

Buch, Claudia M.; Heinrich, Ralph P.

Working Paper — Digitized Version

Banking and balance of payments crises: On possible causes of the twin crises

Kiel Working Paper, No. 848

Provided in Cooperation with:

Kiel Institute for the World Economy – Leibniz Center for Research on Global Economic Challenges

Suggested Citation: Buch, Claudia M.; Heinrich, Ralph P. (1998) : Banking and balance of payments crises: On possible causes of the twin crises, Kiel Working Paper, No. 848, Kiel Institute of World Economics (IfW), Kiel

This Version is available at:

<https://hdl.handle.net/10419/47107>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Kieler Arbeitspapiere

Kiel Working Papers

Kiel Working Paper No. 848

Banking and Balance of Payments Crises
— On Possible Causes of the Twin Crises —

by

Claudia M. Buch and Ralph P. Heinrich

January 1998



Institut für Weltwirtschaft an der Universität Kiel
The Kiel Institute of World Economics

ISSN 0342 - 0787

Kiel Institute of World Economics
Düsternbrooker Weg 120, D-24105 Kiel

Kiel Working Paper No. 848

Banking and Balance of Payments Crises
— On Possible Causes of the Twin Crises —

by

Claudia M. Buch and Ralph P. Heinrich

January 1998

809280

The authors themselves, not the Kiel Institute of World Economics, are responsible for the contents and distribution of Kiel Working Papers. Since the series involves manuscripts in a preliminary form, interested readers are requested to direct criticisms and suggestions directly to the authors and to clear any quotations with them.

Claudia M. Buch
Ralph P. Heinrich
Kiel Institute of World Economics
Düsternbrooker Weg 120
D - 24105 Kiel
Phone: (0)49-431-8814 332
Fax: (0)49-431-85853
E-Mail: CBUCH@IFW.UNI-KIEL.DE

26.01.98 10:54:13

Abstract

Banking and balance of payments crises often happen quite simultaneously. We show that the impact of an expected devaluation on the net worth of commercial banks with a short open foreign exchange position speeds up the timing of a balance of payments crisis. We employ an asymmetric information framework in which domestic commercial banks have to pay a positive risk premium on the international capital market which is determined by their net worth. Some stylized facts from selected transition and developing countries are presented in order to gauge the empirical relevance of the effects that we stress.

(97 words)

Keywords

JEL classification: F31 Foreign Exchange, F36 Financial Aspects of Economic Integration

Contents

1. Motivation	4
2. Causes of Twin Crises	5
3. Speculative Attacks and Commercial Banks' Net Worth	8
3.1. The Standard Model	8
3.2. Foreign Borrowing of Commercial Banks	11
3.3. Endogenous Changes in Banks' Net Worth.....	13
4. Magnitude of the Feedback Effect – Some Stylized Facts	17
4.1. Capital Flows Through Commercial Banks	18
4.2. Net Foreign Assets of Commercial Banks	21
4.3. Profitability of Commercial Banks.....	22
5. Outlook.....	23

1. Motivation*

Banking and balance of payments crises often happen more or less simultaneously (Kaminsky and Reinhard 1996). The two types of crises are preceded and accompanied by similar events. Moreover, banking crises seem to occur prior to balance of payments crises although – from a theoretical point of view – causality is likely to run both ways. One important determinant of both crises is the previous liberalization of the domestic banking sector (internal financial liberalization). For this reason, studying the causes of twin crises is particularly relevant for the transition economies of Central and Eastern Europe although our analysis is not confined to these economies. During the reform process, the traditional monobank systems have been drastically overhauled and replaced by market-type two-tier banking systems. While having obvious benefits in terms of improving the efficiency of the domestic financial systems, these reforms have also had their drawbacks. Consistent approaches to solve the problem of non-performing loans in commercial banks have been lacking, and banking sector stability remains a concern in a number of countries. At the same time, the transition economies have embarked on a comprehensive program of external financial liberalization and have largely opened up for foreign capital (Backé 1996). Because of the scarcity of capital and the resulting return differentials vis-à-vis the rest of the world, the more advanced transition economies have seen sizable capital inflows (Buch and Heinrich 1997).

This paper analyses the links between banking sector and balance of payments crises from a theoretical point of view. In Section 2 we review the existing literature. The paper contributes to this literature by showing that the negative impact of an expected devaluation on the net worth of commercial banks with a short open foreign exchange position speeds up the timing of a balance of payments crisis (Section 3). In addition, a negative shock to the return on commercial banks' domestic lending would raise the risk premium that banks have to pay on international markets and reduce the time until the collapse of a fixed exchange rate regime. We employ an asymmetric information framework. Domestic commercial banks have to pay a positive risk premium on the international capital market which is affected by their net worth. Section 4 confronts the findings of the model with some stylized facts from selected transition and developing countries in order to gauge the empirical relevance of the effects that we stress, and Section 5 concludes.

* This paper has been written in the context of a research project on the integration of the reform states in Central and Eastern Europe into the international capital market. Financial support from the Volkswagen-Foundation is gratefully acknowledged. The authors would like to thank Markus Diehl, Laszlo Halpern, and Christian Pierdzioch for most helpful comments on an earlier draft. Of course, the usual disclaimer applies.

Following Kaminsky and Reinhard (1996: 4f), we define *balance of payments crises* as sharp increases in currency market turbulence, i.e., as a combination of exchange rate and reserve changes. Because this definition implies that balance of payments crises are events rather than processes, we use it as a synonym to the term speculative attack. A *banking crises* is characterized by a sharp decline in the net worth of commercial banks. A crisis may thus be triggered by an unexpected decline in banks' revenues or by an increase in their costs.

2. Causes of Twin Crises

In their empirical analysis of twin crises, Kaminsky and Reinhard (1996) show that banking and balance of payments crises are usually preceded by similar events such as a fall in foreign exchange reserves, a boom in capital inflows, and a lending boom.¹ Generally, banking crises seem to precede balance of payments crises, and this link seems to have become stronger over the past two decades. The theoretical literature offers a number of insights into the possible (common) causes of banking and balance of payments crises (Table 1):

- Velasco (1987) studies a situation in which domestic commercial banks are covered by an automatic deposit insurance system and in which banks are not supervised properly. If the domestic economy is hit by a negative shock, the value of banks' assets declines, and the banks become technically insolvent. However, banks can avert their bankruptcy by borrowing from abroad until a certain borrowing limit is reached. At this point, the banks go bankrupt, and the government assumes their (external) liabilities. The ensuing increase in the budget deficit is financed through domestic money expansion. This monetary expansion eventually becomes inconsistent with an exchange rate target, and a speculative attack occurs. The prediction of the model would thus be that a banking crisis occurs prior to a balance of payments crisis although the former can be „hidden“ for a certain period of time. The link between banking and balance of crises arises because banks are covered by an automatic deposit insurance which allows them to borrow from abroad even though they are technically insolvent. The subsequent bail-out is financed by domestic money creation which creates a conflict with and causes the collapse of the exchange rate target.
- Calvo (1995) similarly assumes that an unlimited lender-of-last-resort facility offered by the central bank (free deposit insurance) exists which may lead to bank runs. Bank runs, in turn, speed up the timing of a balance of payments crisis. He assumes that following a positive productivity shock, foreign capital is used to finance increased domestic investment. Hence, his scenario is similar to that of the transition economies. There is an exogenous run on

¹ In addition to these factors, real exchange rate appreciation, a deterioration in the trade balance, and a worsening of a country's terms of trade usually precede banking as well as balance of payments crises.

commercial banks, and the central bank bails out the commercial banks by exchanging its foreign exchange reserves for the banks' liabilities. The imminent loss of foreign exchange reserves tends to speed up the balance of payments crisis. At the same time, the government deficit is reduced because of the interest earned on the commercial banks' assets that have been taken over. Because of the implied reduction in the inflation rate after switch time, the drop in money demand is lower than in the baseline model without commercial banks. This tends to delay the collapse. In this model, a bank run speeds up a speculative attack if the interest rate is sufficiently small.

