Investigating the Early Signals of Banking Sector Vulnerabilities in Central and Eastern European Emerging Markets

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Abstract

This paper considers the joint role of macro-economic and bank-specific factors in explaining the occurrence of banking problems in the twenty-one Central and East European emerging markets over the recent decade. Using data at the individual bank level we show, using a logit model, that the macroeconomic factors play a central role in determining banking sector instability in the early stages of difficulty, while the bank-specific factors are more important in the later stages and gain more weight as the banking sector develops and the institutional framework becomes mature.

JEL Code: E44, G21.

Keywords: banking sector vulnerability, banking crises, early warning indicators, Central and Eastern Europe.

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Contents

1. Introduction

Most of the Central and Eastern European countries (CEECs) have experienced severe banking crises over the 1990s. These economies have been vulnerable to external shocks coupled with financial liberalisation and economic restructuring. The purpose of our research is to establish whether these crises are primarily a function of the unique difficulties of transition or whether they reflect similar factors to those recorded in the lead up to financial crises elsewhere around the globe. Most of the existing research on the factors that help explain the occurrence of these problems deals with Asian or South American banking crises. Moreover, some extensive cross-country studies, Hardy and Pazarbasioglu (1998), for example, deliberately refrain from including Central and Eastern European transition countries because they feel that these former socialist transition economies suffered a special range of problems that make them non-comparable with most of the other countries.

It is normally argued that the CEECs have faced twin problems. They have started from state banks dominated by directed lending. Such banks have had to switch to a risk based approach and acquire the expertise necessary to run such a system successfully in a competitive environment. At the same time, the opening up of the economy to market forces tends to render many of the previous enterprises uncompetitive in their present activities. This results in a major contraction in the economy and the revelation of a substantial stock of non-performing loans.

The authorities are similarly unprepared for this environment, both in being able to prepare banks for the rigours of the new regime or in detecting problems and assisting in their solution. Major fiscal pressures from declining revenues and increased unemployment compound the difficulty and inhibit recapitalisation. If this were not enough there has normally been a bout of high inflation as the whole structure of prices tries to adjust in a period of shortage.

In many cases this results in a two-stage problem. In the first instance the banks are overwhelmed by the scale of the macroeconomic pressures on the whole range of their customers. In the second, their fragility, lack of experience and the pressure for success among a substantial number of new entrants leads to further problems, exacerbated by any external shocks.

In this paper we seek to explore how the experience of banks across the CEECs conforms to this pattern. We would anticipate that initially economy-wide problems will dominate as the cause of distress, while later the difficulties will become more bank and regime-specific and hence more reminiscent of the experience in other countries. After the second shake out it appears that many of the CEECs have banking and regulatory structures similar to those of their Western European counterparts, assisted by considerable foreign ownership by Western European banks.

2. Framework for Addressing the Problem

It is inevitable that comparative studies of emerging markets should be dominated by concerns over the data. As a result, such cross-country studies tend to focus more on macroeconomic data than on other factors, as they are more readily available and prima facie compatible. In these papers, GDP growth, inflation, exchange rate movements and the terms of trade serve as the warning signals of banking crises, as they all indicate sources of pressure on bank income flows and balance sheets. These broad-based macro-indicators can sometimes be complemented with a set of aggregate banking sector variables such as credit to the private sector, deposits and banking sector foreign reserves. Detailed differences aside, the general conclusions of macro-data driven studies are consistent and intuitive. In brief the results reaffirm that a deteriorating macroeconomic situation and underlying instabilities precipitate banking crises. These results have much in common with the findings for OECD countries, as is illustrated in Mayes et al. (2001) for the Nordic countries.

Demirgüç-Kunt and Detragiache (1998) focus on a further potential trigger of financial fragility that is relevant for our study, namely, financial liberalisation. Although financial liberalisation as it is traditionally viewed – removal of interest rate controls in their case – is a more minor shift than the transition economies faced, it is nevertheless a regime change and hence instructive. Their results indicate that financial liberalisation exerts a negative effect on the stability of the financial sector that is additional to those from adverse macroeconomic developments and related vulnerabilities to balance-of-payments crises. A strong institutional environment can, however, alleviate the adverse impact of liberalization on the financial system (Demirgüç-Kunt and Detragiache, 1998). Unfortunately the study does not include the European emerging markets.

Notwithstanding the valuable insights from previous studies there is little evidence on how authorities, such as central banks and supervisory agencies, could make use of financial fragility indicators in order to safeguard the stability of the banking system as a whole. Similar problems exist in finding clear evidence on why some banks survive the adverse macroeconomic conditions and external shocks whereas the others fail. There are several studies mainly based on US and a few Latin-American countries banking data (e.g. Gonzalez-Hermosillo, 1997, 1999), which try to explore specific banking sector indicators (CAMELS[1] framework) that can serve as valuable early warning signs of banking distress. The particular value of these studies lies in recognition of these factors, which can be addressed by appropriate banking regulation and adequate supervision. The degree of fragility of individual banks is closely linked to the overall propensity to banking crisis (also due to contagion effects), in which the bank-specific factors play important role in systemic stability.

3. Specification of the Model

We follow the normal framework of assuming that bank distress or "crisis", d, depends upon three groups of variables:

- macroeconomic conditions, m
- the financial structure of the economy, s, and
- factors related to the condition of individual banks, b

Thus,

$$d = f(m, s, b).$$

3.1. Definition of Banking Crisis or Bank Distress

There is a considerable debate over how best to measure banking distress or fragility and over how to define a crisis. In order to make our work comparable we employ well-known indicators that can be applied to the data available on individual banks in the CEECs during the period since 1996. Studies of early warning systems that rely on macro-level data reliant papers (such as Demirgüç-Kunt and Detragiache, 1998, 1999; and Hutchinson and McDill, 1999) are mainly based upon the Caprio and Klingebiel (2003) and Lindgren, Garcia and Saal (1996) datasets of systemic and borderline banking crises. Given conceptual ambiguity and data limitations the criteria they use for defining a crisis employ a combination of events, such as, forced closure, merger or government intervention in the operations of financial institutions, runs on banks, or the extension of large-scale government assistance. However, neither Caprio and Klingebiel (2003) nor Lindgren, Garcia and Saal (1996) define

[1] CAMELS – **C**apital **A**ssets **M**anagement **E**arnings **L**iquidity **S**ensitivity to market risk.

incidences of systemic banking crises explicitly for the CEECs, which means we have to rely on our own estimates to separate crisis from non-crisis periods.

The choice of indicators for crises and problem banks normally covers measures of nonperforming assets, problem loans and solvency[2]. Nonperforming loans have often been used as the crisis threshold, because they are the best indicator of near term failure (Gonzalez-Hermosillo, 1999). There is no one generally accepted measure of the existence of "problems", so we have to be somewhat pragmatic in our choice. Gonzalez-Hermosillo, Pazarbasioglu and Billings (1997) define fragile banks as those with nonperforming loans of more than 6–8 percent of total loans. Demirgüç-Kunt and Detragiache (1998a) define a crisis period *inter alia* as one in which the nonperforming loans of the banking system are more than 10% of total assets. Rojas-Suarez (1998) classify as "crisis" banks whose nonperforming loans to total loans are greater than the average for the system as whole during "tranquil" periods plus two standard deviations.

Since we have bank-specific data, it makes more sense to focus on measures we can obtain directly. There rather than conditioning on institutional measures such as the existence of government support, recapitalisation or other such interventions, we apply a modified version of the Gonzalez-Hermosillo (1999) coverage ratio, which is the ratio of capital equity and loan reserves minus nonperforming loans to total assets. The advantage of the coverage ratio is that it takes into account reserves and equity capital, which could cover the amount of the problem loans.[3] Instead of total assets we use the larger of net loan provisions or impaired loans as the denominator. In order to account for bank capital cushion and the potential losses from nonperforming loans, the crisis for a bank is defined as a situation where the ratio of equity and loan reserves surplus is less than the higher of net loan provisions or impaired loans. We label this as a "distressed" bank. Banks with negative or zero equity are labelled as "insolvent"[4].

