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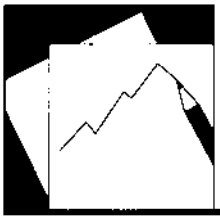

IMF Working Paper

Are Weak Banks Leading Credit Booms? Evidence from Emerging Europe

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Are Weak Banks Leading Credit Booms? Evidence from Emerging Europe

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Abstract

This paper examines the behavior of bank soundness indicators during episodes of brisk loan growth, using bank-level data for central and eastern Europe and controlling for the feedback effect of credit growth on bank soundness. No evidence is found that rapid loan expansion has weakened banks during the last decade, but over time weaker banks seem to have started to expand at least as fast as, and in some markets faster than, stronger banks. These findings suggest that during credit booms supervisors need to carefully monitor the soundness of rapidly expanding banks and stand ready to take action to limit the expansion of weak banks.
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Contents Page

I. INTRODUCTION

In an environment of brisk credit growth, supervisors tend to watch carefully if weak banks are starting to expand rapidly. Sounder banks may have a competitive advantage in meeting the demand for credit owing to their larger capital cushions and better risk management, but weaker banks may have strong incentives to expand aggressively, in an attempt to grow out of problems by boosting their market share and profits. If the pace of expansion overwhelms banks' ability to manage risk, their asset quality would deteriorate over time. How sound are the banks that are driving credit expansion is a question that is particularly relevant for emerging Europe, where bank credit has been growing rapidly—at average annual rates of 25–40 percent—during the last decade.

This question has remained under-explored in the literature. Most studies on countries' experiences with credit booms have focused on the other side of the relationship between bank soundness and credit growth—whether credit booms weaken the banking system, and hence, are associated with financial instability (see, for example, Gourinchas, Valdes, and Landerretche, 2001). When examining this question in a sample of banks from the new member countries of the European Union (EU) and accession countries, Maechler, Mitra, and Worrell (2007) found that rapid loan growth has been associated with an improvement in bank soundness indicators, except when credit growth accelerated sharply. Macro-level studies on credit growth in eastern European economies focused on assessing whether credit growth in the region has been excessive. These studies tend to conclude that bank intermediation in the new EU member states is still below the equilibrium levels consistent with their levels of economic development and the structural characteristics of their banking sectors, and there is ample room for further financial deepening (see, for example, Schadler and others, 2004; and Cottarelli, Dell'Ariccia, and Vladkova-Hollar, 2005).[2]

This paper complements the literature by examining whether credit growth in emerging Europe has been led by weak banks, controlling for the effect of credit growth on bank soundness. The empirical setting is based on a simultaneous equation framework, where bank soundness and credit growth are modeled as functions of each other as well as other bank-specific and macroeconomic factors. The analysis uses detailed bank balance sheet data for the Baltic countries (Estonia, Latvia, and Lithuania) and other central and eastern European countries (CEECs)—the Czech Republic, Hungary, Poland, the Slovak Republic, and Slovenia—for the period from 1994 to 2004. After examining the question of whether credit growth is driven by weak banks, the study explores where the pockets of vulnerabilities are located: in the Baltics or the CEECs, in foreign-owned or domestically owned banks, in banks focusing on household or corporate lending or those that are heavily exposed to

[2] The third stream of literature has focused on the role of foreign-owned banks in credit expansion in central and eastern Europe (see, for example, de Haas and van Lelyveld, 2005). These studies generally do not find any significant differences in the rate of loan growth in foreign- and domestically owned banks, while confirming that foreign-owned banks have a competitive advantage owing to their higher efficiency and liquidity.

foreign or domestic currency-denominated lending. For the latter two parts of the analysis, the publicly available bank-level data are complemented with supervisory data.

The analysis shows that a long spell of credit expansion in emerging Europe has indeed heightened prudential risks. Over time, weaker banks have started to expand at least as fast as, and in some cases faster than, sounder banks. In contrast to the late 1990s, rapid credit growth during 2001–04 was no longer limited to relatively sound and stable banks. These findings are most pronounced in the group of the weakest banks, those in the lowest quintile. They are also robust to alternative measures of bank soundness and alternative model specifications and estimation techniques. The increased prudential risks are most vivid in rapidly growing credit markets: the Baltics and markets for household loans and loans denominated in or indexed to foreign currency. Foreign bank affiliates seem to be taking on more risk than domestically owned banks, although this is commensurate with the strength of their parent banks. All in all, the results suggest that credit booms in some parts of emerging Europe are being led by weak banks.

The rest of the paper is organized as follows. Section II describes the simultaneous equation model, estimation method and data. Section III discusses results, their robustness and the main driving factors. Section IV concludes.

II. Modeling How Bank Soundness Affects Credit Growth

A. Empirical Model

The general specification of the model is as follows:

$$\begin{aligned} BankCreditGrowth_{ijt} = f(&DistanceToDefault_{ij,t-1}, BankCreditGrowth_{ij,t-1}, GDPperCapita_{j,t-1}, GDPgrowth_{j,t-1}, \\ &RIR_{j,t-1}, \Delta RER_{j,t-1}, CostToIncome_{ij,t-1}, InterestMargin_{ij,t-1}, Liquidity_{ij,t-1}, Size_{ij,t-1}, \\ &Foreign_{ijt}, Public_{ijt}); \\ DistanceToDefault_{ijt} = f(&BankCreditGrowth_{ij,t-1}, GDPperCapita_{j,t-1}, GDPgrowth_{j,t-1}, RIR_{j,t-1}, \Delta RER_{j,t-1}, \\ &DistanceToDefault_{ij,t-1}, CostToIncome_{ij,t-1}, InterestMargin_{ij,t-1}, Liquidity_{ij,t-1}, Size_{ij,t-1}, \\ &Foreign_{ijt}, Public_{ijt}); \end{aligned}$$

where *i* denotes individual banks, *j* denotes countries, and *t* is the year index. *BankCreditGrowth* is the annual percent change in real bank credit to the private sector. *RIR* is the real interest rate and *ΔRER* is the annual percent change in the real exchange rate. *CostToIncome* and *InterestMargin* stand for the cost-to-income ratio and the net interest margin. *Public* and *Foreign* are measures of public and foreign ownership.