- Miller (1996) shows the links between a speculative attack and the reserve constraints of commercial banks. Her model differs from standard speculative attack models because broad money is distinguished from base money and because the assumption that a lender-of-last-resort facility exists is given up. A banking crisis is defined as *a situation in which banks do not have enough liquidity to satisfy withdrawals and therefore must restrict cash payments*. Hence, Miller is mainly concerned with the liquidity position of banks although she notes that bank (in)solvency could be incorporated into her model. A banking crisis can be triggered by a deterioration in the balance of payments position because currency (base money) is needed to acquire central bank reserves. If the demand for currency becomes large, the reserve ratio of commercial banks may be violated, and banks would impose a cash payments restriction. The cash payments restriction raises the value of currency relative to bank deposits, i.e., the currency premium. The higher this premium, the lower are the incentives to stage a run on central bank reserves. Hence, in this model, a worsening balance of payments position may trigger a banking crisis which, in turn, *lengthens* the time until a speculative attack occurs.
- In McKinnon and Pill (1995), over-borrowing on international financial markets occurs if domestic banks operate in a distorted microeconomic environment. In the presence of an implicit deposit insurance and insufficient banking supervision, external financial liberalization exposes commercial banks to a variety of risks, including foreign exchange rate risks. Because of asymmetries in information about domestic fundamentals, markets rely on the information that is provided by domestic banks. Yet, banks which operate in a distorted environment fail to take the downside risks of their activities into account and thus signal overly optimistic beliefs about the domestic economy. If investor sentiment changes, foreign capital is suddenly withdrawn. In order to prevent over-borrowing, McKinnon and Pill propose to restrict short-term capital flows, to liberalize FDI-flows, and to limit consumer borrowing and mortgage finance. Again, banking crises are caused by microeconomic distortions in the financial system.
- Krugman (1998) likewise has a model in which moral hazard in financial institutions caused by (implicit) deposit insurance of the government causes banking crises as the main trigger of currency crises. He argues that investment of financial intermediaries into assets fixed in supply (such as land) can cause substantial asset price fluctuations, even more so if the

probability of a bail-out of financial institutions becomes endogenous. This explains the recent Asian experience where the usual macroeconomic difficulties preceding currency crises were absent and where asset prices declined prior to the currency crises. Krugman does not explicitly model the link between banking and balance-of-payments crises but he may have in mind a similar mechanism as in Velasco, i.e., „off-balance-sheet“ government liabilities which become visible after the crisis.

Hence, the models suggest that banking crises (bank runs) typically precede balance of payments crises (speculative attacks). With the exception of the Miller-model, banking crises are caused by implicit deposit insurance systems and insufficient banking supervision, and they tend to shorten the time until a balance of payments crises occurs. Yet, the assumption that banks operate in a distorted environment is not crucial for this-result. The above models neglect the effect that a negative shock and (expectations of) an exchange rate depreciation can have on the net worth of banks and thus on their ability to borrow abroad.² However, in the presence of asymmetric information about the quality of borrowers, the net worth of a (financial) firm is an important determinant of its borrowing capacity (Bernanke et al. 1994). If banks' net worth declines, the borrowing capacity of banks falls, and a balance of payments crisis may be speeded up. Furthermore, banks' net worth is endogenously determined by the balance of payments situation if it depends on the expected exchange rate. A standard speculative attack model is used in the following to show the effect of an exogenous deterioration of banks' net worth on the timing of a speculative attack, and a possible extension to incorporate the endogeneity of banks' net worth is suggested.

Goldfajn and Valdes (1997) have a model which is similar to ours in that it considers a feedback effect from a bank run on the balance of payments without government intervention. However, while Goldfajn and Valdes stress the feedback effect that uncertainty about liquidity needs and thus bank runs can have for the balance of payments, we stress the solvency problem of commercial banks which is caused by a short open foreign exchange position. Also, in their model, twin crises are triggered by adverse real shocks while in ours they are triggered by inconsistent fiscal and exchange rate policies. Moreover, in the model by Goldfajn and Valdes, the utility maximizing behavior of foreign investors creates a negative externality which generates the possibility of fully rational suboptimal equilibrium runs on intermediaries. In our model, the inconsistent fiscal policy eventually forces the government to abandon its preferred fixed exchange rate policy. Another difference is that in their model intermediaries are modeled as providers of insurance against liquidity risk, whereas in our model they are essentially delegated monitors which reduce project risk for investors.

² While Velasco does model the borrowing behavior of banks, his assumption that technically insolvent banks have access to the international capital market seems somewhat unrealistic.

3. Speculative Attacks and Commercial Banks' Net Worth

A speculative attack on the foreign exchange reserves of a central bank occurs if the (shadow) floating exchange rate equals the fixed exchange rate which the central bank tries to defend by selling its reserves.³ The shadow floating exchange rate is determined by market fundamentals, but it may also include a stochastic component. Generally, the probability of a speculative attack increases with the rate of monetary expansion which, in turn, depends on the amount of deficit financing through the monetary authorities, on the interest sensitivity of money demand, and on the volume of foreign reserves of the central bank. Following Flood and Garber (1984), the following section presents a model which can be used to analyze the timing of a speculative attack. The baseline model will be extended to take into account foreign borrowing of commercial banks and the impact of changes in banks' net worth on the collapse time.

3.1. The Standard Model

In the standard model by Flood and Garber, real money demand (M/p) depends on the domestic interest rate i

$$(1) \quad \frac{M_t^D}{p_t} = a_0 - a_1 i_t \quad a_0, a_1 > 0$$

where a_1 = the interest elasticity of money demand. Uncovered interest rate parity holds, i.e., the domestic interest rate equals the foreign interest rate i^* plus the expected rate of depreciation (\dot{s}_t^e / s_t)

$$(2) \quad i_t = i_t^* + \frac{\dot{s}_t^e}{s_t}$$

Setting the foreign price level equal to one and assuming that absolute purchasing power parity holds, the domestic price level is equal to the nominal exchange rate

$$(3) \quad p_t = s_t p_t^* = s_t$$

³ We abstract from the possibility of multiple equilibria. For a more detailed discussion of this aspect and for an explicit formulation of the intertemporal budget constraint of the public and the private sector see Obstfeld (1986). The literature on speculative attacks, which dates back to the seminal paper by Krugman (1979), is surveyed comprehensively by Agénor et al. (1992).

Money supply is given by the stock of loans to the government (domestic assets) plus the foreign reserves of the monetary authorities, expressed in domestic currency

$$(4) \quad M_t^s = D_t + R_t$$

Domestic credit expansion \dot{D}_t is determined by the deficit of the government which is treated as exogenous.⁴

$$(5) \quad \dot{D}_t = \mu$$

Under perfect foresight, the expected exchange rate is equal to the actual exchange rate ($s_t^e = s_t$). Using (2), money demand can thus be written as $M_t^D/p_t = a_0 - a_1 [i_t^* + \dot{s}_t/s_t]$ which gives

$$(1') \quad M_t^D = \alpha s_t - a_1 \dot{s}_t$$

where $\alpha = a_0 - a_1 i_t^*$. Under fixed exchange rates, money demand further simplifies into $M_t^D = \alpha s_t$. Equilibrium on the money market requires money demand to equal money supply which gives

$$(6) \quad R_t = \alpha s_t - D_t \quad \text{if} \quad \dot{s}_t = 0$$

Hence, under fixed exchange rates, foreign reserves are run down proportionally to the primary deficit of the government: $\dot{R} = -\mu$.⁵

An increase in money supply in excess of money demand will lead to pressure on the fixed exchange rate, a loss of reserves of the central bank, thus ultimately forcing a collapse of the fixed exchange rate regime, and an adjustment of the exchange rate to its floating rate equilibrium level. Because under perfect foresight a discrete jump of the exchange rate would provide investors with unlimited profit opportunities, the collapse of the regime will occur at a

⁴ We thus assume that the government neither pays interest on its accumulated deficit nor receives interest payments on international reserves.

