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Credit Growth and Bank Soundness in Emerging Europe

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Abstract

The paper examines prudential risks associated with rapid credit expansion in central and eastern Europe during the last decade. We do not find statistically significant evidence that credit growth has weakened banks. However, weaker banks seem to have started to expand more rapidly than sounder banks in recent years. This tendency is most pronounced in the banks that are growing particularly rapidly: the Baltic banks and banks with significant household and foreign currency credit exposures. Affiliates of foreign banks are taking on more credit risk than domestically owned banks, which is commensurate with the relative strength of the respective parent banks.

I. INTRODUCTION

Credit to the private sector has expanded at a fast clip in the new members of the European Union during the last decade, in tandem with their economic convergence and financial deepening.[2] This rapid credit expansion reflected the gamut of factors—low levels of financial development and pent-up demand pressures following decades of socialist economic management; good macroeconomic discipline and accession to the EU, which helped lower country risk premia; and improved access to foreign capital following the entry of foreign banks and the opening of capital accounts. And rapid credit growth has brought important benefits, helping channel domestic and foreign savings to households and investors and supporting financial sector development and economic growth in these new EU member states (NMS).

Yet, the brisk pace of credit growth has also raised concerns about macroeconomic and prudential risks. Quantifying these risks is a challenge, since the NMS have not gone through a full credit cycle yet, and financial soundness indicators tend to improve in the upward phase of the credit cycle. Experiences in industrial and emerging market countries suggest that credit booms can be associated with unsustainable domestic demand booms, overheating, and asset price bubbles.[3] Financial sector difficulties also cannot be ruled out, for example, loan losses in a deep recession or following a large exchange rate depreciation. How significant these risks are in the NMS and what role public policy should play in containing them are key questions facing policymakers in the NMS.

The existing studies do not point to any apparent signs of a deterioration in financial soundness indicators for the NMS. Many macro-level studies have found that bank intermediation in the NMS is still below the equilibrium levels consistent with the levels of economic development of these countries and the structural characteristics of their banking sectors. Adjustment toward equilibrium is expected to continue in the coming years, but, if it occurs at an excessively rapid pace, it can lead to macroeconomic and financial instability (Schadler and others, 2004; Coricelli and Masten, 2004; Cottarelli, Dell'Ariccia, and Vladkova-Hollar, 2005; and Égert, Backé, and Zumer, 2006).[4] So far rapid credit growth in the NMS has not resulted in a deterioration in financial soundness indicators, but prudential risks appear to be rising in some countries (Hilbers and others, 2005; and Iossifov and Khamis, 2006). Supervisors and regulators need to remain vigilant and possibly consider using macroeconomic and prudential policies to contain the risks. A recent microeconometric

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[2] This paper focuses on the analysis of credit growth in the eight central and eastern European countries that joined the European Union in May 2004: the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, the Slovak Republic, and Slovenia.

[3] See Hernandez and Landerrechter (2001) for a literature review.

[4] The topic of rapid credit growth in the NMS has also been discussed in the financial stability reports of EU central banks and private sector reports (for example, Fitch Ratings, 2005).

study by Maechler, Mitra, and Worrell (2006) found that, although loan growth generally had been associated with an improvement in the soundness of NMS banks, when it became excessive, loan growth could weaken bank soundness.[5] Other bank-level econometric studies have focused on the role of foreign-owned banks in credit expansion in the NMS. These studies generally have not found any significant differences in the rate of credit growth through foreign- and domestically owned banks, but confirmed that foreign-owned banks have a competitive advantage owing to their higher efficiency and liquidity (Micco, Panizza, and Yañez, 2004; de Haas and van Lelyveld, 2005; and Aydin, 2006).

This paper examines the prudential risks associated with rapid credit growth taking into account the role of bank soundness as a determinant of credit growth in the NMS. The econometric analysis is based on a simultaneous equation framework, where credit growth and bank soundness are modeled as depending on each other and various macroeconomic and bank-specific factors. By recognizing the potential two-way causality between credit growth and bank soundness, the study brings together the different strands of the literature discussed above: macro-level studies examining the drivers of credit growth and micro-level analyses focusing on the impact of credit growth on bank soundness. The study also draws on recent literature emphasizing the role of bank soundness as a factor driving credit growth (Dell'Ariccia, Detragiache, and Rajan, 2005; and Neir and Zicchino, 2006): weaknesses in bank balance sheets can reduce the supply of loans to the private sector and private investment both in a financial crisis and in normal times.

The study tests two hypotheses: The first is that rapid credit growth in the NMS has not weakened banks, in line with the existing analyses of financial soundness indicators and published stress-testing results. The second is that credit has been growing more rapidly in sounder banks, as one would expect, given that many rapidly expanding NMS banks are owned by banks from advanced countries. These hypotheses can help understand how significant the prudential risks associated with rapid credit growth are and how best to address them.

The analysis uses a detailed bank-level data set. The core of the data set is the publicly available data on balance sheets of banks that operated in the NMS during 1994–2004. These data are complemented by confidential supervisory data on bank loans broken down by type and currency of indexation or denomination. The data set allows differences to be identified between subgroups of the NMS (the Baltics and the central and eastern European countries),[6] different types of banks (domestically and foreign-owned), and different types of loans (household and corporate, and denominated in or indexed to domestic and foreign currency).

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[5] Their study defined excessive credit growth using the quadratic effect. The sample included Cyprus and Malta, in addition to the eight NMS covered in this study.

[6] The Baltics comprise Estonia, Latvia, and Lithuania; and the Central and Eastern European countries (CEECs) comprise the Czech Republic, Hungary, Poland, the Slovak Republic, and Slovenia.

