Institut für Wirtschaftsforschung Halle
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Are the Central and Eastern European Transition Countries still vulnerable to a Financial Crisis? Results from the Signals Approach

Axel Brüggemann / Thomas Linne

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Diskussionspapiere
Discussion Papers

	Axel Brüggemann	Thomas Linne
Telephone:	0049 - (0)345 - 77 53 832	0049 - (0)345 - 77 53 834
Fax:	0049 - (0)345 - 77 53 820	0049 - (0)345 - 77 53 820
Email:	bgn@iwh-halle.de	thl@iwh-halle.de

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INSTITUTE FOR ECONOMIC RESEARCH HALLE (IWH)
Visitors: Kleine Märkerstraße 8, 06108 Halle
Mail: P.O. Box 11 03 61, 06017 Halle

Telephone: (0345) 77 53 - 60
Telefax: (0345) 77 53 - 820
Internet: http://www.iwh-halle.de

Abstract

The aim of the paper is to analyse the vulnerability of the Central and Eastern European accession countries to the EU as well as that of Turkey and Russia to a financial crisis. Our methodology is an extension of the signals approach. We develop a composite indicator to measure the evolution of the risk potential in each country. Our findings show that crises in Central and Eastern Europe are caused by much the usual suspects as in others emerging markets. In particular an overvalued exchange rate, weak exports and dwindling currency reserves have good predictive power for assessing crisis vulnerabilities.

Keywords:	Financial Crises; Vulnerability indicator; Central and Eastern Europe
JEL classification:	F31; F47

1 Introduction

The aim of the paper is to analyse the vulnerability of selected countries in Central and Eastern Europe to a financial crisis. Our focus is on the accession candidates to the European Union (EU) as well as on Turkey and Russia, two important countries of the region who have lived through severe crises recently. Empirical studies on emerging markets in Asia and Latin America point to an overvalued exchange rate as the main culprit in the build up of a crisis potential. This element also makes the transformation countries especially vulnerable.

At the beginning of the transformation process several countries in Central and Eastern Europe introduced a fixed or predetermined exchange rate system. The exchange rate anchor provided an effective device for guiding a disinflation programme and for establishing macroeconomic stability. However, inflationary persistence in the presence of a fixed – or predetermined – nominal exchange rate has resulted in a real exchange rate appreciation in several countries which was not matched equally by productivity gains. Consequently, the real appreciation has resulted in a decline in the competitiveness of domestic enterprises on international markets and in ongoing current account deficits reaching a share of GDP of up to 11 % for Latvia in 1998.

During the period 1996 through 2001 most of the Central and Eastern European (CEE) countries except Russia experienced an appreciation of the real exchange rate against the Euro. The appreciation was the strongest with about 30 % for Latvia and Turkey. Since the crisis in August 1998 the Russian Rouble appreciated by more than 25 %. Even the Hungarian Forint with a crawling peg arrangement appreciated in real terms by almost one fifth over this period. At the same time, the Czech Republic (December 1995), Hungary (May 1996), Poland (July 1996), and the Slovak Republic (October 2000) have already become members of the OECD. With the membership the countries had to open their capital accounts by accepting the *OECD Codes of Liberalisation of Capital Movements and Current Invisible Operations*. Although the opening of the capital account is generally beneficial for the countries as it enables a better allocation of capital, it exposed them also to the risk of a sudden and massive reversal of capital flows.

In case of financial distress the accession countries are in dilemma situation: on one hand they cannot simply turn to the IMF or other supranational organisations for financial assistance as it would ruin their chances of a rapid accession to the EU and on the other hand, the EU has no financial obligations whatsoever towards non-members.

Against this background it is important to know how stable (or vulnerable) the accessions countries are in fact prior to joining the EU. Two main strands of empirical research have been adopted to examine the vulnerability of countries to financial crises – the qualitative response approach and the signaling approach. The qualitative response approach uses mainly either a logit or a probit regression analysis to estimate the relationship between different indicators and the discrete occurrence of a currency crisis. The probit analysis has been widely used in the construction of early warning systems. The main differences of the particular models lie in the

sample of the used indicators, the country sample, the definition of a financial crisis, the time horizon for which a prognosis is given and the frequency of the employed data. Eichengreen/Rose/Wyplosz (1996) were among the first to adopt a probit model for a multi country study. They analysed the macroeconomic fundamentals of 20 industrial countries before the outbreak of the EMS crisis in 1992. Their findings did not indicate that changes in the fundamentals were a good predictor for speculative attacks on the currencies participating in the EMS. The study of Frankel/Rose (1996) was motivated by the Mexican crisis from 1994. They looked at a panel of 105 developing countries between 1971 and 1992. They found that the vulnerability of country to the occurrence of a currency crisis was increased if the level of FDI and/or the currency reserves was low and the exchange rate overvalued. The object of the study of Sachs/Tornell/Velasco (1996) was to determine which countries were hit hardest by the Mexican crisis. They found strong empirical evidence that countries with low currency reserves and weak economic fundamentals were especially vulnerable for spillover effects. The second strand of empirical research is the signals approach which uses a fundamentally different method to ascertain the risk potential in an economy. It is grouped among the non-parametric approaches and its central element lies in a comparative analysis of the behaviour of indicators during crises times and during tranquil periods. Should an indicator cross a certain threshold, a given indicator will issue a warning signal. After having determined the optimal threshold for each indicator, the signal frequency can be evaluated, which determines the crisis vulnerability of a country. Some models have further aggregated the different indicators in a composite indicator, a technique which will also be applied in our analysis. The signals approach was pioneered by Kaminsky/Reinhart (1996, 1999) and Kaminsky/Lizondo/Reinhart (1998). Until now most applications had a strong regional focus on the Asian and Latin American emerging markets, recent studies have incorporated also selected transition economies (Edison, 2000; Brüggemann/Linne, 1999). This paper builds upon this work but employs a more comprehensive focus on the emerging markets in Central and Eastern Europe.