⁵ This result can also be derived from the definition of the balance of payments. Under the assumption that the current account balance is zero, the balance of payments is given by the change in net foreign assets of the private sector (F_A) and equals changes in central bank reserves under fixed exchange rates: $BOP = -\dot{F}_A = \dot{R}$. Total wealth of the private sector equals domestic and foreign assets, minus the amount of government debt outstanding: $W = F_A + M - D$. Setting the change in total wealth equal to zero, one obtains: $\dot{W} = \dot{F}_A + \dot{M}_D - \dot{D} = 0 \Rightarrow \dot{F}_A + \dot{M}_D - \mu = 0 \Rightarrow \dot{R} + \dot{M}_D - \mu = 0$ and $\dot{M}_D = 0$ under fixed exchange rates and unchanged interest rates.

time when the fixed exchange rate \bar{s} just equals the shadow floating exchange rate. This shadow floating exchange rate is given by the exchange rate which would clear the market for foreign currency in the absence of the exchange rate target. To solve the differential equation (1'), let

$$(7) \quad \begin{aligned} s_t &= k_0 + k_1 M_t \\ \dot{s}_t &= \dot{k}_0 + k_1 \dot{M}_t + k_1 \dot{M}_t = k_1 \dot{M}_t \end{aligned}$$

Substituting (4) and (5) into (7) and upon noting that foreign exchange reserves are constant under floating rates, one obtains: $\dot{s}_t = k_1 \mu$. Money demand under floating rates thus becomes $M_t^D = \alpha s_t - a_1 k_1 \mu$. Solving this equation for s_t gives the shadow floating exchange rate

$$(8) \quad s_t = \frac{M_t^D}{\alpha} + \frac{a_1 k_1 \mu}{\alpha}$$

Comparing (8) to (7) shows that $k_1 = 1/\alpha$ and $k_0 = a_1 \mu / \alpha^2$. Substituting the condition for the money market equilibrium $M_t^S = M_t^D$ and upon noting that $D_t = D_0 + \mu t$ gives $s_t = \frac{D_0 + \mu t + R_t}{\alpha} + \frac{a_1 \mu}{\alpha^2}$. The time of the collapse can be calculated by setting the fixed exchange rate equal to the shadow rate, by noting that at the time of the collapse reserves drop to zero, by solving for t , and by noting that from (6) it is known that $R_0 = \alpha \bar{s} - D_0$

$$(9) \quad \hat{t} = \left[\bar{s} - \frac{a_1 \mu}{\alpha^2} \right] \frac{1}{\mu} \alpha - \frac{1}{\mu} D_0 = \frac{1}{\mu} R_0 - \frac{a_1}{\alpha}$$

Hence, a fixed exchange rate regime collapses the earlier the higher the primary government deficit and thus the increase in domestic credit to the government and the lower the initial level of foreign exchange reserves. An increase in the foreign interest rate would speed up the collapse via its impact on α

$$\hat{t} = \hat{t}(R_0, \mu, \bar{s})$$

Equation (9) highlights the impact of devaluation expectations on the timing of the collapse of a fixed exchange rate regime. Absent devaluation expectations, reserves are depleted at the rate μ , and the fixed exchange rate regime could be sustained until reserves were completely run down, i.e., until $\bar{t} = R_0/\mu$. However, under perfect foresight, an imminent devaluation induces corresponding expectations which reduce the money demand (cf. equation (1')). As a result, reserves must be run down at a faster rate in the period of the regime switch than in previous periods where there were no devaluation expectations. This is why the actual collapse

occurs prior to \bar{t} , as indicated by equation (9). Specifically, the devaluation expectations are $\dot{s} = \mu/\alpha$ and induce a drop in reserves of $\dot{R} = R_0 - \mu(\bar{t} - 1)$.

3.2. Foreign Borrowing of Commercial Banks

This section explicitly takes account of the intermediary role of domestic banks and models their decision to borrow from abroad.⁶ Internal and external financial liberalization have thus already taken place. We assume that the initial domestic money stock is owned by households. Enterprises thus have to meet their financing needs through borrowing. However, due to asymmetries in information, only high-quality borrowers such as banks can raise funds from abroad. Domestic enterprises can thus only access the international capital market through commercial banks.⁷ By implication, domestic commercial banks can charge a spread over the international interest rate on the domestic loan market

$$(10) \quad i_L > i^*_L + \frac{\dot{s}^e}{s} + rp$$

where i_L = expected return on domestic lending.⁸ We assume that there are no domestic deposits and that banks have no equity when they start operations. Hence, they finance their domestic lending exclusively with foreign loans. This, together with the fact that the return on domestic lending is stochastic, implies that foreign lenders face a positive probability of receiving less than the contractually agreed return. $(i^*_L + rp)$ in (10) therefore must be interpreted as the expected return received by foreign lenders. Because they observe only the expected return on domestic lending, they demand a positive risk premium ($rp > 0$).⁹ In contrast to the previous analysis, the assumption that domestic and foreign assets are perfect substitutes has

⁶ We thus retain the assumption that the central bank cannot borrow from abroad in order to replenish its foreign exchange reserves. This assumption is relaxed in Obstfeld (1986) and Buiter (1987). Our results would remain the same, however, if we looked at the consolidated accounts of the domestic banking system, i.e., of the central bank and of commercial banks. Note in addition that the reduction of foreign reserves of the central bank is conceptually identical to an increase in the bank's net foreign liabilities.

⁷ To the extent that direct loans from abroad are often guaranteed by commercial banks, the results of our analysis would not change if we allowed for direct borrowing. If domestic firms raise non-guaranteed loans and have assets in domestic currency only, a similar link between enterprise net worth and balance of payments crises could be analyzed.

⁸ In order to simplify the exposition, we drop time subscripts.

⁹ We abstract from the fact that raising the interest rate may lead to adverse selection and credit rationing. See also Agénor (1997) for an analysis of the effect of an unexpected increase of the country risk premium (Tequila effect) on borrowing behavior due to an exogenous shock such as a currency crisis elsewhere.

thus been relaxed. The risk premium will be shown to depend on the net worth of commercial banks and reflects the presence of asymmetries in information on credit markets.

Assuming that the country's banking industry consists of n identical banks, total foreign borrowing in domestic currency terms is $n \cdot F$. We assume that in the initial period $t = 0$ the demand for domestic currency increases because, in addition to households, enterprises now also want domestic currency. Hence, domestic enterprises borrow currency from commercial banks. Domestic banks take out foreign currency loans of infinite maturity at the interest rate given by the RHS of (10) above and exchange the foreign currency for domestic currency at the central bank at the fixed exchange rate. Then they extend domestic currency loans of infinite maturity to domestic enterprises at the interest rate given by the LHS of (10). Hence, initial foreign reserves increase by the amount of foreign borrowing $R'_0 = R_0 + nF$. Real money demand is now given by¹⁰

$$(1'') \quad \frac{M_t^D}{P_t} = a_0 - a_1 i_0 + \frac{nF}{P_t}$$

and the initial equilibrium on the domestic money market becomes $R'_0 = \alpha \bar{i} + nF - D_0$. Subtracting the amount of the foreign loan from both sides of the equation shows that with foreign borrowing both the fixed exchange rate and the stock of domestic debt remain unchanged. The collapse of the fixed exchange rate now occurs at

$$(9'') \quad \bar{i} = \frac{1}{\mu} (R_0 + nF) - \frac{a_1}{\alpha}$$

Because of the higher stock of initial reserves that can be depleted, the time until the collapse is delayed:

$$\frac{\partial \bar{i}}{\partial F_0} = \frac{n}{\mu} > 0$$

Hence, a greater inflow of foreign capital lengthens the time until a fixed exchange rate must be abandoned. Inter alia, it is obvious from (9'') that, for a given amount of foreign borrowing, an increase in the fiscal deficit will speed up the collapse of the exchange rate peg as was the case in the model without foreign borrowing:

¹⁰ Because asymmetries in information affect the credit market only, we retain the assumption that uncovered interest parity holds for private depositors, i.e. the interest rate relevant to money demand remains as before.

$$(9'') \quad \frac{\partial \bar{t}}{\partial \mu} = -\frac{R_0 + nF}{\mu^2} < 0$$

So far, we have treated the inflow of foreign capital as exogenous. The following section will show how a reduction in the net worth of commercial banks reduces the time until a collapse occurs: as the net worth of banks declines, their borrowing capacity on the international capital market is reduced. Foreign liabilities rise more slowly, and \bar{t} declines.

3.3. *Endogenous Changes in Banks' Net Worth*

The net worth of commercial banks is not exogenous but is rather affected by expectations of exchange rate changes. This can be shown by explicitly introducing the profit function for a representative domestic bank. In the initial period, the bank raises foreign loans to finance domestic loans. Both have infinite maturity. Interest at rates fixed in the initial period is payable in each following period. However, the domestic currency cost of the interest due on the foreign loan depends not only on the interest rate, but also on the exchange rate, its rate of depreciation, and on a risk premium. The added cost of the exchange rate depreciation is zero while the fixed exchange rate regime lasts and rises after its collapse. The representative bank's net worth equals the present value of its expected profit

(11)

$$\begin{aligned} E[\Pi] &= F(i_L - i^* - rp) \int_0^{\bar{t}} e^{-i^*t} dt + F i_L \left(\int_0^{\bar{t}} e^{-i^*t} dt + \int_{\bar{t}}^{\infty} e^{-\left(i^* + \frac{s_j}{\bar{s}}\right)t} dt \right) - F(i^* + rp) \left(\int_0^{\bar{t}} e^{-i^*t} dt + \int_{\bar{t}}^{\infty} \frac{s_L}{\bar{s}} e^{-\left(i^* + \frac{s_j}{\bar{s}}\right)t} dt \right) - K \\ &= F \cdot B \left(i_L - i^* - rp + i_L \int_0^{\infty} e^{-\lambda t} dt - \frac{i^* + rp}{\bar{s}} \int_{\bar{t}}^{\infty} s_t e^{-\lambda t} dt \right) - K \\ \text{where } B &= \int_0^{\bar{t}} e^{-i^*t} dt > 0 \quad \text{and} \quad A = \int_{\bar{t}}^{\infty} i^* + \frac{s_j}{\bar{s}} dj > 0 \end{aligned}$$

where K = fixed cost of financial intermediation such as information costs, \bar{t} = the point in time when the fixed exchange rate regime collapses, \bar{s} = fixed exchange rate prevailing prior to the collapse, and $i^* + \frac{s_j}{\bar{s}}$ = discount factor. The balance sheet restriction in domestic currency terms is $F = L$.

