Buch, Claudia M.

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Bank behavior and bad loans: Implications for reforms in Eastern Europe

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— Implications for Reforms in Eastern Europe —

by

Claudia M. Buch

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List of Variables

L	Loans
$L = a - b \cdot \mu^L$	Loan demand
D	Deposits
$D = c + d \cdot \mu^D$	Deposit supply
E	Equity
r^L	Lending rate
σ^L	Standard deviation return on lending
$H(\tau)$	Density function
$E[r^L] = \mu^L$	Expected return on lending
τ	Standardized return on lending
r^D	Contractual deposit rate
μ^D	Expected deposit rate
ρ	Cost of capital
K	Production costs
Y	Total insolvency costs
η	Variable insolvency cost
$E[\pi]$	Expected profit
ε	Elasticity
n	Number of competitors
O, N	Old, new loans

1. INTRODUCTION

The transformation of the banking systems in formerly centrally planned economies into efficient systems of financial intermediation has been severely hampered by the presence of non-performing loans on the balance sheets of the banks. These non-performing loans have partially been inherited from the past but are also the result of unsound lending policies of the banks. This paper introduces a partial-equilibrium model which helps to explain the behavior of banks in the transformation process. In part 2, the effects of a flow of non-performing loans, i.e. of an increase in the riskiness of new lending and of an increase of insolvency costs on the pricing and lending decisions of banks are analyzed. It is shown that a bank's equity holdings serve as a cushion against fluctuation of the value of its assets. The benchmark cases of a monopolistic bank and of a situation of perfect competition are extended to an analysis of an oligopolistic loan market. In chapter 3, the effects of the presence of a stock of non-performing loans on the lending decisions of banks are analyzed. It is shown that the existing banks have an incentive to lend to their old clients and thus to roll over non-performing loans. Chapter 4 concludes.

2. THE FLOW OF NON-PERFORMING LOANS

A bank can be described as a firm which buys deposits (D) from the population and sells loans (L) to firms.[1] This specification assumes that intermediation between savers and investors is costly and that banks can offer these intermediary services at lower costs than other institutions. These savings of transaction costs occur because banks gain information on loan applicants from their deposit services or because banks use benefits from diversification [Diamond, 1984; Nakamura, 1989].

It is assumed that the bank behaves as a risk-neutral profit maximizer. This assumption is justified for the case of the more advanced reform states of Eastern Europe where the central banks stopped to intervene in the banking system directly and to automatically cover the losses of banks. Subsidized central bank lending has been cut down drastically, and fairly restrictive monetary policies were implemented.[2] Indirect subsidies which used to be chan-

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1 The basic model is based on Baltensperger and Milde [1987], it follows the approaches by Klein [1971] and Dermine [1986]. In this model, the clear separability between loans and deposits is assumed. Hancock [1991], in contrast, uses an approach which does not distinguish between loans and deposits but rather classifies inputs and outputs based on the calculation of the respective user costs. For an application to the liberalization of financial markets in developing countries see Corsepius [1989]. Corsepius analyzes whether banks raise their deposit rates as a response to a liberalization of interest rates.

2 Buch [1995] gives an account of the monetary policy in the Czech Republic, Hungary, and Poland during the transition period.

nelled through the banking system to state-owned enterprises were cut down or were converted into direct transfers of the state budget.[3] Hence, despite the slow progress that has been made in some countries with the privatization of banks, the majority of the banks operates under relatively hard budget constraints.[4]

The bank has a reasonably long time horizon which induces it to take balance sheet risks into account. This long-term perspective also allows the bank to adjust its equity holdings as a response to changes in risk. Hence, at the beginning of each period the bank can choose its optimal balance sheet structure and scale of operations. Expected profits are given by:

$$[1.1] \qquad E[\pi] = (1+\mu^L)\cdot L - (1+\mu^D)\cdot D - K(D,L) - Y(D,L) - (1+\rho)\cdot E$$

All depositors and debtors, respectively, are identical such that the sum of loans and deposits just equals the individual amounts times the number of customers. When maximizing its expected profits, the bank needs to observe its balance sheet restriction

$$[1.2] \qquad L = D + E$$

The asset side of the bank's balance sheet consists of loans only. Liquidity reserves which may be held as a cushion against unforeseen withdrawals of deposits are not considered.

The bank receives an expected return on lending (μ^L) which differs from the contractual lending rate (r^L) because the returns of the project that is being financed with the loan are stochastic. The expected return on loans is normally distributed, and credit risks are stochastically independent. If, in contrast, a positive correlation among credit risks could be observed during the transformation process, the present specification would give only the lower bound of the effects that exogenous changes in lending risks have on the behavior of banks.

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3 For example, the Ministry of Finance in the Polish case has acted as an active owner of banks, forcing banks to behave in a profit-oriented way [OECD, 1994; van Wijnbergen, 1994].

4 Of course, the analysis cannot directly be applied to most successor states of the former Soviet Union where a huge amount of directed credits is still being channelled through the commercial banking system while losses on these loans are automatically covered by the central banks. Even in these countries, however, new banks are emerging that do not have access to central bank refinancing and do thus behave as profit maximizers.

The bank's costs consist of four components: the expected interest payments on its deposits (μ^D), operating costs (K), insolvency costs (Y), and the opportunity costs (ρ) of holding equity (E). Operating costs (K) are increasing in D and L ($K_D, K_L > 0$; $K_{DD}, K_{LL} > 0$)[5] and comprise costs in connection with writing credit contracts, with raising deposits, or with maintaining customer relations. For example, a bank which has to administer many small accounts and which offers a wide range of services will tend to have higher operating costs than a bank which has many large customers and a narrow range of services. For simplicity, the costs of gathering information on customers are assumed to be part of the operating costs and have no direct influence on credit returns. All interest rates are expressed in real terms, i.e. uncertainty over the future price level is ruled out.

By explicitly considering costs of insolvency, the effect of non-performing loans on the behavior of a representative bank can be analyzed. These costs occur whenever the returns from the loan business are insufficient to cover the bank's insolvency costs, i.e. when the return on lending is less than a critical rate ($\hat{r}^L$). This critical lending rate is given by:

$$[1.3] \qquad \hat{r}^L = \frac{\left(1+r^D\right)\cdot D + K(D,L) - L}{L}$$

where r^D denotes the contractual interest rate on deposits. Later, it will be shown that the contractual and the expected deposit rate differ as a consequence of the presence of insolvency costs. The critical lending rate can be standardized with respect to the expected return and to the standard deviation of loan returns (σ^L) to yield

$$\hat{\tau} = \frac{\hat{r}^L - \mu^L}{\sigma^L}.$$

Hence, the bank has positive costs of insolvency if the actual (standardized) return on lending is less than the critical rate or

$$[1.4] \qquad Y = Y(D,L) = \eta \cdot L \cdot \sigma^L \cdot \int_{-\infty}^{\hat{\tau}} (\hat{\tau} - \tau) \cdot h(\tau) d\tau$$

with η = variable insolvency costs which are proportional to the amount of the expected loss. Whenever the bank's expenditures exceed its revenues, it has to start adjustment procedures, renegotiate with its creditors, or adjust the structure of its loan portfolio. The costs of insol-

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5 The bank produces loans and deposits according to a simple production function $D = D(z_j)$ and $L = L(z_j)$ such that the cost function $K = K(D,L) = w \cdot z(D,L)$ can be derived (w = wage level, z = input factors).

vency thus comprise the costs of conciliation agreements as well as the costs of liquidating assets which served as collateral. Although collateral is not explicitly considered in the model, it may be thought of as part of the project returns. The model only considers the costs of the reorganization of the bank, not its bankruptcy. This implies that, in the worst case, the end-period value of the bank's equity just equals zero. Equity thus serves as a cushion against adverse fluctuations in the value of the bank's assets. If revenues fall short of expenditures, the costs of insolvency are borne by the equity holders whose wealth is reduced and by the depositors who receive less than the contractual interest rate on their deposits.

The impact that the risk of insolvency has on the end-period values of debt and equity is shown by equations [1.5] and [1.6]. The expected value of equity at the end of the period depends on the fact whether the actually realized return on lending lies above or below the critical rate:

$$E_{+1} = \begin{cases} 0 & \text{for } r^L < \hat{r}^L \\ (1+r^L)\cdot L - K(D,L) - (1+r^D)\cdot D & \text{for } r^L \geq \hat{r}^L \end{cases}$$

[1.5]

$$E[E_{+1}] = L\cdot\sigma^L\cdot\int_{\hat{\tau}}^{\infty}(\tau-\hat{\tau})\cdot h(\tau)\,d\tau$$

Hence, the expected end-period value of equity is equal to the excess of project returns over the critical lending rate.