Distance to default (DD) measures the probability of bank default, i.e., that the value of assets would become smaller than the value of capital (see, for example, Gropp, Vesala, and Vulpe, 2002). The measure is calculated as $DD \equiv (k+\mu)/\sigma$, where k is equity capital as percent

of assets, μ is return on average assets in percent, and σ is the standard deviation of return on average assets as a proxy for return volatility. DD measures the number of standard deviations a return realization has to fall to exhaust equity, assuming that banks' returns are normally distributed. A higher DD corresponds to a lower upper bound of insolvency risk, implying a lower probability of insolvency. We calculate DD using annual balance sheet data on equity capital (valued at end-year market prices) and return on assets.[3] The standard deviation of returns is calculated for the entire sample period to obtain a long-term view on the risks banks face.[4,5]

While focusing on the importance of bank soundness for credit growth, we control for macroeconomic factors that may affect credit growth. Although there is some variation in the set of macroeconomic variables used as controls in studies of credit growth, most studies include: (i) GDP per capita, to indicate the catching-up phenomenon, whereby credit growth tends to be slower in countries with a higher level of economic and institutional development; (ii) real GDP growth, because it is positively correlated with the demand for bank loans; (iii) real interest rates, which tend to be negatively correlated with demand for loans; and (iv) real exchange rate depreciation, which is expected to reduce the demand for foreign currency loans. These macroeconomic variables are also included in the feedback equation, as they reflect the risks faced by a bank and may affect its soundness.

Bank-specific factors (other than DD) may also affect the rate at which banks expand their loan portfolios. More profitable (higher net interest margin), liquid, and efficient (lower cost-to-income ratio) banks are likely to be able to expand credit at a faster rate. One might also expect loan growth to be positively correlated with bank size and foreign ownership and negatively correlated with state ownership (the share of capital owned by foreigners and the government, respectively).[6] These variables may indirectly capture the effect of financial and other institutional reforms on banks' incentives and their ability to lend to the private sector.

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[3] Typically, market values of equity are used to calculate the value and volatility of assets. However, given that many banks in our sample were not listed during the period in question, using such a market price-based DD measure would reduce the size of the sample dramatically. Furthermore, the market price-based DD measure is constructed on the assumption that bank stocks are traded in well-functioning and liquid markets, which may not hold for emerging European banks for the period in question. For these two reasons, we use a simpler measure of DD based exclusively on balance sheet and income statement data. Such a measure is sometimes called *z-score*, to differentiate it from the market price-based DD measure.

[4] DD is weakly correlated with contemporaneous measures of return on assets and capital. It is primarily driven by the volatility of returns, which is a proxy for the risks faced by the bank.

[5] The results are robust to alternative calculation methods of return volatility such as computing the standard deviation over 3-year rolling windows.

[6] We consider dummy variables for the share of foreign or public ownership exceeding 50 percent as part of robustness analysis and controlling for the type of foreign ownership (through wholly-owned subsidiaries or partial ownership following takeovers of domestic banks during privatization) as part of robustness analysis (see below).

These bank-level variables can be thought of as reflecting the supply-side determinants of credit growth. They are also included in the feedback equation, to control for bank-level factors that may affect DD. All variables in the model, except for those measuring the degree of foreign and public ownership, are lagged, to mitigate against simultaneity. Lagged dependent variables are also included to allow for persistence in DD and loan growth.

B. Estimation Method

The model is estimated using the three-stage least squares (3SLS) method—a convenient method for estimating simultaneous-equation models in the presence of dynamic random effects (Zellner and Theil, 1962; and Arellano, 1990).[7] By taking into account the cross-equation correlation, 3SLS yields more efficient estimates for simultaneous-equation systems than two-stage least squares (2SLS) and single-equation ordinary least squares (OLS) while taking care of potential endogeneity issues.[8] In addition, 3SLS has the desirable feature of leaving the autocovariance matrix of errors unrestricted, so that, in contrast to full information maximum likelihood method, 3SLS does not require that the distribution of errors is known. The 3SLS estimates are robust to the residual autocorrelation of an arbitrary form. Hence, 3SLS renders unbiased estimates, in contrast to 2SLS or single-equation OLS, in models with lagged dependent variables.

However, the efficiency advantage can disappear if autocovariances in a 3SLS model with lagged dependent variables and a sufficient number of strictly exogenous variables satisfy some restrictions. Several tests are conducted to examine the covariance structure of the baseline specification and to confirm the absence of specification problems. Testing for unit roots is complicated by the short time dimension of the data set. Nonetheless, feasible unit root tests for three-dimensional panel data (Kónya and Ohashi, 2005) reject unit roots at the 1 percent significance level. The Hausman specification test, based on a model excluding lagged dependent variables, is inconclusive, but the examination of the residual structure of this model points to nonstationarity problems due to the failure to capture persistence. These specification analyses confirm that the baseline specification is adequately specified by including lagged dependent variables.