The main econometric finding is that credit growth in the NMS has had an insignificant negative impact on bank soundness so far but has recently become ubiquitous and unrelated to bank soundness. In contrast to the late 1990s, rapid credit growth during 2001–04 was not limited to relatively sound and stable banks. With weaker banks expanding credit as rapidly as sounder banks and some of these banks being weak in the absolute sense as well, the prudential risks associated with rapid credit growth (that is, the likelihood that bank soundness might deteriorate in the future) appear to have increased. These risks might or might not materialize, depending largely on the quality of banks' current lending decisions and risk management practices. The finding that rapid credit growth has not significantly weakened banks yet is consistent with the conclusions based on a review of financial soundness indicators and market indicators (see, for example, Hilbers and others, 2005; and Iossifov and Khamis, 2006). This finding provides some comfort that banks will continue to manage the risks associated with rapid credit growth properly in the future. However, the past might not be a guide to the future: higher prudential risks simply might have not yet become apparent in financial soundness indicators, as loan portfolios take time to mature. The key econometric finding of the paper is robust using alternative measures of bank soundness and model specifications.

The results suggest that supervision, rather than an across-the-board tightening of regulations, needs to be the "first line of defense" against the financial risks associated with rapid credit growth. Strong supervision is essential for ensuring sound lending and risk management practices at the individual bank level in an environment of rapid credit growth. Prudent supervisors in the NMS need to pay particular attention to the practices of rapidly expanding weak institutions. A selective, risk-based prudential policy response should help contain the financial risks associated with rapid credit growth, while maximizing the benefits of rapid credit growth for economic and financial development. It would be also consistent with the risk-based approach to supervision that the NMS are moving to as they implement the new capital adequacy accord (Basel II).

In the Baltics, in the context of significantly stronger credit growth than in the CEECs, weaker banks seem to have recently started expanding at least as fast, if not faster, than sounder banks. In contrast, in the CEECs, credit growth continues to take place primarily through sounder banks. In neither of these subgroups, a significant effect of credit growth on bank soundness could be identified. These findings suggest a differentiated policy approach depending, all other things equal, on the magnitude of the identified financial risks. A different intensity of prudential policy response can be achieved by tightening prudential policies to a different degree or using different types of prudential policy measures (see Hilbers and others, 2005, for a classification of such measures).

Weaker banks with large and rapidly growing household or foreign currency loan exposures also seem to be expanding faster than other banks. However, there is no statistically significant evidence that rapid growth in household or foreign currency loans has weakened banks. These results suggest that supervisors in all NMS need to give priority to assessing the

practices of rapidly expanding and relatively weak banks with large household or foreign currency credit exposures.

Another finding of the paper is that foreign-owned banks in the NMS are willing to take on more credit risks than domestically owned banks, although these higher risks seem commensurate with the strength of parent banks. This finding points to the importance of strong cross-border cooperation with foreign supervisors and foreign bank owners in the NMS, particularly in the context of implementing Basel II. Besides regular information exchanges with foreign supervisors and the signing of memoranda of understanding with foreign bank owners, cooperation can include, for example, joint supervisory inspections and crisis management exercises.

The rest of the paper is organized as follows. Section II describes trends in credit to the private sector in the NMS and identifies the key factors underlying rapid credit growth. The section also discusses prudential risks associated with credit growth based on the available financial soundness indicators and the published findings of stress-testing exercises. Section III describes the econometric approach used in this paper and the data set, and presents the key results. Section IV outlines policy implications, and Section V concludes.
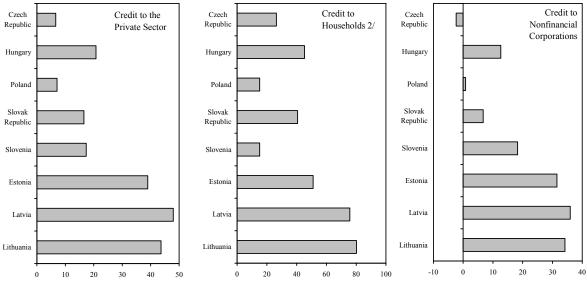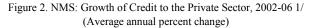
II. Background

A. Credit Developments

Credit to the private sector in most NMS has been growing at double-digit rates for several years now (Figure 2). Credit in the Baltics expanded at a rate 3 times faster than in the CEECs during 2002–06 (44 percent versus 14 percent, respectively). In the latter subgroup, the Czech Republic and Poland stood out as the countries with the slowest rate of credit growth to the private sector.[7] In most NMS, household credit has been growing more strongly than corporate credit in recent years, and, by end–2005, household loans had rivaled corporate loans in importance in banks' portfolios (Figure 3).

The importance of foreign-currency-denominated or indexed lending has varied across the NMS. In the Baltics, the composition of total outstanding loans to the private sector has traditionally been heavily tilted toward foreign currency loans. In 2005, for example, foreign currency loans carried, on average, twice the weight in total outstanding loans in the Baltics (above 60 percent) that they did in the CEECs (around 30 percent). Among the CEECs, Hungary and Slovenia have experienced rapid growth in the share of foreign-currency-denominated loans in total loans to the private sector, while the Czech Republic has remained the least exposed, with a further decreasing share.

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[7] See Tamirisa and Čihák (2006) for an analysis of the factors that contributed to slow credit growth in Poland.

Figure 2. NMS: Growth of Credit to the Private Sector, 2002-06 1/
(Average annual percent change)

Sources: National central banks; and IMF *International Financial Statistics* .
1/ Nominal data as of July 2006 except for Latvia (June 2006) and Slovenia (March 2006). Data starting in 2004 for the Slovak Republic.
2/ Includes credits to nonprofit institutions serving households (NPISH), except for Latvia, Lithuania, and Slovenia, where credit to NPISH is included under credit to nonfinancial corporations.

Figure 3. NMS: Foreign Currency and Household Lending, 2001 and 2005
(In percent of total outstanding loans to the private sector)

Sources: National central banks; and IMF staff estimates.