The potential shortfall of the return on lending with respect to the critical rate explains the difference between the expected interest rate on deposits and the contractual rate. Depositors receive the full interest payments on their deposits only if the return on lending exceeds the critical rate. Otherwise, depositors receive whatever revenue is left after the bank has paid its costs:[6]

$$D_{+1} = \begin{cases} (1+r^L)\cdot L - K(D,L) - \eta\cdot L\cdot(\hat{r}^L - r^L) & \text{for } r^L < \hat{r}^L \\ (1+r^D)\cdot D & \text{for } r^L \geq \hat{r}^L \end{cases}$$

[1.6]

$$E[D_{+1}] = (1+r^D)\cdot D - L\cdot\sigma_\tau^L\int_{-\infty}^{\hat{\tau}}(\hat{\tau}-\tau)\cdot h(\tau)\,d\tau - Y(D,L) \equiv (1+\mu^D)\cdot D$$

The expected rate of return on deposits (μ^D) is derived from the expected value of the deposits at the end of the period. Equation [1.6] shows that the expected deposit rate is smaller than the contractual rate if there is a positive probability that the return on lending is less than the critical rate. The difference between these two rates can be thought of as a risk premium

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6 Note that this specification assumes that debt is senior to equity but not to other liabilities – for example wage payments – that the bank has.

that the bank has to pay to its depositors in order to compensate them for the riskiness of their financial assets.

2.1. Monopoly

To begin with, the bank is assumed to have a monopolistic position on both, the market for credits as well as for deposits. It thus needs to observe the following equilibrium conditions:

$$[1.7] \qquad \begin{aligned} L &= L^D(\mu^L) & \varepsilon(L^D, \mu^L) < 0 \\ D &= D^S(\mu^D) & \varepsilon(D^S, \mu^D) > 0 \end{aligned}$$

Both restrictions are binding. The bank's endogenous variables are the volume of loans and deposits as well as the interest rates. The amount of equity is determined as the residual. Before deriving the first order conditions for the bank's profit maximum, the balance sheet structure is explicitly introduced into the profit function by substituting $D=\beta \cdot L$ and $E=L-\beta \cdot L$ as well as the inverse demand functions.[7] Hence, [1.1] can be rewritten as:

$$[1.1'] \qquad E[\pi] = \mu^L(L) \cdot L - \mu^D(D) \cdot (\beta \cdot L) - K(\beta, L) - Y(\beta, L) - \rho \cdot (L - \beta \cdot L)$$

The bank's control variables are the structure of its liabilities and the volume of loans such that the first order conditions for a profit maximum become:

$$[1.8] \qquad \begin{aligned} E[\pi]_\beta &= -\mu^D \cdot \left[1 + \frac{1}{\varepsilon(D^s, \mu^D)}\right] - K_\beta - Y_\beta + \rho \cdot L = 0 \\ E[\pi]_L &= \mu^L \cdot \left[1 + \frac{1}{\varepsilon(L^D, \mu^L)}\right] - \mu^D \cdot \beta \cdot \left[1 + \frac{1}{\varepsilon(D^S, \mu^D)}\right] - K_L - Y_L - \rho \cdot (1 - \beta) = 0 \end{aligned}$$

In the comparative-static analysis of the model, the effects of changes in the exogenous variables, i.e. the opportunity costs of holding equity (ρ), the variable operating costs, the variable costs of insolvency (η), and of a change in credit risk (σ^L)[8] can be analyzed (Table 1). Both, higher costs of insolvency as well as higher lending risks can be interpreted as results of the transformation process. Insolvency costs are, for example, raised through stricter standards that the banking supervision imposes on banks with regard to their lending

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7 This notion does not restrict any of the variables in the model because liquidity reserves as an additional asset are not considered.

8 Increases in the standard deviation of loan returns can also be expressed through a shift parameter ψ: $\sigma^L = \sigma^L(L, \psi) = \psi \cdot \tilde{\sigma}^L(L)$ [Baltensperger/Milde, 1987, p. 253].

policies, their accounting requirements, the adjustment procedures that are necessary when debtors go bankrupt, and through provisioning requirements.

Economic transformation raises lending risks because the shift to a new set of relative prices made large parts of the existing capital stock obsolete [Siebert/van Long, 1991] and thus rendered many of the previous loan recipients insolvent. In other words, the transformation process and the change in relative prices caused a decline in enterprises' net worth [Gertler/Rose, 1993]. To the extent that a bank cannot instantaneously change its customer base, the share of enterprises which cannot repay their loans increases. Also, enterprises may, as a consequence of the transformation process, have a broader range of potential projects available which returns are more dispersed. Hence, the uncertainty over the return on investment project rises. Finally, the existing information systems prove insufficient as compared to the requirements of a market-based financial system, making loan assessment more difficult and raising the probability that risky loans are made.

Table 1 — Comparative-Static Analysis of the Flow Problem of a Monopolistic Bank.[9]

Exogenous Variables	Endogenous Variables					
	β^*	L^*	D^*	E^*	$\mu^L *$	$\mu^D *$
η	—	—	—	?	+	—
σ^L	—	—	—	?	+	—
ρ	+	—	?	—	+	?

+ = increase, – = decrease, ? = undetermined effect, 0 = no impact.

It is immediately clear that higher variable insolvency costs and an increase in lending risks have qualitatively the same implications for the behavior of banks. Facing higher (variable) insolvency costs, the bank reduces its lending activity (scale effect) and restructures its portfolio towards holding relatively more equity (structural effect).[10] The reduction of

9 See appendix for a detailed derivation of these results.

10 Empirically, Shrieves and Dahl [1992] confirm this result as they find that changes in capital levels are positively related to changes in asset risk. This positive relation can alternatively be explained by managerial risk aversion. Even if the bank's owners are risk

lending reduces insolvency costs, provided that direct outweigh indirect cost effects. The smaller the overall amount of lending, the lower are insolvency costs (direct effect). Apart from that, a lower credit volume reduces the potential for diversification. This indirect effect tends to raise insolvency costs. Because the monopolistic bank has an influence on prices, changes in lending risks and insolvency costs also have an impact on the interest rate structure. A reduction of loan supply and of demand for deposits puts upward pressure on lending rates and downward pressure on deposits rates. Hence, the interest rate spread increases and allows the bank to recover some of the losses from its lending activities. Incidentally, higher interest rate spreads and the resulting positive profits would allow the bank to recapitalize for losses from previous periods, i.e. for the effects of a stock of non-performing loans (see part 3).

The structural effects describe the choice of the optimal amount of deposits and equity at the beginning of the period. If the liabilities' structure is seen to reflect the allocation of control rights in the bank, equity holders increase their say in the bank's activities *ex ante* if the bank faces more adverse external conditions. At the end of the period, however, the structure of the liabilities-side of the bank's balance sheet will have changed, depending on the actually realized return on lending. *Ex post*, control rights are shifted away from equity holders towards depositors in bad states of the world. Because the end period value of equity approaches zero in bad states of the world, depositors gain greater control.[11] The results of this model are therefore compatible with the implications of the optimal control theory which, in contrast to the present specification, analyzes situations with imperfect information that depositors and equity holders have with respect to the actions of bank management. This theory implies that control should shift from equity holders to depositors in bad states of the world, i.e. at the lower tail of the distribution of project returns [Dewatripont/Tirole, 1993].

The results above can easily be extended to a framework of perfect competition [Baltensperger/Milde, 1987, pp. 259], i.e. to a situation where depositors and lenders have unrestricted access to foreign financial markets or where foreign/domestic banks can enter the market. The individual bank takes deposit and lending rates as given by the market. Hence,

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neutral, the bank's managers may behave risk averse. This is because the managers have acquired bank specific human capital and can thus only insufficiently diversify their risk across sectors while investors and equity holders have this option [Saunders et al., 1990]. In fact, Greenwald and Stiglitz [1991] find in a portfolio model with risk aversion that a rising share of (systematic) risk induces the bank to grant less loans. In the model presented above, in contrast, the bank behaves as if it was risk averse due to the presence of insolvency costs.

11 Tirole [1994] notes that due to the fact that the interests of dispersed debt holders are difficult to coordinate, banking supervisors may act in the interest of depositors in this situation. Capital-asset-ratios are means to trigger the necessary shift in control from owners to banking supervisors.

the scale of its activity and the structure of the liabilities side of its balance sheet are the only control variables of the banks. Increases in the riskiness of assets and in insolvency costs have the same structural and scale effects as in the monopoly case. However, changes in these exogenous variables have no impact on the interest rate structure. Banks operating in a competitive environment cannot increase their interest rate spreads in order to offset potential losses on their lending activities. Despite the fact that the expected deposit rate is exogenous to the individual bank, the contractual rate varies with the amount of deposits. A higher level of deposits implies a greater risk of insolvency, and the bank must offer its depositors a higher contractual interest rates in order to keep expected interest rates constant (and equal to the market rate). Under perfect competition, banks adjust their activities as a response to exogenous changes in interest rates. A higher expected return on lending leads to a greater scale of operating but leaves the structure of liabilities unaffected. A higher deposits rate causes both, a lower scale of operations and a decreasing share of deposits in its liabilities.