As shown in Wooldridge (2002), 3SLS is equivalent to the random effects estimator (RE), provided that the covariance matrix has indeed the random effects structure. From a conceptual point of view, the short time dimension and unbalanced nature of our data, in addition to the fact that the period we are looking at was characterized by enormous

[7] When the model is estimated using 3SLS, lagged macroeconomic variables and bank characteristics as well as past credit growth serve as instruments for bank-level credit growth at time *t*. In the simultaneous estimation setting, the same set of variables are also used as instruments for distance to default at time *t*.

[8] The Arellano-Bond (1991) method, which is commonly used for estimating dynamic panel models, does not apply to a simultaneous-equation setting. We use this method on the credit growth equation only, as part of robustness checks (see below).

structural changes in eastern Europe, suggests that random effects estimator could be preferred to the fixed effects estimator (FE). Since the FE only uses the within-variation and ignores the between-variation, it is less likely to be suitable for our purposes where information contained in the means across banks and across time are particularly important. From a purely econometric point of view, a Hausman specification test indeed rejects the presence of fixed effects.[9]

C. Data

Estimating the model requires bank-level and macroeconomic data. Bank financial ratios are calculated using bank balance sheet data from the Bankscope database published by the *Bureau van Dijk*.[10] Bankscope covers most banks operating in central and eastern Europe (around 80 percent),[11] accounting on average for more than 80 percent of total assets of the respective banking systems (Table 1). The Bankscope sample of banks is diverse, including domestically and foreign-owned banks; large, medium-sized, and small banks; as well as

Table 1. Sample Coverage

	Number of Banks		Proportion of Banks Included in the Sample[1/]		Average Number of Observations per Bank
	Total	Bankscope	Number	Assets	
Czech Republic	35	26	74.3	97.6	7.2
Hungary	36	23	63.9	81.7	8.3
Poland	60	33	55.0	85.6	7.6
Slovak Republic	21	20	95.2	83.1	7.1
Slovenia	22	18	81.8	79.9	7.8
Estonia	6	5	83.3	94.1	7.9
Latvia	22	21	95.5	93.2	8.0
Lithuania	13	9	69.2	93.7	6.2

Sources: European Central Bank; Bankscope; and IMF staff estimates.

[1/] In percent of the total number of banks and total bank assets, respectively.

subsidiaries and branches. Nonetheless, the sample is somewhat biased toward larger banks, as suggested by the fact that the coverage of banks in many countries (the Czech Republic, Estonia, Hungary, Lithuania, and Poland) is higher when measured as a share of total bank assets than as the share of the total number of banks.

[9] We use robust standard errors in estimation, which renders similar significance levels as standard errors clustered by country.

[10] For subsample analyses, total bank loan data from Bankscope were supplemented with supervisory data on breakdowns of bank loan portfolios by the currency of loan denomination or indexation and the type of borrower (household or corporate). These additional data were provided by the central banks of the central and eastern European countries in question (except Hungary and Latvia) for research purposes on the condition of strict confidentiality.

[11] Except for Hungary and Poland, where the coverage measured by the number of banks is slightly lower (64 percent and 55 percent, respectively).

The sample used in the study includes 217 commercial banks that operated in central and eastern Europe during 1995–2004. The average number of observations per bank (around 7) is less than the maximum possible number (10), which is not surprising given significant structural changes in the banking sectors of central and eastern European countries during the last decade. Macroeconomic data needed to calculate real GDP growth, GDP per capita, real interest rates, and real exchange rates were taken from the IMF's *International Financial Statistics*.[12]

Sample statistics point to a significant dispersion in credit growth and distance to default at the bank level. The distribution of distance to default is asymmetric, skewed toward positive values. The distribution of credit growth values is more balanced, although, like with distance to default, there is a fat tail corresponding to banks' rapidly expanding their balance sheets. Both in the CEECs (the Czech Republic, Hungary, Poland, the Slovak Republic, and Slovenia) and the Baltics (Estonia, Latvia, and Lithuania), banks were lending at higher rates on average during 2001–04 than 1995–2000, and the variation of credit growth rates across banks decreased over time (Table 2). Banks in the Baltics on average were growing faster than banks in the CEECs in both periods. Distance to default was higher on average in the CEECs than in the Baltic during both periods in question. (Slovenian banks had the highest distance to default, and Latvian banks the lowest, as shown in Appendix I). Distance to default increased in both subgroups of central and eastern European countries over time, but the improvement was much more significant in the Baltics. At the same time, the variation in Baltic banks' distance to default also increased markedly.

This basic statistical analysis implies that bank soundness indicators for CEEC and Baltic banks have become stronger over time, while these banks have stepped up their lending activities; at the same time, the heterogeneity of banks in terms of their soundness indicators also increased, especially in the Baltics. Together with the finding of lower variation in bank credit growth, increased heterogeneity in bank soundness indicators suggests that weak and sound banks may be expanding at similar rates, especially in the Baltics.

[12] For more information on data definitions and sources, see Appendix I.