[2] The explicit criteria, which have been used in the literature are the following: (1) NPL to total banking sector assets above 10% or ratio of NPL to total assets greater than 2% of GDP; (2) The cost of rescue operation at least 2% of GDP; (3) Large scale nationalization; (4) Extensive bank runs; (5) Emergency measures applied such as deposit freezes, prolonged bank holidays, deposit guarantees.

[3] Depending on the scope of nonperforming loans definition Gonzalez-Hermosillo (1999) applies a coverage ratio threshold of zero for US banks and a threshold of 1,5 for Mexican and Colombian banks.

[4] For banks whose data on impaired loans are not available, but the net loan provisions are negative, given the positive equity, are considered as prudent. The maximum of impaired loans ratio or provisions ratio is used in order to employ more observations and alleviate the problem of incomparability in provisions definitions across sample countries.

$$Eq \leq 0 \text{ or}$$

$$\left(\frac{Eq + [LR - Max\,(NLP\ IL)]}{Max\,(NLP,\ IL)} < 1 \middle| \ Eq > 0; NLP > 0 \right)$$

where

- Eq – equity,
- LR – loan reserves,
- NLP – net loan provision and
- IL – impaired loans.

Our definition of "problem" banks thus encompasses the institutions, which are insolvent and institutions, which are at increased risk due to high actual or potential loan losses eroding the capital. The latter category of banks might be called distressed, because, while their own funds cover the loan losses in the current period, they would not withstand the same magnitude of losses next period, holding the equity level constant.

This gives us a three-way categorisation: sound, distressed and insolvent banks. Appendix 2 sets out the data by year and country for all of the banks in our sample. If any bank is in the distressed or insolvent category then we label this as a "crisis" period, although this over-dramatises the situation as the bank is not necessarily of systemic or significant proportions. However, small banks are excluded from our sample as discussed below.

3.2. Early Warning Indicators

The choice of early warning indicators of impending crises that can be used in the analysis is heavily constrained by the data available. The wider the sample of countries, the narrower will be the choice. As set out in Table 1, indicators of the probability of failure for an individual bank can be divided into those that are bank-specific, those that characterize the banking sector through externalities or contagion factors, and macroeconomic factors that affect all banks. The latter two normally apply equally to all banks, although their exposures differ.

Overall there is no universal set of indicators used across previous studies, although there is more communality over broad-based macro-variables, such as GDP, exchange rate and inflation indexes, which have better cross-country

Table 1: Metastudy summary

BANK-SPECIFIC VARIABLES	**Liquid assets ratio**	**Capital-asset ratio**	**Loan-to-assets ratio**	**Bank deposits ratio**	**interest and fee income to total assets (moral hazard)**
Berg, Hexeberg; 1994 Norway:1987-91 (annual, incl.≈20 banks)	n.a.	-***	*Loan growth* +**	+	n.a.
Gonzalez-Hermosillo, Pazarbasioglu and Billings, 1997 Mexico: 4q1991-4q1995	-	-	n.a.	+**	n.a.
Gonzalez-Hermosillo,1999 — US — SW (1986-93)	-**	-***	-*	-***	+***
Gonzalez-Hermosillo,1999 — US — NE (1992-93)	-***	-***	+**	-***	n.a
Gonzalez-Hermosillo,1999 — US — California (92-93)	+	-***	+	-**	n.a
Gonzalez-Hermosillo,1999 — Mexico (1994-95)	-	-***	+**	+*	+
Gonzalez-Hermosillo,1999 — Colombia (1982-87)	-	-	+	+	+**
MACROECONOMIC AND BANKING SECTOR VARIABLES	**Economic activity (GDP growth, income growth)**	**Financial deepening (Loans to GDP)**	**Average annual growth of CPI**	**Depreciation**	**Real interest rate**
Gonzalez- Hermosillo, Pazarbasioglu and Billings, 1997 Mexico: 4q1991-4q1995	- *exp*	+**	+ *exp*	-	+
Demirgüc-Kunt, Detragiache, 1998, 1999: Panel of 65 countries 1980-95	-***	+**	+**	+	+***
Hardy, Pazarbasioglu, 1998 38 country panel, 1980-97	-***	-** Lag(2) +*	+** Lag(2) -**	-** Lag(2) +	+*** Lag(2) +**
Hutschinson; Mc-Dill; 1999 67 country panel, 1975-97	-**	-	+	+	+
Gonzalez-Hermosillo,1999 — US — SW (1986-93)	-**	-***	n.a	n.a	+***
Gonzalez-Hermosillo,1999 — US — NE (1992-93)	-***	-	n.a	n.a	-
Gonzalez-Hermosillo,1999 — US — California (92-93)	-***	+	n.a	n.a	-
Gonzalez-Hermosillo,1999 — Mexico (1994-95)	n.a.	+**	n.a	+	+
Gonzalez-Hermosillo,1999 — Colombia (1982-87)	n.a	+***	n.a	n.a	n.a

***Notes**: Bank deposit ratio: proxy for interest sensitive funding. Note also that in different studies the dependent variable is defined as follows: (1) Berg and Hexeberg, 1994: Problem bank is considered as a bank seeking assistance from an insurance fund; (2) Gonzalez-Hermosillo, Pazarbasioglu and Billings, 1997: Bank Failure is considered as an occurrence of bank intervention in form of financial assistance, recapitalization etc.; (3) Gonzalez-Hermosillo, 1999: Bank Failure is considered as the incidence of intervention; Distress-Coverage ratio i.e ratio of capital equity and loan reserves minus nonperforming loans to total assets; (4) Demirgüç-Kunt and Detragiache, 1998, 1999; Hutschinson and Mc-Dill, 1999: Definition of (systemic) financial crisis based on Caprio and Klingebiel (1996) and Lindgren, Garcia and Saal (1996). For an episode to be classified as crisis at least one of following conditions must apply: (a) NPL to total banking sector assets above 10%, (b) Ratio of NPL to total assets greater than 2% of GDP, (c) The cost of rescue operation at least 2% of GDP, (d) Large scale nationalization, (e) Extensive bank runs, (f) Emergency measures applied such as deposit freezes, prolonged bank holidays, deposit guarantees, (g) * - statistical significance at 10%, ** - statistical significance at 5%, *** - statistical significance at 1%. Exp - expected sign.*

comparability and availability. By contrast the set of bank-specific variables varies a great deal across the studies available on a cross-country basis. Even ostensibly similar bank-specific variables may not be very comparable across countries, as the accounting regulations and supervisory rules can account for large variations.

The basis for comparison of bank-specific variables used in Table 1 is fairly limited and relies mostly on US, Mexican and Columbian data.[5] However there is also a study by Berg and Hexeberg (1994) of Norwegian banks, which serves as good comparison here. Five categories of variables are distinguished:

- Liquidity/assets,
- Capital/assets,
- Loans/assets,
- Deposits/assets,
- Interest + fee income/assets.

All of these are conventional measures of bank strength.

The papers dealing with US and Latin-American banks, despite regional proximity, do not always have consistent results for the same indicators. In general the liquid assets ratio is expected to reduce the probability of bank distress, however the result for Californian banks indicates the opposite and for Mexico and Columbia the coefficients, although with the intuitively correct sign, turned to be statistically insignificant. The same applies to bank deposits to assets ratio and lending indicators, which have opposite and even statistically significant coefficients as for different bank samples. Still, extensive lending in the form of higher loan-to-assets ratio or loan growth ratio seem to be more predominantly a trigger of a crisis with only exception for US Southwest. The most convincing result appears as for capital-asset ratio being consistent across different samples and studies. However, taken together, the degree of heterogeneity is not a good omen for using this approach on the CEECs.

The results for macroeconomic indicators are in better conformity, moreover the studies under consideration incorporate large cross-country samples all over the world. However, we can see that the results vary also here, as some studies come up with conflicting evidence. According to most studies

[5]This meta-analysis summary table is far from a complete survey and should be rather cosidered as an illustration, not a conclusive statement of the similarities and differences across present literature.

financial deepening seems to increase vulnerability to crises, but there are exceptions, which conflict with this statement. It is not immediately apparent what result we should expect. Financial deepening is a sign of economic maturity, so a negative sign would be plausible. The same ambiguity applies to currency depreciation as a possible precipitator of financial and banking crisis. Here, the ambivalent results might stem from cross-country differences in monetary policy (inflation targeting versus exchange rate targeting), country comparative competitive advantages, the level of financial deepening or general stability and maturity of the economic environment. Fortunately, given the aim of our study, the largest weight is carried by bank-specific variables, which can serve as valuable predictors of emerging vulnerabilities. Hence, the main source for crisis indicators is the balance sheet and income statement information. The bank-specific view is complemented by several indicators reflecting the macroeconomic environment and structural developments.