2.2. Oligopoly

In the context of the Eastern European reform states, neither the assumption of perfect competition nor that of a single monopolistic bank is very realistic considering the limited degree of market entry and the oligopolistic market structures that were created when splitting up the monobank. Hence, the above model is extended, first, to an oligopolistic model with a number of n identical banks and, second, to a duopolistic market where different cost structures of banks are allowed for. In the oligopoly-model, total supply and demand of loans and deposits, respectively, are given by:

$$[1.9] \qquad \sum_{i=1}^{n} L_i = L; \qquad \sum_{i=1}^{n} D_i = D$$

For simplicity, simple linear loan demand and deposit supply functions are introduced such that [1.7] can be re-written as

$$[1.7'] \qquad L = a - b \cdot \mu^L; \qquad D = c + d \cdot \mu^D.$$

Assuming Cournot-type competition, bank i maximizes its profits under the assumption that loan supply and deposit demand of all other banks are given:

$$[1.1''] \qquad E\left[\pi_i \middle| \pi_j; j \neq i\right] = \mu^L \cdot L_i - \mu^D \cdot D_i - K_i(D_i, L_i) - Y_i(D_i, L_i) - \rho \cdot (L_i - D_i)$$

Hence, the first order conditions for a profit maximum of bank i become:

$$E[\pi_i]_{L_i} = \frac{\partial \mu_L}{\partial L} \cdot \frac{\partial L}{\partial L_i} \cdot L_i + \mu_L - K_L - Y_L - \rho = 0$$

[1.8']

$$E[\pi_i]_{D_i} = -\frac{\partial \mu_D}{\partial D} \cdot \frac{\partial D}{\partial D_i} \cdot D_i - \mu_D - K_D - Y_D + \rho = 0$$

Where K_L, Y_L denote the partial derivatives of the bank i's cost functions with respect to the bank's output. Because all banks are assumed to have identical cost structures, bank-specific indices can be omitted. If instead of the demand for deposits the balance sheet structure is chosen as a control variable of the bank, qualitatively the same elasticities of β and L with respect to changes in the exogenous variables as in the monopoly case are obtained. The intensity of these reactions, however, depends on the number of competitors on the market. The larger n, the smaller are the adjustments of the individual firm, but the larger will be the reactions of total industry output (see appendix).

Because condition [1.8'] is the same for all banks, $L = n \cdot L_i$ and $D = n \cdot D_i$ as well as [1.7'] can be used to obtain the optimal loan supply and deposit demand of bank i as a function of n:

$$L_i^* = -\frac{b}{1+n} \cdot \left[K_L + Y_L + \rho - \frac{a}{b} \right] \quad \wedge \quad L^* = n \cdot L_i^*$$

[1.10]

$$D_i^* = -\frac{d}{1+n} \cdot \left[K_D + Y_D - \rho - \frac{c}{d} \right] \quad \wedge \quad D^* = n \cdot D_i^*$$

Both quantities are positive if costs are sufficiently small, i.e. if the terms in brackets are negative. It can easily be shown that total loan supply and deposit demand increase with the number of competitors, and thus that the lending rate decreases while the deposit rates increases with n. Hence, greater competition puts pressure on interest rate spreads. If the model is extended to a multi-period framework (see part 3) and if banks have to cover past losses through current profits, this effect explains the reluctance of the regulatroy authorites to let new banks enter the market. Provided that these banks can operate at the same or even lower costs than the incumbent banks, market entry would reduce the scope for the existing banks to recapitalize themselves through interest spreads.

The effects of different cost structures on the market share of an individual bank can be shown in a duopoly-model. The optimal loan supply and deposit demand of bank i depends on the relative cost structures of the two banks or

[1.10']

$$L_i^*(L_j^*) = \frac{1}{3}\cdot b\cdot\left(Y_{j,L} + K_{j,L} + \rho - \frac{a}{b}\right) - \frac{2}{3}\cdot b\cdot\left(Y_{i,L} + K_{i,L}\right); \qquad i \neq j; \quad i = 1,2$$

$$D_i^*(D_j^*) = \frac{1}{3}\cdot d\cdot\left(Y_{j,D} + K_{j,D} + \rho + \frac{c}{d}\right) - \frac{2}{3}\cdot d\cdot\left(Y_{i,D} + K_{i,D}\right); \qquad i \neq j; \quad i = 1,2$$

where $K_{i,L}, L_{i,L}$ denote the partial derivatives of bank i's cost functions with respect to the bank's output. Loan supply of bank 1 thus expands if the marginal costs of bank 2 rise and decreases if its own costs increase, albeit with different intensities (and vice versa). After calculating the total supply of loans by summing up the individual amounts of each bank, market shares can be calculated. It can be shown that the market share of a bank decreases if its costs increase relative to that of its competitor (see appendix).

These results can be used to develop an argument about the optimal sequence of internal and external financial liberalization, assuming that foreign banks operate with lower costs than domestic banks. Internal financial liberalization denotes the de-protection of domestic monopolies by allowing the market entry of domestic banks, together with the privatization of state-owned banks. Foreign financial liberalization allows for the market entry of foreign banks and/or the opening of the capital account, allowing domestic firms to borrow and domestic depositors to open accounts abroad [Blejer/Sagari, 1987]. Starting from a situation of a highly protected, inefficient domestic monopoly, Blejer and Sagari argue that domestic financial liberalization should precede external financial liberalization. The market entry of domestic banks and the privatization of existing banks should lower the costs of intermediation domestically and decrease the potential for price differentiation by monopolistic banks.[12] Only if these efficiency gains have been realized should the economy be opened to foreign banks. If external financial liberalization would be allowed for immediately, foreign banks could appropriate higher market shares than domestic banks because of their cost advantages. Hence, a government which assigns a high weight to domestic banks' profits would decide to postpone external financial liberalization until the efficiency of domestic banking has improved.

In the case of the Eastern European reform countries, however, the case for internal-before-external financial liberalization is less evident. It can be argued that the market entry of foreign banks has beneficial effects also for the efficiency of the domestic banking sector. Taking the following arguments together, the case for an internal-before-external financial

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[12] Blejer/Sagari [1987] differentiate between types of domestic borrowers with different access to investment project and to foreign financial markets. This allows domestic banks to charge different prices for loans.

liberalization strategy is substantially weakened. Instead, a strategy of closely involving foreign banks into the process of internal financial liberalization may be beneficial:

- First, the market entry of new, domestic banks is not necessarily sufficient to challenge the market position of existing banks. New banks are likely to have higher operating costs because they lack a branch network. In addition, the structure of their customers is likely to be biased towards new firms without a sufficiently long track record. Hence, insolvency costs for new banks will be high. While foreign banks may in principle face similar problems, they are yet likely to have access to superior technologies which allows them to operate at lower costs.
- Second, considering the vast amount of improvements that are needed in domestic banking, the question is whether the profits of the incumbent banks are worth protecting or if not the gains of borrowers and depositors from higher quality intermediation outweigh the losses of banks.
- Third, foreign banks can play a positive role in the privatization of banks by acquiring ownership stakes or by forming twinning arrangements with domestic banks. Both options would lead to a substantial transfer of know-how into the domestic banking system and improve its efficiency.
- Fourth, the argument about the optimal degree of sequencing assumes that foreign banks have an absolute cost advantage over domestic banks. Yet, it is likely that domestic banks can provide some services at lower costs than foreign banks because, for example, they have a branch network at hand which reduces their operating costs. Even if unrestricted market access of foreign banks is possible, banks may thus choose not to enter into the traditional businesses of domestic banks but rather to restrict themselves to relatively small market segments. Export trade financing, investment banking, and some areas of wholesale banking are the fields where foreign banks are most likely to be active.

