undertake the investment project. The class of entrepreneurs is not homogeneous. We assume that entrepreneurs are indexed by a quality parameter q uniformly distributed on $[\overline{q_t}-1, \overline{q_t}]$, $\overline{q_t} > 1$, in the population of entrepreneurs. If an entrepreneur of type q obtains additional resources I and decides to invest, he realizes investment returns in the next period of:

$$q(I+e). \tag{1}$$

$\overline{q}_t$ is the aggregate indicator of the productivity of investment projects in period t.

If $\overline{q}_t$ is uncertain in period $t-1$, generation $t-1$ faces macroeconomic risk. For simplicity, we assume that potential entrepreneurs are risk neutral and only care about consumption when old, i.e. they do not consume when young. Consumers consume in both periods. They have utility functions $u(c_t^1, c_t^2)$ defined over consumption in the two periods where c_t^1, c_t^2 are the consumption of the consumer born in period t when young and old,respectively. Consumers are risk averse. If a household can transfer wealth between the two periods at a riskless real interest rate, denoted by r_t, the solution of the household problem generates the saving function, denoted by $s\{r_t\}$. We follow the standard assumptions in the OG-literature that the substitution effect (weakly) dominates the income effect, i.e. savings are a weakly increasing function of the interest rate. We drop the time index whenever convenient.

Depositors face the following informational asymmetries. The quality q is known to the entrepreneur, but not to depositors. Moreover, depositors cannot verify if an entrepreneur invests (see Gersbach and Uhlig 1997). To alleviate such agency problems in financial contracting, financial intermediation can act as delegated monitoring in the sense of Diamond (1984).[3] We assume that there are banks, indexed by j, that can finance entrepreneurs. For all of our arguments, it will be sufficient that two banks exist and compete.

As delegated monitors, banks act as information producers about private investment projects. Banks have access to monitoring technologies by screening applicants in order to assess their credit worthiness when contracts are negotiated as well as by interim or ex post monitoring when entrepreneurs execute their investment projects or in the case they default.

Since we focus on the impact of macroeconomic shocks on banks and GDP, we assume that banks can completely alleviate agency problems in contracting.[4] This is equivalent to the assumption that monitoring outlays for a bank per credit contract is negligible. Our analysis, however, carries over to the case where banks can completely alleviate agency problems in contracting by investing a fixed amount per credit contract in

3 A succinct discussion about the underlying frictions in markets that lead to intermediation can be found in Hellwig [1994].

4 See also Williamson [1986, 1987], for general equilibrium models with financial intermediation in which costly monitoring alleviates agency problems.

monitoring. In this case, the interest rate spread will be positive and will cover in equilibrium the costs of monitoring. For simplicity of presentation, we assume in this paper that such fixed monitoring costs are zero.

Next, we discuss the nature of contracts offered by banks indexed by $j = 1, 2, \cdots$. Bank j can sign deposit contracts $D(r_j^d)$ where $1 + r_j^d$ is the repayment offered for 1 unit of resources. Loan contracts of bank j are denoted by $C(r_j^c)$ where $1 + r_j^c$ is the repayment required from entrepreneurs for 1 unit of funds. Banks also require that entrepreneurs must invest their endowments if they apply for loans. If macroeconomic risk is present, we will allow for contracts to be conditioned on the realization of $\overline{q}_t$ or on the resulting GDP in period $t - 1$. In such cases, state contingent deposit or loan contracts can be written.

If banks can completely alleviate agency problems of entrepreneurs, only entrepreneurs who want to invest will apply for credits. Note that generations save and invest independently. Generations are only connected by financial intermediaries which are the sole long-living institution. A new generation is only affected by the preceding generation if banks have accumulated either profits or losses. In the former case, a generation can buy the shares of the banks. Since we will focus on Bertrand competition and profits and therefore the price of bank shares will be zero in all circumstances, this case is trivial and will be neglected. In the latter case, a generation may be forced by regulation or may want to rescue banks by paying back the preceding depositors. This will be the focus of our analysis. Losses of banks will only occur if aggregate risk is present and hence there is uncertainty about $\overline{q}_t$.

3 Equilibrium without Macroeconomic Shocks

It is useful for the understanding of the results later in the paper to start with the case of no macroeconomic shocks. We treat each generation and each intermediation game separately. We will discuss at the end of the section in which cases this assumption restricts the set of equilibria.

We first derive the equilibrium in the intermediation market in each period. For simplicity of exposition, we assume that two banks are present. Obviously, deposit and loan contracts will have a length of one period since no transformation of maturities needs to take place. We examine the following intermediation game.

Period t

1. Banks offer deposit contracts to consumers and entrepreneurs.
2. Banks offer credit contracts to entrepreneurs.
3. Consumers and entrepreneurs decide which contracts to accept. Resources are exchanged.

Period $t+1$

4. Entrepreneurs pay back. Banks pay back depositors.

In the following we discuss the main assumptions of the intermediation game. We first assume that banks cannot ration deposit contracts in stage 3.[5] Loans are obviously constrained by the amount of deposits obtained. We first consider the loan application decision of an entrepreneur with quality q, given that he observes r_j^d, r_j^c of banks. If he applies for a loan he also invests since banks can alleviate agency problems in contracting completely. If he applies for a loan at the bank which offers the lowest loan rate, his terminal wealth or consumption $W(q)$ will amount to

$$W(q) = q(e + I) - I(1 + \min\{r_j^c\}) \tag{2}$$

5 This assumption coincides with current regulations in most countries. The assumption however, appears crucial for all our results. It is unclear whether the equilibria survive if banks are allowed to ration both market sides.