The rest of the paper is structured as follows. The next section gives an overview of the tested variables. Sections three and four outline the signals approach and describes the construction of the composite indicator. Statistical tests on the quality of the composite indicator as an early warning instrument are presented in section five. Section six provides some country experiences against the background of the composite indicator. The final section draws some conclusions and outlines a few policy options for the transition countries in the wake of accession to the EU.

2 List of Variables

The tested variables comprise a wide range of macroeconomic and financial variables. The choice of variables is based on considerations of the theoretical and empirical literature on currency and banking crises. However, we did not attempt to capture contagion effects, which were important following the Russian crisis in August 1998. Besides their short-term nature, the evidence points to the conclusion that all crises in Central and Eastern Europe were essentially home made and were triggered

mostly by domestic events and developments. The list of explanatory variables is as follows:

- *Growth of Industrial Output.* Currency crises are often preceded by a recession. In general, an economy is more vulnerable to a crisis when economic growth slows down (Hardy/Pazarbasioglu, 1998).

- *Ratio of Budget Deficit to GDP.* This indicator corresponds to the classic Krugman-type explanation for a currency crisis. A large budget deficit is a typical source of a country's vulnerability for a crisis and signals an unsustainable economic policy. A steady rise of the budget deficit can be expected before the eruption of a crisis as the higher deficit will impair the government's willingness to service its debt (Krugman, 1979).

- *Overvaluation of the Real Exchange Rate.* Usually, a currency crisis is closely linked to an overvalued real exchange rate. A persistently overvalued currency has adverse effects on exports, growth prospects, and ultimately, a country's ability to service its debt. The variable is defined as the negative deviation of the real exchange rate from the long term trend. Three different time trends are tested: a linear, a logarithmic, and an exponential trend. The trend with the best fit serves as the benchmark (Kaminsky/Lizondo/Reinhart, 1998).

- *Ratio of Currency Reserves to GDP.* Diminishing currency reserves limit a country's ability to defend its currency, which makes a devaluation of the currency or the abandoning of the peg in case of a speculative attack more likely. Conversely, the higher a country's international liquidity, the better the cushion to defend a speculative attack against the currency (Feldstein, 1999).

- *Growth rate of Exports.* Reduced exports inhibit a country's ability to earn foreign exchange to finance an existing current account deficit. Thus, falling exports add to the crisis potential. Additionally, it is an indicator for decreasing competitiveness and possible problems of domestic enterprises (Radelet/Sachs, 1998).

- *Growth rate of Imports.* Rising imports are symptoms of an overvalued exchange rate which signals a loss of competitiveness. Through the worsening of external balances pressure can be generated on the exchange rate.

- *Growth Rate of Domestic Credit.* In the time leading up to a crisis a rapid credit expansion can usually be observed. The main reason for this stylised fact lies in lending booms that typically follow financial deregulation and the dismantling of capital controls. This may create balance sheet problems for the banks in form of non-performing loans and currency mismatches.

- *Ratio of M2 to Currency Reserves.* This ratio usually rises before speculative attacks. M2 is used as a proxy for the amount of domestic money which could possibly exchanged into a more stable currency.

- *Money Multiplier.* A rise of/in the money multiplier can point to inflationary problems in the future if the money demand remains unchanged. The resulting real appreciation of the exchange rate can put a peg under pressure.

- *Domestic Interest Rate.* Higher interest rates are one possibility to defend the exchange rate against a speculative attack. Also, higher interest rates incorporate a higher risk premium for holding the domestic currency which reflects doubts among market participants about the sustainability of the peg.

- *Interest Rate Differential.* Rising foreign interest rates may induce a sudden reversal of capital flows that put the exchange rate under pressure. A growing interest rate differential can also reflect a growing risk premium of the currency and captures an expected depreciation of the exchange rate.

- *Growth of Capital Flight.* Domestic residents usually dump their own currency ahead of a speculative attack. The main motivation for capital flight - besides tax evasion - is the fear of capital losses as a result of the expected drastic devaluation. As a proxy for the amount of flight capital the bank deposits of domestic residents with BIS-reporting banks are used.

- *Ratio of Foreign Debt to GDP.* Capital account problems can become more severe with large foreign debt. Foreign investors can question the sustainability of the debt.

- *Ratio of short-term Foreign Debt to Foreign Debt.* Following financial liberalisation, massive inflows of foreign capital often create macroeconomic imbalances that ultimately prove unsustainable. The opening of the capital account creates certain incentives for domestic banks which are characterised as an 'over-borrowing' (McKinnon/Pill, 1999).

- *Ratio of Lending Rate to Deposit Rate.* An increase in the Lending/Deposit Ratio may point to a higher risk premium and a worsening in the quality of the loan portfolio.

- *Ratio of Bank Deposits to GDP.* When a banking crisis is looming, domestic residents, who are usually better informed than foreigners, slowly loose faith in the stability of the banking sector and begin to withdraw their savings. Therefore, a drop in bank deposits can be expected before a crisis (Demirgüc-Kunt/Detragiache, 1999).

The sample periods runs from January 1993 through September 2001 and uses monthly data. Since data for GDP and Foreign Debt are only available on a quarterly basis, the monthly data are generated by linear interpolation. The data is taken from the Vienna Institute for International Economic Studies (WIIW), the Bank for International Settlements (BIS), and the IMF's International Financial Statistics.

The country sample comprises the Central and Eastern European accession candidates to the EU plus Russia and Turkey. The sample includes five countries which have experienced a currency crisis:

- Bulgaria. February 1997. To break the hyperinflation the introduction of a currency board was announced with immediate stabilizing effects on the value of the currency.
- Czech Republic. May 1997. Large macroeconomic imbalances, due to a real appreciation and a lack of structural reforms pushed up the current account deficit and put speculative pressure on the Koruna. After ten days of speculative attacks the exchange rate peg is abandoned and the Koruna is left to float.
- Romania. February 1997. Large external imbalances, declining output and investment, and structural weaknesses in the banking and enterprise sectors led to a decline of the Leu by nearly 20 % against the US-Dollar within two weeks.
- Russia. August 1998. After pressure on the Rouble during the summer of 1998 the Central Bank raised interest rates to defend the currency from 30 % to 150 %. Increasing speculative attacks forced the devaluation of the Rouble on August 17^{th} with a subsequent widening of the exchange rate bands and finally a free float.
- Turkey. November 2000. In the wake of problems in the financial sector the Lira undergoes speculative pressures. Massive Central bank interventions to stabilise the crawling peg lead to a reduction of the currency reserves by 25 %.