Table 2. Summary Statistics by Period and Region

	CEECs				Baltics			
	1995-2000		2001-2004		1995-2000		2001-2004	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Bank credit growth	17.9	40.1	27.3	32.7	28.7	56.6	46.8	43.8
Distance to default	14.0	12.5	14.8	13.0	7.7	9.2	12.5	15.3
Net interest margin	4.5	2.6	3.6	3.1	6.1	2.5	3.3	1.3
Cost-to-income ratio	67.4	99.7	71.9	31.8	95.5	107.8	69.6	19.2
Liquidity ratio	17.4	16.1	17.2	18.0	11.2	9.8	17.1	18.0
Bank size	6.4	1.3	7.0	1.3	4.8	1.3	5.8	1.3
Real GDP growth	2.9	2.4	3.3	1.9	5.3	3.5	8.1	1.2
GDP per capita	58.1	23.5	70.1	25.7	30.9	3.9	45.8	10.6
Real interest rate	3.2	3.5	2.5	3.7	-0.5	4.5	0.5	1.9
Real depreciation	0.2	0.3	-0.4	0.3	-0.1	0.8	-0.5	0.7
Foreign ownership	36.2	44.4	52.2	46.3	31.1	39.7	41.1	42.8
Public ownership	15.3	33.7	6.1	21.5	12.5	29.2	3.7	15.0

Source: IMF staff estimates.

Correlation analysis points in the same direction—weakening relationship between distance to default, especially in the Baltics. In the full sample, the correlation coefficient between bank credit growth and (lagged) distance to default was 0.10 and statistically significant in the earlier period and declined to 0.05 and became statistically insignificant in the later period. The weakening of correlation in the full sample is driven by developments in Latvian, Lithuanian, and Slovak banks. For these countries, the coefficients of correlation between bank credit growth and (lagged) distance to default turned from positive and statistically significant in the earlier period to insignificant in the later. For other countries, no major changes in significance or signs of the correlation coefficients were observed.

When comparing correlations across different types of banks, the relationship between credit growth and (lagged) distance to default is found to be weakening in several groups of banks. Correlations for privately owned banks were positive and statistically significant only in the first period and became statistically insignificant in the latter period. For foreign-owned banks and government-owned banks, correlations were insignificant in both periods, but the signs of coefficients turned from positive in the earlier period to negative. Only in domestically owned banks correlations did remain positive and statistically significant throughout the period in question.

III. Are Weak Banks Driving Credit Expansions?

A. Main Results and Their Robustness

We estimate the model for the entire period, 1995–2004, and for two subperiods, 1995–2000 and 2001–04, focusing on the impact of bank soundness on credit growth (Table 3). The main finding is that in the earlier period the coefficient on DD was positive and statistically

Table 3. Simultaneous Modeling of Bank Credit Growth and Distance to Default

	1995-2004		1995-2000		2001-2004	
	Bank Credit Growth	Distance to Default	Bank Credit Growth	Distance to Default	Bank Credit Growth	Distance to Default
Bank credit growth	0.096***	-0.002	0.100***	-0.002	0.095***	-0.001
	[5.83]	[1.14]	[3.89]	[0.76]	[4.71]	[0.54]
Distance to default	0.229**	0.896***	0.350*	0.854***	0.147	0.927***
	[2.16]	[85.84]	[1.94]	[59.85]	[1.20]	[62.15]
Real GDP growth	2.646***		2.415***		2.475***	
	[5.53]		[2.92]		[4.38]	
GDP per capita	-0.116**	0.017***	-0.301***	0.029***	-0.057	0.007
	[1.99]	[2.83]	[3.19]	[3.90]	[0.73]	[0.77]
Net interest margin	0.689		1.757**		1.200**	
	[1.47]		[2.25]		[2.00]	
Cost-to-income ratio	-0.017		-0.037**		0.046	
	[1.13]		[1.96]		[1.49]	
Real interest rate	-0.558*		-0.864		-0.999**	
	[1.65]		[1.58]		[2.24]	
Real depreciation	-4.911*		14.750**		-7.414***	
	[1.95]		[2.45]		[2.65]	
Public ownership	-0.178***		-0.153**		-0.067	
	[3.73]		[2.39]		[0.89]	
Liquidity ratio		0.020***		0.013		0.027**
		[2.67]		[1.17]		[2.55]
Bank size		0.311***		0.240**		0.324**
		[3.33]		[2.07]		[2.22]
Foreign ownership		0.008***		0.012***		0.003
		[2.80]		[3.28]		[0.69]
Constant	16.366***	-2.668***	15.992**	-2.660***	12.721*	-2.252**
	[3.37]	[4.10]	[2.17]	[3.18]	[1.87]	[2.25]
R-squared	0.13	0.91	0.16	0.92	0.15	0.90
Observations	881	881	424	424	457	457

Source: IMF staff estimates.

Notes: Absolute value of *z* statistics in brackets; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. The table reports two equations from a two-equation simultaneous model. The dependent variable in the first equation is annual percent change in outstanding bank loans. In the second equation the dependent variable is distance to default (constructed using bank account data). All the right-hand-side variables, except those measuring the degree of foreign and public ownership, are lagged by one year. The model is estimated using three-stage least squares.

significant, but in the later period it became insignificant—banks with lower DD started to expand just as rapidly as banks with higher DD during 2001–04. The size of the coefficient implies that a one standard deviation increase in distance to default added about 4 percentage points to annual bank credit growth in the earlier period. In the later period, improvements in distance to default had no significant impact on credit growth.

The signs of other coefficients are in line with expectations. Higher real GDP growth has a statistically significant positive impact on credit growth. Similarly, lower real interest rates are found to boost credit growth, although the significance level is marginal. Credit growth also reflects financial catching-up: the coefficient on GDP per capita is negative. Higher bank efficiency, as measured by the cost-to-income ratio, also boosted credit growth, especially in the earlier period. This, together with the significant negative coefficient on the share of bank capital owned by the state, implies that financial sector reforms have given the private sector better access to credit. Bank profitability, as measured by net interest margin, was also a significant driver of credit growth in the entire period. The effect of the real exchange rate on credit growth differed in the two periods: during 1995–2000, real depreciation had a strong positive impact on credit growth, while during 2001–04 real appreciation was associated with stronger credit growth, possibly due to the increased importance of foreign currency lending. Other explanatory variables in the credit growth equation are insignificant. Their coefficients are set to zero, with the validity of the resulting specification confirmed through F-tests for omitted variables. The effect of these variables on credit growth is captured indirectly, through the feedback equation.