One critical issue is the time-effect of signalling variables, whereas this plays a major role when considering the high likelihood of endogenous feedback. Due to likely endogeneity the warning variables might behave controversially depending on the time lag before the incidence of distress and perhaps GMM or some other means of coping with simultaneity will be required.

4. Empirical Study

4.1. Data

Much of the novelty of the present paper is attributable to the underlying data. The study uses macroeconomic and microeconomic variables drawn from Bankscope, IFS and Eurostat for 21 CEE countries including all new EU member states and candidate countries and several republics of former Soviet Union including Russia over the years 1996–2003. The full list is shown in Table 2.

Due to missing entries the initial sample of 684 banks and 2,787 observations was reduced to about 900 observations and 300 banks from 17 countries in the econometric analysis.[6] The following descriptive analysis, except for the table for average values of early warning indicators[7], however employs all data for which the bank status could be identified or 2,787 observations.

Table 3 shows the crisis episodes for the full data set, indicating that 1999

[6]The panel drop-out properties did not justify the weighting of remaining panel members.

[7] For better comparability with logit analysis the average county values of early warning variables include only these more than 300 banks included in the econometric model.

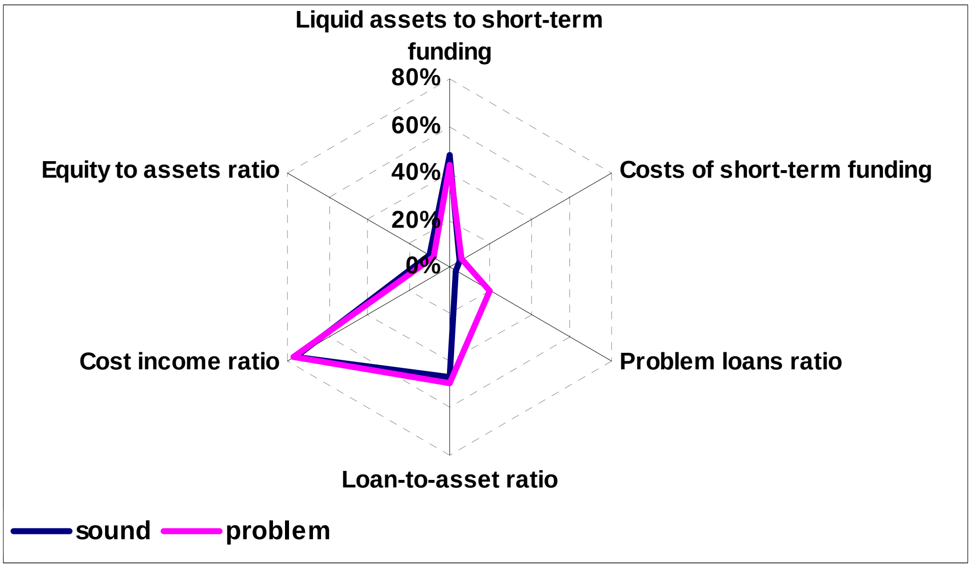
Table 2: Countries included

Albania,	Belarus,
Bulgaria,	Bosnia-Herzegovina,
Croatia,	Czech Republic,
Cyprus,	Estonia,
Hungary,	Latvia,
Lithuania,	FYR Macedonia,
Malta,	Moldova,
Poland,	Romania,
Russian Federation,	Slovakia,
Slovenia,	Turkey,
Ukraine.	

was the year of greatest banking problems – 40 occurrences (14 insolvent, 26 distressed) in 15 different countries. Weighted by the severity of banking problems (insolvency or distress), the countries, which faced the largest number of bank stress incidences over the period 1996–2003, were Poland, Croatia, Turkey, Russia, the Czech Republic and Slovakia. The systemic impact of bank distress, as measured by the number of problem banks from the whole sector and the share of assets from the banking sector total, indicates that broadly the same countries, except Russia, were the most affected. However, Malta and Cyprus also indicated a relatively high level of stress from a systemic perspective.

The mean values of warning variables for sound and problem banks in all sample countries are shown in Appendix 3. Despite the fast restructuring process leading to high diversity as for economic and political achievements across CEE countries, there are no remarkable differences in bank-specific variables between the new EU members and the rest of CEE countries (see Figure 1). The only statistically significant exception is the loan-to-assets ratio, which was higher for problem-banks in EU countries but lower for unsound banks in the non-EU sample. This is probably a feature of the immature lending markets, where banks with a larger lending portfolio exhibit a greater resemblance to banks in developed economies and are thus also more market-oriented.

In contrast to bank-specific variables there is more diversity in the macroeconomic variables between the EU and non-EU sub-samples. While higher concentration is indicated by the Herfindahl index for problem banks in non-EU sample, the opposite of low banking market concentration is coupled with banking problems in EU sample countries. A high Herfindahl index in the non-EU sample also corresponds to a high share of public owned banks. This indicates that the higher the banking concentration the less efficient and market-



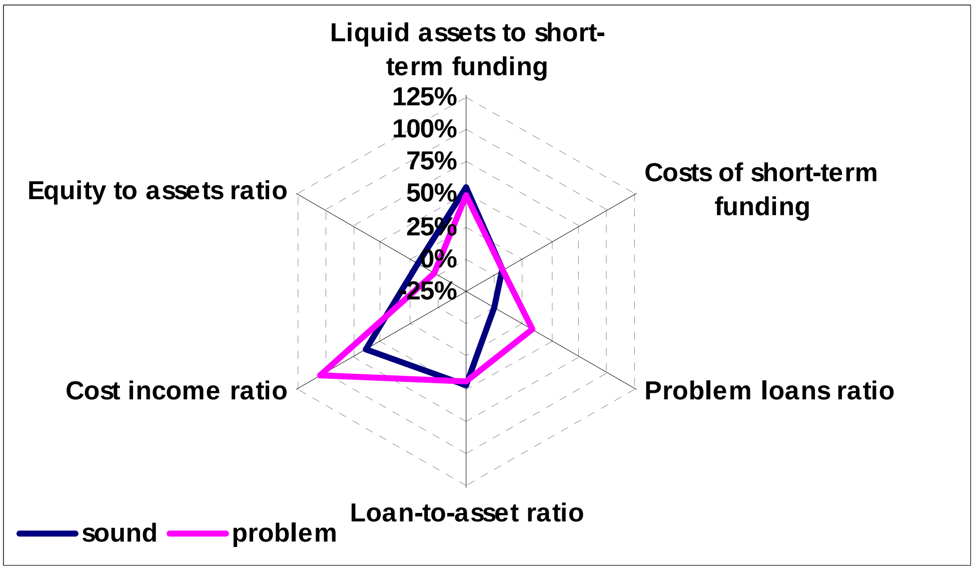


Figure 1: Bank-specific variables of sound and unsound banks in EU-10 and non-EU CEEC.

oriented is the banking environment. Where a CEEC belongs to the EU group, strong market competition triggers bank failures. Weak monetary policy seems to be more of an issue for non-EU countries' banking stability. Both the currency shock (sharp depreciation) and high inflationary pressures tend to be more important triggers of banking problems.

In general, the average indicator levels for sound and problem banks across countries vary a great deal, so no universal threshold level can be found, which adequately signals the vulnerabilities over the whole sample of countries. This might also be taken as one further argument in favour of using differences instead of levels for the explanatory variables in the logit model described in the next section.

The sample countries can also be compared according to the EBRD banking sector reform index (see Figure 2). Unfortunately no observations are available for Cyprus, Malta and Turkey. In general the new EU members demonstrate better advancement in banking reforms than other participants in the study. The exceptions are Croatia and Bulgaria, which belong to the frontline of transition countries in respect of banking sector reforms.