We assume that the risk premium that the bank has to pay on the international market is negatively related to its net worth and thus to expected profits¹¹

$$\frac{\partial \text{rp}}{\partial E(\Pi)} = \text{rp}' < 0$$

Hence, we essentially assume an asymmetric information framework. Under symmetric information, a bank's borrowing capacity would not be tied to its net worth, that is to its ability to pledge collateral. Under asymmetric information, however, access to the credit market is crucially affected by net worth. A similar point is made by Mishkin (1997) who argues that a devaluation of the domestic currency worsens the net worth of firms and aggravates problems in the domestic economy linked to asymmetries in information:

When debt contracts are denominated in foreign currency, an unanticipated depreciation or devaluation of the domestic currency increases the debt burden of domestic firms. Since assets are typically denominated in domestic currency, there is no corresponding rise in the value of firms' assets. The result is a deterioration in firms' balance sheets. The decline in net worth then increases adverse selection and moral hazard problems [...], leading to a decline in investment and economic activity. (p. 42)

However, Mishkin does not directly link this incipient decline in net worth to developments on the balance of payments.

In the initial period, the representative bank forms expectations about the future path of the exchange rate and about the collapse time. Based on these expectations, it sets the terms of domestic loan contracts. Because these loans are denominated in domestic currency, the bank incurs a short open foreign exchange position. If the exchange rate depreciates unexpectedly, the profit of the bank declines, and a banking crisis may ensue.¹² We assume that the representative bank behaves as a Cournot oligopolist facing the inverse demand curve $i_L = i_L(L)$. The bank maximizes profits by appropriately choosing the volume of its activities F , taking the for-

¹¹ Notice that $E[\Pi] > 0$ implies that the end-period equity of domestic banks is positive. If domestic households hold this equity, the induced positive effect on net wealth would raise money demand. A fall in banks' net wealth would thus not only have a negative direct impact on the collapse time but also a negative indirect impact through the decline in money demand. Because both effects run in the same direction, we have neglected the second channel.

¹² A recent empirical study seems to have an opposite result. In analyzing banking crises in developed and developing countries, Demirgüç-Kunt and Detragiache (1997) find that banking crises are unrelated to exchange rate changes. However, crises are related to a deterioration in the balance of payments position and to the open foreign exchange position of commercial banks. Unfortunately, the authors do not report evidence which allows an assessment of the possible correlation between these variables and the exchange rate.

own interest rate, and the responses of other banks as given. The optimal demand for foreign loans is determined by the bank's first and second order conditions for a profit maximum

(12)

$$\frac{\partial E[\Pi]}{\partial F} = B \left[i_L + F \frac{\partial i_L}{\partial F} - i^* - rp + \left(i_L + F \frac{\partial i_L}{\partial F} \right) \int_{\bar{t}}^{\infty} e^{-\Lambda t} dt - \frac{i^* + rp}{\bar{s}} \int_{\bar{t}}^{\infty} s_t e^{-\Lambda t} dt \right] = 0$$

$$\frac{\partial^2 E[\Pi]}{\partial F^2} < 0$$

For simplicity, we assume that the individual bank ignores the effect that its decision has on the timing of the collapse and on the exchange rate that prevails after the collapse, i.e., $\partial \bar{t} / \partial F_i = \partial s_t / \partial F_i = 0$. Equation (12) determines the optimal amount of foreign borrowing.

We focus our comparative static analysis on the effect of a decline in the expected return on domestic lending and its negative effect on the balance of payments. The response in the optimal amount of foreign borrowing to a decline in the expected return i_L is given by

$$(13) \quad \frac{\partial F^*}{\partial i_L} = - \frac{E[\Pi]_{F i_L}}{E[\Pi]_{FF}}$$

Because from (12) we know that the denominator of (13) is always negative at the bank's optimal scale of activities, we need to look at the numerator only

$$(14) \quad E[\Pi]_{F i_L} = \frac{\partial E[P]_F}{\partial i_L} \Big|_{d\tau=0} + \frac{\partial E[P]_F}{\partial rp} \frac{\partial rp}{\partial E[P]} \frac{\partial E[P]}{\partial i_L}$$

$$= B \left(1 + \int_{\bar{t}}^{\infty} e^{-\Lambda t} dt \right) \cdot \left[1 - rp' FB \left(1 + \frac{1}{\bar{s}} \int_{\bar{t}}^{\infty} s_t e^{-\Lambda t} dt \right) \right] > 0$$

From (9') we know that a decline in foreign borrowing by banks speeds up the collapse, and we thus obtain:

$$(15) \quad \frac{\partial \bar{t}}{\partial i_L} = \frac{\partial \bar{t}}{\partial F} \frac{\partial F}{\partial i_L} > 0$$

Hence, an exogenous fall in the expected return on domestic lending would speed up the collapse of the fixed exchange rate even in the absence of government intervention to bail out banks which would fuel money supply. If we interpret the fall in domestic returns as a fall in asset prices, which is essentially the story of Krugman (1998), we can thus show how such a

negative exogenous shock to the domestic banking system can trigger a balance of payments crises.

In addition, an exogenous increase in the government deficit would lead to a collapse of the system. Because this result is essentially the same as in the standard speculative attack literature, we do not derive it in detail. Notice, however, that the impact of a devaluation on banks' net worth speeds up the timing of a collapse¹³

$$(16) \quad \frac{\partial \bar{t}}{\partial \mu} = \left. \frac{\partial \bar{t}}{\partial \mu} \right|_{dF=0} + \frac{\partial \bar{t}}{\partial F} \cdot \frac{\partial F}{\partial \mu} = -\frac{R_0 + nF}{\mu^2} + \frac{n}{\mu} \frac{\partial F}{\partial \mu} < 0$$

Comparing (16) to (9''), the negative second term shows that the timing of a collapse of a fixed exchange rate regime is speeded up if the effect of an increase in μ on the foreign borrowing of banks is taken into account. This comparative static result is depicted in Graph 1. The increase in the fiscal deficit causes the D_0D curve to pivot upwards around D_0 and the R_0R curve to pivot downward around R_0 . The resulting decline from \bar{t} to \bar{t}' in the time until the collapse occurs is a standard Flood and Garber effect without the feedback (9''). However, the feedback from the expected faster collapse causes the R_0R curve and the M_0M curve also to shift downwards. This further precipitates the collapse to \bar{t}'' .

In the framework of our model, at least two policy options to cut the link between banking and balance of payments crises can be discussed. *First*, capital controls could be introduced to shield banks from adverse exchange rate shocks. If private households were forced to hold domestic assets only, banks could obtain refinancing from the domestic market. Notice, however, that in this scenario the underlying framework of the speculative attack model would not apply anymore. *Second*, a (non-interest bearing) minimum reserve requirement r on foreign loans could be introduced. The bank's profit function (11) and the first order condition (12) would then become

$$(11') \quad E[\Pi] = F \cdot B \left(i_L(1-r) - i^* - rp + i_L \int_{\bar{t}}^{\infty} e^{-\Lambda t} dt - \frac{i^* + rp}{\delta} \int_{\bar{t}}^{\infty} s_t e^{-\Lambda t} dt \right) - K$$

(12')

$$\frac{\partial E[\Pi]}{\partial F} = B \left(i_L(1-r) - i^* - rp + i_L \int_{\bar{t}}^{\infty} e^{-\Lambda t} dt - \frac{i^* + rp}{\delta} \int_{\bar{t}}^{\infty} s_t e^{-\Lambda t} dt \right) + F B \frac{\partial i_L}{\partial F} (1-r) \left(1 + \int_{\bar{t}}^{\infty} e^{-\Lambda t} dt \right) = 0$$

¹³ A detailed derivation of this result can be obtained from the authors upon request.