If he does not apply, he obtains $e(1+\max\{r_j^d\})$ from saving his endowments. Thus, there exists a critical quality parameter, denoted by $q^*(r_j^c,\ r_j^d)$, and given by

$$q^*(\min\{r_j^c\},\max\{r_j^d\}) = 1 + \frac{I\min\{r_j^c\} + e\max\{r_j^d\}}{e+I} \tag{3}$$

so that entrepreneurs with $q \geq q^*$ want to have loans while entrepreneurs with $q < q^*$ prefer to save. However, the decision whether to apply for loans or to save will also depend on rationing expectations. We assume that entrepreneurs applying for a loan at bank j and who are rationed, will go to the bank that offers the most favorable deposit contracts. There are three possibilities to formulate the rationing schemes and expectations on the loan side.

First, under myopic or self-fulfilling no-rationing, entrepreneurs make loan application decisions under the assumption that they will not be rationed at any bank. Under this scheme all entrepreneurs applying for a credit go to the banks with the lowest loan interest rate. Second, under simple rationing entrepreneurs take into account that they may be rationed when applying for credits. Rejected entrepreneurs go to the banks with the highest deposit interest rate and save. Third, under complex rationing entrepreneurs apply first for loans at the bank with the lowest loan rate. If they are rejected they may try the second bank. If an entrepreneur who wants to invest is rejected twice, he saves at the bank with the highest deposit rate. In Gersbach (1999) it is shown that all three rationing schemes lead to the same perfect Bayesian equilibrium in which banks make zero profits if no macroeconomic shocks are present. In equilibrium, no rationing will occur. In order to explore the impact of macroeconomic risk and the role of state contingent deposit and loan contracts, we assume self-fulfilling rationing throughout the paper. This greatly simplifies the exposition. In all equilibria studied in the paper, the no-rationing expectations of entrepreneurs are indeed self-fulfilling.

Since banks can induce investment decisions and thereby secure repayments, they do not have to worry that low-quality entrepreneurs apply for loans since such entrepreneurs would have less consumption than with saving endowments. Hence, conditional on granting a credit to an entrepreneur and receiving funds from savers, profits per credit of a bank j amount to:

$$G_j = I(1+r_j^c) - I(1+r_j^d) = I(r_j^c - r_j^d) = I\Delta_j \tag{4}$$

Δ_j is the intermediation margin of bank j. In order to derive the intermediation equilibrium, we assume that savings are never sufficient to fund all entrepreneurs. Since the deposit rate r_j^d cannot exceed $\bar{q}-1$, and we have assumed that savings of consumers are weakly increasing in the deposit rate, a sufficient condition is:

$$(1-\eta)\, s\,\{\bar{q}-1\} < \eta\, I \tag{5}$$

We also assume that investments exceed savings at zero deposit and loan interest rates. In this case $q^* = 1$ and, therefore, we assume

$$(1-\eta)s[0] + \eta\, e\big(1-(\overline{q}-1)\big) < \eta\,(\overline{q}-1)\, I. \tag{6}$$

The boundary conditions together ensure that savings and investment can be balanced at positive interest rates. Finally, we assume that banks that cannot pay back go bankrupt.[6]

A perfect Bayesian Nash equilibrium with myopic or self-fulfilling rationing beliefs in the intermediation game is a tuple

$$\left\{\left\{r_j^{d*}\right\}_{j=1}^{2},\ \left\{r_j^{c*}\right\}_{j=1}^{2}\right\}$$

so that

- entrepreneurs take optimal credit application and saving decisions under the expectations that they are not rationed,
- no bank has an incentive to offer different deposit or loan interest rates,
- no rationing occurs in equilibrium.

In the appendix it is shown:

6 As we will discuss later, the same equilibrium arises when a bank crisis is worked out.

Proposition 1

Suppose $\overline{q} \leq 2$. Then, there exists a unique equilibrium of the intermediation game with

(i)

$$r^* = r_j^{c*} = r_j^{d*} \qquad \forall_j$$

(ii) r^* is determined by

$$(1-\eta)\, s\, \{r^*\} + \eta e \Big(1 + r^* - (\bar{q} - 1)\Big) = \eta\, (\bar{q} - (1 + r^*))\ I$$

(iii)

$$q^* = 1 + r^*$$

Hence, the intermediation game yields the competitive outcome in which savings and investments are balanced and in which there is a common interest for loans and deposits. For the purpose of this paper the important conclusion from proposition 1 is that intermediation margins are zero in equilibrium and savings and investments are balanced. The reason why two-sided price competition of banks yields the Walrasian outcome is caused by the switching possibilities of entrepreneurs.[7] Suppose that a bank offers a deposit rate slightly above r^* in order to attract all depositors. If this bank raises r^c in order to exploit its monopoly power with entrepreneurs, a portion of entrepreneurs will switch market sides in order to save their endowments. This, however, will cause large excess resources for the deviating bank inducing a loss higher than the excess returns from the remaining entrepreneurs. In equilibrium, all entrepreneurs with projects whose returns are equal or above r will obtain funds and invest.

Aggregate income, denoted by y_t^0, is given by:

$$y_t^0 = e + \eta(I + e) \cdot \left\{ \frac{\overline{q}^2 - (1 + r^*)^2}{2} \right\} \tag{7}$$

The first term represents the aggregate endowment in period t. The second term captures the output generated by investments in the last period. Note that banks do

7 See Stahl (1988) and Yanelle (1997) for the innovative theory of two-sided intermediation and Gehrig (1997) for a recent extension to differentiated bank services.

not need to put up equity to perform their intermediary function since they can fully diversify their lending activities.