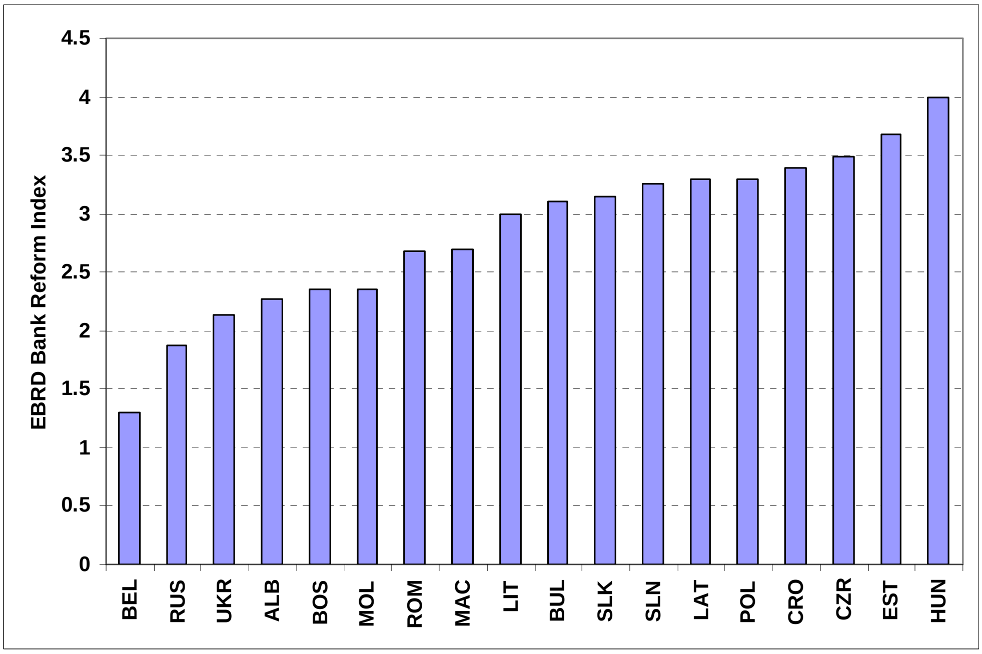


Figure 2: EBRD banking sector reform index, average 1998–2004.

Source: EBRD Transition Report 2004.

Another interesting insight into the pattern of bank problems in different sample countries can be found from the bank transition matrix (see Table 3).

Table 3: Bank transition matrix 1996–2003

in percentages

t+1	Belarus		Bosnia-Herz		Bulgaria		Croatia	
	sound	problem	sound	problem	sound	problem	sound	problem
sound	100	0	94	6	100	0	94	6
problem	50	50	88	13	78	22	24	76
all	97	3	93	7	98	2	87	13

t+1	Czech Rep		Cyprus		Estonia		Latvia	
	sound	problem	sound	problem	sound	problem	sound	problem
sound	95	5	87	13	85	15	94	6
problem	56	44	44	56	100	0	86	14
all	88	12	79	21	87	13	93	7

t+1	Lithuania		Malta		Moldova		Poland	
	sound	problem	sound	problem	sound	problem	sound	problem
sound	98	2	88	12	98	2	88	12
problem	67	33	0	100	100	0	20	80
all	96	4	70	30	98	2	72	28

t+1	Romania		Russia		Slovakia		Slovenia	
	sound	problem	sound	problem	sound	problem	sound	problem
sound	97	3	100	0	97	3	98	2
problem	75	25	67	33	44	56	50	50
all	95	5	99	1	88	12	97	3

t+1	Ukraine		Total	
	sound	problem	sound	problem
sound	99	1	96	4
problem	100	0	45	55
all	99	1	91	9

In the whole sample of 21 countries the historical probability of a sound bank remaining in a prudent state was about 96% against the probability of 4% falling into difficulties and become unsound. About a half of the problem banks[8] eventually recovered, whereas the rest remained unsound over the next year.

The highest chance (15%) of a sound bank becoming a problem bank was found in Estonia. However, none of the problem banks remained unsound over the next period, they either closed down or improved. This might imply some differences in the way in which the market operated, as Estonia only had distressed, but not insolvent banks in the sample period. The probability of falling into problem bank status was also relatively high in Cyprus, Malta and Poland. The transition matrix also demonstrates the persistence of bank problems. The

[8]The transition matrix cannot take into account those banks, which disappeared from the database.

highest likelihood for an unsound bank retaining its vulnerable status was in Malta, where none of the banks recovered once they had fallen into the problem category. This, however, has to be interpreted given the small number of banks in Malta and the fact that none of the problem banks was badly insolvent. The bank problems indicated a high persistence also for Poland, Croatia, Cyprus and Slovakia.[9]

4.2. Model Specification

We use the binomial fixed effects panel logit model to explore the relationship, which can be expressed by the following general specification:

$$E\left(y_{ijt} \middle| x, \beta, \alpha\right) = \beta' x_{ijt} + c_j$$

The dependent variable y denotes the bank status and is equal to 0 or 1 for sound and problem banks respectively. x is a set of early warning indicators having indexes $i = 1, ...N; j = 1, ...K;\ t = 1, ..T$, where N≈300 banks in the panel; K = 17 number of countries in the panel; T = 8 number of years (1996-2003).

In theory we have a choice of models of discrete dependent variables, largely between logit and probit, which are the most commonly used in empirical research on financial crisis and early warning systems. The important distinction from our point of view is that the probit model is based on the normal distribution, whereas logit model applies the logistic distribution. The logistic distribution has fat tails compared to the normal distribution and therefore tends to be more appropriate for model financial data, which are often leptokurtic. Furthermore, Gonzalez-Hermosillo, Pazarbasioglu and Billings (1997) claim in testing for several functional forms, including Weibull, normal and exponential distributions, that the logistic distribution best matches with the features of banking crisis data in Mexico. Similarly, they refer to earlier studies, which found that the logistic distribution best describes the banking difficulties in the United States for the period 1985–1992. However in large samples the two models should give broadly similar results.

[9] The caveat here is that transition matrix is sensitive to the choice of sample period, wherefore for these countries, which suffered more banking sector problems at the beginning of the observation period have lower probability of a sound bank to become problem bank and higher likelihood of problem banks to recover. The availability and goodness of data also play a great role as the banks with missing data drop out of the matrix.

Another issue, which favours the logit specification, is the fact that the probit model does not lend itself well to the fixed effect treatment, as there is no feasible way to remove the heterogeneity and with large number of cross-sectional units as in the current study the estimation of fixed effects is intractable (Green, 1995). In contrast to the probit model, the logit model enables treatment of fixed effects. The fixed effect treatment in current study is needed for extracting country-specific time-constant features.

The maximization of a conditional likelihood function (Chamberlain, 1980) requires sufficient statistics for the group-specific parameters. Therefore only these groups (countries) enter the estimation, which have both the crisis and tranquil observations available over the sample period.

The partial effects from fixed effects logit estimates are not straightforward. The logit coefficients on explanatory variables give the log-odds ratio i.e. $\log\left\{\Lambda(x_t\beta + c)/1 - \Lambda\left(x_t\beta + c\right)\right\} = x_t\beta + c$. Hence the partial effects on the response probabilities cannot be estimated without knowing c, which distribution is unrestricted and thus hard to know (Wooldridge, 2000).

In order to test how well the logit model fits the data it is simplest to look at maximum likelihood measure. Intuitively better measure of model explanatory power is the likelihood ratio index (LRI), whose value is bounded by 0 and 1. The closer LRI is to 1, the better the goodness of fit. In the first model with predominantly first differences gives for LRI 0.71 and the model based on second differences has LRI value of 0.696. These are relatively good results.

Thus,

$$LRI = 1 - \frac{\ln L_{ur}}{\ln L_o} \quad 0 < LRI < 1$$

where restricted log-likelihood is:

$$\ln L_o = n\left[P \ln P + (1 - P)\ln(1 - P)\right]$$

The key consideration in choosing between a random effects (RE) and fixed effects (FE) approach is whether c_i and x_{it} are correlated. Hausman (1978) proposed a test based on the difference between random effects and fixed effect estimates. Since FE is consistent when c_i and $x_{it}$are correlated, but RE is inconsistent, a statistically significant difference is interpreted as evidence against the random effects assumption. However, Hausman test needs strict exogeneity, whereas correlation between x_{is} and u_{it} for any s and t causes both FE and RE to be inconsistent.