The criterion for a crisis to be met is that the nominal exchange rate depreciated by at least 20 % against the US-Dollar within ten trading days.[1] In such a case the corresponding month was declared a crisis month.

3 The Signals Approach

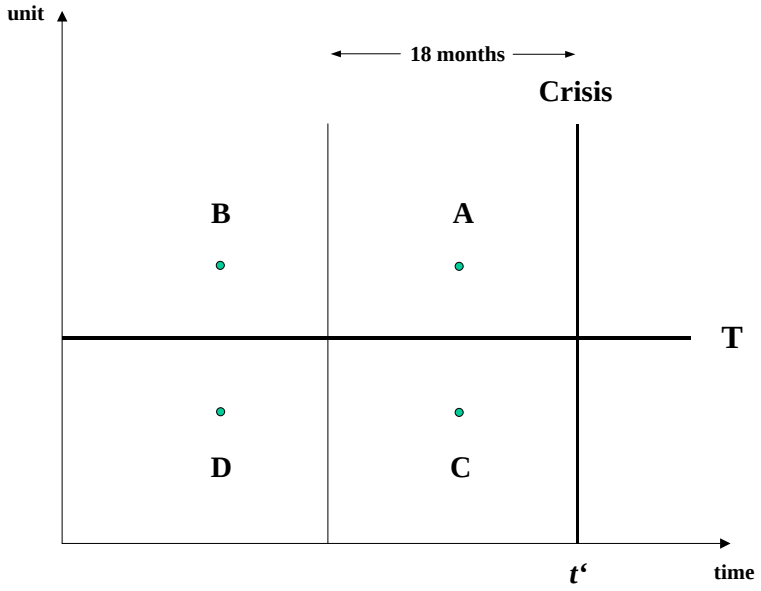
The signals approach was proposed by Kaminsky/Reinhart (1996, 1998) as a method to assess a country's vulnerability and as an early warning system to both a currency and a banking crisis. The working assumption of the signals approach is that many macroeconomic variables behave differently on the eve of a crisis. The basic idea is to identify the different behaviour during tranquil and crisis periods and if successful

[1] Another commonly used indicator in the literature to determine the timing of a crisis is the Emerging Market Pressure Index (EMP) developed by Eichengreen/Rose/Wyplosz (1996). The EMP index takes a weighted sum of changes in the currency reserves, the interest rates, and the nominal exchange rate. As soon as the EMP index deviates by a certain measure from its mean, a crisis is called. All crises we are considering in this paper pass the EMP test.

the variables can be implemented as indicators which 'signal' upcoming troubles. In order to assess whether the signal of an indicator heralds a crisis looming or whether it promises more settled times, it is necessary to determine a threshold value, which serves as a critical cutoff value that is the borderline between a sustainable and an unsustainable development. To find this critical threshold a balance has to be struck between setting it too high (should upward deviations indicate a worsening development) and missing too many crises or setting it too low and calling too many crises (false alarms). In addition, a time frame prior to a crisis has to be defined within which the signals are evaluated. Due to the relatively short data series for most macroeconomic variables available for the transition countries an 18-months crisis window was selected.[2]

Figure 1 illustrates the scheme of the signals approach. An indicator, I^j, is said to signal an upcoming crisis if the indicator crosses some threshold value, T^j, within 18 months prior to a crisis. In this case it constitutes a 'good' signal (case A). A signal issued before that date is correspondingly a 'bad' signal (case B). When an indicator remains silent we can not streakly speak of a signal but call it a realisation instead (cases C and D).

Figure 1: *Scheme of the Signals Approach*



Source: Figure adapted from Kaminsky/Lizondo/Reinhart (1997).

To find the appropriate threshold we followed Kaminsky/Reinhart (1996). For any indicator the observations from all crisis countries were pooled. Iteratively an indicator's frequency distribution was tested at different cutoff points - ranging from 5 % to 35 % and from 65 % to 95 % of the distribution, respectively. The optimal

[2]Most empirical studies for the Asian countries employ a 24-months crisis window (e.g. Kaminsky, 1998; Kaminsky/Reinhart, 1996; Goldstein/Kaminsky/Reinhart, 2000).

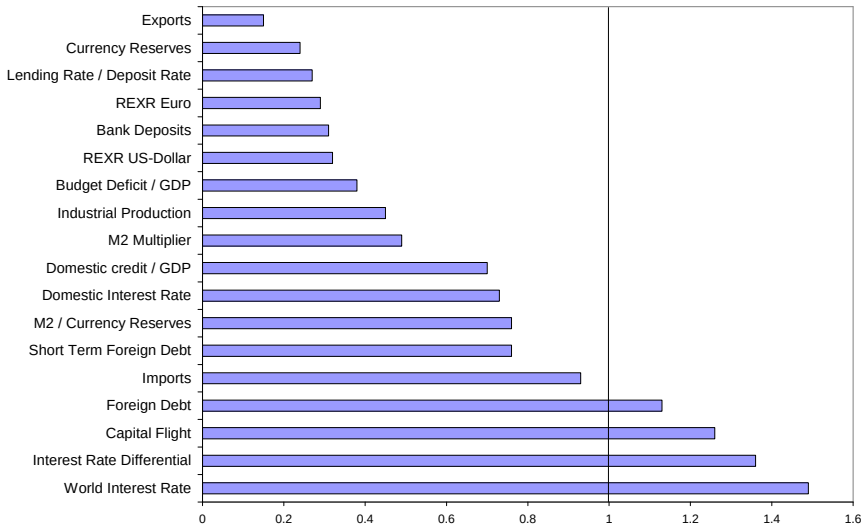
threshold for each indicator is chosen such that the *noise-to-signal ratio* (*NTS ratio*), which is the ratio of bad signals to good signals, is minimised. Formally, the *NTS ratio*, ω_j, is defined as:

$$\omega_j = \frac{[B/(B+D)]}{[A/(A+C)]}, \tag{1}$$

where A - is the number of months a good signal was send,
B - is the number of months a bad signal (false alarm) was send,
C - is the number of months no signal was send but a crisis followed,
D - is the number of months no signal was send and no crisis followed.