4 Temporary Productivity Shocks, Contracts and Regulation Schemes

In this section, we consider the possibility of aggregate productivity shocks. We assume that $\overline{q}_\tau = \overline{q}$ in all periods τ except period t. In period t, $\bar{q}_t$ will be $\bar{q}^1$ with probability p (state 1) and the productivity parameter will be $\bar{q}^2$ with probability $1-p$ (state 2). The distribution of the entrepreneurs' qualities varies accordingly. We assume $\bar{q}^2 < \bar{q}^1$. $z = \bar{q}^1 - \bar{q}^2$ denotes the size of the shock. $\bar{q}^e = p \cdot \bar{q}^1 + (1-p)\bar{q}^2$ is the average productivity of the best possible qualities. We maintain the assumptions that savings and investment can be balanced at positive interest rates for any of the following constellations. Since these assumptions are a routine adjustment of the boundary considerations in the last section we abstain from an explicit repetition of the conditions.

Equilibria of the intermediation game in period $t-1$ will now crucially depend on the regulator's approach towards banking crises. A banking crisis occurs when one or both banks and thus the whole banking system cannot pay back depositors. We distinguish between working out and failure when banking crises occur. If the regulator commits to failure, banks that cannot pay back go bankrupt. If the regulator commits to working out, he will tax future generations to pay back existing obligations.

The exact regulatory policy for working out banking crises are irrelevant for the intermediation game in period t and for our purpose. The only assumption is that, under working out, banks expect that losses will be fully recovered in the future. If banks do not make losses in period t, they expect zero profits in the future because of Bertrand competition. If banks make losses in period t, banks expect that losses are recovered in future periods and no profits occur either.

While we compare the consequences of two regulatory schemes with commitment toward banking crises, our analysis can also be discussed in the following terms. Suppose that the young generation can determine the regulatory approach toward banking crises. If the costs to establish a new banking system after the failure of the existing one are negligible, the young generation would always choose failure in case of a banking crisis. If those costs are prohibitively high and must be born by the young generation, a banking crisis would be worked out.

With stochastic aggregate productivity shocks, banks can offer state contingent contracts in period $t-1$. We denote by $C(r_j^{c1}, r_j^{c2})$ the credit contract offered by bank j. r_j^{c1} and r_j^{c2} denote the interest rate demanded from borrowers in state 1 and state 2 respectively. Similarly, $D(r_j^{d1}, r_j^{d2})$ denote deposit contracts with deposit rates r_j^{d1} and r_j^{d2}, depending on the realization of macroeconomic shocks. We maintain the assumption that banks are risk neutral.[8]

Since consumers are risk averse, they prefer a riskless interest over a lottery $\{r_j^{d1}, r_j^{d2}\}$ with the same expected interest rate. We assume that consumers intertemporal preferences and their attitudes towards risk generate the saving function, now denoted by $s\{r_j^{d1}, r_j^{d2}\}$. The expected deposit rate is denoted by $r_j^{de} = pr_j^{d1} + (1-p)r_j^{d2}$. Similarly, the expected interest rate on loans is given by $r_j^{ce} = pr_j^{c1} + (1-p)r_j^{c2}$.

An entrepreneur is characterized by his quality in the good state, q, or by his average quality, denoted by q^e, and given by:

$$q^e = p \cdot q + (1-p)(q-z) \tag{8}$$

The critical entrepreneur is denoted by $q^{e*}(r_j^{c1}, r_j^{c2}, r_j^{d1}, r_j^{d2})$. An entrepreneur with an expected quality q^e and associated quality q in the good state faces the following choices. Applying for a credit yields expected wealth:

$$\begin{aligned} E(W(q)) = p\left\{q(I+e) - I(1+r_j^{c1})\right\} \\ + (1-p)\Big\{\max\left\{(q-z)(I+e) - I(1+r_j^{c2}), 0\right\}\Big\} \end{aligned} \tag{9}$$

Note that in the bad state, the project returns may be insufficient to pay back credit obligations. Saving funds yields expected wealth

8 Since entrepreneurs as owners of banks are risk neutral, the assumption follows naturally. If entrepreneurs were risk averse, there exists various justifications of the "as-if-risk-neutrality" assumption, because banks can rely on the law of large numbers to smooth out idiosyncratic risk [see Hellwig 1995b].

$$e\Big(p(1+r_j^{d1})+(1-p)(1+r_j^{d2})\Big)=e(1+r_j^{de})$$

Since potential entrepreneurs are risk neutral, the comparison of the expected wealth between investing and saving determines the critical quality level above which entrepreneurs invest. In the following, we examine the intermediation game in period $t-1$, depending on the size of the shock.

5 Small Productivity Shocks

We first consider the case when shocks are so small that funded and investing entrepreneurs are always able to pay back. The upper limit for small shocks will be given in the next proposition. In this case, the critical entrepreneur in terms of expected quality, would be given by:

$$q^{e*}=1+\frac{Ir_j^{ce}+er_j^{de}}{e+I} \tag{10}$$

such that entrepreneurs with $q^e \geq q^{e*}$ apply for loans while entrepreneurs with $q^e < q^{e*}$ save their endowments. Note that q^{e*} implies a critical value in the good state, denoted by q^*, and defined by:

$$q^{e*}=p\,q^*+(1-p)(q^*-z)$$

We first derive the equilibrium when the regulator commits to failure. In the case of failure, depositors know that banks can never pay back a promised deposit rate exceeding the lending rate for the same state of world. Hence, we can restrict our analysis to $r_j^{d1} \leq r_j^{c1}$ and $r_j^{d2} \leq r_j^{c2}$. For instance, if $r_j^{d1} > r_j^{c1}$ were offered, depositors would simply count with $r_j^{d1} = r_j^{c1}$. Conditional on receiving funds and granting a credit to an entrepreneur, expected profits per credit of bank j amount to:

$$\begin{aligned} E(G_j) &= p\cdot I(r_j^{c1}-r_j^{d1})+(1-p)I(r_j^{c2}-r_j^{d2}) \\ &= I(r_j^{ce}-r_j^{de}) \end{aligned} \tag{11}$$

The critical entrepreneur is denoted by q_f^{e*}. We obtain:

Proposition 2

Suppose that the regulator commits to failure. Then, there exists a unique equilibrium of the intermediation game if

$$z \leq \frac{e(1+r^f)}{p(e+I)}$$

where r^f is determined by:

$$(1-\eta)\ s\left\{r^f, r^f\right\} + \eta e\Big(1 + r^f - (\bar{q}^e - 1)\Big) = \eta\Big(\bar{q}^e - (1+r^f)\Big) \cdot I$$

The equilibrium is given by

(i)

$$r^f \ = r_j^{c1} = r_j^{c2} = r_j^{d1} = r_j^{d2}, \qquad \forall j$$

(ii)

$$q_f^{e*} = 1 + r^f$$

The proof is given in the appendix. Note that the interest rates, the critical entrepreneur and the upper bound of the shock are fully determined by the exogenous variables. The proposition implies that financial intermediation with commitment to failure of the regulator yields a Pareto-efficient allocation of risks for the generation under consideration. Risk-neutral entrepreneurs can bear the entire macroeconomic risk since they can repay the same interest rate in both states. The productivity shock is fully absorbed by the fluctuation of the entrepreneurs' income. Banks never default in equilibrium.

Suppose, however, the regulator commits to workouts. In this case, banks might be tempted to request particularly high interests rates on loans in the good state while they request low interest rates in the bad state. It is instructive to show first that the efficient risk allocation within a generation can no longer be an equilibrium.

Proposition 3

Suppose that the regulator commits to workouts. Then, efficient risk allocation cannot be an equilibrium.

The proof is given in the appendix. In the next proposition we establish the equilibrium of the game. The critical entrepreneur who is indifferent between saving and applying for a loan in the case of workouts is denoted by q_w^{e*}.

Proposition 4

Suppose $(\overline{q}^e - 1 - p)e + (\overline{q}^e - 2p)I \leq 0$. Suppose that the regulator commits to workouts. Then, there exists a unique equilibrium with:

(i)

$$r^w = r_j^{c1} = r_j^{d1} = r_j^{d2}$$

(ii)

$$r_j^{c2} = -1$$

(iii) r^w is determined by

$$(1-\eta) \cdot s\{r^w,\ r^w\} + \eta e \cdot \Big(q_w^{e*} - (\overline{q}^e - 1)\Big) = \eta(\overline{q}^e - q_w^{e*})I$$

with

$$q_w^{e*} = 1 + \frac{I\{pr^w - (1-p)\} + er^w}{e + I}$$

The proof is given in the appendix. Under workout, banks want to create a profitable state while they are not concerned about losses in the other state. Competition drives profits in the good state to zero and we have $r_j^{c1} = r_j^{d1}$. In order to demand high interest rates from entrepreneurs in one state, banks do not require any repayment in the bad state in order to motivate them to apply for loans and not for saving. The condition in proposition 4 is fulfilled, as long as the expected upper level of the productivity is not too high and the probability that the good state occurs is not too low.[9]

Proposition 4 holds independent of the size of the shock as long as $\overline{q}^e$ fulfills the condition. Thus, even if the macroeconomic risk is small, future generations face large

9 If the condition in proposition 4 is not fulfilled, the results remain qualitatively the same. Banks will still demand less repayment in the bad state from entrepreneurs. However, $r_j^{c2} = -1$ is no longer feasible in equilibrium since the average loan interest rate would induce too much investment.

aggregate risks. Proposition 4 holds even if there is no macroeconomic risk at all, i.e. $\bar{q}^2 = \bar{q}^1$. This case, however, can only occur if there are sunspot random variables which have the probability distribution $(p, 1-p)$ and on which banks write contingent deposit and loan contracts. An immediate corollary of 4 is:

Proposition 5

Suppose $(\overline{q^e} - 1 - p)e + (\overline{q^e} - 2p)I \leq 0$. Suppose that the regulator commits to workouts. In the bad state future generations face a negative spread of $1 + r^w$ and losses equal to the savings of the last generation.

Obviously, propositions 4 and 5 are extreme since banks can write contracts with entrepreneurs demanding negative interest rates in one state of the world. If we restrict the set of contracts to non-negative interest rates, our results are qualitatively the same, but the potential losses for future generations shrink. Future generations face a negative spread equal to the interest rates on savings and losses are equal to the interest income of the current generation.

In the next proposition, we compare the interest rates and investment levels under both regulatory schemes.

Proposition 6

The comparison between workout and failure yields:

(i) $r^w > r^f$

(ii) $q_w^{e*} < q_f^{e*}$

Proof :

We compare the savings and investment balance in both cases. Suppose that $r^w < r^f$. This implies that

$$q_w^{e*} < 1 + \frac{I\, r^f + e\, r^f}{e + I} = 1 + r^f = q_f^{e*}$$

Hence, using proposition 2, we obtain:

$$(1-\eta)\, s\left\{r^f, r^f\right\} + \eta\, e\left(q_w^{e*} - (\overline{q}^e - 1)\right) < \eta\left(\overline{q}^e - q_w^{e*}\right) I.$$

The strict inequality is reinforced if we lower r^f to r^w in $s\{r^w, r^w\}$ since savings weakly increase if the real interest rate rises. This is, however, a contradiction to the savings and investment balance in the workout case and hence we obtain $r^w > r^f$. Moreover, $r^w > r^f$ implies that $q_w^{e*} < q_f^{e*}$ in order to balance savings and investments.

