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Insolvency costs and incomplete information in commercial banks: Implications for financial reform in Eastern Europe

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**Insolvency Costs and Incomplete Information
in Commercial Banks**

— Implications for Financial Reform in Eastern Europe —

Claudia M. Buch

February 1994



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— Implications for Financial Reform in Eastern Europe —

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LIST OF VARIABLES¹

L	Loans
D	Deposits
E	Bank's equity
$\beta, (1-\beta)$	Deposit (equity) share
r^L	Lending rate
$E[r^L] = \mu^L$	Expected return on lending
τ	Standardized return on lending
σ_L^r	Standard deviation of lending rate
$H(\tau)$	Density function of lending rate
r^D	Deposit rate
μ^D	Expected deposit rate
ρ	Cost of capital
z	Units of input factor
w	Costs per unit of input factor
K	Production costs
Y	Total bankruptcy costs
η	Variable bankruptcy cost
$E[\pi]$	Expected profit of the bank
P	Average profit of the bank
ϵ	Elasticity
X^a	Gross return on investment
I	Investment size
p	Probability of success
q, (1-q)	Population share of type-1 (type-2) enterprises
W	Initial endowment
ES	Equity-share of enterprise
$V = u(\dots)$	Enterprise's utility
R	Loan size
C	Collateral
π	Probability of receiving loan
m	Number of potential credit customers
n	Number of depositors
λ	Share of correctly classified customers

¹ Relates to section IV only.

I. INTRODUCTION

The development of financial markets in the emerging market economies of Eastern Europe is considered one of the crucial elements of the overall reform process. Under central planning, banks used to be passive recipients of orders from the planners; they did not engage in any credit screening activity. At the same time, financial intermediaries have the potential to assume an important role in the transformation process from plan to market. They could gather information on enterprises, sort out profitable investment opportunities, finance these projects, and monitor the appropriate utilization of the invested funds. However, an efficient process of financial intermediation is currently being hampered by at least two factors. First, the balance sheets of many banks are loaded with non-performing loans. The presence of these loans exposes banks to a high risk of insolvency. Secondly, there is evidence that credit markets are segmented due to informational asymmetries. In particular, new private enterprises seem to have difficulties in obtaining external finance.

The purpose of this paper is to present a framework which suits to analyze the effects of these obstacles to an efficient process of financial intermediation. The major conclusions can be summarized as follows. If banks have positive costs of insolvency, they will reduce lending and raise interest rates as the share of non-performing loans on their balance sheets increases. However, in the presence of incomplete information on borrowers, banks may choose to ration credit rather than to adjust interest rates upwards. More specifically, asymmetric information can give a rationale for private enterprises being credit rationed. Because of the lack of collateral in private firms, which might serve as a sorting device, investment information by the banks should be given priority.

The paper starts by giving an overview over some stylized facts of Eastern European financial markets (part two). In the third part, the financial liberalization literature is briefly reviewed. After that, a microeconomic framework of the behavior of banks is presented. At the end of the paper, the main findings are summarized.

II. STYLIZED FACTS

This part summarizes empirical evidence on the behavior of real credit to enterprises, credit availability to private enterprises, non-performing loans on the balance sheets of banks, and real interest rates.² Former Czechoslovakia, Hungary, and Poland were selected as representative countries because of the body of experience they can provide as early reformers. The analysis covers the time period from 1989 onwards.

1. Domestic Credit

Following the liberalization of prices and the introduction of monetary stabilization programs, the stock of real credit dropped substantially in all three countries [Table 1].³ Between 1988 and 1992 real credit fell by 44 percent in Hungary⁴ and by 40 percent in Poland. In former Czechoslovakia, the reduction of real credit balances amounted only to 15 percent. Apart from the different degree to which real credit balances were eroded, the decline of credit displayed different patterns over time. In Poland, real credit fell by 9 percent in 1989 but the bulk of the adjustment took place in 1990 (-52 percent). Real credit rose in 1991 (+ 16 percent) and 1992 (+ 18 percent). In the first half of 1993, real domestic credit stayed virtually constant. In Hungary, real credit developed in a rather different pattern. It remained almost constant in 1989 but dropped throughout the entire period between 1990 and 1993 (mid-year) with the greatest contraction in 1991 (- 20 percent). In former Czechoslovakia, the temporal pattern of change was, again, quite different. Here, real domestic credit increased in 1989 by 11 percent, stayed virtually unchanged in 1990 and dropped by one fourth in 1991 due to the liberalization of prices in this year. 1992 saw a slight recovery of 3 percent.

2 Other indicators, focusing on institutional and legislative aspects of the respective banking systems, were described in Buch [1993a, b].

3 Nominal values were deflated by consumer price indices. For Hungary and Poland, this overstates the true amount of credit contraction as between 1989 and 1992 consumer prices rose faster than industrial producer prices. In former Czechoslovakia, the two price indices moved in a rather parallel fashion [Estrin et al., 1993, pp. 27].

4 Hungarian data for 1992 covers only the first three quarters of the year.

Table 1 — Development of Money, Credit, and Prices*, 1989 — 1993(1-6).

	1989	1990	1991	1992	1993 (1-6)
<u>CSFR^a</u>					
CPI	1	10	58	11	...
Domestic Credit	12	9	18	14	4
Private Sector	...	4923 ^b	893	433	111
State Sector ^c	-2	0,3	20	16	5
M2	5	-1	27	20	...
<u>Hungary</u>					
CPI	17	29	34	23	11
Domestic Credit ^d	16	11	8	15	6
Private Sector	...	132	51	24	-5
State Sector ^c	...	26	16	-1	-6
M2	15	29	28	26	3
<u>Poland</u>					
CPI	251	586	70	43	17
Domestic Credit	221	194	98	91	20
Private Sector	80	765	169	49	23
State Sector ^c	206	230	44	12	6
M2	515	166	45	43	13

*) nominal changes in percent per period. — ^a Data for 1993 covers only the Czech Republic. — ^b March-December 1990. — ^c CSFR: Credit to state-owned enterprises; Hungary: Credit to large firms; Poland: Credit to state-owned enterprises and co-operatives. — ^d 1992 and 1993 = credit liabilities of non-financial sector.

Source: IMF, NBH, NBP, PlanEcon, SBC; own calculations.

Essentially, the decline of real credit reflected a necessary reduction of a debt overhang which had been accumulated under central planning.⁵ A contraction of money supply, measured by the change in M2, cannot generally be held responsible for this decline. Only in

⁵ Bennett/Schadler [1992, p. 3] define such a debt overhang as *the excess of the present value of interest payments due on debt over the present value of prospective enterprise profits and primary surpluses of the government.*

Poland did credit growth generally exceed that of the money stock. In Hungary, between 1990 and 1992, money supply expanded more rapidly than the volume of credit; in former Czechoslovakia, this was the case in 1991 and 1992. A contraction of real credit after the initial price adjustments had taken place might therefore be the result of structural deficiencies of the financial systems. In particular, uncertainty over the future of enterprises, a lack of information, and insufficient credit assessment skills of bankers may have caused a reluctance to lend.⁶ The different patterns of credit development over time may thus be the result of national policies which supported a risk-oriented lending behavior of banks.

As the uncertainty over the performance of new, private enterprises is in particular large, access to bank credit may have been more difficult for these firms than for existing enterprises [OECD, 1993, p. 16]. However, information on the credit that has been allocated to new, private sector enterprises is scarce and mostly anecdotal. National statistics either do not explicitly differentiate between private and state-owned enterprises or use non-uniform definitions across countries. Moreover, data on credit to the private sector does not differentiate between newly emerging private enterprises and privatized firms. Yet, privatized firms because of their well established relations to banks should have easier access to credit than new, private firms.

Based on survey data, Swan and Webster [1993] and Webster [1993a, b] show for 1991 that new, private enterprises faced in fact obstacles to obtaining bank finance in Poland and Hungary. In former Czechoslovakia, in contrast, did private enterprises not seem to have been credit rationed to a significant extent. Available statistical information on the respective countries confirms this tendency. In former Czechoslovakia, credit to the private sector virtually exploded during the 1990-1992-period while credit to the state sector almost stagnated in 1989-1990 and rose in 1991-1992 by only 18 percent annually on average. As a result, the share of private sector credit in total credit increased from virtually zero at the beginning of reforms to 22 percent in 1992. In the Czech Republic, this tendency strengthened even further, and the private sector held a share of two-thirds in total credit in September 1993.⁷ In Hungary, the share of private sector credit increased somewhat more modestly from 3.8 percent in 1989 to 10.3 percent in 1992. In Poland, did the share of private enterprises in total

⁶ Another explanation for the decline of real credit is that credit ceilings may have prohibited banks from lending more. However, while credit ceilings were not even binding in former Czechoslovakia, Polish banks have obviously not followed the guidelines set by their central bank [Schmieding/Buch, 1992].

⁷ This sharp increase is also a result of the progress that has been made with privatizing state-owned firms because the first round of the voucher privatization program was completed in 1993.

bank credit rise from 5.4 percent in 1989 to 33.5 percent in 1991 and to 35.51 percent in 1992.

Generally, growth of credit to the private sector clearly exceeded growth of credit to the state sector. However, comparing the private sector share in total credit to the share in production and employment [Table 2], it is obvious that the share in credit underrates this sector's contribution to the overall production in the Hungarian and the Polish economies.

Table 2 — Share of Private Sector in Credit, GDP, and Employment, 1989 — 1992.

		1989	1990	1991	1992
<u>CSFR</u>	Share of private sector in ..				
	Credit	...	0.05	4.8	22.2
	GDP	4.1	5.2	9.3	20.0
	Employment	1.2	6.4	16.4	...
<u>Hungary</u>	Credit	...	6.89	8	10.31
	GDP ^a	...	10	27	35
		(13)	(13.6)	(16)	(25)
	Employment	33
<u>Poland</u>	Credit	5.4	13.1	33.5	35.5
	GDP ^b	28.6	30.9	42.1	45-50
	Employment	44.3	45.8	51.1	57

^a Upper value gives estimate of Hungarian Ministry of Finance, lower value estimate of United Nations Economic Council for Europe. — ^b Including co-operatives. — ^c Estimate.

Source: Statistical Reports of National Banks, EBRD, IMF; own calculations.

2. Non-Performing Loans

A high share of non-performing loans on the balance sheets of Eastern European banks may be one explanation for the reluctance of banks to lend out more funds. Again, systematic evidence on the extent of non-performing loans on the balance sheets is not available. The most comprehensive assessment of the size of the bad loan problem was made by the OECD [1993]. According to this estimate, the amount of bad debt as a percentage of total

loans is highest in Poland (32 percent) and lowest in former Czechoslovakia (11-15 percent) [Table 3]. Especially in Poland, where high inflation rates eroded the real value of loans from the past, non-performing loans are primarily a result of unsound lending practices. In both countries, the share of bad debt on the balance sheets of banks has grown substantially from 16 percent in 1991 and 2.6 percent in 1990, respectively. In Hungary, non-performing loans increased sharply between 1991 and 1992 to from 7 to 38 percent of total bank credits. However, in March 1993, this ratio was down to 30 percent as a result of a debt consolidation scheme, which will be described below. In both, former Czechoslovakia and Hungary, do the low initial shares of non-performing loans probably misrepresent the true size of the problem. Disclosure rules at that time did not force banks to assess and declare credit risk.