B. Factors Driving Credit Growth in the NMS

Rapid credit growth in the NMS in part reflects the deepening of their financial systems. Credit to the private sector is generally expected to grow faster than nominal GDP in emerging market and transition countries as their financial systems develop. The levels of bank intermediation in the NMS in the early years of transiti on indeed w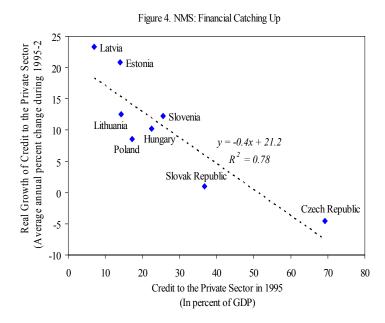ere significantly below what would have been expected, given their levels of economic development, and macro-level studies agree that an increase in credit-to-GDP ratios in the NMS is needed to bring these ratios to the levels consistent with the countries' incomes (Schadler and others, 2004; Cottarelli, Dell'Ariccia, and Vladkova-Hollar, 2005; and Hilbers and others, 2005). Such an equilibrium adjustment manifests itself in credit growth being higher in those NMS with lower initial ratios of bank intermediation (Figure 4).

Macroeconomic conditions have been favorable for credit expansion. Successful disinflation and improved economic prospects, both due to income convergence and the business cycle, have helped unleash pent-up demand for credit (Figure 5). Real lending rates have declined gradually during the last decade, in part reflecting a trend decline in policy rates. In some NMS, currency appreciation has been an important factor in stimulating demand for credit. Predictable exchange rates and expectations of long-term appreciation might have created incentives for borrowing in foreign currency and, against the backdrop of

Figure 4. NMS: Financial Catching Up

$y = -0.4x + 21.2$

$R^2 = 0.78$

Sources: IMF *International Financial Statistics*, and staff estimates.

ample global liquidity in recent years, might have stimulated capital inflows funding credit expansion (Table 1). In some countries, incentives created by easy monetary and/or fiscal policies may have contributed to strong growth in bank credit.
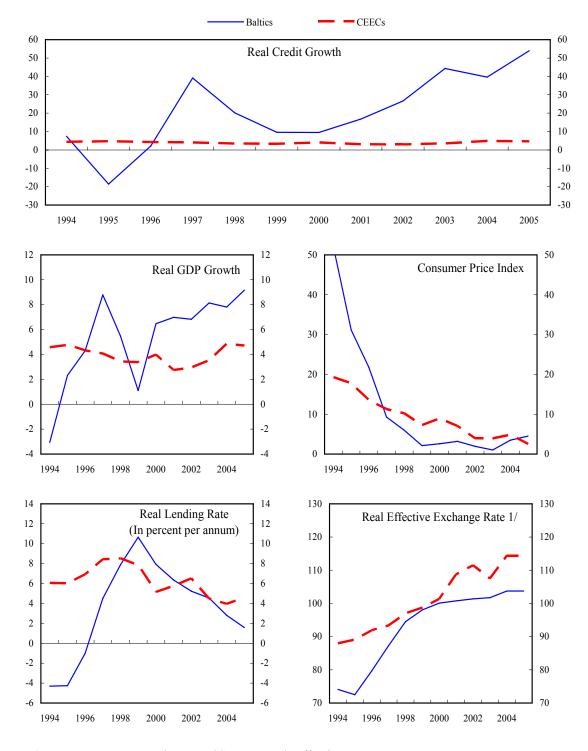
Figure 5. NMS: Macroeconomic Environment and Credit to the Private Sector, 1994-2005
(Annual percent change, unless indicated otherwise)

Sources: IMF *International Financial Statistics,* and staff estimates.
1/ CPI-based index with 2000 as base year.

Table 1. Exchange Rate Regimes in the NMS

| | 1995-2000 | 2001-2006 | Progress in Euro Adoption | |
	IMF Classification 1/	IMF Classification 1/	ERM II	EMU 2/
Czech Republic	Intermediate - until 1997	Float	Has not joined yet	No official target date (most probably in 2010)
Hungary	Intermediate	Intermediate	Has not joined yet	Target date set for January 1, 2010
Poland	Intermediate	Float	Has not joined yet	No official target date
Slovak Republic	Intermediate - until 1998	Float - until 2005	Joined on November 30, 2005	Target date set for January 1, 2009
Slovenia	Float	Float - until 2004	Joined on June 28, 2004	Plans to introduce euro on January 1, 2007
Estonia	Fixed	Fixed	Joined on June 28, 2004	Target date set for January 1, 2008
Latvia	Fixed	Fixed	Joined on May 2, 2005	Target date set for January 1, 2008
Lithuania	Fixed	Fixed	Joined on June 28, 2004	Target date set for January 1, 2007

Sources: IMF *Annual Report on Exchange Arrangements and Exchange Restrictions* and *International Financial Statistics* ; European Central Bank; National central banks, and IMF staff estimates.

1/ "Fixed" includes currency boards, conventional pegs, and narrow bands. "Intermediate" includes tightly managed floats and broad bands. "Float" includes managed and independent floats.

2/ Information available from European Commission and national authorities, as of November 2006.

Structural changes in the banking sectors of the NMS have created incentives for a rapid expansion of credit to the private sector. Bank privatization in the late 1990s–early 2000s improved the incentive structure for banks, while the entry of foreign banks has brought additional expertise and know-how into the sector. Against the backdrop of favorable macroeconomic conditions, increased investor confidence in NMS, and EU accession, many foreign-owned banks have considered the NMS to be important future markets, where the strategic benefits of expanding market shares justify taking on additional credit risks. Higher profitability of lending in NMS markets, compared with other EU markets, is another factor that has encouraged the expansion of foreign-owned banks in the NMS in recent years.

Subsidies and tax policies have stimulated the growth of selected credit markets. Construction saving subsidies have promoted saving and lending through building societies in some countries, for example, the Czech Republic and Hungary. A favorable tax treatment of housing loans, including tax exemption of construction saving yields and the deductibility of housing loan interest payments, also have encouraged credit growth in some countries. Open-ended government interest rate subsidies may have stimulated the growth of consumption lending in some countries, for example, in Hungary. In Estonia, the deductibility of mortgage interest has encouraged real estate borrowing.