In the feedback equation for DD, significant determinants include the bank size and GDP per capita: larger banks and banks in more developed countries are characterized by higher DD. The coefficient on the foreign ownership variable is positive and statistically significant, but only during 1995–2000, suggesting that the opening of the banking sectors to foreign participation helped strengthen banks only in the earlier period. Liquidity also contributed positively to bank soundness. The coefficient on the lagged DD is positive and statistically significant, suggesting that banks that were sound and stable in the past are likely to remain so in the future. (Although the coefficient on the lagged DD is close to unity, statistical tests confirm that it is less than 1.) There is no evidence that credit growth weakened banks (reduced their DD)—the coefficient on credit growth is statistically insignificant in all periods—possibly because of the lag with which the consequences of faster expansion of weaker banks show up in bank soundness indicators during credit booms.

The findings are robust to alternative definitions of bank soundness. If weak banks are defined as those in the bottom quintile of DD distribution, the coefficient on DD of such banks is found to be negative and statistically significant in the later period, implying that weak banks grew faster than healthy banks in that period (Table 4). Defining weak banks based on a threshold value of DD instead of the lowest quintile of the DD distribution renders

the same conclusion. The results are also preserved if the volatility of returns in the DD measure is calculated for subperiods rather than for the entire sample period.[13] In regressions using the share of nonperforming loans in total outstanding loans (the NPL ratio) as a measure of bank soundness, weaker banks are also found to be expanding faster than sounder banks during the later period: the coefficient on the NPL ratio in the credit growth equation is positive and statistically significant during the later period, while during the earlier period it was negative and statistically insignificant.[14]

Table 4. Credit Growth in Weak Banks

	1995-2000	2001-2004
Bank credit growth	0.106***	0.089***
	[4.07]	[4.43]
Distance to default	0.417**	0.242*
	[2.09]	[1.86]
Distance to default of weak banks	-1.771	-3.859***
	[1.33]	[2.80]
Dummy variable for weak banks	8.784	19.683***
	[1.30]	[3.15]
F-test	2.25	10.62***
	[0.32]	[0.01]
R -squared	0.16	0.17
Observations	424	457

Source: IMF staff estimates.

Notes: Absolute value of *z* statistics in brackets; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. The table reports one equation from a two-equation simultaneous model. The dependent variable is annual percent change in outstanding bank loans. All the right-hand-side variables, except for those measuring the degree of public ownership, are lagged by one year. Weak banks are defined as the lowest quintile of banks by their distance to default. The table also reports chi-squared statistics and probabilities for the F-tests of joint significance of the interaction term and the dummy variable for weak banks. The model is estimated on the full sample using three-stage least squares.

Results are also preserved in alternative specifications of the model. Controlling for time- and country-specific factors, or adding measures of financial and institutional development or regulatory measures does not significantly change the coefficients of interest. Using dummy

[13] Note that this approach to calculating DD implies a more sanguine assessment of the risks facing banks than the baseline approach of calculating the volatility of returns for the entire sample period, as the volatility of returns declined in the later part of the sample in part owing to favorable macroeconomic conditions.

[14] The NPL ratio is an imperfect measure of bank soundness: it can be manipulated by the bank, for example, by restructuring and refinancing loans, to disguise poor asset quality (the evergreening problem).

variables for the share of foreign or public ownership exceeding 50 percent and controlling for the type of foreign ownership (through wholly-owned subsidiaries or partial ownership after takeovers of domestic banks during privatization) also preserves the gist of the results.[15] Estimating the DD equation separately using the Arellano-Bond method does not significantly alter the coefficients of interest either, although the short time dimension of the data set precludes the subsample analysis using the Arellano-Bond method.[16]

B. What is Driving the Results?

To understand the factors driving the results, we run the model on various subsamples, split by region (the Baltics and the CEECs), the type of bank ownership (domestically owned and foreign-owned banks), the currency of loans (foreign- or domestic currency-denominated), and the type of borrower (households or corporates). This helps us identify the pockets of vulnerabilities, which account for the result that weaker banks are increasingly driving credit expansions in emerging Europe.

The analysis shows that the role of weaker banks in credit expansion in the Baltics increased over time (Table 5). The opposite is true in the CEECs: sounder banks were expanding more rapidly during 2001–04, while during 1995–2000 no statistically significant differences in the rates of credit growth through weaker and sounder banks were identified. These results are robust to excluding the lagged dependent variable and estimating regressions separately on the CEEC and Baltic subsamples. One possible explanation of the more prominent role of weaker banks in credit expansion in the Baltics is that in the context of more rapid Baltic credit growth—ten times higher in real terms than in the CEECs in the later period—ensuring sound credit assessment and risk management at the individual bank level is much more challenging. The fact that more foreign bank affiliates in the Baltics are branches than subsidiaries may also make supervision more difficult, as branches are regulated less than subsidiaries in host countries.