The three reform countries tried to solve the problem of non-performing loans by various policy measures although none of the countries implemented a broad and encompassing program favored by many academics. Such a program would have consisted of a write-off of loans, a recapitalization of banks with interest-bearing government bonds, and the subsequent privatization of banks [Begg/Portes, 1992; Hinds, 1990; Schmieding/Buch, 1992].⁸ Out of the three countries, former Czechoslovakia tackled the problem first and most comprehensively by transferring non-performing loans to a newly established Consolidation Bank. Covered by this program were so called Perpetual Inventory Credits which had under central planning been granted at low interest rates. In exchange for these credits, banks were recapitalized by government bonds. Enterprises were not relieved off their debt. Instead, the Consolidation Bank tries to recoup the credits from the enterprises. Hungary at first tried to let its banks grow out of the bad debt problem. Banks which were incurring large profits should use these to write off non-performing loans. In March 1993, however, Hungary implemented a debt consolidation scheme. According to this scheme, two-thirds of all non-performing loans can be sold to a state-owned fund at a price of about 80 percent of the loans' face value. The fund then manages the purchased loans. Banks are recapitalized, if necessary, by government bonds. Hence, both former Czechoslovakia and Hungary rely on a more or less centralized approach to solving the bad debt problem. Poland, in contrast, did nothing at first to solve the issue. More recently, it implemented a decentralized, market-based solution. According to the Law on the Restructuring of Banks and Enterprises, which became effective in early 1993, state-owned banks have to establish a separate organizational unit. This unit is supposed to deal with problem loans. It prepares debt consolidation schemes which, among

⁸ The situation of Eastern Germany can be viewed as an interesting benchmark case. Here, the complete institutional infrastructure of West Germany was transferred, and the stock problem of non-performing loans was solved at one stroke through guarantees of the West German government. In addition, the government tries to spur credit allocation to the private sector by giving credit guarantees for new credits [Wagner, 1993].

others, might provide for the sale of bad loans on the market. Financial funds from international organizations as well as from the Polish government have been made available with which selected banks can be recapitalized [Schmieding/Buch, 1992].

Table 3 – Non-Performing Loans in Eastern Europe, 1987 — 1993.

	CSFR	Hungary	Poland
Amount of Non-Performing Loans	1992: Csk 130 bn of which suspicious - 55 bn non-performing - 75 bn	1987: Ft 3 bn 1990: Ft 43 bn 1992: Ft 265 bn 1993 (March): Ft 194.3 bn of which subaverage 38.4 bn doubtful 67.5 bn bad 88.4 bn	1991: 30,5 tr zloty 1992: 60,8 tr zloty 1993 (March): 85,1 tr zloty
Percentage of Total Assets	1987: 0.3 % 1990: 2.6 % 1992: 11 % all banks; 15 % four large, state-owned banks	1991: 7 % 1992: 38 % 1993: 30 %	All banks: 1991: 16 % 1992: 26 % 1993: 32 % Nine state-owned banks: 1990: 10 % 1991: > 20 % 1992: 30-60 %

Source: OECD, 1993; Data from National Central Banks; own calculations.

3. Real Interest Rates

Low nominal interest rates were one major reason for the distortions of financial flows under central planning. Interest rates were not used as prices for financial funds which would have reflected the amount of risk of a loan. Accordingly, the liberalization of interest rates was one major step towards a market-based financial system. In Hungary, this liberalization of interest rates had already started in 1987 when interest rates on both, enterprise deposits and loans to enterprises, were freed. In 1989, interest rates on household deposits maturing in more than three years were liberalized as well. However, only in January 1991, were all official interest rate ceilings abolished. In Poland, the interest rate policies of commercial banks were liberalized in January 1990, and the central bank started to set its refinancing rate in accordance with expected inflation [Galbis, 1993]. In former Czechoslovakia, ceilings on lending rates were set by the central bank during the first months of the reform program

[Calvo/Coricelli, 1993, p. 96]. Since then, banks in former Czechoslovakia have not been subjected to interest rates ceilings.

Despite these liberalization efforts, real lending rates were negative at the early stages of financial reforms [Graph 1].⁹ In former Czechoslovakia, the average lending rate to enterprises stayed negative in real terms from mid-1990 to mid-1991 with an average of -16 percent and -33 percent in the second half of 1990 and the first half of 1991, respectively. Afterwards, positive lending rates were achieved and reached an average of 7 percent in the second half of 1991. In 1992, real interest rates declined to 5.3 percent on average, not taking the low real interest rates at the end of the year into account.¹⁰ Interestingly, in the Czech Republic real interest rates for private sector credit were in 1992 about 2 percentage points higher than average interest rates on credits to all enterprises. This can partially be explained by higher risk premia that are being charged on private sector credits. In Hungary, real lending rates for loans with maturities of less than one year remained positive throughout much of the 1990-1993-period. Only in the first half of 1991 were lending rates negative with an average of -12 percent. If this period is not taken into account, real lending rates averaged about 11 percent throughout. For Poland, real interest rates have been calculated for the refinancing rate for banks which is set by the central bank on the basis of expected inflation. Because future inflation was typically under-estimated, the real interest rate was negative in almost the entire period between 1990 and mid-1993 (-7 percent on average). However, the variations of interest rates could be reduced substantially such that in late 1992 and early 1993 average real interest rates were only slightly negative and almost equal to zero. Only in the second half of 1991 were real interest rates positive (10 percent). For many Polish firms, however, actual real interest rates are much higher than the refinancing rate indicates. Nominal lending rates of Polish banks for credits with the lowest risk rate, for example, varied between 35 and 55 percent in mid-1993, the lower bound given by the refinancing rate for commercial banks.

⁹ Real interest rates have been calculated based on the formula:

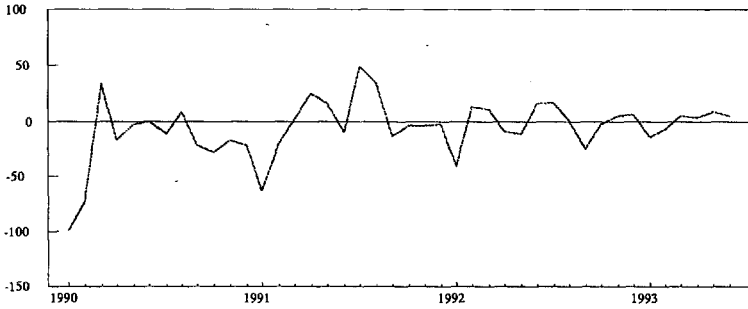
$$i_{real} = \left[\frac{(1 + i_{nom})}{(1 + \pi)^{12}} - 1 \right] * 100$$

where i_{nom} = annual interest rate, π = monthly rate of inflation, all expressed in proportional form. This formulation assumes that the current inflation rate is the best predictor of future inflation.

¹⁰ For 1992, inflation rates from the Czech Republic were used. As annual inflation was higher in the Czech than in the Slovak Republic, this tends to underestimate effective real interest rates.

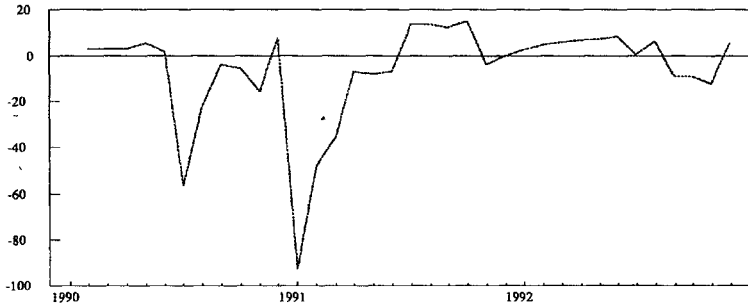
Graph 1 — Real Interest Rates in Poland, Former Czechoslovakia, and Hungary, 1990-1993.

(a) Poland: Refinancing rate of Central Bank*

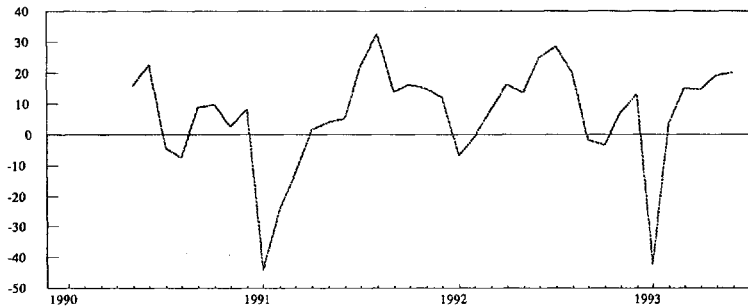


*) Gives lower bound of lending rates of commercial banks.

(b) Former Czechoslovakia: Average lending rate to enterprises



(c) Hungary: Lending rate for loans under one year (all banks)



Source: National Banks, own calculations.

In summary, the following stylized facts emerge:

- In all three countries did real credit contract. However, the extent and timing of these contractions was different.
- Credit to the private sector grew more rapidly than credit to the state sector. Except for the case of former Czechoslovakia, however, the share of private sector credit in total credit underrates this sector's contribution to GDP.
- All three countries are having a substantial problem with non-performing loans.
- At the early stage of financial reform, real interest rates were negative. However, positive and often high real lending rates were charged soon. Real lending rates were on average lowest in former Czechoslovakia.

III. MODELS OF FINANCIAL LIBERALIZATION

This chapter reviews models of financial liberalization. It starts by contrasting the traditional neoclassical and neo-structuralist approaches which both fail to take account of institutional features of financial markets such as adverse selection and moral hazard. After that, an endogenous growth model with adverse selection is summarized.

1. Traditional Models

The classical case for financial liberalization was made in the early 1970s by McKinnon and Shaw. They depart from a situation of financial repression in which interest rates are suppressed below their optimal level in the hope that low interest rates would spur investment and growth. Interest rates may even become negative in real terms. Often, interest rate ceilings are combined with credit programs through which the government allocates credit to targeted industries and with reserve requirements imposed on commercial banks that serve as a tax on lending. In this sense, the financial system of a centrally planned economy was a perfectly repressed system because credit allocation was completely centralized and nominal interest rates were not adjusted to take account of inflation.¹¹

According to the neoclassical view of McKinnon and Shaw, financial liberalization consisting of the abolition of centrally fixed interest rates, the introduction of a tight monetary policy, and a lowering of reserve requirements will divert resources away from

¹¹ For a detailed description of the financial system of socialist economies see Kornai [1992].