The response of the optimal demand for foreign loans to an increase in the reserve requirement is given by

$$(16) \quad \frac{\partial F^*}{\partial r} = -\frac{E[\Pi]_{Fr}}{E[\Pi]_{FF}}$$

Again, we only need to focus on the numerator, which is given by

$$(16') \quad E[\Pi]_{Fr} = \left. \frac{\partial E[\Pi]_F}{\partial r} \right|_{dr=0} + \frac{\partial E[\Pi]_F}{\partial p} \frac{\partial p}{\partial r} = -Bi_L \left(1 + \frac{1}{\varepsilon(L, i_L)} \right) - \frac{\partial r p}{\partial r} \left(B + \frac{1}{s} \int_i^{\bar{s}} s_i e^{-\Lambda} dt \right)$$

where the first term of (16') being negative if at the bank's optimal loans supply the demand for loans is interest elastic $\varepsilon(L, i_L) < -1$ ¹⁴ and the second term being positive if the risk premium declines when the reserve requirement increases. Hence, introducing a reserve requirement has two opposing effects on the amount of foreign borrowing (and thus on the collapse time). On the one hand, the return on domestic lending would decline, causing a reduction in borrowing. On the other hand, the risk premium would decline, causing an increase in borrowing. Assuming that the first effect dominates, we can thus not rule out that the introduction of a reserve requirement would speed up the collapse of a foreign exchange regime, rather than enhancing its sustainability.¹⁵

4. Magnitude of the Feedback Effect – Some Stylized Facts

Changes in exogenous variables such as an increase in the government deficit can explain why banking and balance of payments crises happen simultaneously. Negative shocks affect both the net worth of commercial banks and the balance of payments position of an economy. However, the empirical evidence reported by Kaminsky and Reinhart (1996) also suggests that banking crises precede balance of payments crises. This could be the case because the net worth of commercial banks reacts faster to changes in the external environment and/or because (exogenous) changes in the net worth of banks have a feedback effect on the balance of payments. For this to be the case, capital inflows channeled through commercial banks must be sufficiently large in order to affect the overall balance of payments position of an economy. The importance of the alternative feedback channel (a deterioration in the balance of payments worsens the net worth of commercial banks) depends on the foreign exchange exposure of

¹⁴ Under our assumption of imperfect competition on the loan market, this condition indeed holds.

¹⁵ Notice that a similar effect would be obtained for a differential reserve requirement on domestic and foreign liabilities.

banks. In this section, we present some highly stylized facts which allow us to gauge the empirical relevance of these effects for selected transition economies.

Taking into account that our main effect also works into the opposite direction, the sequence of events during the transformation process could be as follows:

1. The transformation process leads to a positive interest rate differential. Capital flows in through commercial banks. Expectations of (nominal) exchange rate appreciation raise the net worth of banks and may cause additional capital inflows.
2. The government deficit increases, and the current account balance worsens.
3. Expectations of a devaluation (and also poor lending decisions of the past) reduce the net worth of banks, and the banks have to pay higher risks premi \grave{a} on the international capital market. A banking crisis ensues. Because of the decline in banks' net worth, the capital account worsens.
4. A speculative attack eventually occurs, and the exchange rate is realigned. Banks' net worth possibly decreases further, and the government may have to bail out the banks.¹⁶

4.1. *Capital Flows Through Commercial Banks*

Table 2 shows the share of gross and net capital inflows channeled through commercial banks for the years 1989 through 1996 for selected Central European countries as well as for Mexico and Thailand. We restrict our analysis of the transition economies to four of the more advanced reform states, i.e., to the Czech Republic, Estonia, Hungary, and Poland. An analysis of the Russian case is somewhat beyond the scope of this paper because substantial capital flight characterized the reform process until very recently. Yet, even in Russia have commercial banks been both gross and net importers of capital.

When analyzing the data, the following caveats should be borne in mind:

First, a lack of comprehensive data constrains our analysis. Time series for the Czech Republic and for Estonia only start in 1992/93, and data for 1996 have not been available for Poland. Generally, data on foreign direct investment and on portfolio investment in the banking sector have not been available. Hence, we only look at changes in loans raised by commercial banks and compare these to total inflows of capital.

Second, in order to determine the total effect of changes in banks' net worth on the borrowing capacity of an economy, it would be necessary to take into account the liabilities

¹⁶ The effect would be similar as in Velasco.

that commercial banks assume indirectly be guaranteeing loans of the corporate sector. However, consistent data on such guarantees have not been available. Also, we cannot capture the impact that a loss of confidence in the domestic financial system has on the overall creditworthiness of an economy.

Third, analyzing the magnitude of capital inflows through commercial banks does not allow us to clearly discriminate between our model and other models which include market imperfections. If we were to find a significant role of commercial banks in intermediating foreign capital, this may also be due to the fact that an underpriced deposit insurance allows banks to borrow excessively. Hence, we complement our analysis by data on the net foreign assets and the profitability of banks, two variables which are central to our line of reasoning.

The experience during the most prominent recent currency crises of Thailand (1997) and Mexico (1995) shows that links between banking and balance of payments crises are more complex than our simple empirical analysis suggests (Table 2). In the case of Thailand, capital imports through commercial banks prior to the crisis were substantial, accounting for 55 percent of net capital inflows between 1994 and 1996. In the case of Mexico, in contrast, foreign debt was built up through commercial banks particularly between 1989 and 1991. In the three years prior to the crisis (1992-1994), the share of banks in net capital imports was only slightly above 7 percent. After and during the crisis, however, Mexican banks were important net exporters of capital. In Thailand, capital imports through commercial banks already declined prior to the crisis when the country was still a capital importer.

The role of banks in intermediating foreign capital flows has also differed substantially among the transition countries of Central and Eastern Europe. With the notable exception of Hungary, foreign liabilities of commercial banks surged particularly in 1995 and 1996.

- The importance of banks in raising external finance in the transition economies under review has been most important in the *Czech Republic* (see also UNECE 1997: 166). Here, banks contributed about 22 percent to total capital inflows throughout the transition period. Yet, net inflows through banks already fell substantially in 1996. This can be taken as weak evidence in support of the hypothesis that inflows through banks level off prior to the actual balance of payments crisis.¹⁷ Data of the Czech National Bank also imply that commercial banks were an important channel for foreign capital inflows only up to the second quarter of 1996 (CNB 1997). Since then, the external indebtedness of commercial banks increased at a

¹⁷ Notice, in addition, that the Czech National Bank widened the exchange rate band of the Koruna in February 1996 hereby increasing the exchange rate risk of foreign investors and initiating a withdrawal of deposits (UNECE 1997: 163).

much lower pace.¹⁸ Consequently, the share of commercial banks in Czech foreign liabilities increased from about 10 percent in 1992 to almost 40 percent in 1996 (Table 3).

- Commercial banks in *Estonia* made a substantial contribution to capital inflows in the years 1995 and 1996. According to data by the Bank of Estonia for the first half of 1997, commercial banks again accounted for about 20 percent of net capital inflows (Eesti Pank 1997). Yet, during 1992 and 1994, when the economy as a whole imported foreign capital, were commercial banks net exporters of capital.
- The role of commercial banks in *Poland* has likewise changed over time. Between 1988 and 1992, gross capital inflows were negative and so were gross flows through commercial banks. During the period of positive capital inflows (1993-Q2 1995), however, the share of commercial banks was quite significant (61.3 percent). Overall, Polish commercial banks were importers of capital while aggregate capital inflows were negative during the period under review.
- The contribution of *Hungarian* commercial banks to gross and net capital inflows was minor. In contrast to the *Czech* case, the share of commercial banks in Hungarian foreign liabilities thus increased only slightly from 4 to 4.9 percent between 1993 and 1996 and even declined if only private liabilities are considered (Table 3).

Table 5 breaks down bank lending to selected countries by maturity and type of borrower for December 1995 through mid-1997. Whereas in Asia and Latin America the share of short-term loans has remained roughly stable at values slightly above 60 and 50 percent, respectively, this share has risen quite substantially from about 40 to 50 percent for the transition economies – Hungary being the notable exception. This share is a few percentage points above average in the Czech Republic and Russia, but has risen most sharply in Poland. In mid-1997, commercial banks were far more important channels of foreign loans in Eastern Europe (53 percent of total loans) than in Asia (39 percent) or Latin America (24 percent), the largest share being reported for the Czech Republic. Although the share of banks has been on a decline in Eastern Europe as a whole, these data suggest that the potential link between banking and balance of payments problems could be relatively strong.