In the analysis so far, a higher lending risk reflects the *flow* of non-performing loans. Focusing in the flow problem seems justified if one considers that many of the non-performing loans currently burdening banks are the result of poor credit assessment skills and insufficient information systems as well as of an increase in uncertainty over the future profitability of enterprises rather than a legacy from the past. This holds in particular for those countries where high inflation rates in the aftermath of price liberalization have served to erode the real value of the existing loans portfolios. However, all emerging market economies are also facing a substantial *stock* problem of bad debt, at least at the beginning of the transformation process. One interpretation of this stock problem is that higher administratively fixed interest rates in a situation of financial liberalization reduce the bank's ability to cover their interest costs out of the returns on lending. In addition, the shift in relative prices as a result of price

and trade reform changes the earnings perspectives of traditional customers and thus led to a deterioration of the quality of the existing loan portfolios.

3. THE STOCK OF NON-PERFORMING LOANS

An inherited stock of bad debt may lead to distress lending, i.e. to a roll over of non-performing loans. Distress lending and the resulting creditor passivity [Begg/Portes, 1993] can be explained by three factors. First, the bank could exercise an option value of waiting. Instead of writing off loans that turned out non-performing, the bank may extend fresh credit to enterprises and hope to recover at least some of the losses carried forward from the previous period [Perotti, 1993a]. This behavior will be analyzed below. Secondly, the bank may expect to be bailed out by the government or by the central bank. The bank would thus not take the negative impact that distress lending has on its own probability of insolvency into account. Considering the fact that most state-owned banks have been or are still being protected by general deposit insurance schemes, the possibility that banks gambled on bail outs cannot completely been dismissed. Yet, the crucial question is whether the fate of managers has been tight to the fate of the bank under such schemes, whether effective ownership has been imposed on banks, and whether unconditional bail outs have been avoided. Third, in a multi-period model, distress lending could also be explained by short-sighted behavior of the commercial bank. By rolling over loans, the management of the bank may hope to cover losses in the short run and thus avoid to be dismissed. Finally, the bank may fear that the insolvency of its clients sends negative signals about its own solvency to its depositors. By revealing information about the poor financial state of its loan customers the bank may thus cause a bank run [Begg/Portes, 1993]. This argument assumes asymmetric information that depositors have with respect to the loan portfolios of the bank.[13]

Perotti [1993a] has formalized the idea that banks lend to their old clients because they exercise an option value of waiting.[14] This idea can be integrated into the above framework by making three assumptions.

First, in order to show the bias in the lending decision of the bank caused by the presence of a stock of bad debt, the bank is assumed to have two investment alternatives. Either,

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13 This asymmetry of information has thus far been excluded from the analysis but may well provide the rationale for a publicly provided deposit insurance and for banking regulation.

14 For the purpose of this argument it is not required that banks gamble on a potential future bail-out by the government or by the central bank. If this moral hazard behavior were to be introduced, insolvency costs could be set at zero because the bank would assume that any future losses are automatically covered.

it can invest into a new firm (N), yielding a high return at low risk, or, the bank may grant loans to its old clients (O) which gives it a low return at high risk:

$$[3.1] \qquad \begin{aligned} \mu_N^L &> \mu_O^L \\ \sigma_N^L &< \sigma_O^L \end{aligned}$$

Alternatively, one could model the alternative investment opportunity as loans to private sector firms and explain private sector credit rationing by the presence of non-performing loans [Perotti, 1993a, 1993b].[15] Obviously, loans to old clients are inefficient investments, being located below the efficient frontier and being clearly dominated by investments into new firms. This holds for both, the case of a risk-neutral bank (vertical indifference curves) as well as of a risk-averse bank (concave indifference curves).[16] The extreme specification of risk-and-return combinations has thus been chosen in order to show that the presence of a stock of bad debt may bias the lending decision of the bank towards lending to old firms. If the higher return on investment into new firms was merely a reflection of a higher risk embodied in these firms, i.e. if both investments were to lie on the efficient frontier, assumptions about the degree of risk aversion of banks were needed in order to find out the superior investment opportunity.

Second, banks do not hold low-risk reserves as a cushion against stochastic withdrawals of deposits. The liquidity services that different assets provide are thus not considered. In addition, potential diversification effects of combining loans to old and new firms into one portfolio as well as from the impact that diversification may have on insolvency costs are not considered. The standard deviation of a portfolio of the two assets would thus be equal to the weighted average of the standard deviation of its components. Because the standard deviation of loans to new firms is lower than that of loans to old firms, a bank not burdened by a stock of bad loans would invest all its funds into either firm, depending on the relevant expected profits.

Third, two periods are analyzed. On the basis of the two variables risk and return alone, any bank which has no old clients and thus no non-performing loans (new bank) would decide to invest into new firms. The situation may change, however, if a third variable is added to the decision problem. It is now assumed that the bank has business relationships and that loans to these firms have not been served fully in the past.

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15 Asymmetric information seems a more plausible argument for private-sector equilibrium credit rationing.

16 It was shown above that even risk-neutral banks behave as if they were risk averse due to the presence of insolvency costs.

In the first period, the bank's loans yielded a return which was insufficient to cover the bank's costs, and the equity base was too small to absorb these losses. This situation may have occurred because the bank could not foresee the decline in expected returns or because it did not adjust its capital structure accordingly. The question why banks entered into unprofitable loan agreements in the first place, i.e. the time-inconsistency of bank lending, is not of relevance for the analysis of the Eastern European situation. The presence of a stock of bad loans on the balance sheets of banks is not the result of a rational decision process of the banks. It is rather a legacy from the past. The bank thus carries a stock of non-performing loans over from the base period, resulting in a loss ($\pi_{-1} < 0$). The loss can be carried over to the next period at no costs. The presence of a loss raises the critical interest rate such that the costs of insolvency are the higher the greater the loss carried over from the base period:

$$[3.2] \qquad \hat{r}_L = \frac{(1+r^D)\cdot D + K - L - \pi_{-1}}{L} \quad \Rightarrow \quad \frac{\partial \hat{r}_L}{\partial \pi_{-1}} < 0, \quad \frac{\partial Y}{\partial \pi_{-1}} < 0; \qquad \pi_{-1} < 0$$

This specification implies that the bank can postpone the payment of its various costs but that its creditors retain their claim on the bank. Equally, the bank has a residual claim on the profits of the (old) firm.

In the second period, the bank can optimize on the scale and scope of its activities but the loss that has been carried over from the base period enters into its decision process in two ways. First, if the loss has not been written off, the bank's revenue in the second period must cover the previous period's loss plus current expenditures. Second, the loss gives the bank a residual claim on the returns of old credit customers. The case that the bank is equity constrained is not considered in this model. If banks enter the second period with zero capital and cannot raise new capital while facing positive costs of insolvency, it would be optimal to close the bank. Continued lending to (risky) firms could then only be explained by the expectancy of a bail-out.

A bank which does have a stock of bad debt on its balance sheet (old bank) needs to consider that lending to enterprises may give it a chance to recover some of the losses from the first period. The old bank has a residual claim on the project returns of the enterprise [Perotti, 1993a, b].[17] This residual claim is a private return to the bank which new banks

[17] The analysis is thus only valid to the extent that the legal system allows banks to enforce old claims against their customers. Distress lending has also been analyzed for an international context where legal constraints to debt repayment may not exist or, in other words, when debtors are sovereign [Mohr, 1991]. Contracts must therefore incorporate incentives to honour a loan agreement. Mohr shows that a binding sovereignty restriction requires that the costs of debt repudiation for the debtor, measured as the assets that can be confiscated by the creditor, must exceed the costs of debt repayment. Parameter

would not take into account [Hellwig, 1977, p. 1900]. Up to a threshold level of $\hat{X}$ which is defined as the project return which allows the enterprise to cover both, its present interest claims as well as the loss that has been carried forward, the bank has a claim on the firm which exceeds the current claims. Investment of the firm by assumption depends upon the provision of new loans. This is a reasonable assumption considering that the enterprise has not been able to service its debt in the previous period. The enterprise has thus neither retained earnings nor liquidity reserves at its disposal. In other words, the only chance for the old bank to realize its residual claim is to lend to the old firm itself because new banks would not finance the investment project. Analytically, the loss of the previous period that can be recovered per new unit lend is given by the residual claim:

$$[3.3] \qquad \theta = \frac{1}{L} \cdot \int_{(1+r^L)\cdot L}^{\hat{X}} (\hat{X} - X) \cdot \phi(X)\, dX \qquad \text{with} \qquad \hat{X} = -\pi_{-1} + (1+r^L)\cdot L; \;\; \pi_{-1} < 0$$

The bank will therefore invest into old firms if the profit from this investment (π_O) exceeds the return from investing into new firms (π_N):

$$[3.4] \qquad \begin{aligned} & \pi_O > \pi_N \\ & \Leftrightarrow \\ & (1+\mu_O^L+\theta)\cdot L_O - Y(D_O, L_O, \pi_{-1}) + \pi_{-1} - K(D_O, L_O) - \rho \cdot E_O > \\ & (1+\mu_N^L)\cdot L_N - Y(D_N, L_N, \pi_{-1}) + \pi_{-1} - K(D_N, L_N) - \rho \cdot E_N \end{aligned}$$