Applying the Hausman test, however, did not find statistically significant difference between random effects and fixed effect specification of the model. Nevertheless, the theoretical arguments and maximum likelihood measures indicate that the fixed effects model seems to be a more appropriate specification given the aim of the study.

Bank-specific variables from financial statements are closely interlinked, which causes estimation problems from high collinearity if several are included. To cope with the problem two methods were applied. First the factor loadings were calculated and employed in order to filter out the dominating variables of similar nature, e.g. the most representative efficiency variable from different proxy-measures. Secondly, since it is not immediately apparent what the appropriate metric is, the inverse values of the variables were used instead of original ratios.

To overcome problems of endogeneity in using bank-specific variables, because the financial variables from banks accounts might be itself a reflection of crisis, the explanatory variables are modelled in differences and not in levels. Statistically significant explanatory variables (in difference form) were in turn tested for exogeneity. For this purpose the simple procedure described by Wooldridge (2000) was carried through[10]. As a result the contemporaneous values of differences of loan-asset ratio, equity investments ratio and cost-income ratio turned to be not exogeneous. Hence, for these variables only the lagged difference values can be used in order to avoid misleading results due to endogeneity.

5. Results

The results from the fixed effects panel logit model (see Table 4) indicate that macroeconomic variables tend to give a signal earlier than most of financial variables. This might be because the year lags are too long for many volatile bank-specific indicators. The Wald test, however, strongly rejects the hypothesis that either the bank-specific variables or macroeconomic variables are irrelevant for explaining the crisis probability.[11]

[10] In the first step the explanatory variable of interest is regressed against the rest of explanatory variables. In the second step the residuals from the OLS are substituted into the logit estimation. If the t-statistic of residual turns to be statistically significant the variable of interest is not exogenous.

[11] For bank-specific variables the χ^2 (10) = 36.16 and Prob $>$ χ^2 = 0.0001. For macroeconomic variables the χ^2(6) = 18.30 Prob $>$ χ^2 = 0.0055.

Variables in all categories of bank conditions offer some degree of explanation of ensuing crisis although the market risk is the weakest. Problem loans, not surprisingly, stand out as the clearest indicator of subsequent distress. The only other bank characteristic that offers some clear explanation looking two years ahead (see column 2) is the cost-income ratio, demonstrating that inefficiencies can have detrimental effect on bank soundness.

With only a one year horizon (see column 1) several variables act as indicators. The solvency ratio indicates a clear path, being negative throughout the period leading to distress. However, in a sense solvency indicators are not so much early warning signs, as actual results of bank's long-term mismanagement. However, Sundararajan et al. (2002) have claimed that banks with higher equity need to borrow less to support a given level of assets and thus have lower interest expenses, which results in higher net interest and net income.

The liquidity measures tend to have intuitively correct signs. The inverse liquidity ratio is positively correlated with banking problems in both the following year and two-years ahead models. Interest expenses on funding increase immediately before crisis, while they have been decreasing further ahead of the crash. The inverse moral hazard indicator shows that vulnerable banks have low profitability in the pre-crisis year. The loan-assets ratio does not indicate any clear pattern, although it tends to be lower in the pre-crisis year, which is rather counter-intuitive.

Table 4: Panel logit model results

Indicators	**Following year**	**Two years ahead**
LIQUIDITY		
Short-term liabilities and deposits to liquid assets, i.e.inverse liquidity ratio	0.22 d* (1.58)	0.21 dL (1.45)
Interest expenses to short-term funding	6.07 d** (1.93)	-0.64 dL (-0.27)
Bank deposits to all deposits	-0.00 d (-0.01)	-0.03 dL (0.19)
CREDIT RISK		
Loan-asset ratio	-1.57 dL (-1.11)	0.01 dL (0.01)
Problem loans ratio	8.82 d*** (5.89)	1.47 dL*** (2.65)
SOLVENCY		

Indicators	Following year	Two years ahead
Equity-to-assets ratio	-9.78 d*** (-4.32)	-0.29 dL (-0.11)
MARKET RISK		
Equity investments to assets ratio	-1.98 dL (-0.27)	4.09 dL (0.71)
Trading-income ratio	-0.02 d (-1.33)	-0.00 dL (0.28)
EFFICIENCY AND PROFITABILITY		
Cost-income ratio	0.15 dL (0.58)	0.38 dL* (1.76)
Assets divided by interest and fee income – inverse moral-hazard	0.09 d** (2.13)	0.03 dL (1.07)
MACROECONOMIC AND STRUCTURAL INDICATORS		
Private lending to GDP	-3.84 d (-1.13)	5.76 dL* (1.64)
GDP real growth	-7.99 (-1.21)	-16.00 L*** (-3.19)
CPI growth	-5.40 (-1.39)	1.95 L (0.72)
EURIBOR_3mth	0.13 d (0.71)	0.36 dL** (2.40)
Exchange rate change (domestic currency/$)	106.28 (0.61)	-262.80 L* (-1.66)
Herfindahl sector concentration index	-0.00 d (-1.33)	-0.00 dL (-1.11)
Share of state-owned banks	-3.02 L*** (-2.79)	-0.01 L2 (-1.10)
MODEL STATISTICS		
Log likelihood	-203.19	-232.74
Likelihood ratio index	0.74	0.69
AIC	440.371	556.0785
BIC	522.3298	577.3324
Observations (distress)/banks/countries	917 (121)/303/17	900 (117)/302/17

***Notes**: (1) z-values in brackets. Albania, Belarus, Bulgaria and Hungary were dropped due to no crisis observations in model sample. (2) d indicates first difference, L one lag and, L2 two lags. (3) *, **, *** indicate significance at the 10, 5 and 1% levels respectively.*

The interpretation of market risk indicators is more ambiguous, as it was the only risk component, which turned out to be also jointly insignificant. Therefore no conclusions can be drawn based on coefficient on equity investments ratio or trade income ratio.

Our two bank structure indicators offer some support to traditional hypotheses. The negative sign for the Herfindahl index, although the coefficient is insignificant, suggests that high competition might lead to more frequent occurrences of bank failure. The behaviour of the financial deepening measure, proxied by private lending to GDP, is also intuitive. A crisis is correlated with financial deepening ex ante and financial contraction at the time of the crisis. The share of state-owned banks indicates that privatisation or a higher proportion of private banks has been accompanied with crisis episodes in the transition countries. However, it appears that this positive correlation of private banks with distress incidences falls primarily in the non-EU group of CEE countries (see Appendices 1 and 2).

The macroeconomic variables point in the expected directions, although mainly further ahead rather than in the current period. Declining GDP growth and instabilities in the external and domestic environment lead to higher likelihood of crises. Rises in Euribor-3M interest rates raises the costs of funding, which precipitates financial problems for many CEE countries. Pre-crisis inflationary pressures and the eventual drop also belong to a story of crisis. Currency depreciation seems to trigger banking problems, but the sign is reversed in the current period. Depreciation on its own puts pressure on both banks' balance sheets and those of their borrowers if loans have been taken out in foreign currency. There is a delay before payments are due and this bites. This might indicate loose monetary control in the preceding period and restrictive monetary policy ex post, which leads to eventual stress in the banking sector.

Given the individual statistical insignificance of many predictive variables and unobserved effects characteristic of the logit model, which does not allow for good interpretation of partial effects, we need to explore the patterns of the proposed early warning indicators in explaining bank distress further. A simple first step is to look at the model's predictive power. Table 5 summarises the in-sample predictive properties of the model estimates. Missing observations the estimated model means we have 121 crisis observations from 17 CEE countries. The in-sample predictive power of the model seems encouraging. In seven countries the in-sample prediction of crises was perfect, although it coupled with a somewhat higher degree of noise. The model worked best in case of Latvia, Moldova, Russia and Lithuania. The only countries where the estimates did not recognize any crisis were Slovenia and Ukraine. The in-sample predictive performance in picking up the crisis episodes was also relatively weak for Poland, Turkey and Croatia. The in-sample estimation revealed that the model overpredicts problems for Estonia and Malta, whereas it was insufficiently sensitive in capturing banking problems in Poland, Croatia, Slovakia and Turkey. The model's poor performance for Poland might be largely due to a stringent national definition of sub-standard loans, i.e. loans overdue 30 days instead of the common international and EU definition of overdue 90 days.[12] Therefore the threshold for defining bank distress for Poland is too low.