■

As proposition 6 describes, under the workout regime the current generation overinvests compared to the bank failure regime and depositors receive attractive interest rates. Since entrepreneurs do not need to pay back in one state of the world under workout, a larger share of entrepreneurs invests instead of saving, compared to the failure regime.[10]

6 Big Productivity Shocks and Bank Failure

In this section, we complete our analysis with the case when the shock is sufficiently large so that complete insurance of savers is not possible under the failure regime. The essential condition is that the wealth of entrepreneurs is insufficient to insure depositors, i.e. $z \geq \frac{e(1+r^f)}{p(e+I)}$, where r^f is determined by proposition 2. We obtain:

Proposition 7

Suppose that the regulator commits to failure and that $z > \frac{e(1+r^f)}{p(e+I)}$. Then, there exists a unique equilibrium of the intermediation game with:

(i)

$$r^1 = r_j^{c1} = r_j^{d1}, \qquad \forall_j$$

(ii)

$$r^2 = r_j^{c2} = r_j^{d2}, \qquad \forall_j$$

10 To prevent the overinvestment result, the regulator could fix deposit rates from the beginning at the level r^f. Such ex ante deposit rate ceiling would, however, not eliminate the risk generation incentive of banks since banks still would like to create a profitable and an unprofitable state of world.

(iii)

$$r^1 = \frac{I(1+r^2) + (e+I)\ \{zp - 1 - (1-p)r^2\}}{p(e+I)}$$

(iv) r^2 *is determined by*

$$(1-\eta)\cdot s\left\{r^1(r^2),\ r^2\right\} + \eta e\Big(q^* - (\bar{q}^e - 1)\Big) = \eta(\bar{q}^e - q^*)\cdot I \quad \textit{with}$$

(v)

$$q_f^{e*} = 1 + pr^1 + (1-p)r^2 = \frac{I\,(1+r^2)}{e+I} + zp$$

Hence, banks offer state contingent deposit and loan contracts. Part of the macroeconomic risk is shifted to depositors. The risk allocation among the agents of the generation under consideration is efficient under the regulatory scheme which prevents the aggregate risk from being shifted to future generations. Note that there is space for further improvements in risk allocation by repackaging deposit contracts into two securities. One very risky contract to risk-neutral entrepreneurs who save. One less risky or even riskless contract for risk-averse consumers. Such finer contract arrangements would further improve the risk allocation. They yield, however, the same conclusions since the amount of aggregate risk shifted to savers remains the same.

7 Raising Equity and Capital Requirements

Until now, banks did not need to put up any capital to perform intermediation. On the one hand, banks could completely diversify idiosyncratic risks. On the other hand, banks could write state contingent deposit and loan contracts or could shift aggregate risk to future generations. In this section, we allow banks to raise equity. Under failure there is clearly no need to raise equity since the competition of banks shifts aggregate risk to entrepreneurs and consumers anyway.

Suppose that banks can additionally offer equity contracts in case of workouts. An equity contract specifies that the holder will either receive a proportional part of a bank's profit as a dividend in the next period or in case of default will receive nothing. We obtain:

Proposition 8

Suppose that $(\overline{q}^e - 1 - p)e + (\overline{q}^e - 2p)I \leq 0$. *Suppose that the regulator commits to workouts. Then, banks cannot successfully offer equity contracts in equilibrium.*

Proof :

Consider the equilibrium without equity contracts, described in proposition 4, with deposit contracts $r_j^{d1} = r_j^{d2} = r^w$ that insure consumers. Moreover, $r_j^{c1} = r^w$ and $r_j^{c2} = -1$. Suppose that a bank wants to offer equity contracts. Consumers or non-investing entrepreneurs would only apply for such contracts if the average repayment is at least $1 + r^w$. Loan contracts are limited by the requirement that the average repayment cannot exceed $p(1 + r^w)I$. Otherwise, entrepreneurs would not apply for such contracts. Hence, the return on equity in the good state cannot exceed $1+r^w$ since demanding a higher loan rate in this state would imply a larger expected repayment than $p(1 + r^w)I$. Therefore, the bank must offer a return on equity in the bad state of $1+r^w$ as well in order to attract savers. But since repayments by creditors are bounded above by $p(1 + r^w)I$, the bank cannot secure repayment of $1 + r^w$ per unit of loan in the bad state as well. In summary, in one state of the world the return on equity will be below $1 + r^w$ while the return on equity in the other state of the world is at most $1+r^w$. Hence, banks cannot offer equity contracts with expected returns at least equal to $1 + r^w$. Thus, no bank can offer successfully equity contracts.

■

The preceding proposition illustrates that competition in conjunction with workouts of financial crises impedes the possibilities of banks to raise equity. Hence, regulatory requirements that banks must hold equity in a certain proportion to outstanding loans alone can induce banks to raise equity and can decrease the incentives to create profitable and non-profitable states and reduces the costs of workouts. Capital requirements are traditionally viewed as a form of prudential regulation which induces banks to internalize the risk of their investment decisions. Our model provides a new justification of capital adequacy rules since they can be justified by the need to solve the equity raising dilemma. It is, however, clear that the issue of capital adequacy rules is much more complex than the brief account we can offer in this section.

8 Conclusions and Extensions

We have examined the incidence of macroeconomic shocks in a model of financial intermediation under different regulatory schemes towards banking crises. The current framework should allow a number of potentially useful extensions. For instance, if the regulatory agency can commit to a particular regulatory scheme, the decision whether or not to rescue insolvent banks would depend on the majority voting in a particular period. It is obvious that there are conflicting interests about the appropriate regulatory scheme. A generation will always vote to introduce regulatory actions in order for working banking crises and to distribute negative productivity shocks across future generations if such productivity shocks occur when it is old. A young generation will suffer if they must work out banking crises and pay back the depositors. Hence, regulatory schemes depend strongly on the relative sizes of subsequent generations and on potential costs to set up new banks. The political economy of regulatory schemes and the induced impulse responses to shocks could provide useful insights into the timing of bank failures and workouts.

Our analysis points out that the combination of allowing banks to fail and contingent deposit and loan contracts yields an efficient risk and investment allocation. However, there is a large number of further issues to be taken into account in banking regulation outlined in the surveys with different emphasis by Bhattacharya and Thakor (1993), Dewatripont and Tirole (1994), Hellwig (1994), Freixas and Rochet (1997), Bhattacharya, Boot and Thakor (1998), and Allen and Santomero (1998). How an overall second-best banking regulation scheme should be designed remains open.