Because of the different risks embodied in the two investment alternatives, the optimal demand for deposits, and the optimal supply of loans will differ under the two investment alternatives. Investment into old firms implies cet. par. a lower overall level of activity and a larger share of equity relative to deposits. Generally, in order for investment into old firms to yield higher expected profits than investment into new firms, the residual claim θ must outweigh the lower return on the investment into old firms, the higher probability of returns below the critical rate and thus the higher costs of insolvency, and the smaller scale of operations. The effects on the operating costs and on the opportunity costs of holding equity may

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constellations are conceivable under which banks engage in involuntary lending by maintaining a creditor-relationship which is in principle unprofitable. This is the case if the costs of maintaining a creditor-relationship are greater than the costs of terminating it, i.e. of realizing the current loss. In order to obtain this result, it is assumed that the negative returns on international lending are compensated for by positive profits that the bank makes on its domestic activities. In addition, the model does not explain why rational banks enter into a credit relationship in the first place which will turn unprofitable in the long-run.

be assumed just to offset each other. It is therefore the more likely that the bank rolls over loans to old clients

— the larger the loss carried over from the previous period because this raises the residual claim of the bank,
— the smaller variable insolvency costs are because low insolvency costs give the bank an incentive to gamble on high future profits of the firm,
— the smaller the return differential between the two investment alternatives. This can be made more clear if, for simplicity, insolvency costs are set at zero. In this situation, $D_N = D_O; L_N = L_O$ hold and condition [3.4] becomes:

[3.4']
$$\begin{aligned} & \pi_O > \pi_N \Leftrightarrow \\ & (1+\mu_O^L+\theta)\cdot L+\pi_{-1}-K(D,L)-\rho\cdot E > (1+\mu_N^L)\cdot L+\pi_{-1}-K(D,L)-\rho\cdot E \Leftrightarrow \\ & (1+\mu_O^L+\theta)\cdot L-(1+\mu_N^L)\cdot L>0 \quad \Leftrightarrow \\ & (\mu_O^L+\theta-\mu_N^L)>0 \end{aligned}$$

These results have no immediate impact on the effects that increases in the riskiness of new loans and of insolvency costs have on the behavior of banks (flow problem). The bank would still reduce lending and raise interest rates if one of these exogenous variables were to rise. However, the stock of bad debt is an additional exogenous variable to the decision problem of the bank. A greater stock of bad debt has effects on both, the insolvency costs and on the residual claim that the bank has on the enterprise's return. The combined effect of a higher stock of bad debt on the level of lending is thus undetermined: higher insolvency costs would require a reduction in lending, a higher residual claim would lead to an increase in lending. Even if these two effects just offset and, hence, the volume of new lending and the lending rate would be unaffected by the increase in the stock of old debt, the increase in insolvency costs as a response to a higher stock of bad debt requires a restructuring of the liabilities-side of the balance sheet. In the optimum, the bank holds less deposits, which would put downward pressure on the deposit rate. Interest rate spreads would thus rise as a response to an (exogenous) increase in the stock of bad debt.[18] Both, an increase in the stock and in the flow of bad debt, put thus upward pressure on interest rate spreads [Hansson/Sachs, 1994, p. 11]. Provided that insolvency costs are sufficiently high, a rise of either of these exogenous variables induces the bank to reduce lending. If, however, insolvency costs are small, a higher

[18] There are, of course, also other factors that contribute to rising interest rate spreads. The OECD, for example, estimates that in Hungary 40 percent of the observed interest rates spreads are attributable to non-performing loans while 20 percent are caused by the fact that banks have to hold minimum reserves which yield only below-market interest rates [OECD, 1993b, pp. 196].

stock of bad debt may actually increase overall lending as only the positive effects on the residual claim are considered.

Incidentally, the presence of a stock of bad debt strengthens the case against an early market entry of foreign banks. Because foreign banks have no old loans to cover and because they have cost advantages over domestic banks, they can offer intermediary services at lower costs than the incumbent banks. Hence, all new borrowers may be served by the new banks while old banks are left with the stock of their old customers. If the residual claims is too small (or if insolvency costs are too high), market entry of foreign banks may lead to the bankruptcy of domestic banks. Yet, restricting market access implies that efficiency gains are foregone. A superior strategy is thus to recapitalize banks and not to hold managers accountable for past losses which they are not responsible for.

4. CONCLUSIONS

The findings of this paper can be summarized as follows:

— Higher lending risks and/or higher insolvency costs induce banks to lower their volume of lending, to hold more equity, and to increase both, their lending rates as well as their interest rates spreads. These interest rate effects are the smaller the greater the degree of competition in the domestic banking sector and the more open the domestic banking system is to foreign financial competition.

— A larger stock of bad debt on the balance sheets of banks will lead to higher interest rate spreads, and may lead to a reduction of total lending.

— Banks which portfolios are burdened with a stock of non-performing loans will tend to concentrate their lending on their old, state-owned clients and will bias their lending against new, private enterprises. Hence, in the presence of a stock of non-performing loans, market shares will tend to be preserved.

— It has been argued that banks as a consequence of existing customer relations have superior information on enterprises and should thus be assigned an important role in the restructuring of firms [van Wijnbergen, 1992, 1994]. Van Wijnbergen argues that banks having residual claims can provide effective governance to firms, provided that the banks themselves face the right incentives. This effect is not captured by the present model because project returns are exogenous and do not depend on restructuring efforts within the firm. The analysis has shown that banks with existing customer relations have also an incentive to roll over bad loans. Hence, the information potential of banks should only be used if distress lending cannot occur. This can be achieved, for example, by forbidding banks to lend to firms which loans have not been serviced in the past and which are undergoing restructuring.

— The lower the degree of capitalization of the existing state-owned banks, the greater will be the incentives for the central banks to provide low-interest refinancing and to restrict the market entry of foreign banks.

— If depositors are protected by an implicit or explicit deposit insurance, they will demand a lower risk premium, and the deposit supply may not be affected by changes in the perceived riskiness of banks.

Appendix

1. A Model of the Banking Firm[1]

The representative bank maximizes expected profits given by:

[A.1] $E[\pi]=\mu^L(L)\cdot L-\mu^D(D)\cdot D-K(D,L)-Y(D,L,q)-\rho\cdot E$

Stochastic Structure:

The return to lending is a normally distributed random variable with $E[r^L]=\mu^L$, and $\sigma^L(L)$. It is assumed that projects are stochastically independent such that a larger number of projects being financed tends to reduce the overall lending risk through diversification: $\sigma_L^L=-1/2<0$. Non-performing loans are defined as loans with a high default risk. An increase in risk can thus be expressed as an increase of the standards deviation of loan returns by a (multiplicative) shift parameter: $\sigma^L(L,\psi)=\psi\cdot\tilde{\sigma}^L(L) \Rightarrow \sigma_{L,\psi}^L=\tilde{\sigma}_L^L=-1/2$. All loan applicants are identical, information about the loan returns is incomplete but symmetrically distributed among loan applicants and the bank. Investors, in addition, are assumed to be risk neutral such that an increase in project risk has no impact on loan demand.

Cost structure:

(a) Production Costs

The bank has strictly convex, increasing operating costs, depending on the level of loans and deposits that are being produced :

[A.2] $$K=K(D,L)$$
$$K_D,K_L,K_{DD},K_{LL}>0$$

(b) Costs of Insolvency

If the return from lending falls below the critical lending rate $\hat{r}^L$, the bank is insolvent and has to bear insolvency costs. $\hat{r}^L$ can be derived from:

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1 The analysis is based on Baltesperger and Milde [1987] pp. 184-199 and pp. 259-265.