Table 5: Model predictive power (in-sample)

In-sample crisis probability

	Overall predictive power	Crisis occurrence	Type I error	Probability of missing crisis	Type II error	Probability of issuing wrong signal
Bosnia-Herzegovina	97%	9%	33%	3%	0%	0%
Croatia	80%	24%	84%	20%	0%	0%
Czech Republic	83%	8%	33%	3%	16%	15%
Cyprus	86%	23%	0%	0%	18%	14%
Estonia	62%	14%	0%	0%	44%	38%
Latvia	98%	5%	0%	0%	2%	2%
Lithuania	92%	3%	0%	0%	8%	8%
FYR Macedonia	93%	7%	0%	0%	7%	7%
Malta	75%	50%	13%	6%	38%	19%
Moldova	91%	4%	0%	0%	9%	9%
Poland	64%	39%	94%	36%	0%	0%
Romania	94%	6%	50%	3%	3%	3%
Russian Federation	98%	1%	0%	0%	2%	2%
Slovakia	85%	12%	60%	7%	8%	7%
Slovenia	96%	4%	100%	4%	0%	0%
Turkey	86%	16%	86%	14%	0%	0%
Ukraine	95%	2%	100%	2%	4%	4%
Total	87%	13%	69%	9%	5%	4%

The second step was to run an out-of-sample and see how well the model manages to recognize the crises of 2003 based on the estimates from the years 1996–2002. There were 21 crisis episodes out of 186 observations in 2003. These were concentrated in six countries: Croatia, Cyprus, Estonia, Malta, Poland and Slovenia.

As shown in Table 6 the model managed to recognize banking problems in two out of the six countries, Cyprus and Estonia,[13] but it also extracted a high degree of noise. The model failed to pick up any of the crises in Poland, Slovenia, Malta and Croatia. This is a similar result to the in-sample prediction, which also highlighted the model sensitivity for Estonia and Cyprus, and

[12] The definition of substandard loans was brought in line with EU standards in January 2004.

[13] The model recognised 3 episodes of bank distress out of 21. Two incidences were picked up as for Cyprus and one incidence for Estonia.

its weakness in identifying problems predominantly in Poland, Slovenia and Croatia. For the 11 countries, which did not experience banking problems in 2003, the wrong signal was extracted only once for Russia (type-II error 3%) and three times for Romania (type-II error 33%). In general the results tend to be weaker for banking sectors in highly regulated markets.

Table 6: Model out-of-sample predictive power

Out-of-sample crisis probability 2003

	Overall predictive power	Crisis occurrence	Type I error	Probability of missing crisis	Type II error	Probability of issuing wrong signal
Croatia	76%	24%	100%	24%	0%	0%
Cyprus	75%	50%	0%	0%	50%	25%
Estonia	75%	25%	0%	0%	100%	75%
Malta	48%	48%	100%	48%	0%	0%
Poland	48%	48%	100%	48%	8%	4%
Slovenia	92%	8%	100%	8%	0%	0%
Total	76%	11%	86%	10%	16%	14%

Given the limitations of descriptive statistics and the logit model the research could be further elaborated by employing duration models or conducting bank survival analysis. Gonzalez-Hermosillo (1997, 1999) has successfully employed the logit technique and survival models in parallel. As claimed by Hardy and Pazarbasioglu (1998), the formerly socialist transition economies suffered a special range of problems that make them noncomparable with most of the other countries. The source for these noncomparabilities is mainly related to institutional factors, such as privatisation and liberalisation, enactment of new banking regulations and reforms in the monetary system. Therefore, further analysis of banking vulnerabilities could incorporate a wider range of indicators reflecting the major institutional changes during the transition process and a broader background for the differences in the development of the banking sector across the sample countries.

6. Conclusions

Using panel data at the bank level, it is possible to find bank-specific, bank sector structure and macro-economic variables that are able to predict vulnerabilities in the CEE countries' banking sector over the period since 1996. Macro-economic variables tend to perform better in predicting a couple of years ahead, as they are more persistent compared to the more volatile financial variables. However, the financial variables have more to say about the crisis pattern, explaining how both the causes and the reactions contribute to a crisis or its avoidance. Not surprisingly the indicators are inter-related and while individual factors may be weakly determined their joint effect is clear.

There are some interesting differences between the ten new EU members and the rest of the observed CEE countries. Although these two groups had broadly similar patterns of differences between the sound and problem banks, the high loan-to-assets ratio in the EU sample was associated with problem banks, whereas the same was characteristic of sound banks in the non-EU sub-sample. Similarly, although not statistically significant, the higher trade-income ratio was a feature of distressed banks in the EU group, while being rather the indicator of prudent institutions for the non-EU group. With the macroeconomic variables, the non-EU banks turned out to be more vulnerable to inflationary pressures and exchange rate movements.

The in-sample and out-of-sample predictions with the model had relatively encouraging results. It managed to predict all distress episodes in seven countries out of the seventeen studied in detail. Out-of-sample prediction as for the year 2003 revealed that the model was able to capture the bank-distress incidences in two countries out of six. In the remaining countries the number of incidences are either over- or under-estimated. The estimates tend to be over-sensitive for Estonia and Cyprus, in which cases all the distress episodes were identified but further problems were suggested that did not actually occur. On the other hand, the occurrence of unsound banks in Poland, Croatia, Turkey, Malta and Slovenia was underestimated.

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Appendix 1. Crisis episodes by number of banks and proportional to banks' number and banking sector's total assets

year		Albania	Belarus	Bosnia-Herz	Bulgaria	Croatia	Czech Rep	Cyprus	Estonia	Hungary	Latvia	Lithuania
1996	# crisis	n.a.	0	0	3	0	5	0	0	0	1	2
	% banks	n.a.	0%	0%	38%	0%	25%	0%	0%	0%	7%	40%
	% total assets	n.a.	0%	0%	34%	0%	28%	0%	0%	0%	0%	21%
###	# crisis	0	1	2	4	1	5	1	1	1	2	1
	% banks	0%	50%	33%	27%	3%	26%	20%	13%	9%	12%	14%
	% total assets	0%	96%	39%	20%	5%	68%	3%	3%	0%	9%	3%
###	# crisis	0	1	0	0	3	4	1	1	0	2	0
	% banks	0%	25%	0%	0%	9%	24%	17%	25%	0%	13%	0%
	% total assets	0%	95%	0%	0%	6%	45%	3%	1%	0%	42%	0%
###	# crisis	2	0	3	1	3	2	1	0	0	2	0
	% banks	40%	0%	20%	5%	9%	12%	14%	0%	0%	13%	0%
	% total assets	86%	0%	13%	6%	11%	28%	3%	0%	0%	11%	0%
###	# crisis	0	0	1	1	7	1	1	1	0	1	1
	% banks	0%	0%	6%	5%	19%	6%	13%	20%	0%	6%	11%
	% total assets	0%	0%	3%	6%	11%	1%	0%	1%	0%	3%	27%
###	# crisis	0	0	2	0	5	1	0	1	0	0	0
	% banks	0%	0%	13%	0%	15%	7%	0%	25%	0%	0%	0%
	% total assets	0%	0%	11%	0%	8%	1%	0%	19%	0%	0%	0%
###	# crisis	0	0	0	0	5	1	5	0	0	0	0
	% banks	0%	0%	0%	0%	16%	7%	42%	0%	0%	0%	0%
	% total assets	0%	0%	0%	0%	5%	1%	87%	0%	0%	0%	0%
###	# crisis	0	0	0	0	6	0	3	1	0	0	0
	% banks	0%	0%	0%	0%	17%	0%	30%	17%	0%	0%	0%
	% total assets	0%	0%	0%	0%	5%	0%	29%	5%	0%	0%	0%