C. Structure of NMS Financial Systems

Although there are intraregional differences, the financial systems of the NMS share certain structural characteristics. Commercial banks constitute the bulk of NMS financial systems, and private sectors in the NMS rely considerably more on bank financing than stock market financing. The concentration of NMS banking sectors is higher than the EU-25 average, but this is largely due to the Baltics: the share of the five largest credit institutions in the CEECs stands at about the EU average (60 percent), whereas in the Baltics it is almost 80 percent (Figure 6). Foreign presence is large in all NMS, with an average of 77 percent of bank assets owned by foreigners. Still, the variance is wide across countries, ranging from 36 percent in Slovenia to 97 percent in Estonia. The form of foreign bank ownership also differs across the NMS. In Hungary, Latvia, and Poland, at least 90 percent of foreign-owned affiliates are

subsidiaries, while in the Czech Republic, Lithuania, and Slovenia the proportion is about 70 percent. In Estonia, only one half of foreign-owned affiliates are subsidiaries (ECB, 2005), although they account for 90 percent of the banking sector's assets. The proportion of branches in the total number of foreign affiliates in the Baltics is higher than in the CEECs.
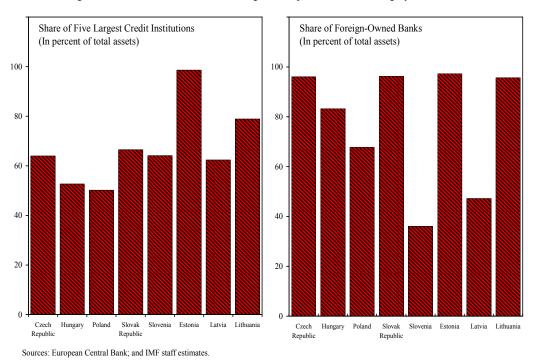
Figure 6. NMS: Concentration and Foreign Participation in the Banking System, 2004

Sources: European Central Bank; and IMF staff estimates.

D. Indicators of Banking System Soundness

Indicators of banking system soundness for the NMS are generally favorable (Figure 7). Capital ratios are comparable to those in Western Europe,[8] while returns on assets are generally higher. Although nonperforming loans are somewhat higher, the coverage of nonperforming loans by provisions is similar to Western Europe's. Within the NMS, the banking sectors in the CEECs appear more capitalized than those in the Baltics, but at the same time the share of nonperforming loans in total loans and provisions against nonperforming loans are, on average, lower in the Baltics, and profitability is higher. These macroprudential indicators should not be interpreted as providing much comfort, however, because most of them are backward looking and tend to show an improvement in the ascending part of the credit cycle.

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[8] Western Europe comprises Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.
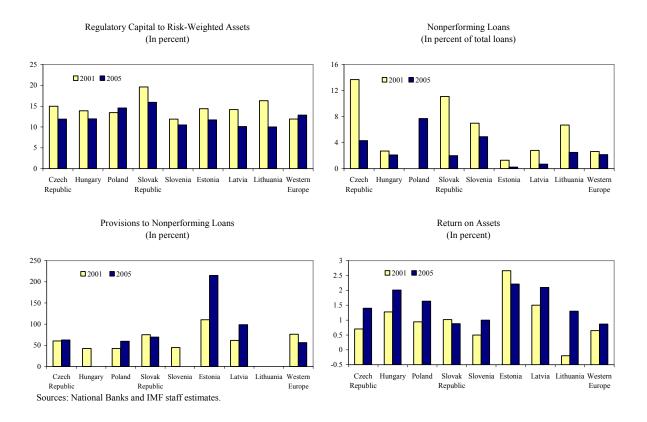
Figure 7. New Member States: Selected Financial Soundness Indicators

Regulatory Capital to Risk-Weighted Assets
(In percent)

Nonperforming Loans
(In percent of total loans)

Provisions to Nonperforming Loans
(In percent)

Return on Assets
(In percent)

Sources: National Banks and IMF staff estimates.

Market indicators of banking system soundness point to moderate macroprudential risks and a wide range of systemic risks among the NMS (Table 2).[9] According to Fitch's composite indicators of banking system soundness, macroprudential risk is at medium level in all NMS, except Poland. This conclusion is based on an early warning model of above-trend private sector credit growth and takes into account the possibility of asset price bubbles and currency overvaluation. The Fitch's banking system indicator combines the system average of individual bank ratings and a qualitative assessment of systemic risks, taking into account asset quality, capital adequacy, liquidity, and foreign exchange exposures, among other things.[10] In four out of the eight NMS (the Czech Republic, Estonia, Latvia, and Slovenia) the

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[9] Market indicators of NMS banks are worse than in major advanced countries but broadly comparable to those of banks from other emerging markets. The exceptions are the market indicators for Czech and Estonian banks, which are stronger.

[10] The assessment of systemic risks is based on the existence and severity of nine factors: (i) interbank positions; (ii) high borrower indebtedness; (iii) foreign currency borrowing without foreign currency resources; (iv) exposure to sovereign risk; (v) common exposure to a particular sector, industry, company, or individual; (vi) deposit concentration; (vii) coexistence of low liquidity and low capital ratios and a large share of demand deposits; (viii) inadequate regulatory and supervisory framework, opaqueness, and poor corporate governance;

(continued…)

institutions that own the majority of banking system assets have adequate or high ratings, and are identified risks moderate or low. Other NMS are deemed to have banking systems with mostly low-rated institutions and high identified systemic risks.[11] Financial strength ratings by Moody's are broadly comparable to Fitch's.

Table 2. Fitch's Summary Indicators of Bank Soundness 1/

Banking System Indicator	Macroprudential Indicator		
	1	2	3
A	Switzerland	Australia, Luxembourg, Netherlands, Spain, UK, USA	
B	Belgium, Bermuda, Canada, Chile, Denmark, France, Germany, Hong Kong SAR, Italy, Mexico, Singapore, Sweden	Austria, Bahrain, **Czech Republic**, **Estonia**, Finland, Kuwait, New Zealand, Norway, Portugal, Qatar, Saudi Arabia	Iceland, Ireland, South Africa
C	Brazil, Japan, Korea, Malaysia, Malta, Oman, UAE	Greece, **Latvia**, San Marino, **Slovenia**	
D	Benin, Colombia, Cyprus, El Salvador, Indonesia, Israel, Lebanon, Panama, Peru, Philippines, **Poland**, Taiwan, Thailand, Venezuela	Bulgaria, Costa Rica, Croatia, **Hungary**, India, Kazakhstan, **Lithuania**, Romania, **Slovak Republic**, Turkey, Ukraine	Russia
E	Argentina, Bolivia, China, Ecuador, Egypt, Tunisia, Uruguay	Dominican Republic, Iran, Vietnam	Azerbaijan

Source: Fitch Ratings, September 2006.