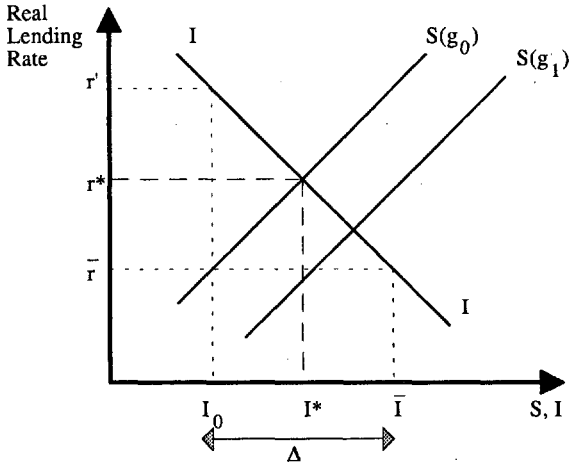
non-productive inflation hedges and inefficient self-finance. More funds are raised because domestic savings are elicited through higher real interest rates. These higher savings are then allocated to more efficient uses. Financial liberalization will also eliminate the scope for rent-seeking activities that emerge from repressed financial systems. The implications of the McKinnon/Shaw- model with inside money¹² are shown in graph 2.¹³ As real interest rates are fixed at \bar{r} below the market-clearing interest rate r^* , desired investments exceed desired savings. Not every firm willing to pay the low interest rate can actually receive credit. Hence, interest rate ceilings lead to *disequilibrium* credit rationing in the amount of $\Delta = \bar{I} - I_0$. Because of the capital market distortion, firms' access to fixed and working capital is restricted, and production is suboptimal.

The interest rate ceiling distorts the economy in three different ways. First, future consumption is discriminated against current consumption such that savings are suppressed below their socially optimal level. Secondly, because of the low cost of capital, investors engage in capital-intensive, low-yield projects. Thirdly, funds are channelled towards preferential sectors of the economy which are not necessarily the most profitable ones. An abolition of the interest rates ceiling allows real interest rates to adjust to their market-clearing levels. This higher real interest rate contributes to the elimination of the capital market distortions, raises investment, and thus spurs economic growth. Because savings are a function of the economy's growth rate (g), the supply of savings will shift as a result of higher real interest rates. This stimulates investment even further. [Fry, 1987, pp. 6-7] Hence, by eliminating interest rates ceilings, financial liberalization has positive effects on economic growth.

¹² Inside money is defined as money backed by private debt. McKinnon originally employs a model with outside money (commodity money) which confines enterprises to self-finance. Underlying this assumption is the hypothesis that money and physical capital are complementary. Most extensions of the original neo-classical models, however, are using an inside-money-approach, thus following Shaw [Fry, 1987, pp. 3-4].

¹³ For formal, neoclassical models see Kapur [1992] or Mathieson [1980].

Graph 2 — Disequilibrium Credit Rationing



The neo-classical models of financial liberalization can be criticized for three reasons. First, it is implicitly assumed that prior to the abolition of the interest rate ceilings, allocation of credit was administratively decided upon. Otherwise, if firms in a competitive market environment had been free to choose their investment project, they could obtain low-cost credit and invest into high-yield projects. Investment into low-yield projects would not be a profit-maximizing strategy. Secondly, the mechanism of credit allocation must be assumed to improve after the liberalization of interest rates. Banks are considered to screen potential loan applicants more efficiently. If the mechanism of credit allocation remains unchanged, however, higher allocative efficiency is not an unambiguous outcome of financial liberalization. In a more realistic scenario, a prolonged period of financial repression may have altered incentive mechanisms within banks [Gertler/Rose, 1993]. Consequently, banks are unable to screen and monitor loan applicants efficiently. Thirdly, the analysis is based on the presumption that higher real interest rates raise savings via the substitution effect. On empirical grounds, however, this assumptions must be challenged as savings rates were often unaffected by financial market reform. [Pagano 1993; Schiantarelli et al. 1993].

In addition, the neoclassical view of financial liberalization has been criticized by neo-structuralist, Keynesian writers. The major contribution of these authors is that they introduce a third asset into the analysis. Households can now, apart from bank deposits and inflation hedges, hold loans on the curb or unofficial capital market. Neo-structuralists argue that the effect of domestic financial liberalization on economic growth depends on the substitutability

of time deposits held in banks, on the one hand, and deposits held on curb or unorganized money markets, on the other hand [Dornbush/Reynoso, 1989]. Curb markets enable private savers to lend directly to enterprises or farmers. These markets are assumed to be more efficient in lending than commercial banks because the former are not subject to reserve requirements [Van Wijnbergen, 1983, p. 434]. As financial liberalization diverts savings to the official banks, it leads to a reduction in the supply of loanable funds and a rising curb market rate. This leads to a reduction in production and to rising prices, which are determined by a mark-up over costs.

According to the neo-structuralist view, substitution is closest between curb market and banking system deposits while in the McKinnon/Shaw framework, substitutability is closest between (unproductive) inflation hedges and bank deposits. However, as Schiantarelli et al. [1993] note, it is not clear why curb markets should provide more efficient financial intermediation than formal banking systems. While informal intermediaries tend to have closer contacts to their customers they also tend to operate in highly segmented markets. This, however, counteracts efficiency. Another major shortcoming of the neo-structuralist approach is that it fails to model the incentives of savers to switch their deposits away from a more efficient form of financial intermediation towards the inefficient – because of the reserve requirement – commercial banking system. An explanation for this phenomenon has been given by Kapur [1992]. The neo-structuralists, he argues, neglect the purpose for which reserves are held. Reserves have a liquidity enhancing and a seigniorage creating function.¹⁴ If these functions are incorporated into the neo-structuralist model, financial liberalization will be welfare-improving. This analysis suggests that financial market reforms need to be evaluated within a second-best framework. In a first-best world, mandatory reserves or other government-imposed distortions would have no *raison d'être*. However, a potential lack of insurance markets that would protect risk-averse depositors against the sudden need to meet some unforeseen expenses may justify a second-best-approach to be taken.

Overall, three major implications for financial market reforms in Eastern Europe emerge from these models. First, higher real interest rates should lead to a better quality of investment and may lead to higher savings. In addition, interest rate liberalization must be accompanied by a reduction of reserve requirements and the abolition of directed credit programs in order to yield positive effects on investment efficiency. Secondly, the re-structuring of household portfolios away from low-yield demand deposits and inflation hedges towards longer-term financial assets is more likely to occur than a change in the overall size of house-

¹⁴ In contrast to models that treat minimum reserves as an inevitable tax and a source of government revenue, reserves could be thought of as voluntarily held in this model.

holds' portfolios. Thirdly, in countries where the private sector has traditionally played a certain role, such as in Poland, firms should have access to informal financial markets and to arms-length lending. In these countries, the reform of the official financial system may be less important at the early stages of the transformation process than in countries with an originally small private sector, such as in former Czechoslovakia. This hypothesis is confirmed by the stylized facts above. While Poland put fairly little effort into reforming its financial system at early stages of reform, the country is yet the first to report positive growth. Incidentally, this may imply that financial markets are less important for development and growth than theoretical analysis suggests. However, this interpretation is misleading. Curb market finance and financing from retained earnings is inefficient to the extent markets are segmented and that present cash flow is unrelated to future earnings perspectives. The Polish financial system may thus still have to prove whether it can support sustained economic growth.

On a theoretical basis, both the neo-classical as well as the neo-structuralist models of financial liberalization fail to account for institutional features of financial markets. Nevertheless, market imperfections such as informational asymmetries, moral hazard, and adverse selection are considered to have substantial impact on the efficiency of financial markets and on the way in which credit is allocated. Incidentally, these factors, which are not explicitly taken into account by both approaches, give a theoretical rationale for the existence of financial intermediation. Besides, the implications of financial liberalization strategies in terms of growth prospects are restricted by the underlying production function. Traditional neo-classical growth theory based on the Solow-model identifies an increase in the savings rate, which leads to the accumulation of capital, as a source of short-run economic growth in the transition to a new steady state. With constant returns to scale and no technological progress, the long-run rate of growth of per-capita income is zero. Long-run growth can thus only be explained by exogenous increases in productivity. Hence, financial liberalization could at best explain temporary output growth. The explanatory power of the traditional growth models has thus been challenged by proponents of the new growth theory who consider the process of capital accumulation much richer than in the concept underlying the Solow-model. In these endogenous growth models, the growth rate of the economy is determined endogenously through the accumulation of factors of production.¹⁵

¹⁵ Endogenous growth can be modelled through constant or through increasing returns. If the latter avenue is chosen, the existence of an equilibrium needs to be ensured by either assuming constant returns at the firm level or by dropping the assumption of perfect competition [Sala-i-Martin, 1990].

2. Models with Endogenous Growth

In models with endogenous growth, it is possible to develop scenarios in which financial intermediation can have a positive permanent impact on economic growth. These models can be divided into three subgroups, depending on the function of banks and other financial intermediaries that they stress. First, in Bencivenga and Smith [1991] and Levine [1992], banks mainly provide liquidity services through the provision of payments systems and through their holdings of diversified asset portfolios. Similarly, in Saint-Paul [1992], the presence of financial intermediation permits the exploitation of comparative advantages by providing the means for specialization in production. Secondly, in Roubini and Sala-i-Martin [1992], the interaction between financial market reforms and the fiscal deficit is analyzed. While financial market development reduces the transactions costs of converting illiquid into liquid assets, it also reduces the leeway of the government to use a financially repressed system as a source of government finance.¹⁶ Hence, liberalization may be postponed until alternative sources of government finance have been found. Thirdly, in King and Levine [1992] as well as Greenwood and Jovanovic [1990] banks collect information and screen potential loan applicants in order to divert resources to their most efficient use. As King and Levine note, intermediaries may be able to identify promising "Schumpeterian" entrepreneurs which would – in the absence of intermediation services – end up without access to external finance. Bencivenga and Smith [1993], finally, analyze the implications of credit rationing on output growth. A short summary of their work is presented below because it relates to later parts of this paper.

Bencivenga and Smith employ a two-period, overlapping generations model. The young generation can be divided into borrowers and lenders. Lenders sell their labor to firms and earn a wage, they have no initial endowment of the consumption good, and value consumption in both periods of their life. Borrowers, in contrast, value only consumption in period 2, they can either sell their labor to firms or operate an investment project. Investment of x units of the consumption good in period t yields an output of Qx units of the capital good in period $t+1$ with a probability of p_i , $i = H, L$. Two types of borrowers exist, high-risk (H) and low-risk (L) borrowers, with their respective probabilities of success being $1 \geq p_L > p_H > 0$. Instead of investing, borrowers can store period-one-income and receive an interest income. It is assumed that borrowers with access to superior investment opportunities have also access to better storing facilities. Hence, low-risk borrowers have the lower opportunity cost of being denied credit and drop out first when lending rates are raised. Lenders cannot distin-

¹⁶ Giovannini/deMelo [1991] analyze the channels that run from the financial system towards the financial situation of the government.

guish L-type from H-type borrowers while borrowers each know their own type. Information is thus asymmetric ex ante.