year	crisis	Macedonia	Malta	Moldova	Poland	Romania	Russian Fed	Slovakia	Slovenia	Turkey	Ukraine
1996	# crisis	0	0	0	2	1	1	2	0	0	0
	% banks	0%	0%	0%	7%	50%	3%	15%	0%	0%	0%
	% total assets	0%	0%	0%	0%	23%	0%	69%	0%	0%	0%
1997	# crisis	0	0	0	3	0	0	3	0	1	0
	% banks	0%	0%	0%	9%	0%	0%	18%	0%	8%	0%
	% total assets	0%	0%	0%	5%	0%	0%	70%	0%	8%	0%
1998	# crisis	0	0	1	4	0	2	5	1	1	2
	% banks	0%	0%	17%	12%	0%	7%	33%	6%	7%	12%
	% total assets	0%	0%	24%	31%	0%	16%	68%	5%	5%	27%
1999	# crisis	2	1	0	8	2	6	3	0	4	0
	% banks	22%	20%	0%	22%	18%	10%	25%	0%	13%	0%
	% total assets	48%	40%	0%	62%	0%	8%	15%	0%	31%	0%
2000	# crisis	0	1	0	11	3	3	2	0	1	0
	% banks	0%	20%	0%	30%	18%	3%	14%	0%	4%	0%
	% total assets	0%	38%	0%	77%	0%	1%	9%	0%	0%	0%
2001	# crisis	0	2	0	12	0	0	1	0	8	1
	% banks	0%	33%	0%	32%	0%	0%	6%	0%	33%	3%
	% total assets	0%	80%	0%	82%	0%	0%	3%	0%	29%	1%
2002	# crisis	1	3	0	14	1	1	0	1	5	1
	% banks	9%	60%	0%	42%	6%	1%	0%	8%	20%	3%
	% total assets	3%	83%	0%	88%	0%	0%	0%	8%	13%	2%
2003	# crisis	0	3	0	12	0	0	0	1	2	0
	% banks	0%	50%	0%	39%	0%	0%	0%	7%	8%	0%
	% total assets	0%	83%	0%	56%	0%	0%	0%	8%	3%	0%

Appendix 2. Crisis episodes 1996–2003 grouped by countries

year	crisis	Albania	Belarus	Bosnia-Herz	Bulgaria	Croatia	Czech Rep	Cyprus	Estonia	Hungary	Latvia	Lithuania
1996	sound	n.a.	2	2	5	30	15	4	7	8	14	3
	distress	n.a.	0	0	2	0	3	0	0	0	1	0
	insolvent	n.a.	0	0	1	0	2	0	0	0	0	2
1997	sound	2	1	4	11	36	14	4	7	10	15	6
	distress	0	1	2	4	1	5	1	1	1	2	1
	insolvent	0	0	0	0	0	0	0	0	0	0	0
1998	sound	1	3	12	19	30	13	5	3	8	13	8
	distress	0	0	0	0	3	4	1	1	0	1	0
	insolvent	0	1	0	0	0	0	0	0	0	1	0
1999	sound	3	6	12	18	30	15	6	4	12	13	7
	distress	0	0	3	1	2	2	1	0	0	2	0
	insolvent	2	0	0	0	1	0	0	0	0	0	0
2000	sound	5	6	15	20	29	15	7	4	14	17	8
	distress	0	0	1	1	7	1	1	1	0	1	1
	insolvent	0	0	0	0	0	0	0	0	0	0	0
2001	sound	4	10	13	21	29	14	10	3	11	13	9
	distress	0	0	1	0	5	1	0	1	0	0	0
	insolvent	0	0	1	0	0	0	0	0	0	0	0
2002	sound	5	10	16	24	26	14	7	4	12	16	9
	distress	0	0	0	0	5	1	5	0	0	0	0
	insolvent	0	0	0	0	0	0	0	0	0	0	0
2003	sound	3	6	12	22	30	14	7	5	9	19	9
	distress	0	0	0	0	6	0	3	1	0	0	0
	insolvent	0	0	0	0	0	0	0	0	0	0	0
1997-2003	sound	23	44	86	140	240	114	50	37	84	120	59
	distress	0	1	7	8	29	17	12	5	1	7	2
	insolvent	2	1	1	1	1	2	0	0	0	1	2
Observations total		25	46	94	149	270	133	62	42	85	128	63

year	crisis	Macedonia	Malta	Moldova	Poland	Romania	Russian Fed	Slovakia	Slovenia	Turkey	Ukraine	Total
1996	sound	6	4	6	28	1	36	11	16	10	6	214
	distress	0	0	0	1	1	1	2	0	0	0	11
	insolvent	0	0	0	1	0	0	0	0	0	0	6
1997	sound	6	5	6	32	5	39	14	22	12	11	262
	distress	0	0	0	2	0	0	2	0	0	0	23
	insolvent	0	0	0	1	0	0	1	0	1	0	3
1998	sound	4	6	5	29	8	25	10	15	14	15	246
	distress	0	0	1	3	0	0	3	1	0	2	20
	insolvent	0	0	0	1	0	2	2	0	1	0	8
1999	sound	7	4	9	28	9	56	9	17	27	25	317
	distress	2	1	0	6	1	1	2	0	2	0	26
	insolvent	0	0	0	2	1	5	1	0	2	0	14
2000	sound	9	4	9	26	14	95	12	17	25	25	376
	distress	0	1	0	11	2	0	1	0	0	0	29
	insolvent	0	0	0	0	1	3	1	0	1	0	6
2001	sound	10	4	10	26	16	114	15	15	16	30	393
	distress	0	2	0	12	0	0	1	0	7	0	30
	insolvent	0	0	0	0	0	0	0	0	1	1	3
2002	sound	10	2	10	19	17	118	14	12	20	29	394
	distress	1	3	0	14	1	1	0	1	5	0	37
	insolvent	0	0	0	0	0	0	0	0	0	1	1
2003	sound	11	3	6	19	16	76	14	13	24	22	340
	distress	0	3	0	12	0	0	0	1	2	0	28
	insolvent	0	0	0	0	0	0	0	0	0	0	0
1997-2003	sound	63	32	61	207	86	559	99	127	148	163	2542
	distress	3	10	1	61	5	3	11	3	16	2	204
	insolvent	0	0	0	5	2	10	5	0	6	2	41
Observations total		66	42	62	273	93	572	115	130	170	167	2787

Appendix 3. Mean level of warning indicators for sound (0) and unsound (1) banks in country comparison