[A.3]

$$(1+r^L)\cdot L - K \;<\; (1+r^D)\cdot D \quad \text{for } r^L < \hat{r}^L$$

$$(1+r^L)\cdot L - K \;\geq\; (1+r^D)\cdot D \quad \text{for } r^L \geq \hat{r}^L$$

$$\Rightarrow \quad \hat{r}^L = \frac{(1+r^D)\cdot D + K - L}{L}$$

$$\Leftrightarrow \quad \hat{r}^L = \frac{1}{L}\cdot\left[D + \mu^D \cdot D + Y\cdot\frac{1+\eta}{\eta} + K - L\right]$$

$$\hat{\tau} = \frac{\hat{r}^L - \mu^L}{\sigma^L}$$

The costs of insolvency can be expressed as

[A.4] $$Y = Y(D,L) = \eta\cdot L\cdot\sigma^L\cdot\int_{-\infty}^{\hat{\tau}}(\hat{\tau}-\tau)\,h(\tau)\,d\tau$$

(c) Interest Costs

The expected deposit rate differs from the contractual rate to the extent that, in the case of insolvency, depositors do not receive full contractual interest payments:

[A.5] $$D_{+1} = \begin{cases}(1+r^L)\cdot L - K - \eta\cdot L\cdot(\hat{r}^L - r^L) & \text{for } \hat{r}^L > r^L \\ (1+r^D)\cdot D & \text{for } \hat{r}^L > r^L\end{cases}$$

The expected end-period value of the deposits is thus given by:

[A.5'] $$E[D_{+1}] = (1+r^D)\cdot D - L\cdot\int_{-\infty}^{\hat{r}^L}(\hat{r}^L - r^L)\,b(r^L)\,dr^L - Y(L,D) \;\equiv\; (1+\mu^D)D$$

$$\Leftrightarrow \quad (1+\mu^D)\cdot D = (1+r^D)\cdot D - \frac{Y(L,D)}{\eta} - Y(L,D)$$

The expected and the contractual deposit rate do thus differ in the presence of insolvency costs. If information is symmetrically distributed between depositors and the bank, depositors demand a risk premium by the amount of:

[A.6] $$r_D - \mu_D = \frac{Y\cdot(1+\eta)}{\eta\cdot D} > 0$$

Substitute r^D into $\hat{r}^L$ to get

$$[A.3'] \qquad \hat{r}^L = \frac{D + \frac{Y(D,L)\cdot(1+\eta)}{\eta} + \mu^D(D)\cdot D - K - L}{L}$$

and

$$\frac{\partial \hat{r}_L}{\partial D} = \frac{1}{L}\cdot\left[1 + Y_D\cdot\left(\frac{1+\eta}{\eta}\right) + \mu_D^D\cdot D + \mu^D + K_D\right] = \frac{1}{L}\cdot\left[1 + Y_D\cdot\left(\frac{1+\eta}{\eta}\right) + \mu^D\cdot\left(1 + \frac{1}{\varepsilon(D,\mu^D)}\right) + K_D\right],$$

i.e. the critical lending rate rises or falls with D if $Y_D > 0$. We can use this result to derive the impact of changes in D on Y:

$$[A.7] \qquad \begin{aligned} \frac{\partial Y}{\partial D} \equiv Y_D &= Y_{\hat{r}}\cdot\hat{r}_{\hat{r}_L}\cdot\hat{r}_{L,D} = \eta\cdot L\cdot\sigma^L\cdot H(\hat{\tau})\cdot\frac{1}{\sigma^L}\cdot\hat{r}_{L,D} \\ &= \eta\cdot L\cdot\sigma^L\cdot H(\hat{\tau})\cdot\frac{1}{\sigma^L}\cdot\frac{1}{L}\cdot\left[1 + Y_D\cdot\left(\frac{1+\eta}{\eta}\right) + \mu^D\cdot\left(1 + \frac{1}{\varepsilon(D,\mu^D)}\right) + K_D\right] \end{aligned}$$

$$\Rightarrow \quad Y_D = \frac{\eta\cdot H(\hat{\tau})\cdot\left[1 + \mu^D\cdot\left(1 + \frac{1}{\varepsilon(D,\mu^D)}\right) + K_D\right]}{1 - (1+\eta)\cdot H(\hat{\tau})}$$

such that $Y_D > 0$ if $1-(1+\eta)\cdot H(\hat{\tau}) > 0$, i.e. the probability of bankruptcy H must be sufficiently small as compared to the costs of bankruptcy. The same condition holds for $Y_{DD} > 0$ and $Y_{D\eta} > 0$.

The critical lending rate rises when the variable insolvency costs rise provided that insolvency costs and the lending volume are sufficiently large (i.e. if the denominator of the fraction if positive):

$$\frac{\partial \hat{r}}{\partial \eta} = \frac{\partial\left[\frac{Y + Y\cdot\eta}{\eta\cdot L}\right]}{\partial \eta} = \frac{Y}{L\cdot\eta - (1+\eta)\cdot b(\hat{r})}$$

We can thus derive the response of Y with respect to changes in L:

[A.8] $$Y_L = \eta \cdot \sigma^L \cdot \int_{-\infty}^{\hat{\tau}} (\hat{\tau} - \tau) h(\tau) d\tau + \eta \cdot L \cdot \sigma_L{}^L \cdot \int_{-\infty}^{\hat{\tau}} (\hat{\tau} - \tau) h(\tau) d\tau + Y_{\hat{\tau}} \hat{\tau}_\sigma \sigma_L^L + Y_{\hat{\tau}} \hat{\tau}_{\hat{r}_L} \hat{r}_{L,L}$$

After some transformations and upon noting that $\sigma_L^L = -1/2$ one obtains

[A.8'] $$Y_L = \left[1 + \varepsilon(\sigma^L, L)\right] \frac{Y}{L} + Y_{\hat{\tau}} \cdot \hat{\tau}_\sigma \cdot \sigma_L^L + Y_{\hat{\tau}} \cdot \hat{\tau}_{\hat{r}} \cdot \hat{r}_L$$

$$\text{with} \quad Y_{\hat{\tau}} = \eta \cdot L \cdot \sigma^L \cdot H(\hat{\tau}) > 0$$

where the first term is positive and the second term may be positive or negative. In the following, direct effects are assumed to dominate indirect effects such that $Y_L > 0$ holds. The positive reaction of insolvency costs with respect to changes in L can be explained by the fact that the diversification effects does lower the variance of r but that the variance of r·L increases.

2. Monopoly

The monopolistic bank has both quantities and prices as endogenous variables to its maximization problem. Price elasticities of loan demand and deposit supply are given by:

[A.9] $$\varepsilon(L, \mu^L) < 0$$

$$\varepsilon(D, \mu^D) > 0$$

In order to derive the optimal policy mix for the monopolistic bank, we re-write [A.1]. In order to take account of the structure of the liabilities' side of the bank's balance sheet where D = L·β and E = L - L·β = L·(1-β) such that

[A.10] $$K_\beta = K_D \cdot D_\beta = K_D \cdot L$$

$$Y_\beta = Y_D \cdot D_\beta = Y_D \cdot L$$

$$K^{d\beta=0} = K_L^{dD=0} + K_D \cdot D_L = K_L^{dD=0} + K_D \cdot \beta$$

[A.1] thus becomes

[A.1'] $$E[\pi] = \mu^L(L) \cdot L - \mu^D(D) \cdot (L \cdot \beta) - K(L, \beta) - Y(L, \beta) - \rho \cdot (L - \beta \cdot L)$$

The bank's control variables are β and L, i.e. the first order conditions for a profit maximum are

$$E[\pi]_{\beta} = -\mu^{D} \cdot \left[1 + \frac{1}{\varepsilon(D^{s}, \mu^{D})}\right] - K_{\beta} - Y_{\beta} + \rho \cdot L \quad = 0$$

[A.11]

$$E[\pi]_{L} = \mu^{L} \cdot \left[1 + \frac{1}{\varepsilon(L^{D}, \mu^{L})}\right] - \mu^{D} \cdot \beta \cdot \left[1 + \frac{1}{\varepsilon(D^{S}, \mu^{D})}\right] - K_{L} - Y_{L} - \rho \cdot (1-\beta) = 0$$

The endogenous interest rates do not appear as control variables of the bank, they are rather determined by substituting the optimal values for D and L into the respective demand and supply functions. These results imply that in the profit maximum the marginal costs of raising β, or of raising D at a given level of Y, must equal the marginal benefit of doing so, i.e. of reducing the costs of holding equity. Lending activity is optimal when the marginal return on lending one unit more equals the marginal cost of raising new deposits and new equity, both weighted by their respective shares, plus the marginal operating and bankruptcy costs. The second order conditions are derived under the assumption that $E[\pi]_{\beta L} = 0$, i.e. that structure and scale of the bank's operations can be determined independently.

[A.12]

$$E[\pi]_{\beta\beta} = -K_{\beta\beta} - Y_{\beta\beta} \quad < \quad 0$$

$$E[\pi]_{LL} = -K_{LL} - Y_{LL} \quad < \quad 0$$

$$E[\pi]_{qq} = -Y_{qq} = -\frac{Y_{q} \cdot \sigma_{q}/\sigma}{1 - H(\hat{\tau}) \cdot (1+\eta)} \quad < \quad 0$$

$$|D_{1}| = E[\pi]_{\beta\beta} < 0$$

$$|D_{2}| = E[\pi]_{\beta\beta} \cdot \left[E[\pi]_{LL} \cdot E[\pi]_{qq} - E[\pi]_{qL} \cdot E[\pi_{Lq}]\right] < 0$$

$$|D_{3}| = E[\pi]_{\beta\beta} \cdot E[\pi]_{LL} > 0$$

The first conditions shows that corner solutions can be ruled out if the probability of insolvency is sufficiently small or if the costs of insolvency are not very high, respectively $[1/(1+\eta) > H(\hat{\tau})]$.