In equilibrium, lenders announce contracts $(R_{it}, q_{it}, \pi_{it})$ with R = gross real interest rate, q = loan quantity, and π = probability of a borrower being granted credit. Because lenders cannot discriminate among their customers, a self-selection mechanism is needed which ensures that borrowers reveal their own type [Rothschild/Stiglitz, 1976, p. 632]. The self-selection constraints require that H-type borrowers must receive a higher utility from a H-type-contract than from an L-type contract and vice versa. If the announced contracts meet these constraints, no lender has an incentive to diverge from his offer, contracts earn zero expected profits, and each borrower receives his optimal contract given that all other borrowers maximize their utility.¹⁷

Credit rationing prevails in equilibrium because H-type lenders are certain to receive a contract, while L-type lenders are not ($\pi_{Lt} < 1$). Thus, L-type borrowers are being made worse off by the presence of H-type borrowers. Because of their lower opportunity cost of being denied credit and their greater probability of success, L-type borrowers under perfect information could be offered more favorable contracts in terms of price and quantity than H-type borrowers. However, H-type borrowers would prefer L-contracts over H-contracts. If they were certain to receive an L-contract ($\pi_{Lt} = 1$), they would apply for it, and lenders would incur losses (adverse selection). Hence, lenders need to specify contracts for L-type borrowers such that these contracts are not preferred by H-type borrowers over H-type contracts. This is captured by the self-selection constraints. For these constraints to hold, the probability of receiving an L-contract must be smaller than one.

The production function incorporates a Romer-type externality as production depends on the firm's own capital (k_t) and on labor inputs (L_t) as well as on the average capital stock of the economy \bar{k}_t [Romer, 1985]: $Y_t = \bar{k}_t^\theta \cdot k_t^{1-\theta} \cdot L_t^{1-\theta}$, $\theta \in (0,1)$. Increasing returns are external to the individual firm which ensures the existence of a competitive equilibrium. However, this externality also implies that the equilibrium outcome is sub-optimal. The spillover from investment into firm-capital on the overall capital stock is not taken into account by the individual firm. In this framework, the growth rate of the capital stock increases when credit rationing declines. Policies that reduce credit rationing thus lead to higher growth. Both, improvements in the overall technology (higher Q) and improvements in the technology of H-type borrowers (higher p_H), reduce the scope for credit rationing and thus spur growth. How-

¹⁷ Existence of this separation equilibrium requires that no lender has an incentive to offer a pooling contract.

ever, if only the technology of L-type borrowers is improved (higher p_L) the adverse selection problem is aggravated. In this case, in order to prevent H-type borrowers from applying for L-type contracts, the probability of receiving these contracts must be reduced. The negative impact of more credit rationing may outweigh the positive impact of this technological improvement on output.

As regards the policy implications of this model, it is hard to see how the governments in Eastern Europe could improve the technologies of only one class of borrowers. For this government policy to be successful, governments should have superior information as compared to commercial banks. This is an unlikely situation, if one considers the shortage of qualified personnel that all emerging market economies face. Hence, policies that aim at reducing the underlying informational asymmetry seem more promising. However, these policies are not modelled within the framework of the present endogenous growth models. Generally, the endogenous growth literature makes a substantial contribution to explaining the links between financial intermediation and growth. It helps to answer the question whether financial liberalization may actually spur growth or whether advanced financial markets are merely a by-product of an overall growth process. However, the existing models tend to make highly stylized assumptions on the nature of the process of financial intermediation and fail to model decision processes within intermediaries. Thus, the following section looks at the microeconomic foundations of the endogenous growth models in more detail.

IV. A MODEL OF THE BANKING FIRM

This section introduces a microeconomic, partial-equilibrium model within which the behavior of banks can be analyzed.¹⁸ After analyzing the effects of non-performing loans on the balance sheets of banks on the credit and pricing decisions of a monopolistic bank, the basic model is extended to a framework with asymmetric information. A potential for credit rationing for private enterprises is explained by informational advantages that state-owned banks have with respect to state-owned firms as compared to private firms.

1. Non-Performing Loans and Costs of Insolvency

The bank is viewed as a firm which buys deposits (D) from the population and sells loans (L) to firms.¹⁹ In order to analyze the isolated impact of non-performing loans on the behavior of the bank, it is assumed that the bank behaves as a risk-neutral profit maximizer or, in other words, that it has already been privatized. This allows an analysis of bank privatization and/or a hardening of banks' budget constraints in the presence of non-performing loans. Other goals of the bank, such as the support of the economic policy of the government and the obligation to channel directed credits to preferred sectors of the economy, are not considered. In addition, it is assumed that banks have a reasonable long time horizon which induces them to take balance sheet risk into account. Later, these assumptions will be relaxed. Expected profits are thus given by:

$$[1.1] \quad E[\pi] = \sum_{i=1}^m \mu_i^L \cdot L_i - \sum_{j=1}^n \mu_j^D \cdot D_j - K(D, L) - Y(D, L) - \rho \cdot (L - D)$$

with $i = 1, \dots, m$ = number of credit contracts and $j = 1, \dots, n$ = number of deposit contracts. All depositors and debtors, respectively, are identical such that $m \cdot L_i = L$ and $n \cdot D_j = D$. The asset side of the bank's balance sheet consists of credits only. Liquidity reserves which are typically held as a cushion against unforeseen withdrawals of deposits are not considered. The balance sheet restriction thus becomes: $L = D + E$ with E = equity capital and ρ = opportunity costs of holding equity. The expected return on credits is $E[r^L] = \mu^L \approx N(0, \sigma_L')$.

¹⁸ The basic model employed in this section is based on an approach by Baltensperger/Milde [1987], it follows the approaches by Klein [1971] and Dermine [1986] For an application to the liberalization of financial markets in developing countries see Corsepisus [1989].

¹⁹ In this model, the clear separability between loans and deposits is assumed. Hancock [1991], in contrasts, uses an approach which classifies inputs and outputs based on the calculation of the respective user costs.

For simplicity, it will be assumed that credit risk are stochastically independent such that $\sigma_L' = -1/2$. On deposits, the bank pays an interest rate of μ^D which is smaller than the contractual rate r^D due to the fact that in the case of insolvency depositors are paid only a fraction of the contractual interest rate²⁰. All interest rates are expressed in real terms, i.e. uncertainty over the future price level is ruled out. Operating costs (K) are increasing in D and L ($K_D, K_L > 0$; $K_{DD}, K_{LL} > 0$),²¹ These operating costs comprise costs in connection with writing credit contracts, with raising deposits, with maintaining customer relations, and with running the payments system. For simplicity, the costs of gathering information on customers are assumed to be part of operating costs and have no direct influence on credit returns.²²

The costs of insolvency (Y) occur whenever the returns from the credit business are insufficient to cover the bank's costs, i.e. when the return on lending is less than the critical lending rate $\tau < \hat{\tau}$. These costs are given by

$$[1.2] \quad Y = Y(D, L) = \eta \cdot L \cdot \sigma_L' \int_{\tau}^{\hat{\tau}} (\hat{\tau} - \tau) h(\tau) d\tau$$

where

$$\hat{\tau} = \frac{\hat{r}_L - \hat{\mu}_L}{\sigma_L'}, \quad \hat{r}_L = \frac{(1 + \mu^D)D + K - L}{L}$$

with η representing the variable, proportional insolvency costs with respect to the amount of the expected loss. Here, only the case of costly reorganization of the bank is considered; the bank cannot go bankrupt. Whenever expenditures exceed revenues, the bank has to start costly adjustment procedures, renegotiate with its creditors, or adjust the structure of its loan portfolio. Alternatively, the costs of insolvency may be interpreted as managerial risk aversion if it is assumed that managers' performance is evaluated based on the solvency of the bank. If revenues fall short of costs, 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 no-bankruptcy assumption implies that, in the extreme case, the end-period value of all deposits and of the bank's equity approaches zero. Note that the bank's equity serves as a cushion against adverse fluctuations in the value of the bank's assets. In a

²⁰ This is the no-insurance case analyzed in Dermine [1986]. Dermine models the situation with a deposit insurance and risk-adjusted insurance premia.

²¹ 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.

²² Later, when borrowers of different type are introduced, this assumption will be dropped.

parallel fashion, reserve holdings as a safeguard against sudden withdrawals of deposits, i.e. the case of illiquidity, could be modelled. The current notion, however, captures the impact of non-performing loans on the profits of the bank through rising the probability of insolvency $H(\hat{\tau})$.

Owing to the structure of the Eastern European banking systems, the bank is assumed to have a monopolistic position on both, the market for credits as well as for deposits.²³ The supply of banks credits and of deposits are²⁴:

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

Both restrictions are assumed to be binding. The monopolist bank's endogenous variables are L , D (through which E is determined), μ^L , and μ^D . In order to simplify the analysis, the inverse demand functions $\mu^L = \mu^L(L^S)$ and $\mu^D = \mu^D(D^S)$ are substituted for the interest rates such that L and D remain as control variables.

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 $E = L - \beta \cdot L$.²⁵ Hence, [1.1] can be rewritten as:

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

The first order conditions for a profit maximum thus become:

$$\begin{aligned} [1.2] \quad E[\pi]_{\beta} &= -\mu^D \cdot L \cdot \left(1 + \frac{1}{\varepsilon(D^S, \mu^D)}\right) - K_{\beta} - Y_{\beta} + \rho \cdot L \\ [1.3] \quad E[\pi]_L &= \mu^L \cdot \left(1 + \frac{1}{\varepsilon(L, \mu^L)}\right) - \mu^D \cdot \beta \left(1 + \frac{1}{\varepsilon(D, \mu^D)}\right) - K_L - Y_L - \rho \cdot (1 - \beta) \end{aligned}$$

²³ This is equivalent to the assumption that the bank has a large market share with respect to the relevant market and can influence interest rates through its pricing decision.

²⁴ Note that the demand for loans depends on the interest rate r^L , not on the expected interest return of the bank.

²⁵ This notion does not restrict any of the variables in the model as, as was mentioned before, reserves as an additional asset are not considered.

In the comparative static analysis of the model, the effects of changes in the exogenous variables, i.e. the opportunity costs of holding equity, the variable operating costs, the variable costs of insolvency, and of changes in the probability of insolvency on the endogenous variables can be analyzed. Also, the impact of non-performing loans on the decisions of the bank can be shown within this framework. Economic transformation raises the amount of non-performing loans because the shift to a new set of relative prices made many of the previous loan recipients insolvent. In other words, economic transformation and the change in relative prices caused a decline in enterprises' net worth [Gertler/Rose, 1993]. If banks continue to lend to these enterprises, the share of enterprises which cannot repay their loans increases. Accordingly, the probability of the bank's insolvency rises as there is a higher probability H that r falls below \hat{r} . The following elasticities can be obtained :

$$\begin{aligned}
 & \varepsilon(\beta^*, H) < 0 \\
 [1.4] \quad & \varepsilon(L^*, H) < 0 \\
 & \Rightarrow \varepsilon(D^*, H) < 0
 \end{aligned}$$

Facing a higher probability of default, the bank reduces its lending activity (scale effect) and restructures its portfolio towards holding more equity (structural effect).²⁶ The impact of a change in $H(\hat{r})$ on D has to be measured as the combined impact of scale and structural effects. Via the impact on credit demand and deposit supply, a rise in the probability of insolvency raises the interest rate on credits and lowers the interest rates paid out on deposits. Interest rate spreads are thus rising.