9 Appendix

Proof of proposition 1:

We first show the existence of the equilibrium. We note that r^* is uniquely determined. The boundary conditions ensure that at least one solution exists. For sufficiently high interest rates investments become zero and hence the left side of the equation for r^* is greater than the right side. For $r^* = 0$ the boundary condition ensures that the right side is greater than the left side. Hence, since both sides are continuous in r by the mean value theorem at least one solution exists.

Moreover, the left side of the implicit equation for r^* in proposition 1 is monotonically increasing in r^*. In contrast, the right side is decreasing in r^*. Hence, the solution is unique.

Loan application decisions of entrepreneurs are optimal, given $r^d = r^c = r^*$. Profits of banks per credit contract are zero (see Equ. (4)).

Changing one interest rate while leaving the other at r^* is never profitable for a bank. Consider a change of r_j^d. Either profits are negative if $r_j^d < r^*$ or a deviating bank obtains no resources. Consider a change of r_j^c. Either profits are negative since the interest rate margin is negative or the deviating bank does not obtain loan applicants and will make negative profits because of our rationing assumption.

Suppose, however, bank j offers slightly better conditions for depositors ($r_j^d = r^* + \epsilon$) and tries to exploit its monopoly power on the lending side, i.e., the bank changes both interest rates.

Since bank j would obtain all deposits, overall profits, denoted by π_j depending on its choice r_j^c amount to:

$$\begin{aligned}\pi_j = \eta(\bar{q} - q^*) \cdot I(1 + r_j^c) - \eta e\Big(q^* - (\bar{q} - 1)\Big)(1 + r^* + \epsilon) \\ - (1 - \eta)s\left\{r^* + \epsilon\right\}(1 + r^* + \epsilon)\end{aligned} \tag{12}$$

where

$$q^* = 1 + \frac{I \cdot r_j^c + e(r^* + \epsilon)}{e + I}$$

and

$$r_j^c > r^* + \epsilon$$

Note that bank j has excess resources of

$$(1-\eta)s\left\{r^* + \epsilon\right\} + \eta e\Big(q^* - (\bar{q} - 1)\Big) - \eta(\bar{q} - q^*) \cdot I$$

which, however, cannot be invested and cannot be used next period since the good is perishable. We obtain

$$\begin{aligned}
\frac{\partial \pi_j}{\partial r_j^c} &= \eta\left\{(\bar{q} - q^*) \cdot I - \frac{I}{e+I} \cdot I(1 + r_j^c)\right\} - \eta e \frac{I}{e+I} \cdot (1 + r^* + \epsilon) \\
&= \frac{\eta I}{e+I}\Big\{(\bar{q} - 1)(e+I) - 2Ir_j^c - I - e(1 + 2r^* + 2\epsilon)\Big\} \\
&< \frac{\eta I}{e+I}\Big\{(\bar{q} - 2)(e+I)\Big\}
\end{aligned}$$

Therefore, $\frac{\partial \pi_j}{\partial r_j^c}$ is negative if $\overline{q} \leq 2$.

Hence, profits are decreasing for $r_j^c \geq r^* + \epsilon$ in the loan interest rate. Thus, bank j cannot make profits by offering $r_j^d = r^* + \epsilon$ and some lending rate $r_j^c \geq r^* + \epsilon$. Finally, it is obvious that setting $r_j^d = r^* + \varepsilon$ and $r_j^c < r^* + \varepsilon$ is not profitable because profits are negative.

Uniqueness follows through similar observations. Any interest rate constellation which would yield excess resources can be improved by a deviating bank. Any interest rate constellation with $r^d < r^c$ and no excess resources cannot be an equilibrium either. A bank can profitably deviate by setting $r^d + \varepsilon$, $(\varepsilon > 0)$ and $r^c - \delta$, $(\delta > 0)$ where δ has to be selected so that no excess resources occur.

■

Proof of proposition 2:

We observe that for given r_j^{ce} and r_j^{de}, and hence a given critical entrepreneur q^{e*} and a given profit per credit, banks can offer risk averse depositors the highest utility by setting $r_j^{d1} = r_j^{d2}$. Hence, Bertrand competition will lead to $r_j^{d1} = r_j^{d2} = r_j^{de}$. Moreover, banks are forced to offer $r_j^{ce} = r_j^{de}$. Raising r_j^{de} slightly and increasing r_j^{ce} to obtain monopoly profits from entrepreneurs is not profitable for the same reasons as outlined in proposition 1. $r_j^{d1} = r_j^{d2} = r_j^{de} = r_j^{ce}$ and the repayment conditions $r_j^{d1} \leq r_j^{c1}$ and $r_j^{d2} \leq r_j^{c2}$ imply $r_j^{c1} = r_j^{c2} = r_j^{d1} = r_j^{d2}$.

This equilibrium interest rate is denoted by r^f and determined by the saving and investment balance. Finally, we need to verify that banks are able to pay back in both states of the world. Otherwise, their deposit rates would not be credible. In the bad state the repayment condition is given by

$$(q^* - z)(e + I) = (q^{e*} - zp)(e + I) \geq I\,(1 + r^f)$$

Using $q^{e*} = 1 + r^f$ this implies

$$z \leq \frac{e(1 + r^f)}{p(e + I)}$$

■

Proof of proposition 3:

Consider the efficient risk allocation. A bank j can offer the following interest rates

$$r_j^{d1} = r_j^{d2} = r^f + \epsilon$$

$$r_j^{c2} = r^f + \delta$$

$$r_j^{c1} = \frac{\delta(p - 1) + pr^f}{p}$$

where δ is larger than ϵ. Bank j would obtain all deposits since $r_j^{de} > r^f$. The critical entrepreneur amounts to

$$q^{e*} = 1 + \frac{Ir^f + e(r^f + \epsilon)}{e + I} = 1 + r^f + \frac{e\epsilon}{e + I}$$

Hence, for sufficiently small ϵ, savings and investments are almost balanced. Since $r_j^{d1} > r_j^{c1}, r_j^{d2} < r_j^{c2}$ bank j will not be able to pay back depositors in the first state.