Comparative Statics:

The exogenous variables to the bank's maximization problem are the costs of capital ρ, the bankruptcy costs η and the probability of bankruptcy H(τ). Note that due to the fact that H measures the area under the probability distribution of the credit returns, a higher probability of bankruptcy can have two causes: (i) a shift in the expected value of r, keeping the standard deviation constant or (ii) a higher standards deviation or a tilt of the probability distribution towards the left. Here, *mean preserving spreads* are assumed: all projects have the same mean

returns but differ in their bankruptcy probabilities or risk characteristics, respectively. If $H_2 > H_1$, project 2 is more risky and induces a greater probability of bankruptcy.

$$\int_{-\infty}^{+\infty} E[\pi]\, h_1(\tau)\, d\tau = \int_{-\infty}^{+\infty} E[\pi]\, h_2(\tau)\, d\tau$$

$$\int_{-\infty}^{\hat{\tau}} h_2(\tau) \geq \int_{-\infty}^{\hat{\tau}} h_1(\tau)$$

Changes in the costs of equity:

$$\varepsilon(\beta^*,\rho) = -\frac{E[\pi]_{\beta\rho}}{E[\pi]_{\beta\beta}} \cdot \frac{\rho}{\beta} = -\frac{L}{-K_{\beta\beta} - Y_{\beta\beta}} \cdot \frac{\rho}{\beta} > 0$$

$$\varepsilon(L^*,\rho) = -\frac{E[\pi]_{L\rho}}{E[\pi]_{LL}} \cdot \frac{\rho}{L} = -\frac{-(1-\beta)}{-K_{LL} - Y_{LL}} \cdot \frac{\rho}{L} < 0$$

$$\Rightarrow \varepsilon(D^*,\rho) \gtrless 0, \qquad \varepsilon(E^*,\rho) < 0$$

Changes in the variable insolvency costs:

$$\varepsilon(\beta^*,\eta) = -\frac{E[\pi]_{\beta\eta}}{E[\pi]_{\beta\beta}} \cdot \frac{\eta}{\beta} = -\frac{-Y_{\beta\eta}}{-K_{\beta\beta} - Y_{\beta\beta}} \cdot \frac{\eta}{\beta} < 0$$

$$\varepsilon(L^*,\eta) = -\frac{E[\pi]_{L\eta}}{E[\pi]_{LL}} \cdot \frac{\eta}{L} = -\frac{-Y_{L\eta}}{-K_{LL} - Y_{LL}} \cdot \frac{\eta}{L} < 0$$

For these results to hold it is required that the critical lending rate increases when insolvency costs rise and that the direct effects exceed the (negative) indirect terms in brackets in:

$$Y_{L\eta} = \left[1 + \varepsilon(\sigma^L, L)\right] \cdot \sigma^L \cdot \int_{-\infty}^{\hat{\tau}} (\hat{\tau} - \tau) h(\tau) d\tau + Y_{\hat{\tau}\eta}(\hat{\tau}_\sigma \cdot \sigma_L^L + \hat{\tau}_{\hat{r}} \cdot \hat{r}_L)$$

Changes in the standard deviation (shift parameter):

$$\varepsilon(\beta^*,\psi) = -\frac{E[\pi]_{\beta\psi}}{E[\pi]_{\beta\beta}} \cdot \frac{\psi}{\beta} = -\frac{-Y_{\beta\psi}}{-K_{\beta\beta} - Y_{\beta\beta}} \cdot \frac{\psi}{\beta} < 0; \qquad Y_{D\eta}, Y_{\beta\eta} > 0$$

$$\varepsilon(L^*,\psi) = -\frac{E[\pi]_{L\psi}}{E[\pi]_{LL}} \cdot \frac{\psi}{L} = -\frac{-Y_{L\psi}}{-K_{LL} - Y_{LL}} \cdot \frac{\psi}{L} < 0$$

where

$$Y_{L\psi} = \left[1 + \varepsilon(\tilde{\sigma}, L)\right] \cdot \frac{Y}{\psi} \cdot \frac{1}{L} + Y_{\hat{\tau}\psi} \cdot \left(-\frac{\hat{\tau}}{\tilde{\sigma}}\right) \cdot \tilde{\sigma}_L^L + Y_{\hat{\tau}_{\tilde{\psi}}} \cdot \frac{1}{\tilde{\sigma} \cdot \psi} \cdot \hat{r}_L + Y_{\hat{\tau}} \cdot (-1) \cdot \frac{1}{\tilde{\sigma} \cdot \psi^2} \cdot \hat{r}_L > 0$$

while the first and the last effect are positive, the second and the third effect are negative. Again, upon assuming that direct dominate indirect effects (the latter being determined by induced changes of the critical lending rate), the combined effects is positive. Similarly, Balten-

sperger and Milde [1987, p. 198] show that $Y_{D\psi} > 0 \Rightarrow Y_{\beta\psi} > 0$. In all cases, the effects on the interest rates are derived simply by substituting into the respective supply and demand functions (Table 1).

3. Oligopoly

The above model is extended to an oligopolistic model with a number of n identical banks where total supply and demand of loans and deposits, respectively, are given by:

[A.13] $$\sum_{i=1}^{n} L_i = L; \qquad \sum_{i=1}^{n} D_i = D$$

Simple linear loan demand and deposit supply functions are introduced such that loan demand and deposit supply can be written as

[A.9'] $$L = a - b \cdot \mu^L; \qquad D = c + d \cdot \mu^D.$$

Assuming Cournot-type competition, bank i maximizes its profits under the assumption that loan supply and deposit demand of all other banks are given.

[A.1''] $$E\left[\pi_i \middle| \pi_j; j \neq i\right] = \mu^L \cdot L_i - \mu^D \cdot D_i - K_i(D_i, L_i) - Y_i(D_i, L_i) - \rho \cdot (L_i - D_i)$$

Hence, the first order conditions for a profit maximum of bank i become:

[A.11'']

$$E[\pi_i]_{L_i} = \frac{\partial \mu_L}{\partial L} \cdot \frac{\partial L}{\partial L_i} \cdot L_i + \mu_L - K_L - Y_L - \rho = 0$$

$$E[\pi_i]_{D_i} = -\frac{\partial \mu_D}{\partial D} \cdot \frac{\partial D}{\partial D_i} \cdot D_i - \mu_D - K_D - Y_D + \rho = 0$$

or

$$E[\pi_i]_{L_i} = \frac{\partial \mu_L}{\partial L} \cdot \frac{\partial L}{\partial L_i} \cdot L_i + \mu_L - \frac{\partial \mu^D}{\partial D} \cdot \frac{\partial D}{\partial D_i} \cdot \frac{\partial D_i}{\partial L_i} \cdot L_i \cdot \beta_i - \mu^D \cdot \beta - K_L - Y_L - (1-\beta) \cdot \rho = 0$$

$$E[\pi_i]_{\beta_i} = -\frac{\partial \mu^D}{\partial D} \cdot \frac{\partial D}{\partial D_i} \cdot L_i \cdot \beta_i - \mu^D \cdot L_i - K_\beta - Y_\beta + \rho \cdot L_i = 0$$

Where K_L, Y_L denote the partial derivatives of the bank i's cost functions with respect to the bank's output. Because all banks are assumed to have identical cost structures, bank-specific indices can be omitted. Transformation of these conditions gives the optimal balance sheet structure and loan supply of each banks as a function of the total number of competitors in the market:

[A.14]

$$L_i^* = -\frac{b}{1+n}\left[K_L + Y_L + \rho - \frac{a}{b}\right]; \qquad \frac{\partial L_i^*}{\partial n} = -\frac{n \cdot L_i^*}{(1+n)} < 0$$

$$= -\frac{b}{1+n} \cdot \left[K_L + Y_L + \rho \cdot (1-\beta) + \mu^D \cdot \beta \cdot \left(1 + \frac{1}{\varepsilon(D^S, \mu^D)}\right) - \frac{a}{b}\right]$$

$$\beta_i^* = -\frac{d}{(1+n) \cdot L_i^2}\left[K_\beta + Y_\beta - \rho \cdot L_i - \frac{c}{d} \cdot L_i\right]$$

$$D_i^* = -\frac{d}{1+n}\left[K_D + Y_D - \rho - \frac{c}{d}\right] = \beta_i^* \cdot L_i^*; \qquad \frac{\partial D_i^*}{\partial n} = -\frac{n \cdot D_i^*}{(1+n)} < 0$$

Because condition [A.14] is the same for all banks, $L = n \cdot L_i$ and $D = n \cdot D_i$ as well as [A.9'] can be used to obtain the optimal total loan supply and deposit demand as a function of n:

[A.14']

$$L^* = -b \cdot \frac{n}{1+n} \cdot \left[K_L + Y_L + \rho - \frac{a}{b}\right]; \qquad \frac{\partial L^*}{\partial n} = \frac{L^*}{n(1+n)} > 0$$

$$D^* = -d \cdot \frac{n}{1+n} \cdot \left[K_D + Y_D - \rho - \frac{c}{d}\right]; \qquad \frac{\partial D^*}{\partial n} = \frac{D^*}{n(1+n)} > 0$$

Both quantities are positive if costs are sufficiently small, i.e. if the terms in brackets are negative. It can easily be shown that aggregate loan supply and deposit demand increase with the number of competitors, and thus that lending rates decrease while deposit rates increase with n. Hence, greater competition puts pressure on interest rate spreads.