In this framework, a rise of H reflects the *flow* of non-performing loans. As H rises, there is a greater probability of each loan to yield a return below the critical level. The analysis of the flow problem is not an unrealistic assumption if one considers that most of the non-performing loans currently burdening banks are the result of poor credit assessment skills and information systems as well as of an increase in uncertainty over the future profitability of enterprises rather than a legacy from the past. However, all emerging market economies

²⁶ Empirically, Shrieves and Dahl [1992] confirm this result as they find changes in capital levels positively related to changes in asset risk. This positive relation, however, can also be explained by managerial risk aversion. Even if the bank's owners are risk 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 many sectors as investors and equity holders could [Saunders et al., 1990]. In fact, in a portfolio model with risk aversion do Greenwald and Stiglitz [1991] find that a rising share of (systematic) risk induces the bank to allocate less credit. In the model presented above, in contrast, the bank behaves as if it was risk averse due to the presence of bankruptcy costs.

are also facing a *stock* problem of non-performing loans. One interpretation of this stock problem is that higher institutional interest rates in a situation of financial liberalization reduce the bank's ability to cover their interest costs out of returns from outstanding credits. In fact, this was the reason why the Perpetual Inventory Credits which carried low nominal interest rates were removed from the balance sheets of Czechoslovakian banks. In addition, the shift in relative prices as a result of price and trade reform changed the earnings perspectives of traditional customers and thus lead to a deterioration of the existing loan portfolios.

The stock of non-performing loans can be introduced into the model as a reduction of the bank's equity base. Thus far, costly adjustment of the equity position of the bank had been assumed. However, raising equity will usually be associated with adjustment costs which may, in the short run, be prohibitively high. The implication of the bank being under-capitalized or, in other words, equity-constrained is that the bank can only maintain its optimal passive structure by reducing the supply of credit. This, again, would drive up interest rates. Hence, there is scope for the government to intervene in order to prevent under-capitalized banks from restricting their lending activities. This intervention could take the form of either replacing the bank's non-performing assets by interest-bearing government bonds²⁷ or by injecting new equity.

Both, a greater stock and flow of non-performing loans on the balance sheets of banks can thus explain a reduction in aggregate lending. This finding contrasts somewhat with the observation of "distress lending", i.e. of banks rolling over non-performing loans. This distress lending would keep overall lending at least constant or may even raise it. Distress lending can be explained by two factors, both of which are not captured by the present model. First, the bank could misperceive the negative impact that distress lending has on its own probability of insolvency. It would thus not take the full value of $H(\hat{\tau})$ into account. In a multi-period model, this could be explained by short-sighted behavior of the 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.

Secondly, the assumption that the bank behaves as a profit maximizer must be relaxed if one considers the slow progress that has been made in the Eastern European reform states with respect to the privatization of banks [Buch, 1993a]. Currently, much of the lending is being done by state-owned banks which pursue goals other than the maximization of profits. Many of these banks support the economic policy of the government by granting directed credits at low interest rates to state-owned enterprises without considering the profitability of

²⁷ See Schmieding and Buch [1992] for a detailed analysis.

such loans.²⁸ Often, central banks compensate banks for losses on these loans, such that distress lending is the result of soft budget constraints of banks. If, however, the central bank does not intervene to cover the losses on directed credits, banks will reduce lending and raise interest rates on non-directed, regular loans.²⁹ At the same time, directed credits potentially add to the stock of non-performing loans. If, in the long-run, the banks' budget constraints are hardening, the implications of the above analysis become even more severe. A higher stock of non-performing loans would lead to an even greater reduction of real lending. In addition, if banks have to allocate a certain proportion of their loans as directed credits, they have fewer funds available that they can lend independently. As the following section will show, this increases the scope for private sector credit rationing and puts upward pressure on lending rates for non-directed credits.

This section has analyzed the problem of non-performing loans on the balance sheets of banks in Eastern Europe under the assumption that banks' are having positive costs of insolvency. These costs of insolvency actually increase over the process of financial liberalization as bankruptcy laws are becoming more strictly enforced, as disclosure rules are tightened, and as better audits of banks' balance sheets are undertaken. Within the framework of this section, it is thus possible to explain at least two of the stylized facts of the financial markets in the emerging market economies. First, profit maximizing banks which balance sheets are burdened with non-performing loans tend to reduce their lending activities. Lending will be reduced to a greater extent the higher insolvency costs are. This mechanism is most evident in Hungary, where insolvency costs were raised through the implementation of a bankruptcy law. Conversely, if real lending increases as was the case in Poland in 1991-92 despite a substantial non-performing loans problem, this gives evidence that banks do not behave as profit maximizers and do not weigh insolvency costs heavily. Secondly, the high real lending rates that were observed in all three countries can be explained by the presence of non-performing loans. In former Czechoslovakia where the stock of non-performing loans was reduced first, real interest rates were lowest, which is in line with the results of the above analysis.

In summary, two major policy implications emerge. First, the stock problem of non-performing loans should be tackled by recapitalizing the banks with interest-bearing government bonds. Secondly, when addressing the flow of non-performing loans, two cases have to

²⁸ In Russia, for example, about 50 percent of all bank loans were granted as directed credits in 1992. In 1993, this share was in the order of 30-40 percent.

²⁹ There is in fact anecdotal evidence from Russia that banks which are being involved in directed credit programs are cautious in lending out their own funds.

be distinguished. Either banks have already been privatized and operate as profit maximizers. In this situation, a reduction in lending will be a rational strategy which can only be avoided by improving the credit assessment skills of the bankers and the information systems of the bank. This issue is taken up in section 2.3.³⁰ Alternatively, banks may yet be state-owned, operate under soft budget constraints, and thus disregard insolvency costs. In this situation, they may use the additional leeway that a recapitalization program would provide to continue lending to non-profitable enterprises. They may expect to be bailed out by the government if they engage in this moral hazard behavior. This necessitates the introduction of safeguards against unsound lending such as ceilings on credits from state-owned banks to state-owned enterprises. In addition, the recapitalization of banks should be closely tied to the privatization of banks in order to prevent a re-occurrence of the problem of non-performing loans.

2. Incomplete Information

The previous section has shown that a higher share of non-performing loans on the balance sheets of banks may cause a decrease in overall lending and higher interest rates. This result warrants two modifications. First, the reduction of lending may not be spread uniformly across enterprises. Instead, the allocation of credit depends on the quality of information that banks have. Generally, the transition from plan to market led to a sharp increase in informational asymmetries. While the existing state-owned banks tend to have close, well-established business relationships with state-owned enterprises, new, private enterprises have less well-established relations with banks and can offer less reliable records of past performance. Nevertheless, it may be argued that private enterprises will be more profitable in the long-run as compared to the existing firms. Hence, in a situation with perfect information, the less well-established record of private firms should be outweighed by these firms' higher long-run profitability.³¹

Secondly, this section will show that in the presence of incomplete information, banks may prefer not to raise interest rates but to restrict lending instead in order to avoid a deterioration of the quality of loans applicants. This result will be derived under the assumption that banks are profit-maximizers. Many banks in Eastern Europe pursue other goals. Most importantly, as was mentioned above, state-owned banks are often agents of the government and channel indirect subsidies in the form of directed credit towards ailing, state-owned firms. However, this interdependence between the government's economic policy and the banking

³⁰ Macroeconomic stabilization which has yet to be achieved in most successor states of the Soviet Union would, in addition, remove basic uncertainties.

³¹ See Part II.2 on the empirical evidence for credit rationing in Eastern Europe.

system would only aggravate the findings below. If banks channel cheap credit to state-owned enterprises, credit to private firms – at a given level of total loans – would be rationed to a greater extent than in the benchmark case of profit-maximizing banks. In addition, state-owned banks may disregard the negative impact that higher interest rates may have on the quality of the pool of loans applicants. This would give a further explanation for the observation that high real interest rates coincide with a high share of non-performing loans.

Generally, models with asymmetric information can be divided into two broad groups. If information is asymmetric *ex ante*, lenders are concerned with selecting the right borrower from a group of seemingly identical customers. Despite their appearing similarity, customers may differ in their honesty, ability, willingness to put effort into a project, or with respect to the riskiness of their projects [Clemenz/Ritthaler, 1992, p. 14.]. Hence, banks may end up with a suboptimal pool of customers (adverse selection). Another form of informational asymmetry occurs *ex post*, i.e. after finance has been granted. While all borrowers may be identical when receiving finance or while the bank may be able to identify borrowers of different type, the bank may not be able to costlessly observe the outcome. If this is the case, borrowers have an incentive to falsely state the true project outcome, and to retain some of the return for themselves. Also, the actually realized return may depend on the effort that the manager assigns to running the project which, again, the bank may not be able to observe. Hence, in this principal-agent framework, banks assign funds to monitor the firm.

The main focus of the models presented next will be *ex ante* informational asymmetries which result in adverse selection. In addition, the analysis will focus on the analysis of debt contracts. The issuance of equity gives rise to problems which primarily stem from *ex post* asymmetric information. If the preferences of the owners of a firm and of the managers do not coincide; the question arises of how to influence the manager's behavior such that he acts in the interest of the owners. One way or another, owners have to monitor the actions of the manager. Hence, if monitoring is costly and if bankruptcy costs are non-negative for the manager, a fixed-rate debt contract may be the optimal solution [Goodhart, 1989, p. 168].

2.1. The Stiglitz-Weiss Framework

The rationale behind models with *ex ante* asymmetric information that result in adverse selection is given by the seminal paper of Stiglitz and Weiss [1981].³² They define credit rationing as a situation where, *in equilibrium*:

"(a) among loan applicants who appear to be identical some receive a loan and others do not, and the rejected applicants would not receive a loan even if they offered to pay a higher interest rate; or (b) there are identifiable groups of individuals in the population who, with a given supply of credit, are unable to obtain loans at any interest rate, even though with a larger supply of credit, they would" [Stiglitz/Weiss, 1981, p. 394-395].³³

In the original model of Stiglitz and Weiss, the bank knows only the expected returns of enterprises but cannot differentiate between borrowers with different risk characteristics. Expected returns are assumed to be identical for all borrowers (mean preserving spreads). Borrowers, in contrast, know the probability distribution of project returns. Adverse selection stems from the fact that the average profit of a firm from a loan project increases with the riskiness of the project while the expected profit to the bank decreases. This is because the debtor has only limited liability in the case of failure and because — in the case of success — the bank does receive a fixed return regardless of the profitability of the project.³⁴ It can be shown that for each borrower there is a certain threshold level of risk beyond which his expected profit from borrowing becomes negative. The higher the interest rate, the higher is this threshold level of riskiness, such that at high levels of interest only high risk borrowers remain in the market. As the bank raises the rate of interest charged on loans, the average expected profit on the remaining customers rises but, at the same time, low-risk borrowers retreat from the market. This adverse selection effect lowers the bank's profits. In addition, there may be a moral hazard effect as the remaining customers tend to choose risky projects. Hence, there exists a level of interest rates at which the bank maximizes profits and which

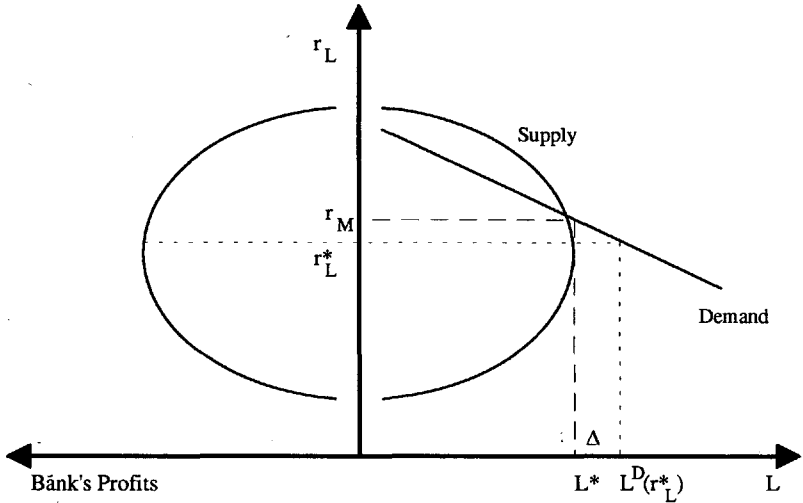
³² De Meza and Webb [1992] show that credit may also be rationed in a situation of symmetric information. Their result is due to the fact that borrowers are not concerned with the loss in the case of bankruptcy while creditors recover some positive amount in this situation. Hence, creditors set their required interest rate below the one the borrower would pay.