¹⁸ Between the end of 1992 and mid-1997, did the increase in commercial banks' long-term foreign liabilities account for 54 percent of the total increase in long-term liabilities (CNB 1997). Banks did also build up quite substantial foreign assets. Because data on the short-term liabilities of banks have not been available, it is difficult to assess the change in total net foreign assets on the basis of the CNB-data. Assuming that banks' short-term liabilities increased, commercial banks were net importers of foreign capital. Hence, while the Czech Republic in the aggregate increased its net foreign assets, commercial banks are unlikely to have raised their net foreign assets between 1993 and 1997.

4.2. *Net Foreign Assets of Commercial Banks*

While the share of banks in capital imports gives an idea of the possible feedback effects running from banking crises to balance of payments crises, looking at the foreign exchange exposure of banks allows an analysis of the reverse feedback channel. Graph 2 plots data on the net foreign assets of commercial banks relative to total assets. Net foreign assets are defined as the difference between total foreign currency assets and foreign currency liabilities, expressed in domestic currency terms. If assets exceed liabilities, a bank has an open long position in foreign currency: a devaluation of the domestic currency raises the value of its net foreign assets. Conversely, a devaluation raises net liabilities if a bank has a short open position. To some extent, the data in Graph 2 give a misleading picture of the foreign exchange exposure because the maturity structure and the currency structure of foreign assets and liabilities are not considered. Also, the data do not show whether banks have hedged their foreign currency risk through, for example, forward contracts.

For the case of Mexico it may look as if the banks' exposure to foreign exchange risks had been fairly small and constant prior to the crisis of 1995. Yet, as Mishkin (1997) argues, commercial banks' net worth was negatively affected by the depreciation of the peso. The devaluation sharply increased the value of foreign liabilities of commercial banks. Even if the banks had matching foreign currency assets, they were often not hedged against exchange rate risk because of the credit risk involved. Also, banks with short-term liabilities and long-term assets were exposed to liquidity risk.

Net foreign assets of Thai commercial banks had declined significantly prior to the balance of payments crisis in 1997. To some extent, the significant decline in net foreign assets is also due to fact that an offshore banking center, the Bangkok International Banking Facility (BIBF), through which foreign currency loans have been granted, had been established in 1993 (Dekle and Pradhan 1997, BIS 1997a). Hence, former domestic interbank loans from foreign parent banks to their Thai subsidiaries may now have been booked as short-term loans from abroad, leading to a reported increase in the foreign liabilities of Thai banks. Anecdotal evidence suggests that Thai banks and firms had accumulated sizable unhedged foreign debts prior to the exchange crisis of 1997 (The Economist 9.8.1997, BIS 1997b). The Bank of Thailand had reacted to the increased foreign exchange exposure of commercial banks already in 1995 by, for example, imposing ceilings on banks' net foreign liabilities (BIS 1997a: 113).

The past couple of years witnessed a significant decline in the net foreign assets of Central and Eastern European banks. Net foreign assets of Polish commercial banks stood at above 10 percent of total assets between early 1990 and the end of 1994. Subsequently, they declined to about five percent at the end of 1996. Net foreign assets of Hungarian banks,

started to decline already in late 1993, and were negative since early 1994. Similarly, the net foreign assets of Czech and Russian banks declined continuously since 1993. At the end of 1996, Russian banks' net foreign assets were practically zero, and a large proportion of the banks' foreign liabilities were unhedged (The Economist 6.12.1997). Czech and Hungarian banks had negative foreign assets by about 4-5 percent of total assets. Net foreign assets of Estonian banks fell even more drastically from 40 percent of total assets at the end of 1991 to values barely above zero in 1997.

4.3. *Profitability of Commercial Banks*

A final piece of evidence that allows us to study the links between banking and balance of payments crises is information about the profitability of banks. If the story that changes in banks' net worth affect the risk premium that banks face on the international capital market has some truth to it, banks' capital imports should be related to their profitability. Yet, obtaining reliable profit figures for banks in transition economies is notoriously difficult because of adjustments in accounting standards and because of the underreporting of nonperforming assets. During the transformation process, nonperforming loans on the balance sheet of banks have been pervasive, and the true quality of assets has only gradually been brought to the surface. Lacking better sources, Table 4 draws on publicly available information on bank profitability.

The data provide fairly little support to the hypothesis that changes in the (expected) profitability of commercial banks due to increased reporting of non-performing loans deterred foreign investors from lending to domestic commercial banks. It seems that particularly commercial banks in the Czech Republic were able to borrow from abroad despite extremely high levels of classified assets. One possible explanation is the fact that these high non-performing loans did in the aggregate not cause losses in the domestic banking system. At least until 1995, Czech banks reported positive profits and as many as four Czech banks were ranked among the ten largest Central European banks in terms of capital assets in autumn 1997 (The Banker 1997).

The profitability of Hungarian banks in 1992 and 1993 as well as of Polish banks in 1993 and 1994 was negative, in contrast. This may explain why banks had limited access to the international capital market. Consequently, for Poland, the recovery of profits in 1995 and 1996 should have increased the borrowing capacity of commercial banks. In Estonia, finally, banks which survived the banking crisis of 1992/93 showed quite healthy profits in subsequent years and should have thus faced relatively favorable borrowing terms on international markets.

In summary, the empirical evidence lends support to the hypothesis that the currency crisis of Thailand in 1997 was preceded by large inflows of foreign capital through commercial banks, and that these inflows reversed during the crisis. While net inflows through banks prior to the Mexican crisis were less significant, capital exports through banks during and after the crisis were substantial. Some reversal of commercial banks' capital imports could also be observed during the recent Czech crisis. A comparison between the data of the Central European countries and those of Thailand shows that inflows through commercial banks were at least temporarily of similar importance in the Czech Republic, in Poland, and in Estonia. Hungarian banks, in contrast, played a relatively unimportant role. Bank balance sheet data show that net foreign assets of banks in the transition economies under review declined in recent years. *Ceteris paribus*, this should increase the banks' exposure to adverse exchange rate shocks and lower their propensity to borrow from abroad in the future. The evidence on the links between bank profitability and capital inflows through banks is somewhat mixed. As foreign investors are becoming more aware of potential banking crises, risk premia are likely to increase.

5. Outlook

This paper has given one explanation for the empirical observation that banking and balance of payments crises often occur simultaneously. It has focused on the fact that the net worth of domestic banks which borrow internationally and lend domestically is negatively affected by (unexpected) exchange rate changes. A decline in banks' net worth, in turn, raises the risk premium that banks have to pay on the international capital market and lowers the amount of foreign borrowing. Hence, the collapse of a fixed exchange rate regime is speeded up. Adverse shocks to domestic fundamentals such as a decline in the expected return on domestic lending, an increase in non-performing loans, or an increase in the government deficit could lead to a foreign exchange crisis.

There are two ways of viewing the links between banking and balance of payments crises. As in the traditional literature, pegged exchange rates which are inconsistent with domestic fundamentals can cause twin crises, even more so because they may induce banks not to take exchange rate risks into account and thus to borrow excessively. Yet, twin crises can also ensue in the absence of macroeconomic disequilibria if a negative shock reduces the net worth of domestic financial institutions. Such a negative shock could be an increase in non-performing loans of commercial banks, a sudden decline in asset prices, or the withdrawal of a government guarantee to bail out distressed commercial banks. The resulting decline in the expected return on domestic lending would reduce the net worth of commercial banks, increase the risk premium, and lead to a decline in foreign borrowing. This, in turn, would speed up the collapse of

a fixed exchange rate regime. Our results thus stress the need to make external financial liberalization an integral part of a consistent domestic reform package.

In addition, our model holds the following implications:

- In contrast to other work, we have abstracted from distortions in the domestic financial system caused by free deposit insurance. Yet, we wish to stress that our model offers *an additional* explanation for the links between banking and balance of payments crisis. Rather than underrating the importance of improving banking supervision and of reforming deposit insurance, it strengthens the results of previous work.
- Our most important policy conclusion is the crucial need to monitor the short open foreign exchange position of banks, to limit exposure to foreign exchange risks, and to back foreign exchange exposure by equity.¹⁹ Instead of fixing limits for foreign exchange risks individually, it is important to take correlations between foreign exchange risks and other risks into account.
- One way to reduce feedback effects between banking and balance of payments crises could be to restrict cross-border capital movements. However, this would have the adverse effects of shielding domestic commercial banks from foreign competition and of restricting investment to domestic savings. Likewise, our results lead us to caution against the introduction of minimum reserve requirements on foreign borrowing because these may have the unwanted effect of speeding up rather than delaying a foreign exchange crisis.