The comparative static analysis of this model yields qualitatively the same results as in the monopoly case above, only the intensity of the reaction differ. The larger the number of competitors, the smaller will be the reactions of each individual competitor, but the larger will be the reactions of total output. Hence, total output in the oligopoly case reacts by more than monopoly output to changes in exogenous variables. If, for example, insolvency costs rise, loan supply and deposit demand are reduced by more than in the monopoly case. Therefore,

changes in interest rate spreads, not their absolute levels, are greater than in the monopoly situation.

4. Duopoloy

So far, it has been assumed that all banks have identical cost structures. The effects of different cost structures on the market share of an individual bank can be shown in a duopoly-model. In such a situation, each bank maximizes its expected profits under the assumption that its competitor has already chosen its optimal input-output-structure. Hence, total loan supply and deposit demand become:

[A.13'] $$L = L_1 + L_2 \qquad D = D_1 + D_2$$

and the profit function of bank 1 is given by

[A.1'''] $$E[\pi_1|\pi_2] = \mu^L(L_1,L_2)\cdot L_1 - \mu^D(D_1,D_2)\cdot D_1 - K_1(D_1,L_1) - Y_1(D_1,L_1) - \rho\cdot(L_1 - D_1)$$

Note that the cost functions are now indexed, allowing for different cost structures. The first order conditions for a profit maximum of bank 1 are given by

[A.11'''] $$\frac{\partial E[\pi_1]}{\partial L_1} = \frac{\partial \mu^L}{\partial L_1}\cdot L_1 + \mu_L - K_{1,L} - Y_{1,L} - \rho = 0$$
$$\frac{\partial E[\pi_1]}{\partial D_1} = -\frac{\partial \mu^D}{\partial D_1}\cdot D_1 - \mu_D - K_{1,D} - Y_{1,D} + \rho = 0$$

By substituting [A.9'] and transforming [A.11'''], the reaction functions of bank i can be written as

[A.14] $$L_i^*(L_j) = -\frac{b}{2}\cdot\left(Y_{i,L} + K_{i,L} + \rho - \frac{a}{b} + \frac{L_j}{b}\right); \qquad i \neq j$$
$$D_i^*(D_j) = -\frac{d}{2}\cdot\left(Y_{i,D} + K_{i,D} - \rho - \frac{c}{d} + \frac{D_j}{d}\right); \qquad i \neq j$$

The optimal loan supply and deposit demand of each bank are given by the intersection of these functions and depend on the relative cost structures of the banks, i.e.

[A.15]

$$L_i^*(L_j^*) = \frac{1}{3} \cdot b \cdot \left(Y_{j,L} + K_{j,L} + \rho - \frac{a}{b} \right) - \frac{2}{3} \cdot b \cdot \left(Y_{i,L} + K_{i,L} \right); \qquad i \neq j$$

$$D_i^*(D_j^*) = \frac{1}{3} \cdot d \cdot \left(Y_{j,D} + K_{j,D} + \rho + \frac{c}{d} \right) - \frac{2}{3} \cdot d \cdot \left(Y_{i,D} + K_{i,D} \right); \qquad i \neq j$$

where $K_{i,L}, L_{i,L}$ denote the partial derivatives of bank i's cost functions with respect to the bank's output. Loan supply of bank 1 thus expands if the marginal costs of bank 2 rise and decreases if its own costs increase, albeit with different intensities (and vice versa). After calculating the total supply of loans by summing up the individual amounts of each bank, market shares can be calculated. It can be shown that the market share of a bank decreases if its costs increase relative to that of its competitor, for example:

[A.16]

$$\frac{\partial \left(\frac{L_1^*}{L^*} \right)}{\partial K_{1,L}} = 2 \cdot b \cdot \frac{L_1^* - L^*}{L^{*2}} - \frac{L_1^*}{L^{*2}} < 0$$

List of References

Baltensperger, Ernst, and Hellmuth Milde [1987], Theorie des Bankverhaltens, Berlin.

Begg, David, and Richard Portes [1993], Enterprise Debt and Economic Transformation: Financial Restructuring in Central and Eastern Europe, in: Mayer, Colin, and Xavier Vives, (eds.) Capital markets and financial intermediation, Cambridge, 230-254.

Blejer, Mario, and Silvia Sagari [1987], The Structure of the Banking Sector and the Sequence of Financial Liberalization, in: Connolly, Michael, and Claudio González-Vega, Economic Reform and Stabilization in Latin America, New York, 93-107.

Buch, Claudia M. [1995], Monetary Policy and the Transformation of the Banking System in Eastern Europe, Institute of World Economics, Working Paper, No. 676, Kiel.

Corsepius, Uwe [1989], Kapitalmarktreformen in Entwicklungsländern - Eine Analyse am Beispiel Perus, Institut für Weltwirtschaft, Kieler Studien, No. 225, Tübingen.

Dermine, Jean [1986], Deposit Rates, Credit Rates and Bank Capital - The Klein-Monti Model Revisited, Journal of Banking and Finance 10, 99-114.

Dewatripont, Mathias, and Jean Tirole [1993], Efficient governance structure: implications for banking regulation, in: Mayer, Colin, and Xavier Vives (eds.), Capital markets and financial intermediation, Cambridge University Press, 12-34.

Diamond, Douglas, W. [1984], Financial Intermediation and Delegated Monitoring, Review of Economic Studies, 393-414.

Greenwald, Bruce, and Joseph E. Stiglitz [1991], Towards A Reformulation of Monetary Theory: Competitive Banking, The Economic and Social Review 23, 1-34.

Hancock, Diana [1991], A theory of production for the financial firm, Boston.

Hellwig, Martin [1977], A Model of Borrowing and Lending with Bankruptcy, Econometrica, Vol. 45, No. 8 (November), 1879-1906.

Mohr, Ernst [1991], Economic Theory and Sovereign International Debt, London.

Nakamura, Leonard I. [1989], Loan Workouts and Commercial Bank Information: Why Banks are Special, Federal Reserve Bank of Philadelphia, Working Paper No. 89-11, Philadelphia.

Organisation for Economic Cooperation and Development (OECD) [1993a], Transformation of the Banking System: Portfolio Restructuring, Privatisation and the Pament System, Paris.

— [1993b], Economic Surveys – Hungary, Paris.

— [1994], Economic Surveys - Poland, Paris.

Perotti, Enrico C. [1993a], Bank lending in transition economies, Journal of Banking and Finance, Vol. 17, 1021-1032.

— [1993b], Eastern European Financial Systems: The Creation of Inside Money, Boston University and Central European University, November, mimeo.

Saunders, Anthony, Elizabet Strock, and Nickolaos G. Travlos [1990], Ownership structure, deregulation, and bank risk taking, The journal of finance, Vol. 45, No. 2, 643-654.

Shrieves, Ronald E., and Andrew Dahl [1992], The relationship between risk and capital in commercial banks, Journal of Banking and Finance 16, 439-457.

Siebert, Horst, und Ngo van Long [1991], A model of the socialist firm in transition to a market economy, Institute of World Economics, Working Papers, No. 479, Kiel.

Tirole, Jean [1994], On banking and intermediation, European Economic Review, No. 38, 469-487.

van Wijnbergen, Sweder [1992], Enterprise Reform in Eastern Europe, CEPR Discussion Paper No. 738, November 1992, London.

— [1994], On the Role of Banks in Enterprise Restructuring: The Polish Example, Centre for Economic Policy Research, Working Paper, No. 898, February, London.