³³ This is identical to the so-called type II credit rationing under which the loan quantity at fixed loan size, not the loan size is rationed [Allen, 1987, p. 2]. See also Cosci [1993, pp. 7].

³⁴ For the purpose of this argument it is assumed that firms cannot offer collateral to the banks which would suffice to cover any expected losses. Equivalently, cross-subsidization of investment projects between different branches of a specific enterprise is ruled out.

lies below the market-clearing interest rate level. The market for loans with such a backward-bending supply curve is depicted by graph 3.

Graph 3 — Equilibrium Credit Rationing



Banks maximize profits at r_L^* and at the corresponding amount of credits L^* . At this rate of interest, borrowers demand credit at the amount of $L^D(r^*)$, they are thus rationed by the amount $\Delta = L^D(r^*) - L^*$. The reason for this rationing is that the bank optimal lending rate has put an upper ceiling on the deposit rate.³⁵

Stiglitz and Weiss then argue that there may be situations in which groups of observationally different borrowers exist and in which some of these groups may be systematically excluded from the credit market (red-lining or type-b rationing) [Stiglitz/Weiss, 1981, p. 406-407; 1987]. As mentioned above, banks in Eastern Europe can clearly separate private and state-owned enterprises but may have different sets of information with respect to each group. Assume in addition that the average return to the bank from lending to state-owned enterprises is greater than the return from lending to private enterprises. If the bank has costs

³⁵ The volume of deposits that the bank can raise at this rate may, however, lie below the demand for funds [Clemenz/Ritthaler, 1992, p. 14].

of funds that lie just in an intermediate range, private enterprise will be completely credit rationed while at least some state enterprises will receive a loan. This is, because in equilibrium expected returns from lending to state-owned and private enterprises must be equal (and equal to the costs of loanable funds to the bank).

There are three possible explanations why the average return to the bank from lending to private enterprises may be smaller than that from lending to state enterprises. First, private investment may be more risky than state enterprises' investment. In this case, the overall return (bank's plus firm's profits) from investment into private activity may be greater than the overall return from state enterprise investment. However, for bank profits alone, the opposite holds. Secondly, private investors may have access to a broader range of projects, including high-risk projects, than state enterprises do. Because firm profits increase with the riskiness of the project, private borrowers will tend to choose these risky projects. Again, the bank's profits would be adversely affected. Thirdly, evaluation of private investment may be more difficult than evaluation of state enterprise investment. Hence, the bank may observe only a fraction of the return to private enterprises.

While it is not obvious a priori that private investment *per se* is more risky than investment by state-owned enterprises, the latter two explanations capture features of financial markets in Eastern Europe. New, private enterprises can start their operations in a number of new areas while state-owned enterprises tend to keep on operating in their inherited field of experience. Thus, a broader range of investment opportunities that private investors face can be a result of both, their greater flexibility and their ability to start operations anew. In addition, the existing state-owned banks tend to have close business relations with the state-owned enterprises which reduces informational asymmetries and eases project evaluation. Interlocking ownership between state-owned banks and enterprises may add to this. Accordingly, informational asymmetries are less severe for the existing, state-owned banks when dealing with these enterprises rather than with new, private firms.

In the original model by Stiglitz and Weiss, asymmetric information may result in underinvestment [Hillier/Ibrahim, 1993, p. 288] because some potentially profitable firms do not receive external finance.³⁶ Thus, the assumption may be relaxed that overcoming the informational asymmetry is prohibitively costly. There may in fact exist market mechanisms that would serve to reduce this asymmetry. So far, banks only had one instrument – the in-

³⁶ DeMeza and Webb [1987], in contrast, show that asymmetric information can also lead to overinvestment. This is the case when both projects have the same return in case of success but different probabilities of being successful.

terest rate – to control for two variables – risk and return. If banks are given more instruments, they can offer separating contracts for different classes of borrowers and obtain their preferred risk-return-combination in a no-rationing-equilibrium. This situation is analyzed next.

2.2. *Sorting Equilibrium*

The provision of collateral as a sorting device has been proposed as one mechanism that serves to mitigate the adverse effects of informational asymmetries³⁷ [Bester, 1985]. To the extent that investors with inside information are willing to commit their own wealth to an investment project do banks receive a signal on the creditworthiness of the customers. As low-risk borrowers accept high collateral requirements, they distinguish themselves from high-risk borrowers. This result is derived under the assumption of perfect competition. Hellwig [1988], in contrast, analyzes the behavior of a monopolistic bank under ex ante asymmetric information.³⁸ Under certain parameter constellations, self-selection mechanisms are insufficient to prevent credit rationing to occur, and the bank's profit maximum may be reached only if credit is rationed.³⁹

The Hellwig-model is specified as follows. In a monopolistic market, one bank serves many potential investors of type a . Each investor can invest an exogenously given amount I in order to receive a gross return of \tilde{X}^a . Hence, the fixed-size investment case is analyzed. There are two types of investment project $t = 1, 2$ and each entrepreneur can choose only one project with

³⁷ In this paper, multi-period models are not considered. In Sharpe [1990] as well as Besanko and Thakor [1992], for example, repeated games are developed which allow the impact of reputational concerns on the behavior of borrowers. In these multi-period models, borrowers will tend to reveal their own type and will not behave against the interest of lenders. This will happen to the extent that borrowers benefit from the maintenance of longer-term business relationships.

³⁸ Bester and Hellwig [1987] use a model in which ex ante asymmetric information leads to moral hazard because a given firm has the choice between two different projects which differ according to their riskiness. They show that a monopolistic bank may ration credit only if the collateral that firms can offer is insufficient. However, in the context of this analysis, the focus will be on adverse selection.

³⁹ Baltensperger and Milde [1987] show that self-selection can also be ensured through variations of the loan size. The effect is similar to that of pledging collateral, with a smaller loan size corresponding to more collateral. However, if the equity endowment of enterprises is fixed, varying loan sizes do not eliminate the scope for underinvestment.

$$[2.1] \quad \tilde{X}^a = \begin{cases} X_i & \text{with } p_i \\ 0 & \text{with } 1-p_i \end{cases}$$

and

$$[2.2] \quad \begin{aligned} 0 < p_1 < p_2 < 1 \\ 0 < X_2 < X_1 \\ p_1 X_1 < p_2 X_2 \end{aligned}$$

i.e. project 2 is less risky because it has a higher probability of success (p), while project 1 has a greater return in the case of success, but project 2 yields the higher expected return.⁴⁰ It is assumed that the return on project 2 exceeds the bank's cost of funds. Hence, the bank has always a preference for financing project 2. The bank does not know whether an investor applying for a loan has access to an investment project of type 1 or 2. However, the bank knows that a share of q of the total population are type 1 investors and, accordingly, a share $(1-q)$ are of type 2. In addition, the bank can observe whether a firm was successful but it cannot observe the actual return. In order to keep the analysis simple, we will at first abstract from the existence of a class of enterprises such as existing state-owned enterprises on which the bank has perfect information. As will be shown later, this would not change the qualitative nature of the results.

Each investor has an initial endowment of W which he partially uses to equity finance (ES) his project ($W \geq ES$). However, his equity share is insufficient to finance the whole investment such that a bank loan $L = I - ES$ is needed. As an alternative to investing into the (risky) project, the firm can invest its initial endowment into bank deposits or into riskless bonds. The return on bank deposits is riskless as well because the bank can diversify its risks across many projects. It can be shown that the bank has an incentive to set its deposit rate r^D just equal to the risk-free rate and, by assumption, receive all the firm's excess funds plus household deposits (D) at this rate. Firms are risk averse and have identical strictly monotone and concave utility functions.⁴¹ A firm's utility when not receiving a loan is therefore:

$$[2.3] \quad V_0^* = u(r^D \cdot W)$$

If the firm receives a loan, utility is given by

$$[2.4] \quad V_i^*(R, C) = p_i \cdot u(r^D \cdot W + X_i - R) + (1-p_i) \cdot u(r^D \cdot W - C)$$

⁴⁰ The assumption of mean preserving spreads as in the Stiglitz/Weiss-model has therefore been dropped. Instead, first order stochastic dominance is assumed.

⁴¹ This is similar to assuming risk neutral borrowers with positive bankruptcy costs.

where C = collateral and $R = (1 + r^L) L$. In the case of success, the firm receives interest payments on its bank deposit plus the project return and has to pay interest. In the case of failure, it receives interest payments but has to pay the collateral to the bank. The larger the probability of failure, the more disutility does a firm receive from the collateral requirement.

The bank offers contracts (R_1, C_1) and (R_2, C_2) to firms and, in addition, determines probabilities π_1, π_2 which indicate the willingness of the bank to grant loans to the firms. This set-up resembles a three-stage game. In the first stage, the bank offers the contract. Then, firms select their preferred contract and, in the third stage, the bank may reject applicants [Hellwig, 1987, p. 320]. The bank maximizes its average profit per transaction by choosing the optimal debt contract $[(R_1^*, C_1^*), (R_2^*, C_2^*), \pi_1^*, \pi_2^*]$. Average profits are given by

$$[2.5] \quad P = q \cdot \pi_1 \cdot E[\Pi(p_1; R_1, C_1)] + (1-q) \cdot \pi_2 \cdot E[\Pi(p_2; R_2, C_2)]$$

with the expected profits

$$E[\Pi(p_i; R_i, C_i)] = p_i \cdot R_i + (1-p_i) \cdot C_i - r^D \cdot I.$$

When determining the optimal debt contract, the bank must meet the following restrictions:

- It must be individually rational for a firm to accept a loan contract, i.e. its expected utility from investing into bank deposits must be smaller than the one from investing into a risky project: $V_1^*(R_i, C_i) \geq V_0^*$. This means that a firm is not credit rationed if it is just indifferent between investing into bank deposits or the risky project.
- Contracts must be incentive compatible, i.e. firm 1 will accept contract (R_1, C_1) only if it receives a greater increase in utility (as compared to the no-investment case) than from accepting contract (R_2, C_2) (and vice versa):⁴²

$$\pi_1 [V_1^*(R_1, C_1) - V_0^*] \geq \pi_2 [V_1^*(R_2, C_2) - V_0^*]$$

$$\pi_2 [V_2^*(R_2, C_2) - V_0^*] \geq \pi_1 [V_2^*(R_1, C_1) - V_0^*]$$

- Firm value must not become negative: $r^D \cdot W + X_i \geq R_i \geq 0 \wedge r^D \cdot W \geq C_i \geq 0 \quad \forall i$.
- The credit contract must be feasible: $W + D \geq [q \cdot \pi_1 + (1-q) \cdot \pi_2]$
- Probabilities may not become negative: $1 \geq \pi_i \geq 0$.