The majority of indicators has a good forecasting ability for currency crises. Altogether, 14 out of 18 indicators have a *NTS ratio* of smaller than one (see Figure 3). The best indicators are Exports (*NTS ratio*: 0.15), Currency Reserves (0.24), the Ratio of the Lending to Deposit Rate (0.27), and the Real Exchange Rate (0.29). Only four indicators issue more bad signals than good ones: Foreign Debt (1.13), Capital Flight (1.26), Interest Rate Differential (1.36), and the World Interest Rate (1.49).

Figure 2: *Noise-to-Signal Ratio of the Indicators*



Source: Own calculations.

After having determined the optimal threshold for each indicator this threshold will be applied to the country-specific distribution of an indicator. In other words, the relative threshold is the same for an indicator across countries, but the absolute threshold is different across countries. For instance, the *NTS ratio* for Exports is minimised at the 15^{th} percentile of the frequency distribution. This means for Hungary that Exports are issueing signals if the annual decline is stronger than 2 %, while for Romania this is already the case at a decrease of more than 0.7 %.

4 The Construction of the Composite Indicator

Generally, the greater the incidence the flashing indicators the more vulnerable a country is to a crisis. However, by just counting the number of signaling indicators important information about a country's vulnerability may be lost. Therefore, it is useful to combine the individual indicators in composite indicator. Composite indicators have been used by Kaminsky (1998), Goldstein/Kaminsky/Reinhart (2000) and Edison (2000). We extend their work by incorporating additional elements, namely the strength of the signal, the timing of the signal while keeping the prognostic quality of an indicator.

(a) Strength of the Signal. In order to distinguish extreme signals from normal signals a second threshold is introduced. An indicator issues extreme signals if it exceeds a second threshold, T_2^j. The signals are consequently double weighted. If the signal falls in the interval between the first and the second threshold it is single weighted as before and zero if the indicator remains silent. Thus, at any point in time one of three possible outcomes for the indicator is realised:

$$I_t^j = \begin{cases} 0 & I_t^j < T_1^j \\ 1 \quad for & T_1^j \leq I_t^j < T_2^j \\ 2 & I_t^j \geq T_2^j \end{cases} \qquad j = 1, ..., k. \tag{2}$$

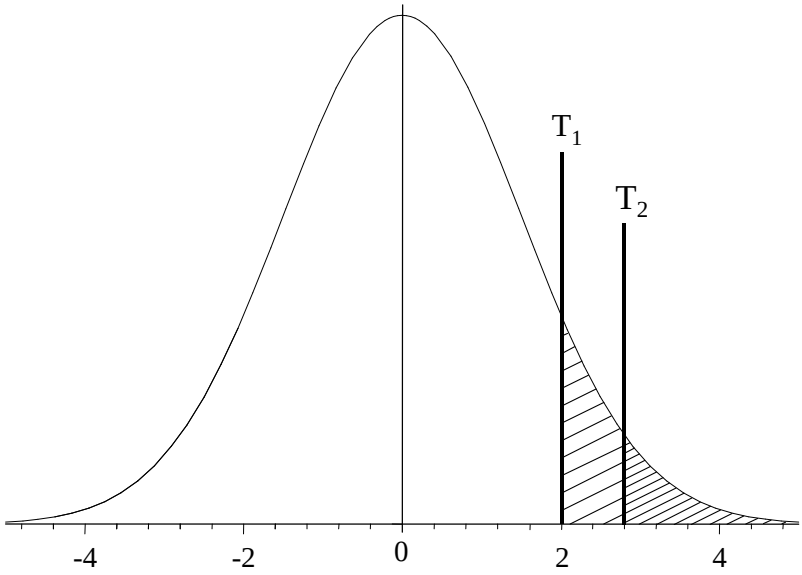
where k is the number of indicators and t is the time index. The first threshold, T_1^j, is equal to the percentile of the frequency distribution which minimises the *NTS ratio*.

$$T_1^j = f(\tau^j, I^j) \qquad \Longleftrightarrow \qquad \min\left[NTS\ ratio\right]. \tag{3}$$

The second threshold, T_2^j, is defined such that the original percentile of the frequency distribution, which corresponds to the first threshold, is devided in half (see Figure 3).

$$T_2^j = f(\frac{\tau^j}{2}, I^j). \tag{4}$$

Figure 3: *Stylised Frequency Distribution of an Indicator and the Thresholds*



(b) Timing of the Signal. The timing of the signal plays an important role in determining a country's vulnerability for a crisis. It is assumed that past signals are less important for the current crisis potential than more recent signals. For this purpose a moving 18-months window is constructed with a geometric weighting scheme:

$$Z_t^j = \sum_{i=1}^{18} \frac{I_{t+1-i}^j}{i} \qquad for \quad t \geqslant 18. \tag{5}$$

(c) Prognostic Quality of the Indicators. In addition, the forecasting ability of an indicator is taken into account by weighting the signal with the inverse *NTS ratio*. Indicators with a good forecasting performance carry more weight than indicators with a bad performance. Indicators with a *NTS ratio* of greater than 1 are dropped from the following analysis [Interest Rate Differential (*NTS ratio*: 1.36), Foreign Interest Rate (1.49), Capital Flight (1.26) und Foreign Debt (1.13)]. This leaves altogether 14 indicators which are combined in the composite indicator (CI):

$$CI_t = \sum_{j=1}^{k} \frac{Z_t^j}{\omega^j}. \tag{6}$$

Generally, a rise of the composite indicator points to an increase of the crisis potential of a country and conversely, a lower value indicates a relaxation of the macroeconomic situation.