The limited empirical analysis of this paper suggests that the feedback effects running from banking to balance of payments problems and thus the tendencies of crises to be self-enforcing differ between countries. Even though the net foreign assets of Central and Eastern European banks mostly exceed those of Thailand and Mexico, there was a continuous decline in net foreign assets and thus presumably an increase in banks' exposure to foreign exchange risks. All countries with the exception of Hungary saw substantial imports of foreign capital through commercial banks and thus appear vulnerable to shocks that cause a decline in banks' net worth. Analyzing the exposure of the countries under review to full-fledged currency crises, however, would require an analysis of a number of additional factors such as developments of foreign trade, of the real exchange rate, and of the budget deficit.

¹⁹ Banking supervisors are becoming increasingly aware of the need to monitor exchange rate risks. In Estonia, for example, foreign liabilities of commercial banks have been subject to an increased minimum reserve requirement since October 1997 (Handelsblatt 1997).

*Tables and Graphs**Table 1 — Summary of the Literature*

Model	Sequence of events	Main cause of crises
Calvo (1995)	Positive domestic shock triggers capital inflows. Exogenous bank run leads to a bail out of commercial banks through the central bank. Under the assumption that interest rates are small, a bank run speeds up a balance of payments crisis.	Free deposit insurance (lender of last resort facility).
Goldfajn/Valdés (1997)	Adverse productivity and foreign interest rate shocks. Balance of payments crises are aggravated by a run on commercial banks' deposits.	Banks transform maturities and are exposed to liquidity risk due to bank runs.
Krugman (1998)	Financial intermediaries lend excessively which causes an asset price inflation. Asset price bubble bursts, insolvency of financial intermediaries becomes evident. Government steps in and fixed exchange rate becomes unsustainable (!)	Implicit government guarantee of banks' liabilities
McKinnon/Pill (1995)		Distorted microeconomic environment, free deposit insurance and insufficient supervision. Asymmetries in information about state of domestic economy.
Miller (1996)	Balance of payments crisis occurs first. Liquidity crisis of banks lengthens time until a speculative attack.	Balance of payments crisis triggers bank run.
Velasco (1987)	Adverse external shock. Banking distress (banks are insolvent but not illiquid) occurs prior to balance of payments crisis.	Free deposit insurance.

Table 2 — Capital Imports Through Commercial Banks 1989-1995

	1989	1990	1991	1992	1993	1994	1995	1996	Ø ^a
<i>Gross capital imports through commercial banks (bn US-Dollar)</i>									
Czech Republic	...	...	...	...	4	888	3310	2827	7028
Estonia	...	...	...	7	7	38	82	174	382
Hungary	...	...	-359	-29	-69	365	321	394	747
Mexico	680	9061	7845	1626	3622	2799	-5297	-4035	13065
Poland	-837	-769	-440	437	114	609	281	...	-10269
Russia	...	...	...	...	...	1032	2482	4490	8099
Thailand	699	1027	213	1757	3589	14295	13218	2909	41693
<i>Net capital imports through commercial banks (bn US-Dollar)</i>									
Czech Republic	...	...	...	...	39	725	3086	362	4211
Estonia	...	...	...	-41	-38	-65	41	195	107
Hungary	...	...	-243	588	-197	556	445	-735	531
Mexico	-39	8312	6748	1648	1939	1914	-6807	-4762	6795
Poland	-434	-4923	-1207	-386	710	2324	4225	...	-9381
Russia	...	...	...	...	...	-831	7280	2094	10195
Thailand	699	1027	213	1862	3324	13268	10482	5650	37509

(continues on next page)

.... Table 2 (continued)

	1989	1990	1991	1992	1993	1994	1995	1996	Ø ^a
<i>Share of commercial banks in gross capital imports (%)</i>									
Czech Republic	...	...	...	...	0.1	12.3	29.9	43.6	22.5
Estonia	...	...	...	4.8	2.1	11.1	22.3	25.8	17.8
Hungary	...	...	-24.1	-3.4	-1.3	12.0	4.9	-101.4	4.4
Mexico	29.8	52.9	30.0	7.6	9.7	13.1	169.2	-38.2	9.4
Poland	45.8	16.9	12.5	-49.2	44.7	591	21.9	...	53.9
Russia	...	...	...	...	...	-12.2	-20.9	58.8	-63.9
Thailand	10.1	10.9	1.8	18.5	47.1	104.4	51.8	16.3	37.2
<i>Share of commercial banks in net capital imports (%)</i>									
Czech Republic	...	...	...	...	1.6	16.1	37.5	8.9	21.8
Estonia	...	...	...	-158.3	-20.0	-39.2	17.7	33.0	7.8
Hungary	...	...	-16.5	141.4	-3.2	16.5	6.7	51.8	3.3
Mexico	-3.5	98.5	26.8	6.1	5.7	12.1	64.9	-115.6	6.3
Poland	28.5	57.0	28.3	23.1	77.4	201.9	83.3	...	49.0
Russia	...	...	...	...	...	2.7	-53.5	-7.8	-14.3
Thailand	10.6	11.3	1.8	19.6	31.7	109.1	47.8	29.0	35.8
<i>In Italics:</i> Underlying total gross (net) capital flow was negative. Gross capital inflows = Capital account (credit) + change in FDI in reporting economy + change in portfolio investment (PI) liabilities + change in other investment (OI) liabilities, Net capital inflows = Capital account + financial account, Gross capital inflows through banks = change in OI banks' liabilities, Net capital inflows through banks = change in OI banks' liabilities + change in OI banks' assets. Use of IMF credit and exceptional financing are not considered as capital inflows. a) 1993-1996 for the Czech Republic, 1990-1996 for Hungary, 1988-1995 (Q2) for Poland, 1994-1997 (Q1) for Russia, 1992-1997 (Q1) for Estonia, 1988-1996 for Thailand, 1988-1997 (Q2) for Mexico.									

Sources: IMF (1997).

Table 3 — Structure of Foreign Liabilities 1992–1996

	1992	1993	1994	1995	1996
<i>Share of banks in total foreign liabilities (%)</i>					
Czech Republic	9.6	7.8	12.8	31.3	39.2
Hungary	...	4.0	4.6	5.3	4.9
<i>Share of banks in private foreign liabilities (%)</i>					
Czech Republic	26.3	20.0	20.8	41.4	46.8
Hungary	...	37.5	30.8	26.3	20.0

Source: UNECE (1997: 158)

Table 4 — Profitability of Commercial Banks 1992–1997

	1992	1993	1994	1995	1996
<i>Return on Assets (ROA) (%)</i>					
Czech Republic ^b	...	0.3	0.4	0.2	...
Estonia	...	2.3	0.7	1.9	2.4
Hungary	-0.1	-5.8	1.0	0.4	1.0 ^a
Mexico ^b	1.7	1.8	0.6	0.4	...
Poland	2.7	-0.2	-0.0	2.0	2.5
<i>Return on Equity (ROE) (%)</i>					
Czech Republic ^b	...	8.7	11.9	5.4	...
Estonia	...	21.4	10.4	20.3	24.5
Hungary	-1.8	-103.5	14.5	4.4	11.9 ^a
Mexico ^b	28.8	28.2	9.9	...	...
Poland	54.0	-4.6	-0.1	53.7	66.6
<i>Nonperforming loans (% of total loans)</i>					
Czech Republic	18.9	23.8	37.7	34.9	34.5
Estonia	6.2	6.7	3.6		
Hungary	13.4	30.0	27.2	16.1	12.8
Mexico	...	...	10.5	14.4	12.5
Poland	26.5	31.9	29.3	20.4	12.5
Russia	2.7	12.1	31.1	33.5	19.4
Thailand	...	...	7.5	7.7	...
a) (profit/loss * 2) / total assets/equity at the end of June. — b) Based on average assets/equity.					

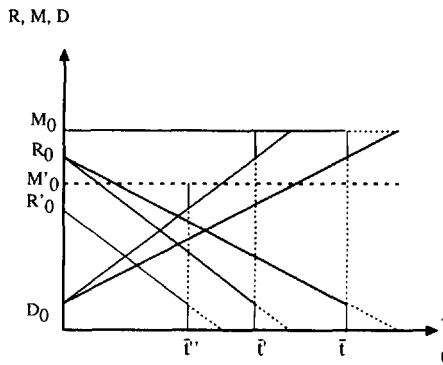
Sources: BIS (1997a), Burgtorf (1997), Eesti Pank (various issues), Golajewska/Wyczanski (1994, 1997), OECD (1996), Procházka (1996), SBS (various issues).