⁴² This restriction is similar to the self-selection constraint in the model by Bencivenga and Smith.

The marginal rates of substitution between interest rates and collateral requirements are such that the bank would always prefer higher interest rates and collateral while for the firm, obviously, the opposite holds true. However, if $C > 0$ and $R < X_t$, the firm would accept a rise in the interest rate if it were compensated by a lower collateral requirement. This would shift part of the project risk from the firm to the bank. In other words, due to its risk aversion, the firm would be willing to pay a premium for being able to shift some of the project risk to the bank. Under complete information, there would be no need for the risk-shifting function of collateral. The bank would offer contracts $(X_1, 0)$ and $(X_2, 0)$ to type-1 and type-2 firms, respectively, and take all the risk off the firms. If funds were scarce, the bank would first grant credit to all type-2 firms and only allocate the remainder to type-1 firms. Under asymmetric information, the bank can no more assign a certain contract to a specific firm. If it did not demand any collateral and set interest rates equal to expected returns, type-1 borrowers would have an incentive to apply for type-2 contracts. Accordingly, the bank uses the collateral requirement and the probability of acceptance to sort between the two groups of borrowers. It makes use of the fact that *cet. par.* type-2 firms would accept a higher collateral requirement than type-1 firms because the former have a lower probability of reaching the bad state of the world.⁴³

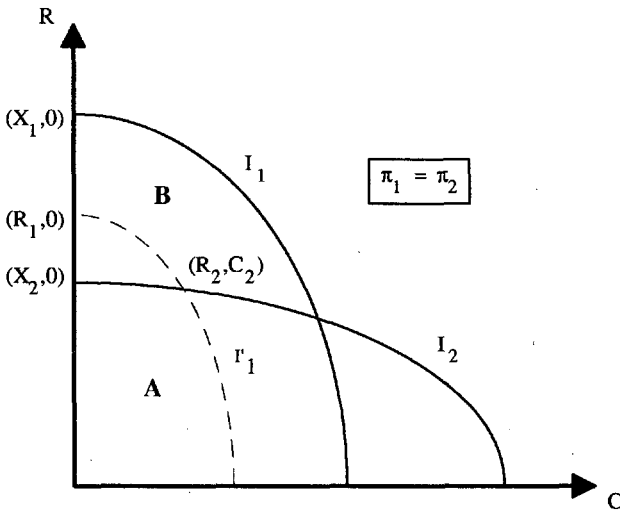
The interdependence of interest rates and collateral requirements is shown in graph 4. I_1 and I_2 depict the indifference curves where type-1 and type-2 firms are just indifferent between investing into the risky project and depositing their wealth in a bank account. Raising the interest rate by moving from area A to area B would reduce the number of type-2 borrowers. Because of firm 2's lower probability of default, it has a lower marginal rate of substitution between interest rates and collateral requirements.⁴⁴ The optimal debt contract offered by the bank has to satisfy the following conditions: If type-1 firms have a positive probability of receiving credit ($\pi_1^* > 0$), they face no collateral requirement ($C_1^* = 0$) and a non-negative interest rate ($R_1^* \geq 0$). If type-2 firms have a positive probability of receiving credit ($\pi_2^* > 0$), the condition for individual rationality for type-2 firm and the incentive

⁴³ At this stage, a comparison of the present model with the approach of Stiglitz and Weiss is in order. The latter assume that both, bank and firm, are risk neutral but that the returns of the bank (firm) decrease (increase) with the riskiness of the project chosen. In the Hellwig-model, firms are risk-averse, and the bank is risk-neutral. What is essential for the credit rationing result to obtain is thus not the exact specification of the individual attitudes towards risk but the fact that under certain parameter constellations, borrowers may pursue goals different from those of the lenders.

⁴⁴ The marginal rate of substitution is given by
$$MRS = \frac{dC}{dR} = -\frac{1-p_t}{p_t} \cdot \frac{u'(r^D W - C)}{u'(r^D W + X_t - R_t)}$$

compatibility condition for type-1 firm bind, the collateral requirement is positive ($C_2^* > 0$), and the interest rate is below the project return ($R_2^* < X_2$). In other words, the bank has an incentive to sort customers apart. Starting from point $(X_2, 0)$, the bank can lower R_2 and raise C_2 while keeping the allocation of risk and its own profits constant. At the same time, this change of contractual terms allows the bank to raise R_1 and to receive higher profits. When making these adjustments, the bank has to make sure that type-1 firms are just indifferent between type-1 and type-2 contracts. Hence, (\hat{R}_2, \hat{C}_2) and $(R_1, 0)$ is one potential outcome. As an alternative to lowering R_2 and raising C_2 , the bank could lower the probability with which type-2 firms receive credits [Graph 4].⁴⁵

Graph 4 — Trade-Off Between Interest Rates and Collateral



⁴⁵ Note that the graph has been drawn under the assumption $\pi_2 = \pi_1$. Lowering π_2 would not constitute a case of credit rationing because type-2 firms are just indifferent in equilibrium whether they receive a loan. The fact that $R_1^* < X_1$ and $\pi_1 < 1$ is a possible outcome distinguishes the present model from the perfect competition case presented in Bester [1985]. Under perfect competition, any competing bank could offer a slightly higher rate $R_1^* + \epsilon$ and attract the formerly rejected firms. As the bank could make positive profits, the initial situation cannot have been an equilibrium [Bester, 1985, p. 853]. The final equilibrium is thus the intersection of the two indifference curves I_1 and I_2 .

In order to determine the optimal profit maximizing strategy of the bank, it is assumed that

$$[2.6] \quad p_2 \cdot X_2 > r^d \cdot I,$$

i.e. the returns to project 2 exceed the bank's costs of funds. In the perfect information case, this would imply that the bank requires no collateral and sets $R_2^* = X_2$. If the bank has only insufficient funds to finance all investment projects, it sets $\pi_2 = \min[1, W + D/I]$. Under imperfect information, the bank can only come close to this result if the share of high-risk borrowers q is sufficiently small. When analyzing the characteristics of possible equilibria, Hellwig distinguishes situations which differ depending on the size of q , the sufficiency of bank's funds, and the profitability of type-1 investment. Here, we treat the case of sufficient funds ($W+D \geq I$) and small q . Provided that projects of type 1 are in principle profitable, the bank sets the interest rate for type-1 borrowers above the maximum obtainable return for type-2 borrowers and the probability of receiving credit equal to one. There is no rationing. Rationing may occur if type-1 projects are in principle unprofitable. Then, under perfect information, the bank would set $\pi_1 = 0$. With a positive probability of type-2 firms to receive credit, however, this policy is suboptimal under incomplete information. Hence, in order to ensure incentive compatibility, the bank must assign a positive probability to type-1 firms obtaining credit ($\pi_1^*(q) < 1$ and $R_1^* = X_2$). As all type 1-firms would like to receive credits but only receive a loan with a probability of less than one, equilibrium credit rationing occurs.

Thus, there remains some scope for credit rationing even if collateral requirements are introduced. The reason why credit rationing occurs is that the costs for the bank of sorting enterprises apart by means of collateral and interest rate requirements may at some point outweigh the benefits from sorting. If q is small, the risk that a collateral requirement imposes on type-2 enterprises causes a fairly high costs as compared to the costs savings of not having to subsidize type-1 borrowers. Hence, under perfect competition, a pooling contract would be optimal if q is sufficiently small [Hellwig, 1987].⁴⁶

These baseline results do not change qualitatively if state-owned firms, on which the bank has perfect information, are introduced. Assume that these enterprises have investment opportunities which are identical to those of private firms and that population shares are identical as well. As the bank can sort type-1 and type-2 state-owned firms apart, it sets

⁴⁶ In this case, $\pi_1 < 1$ would not be feasible.

$R_1^S = X_1$ and $R_2^S = X_2$, $C_1^S = C_2^S = 0$, and $\pi_1^S = \pi_2^S = 1$. The bank's overall profits from doing business with state-owned firms are thus:

$$[2.7] \quad P^S = q \cdot p_1 \cdot X_1 + (1-q) \cdot p_2 \cdot X_2 - r^d \cdot I$$

While profits from business with private firms are

$$[2.8] \quad P^P = q \cdot \pi_1^P (p_1 \cdot R_1^P - r^d \cdot I) + (1-q) \cdot \pi_2^P \cdot [(p_2 \cdot R_2^P + (1-p_2) \cdot C_2^P - r^d \cdot I)]$$

Because $\pi_2^P = 1$ and $p_2 R_2^P + (1-p_2) C_2^P = p_2 X_2$, [2.7] and [2.8] differ to the extent that $\pi_1^P < 1$ and $R_1^P < X_1$. In other words, the bank is indifferent between granting loans to type-2 state-owned or private enterprises while it prefers type-1 state-owned to private firms. Provided that loanable funds are sufficient and that all projects are in principle profitable, the presence of state-owned firms will not affect the extent to which private firms are credit rationed. However, if funds are scarce, the bank first finances all type-2 firms, then type-1 state-owned enterprises, and allocates only the remainder to type-1 private firms. This does not change the qualitative nature of the results but aggravates credit rationing of type-1 private firms.

The level of initial net worth thus determines whether a no-rationing, separating equilibrium is obtained. Calomiris and Hubbard [1990] take explicit account of the fact that borrowers exist which differ with respect to asymmetric information, expected return from investment, and their internal net worth. The level of internal net worth determines how much collateral a firm can pledge. Five types of borrowers exist, while lenders can only differentiate between three different groups according to the following scheme:

	State-Owned	Private		Private	
Initial Net Worth	C_S	C_H (High)		C_L (Low)	
	Symmetric Information	Asymmetric Information		Asymmetric Information	
Return	R_S	<u>Type 1</u> $R_L \quad p$ $R_U \quad 1-p$	<u>Type 2</u> R_2	<u>Type 1</u> $R_L \quad p$ $R_U \quad 1-p$	<u>Type 2</u> R_2

Expected returns are given by

$$R_L > R_2 > R_S > R_V > 0$$

$$R_2 > R_S > [pR_L + (1-p)R_V] \Leftrightarrow \underline{\underline{R_2 > R_S > R_1}}$$

Calomiris and Hubbard show that for each class of observationally different asymmetric information borrowers ($i = H, L$) a critical level of internal net worth C_{i1}^* exists above which sorting occurs. If for both groups of these borrowers this level of internal net worth is not reached, a pooling contract is offered and leads to rationing. In this case, lending to symmetric information borrowers is most profitable due to the intermediate return that lenders can earn from this group. If internal net worth is sufficiently large only in the H-group, type-2 borrowers in this group are financed first. By means of collateral requirements, these borrowers can be sorted apart. Rationing is limited to low net-worth type-1 borrowers. Finally, if internal net worth exceeds the critical level C_{i1}^* for both asymmetric information groups, a perfect information (separating) equilibrium is replicated.