4.1 Conditional Probabilities of a Crisis

Although the development of the composite indicator gives some indication about the vulnerability of a country to a crisis, it does not allow to draw any conclusions about the probability of the occurrence of a crisis. Since both the composite indicator and the distribution of crises are known it is possible to compute the conditional probabilities of a crisis. Following Edison (2000) the conditional probabilities are calculated as follows:

$$\Pr\left[crisis_{t,t+18} \mid CI_l \leqslant CI_t < CI_u\right] = \frac{\Sigma \; \# \; months \; for \; CI_l \leqslant CI_t < CI_u \; and \; crisis \; follows}{\Sigma \; \# \; months \; for \; CI_l \leqslant CI_t < CI_u} \tag{7}$$

where $crisis_{t,t+18}$ is the occurrence of a crisis within 18 months given that the composite indicator CI_t falls in the interval which is marked by the upper (CI_u) and lower boundary (CI_l) of the indicator.

The conditional probabilities of a crisis for different values of the composite indicator are presented in Table 1.

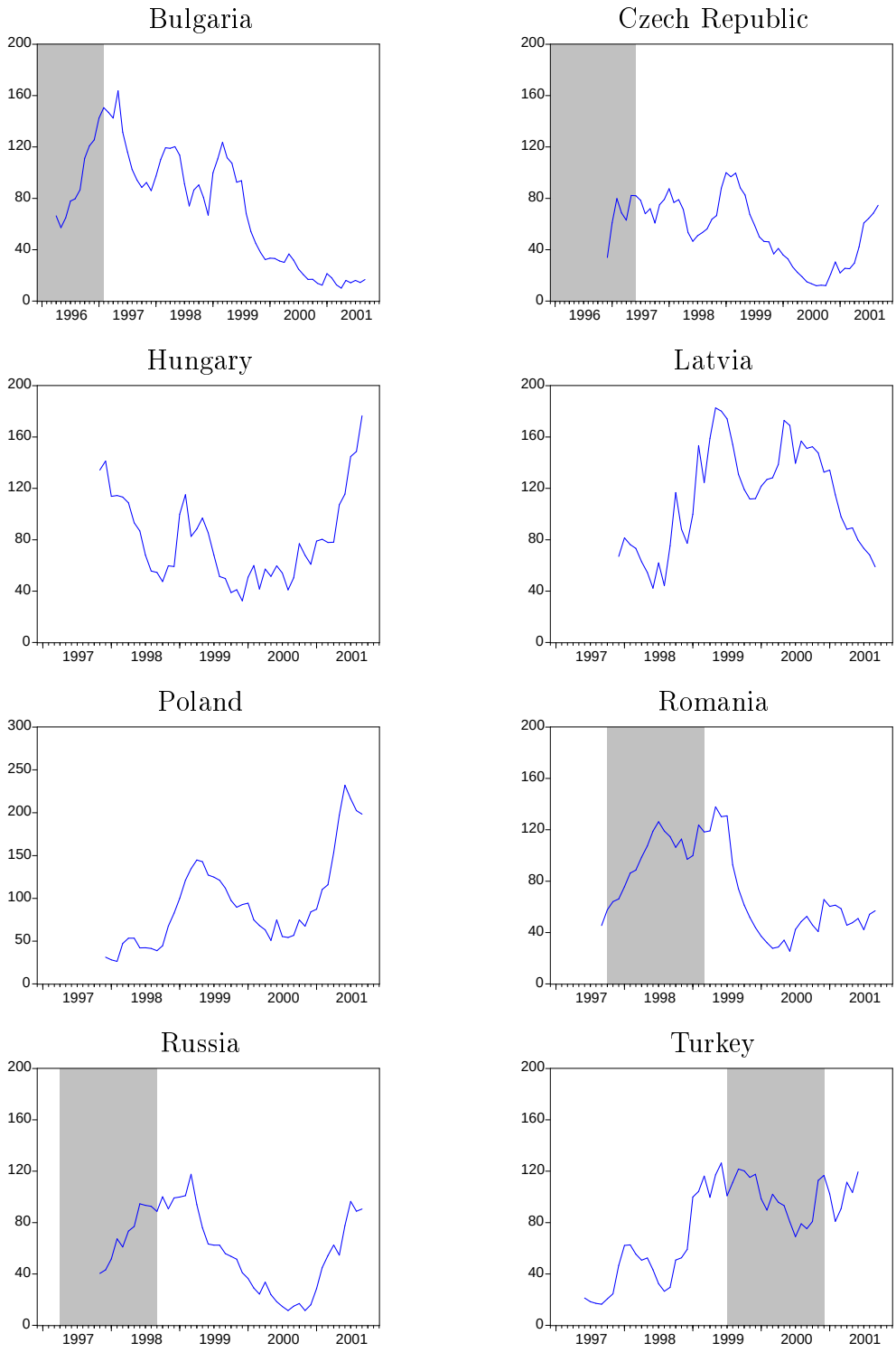
Table 1: Conditional Probabilities of a Financial Crisis

Index of the Composite Indicator	Probability of a Crisis
0 – 20	0.2143
21 – 40	0.1781
41 – 60	0.2813
61 – 80	0.2250
81 – 100	0.2593
101 – 120	0.3333
121 – 140	0.6154
> 141	0.8571
Memorandum	
	unconditional probability
	0.1781

Source: Own calulations.

For a wide range of values of the composite indicator the odds of a crisis increase as the indicator increases. However, for a certain range of values there is an inverse relationship between the value of the composite indicator and the conditional probabilities. This 'anomaly' is again due to outliers like the Czech crisis which occurred at relatively low values of the composite indicator (see Figures 4 and 5).