1/ The banking system indicator measures intrinsic bank systemic risk on a scale from A (very high quality) to E (very low quality). The macroprudential indicator measures the vulnerability of the banking system to macroeconomic shocks as low (value of 1), medium (value of 2), or high (value of 3).

E. Financial Risks and Stress Tests

Generally, the main risk to bank soundness associated with rapid loan growth is credit risk. Credit risk can arise from a number of sources: inappropriate loan assessments and difficulties in monitoring and assessing risks; aggressive lending strategies; overvalued asset prices or exchange rates; and an excessive concentration of loans. Risks associated with rapid credit growth to households are in many respects similar to those associated with lending to corporates, but the key difference is the much larger number of loans involved (which, on

and (ix) other systemic factors (for example, off-balance-sheet operations and unprovisioned contingent liabilities).

[11] Fitch's report on bank systemic risk is as of September 2006. Compared to the report dated July 2005, macroprudential risks in the NMS have, on average, increased while systemic risks stayed mostly the same.

one hand, helps diversification of risks, and, on the other, can make credit decisions and management more labor intensive) and the lower availability of reliable financial data.

Market risks can also become an issue in an environment of rapid credit growth. Interest rate risk can rise, for example, if rapid credit growth is accompanied by a move toward a greater use of fixed-rate or foreign currency instruments without banks' hedging the risk of adverse movements in the prices of these assets. Direct foreign exchange risk may arise from net open foreign exchange positions and external borrowing to fund credit growth. Housing price risk is a concern from the perspective of collateral valuation. Maturity and liquidity risks generally arise from long-term loans financed through short-term borrowing by banks.

In the NMS, published stress test results point to the resilience of these countries' banking systems to credit risk and market risk. A review of stress-testing results presented in the IMF's Financial System Stability Assessments (FSSAs) and Financial Stability Reports during 2001–04 suggests that NMS banking systems should be able to sustain significant macroeconomic shocks (Čihák, 2006). However, the dispersion of stress testing exercises and results across individual banks might be large in some NMS; also, some FSSA stress-testing exercises preceded the acceleration of credit in the NMS. In sum, although stress testing results are fairly positive so far in all NMS that disclose them to the public, there are growing concerns about financial risks associated with rapid credit growth. These risks are difficult to quantify given the relatively short credit history of the region.

III. ECONOMETRIC ANALYSIS USING BANK-LEVEL DATA

Against this backdrop, this paper focuses on an econometric analysis of the two-way relationship between bank credit growth and soundness in the NMS. Sounder banks are generally expected to have a competitive advantage in meeting the demand for credit, given their larger capital cushions and presumably better risk management. But if loan portfolios grow faster than banks' ability to assess and manage risks, credit risk might increase and asset quality decline, leading to higher provisions and lower profits. Retained earnings and, hence, capital adequacy ratios might also decline. A simultaneous equation model allows the two-way relationship between bank credit growth and soundness to be explored.[12]

A. The Empirical Model

We model credit growth and bank soundness as functions of each other and various macroeconomic and bank-specific factors. Credit growth is measured as the annual percent change in total outstanding loans of individual banks, while the soundness of banks is

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[12] One could also argue the opposite: weaker banks might be expected to extend credit aggresively in order to survive. In that case, the risks associated with rapidly growing loan portfolios would be more pronounced.

measured by their distance to default.[13] Lagged dependent variables are included in the model to allow for possible persistence in loan growth and distance to default. A parsimonious baseline specification was selected by sequentially testing the relevance of various macroeconomic and bank-specific variables identified in the recent literature as structural determinants of credit growth and bank soundness.

A starting point for the selection of the baseline specification was macroeconomic variables reflecting the demand-side determinants of bank loan growth and the effect of macroeconomic conditions on bank soundness. Although there is some variation in the set of variables used in the macro-level studies of credit growth,[14] 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, 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 reflect the risks faced by a bank and, hence, might affect its soundness.

The set of explanatory variables can be expanded to include bank-specific variables likely to affect bank soundness and the rate at which banks expand their loan portfolios. These variables reflect the supply-side determinants of credit growth, the importance of which was emphasized by Dell'Ariccia, Detragiache, and Rajan (2005) and Neir and Zicchino (2006). In line with the recent studies of bank soundness (De Nicoló and others 2005; and Maechler, Mitra, and Worrell, 2006), measures of bank profitability (proxied by the net interest margin), liquidity (the liquidity ratio), and efficiency (the cost-to-income ratio) are also included as explanatory variables in the equations for bank credit growth and bank soundness. More profitable, liquid, and efficient banks are likely to be sounder and able to expand credit at a faster rate. One might also expect bank soundness and 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).[15] These variables indirectly might 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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[13] See Appendix I for a discussion of distance to default measure.

[14] Schadler and others (2004); Coricelli and Masten (2004); Cottarelli, Dell'Ariccia, and Vladkova-Hollar (2005); and Égert, Backé, and Zumer (2006).

[15] An alternative measure of foreign ownership (a dummy variable for this share exceeding 50 percent) also suffers from the drawback that it might not reflect effective foreign control of a bank in which privatization modalities have prevented the selling of more than 49 percent of ownership of the bank.

The general specification of the model is as follows:

Equation 1: Bank Credit Growth

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

Equation 2: Distance to Default

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

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.