Since, however, banking crises are worked out, expected bank profits per credit amount to

$$E(G_j) = (1-p) \cdot I(\delta - \epsilon) \tag{13}$$

For sufficiently small ϵ, excess resources from depositors are negligible. However, for $\delta > \epsilon$ and δ sufficiently large, expected profits are large. Hence, the profitable deviation of bank j destroys the existence of the efficient risk allocation equilibrium.

■

Proof of proposition 4:

We first observe that r^w is uniquely determined. The left side of the implicit equation for r^w in proposition 4 is increasing in r^w since $s\{r^w,\ r^w\}$ and q_w^{e*} are monotonically increasing in r^w. In contrast, the right side is decreasing in r^w. The corresponding boundary conditions ensure that a unique solution exists.

The most promising deviation by bank j would be[11]

$$r_j^{d1} = r_j^{d2} = r^w + \epsilon \tag{14}$$

$$r_j^{c2} = -1 \tag{15}$$

The bank would obtain all resources and would try to maximize expected profits by choosing the monopoly interest rate r_j^{c1}. Expected profits are given by

$$\begin{aligned} E(\pi_j) = p \cdot \Big\{ &\eta(\bar{q}^e - q^*) \cdot I\Big(1 + r_j^{c1}\Big) - \eta e\Big((q^* - (\bar{q}^e - 1)\Big)(1 + r^w + \epsilon) \\ &-(1-\eta) \cdot s\{r^w + \epsilon,\ r^w + \epsilon\}(1 + r^w + \epsilon)\Big\} \\ \text{with:} \qquad &q^* = 1 + \frac{I\Big(pr_j^{c1} - (1-p)\Big) + e(r^w + \epsilon)}{e + I} \end{aligned} \tag{16}$$

We obtain:

11 It is straightforward but tedious to check that any other potential deviation is not profitable.

$$
\begin{aligned}
\frac{\partial E(\pi_j)}{\partial r_j^{c1}} &= \frac{p\,\eta\,I}{e+1}\cdot\Big\{(\bar{q}^e-1)(e+I) \\
&\qquad - I\left\{(pr_j^{c1}-(1-p)\right\} - e(r^w+\epsilon) - pI(1+r_j^{c1}) - ep(1+r^w+\epsilon)\Big\} \\
&= \frac{p\,\eta\,I}{e+I}\cdot\Big\{(\bar{q}^e-1)(e+I) - I(2pr_j^{c1}+2p-1) \\
&\qquad - e(p+r^w(1+p)+\epsilon(1+p))\Big\} \\
&\leq \frac{p\,\eta\,I}{e+I}\cdot\Big\{(\bar{q}^e-1-p)(e+I)+I(1-p)\Big\} \\
&\leq 0,\ \text{if } (\bar{q}^e-1-p)e+(\bar{q}^e-2p)I \leq 0
\end{aligned}
\tag{17}
$$

Note that we have used $r_j^{c1} = r^w = 0$ and $\varepsilon = 0$ to obtain the inequality. Hence, under the assumption in the proposition the deviation is not profitable.

■

Proof of proposition 7:

a) In the bad state the interest rate r^2 in (iii) is determined by the requirement that the critical entrepreneur can just pay back. We must have

$$(q^* - z)(e+I) = I\,(1+r^2) \tag{18}$$

Using

$$q^e = pq + (1-p)(q-z)$$

which implies for the critical quality levels $q^{e*} = p\,q^* + (1-p)(q^*-z)$

$$q^* - z = q^{e*} - zp$$

. We obtain

$$(q^{e*} - zp)(e+I) = I\,(1+r^2) \tag{19}$$

Inserting

$$q^{e*} = 1 + pr^1 + (1-p)r^2$$

yields

$$r^1 = \frac{I\,(1 + r^2) + (e + I)\,\{zp - 1 - (1 - p)\,r^2\}}{p\,(e + I)}$$

which corresponds to (iii). (v) follows by solving equation (19) for q^{e*}.

b) For sufficiently large productivity shocks we always have $r^1 > r^2$.

Using (iii), $r^1 > r^2$ implies

$$\begin{aligned} p(e+I)r^2 < p(e+I)\,r^1 &= I(1+r^2) + (e+I)\left\{zp - 1 - (1-p)\,r^2\right\} \\ er^2 &< I + (e+I)(zp-1) \end{aligned} \tag{20}$$

For a given r^2, q^{e*} is increasing in z. Hence, in order to fulfill the savings/investment balance in (iv) an increase in z leads to a decline in r^2. Hence, for sufficiently high z, equation (20) will be fulfilled.

c) Expected profits of banks are zero. However, we have to consider possible deviations. Suppose bank j offers deposit interest rates r^1 and $r^2 + \epsilon$. Since bank j obtains all deposits, it could change the individually optimal interest rates on loans. In order to avoid the excess resource problem bank j needs to make sure that enough entrepreneurs want to apply for credits. Hence q^e should not raise above $q^{e*} = 1 + pr^1 + (1-p)r^2$.