Weaker foreign-owned banks appear to be lending more aggressively than domestically owned banks, possibly because of easy access to funding through their parent banks. Controlling for the DD of parent banks indeed shows that, although rapid credit growth in recent years has become uncorrelated with the DD of foreign bank affiliates, it remains positively correlated with the DD of their parent banks. Separate regressions, using the samples of foreign- and domestically owned banks, also show that lending by foreign- owned

[15] We control for the type of foreign ownership by interacting the continuous foreign ownership variable with a dummy for banks privatized to foreigners. Privatization by selling to foreigners does not have a significant effect on bank soundness indicators over the long run. Even though the coefficient on the interaction term is positive and marginally significant in the earlier period, it becomes negative and insignificant in the later period, suggesting that gains from privatization (at least in terms of enhancing bank soundness) are short-lived.

[16] Results are also robust to excluding Slovenia, the most developed eastern European economy.

banks does not depend on DD; for domestically owned banks a positive relationship is identified between credit growth and DD. Among foreign-owned affiliates, Nordic banks stand out as the ones whose lending is the least related to DD. This result is consistent with the earlier discussed finding of higher prudential risks in the Baltics, where Nordic banks are particularly active.

Table 5. Differences in Bank Credit Growth in the Baltics and Other Central and Eastern European Countries

	1995-2000	2001-2004
Bank credit growth	0.095***	0.094***
	[3.64]	[4.70]
Distance to default	0.241	0.433***
	[1.23]	[3.01]
Distance to default of Baltic banks	0.684	-0.961***
	[1.46]	[3.72]
Baltic banks	-6.839	18.209***
	[0.81]	[2.77]
F -test	2.14	15.40***
	[0.34]	[0.00]
R -squared	0.16	0.17
Observations	424	457

Source: IMF staff estimates.

Notes: Absolute value of z statistics in brackets; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. The table reports one equation from a two-equation simultaneous model. The dependent variable is annual percent change in outstanding bank loans. The equation includes an interaction term for the distance of default of Baltic banks and a dummy variable for Baltic banks. Only the most relevant coefficients are reported; other coefficients are broadly unchanged (see Table 3). All the right-hand-side variables, except for those measuring the degree of foreign and public ownership, are lagged by one year. The table also reports chi-squared statistics and probabilities for the F-tests of joint significance of the interaction term and the dummy variable for Baltic banks. The model is estimated on the full sample using three-stage least squares.

Credit growth through banks with large and rapidly expanding foreign currency loan portfolios is negatively correlated with DD, suggesting that weaker banks are expanding at a faster rate in these market segments (Table 6). The opposite is true of banks that are not actively engaged in foreign currency lending: loans are growing more rapidly through

Table 6. Differences in Credit Growth in Banks with High Exposures to Foreign-Currency Lending and Household Lending

	Foreign-Currency Lending		Household Lending	
	1995-2000	2001-2004	1995-2000	2001-2004
Bank credit growth	0.157***	0.073**	0.180***	0.086***
	[4.25]	[2.51]	[5.45]	[3.80]
Distance to default	0.422**	0.279*	0.613***	0.355**
	[2.44]	[1.68]	[3.33]	[2.38]
Distance to default of exposed banks	0.006	-0.794*	-0.886**	-1.889***
	[0.01]	[1.74]	[2.16]	[2.86]
Exposed bank dummy	23.238	29.541***	50.436***	28.312***
	[1.48]	[2.80]	[4.35]	[2.68]
F-tests	10.33***	8.11***	23.79***	9.13***
	[0.01]	[0.02]	[0.00]	[0.01]
R-squared	0.41	0.22	0.45	0.24
Observations	197	258	215	285

Source: IMF staff estimates.

Notes: Absolute value of *z* statistics in brackets; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. The table reports one equation from a two-equation simultaneous model. The dependent variable is annual percent change in outstanding bank loans. All the right-hand variables, except for those measuring the degree of public ownership, are lagged by one year. Banks with high exposure to foreign-currency lending are defined as those with higher-than-average proportion of foreign-currency-denominated loans and higher-than-average rate of growth in the proportion of foreign-currency-denominated loans. Banks with high exposure to household lending are defined as those with higher-than-average proportion of loans to households and higher-than-average rate of growth in the proportion of loans to households. Only the most relevant coefficients are reported; other coefficients are broadly unchanged (see Table 3). The table also reports chi-squared statistics and probabilities for the F-tests of joint significance of the interaction term and the dummy variable for exposed banks. The model is estimated using three-stage least squares. The sample covers Czech, Estonian, Lithuanian, Polish, Slovak, and Slovenian banks, based on data availability.

sounder banks. A similar result is found for banks with large and rapidly growing loan exposures to the household sector. These findings point to more acute prudential risks in the banks that are aggressively lending in foreign currency and to the household sector. However, these results are only preliminary. Owing to data limitations, the analysis had to be restricted to a subset of countries (excluding Hungary and Latvia) and to the dummy measures of exposures, with exposed banks defined as those with a higher-than-average proportion and growth of loans in the respective categories.

IV. CONCLUDING REMARKS

Using data for emerging European banks and controlling for the feedback between indicators of bank soundness and credit growth, this study finds that in an environment of sustained Concluding Remarks rapid growth of credit, banks with lower indicators of soundness over time start to expand faster than banks with higher indicators of soundness.

Whether prudential risks associated with a rapid expansion of weaker banks materialize or not in the future would depend on the quality of banks' current lending and risk management broader macroeconomic and financial environment. The fact that rapid credit growth has not decisions, the strength of supervisory and regulatory practices, as well as the stability of the weakened banks so far provides some comfort that banks would be able to manage risks well. Yet, on the other hand, higher prudential risks may simply take time to become visible in bank soundness indicators, as loan portfolios take time to mature and emerging Europe is still in the initial stages of the credit cycle.