These two equations can be estimated jointly using the three-stage least squares method. As Arellano (1990) pointed out, three-stage least squares (3SLS) is a convenient method for estimating linear models using panel data with a relatively short time dimension and including lags of the dependent variables. Applied studies commonly use 3SLS to estimate systems of equations with lagged dependent variables (for example, Hall, 1987; and Sab and Smith, 2002). There are several advantages to using 3SLS in this context. First, unlike a commonly used method for estimating single-equation dynamic panel models—the method suggested by Arellano and Bond (1991)—3SLS applies to a simultaneous equation setting. Second, by taking into account the cross-equation correlation, 3SLS yields more efficient estimates for simultaneous equation systems than two-stage least squares (2SLS). Third, 3SLS has the desirable feature of leaving the autocovariance matrix of errors unrestricted, so that the resulting estimates are robust to the residual autocorrelation of an arbitrary form. Hence, 3SLS renders unbiased estimates, in contrast to 2SLS, in models with lagged dependent variables. If, however, autocovariances in a 3SLS model with lagged dependent variables and a sufficient number of strictly exogenous variables satisfy some restrictions, 3SLS might be inefficient. Thus, it is necessary to examine the covariance structure of the baseline specification to confirm the absence of specification problems. Several tests, explained in more detail in Section C below, are conducted for that purpose.

B. Data and Basic Statistics

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*.[16] Bankscope covers most banks operating in the NMS (around 80 percent),[17] which on average account for more than 80 percent of total assets of NMS banking systems (Table 3). The Bankscope sample of NMS banks is fairly diverse, including domestically and foreign-owned banks; large, medium-sized, and small banks; and subsidiaries and branches. Nonetheless, the sample is somewhat biased toward larger banks, as suggested by the fact that the coverage of banks in many NMS (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.

Table 3. 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.

The sample used in the study includes 217 commercial banks that operated in the NMS 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 NMS banking sectors 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*.[18]

Sample statistics point to a significant dispersion in credit growth and distance to default at the bank level. Histograms suggest that the distribution of distance to default is asymmetric, skewed toward positive values (Figure 8). The distribution of credit growth values is more

[16] 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 NMS (except Hungary and Latvia) for research purposes on the condition of strict confidentiality.

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

[18] For more information on data definitions and sources, see Appendix II.

balanced, although, like with distance to default, there is a fat tail corresponding to banks' rapidly expanding their balance sheets. Both in the CEECs and the Baltics, 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 4). Banks in the Baltics on average were growing faster than banks in the CEECs in both periods. Distance to default on average has increased in both subgroups of the NMS over time, but the improvement has been more significant in the Baltics. However, the variation in banks' distance to default increased in recent years, especially in the Baltics.
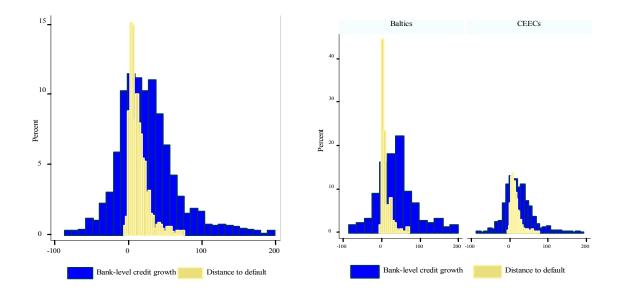
Figure 8. Histograms for Credit Growth and Distance to Default, 1995-2004 1/

Sources: Bankscope and IMF staff estimates.
1/ Distance to default is measured by the number of standard deviations a return realization would have to fall for bank equity to be depleted.

Table 4. Summary Statistics by Period and Region

	1995-2004				1995-2000				2001-2004			
	CEECs		Baltics		CEECs		Baltics		CEECs		Baltics	
Variable	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Bank credit growth	22.2	37.2	38.3	50.9	17.9	40.1	28.7	56.6	27.3	32.7	46.8	43.8
Distance to default	14.4	12.7	10.2	13.0	14.0	12.5	7.7	9.2	14.8	13.0	12.5	15.3
Net interest margin	4.1	2.9	4.7	2.4	4.5	2.6	6.1	2.5	3.6	3.1	3.3	1.3
Cost-to-income ratio	69.4	76.7	81.8	76.4	67.4	99.7	95.5	107.8	71.9	31.8	69.6	19.2
Liquidity ratio	17.3	17.0	14.3	15.0	17.4	16.1	11.2	9.8	17.2	18.0	17.1	18.0
Bank size	6.7	1.3	5.3	1.4	6.4	1.3	4.8	1.3	7.0	1.3	5.8	1.3
Real GDP growth	3.1	2.2	6.7	2.9	2.9	2.4	5.3	3.5	3.3	1.9	8.1	1.2
GDP per capita	63.5	25.2	38.8	11.0	58.1	23.5	30.9	3.9	70.1	25.7	45.8	10.6
Real interest rate	2.9	3.6	0.0	3.4	3.2	3.5	-0.5	4.5	2.5	3.7	0.5	1.9
Real depreciation	-0.1	0.4	-0.3	0.8	0.2	0.3	-0.1	0.8	-0.4	0.3	-0.5	0.7
Foreign ownership	43.4	45.9	36.4	41.6	36.2	44.4	31.1	39.7	52.2	46.3	41.1	42.8
Public ownership	11.1	29.1	7.9	23.2	15.3	33.7	12.5	29.2	6.1	21.5	3.7	15.0

Source: IMF staff estimates.

This basic statistical analysis implies that CEEC and Baltic banks have grown stronger over time and have stepped up their lending activities; at the same time, the heterogeneity of banks in terms of their soundness also increased, especially in the Baltics. Together with the finding of decreased variation in bank credit growth, increased heterogeneity in bank soundness implies that weak and sound banks are expanding at similar rates, especially in the Baltics. The econometric analysis presented in the next subsection builds on this observation by exploring the relationship between credit growth and bank soundness in a multivariate and simultaneous equation setting, controlling for other relevant factors.