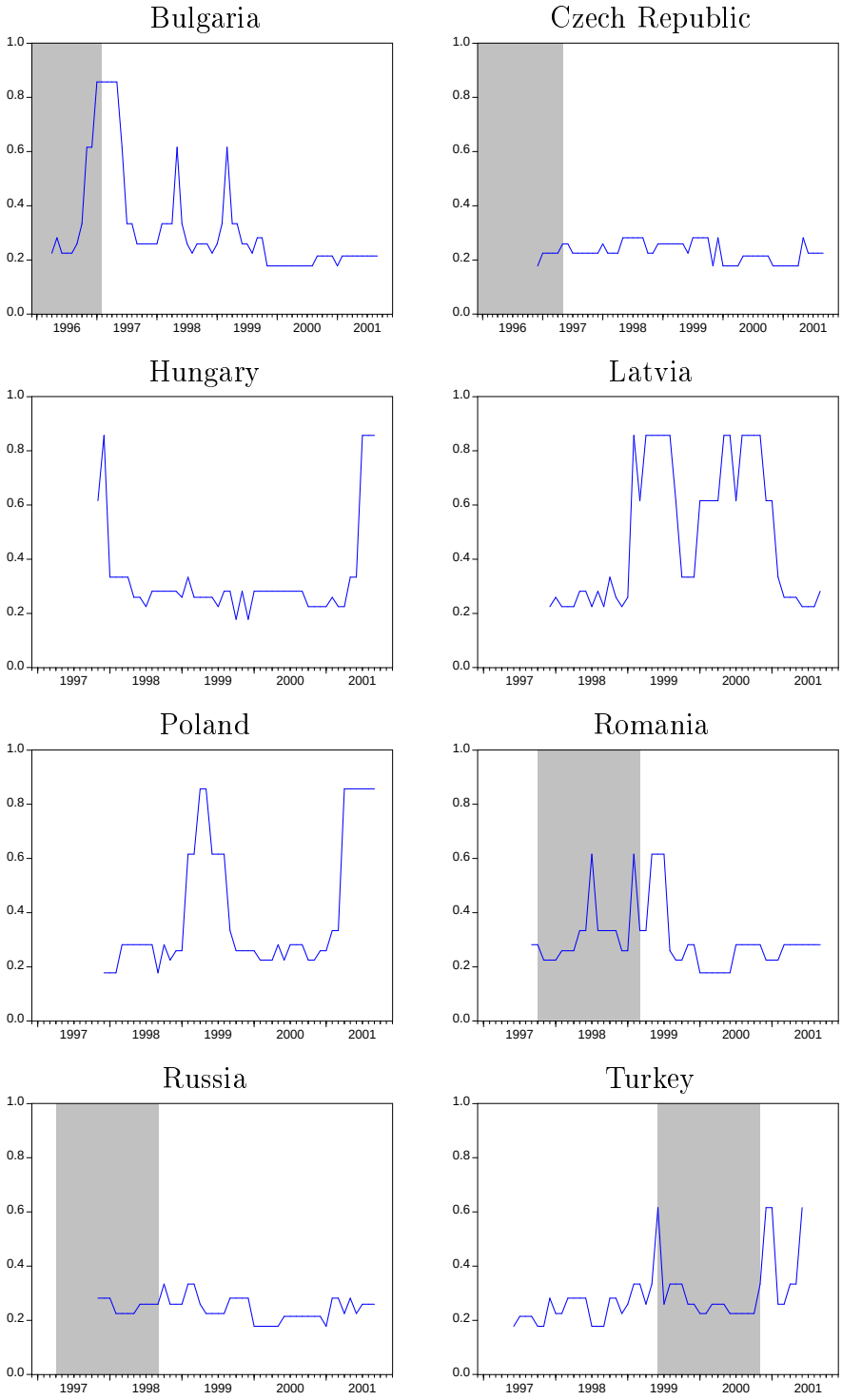
Figure 4: *Composite Indicator for Selected CEE Countries*



Note: The shaded areas mark the 18-months window before a crisis. The composite indicator is normalised such that January 1999 is equal to 100.

Source: Based on own calculations.

Figure 5: *Conditional Probabilities of a Crisis for Selected CEE Countries*



Note: The shaded areas mark the 18-months window before a crisis.
Source: Based on own calculations.

5 Tests of the Quality of the Composite Indicator

5.1 The Quadratic Probability Score Test

The Quadratic Probability Score Test (*QPS test*) is one way to assess the prognostic quality of the composite indicator. The test determines the discrepancy between the realisation of an event, R_t, and its estimated probability, P_t (Diebold/Rudebusch, 1989). In this case, the event is the crisis period which is equal to 1 and 0 otherwise. The *QPS test* for N observations is specified as follows:

$$QPS = \frac{1}{N} \sum_{t=1}^{N} 2 \left(P_t - R_t\right)^2 \tag{8}$$

The *QPS test* statistic lies in the range between zero and 2. The prognostic quality of an indicator is better, the closer the test statistic is to zero. The test statistic for the composite indicator is 0.331 (see Table 2). This is the average of the test statistics for those countries, which have actually experienced a crisis, namely: Bulgaria, the Czech Republic, Romania, Russia, and Turkey. In studies by Berg/Pattillo (1999a) and Goldstein/Kaminsky Reinhart (2000), who have constructed a similar composite indicator and applied it to the Asian crises countries, the test statistic was lower (0.27 and 0.11). The main reason for the better performance of the composite indicator in these studies is the larger crises sample of 23 and 25 countries, respectively. This makes the test statistic more robust against outliers, i.e. countries with an extreme signaling. The test statistic for the Central and Eastern European crises sample is biased ‚upward', because in the case of the Czech Republic the crisis in May 1997 occurred at a relatively low conditional probability (0.26).

Table 2 shows the goodness-of-fit measures for the composite indicator.

Table 2: Goodness of Fit of the Composite Indicator

	Composite Indicator Original Specification (14 Indicators)
Goodness of Fit	
Quadratic Probability Score (QPS)	0.331
Cutoff Probability at 25 %	
Percent of crises correctly called[a]	67.5
Percent of tranquil periods correctly called[b]	47.0
False alarms as a percent of total alarms[c]	53.0
Percent of observations correctly called[d]	52.4
Cutoff Probability at 50 %	
Percent of crises correctly called[a]	15.6
Percent of tranquil periods correctly called[b]	95.4
False alarms as a percent of total alarms[c]	4.7
Percent of observations correctly called[d]	74.3

[a] A crisis period is correctly called when the estimated probability is above the cutoff probability and a crisis occurs within 18 months. This is equal to A/[A+C] in Figure 1.