All in all, the findings of the study highlight the importance of forward-looking and risk-based supervision during credit booms. Supervisors need to carefully monitor the soundness of rapidly expanding banks and stand ready to take measures to limit the expansion of weak banks. If left unchecked, rapid growth of weak banks may eventually undermine systemic stability, at a severe cost to the broader economy and taxpayers.

APPENDIX I. DATA SOURCES AND METHODOLOGY

Macroeconomic data were taken from the February 2006 version of the IMF's *International Financial Statistics*. Bank-level data were downloaded from the February 2006 version of Bankscope[17] and cleaned up by carefully matching bank identities and deleting duplicate entries, as well as the entries with possible measurement errors. The Bankscope data set was complemented with confidential supervisory data on the composition of bank loans obtained from the central banks of all central and eastern European countries, except Latvia and Hungary, as well as data on bank ownership from various sources, such as *Euromoney* and banks' websites. Details on the coverage and compatibility of different components of the data set are also presented below. Appendix Tables 1–2 present the summary statistics for the final data set. The definitions of variables and units of measurement for bank-level and macroeconomic data are presented in Appendix Table 3.

Matching bank identifiers. Bankscope uses a unique identifier for each bank. This identifier remains unchanged when the bank's name changes and sometimes even when the bank is merged with or acquired by another bank. Only if a merger or an acquisition intrinsically changes the bank is a new identifier assigned to the new bank. Data for the banks operating in central and eastern Europe during 2002–04 were first downloaded using the February 2006 update of Bankscope. The data were then merged with the historical data set provided by Ugo Panizza, using the unique identifiers and cross-checking based on the 2002 data.

Avoiding duplications. Bankscope includes both consolidated and unconsolidated balance sheet data. When both are available for the same bank, a different identifier is assigned to each type of data. Moreover, at the time of mergers, the banks involved might stay in the data set along with the merged entity. To make sure that observations are not duplicated for the same bank, the following procedure was applied to include information from only one of the balance sheets. First, using the "rank" variable in Bankscope, which ranks the banks within a country, nonranked banks were dropped to avoid duplications. However, a second step was necessary to make sure that the duplication was not due to a merger event. If a bank was not ranked but had assets greater than the country average, its history of mergers and acquisitions was examined carefully. Next, the premerger banks were reranked to ensure that they were included in the data set, and the postmerger banks were deranked to exclude them from the premerger period. Many such banks had both consolidated and unconsolidated balance sheets. To be able to identify individual banks, the unconsolidated data were preserved when both balance sheets were available. If unconsolidated data were unavailable, consolidated data were used to avoid dropping the banks from the sample.

[17] The Bankscope data set for 1995–2002 was provided by Ugo Panizza. These data were used in a study of bank ownership and performance in developing and industrial countries (Micco, Panizza, and Yañez, 2004).

Excluding outliers. To ensure that the analysis is not affected by potential measurement errors and misreporting, about 4 percent of the observations on the tails of the distributions of the two main variables (bank-level credit growth and distance to default) were dropped.

Coding ownership. Bankscope does not provide historical information about bank ownership; it provides only the share held by foreign and public investors in the current year. Thanks to extensive work by Micco, Panizza and Yañez (2004), the historical ownership data up to 2002 were available for the study. While extending the time coverage to 2004, the most recent ownership information from Bankscope data on central and eastern European banks was obtained. This information was complemented with information from banks' websites and Bankscope data on parent banks to update ownership information for 2003 and 2004.

Merging in loan breakdowns. The central banks in six of the eight countries included in the study provided bank-by-bank data on the composition of loans, as collected by supervisory authorities. The data covered the period from 1995 to 2005 (except in the Czech Republic, where the coverage was from 2000 to 2005) and broke down total loans into (i) loans to households in local currency, (ii) loans to corporates in local currency, (iii) loans to households in foreign currency, and (iv) loans to corporates in foreign currency. For confidentiality reasons, most countries were unable to disclose the identity of the banks. Banks from the supervisory data set and from the Bankscope data set were matched using data on total loans and total assets. To reduce the likelihood of measurement errors and ensure data consistency, dummy variables identifying banks with rapidly growing household and foreign currency portfolios, rather than actual data on household and foreign currency loans, were used.

Appendix Table 1. Summary Statistics

	Observations	Mean	Standard Deviation	Minimum	Maximum
Bank credit growth	1,087	25.31	40.80	-86.74	198.24
Distance to default	1,087	13.55	12.89	-6.27	75.48
Net interest margin	1,086	4.21	2.79	-4.50	23.61
Cost-to-income ratio	1,081	71.99	76.90	-959.51	946.87
Liquidity ratio	1,077	16.74	16.61	0.00	98.39
Bank size	1,087	6.40	1.44	2.30	10.30
Real GDP growth	1,087	3.83	2.78	-2.97	12.05
GDP per capita	1,087	58.52	25.16	24.60	147.32
Real interest rate	1,087	2.29	3.74	-19.52	10.73
Real depreciation	1,087	-0.13	0.52	-2.94	2.59
Foreign ownership	1,087	41.98	45.20	0.00	100.00
Public ownership	1,087	10.50	28.09	0.00	100.00

Sources: Bankscope; and IMF staff estimates.