C. Econometric Results

We estimate the general specification of the model for the whole period as well as for two subperiods, 1995–2000 and 2001–04 (Table 5). The signs of coefficients are in line with expectations. Higher real GDP growth has a statistically significant positive impact on credit growth.[19] Similarly, lower real interest rates are found to boost credit growth, but the significance level is marginal. Credit growth in the NMS also reflects financial catching-up: the coefficient on GDP per capita is negative in all periods.[20] Higher bank efficiency, as measured by the cost-to-income ratio, also boosted credit growth, especially in the earlier

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[19] The significance levels reported in the tables are based on robust standard errors. Significance levels are similar when standard errors are clustered with respect to the country variable used.

[20] Changes in the exchange rates did not have a statistically significant impact on credit growth in regressions for the entire period, but this finding seems to reflect differences in how changes in the exchange rate affected credit growth in subperiods: 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.

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 greater access to credit. In the entire period, bank profitability, as measured by net interest margin, was a significant driver of credit growth.

In the distance-to-default equation, significant determinants of bank soundness appear to be bank size and GDP per capita, with larger banks and banks in more developed countries being sounder. The coefficient on the foreign ownership variable is positive and statistically significant during 1995–2000. This finding suggests that the opening of the NMS banking sectors to foreign participation has been associated with an improvement in bank soundness during this period. Liquidity also contributed positively to bank soundness, especially during 2001–04. The coefficient on the lagged distance to default is positive and statistically significant, suggesting that banks that were sound and stable in the past are likely to remain so in the future.[21] Given the high persistence in distance to default and the finding that credit growth has not been a statistically significant determinant of distance to default, we focus the subsequent discussion of results on the equation for credit growth and the question as to whether weaker banks have been expanding at a faster rate than other banks in the NMS.

Specification tests confirm that the model is adequately specified. Testing for unit roots is complicated by the fairly 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.

To gain additional flexibility in the analysis, we restrict the coefficients of the statistically insignificant variables to zero, confirming the validity of the resulting specification through F-tests for omitted variables. The resulting parsimonious baseline specification is presented in Table 6.

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[21] Although the coefficient on lagged distance to default is rather close to unity, statistical tests confirm that it is different from 1.

Table 5. Unrestricted Specification

	1995-2004		1995-2000		2001-2004	
	Bank Credit Growth	Distance to Default	Bank Credit Growth	Distance to Default	Bank Credit Growth	Distance to Default
	(1)	(2)	(3)	(4)	(5)	(6)
Bank credit growth	0.097***	-0.002	0.093***	-0.002	0.094***	-0.002
	[5.87]	[1.40]	[3.56]	[0.78]	[4.59]	[0.65]
Distance to default	0.223**	0.896***	0.304*	0.852***	0.150	0.926***
	[2.09]	[85.14]	[1.66]	[57.64]	[1.23]	[61.26]
Real GDP growth	2.763***	0.016	2.134**	-0.006	2.751***	0.028
	[5.55]	[0.33]	[2.48]	[0.08]	[4.54]	[0.38]
GDP per capita	-0.099	0.015**	-0.241**	0.031***	-0.038	0.005
	[1.60]	[2.37]	[2.40]	[3.81]	[0.44]	[0.44]
Net interest margin	0.853*	-0.009	1.890**	0.034	1.300**	0.061
	[1.73]	[0.18]	[2.29]	[0.52]	[2.10]	[0.80]
Cost-to-income ratio	-0.018	-0.001	-0.037*	-0.001	0.037	-0.001
	[1.12]	[0.69]	[1.95]	[0.80]	[1.16]	[0.14]
Liquidity ratio	0.092	0.019**	-0.067	0.014	0.152	0.026**
	[1.14]	[2.40]	[0.48]	[1.26]	[1.55]	[2.14]
Bank size	-0.091	0.365***	-3.456*	0.236	0.689	0.387**
	[0.08]	[3.29]	[1.88]	[1.60]	[0.51]	[2.31]
Real interest rate	-0.502	-0.014	-0.665	0.002	-0.776	-0.016
	[1.42]	[0.41]	[1.18]	[0.04]	[1.60]	[0.26]
Real depreciation	-4.379*	-0.284	15.794***	-0.194	-6.470**	-0.254
	[1.71]	[1.12]	[2.62]	[0.40]	[2.25]	[0.72]
Foreign ownership	0.018	0.006*	0.089	0.013***	-0.033	0.002
	[0.54]	[1.94]	[1.60]	[2.91]	[0.89]	[0.44]
Public ownership	-0.162***	-0.005	-0.044	0.002	-0.084	-0.008
	[2.86]	[0.90]	[0.54]	[0.27]	[1.00]	[0.77]
Constant	12.274	-2.666***	30.606**	-2.862***	5.138	-2.706**
	[1.44]	[3.16]	[2.23]	[2.58]	[0.47]	[2.01]
R-squared	0.14	0.91	0.17	0.92	0.16	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 underlying model consists of two equations. The dependent variable in the first equation is annual percent change in outstanding loans. In the second equation, the dependent variable is distance to default. The latter is estimated based on bank accounts. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year.

Which factors have been driving credit growth in the NMS?

Although credit growth in the NMS has reflected both macroeconomic and bank-specific factors, it has been mostly demand driven (Figure 9). Economic growth has been the single most important driver of credit growth in the NMS during 1997–2004. In recent years, exchange rate appreciation has contributed substantially to an increase in credit growth in most NMS. A positive contribution of real GDP growth to credit growth has been larger in the Baltics than in the CEECs, while the negative contribution of GDP per capita has been generally smaller in the Baltics. This suggests that higher credit growth rates in the Baltics largely reflect these countries' higher economic growth and lower levels of development. Relatively large real exchange rate appreciations in Estonia and Lithuania and comparatively low real interest rates in Estonia and Latvia helped fuel credit growth during 2001–04. Bank-specific factors seem somewhat less important than macroeconomic factors in explaining credit growth in the NMS. The importance of bank efficiency (cost-to-income ratio) has remained broadly unchanged throughout the period in question, while the positive contribution of profitability (net interest margin) seems to have declined over time in the NMS.
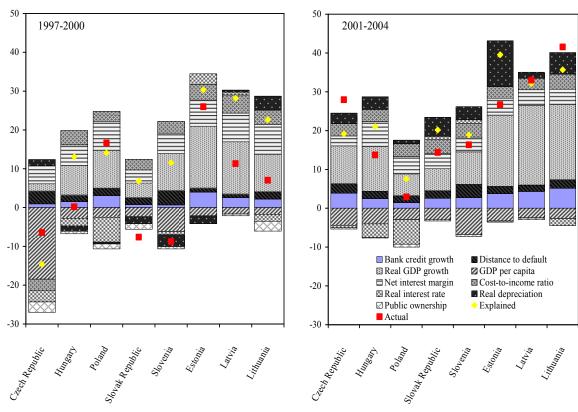
Figure 9. NMS: Decomposition of Predicted Credit Growth, 1997-2004
(In percent per year)

Source: IMF staff estimates.