[b] A tranquil period is correctly called when the estimated probability is below the cutoff probability and no crisis occurs within 18 months. This is equal to D/[B+D] in Figure 1.

[c] A false alarm is an observation with an the estimated probability of crisis above the cutoff probability and no crisis occurs within 18 months. This is equal to B/[B+D] in Figure 1.

[d] This is equal to [A+D]/[A+B+C+D] in Figure 1.

Source: Own calculations, Table taken from Berg/Patillo (1999b).

The indicator correctly calls about three quarter of the observations at the 50 % cutoff probability. This is based almost entirely on the correct prediction of the tranquil periods. These are periods that are not followed by a crisis within 18 months. The vast majority of crisis periods (84.4 %) are missed. Although only few crisis months are correctly anticipated, only 5 % of alarms are false, i.e. there is a signal but no crisis occurs within the next 18 months. To put it in other words: a high cutoff probability ensures a lower probability of committing a Type II error – that is predicting a crisis which does not occur – while at the same time the chance of committing a Type I error – that is failing to predict a crisis which actually occurs – is quite high.[3]

[3] Of course, for a lower cutoff probability than 50 % the probability of a Type I error declines and of a Type II error rises.

5.2 The Pesaran-Timmermann Test

The *QPS test* allows no conclusions about the statistical significance of the goodness of fit. For this purpose the Pesaran-Timmermann test (*P-T test*) is employed (Pesaran/Timmermann, 1992). The null hypothesis of the *P-T test* assumes that the forecasts for a binary event (in this case crisis and tranquil periods) are independent from the actual outcomes.[4]The results of the *P-T test* show that the null hypothesis is strongly rejected for a broad range of thesholds (see Table 3). Therefore, assessments of a country's crisis vulnerability, which are based upon the composite indicator, are statistically superior to random forecasts. This results holds irrespective of the threshold of the conditional probability. The results are confirmed by a comparison of the conditional and unconditional probability of a crisis. A forecast of a crisis, which is based upon the signals approach and calls a crisis in case of an alarm, i.e. Pr[$crisis \mid signal$], is correct in 31 % of all cases. Whereas the chances of being correct with a pure guess, i.e. Pr[$crisis$], is just 18 %.

Table 3: Prognostic Quality of the Composite Indicator (Pesaran-Timmermann Test)

Threshold	**25 %**	**30 %**	**35 %**	**40 %**	**45 %**	**50 %**
P-T test statistic	4.87*	8.24*	9.73*	9.73*	9.73*	9.73*

Note: The Pesaran-Timmermann test statistic is asymptotic normally distributed. The null hypothesis is, that the forecasts and the actual outcomes are independent. *means, that the null hypothesis is rejected at the 5% significance level. The critical value for $\chi^2_{0.05}(1)$ is 3.841.

Source: Own calulations.

6 The Evolution of the Risk Potential for the CEE Countries

6.1 An Overview

We have studied the evolution of the crisis potential for financial crises in the CEEC at various times from 1993 until September 2001. Looking at the more recent past, two distinct phases can be discerned. First, after the Russian crisis from August 1998 all countries in the region exhibited a heightened risk potential. During 1999 and sometimes until the first months of 2000, the spill-over effects due to trade links, third market effects and the slowdown in Western Europe contributed to a weak economic performance in the transition economies. This in turn caused many of the individual indicators to cross their respective thresholds and to emit a multitude

[4]For a binary event, i.e. for a 2×2 case, the *Pesaran-Timmermann test* is just a χ^2 test of independence.

of warning signals. The situation started to improve in the second of half 1999 as economic recovery was widespread in Western Europe and the transition economies. In particular, as industrial production and exports started picking up again, these indicators often left the signaling area and did not exhibit any further violations of their thresholds for quite some time. During the second phase starting in mid 2000 the more or less uniform development came to an end, and the development of the risk potential was more heterogeneous. In several countries like Bulgaria, Latvia, and Slovenia the positive development has continued and the composite indicator has remained at very low levels. Little activity came from the indicators capturing changes in the international competitiveness, also a strong domestic demand helped keep the more internal indicators at a subdued signaling activity. Other countries such as Slovakia, Lithuania, Estonia, and Romania also at first experienced distinct improvements in the development of the composite indicator, but here the situation has deteriorated again in the first half of 2001. Unlike the first group, these countries were not able to decouple themselves quite as successful from the adverse international developments and the growth slowdown experienced in the EU. Yet, the values attained by the composite indicator by September 2001 did typically not come close to those seen in the aftermath of the Russian crisis. In four of the observed countries – Poland, Russia, Hungary and to a somewhat lesser extend the Czech Republic – the crisis potential as measured by the composite indicator has increased sharply from about mid 2000 on. Turkey's experience does not fit the pattern as the risk potential reached worrying dimension already back in 1999 and never substantially decreased until the outbreak of the financial crises in November 2000.

6.2 Turkish Crisis started as Banking Crisis

In Turkey liquidity problems in the banking sector were the immediate cause for the outbreak of the crisis. Due to the IMF backed adjustment program from 1999, interest rates had declined, which resulted in a reduction of the deposits and in a shift towards short term deposits by the public. A slowdown in economic growth and delays in implementing structural reforms led foreign investors to pull out a good share of their portfolio investments. The crisis broke out when this culminated in the non-prolongation of a credit to the Demir Bank - the ninth largest bank of the country - and the subsequent reduction in credit lines among the banks. Even though the IMF, the National Bank and the government provided liquidity and initiated reforms, the conditions remained highly unstable. A political squabble between the President and the Prime Minister in February 2001 served as the starting point for the next phase of the unfolding financial crisis. Convinced that political stability and the desire to adopt reform measures was lacking, investors pulled out of the Lira, forcing the authorities to abandon the crawling peg regime that was a central part of the IMF adjustment program. Within two days the Lira lost over 40 % against the Euro and the US-Dollar. In evaluating the crisis, it is important to remember that the underlying reasons for its outbreak lay not in the current political sphere or even in the health of the banking system. Rather, as can be seen by the continuous build up of crisis potential as witnessed by the composite indicator, a seriously flawed development of fundamentals was at the core of the crisis occurrence. In particular,

the drastic overvaluation of the exchange rate, decelerating exports, a widening current account deficit, low currency reserves and rising short term foreign debt showed that the external imbalances were increasing over time, putting steadily greater strain on the banking system and the exchange rate arrangement. After the outbreak of the crisis the risk potential has remained high, signaling that the stabilization and reform measures still have to feed themselves through the system. It seems though that the worst is over and with inflation and risk premia slowly declining the present risk potential is also slowly shrinking.