Appendix Table 2. Summary Statistics by Country

	Observations	Mean	Standard Deviation		Observations	Mean	Standard Deviation
Czech Republic				**Slovenia**			
Bank credit growth	159	25.99	46.19	Bank credit growth	133	15.93	24.95
Distance to default	159	13.32	14.49	Distance to default	133	24.27	14.36
Net interest margin	159	2.38	1.54	Net interest margin	133	3.88	1.90
Cost-to-income ratio	157	73.58	116.09	Cost-to-income ratio	133	70.87	37.23
Liquidity ratio	159	26.32	21.15	Liquidity ratio	133	12.71	7.26
Bank size	159	7.15	1.26	Bank size	133	6.18	1.05
Real GDP growth	159	2.44	2.33	Real GDP growth	133	3.66	1.51
GDP per capita	159	69.28	13.13	GDP per capita	133	112.30	14.40
Real interest rate	159	1.97	2.70	Real interest rate	133	0.13	1.95
Real depreciation	159	-0.14	0.33	Real depreciation	133	0.07	0.60
Foreign ownership	159	46.65	46.23	Foreign ownership	133	11.76	29.35
Public ownership	159	11.09	29.88	Public ownership	133	8.29	25.03
Hungary				**Estonia**			
Bank credit growth	192	20.73	36.11	Bank credit growth	34	40.67	36.64
Distance to default	192	12.15	9.15	Distance to default	34	9.95	9.51
Net interest margin	191	4.85	3.35	Net interest margin	34	4.61	1.84
Cost-to-income ratio	191	74.61	59.54	Cost-to-income ratio	34	76.94	31.46
Liquidity ratio	187	7.55	6.26	Liquidity ratio	31	7.50	11.96
Bank size	192	6.68	1.23	Bank size	34	5.82	1.63
Real GDP growth	192	3.77	2.01	Real GDP growth	34	6.93	2.32
GDP per capita	192	58.40	15.50	GDP per capita	34	47.25	14.54
Real interest rate	192	2.68	2.28	Real interest rate	34	-1.20	6.15
Real depreciation	192	-0.09	0.35	Real depreciation	34	-0.66	1.73
Foreign ownership	192	62.19	45.10	Foreign ownership	34	54.53	40.33
Public ownership	192	5.94	22.70	Public ownership	34	0.00	0.00
Poland				**Latvia**			
Bank credit growth	262	25.49	36.95	Bank credit growth	137	36.99	54.27
Distance to default	262	12.51	9.47	Distance to default	137	8.86	12.76
Net interest margin	262	5.18	3.19	Net interest margin	137	4.66	2.57
Cost-to-income ratio	259	62.45	38.64	Cost-to-income ratio	137	82.63	95.15
Liquidity ratio	261	11.85	10.40	Liquidity ratio	137	12.22	15.26
Bank size	262	6.76	1.49	Bank size	137	5.09	1.18
Real GDP growth	262	3.24	2.04	Real GDP growth	137	6.94	2.18
GDP per capita	262	46.96	4.60	GDP per capita	137	36.40	8.86
Real interest rate	262	6.38	2.88	Real interest rate	137	-0.31	2.47
Real depreciation	262	-0.02	0.16	Real depreciation	137	-0.14	0.26
Foreign ownership	262	39.46	45.04	Foreign ownership	137	23.60	36.12
Public ownership	262	15.62	33.08	Public ownership	137	6.40	18.93
Slovak Republic				**Lithuania**			
Bank credit growth	119	17.65	35.60	Bank credit growth	51	40.18	50.61
Distance to default	119	12.72	14.47	Distance to default	51	13.94	15.02
Net interest margin	119	3.04	1.88	Net interest margin	51	4.67	2.28
Cost-to-income ratio	119	69.35	120.21	Cost-to-income ratio	51	82.93	21.99
Liquidity ratio	118	38.37	18.44	Liquidity ratio	51	23.91	11.12
Bank size	119	6.48	1.13	Bank size	51	5.57	1.53
Real GDP growth	119	1.89	2.60	Real GDP growth	51	6.07	4.48
GDP per capita	119	46.50	10.44	GDP per capita	51	39.51	10.88
Real interest rate	119	-0.27	2.72	Real interest rate	51	1.79	2.26
Real depreciation	119	-0.22	0.58	Real depreciation	51	-0.63	0.72
Foreign ownership	119	52.95	45.21	Foreign ownership	51	58.56	42.95
Public ownership	119	13.14	31.35	Public ownership	51	17.11	35.68

Sources: Bankscope; and IMF staff estimates.

Appendix Table 3. Variable Description

Variable	Measuring	Description 1/	Data Source
Distance to default	Risk of insolvency	Return on average assets plus equity (valued at market prices) as a percent of assets divided by the standard deviation of return on average assets	Bankscope
Net interest margin	Profitability	Interest income, on a taxable equivalent basis, earned on assets less interest expense paid on liabilities and capital divided by average earning assets	
Cost-to-income ratio	Efficiency	Total operating expenses divided by total operating income	
Liquidity ratio	Liquidity	Net liquid assets divided by total deposits	
Bank credit growth	Bank risk	Annual percentage change in total loans	Bankscope
Bank size		Logarithm of total assets	
Foreign ownership		Share of capital held by foreign investors	Bankscope, banking sector publications, banks' websites
Public ownership		Share of capital held by the government	
GDP per capita	Market risk	Real GDP per capita, in hundreds of USD	IFS and WEO
Real GDP growth		Annual growth rate of real GDP	
Real interest rate		Money market rate minus inflation 2/	
Real depreciation		Annual percentage change in real exchange rate expressed in domestic currency per USD	

1/ Data used for all calculations are in USD, unless noted otherwise.
2/ In cases where data on money market rate are missing, deposit rate is used instead.

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