The above considerations are relevant for the situation of Eastern Europe because a lack of collateral is one of the major obstacles to functioning financial markets. This is the result of both, an unclear legal framework regarding the provision of collateral as well as of unresolved ownership issues and limited access to collateralizable assets. Incidentally, new, private enterprises are hit hardest by the resulting "collateral gap" [Schmieding, 1991]. In this situation, a sorting equilibrium may not exist. *Ex ante* screening of borrowers is thus required. This can be achieved through banks' investment into screening loan applicants. As a matter of fact, screening and sorting are substitute technologies [Devinney, 1986]. While under sorting through collateral, the borrower pays the cost of overcoming informational asymmetries, under screening the bank does.

Note that the above argument does not apply to the recently privatized enterprises. These private firms tend to have maintained their relationships with the existing banks. Hence, they have no informational disadvantage as compared to state-owned enterprises. At the same time, privatized firms may have easier access to collateral through foreign partnerships. In addition, banks may take the successful privatization of such firms as a signal for future profitability. These factors should give privatized firms a particular advantage over new private firms in obtaining finance.

2.3. Investment into Information⁴⁷

Under the assumption that collateral is insufficient but that the acquisition of information causes finite costs, banks' investment into information on potential borrowers allows banks to sort out and correctly identify loan applicants. Investment into information takes place until the marginal costs equal the marginal benefits of identification. Here, the costs are determined by the personnel and the technical equipment that need to be employed for credit assessment, the benefits derive from the possibility to renounce from using (costly) sorting devices and to be able to tailor-make loan contracts. At the bank's optimum level of investment into information, three scenarios regarding remaining uncertainties are thus possible. First, less than the actually existing different groups of borrowers are identified. Secondly, only a fraction of all customers is being classified. Thirdly, customers are not classified correctly. Here, the second case is considered. The bank knows how many groups of customers exist but chooses not to classify all customers. With m loan applicants, the expected return from an investment project is given by:⁴⁸

$$[3.1] \quad E[p \cdot X]^0 = m \cdot \overline{p \cdot X} = m \cdot (1-q) \cdot p_2 \cdot X_2 + q \cdot p_1 \cdot X_1$$

with $\overline{p \cdot X}$ = average return. The variance of project returns is equal to

$$[3.2] \quad \text{Var}[p \cdot X]^0 = m \cdot \text{Var}[p_i \cdot X_i] = m \cdot (1-q) \cdot (p_2 \cdot X_2 - \overline{p \cdot X})^2 + q \cdot (p_1 \cdot X_1 - \overline{p \cdot X})^2 > 0$$

Now, the bank can invest into information which leads to the correct classification of $0 < \lambda < 1$ customers. This investment does not affect the expected return from investment but reduces the project variance:

$$[3.1'] \quad E[p \cdot X] \equiv \mu^X = (1-\lambda) \cdot \overline{p \cdot X} + \lambda \cdot m \cdot [(1-q) \cdot p_2 \cdot X_2 + q \cdot p_1 \cdot X_1] = m \cdot \overline{p \cdot X} = E[p \cdot X]^0$$

$$[3.2'] \quad \text{Var}[p \cdot X] \equiv (\sigma^X)^2 = (1-\lambda) \cdot m \cdot \text{Var}[p \cdot X]^0 < \text{Var}[X]^0$$

⁴⁷ This section follows Baltensperger and Milde pp. 169.

⁴⁸ The assumptions on risk, return, and population shares are identical to those of the Hellwig-model with private firms only.

In order to produce information, z units of an input factor must be employed at a cost of w . Through the production of information, the share of correctly classified customers λ increases, which has a negative impact on the variability of project returns:

$$[3.3] \quad \lambda = \lambda(z), \quad \lambda_z(z) > 0 \quad \Rightarrow \quad \sigma^x = \sigma^x(z), \quad \sigma^x_z(z) < 0$$

This makes the critical rate of return ($\hat{\tau}$) a function of the standard deviation and of the information activity. The expected profit of the bank from each transaction can thus be written as

$$[3.4] \quad E[P] = [\mu + C + \sigma(z) \cdot \hat{\tau}] \cdot \left(\frac{r-i}{1+r} \right) - \sigma(z) \cdot \int_{-\infty}^{\hat{\tau}} (\hat{\tau} - \tau) f(\tau) - wz$$

where i = opportunity cost in investment into loans for the bank (interest rate on government bonds). In equilibrium, the bank chooses the optimal level of investment into information z^* and the critical loan size \hat{y}^* according to the first order conditions

$$[3.5] \quad \sigma_z(z^*) \cdot \int_{-\infty}^{\hat{y}^*} y \cdot f(y) dy = w$$

$$\int_{-\infty}^{\hat{y}^*} f(y) dy = \frac{r-i}{1+r}$$

In the first equation, the LHS gives the marginal benefits of investment into information, the RHS the marginal costs. Hence, the less input units need to be invested for reducing the standard deviation of project returns (σ_z large), the greater will be the level of investment into information.

Investment activities of banks can actually explain the existence of financial intermediation endogenously. Financial intermediaries reduce transaction costs which arise from ex ante asymmetric information.⁴⁹ Cost-savings effects from diversification enable intermediaries to collect and process information at a lower cost than individual market participants could. There are a number of channels through which investment into information can be facilitated:

⁴⁹ Williamson [1987] applies this to the case of ex post asymmetric information.

- Banks must be given incentives for investing into information. This requires that interest rates can be set independently, and that other non-interest terms can be determined by the bank. While former Czechoslovakia, Hungary, and Poland have made substantial progress in this regard, many states, especially some successor states of the Soviet Union, lag behind. Here, interest rates remain at low or even negative levels and can thus not provide a fair return for investment into information.
- Banks often use their deposit base as a source of information on loan customers. Banks learn about the financial situation of a client by observing the development of his deposits. Hereby, they exploit economies of scope between the deposit and the lending business. To the extent that in Eastern Europe deposits tend to be concentrated in the large savings banks, this potential source of information remains unutilized. Hence, in order to enlarge and better use the information capital of the banking systems, the lending activities of the savings banks should be promoted.
- Credit assessment procedures must be formalized. In many Eastern European banks there are no standardized form sheets or procedures that have to be followed when setting up a loan proposal. Accordingly, there are high costs associated with every single contract, and different loan applications cannot easily be compared. An upgrading of credit assessment procedures also requires a mandatory risk analysis to be done. More formalized accounting procedures will support these activities.
- The credit assessment skills of the existing staff must be trained. Eastern European banks have to rely on local personal, and there is large scope for Western banks and other institutions to provide for a transfer of know-how.

V. SUMMARY AND CONCLUSIONS

In contrast to the macroeconomic approaches to financial liberalization, microeconomic models of the banking firm explicitly capture relevant features of the financial markets in transition. These latter models imply that the effects of interest rate liberalization and other liberalization measures on the efficiency of resource allocation depend upon the degree of market imperfections in the Eastern European banking systems. It was first shown that, in the presence of positive costs of insolvency, non-performing loans on the balance sheets of banks can lead to higher lending rates and a reduction of loan supply.

The analysis makes a strong case for solving both, the stock and the flow problem of bad debt. A high stock of bad debt reduces the bank's equity position and leaves it undercapitalized. In order to maintain its optimal balance sheet structure and to avoid insolvency costs, the bank would thus have to substantially scale down its lending activities. This adverse effect can be avoided by recapitalizing banks. However, it has also been shown that a decline in the profitability of new loans (flow problem) would lead to a reduction in overall lending. In private banks, this is the result of a lack of information and of an increase in investment risk. In this case, the reduction of lending can be made less severe by improving the information systems and the credit assessment skills of bankers. If banks are state-owned and participate in directed credit programs, the flow of non-performing loans may actually increase as a result of a recapitalization program. This is because such a program gives banks additional leeway for lending and makes future bail-outs more likely. Hence, the paper identified the privatization of banks as means to cope with the flow problem of non-performing loans. To the extent that the privatization cannot be accomplished over night, safeguards in the form of ceilings on lending from state banks to state enterprises may be introduced. In addition, directed credit programs and other state intervention in credit allocation should be abolished in order to free resources for the private sector.

At some stage, banks may prefer not to raise interest rates as a response to an increase of non-performing loans but to ration credit instead. This is the case if information is asymmetrically distributed and if sorting devices do not exist. In this situation, higher interest rates adversely affect the pool of loan applicants. To the extent that information on private enterprises is more costly to the existing banks than information on state-owned enterprises, the private sector is more likely to be credit rationed. Policies should aim at the improvement of information systems by adjusting the legal and the accounting systems to Western standards, by training bankers, establishing public information systems on creditors, and by improving the technical equipment of banks. In addition, private sector's access to collateral

as a sorting device should be eased by allowing private ownership and by quickly solving restitution issues.

Close ties between existing state-owned banks and enterprises are one cause for the good access that banks have to information on these firms. Privatized banks with hard budget constraints may actually use this information capital and contribute to a more efficient allocation of resources. This gives an additional argument for the quick privatization of banks. Also, a higher market shares of new banks would reduce the scope for private sector credit rationing. New market entrants may have more equal costs of acquiring information on private and on state-owned enterprises. They will thus bias their lending to a lesser extent against private enterprises than state-owned banks do.

The findings of this paper are confirmed by the available empirical observations although certainly more detailed, micro-economic evidence is required. Generally, high real interest rates and the reduction of the real credit that could be observed in Eastern Europe can be explained by the presence of non-performing loans on the balance sheets of banks. However, when adjusting real lending rates upwards, banks may not have taken due account of adverse selection effects. The different timing of the reduction in real credit can, apart from macroeconomic factors, be explained by incentives of banks to take balance sheet risk into account. Former Czechoslovakia was the first country to deal with the stock problem of bad debt on the balance sheets of banks. This, first of all, reduced the undercapitalization of banks. At the same time, this recapitalization seems to have sent a signal to banks to contain the flow problem and to restrict lending to ailing state-owned firms. Hence, the decline of real credit was least severe in former Czechoslovakia, credit to the private sector expanded more rapidly than in the other two countries, and real interest rates were lower on average. In Hungary, the enforcement of bankruptcy laws since 1992 has similarly induced banks to be more cautious about their lending activities. In Poland, in contrast, real credit expanded in 1991 and 1992 despite the high share of non-performing loans on the balance sheets of commercial banks. This indicates that Polish banks have not been subjected to hard budget constraints and were not given proper incentives to consider balance sheet risk.

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