			New EU members (444 observations, o/w 79 crisis episodes)											Non-EU members (473 observations, o/w 42 crisis episodes)													
INDICATORS		crisis	Czech Rep	Cyprus	Estonia	Hungary	Latvia	Lithuania	Malta	Poland	Slovakia	Slovenia	EU	Albania	Belarus	Bosnia-Herz	Bulgaria	Croatia	Macedonia	Moldova	Romania	Russia	Turkey	Ukraine	non_EU	Total
Liquidity	Liquid assets to short-term funding	0	61%	39%	35%	44%	52%	44%	56%	50%	55%	37%	47%	102%	33%	64%	66%	58%	58%	51%	60%	47%	60%	51%	55%	52%
		1	40%	31%	36%	-	56%	53%	29%	48%	36%	50%	44%	-	-	44%	-	51%	26%	33%	49%	68%	52%	33%	49%	46%
		all	61%	36%	35%	44%	53%	45%	41%	49%	53%	38%	47%	102%	33%	63%	66%	57%	58%	52%	59%	47%	58%	51%	54%	64%
	Costs of short term funding	0	7%	5%	4%	6%	3%	3%	4%	8%	7%	5%	5%	5%	10%	2%	2%	5%	4%	7%	12%	6%	20%	7%	7%	6%
		1	8%	4%	4%	-	3%	3%	4%	7%	10%	5%	6%	-	-	2%	-	5%	5%	14%	11%	9%	20%	8%	8%	7%
		all	7%	4%	4%	6%	3%	3%	4%	8%	7%	5%	6%	5%	10%	2%	2%	5%	4%	7%	12%	6%	20%	7%	7%	7%
	Bank deposits to customer deposits ratio	0	53%	8%	20%	26%	20%	39%	15%	162%	22%	19%	54%	0%	30%	16%	11%	18%	18%	26%	23%	47%	24%	27%	30%	41%
		1	22%	3%	13%	-	32%	3%	11%	44%	17%	19%	32%	-	-	4%	-	21%	11%	112%	2%	15%	10%	19%	19%	28%
		all	50%	7%	19%	26%	21%	38%	13%	116%	21%	19%	50%	0%	30%	15%	11%	19%	17%	30%	22%	47%	21%	26%	29%	39%
Credit Risk	Problem loans ratio	0	-9%	4%	6%	4%	3%	4%	3%	3%	4%	4%	3%	1%	5%	5%	3%	7%	7%	7%	4%	-16%	6%	7%	-1%	1%
		1	27%	18%	12%	-	23%	14%	12%	20%	30%	17%	20%	-	-	28%	-	30%	28%	19%	23%	15%	57%	2%	33%	24%
		all	-6%	7%	7%	400%	4%	5%	7%	10%	7%	5%	6%	1%	5%	7%	3%	13%	9%	8%	5%	-16%	15%	6%	2%	4%
	Loan-to-asset ratio	0	34%	55%	57%	54%	37%	46%	38%	50%	39%	54%	46%	0%	57%	50%	41%	50%	45%	50%	41%	49%	35%	51%	47%	47%
		1	50%	61%	59%	-	29%	27%	52%	49%	50%	49%	49%	-	-	50%	-	46%	56%	61%	42%	30%	28%	54%	44%	47%
		all	35%	58%	58%	54%	37%	46%	46%	49%	40%	54%	46%	0%	57%	50%	41%	49%	45%	49%	42%	49%	33%	51%	47%	47%
Market risk	Equity investments ratio	0	0,4%	0,2%	0,5%	0,3%	0,9%	1,3%	0,7%	1,0%	0,3%	2,2%	1,0%	-	0,3%	0,7%	0,6%	0,9%	4,9%	1,1%	1,0%	2,2%	2,2%	1,2%	1,6%	1,3%
		1	0,6%	0,1%	0,2%	-	2,8%	0,4%	0,8%	1,9%	0,5%	0,3%	1,4%	-	-	0,6%	-	2,4%	28,8%	0,2%	0,4%	0,2%	1,2%	0,4%	2,5%	1,8%
		all	0,5%	0,2%	0,5%	0,3%	1,0%	1,2%	1,6%	1,3%	0,3%	2,1%	1,2%	-	0,3%	0,7%	0,6%	1,3%	5,5%	1,1%	1,0%	2,2%	2,0%	1,1%	1,8%	1,5%
	Trade income ratio	0	156%	160%	160%	141%	76%	249%	57%	223%	312%	105%	168%	3%	352%	1002%	350%	89%	105%	35%	61%	202%	742%	78%	243%	209%
		1	48%	22%	156%	-	25%	57%	44%	412%	152%	220%	284%	-	-	177%		196%	309%	26%	43%	47%	89%	155%	166%	243%
		all	148%	129%	160%	141%	74%	244%	51%	297%	291%	109%	189%	3%	352%	929%	350%	115%	119%	35%	60%	201%	635%	79%	236%	213%
Efficiency and profitability	Cost income ratio	0	98%	67%	74%	72%	89%	87%	62%	64%	82%	64%	76%	30%	74%	59%	74%	63%	55%	51%	72%	63%	76%	57%	64%	69%
		1	62%	91%	71%	-	127%	79%	55%	76%	94%	76%	77%	-	-	92%		112%	38%	50%	60%	-	131%	103%	103%	85%
		all	95%	71%	74%	72%	90%	87%	56%	69%	84%	64%	76%	30%	74%	63%	74%	75%	55%	53%	71%	63%	80%	57%	66%	71%
	Moral hazard i.e interest and fee income to total assets	0	8%	6%	8%	9%	8%	7%	5%	11%	8%	8%	8%	8%	14%	6%	6%	8%	7%	13%	16%	9%	24%	12%	10%	10%
		1	10%	5%	8%	-	13%	9%	5%	9%	12%	8%	9%	-	-	7%	-	7%	11%	16%	18%	8%	26%	10%	11%	10%
		all	8%	6%	8%	9%	8%	7%	5%	10%	9%	8%	8%	8%	14%	6%	6%	7%	8%	14%	16%	9%	24%	12%	11%	10%
Capital	Equity to assets ratio	0	7%	8%	10%	9%	9%	13%	8%	13%	10%	11%	10%	2%	14%	14%	18%	15%	25%	24%	19%	19%	11%	18%	17%	14%
		1	5%	7%	9%	-	-10%	7%	7%	9%	0%	8%	7%	-	-	5%	-	8%	11%	18%	11%	-4%	-22%	0%	3%	6%
		all	7%	7%	10%	9%	9%	12%	8%	12%	9%	10%	10%	2%	14%	13%	18%	13%	25%	24%	18%	19%	6%	17%	16%	13%
Macroeconomic and Sectoral variables	Herfindahl-banking sector index	0	1760	2797	4150	3610	1929	2734	3711	1222	1802	1927	2137	5422	5404	1363	1419	2132	3309	1863	3567	2357	1343	1057	2175	2161
		1	1743	2856	4707	4033	2009	2505	3306	1085	1875	2068	1819	5999	9173	1336	2517	2507	2742	2530	3905	2505	1222	1122	2385	2052
		all	1758	2809	4217	3615	1934	2719	3614	1189	1812	1931	2094	5468	5568	1361	1485	2174	3284	1874	3592	2361	1328	1058	2187	2151
	State-owned banks share	0	4%	23%	0%	8%	4%	17%	12%	30%	21%	34%	20%	59%	62%	23%	19%	14%	1%	10%	45%	44%	34%	11%	27%	24%
		1	4%	4%	0%	-	5%	38%	0%	26%	41%	22%	21%	-	-	30%	-	11%	2%	0%	50%	42%	33%	12%	20%	20%
		all	4%	19%	0%	8%	4%	17%	6%	28%	23%	33%	20%	59%	62%	23%	19%	13%	1%	9%	45%	44%	33%	11%	27%	23%
	Real GDP growth	0	2%	3%	6%	4%	6%	6%	1%	4%	4%	4%	4%	6%	5%	8%	3%	4%	2%	2%	2%	5%	3%	4%	4%	4%
		1	1%	3%	7%	5%	5%	5%	-1%	3%	4%	3%	3%	9%	10%	14%	-5%	4%	3%	-7%	2%	5%	0%	3%	3%	3%
		all	2%	3%	6%	4%	6%	6%	1%	4%	4%	4%	4%	6%	6%	9%	3%	4%	2%	2%	2%	5%	3%	4%	4%	4%
	Loans to private sector GDP	0	54%	113%	25%	31%	19%	13%	110%	26%	45%	34%	39%	4%	10%	43%	18%	41%	20%	20%	9%	15%	20%	13%	21%	27%
		1	66%	117%	26%	24%	13%	11%	113%	27%	52%	37%	47%	3%	12%	45%	28%	44%	20%	14%	8%	14%	19%	12%	27%	39%
		all	55%	113%	25%	30%	18%	13%	111%	26%	46%	34%	40%	4%	10%	44%	18%	41%	20%	19%	9%	15%	20%	13%	21%	28%
	Average annual growth of CPI	0	3%	4%	8%	11%	5%	3%	3%	7%	7%	8%	6%	6%	99%	2%	7%	4%	3%	18%	41%	27%	58%	16%	23%	17%
		1	2%	3%	6%	19%	6%	15%	2%	5%	8%	7%	5%	0%	68%	5%	1%	4%	0%	8%	41%	54%	54%	9%	25%	13%
		all	2%	4%	8%	11%	5%	4%	3%	7%	7%	8%	6%	5%	98%	2%	6%	4%	2%	18%	41%	28%	57%	16%	23%	17%
	Average annual rate domestic/USD	0	0,02%	0,01%	0,00%	0,04%	-0,01%	-0,06%	-0,02%	0,04%	0,01%	0,06%	0,02%	0,00%	1,11%	-0,02%	0,00%	0,01%	-0,01%	0,24%	0,26%	0,13%	0,48%	0,12%	0,14%	0,09%
		1	0,03%	-0,14%	0,01%	-	0,02%	0,00%	-0,02%	0,01%	0,09%	-0,04%	0,00%	-	-	0,07%	-	0,02%	0,00%	0,16%	0,42%	0,66%	0,74%	-0,01%	0,18%	0,07%
		all	0,02%	-0,03%	0,00%	0,04%	-0,01%	-0,06%	-0,02%	0,03%	0,02%	0,06%	0,01%	0,00%	1,11%	-0,01%	0,00%	0,02%	0,00%	0,24%	0,26%	0,13%	0,53%	0,12%	0,14%	0,08%