6.3 Trouble brewing in Poland

Of the countries considered Poland exhibited the steepest increase in the composite indicator since mid 2000. The reason for this development lay in the monetary policy that was adopted in the fall of 1999 to break the inflation bias in the Polish economy and to reduce the then large current account deficit. In several steps the national Bank raised the interest rates sharply, which resulted in real interest rates in excess of 10 % per annum. While being successful in curbing the current account deficit and in reducing the inflation rate, this policy also throttled the domestic economy. Consumption and investment shrank, which in turn depressed growth. This turn of events led to the emergence of new risk factors for a financial crisis. One was the rising budget deficit. Having passed a budget on the assumption of growth of 4.5 % for 2001, the resulting much lower growth led to reduced tax earnings which were not met by slashed expenditures. In addition, the high real interest rates worsened the profit situation of many enterprises. Due to variable interest rate structures the cost of servicing existing debt went up at the same time as depressed demand cut into their earnings. This combination led to a sizable increase of non-performing loans and therefore to increased instability of the banking sector. Under this setting it only needed some bad news for an attack on the Złoty to occur as it did in July 2001. Weak trade figures for the month of May 2001 coincided with the news that most of the planned budget deficit had been exhausted already in the first half of the year. This and the general uncertainty prevailing in the international markets resulting from the financial crises in Turkey and Argentina led investors to flee the Złoty which devalued by over 10 % within a couple of days. The forced devaluation did not erupt into a full blown financial crisis and since July the composite indicator has indeed shown some improvement. Yet, this is almost exclusively due to the effects of the devaluation on the Złoty, reducing its real appreciation against the Euro and the US-Dollar and thus leading to less signaling activity. Until the end of January 2002 the Złoty had started appreciating again, indicating that the drop of the composite indicator will prove to be short lived. With a still sluggish international environment and a continuing weak domestic demand in early 2002, there are appreciable downside risks for the possibility of further attacks on the Złoty.

The development in the Czech Republic, Hungary and Russia has been more benign, but with some clearly worrying aspects. In Russia, where the economic recovery has been driven largely by energy products and related industries, the decline in the world market price for oil induced a slowdown in industrial production. At the same time, the Rouble has appreciated steadily, hurting the competitiveness of

the export oriented firms. Furthermore, the largely unrestructured banking system continues to be a cause of concern. The Czech Republic and Hungary both suffered from the slowdown in Western Europe, with 70 and 75 % of their exports destined for the EU. Strong capital inflows exerted upward pressure on the exchange rates especially against the Euro. In the case of the Czech Republic the crisis potential was exacerbated by a large consolidated budget deficit, which – inclusive banking restructuring costs – has risen to 7.5 % in 2001. An active industrial policy entailing increasing subsidies to ailing enterprises will probably lead to a further rise in 2002. While in all of the three countries the risk of a financial crisis still seems relatively minor, these developments will have to be countered by economic policy to prevent a further deterioration and a loss of confidence among market participants.

7 Conclusions

This paper extends a line of research that tries to determine the empirical regularities that underlie the outbreak of crises. The paper demonstrates the applicability of the signals approach to the Central and Eastern European countries. Using the signals approach as a early warning system helps to identify those countries which are most vulnerable to a crisis, yet the forecasting capabilities should not be overstated. While the signals approach does give a good indication where the trouble in the economy stems from, a policy oriented analysis must dig deeper to understand the causes behind the indicator misalignments. Thus, the signals approach should usefully be employed as a complemetary tool to the traditional country analysis.

Our analysis provides insights as to which indicators are relevant for determining the vulnerability of a country. For the countries of the region we found the usual suspects of a crisis: dwindling currency reserves, an overvalued exchange rate, and a rising budget deficit. The good performance of the indicators 'Ratio of Lending Rate to Deposit Rate' and 'Bank deposits', which are related to developments in the banking sector, indicate the close interrelation between a currency crisis and a banking crisis. It thus highlights the importance of a 'twin crisis' problem in Central and Eastern Europe.

Concerning the conclusions for economic policy makers two recommendations based on our empirical findings stand out: First, watch out for the fiscal deficit. If fiscal surpluses are out reach, for instance, because of the public expenditures to finance investments required to fullfil EU-obligations prior to EU-accession, it is all the more important to maintain an adequate deficit level. A relatively high fiscal deficit could easily tilt the market sentiment against the domestic currency.

Second, the exchange rate policy seems to be the key to avoid a financial crisis. Against the background of persistent current account deficits in the EU-accession countries and the importance of overvalued exchange rates as a driving force in the build up of crisis potential, these countries are well advised to make their exchange rate systems more flexible. Poland and Hungary have shown the way by abandoning the crawling peg. The key aspect is to avoid an excessively high appreciation of the

real exchange rate. This would maintain the competitiveness of domestic enterprises on international markets and the export earnings would enable the central bank to keep an adequate level of foreign exchange reserves.

From a technical side there is still room for refinement of the composite indicator. The threshold of an indicator is endogenously determined by the sample size. This gives rise to the 'percentiling problem' which is most relevant for the transformation countries. These countries have relative short time series of macroeconomic variables available and at the beginning of the transformation process the variables often showed some aberrent behaviour. The problem is selecting the starting point of the sample. When selecting an early starting point with an extreme behaviour of the variables it is quite possible that the threshold will never be crossed again in the future - no matter how large the deviations from 'normal' values for an indicator are.

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