From

$$q^{e*} = 1 + \frac{I\,r^{ce} + e \cdot \Big(pr^1 + (1-p)(r^2 + \epsilon)\Big)}{e + I} = 1 + pr^1 + (1-p)r^2$$

we obtain

$$r^{ce} \leq pr^1 + (1-p) \cdot r^2 \leq r^{de} = pr^1 + (1-p)(r^2 + \varepsilon)$$

Hence, expected profits per credit amount to

$$\begin{aligned} E(G_j) &= p(r_j^{c1} - r_j^{d1}) \cdot I + (1-p)(r_j^{c2} - r_j^{d2}) \cdot I \\ &= I\,(r^{ce} - r^{de}) \\ &\leq 0 \end{aligned}$$

Hence, bank j does not find a profitable set of interest rates $\left\{r_j^{c1}, r_j^{c2}\right\}$.

$\blacksquare$

References

[1] Allen, F. and D. Gale (1997), "Financial Markets, Intermediaries, and Intertemporal Smoothing", *Journal of Political Economy*, Vol. 105, No. 3, 523-546.

[2] Allen, F. and A. Santomero (1998), "A Theory of Financial Intermediation", *Journal of Banking and Finance*, 21, 1461-1485.

[3] Baltensperger, E. (1995), "Panel Discussion - Statements and Comments, Conference on Capital Adequacy Rules as Instruments for the Regulation of Banks", Schweizerische Zeitschrift für Volkswirtschaft und Statistik, (4/2), 823-825.

[4] Bernanke, B. and M. Gertler (1989), "Agency Costs, Net Worth, and Business Fluctuations", *American Economic Review*, Vol. 79, No. 1, 14-31.

[5] Bhattacharya, S. and A. Thakor (1993), "Contemporary Banking Theory", *Journal of Financial Intermediation*, 3, 2-50.

[6] Bhattacharya, S., A. Boot and A. Thakor (1998), "The Economics of Bank Regulation", *Journal of Money, Credit and Banking*, 30(4), 745-770.

[7] Blum, J. and M.F. Hellwig (1995), "The Macroeconomic Implications of Capital Adequacy Requirements", *European Economic Review*, Vol. 39, 733-749.

[8] Dewatripont, M. and J. Tirole (1994), "The Prudential Regulation of Banks", *MIT Press*.

[9] Diamond, D. (1984), "Financial Intermediation and Delegated Monitoring", *Review of Economic Studies*, Vol. 51, 393-414.

[10] Freixas, X. and J.-C. Rochet (1997), "Microeconomics of Banking. *MIT Press*, Cambridge, MA.

[11] Gehrig, T., (1996), "Market Structure, Monitoring and Capital Adequacy", *Schweizerische Zeitschrift für Volkswirtschaft und Statistik*, Vol. 132 (4/2), 685-702.

[12] Gehrig, T., (1997), "Excessive Risks and Banking Regulation", *in: Banking Competition and Risk Management*, edited by Gabriella Chiesa, Rome, 241-269.

[13] Gersbach, H. and H. Uhlig (1997), "Debt Contracts, Collapse and Regulation as Competition Phenomena", *Center for Economic Policy Research* Discussion Paper Series, No. 1742.

[14] Gersbach, H., "Financial Intermediation with Market Side Switching", *University of Heidelberg* Working Paper.

[15] Gorton, G. and Kahn, J. (2000), "The Design of Bank Loan Contracts", *The Review of Financial Studies*, Vol 13, (2), 331-364.

[16] Hege, U. (1997), "Multi-Party Debt Renegotiation and the Maturity and Seniority of Large Creditors", Working Paper, Tilburg University.

[17] Hart, O. (1995), "Firms, Contracts and Financial Structure", Clarendon Press, Oxford.

[18] Hellman, T., Murdock, K., Stiglitz, J. (1998), "Liberalization, Moral Hazard in Banking, and Prudential Regulation: Are Capital Requirements Enough?", Research Paper, No. 1466, Stanford University.

[19] Hellwig, M.F. (1994), "Banking and Finance at the End of the Twentieth Century", *WWZ-Discussion Paper*, No. 9426, University of Basel.

[20] Hellwig, M.F. (1995a), "Systemic Aspects of Risk Management in Banking and Finance", *Schweizerische Zeitschrift für Volkswirtschaft und Statistik*, Vol. 131, 723-737.

[21] Hellwig, M.F. (1995b), "The Assessment of Large Compounds of Independent Gambles", *Journal of Economic Theory*, 67, 299 - 326.

[22] Hellwig, M.F. (1998), "Banks, Markets, and the Allocation of Risks in an Economy", *Journal of Institutional and Theoretical Economics,* Vol. 154/1, 328-345.

[23] Holmström, B. and J. Tirole (1997), "Financial Intermediation, Loanable Funds, and the Real Sector", *The Quarterly Journal of Economics*, Vol. 112, No. 3, 663-691.

[24] Kiyotaki, N. and J. Moore (1997), "Credit Cycles", *Journal of Political Economy*, Vol. 105, No. 1, 211-248.

[25] Repullo, R. and Suarez, J.S. (1998), "Monitoring, Liquidation and Security Design", *The Review of Financial Studies*, 11, 163-187.

[26] Suarez, J. and O. Sussman (1997), "Endogenous Cycles in a Stiglitz-Weiss Economy", *Journal of Economic Theory*, Vol. 76, 47-71.

[27] Townsend, R. (1979), "Optimal Contracts and Competitive Markets with Costly State Verification", *Journal of Economic Theory*, Vol. 21, 1-29.

[28] Uhlig, R. (1995), "Transition and Financial Collapse", CentER Discussion Paper 66.

[29] Williamson, S.D. (1986), "Costly Monitoring, Financial Intermediation and Equilibrium Credit Rationing", *Journal of Monetary Economics*, Vol. 18, 159-179.

[30] Williamson, S.D. (1987), "Financial Intermediation, Business Failures, and Real Business Cycles", *Journal of Political Economy*, Vol. 95, 1196-1216.

[31] Yanelle, M. (1997), Banking Competition and Market Efficiency, *Review of Economic Studies*, 64, 215-239.