Table 5 — Structure of Bank Lending 1995-1997

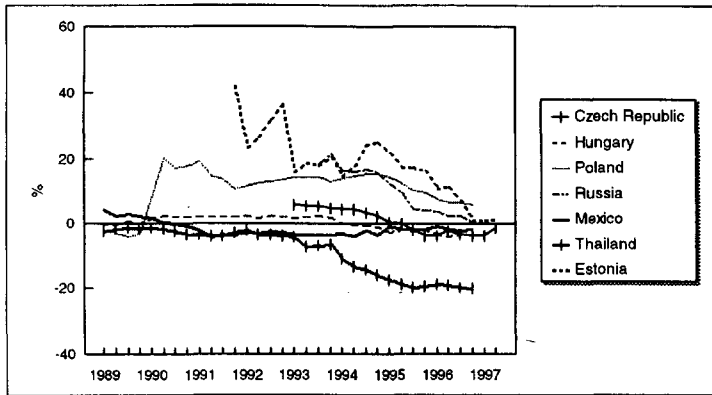
	1995	1996	1997 (June)
<i>Share of short-term loans (maturity < 1 year) (% of total loans)</i>			
Asia	63.5	61.5	62.2
Thailand	69.4	65.2	65.7
Latin America	52.3	53.7	52.3
Mexico	45.4	44.7	45.5
Eastern Europe	39.1	44.2	50.8
Czech Republic	48.6	49.3	53.4
Hungary	34.6	39.2	37.0
Poland	29.6	33.2	46.2
Russia	39.4	46.3	55.4
<i>Share of loans raised by banks (% of total loans)</i>			
Asia	40.7	40.2	39.5
Thailand	41.0	36.9	37.6
Latin America	24.6	24.2	23.7
Mexico	20.0	19.5	18.8
Eastern Europe	70.0	64.2	52.9
Czech Republic	61.3	62.3	63.6
Hungary	56.7	53.8	50.5
Poland	26.1	28.3	34.7
Russia	84.2	75.2	55.0

Source: BIS (1998)

Graph 1 — Foreign Borrowing and the Timing of the Collapse



Graph 2 — Net Foreign Assets of Commercial Banks 1989–1997



Net foreign assets = (foreign assets – foreign liabilities) / total assets

Source: IMF (1997)

References:

- Agénor, P.-R. (1997). *Borrowing Risk and the Tequila Effect*, International Monetary Fund, Working Paper No. 97/86, Washington DC.
- , J.S. Bhandari, and R.P. Flood (1992). *Speculative Attacks and Models of Balance of Payment Crises*, IMF Staff Papers, Vol. 39, No. 2.
- Backé, P. (1996). *Progress towards Convertibility in Central and Eastern Europe*. Österreichische Nationalbank. *Focus on Transition I*: 39–67.
- Bank for International Settlements (BIS) (1997a), *Annual Report 1996*, Vol. 67, Basle.
- (1997b), *International Banking and Financial Market Developments*, November, Basle.
- (1998), *The Maturity, Sectoral and Nationality Distribution of International Bank Lending, First Half 1997*, January, Basle.
- The Banker (1997), *Top 100 Central Europeans*, September 1997, Vol. 147, No. 859.
- Bernanke, B., M. Gertler, and S. Gilchrist (1994), *The Financial Accelerator and the Flight to Quality*, NBER Working Paper, No. 4789, Cambridge MA.
- Buch, C.M., and R.P. Heinrich (1997), *Financing the Transition — Risks and Benefits of Integrating into the International Capital Market*, Kiel Institute of World Economics, Working Paper, No. 818, forthcoming in: *Bank i Kredyt*, Warsaw.
- Buiter, W.H. (1987). *Borrowing to Defend the Exchange Rate and the Timing and Magnitude of Speculative Attacks*, *Journal of International Economics*, Vol. 23, No. 3/4, 221–239.
- Burgtorf, A. (1997), *Banking systems in the Czech Republic, Hungary and Poland — stability or collapse?*, *Deutsche Morgan Grenfell, Focus Eastern Europe*, 27.1.1997, 10–14.
- Calvo, G.A. (1995). *Varieties of Capital-Market Crises*, Inter-American Development Bank, Working Paper No. 306, Washington, DC.
- Czech National Bank (CNB) (1997), *Report of the Monetary Development in the Czech Republic for the First Half 1997*, Prague.
- Dekle, R., and M. Pradhan (1997), *Financial Liberalization and Money Demand in ASEAN Countries: Implications for Monetary Policy*, International Monetary Fund, Working Paper, No. 97/36, Washington DC.
- Demirgüç-Kunt A., E. Detragiache (1997). *The Determinants of Banking Crises: Evidence from Developing and Developed Countries*, International Monetary Fund, Working Paper No. 97/106, Washington DC.
- The Economist (9.8.1997), *Thailand's economic package – What the doctor ordered*, London, 52–53.
- (6.12.1997), *Russia's economy – Russian roulette*, No. 8046, London.
- Eesti Pank, *Annual Report*, various issues, Tallinn.
- (1997), *Statistical Datasheets*, 1. December 1997, Tallinn.
- Flood, R.P., and P.M. Garber (1984). *Collapsing Exchange-Rate Regimes, Some linear examples*, *Journal of International Economics*, Vol. 17, 1–13.
- Goldfajn, I., and R.O. Valdés (1997). *Capital Flows and the Twin Crises: The Role of Liquidity*, International Monetary Fund, Working Paper No. 97/87, Washington DC.

- Handelsblatt (1997), Die Zentralbank in Tallinn hat die Zügel straffer angezogen, 5.12.1997, Düsseldorf.
- International Monetary Fund (IMF) (1997), International Financial Statistics (IFS) on CD-Rom, November, Washington DC.
- Kaminsky G.L., and C.M. Reinhard (1996). The Twin Crises: The Causes of Banking and Balance-of-Payments Problems, International Finance Discussion Papers No. 544, Board of Governors of the Federal Reserve System.
- Krugman, P.R. (1979). A Model of Balance-of-Payment Crises, *Journal of Money, Credit, and Banking*, Vol. 11, 311–25.
- , (1998). What Happened to Asia?, <http://web.mit.edu/krugman/www/DISINTER.html>, 9.1.1998.
- McKinnon R.I., and H. Pill (1995). Credible Liberalizations & International Capital Flows: The „Over-Borrowing Syndrome“, Center for Economic Policy Research, Policy Paper No. 437, Stanford University, Stanford, CA.
- Miller, V. (1996). Speculative Currency Attacks with Endogenously Induced Commercial Bank Crises, *Journal of International Money and Finance*, Vol. 15, No. 3, 383–403.
- Mishkin, Frederic S. (1997), Understanding Financial Crises: A Developing Country Perspective, in: Bruno, M., and B. Pleskovic (eds.), Annual World Bank Conference on Development Economics 1996, Washington DC, 29–62.
- OECD (1996). Bank Profitability — Financial Statements of Banks. Update on CD-Rom, Paris.
- Obstfeld, M. (1986), Speculative attack and the external constraint in a maximizing model of the balance of payments, *Canadian Journal of Economics*, Vol. 29, No. 1, 1–22.
- Procházka, P. (1996) Banking Sector Development and Legal Harmonization with EU Standards — The Case of the Czech Republic, in: Radzyner, O., and P. Havlik (eds.), Monetary Policy in Central and Eastern Europe: Challenges of EU Integration, 25–30.
- State Banking Supervision (SBS), Annual Report, various issues, Budapest.
- United Nations Economic Commission for Europe (UNECE) (1997), Economic Survey of Europe in 1996–1997, New York and Geneva.
- Velasco, A. (1987). Financial Crises and Balance of Payments Crises, A Simple Model of the Southern Cone Experience, *Journal of Development Economics* 27: 263–283, Columbia University, New York.
- Wyczanski, P., and M. Gołajewska (1994), Rynki Finansowe: Zarys Analizy Wyników Działalności Banków Depozytowo-Kredytowych w Latach 1990–1993, Narodowy Bank Polski, Department Analiz i Badań, Materiały i Studia, No. 41, Warszawa.
- , — (1997) Sytuacja Finansowa Banków w 1996 R., Narodowy Bank Polski, Department Analiz i Badań, Materiały i Studia, Nr. 65, Warsaw.