Table 6. Baseline Specification

	1995-2004		1995-2000		2001-2004	
	Bank Credit Growth	Distance to Default	Bank Credit Growth	Distance to Default	Bank Credit Growth	Distance to Default
	(1)	(2)	(3)	(4)	(5)	(6)
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 underlying model consists of two equations. The dependent variable in the first equation is annual percent change in outstanding loans. In the second equation, the dependent variable is distance to default. The latter is estimated based on bank accounts. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year.

Slower credit growth in the CEECs has largely reflected weaker economic activity than in the Baltics. Relatively high income levels in the Czech Republic and Slovenia have implied less scope for financial catching up in these countries. Real interest rates have exerted downward pressure on credit growth in Poland and Hungary, while the contribution of real interest rates to credit growth in the Czech Republic, the Slovak Republic, and Slovenia has been small. High profitability was an important factor explaining strong credit growth in Poland during 1997–2000, and in Hungary during 2001–04, while in Slovenia bank soundness contributed to credit growth throughout the period in question. Exchange rate appreciation had a significant impact on credit growth rates in most NMS between 2001 and 2004, particularly in Estonia, Lithuania, and the Slovak Republic.

The predicted values of credit growth are fairly close to the actual rates. Predicted credit growth rates for the second half of the 1990s were generally above actual rates in most countries. In the later period, 2001–04, actual credit growth rates on average were below the predicted rates for the CEECs countries, but on average above the predicted rates in the Baltics. Predicted credit growth rates for all NMS were higher during 2001–04 than in the second half of the 1990s, reflecting improvements in macroeconomic conditions and the strengthening of the financial systems.

How Significant Are Prudential Risks in the NMS?

Credit growth in the NMS had a negative, but statistically insignificant, impact on bank soundness both during 1995–2000 and 2001–04 (Table 6, Column 6, compared to Table 6, Column 4). This finding is consistent with the conclusions based on a general analysis of financial soundness indicators in Hilbers and others (2005) and Iossifov and Khamis (2006), who have not found any significant deterioration in financial soundness indicators in the NMS. Market indicators for the NMS banking systems discussed earlier point to similar conclusions. However, unlike the econometric analysis using bank-level data, these other analyses do not draw on the information contained in the disaggregated data on the dispersion of soundness indicators across banks; they largely examine average, system-wide soundness indicators.

In contrast to the late 1990s, the pace of credit growth in the NMS during 2001–04 was no longer dependent on bank soundness—weaker banks were expanding credit just as rapidly as sounder banks (Table 6, Column 5, compared to Table 6, Column 3). With some relatively weak banks being weak in the absolute sense as well, the implication of this econometric finding is that the prudential risks associated with rapid credit growth in the NMS have risen in recent years. Rapid expansion by weak banks risks undermining the soundness of the banking system in future years, to the extent that weak banks have incentives to try to outgrow their initial problems by venturing into high-risk/high-return activities, which might magnify the eventual costs of dealing with the underlying weaknesses. The prudential risks associated with rapid expansion by weak banks might become apparent in financial soundness indicators only with a delay, or not at all, if weak banks strengthen their risk

management practices, avoid taking on excessive risks, and build up sufficient capital cushions.

The above econometric findings are generally robust to alternative specifications of the model and alternative measures of bank soundness: controlling for time- and country-specific factors, using alternative measures of foreign and public ownership, and adding an explicit measure of financial development.[22] Using an alternative, narrower measure of bank soundness (the share of nonperforming loans in total outstanding loans) implies that, during 2001–04, weaker banks were expanding more rapidly than sounder banks: the coefficient on nonperforming loans (NPLs) in the credit growth equation is positive and statistically significant during 2001–04, while, during 1995–2000, it was negative and statistically insignificant (Table 7). Regressions with loan loss reserves as a measure of bank weakness show that the positive statistically significant effect of bank weaknesses on the rate of bank credit growth has increased in recent years (Table 7). Regressions using the annual percent change in NPLs as a measure of bank weakness indicate that credit growth in recent years has been associated with slower growth in NPLs, possibly reflecting generally favorable macroeconomic conditions in recent years.

The results are also broadly robust to alternative ways of calculating distance to default. In particular, calculating the volatility of returns for the corresponding subperiods rather than for the entire period renders a statistically significant negative coefficient on credit growth in the bank soundness for the period 2001–04. However, this approach to calculating distance to default implies a more sanguine assessment of risks facing individual banks than the baseline approach of calculating the volatility of returns for the entire sample period, as the volatility of returns has declined in recent years in part owing to favorable macroeconomic conditions. Results also do not change significantly when a quadratic term of distance to default is included to capture possible nonlinearities in the relationship between credit growth and bank soundness (following Maechler, Mitra, and Worrell, 2006): the quadratic term is found to be statistically insignificant.

Likewise, results are broadly robust to estimating the bank credit growth and the distance to default equations separately using the Arellano-Bond method, although a short time dimension of the data set precludes the subsample analysis using this method. Estimating the baseline specification excluding the lagged dependent variables also does not significantly alter the main parameters. Assuming faster feedback effects between bank credit growth and soundness (by replacing lagged bank credit growth and distance to default with their contemporaneous values in the respective equations) also does not alter the results.

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[22] Including additional measures of institutional development (for example, the banking reform index produced by the European Bank for Reconstruction and Development), regulatory measures (such as supervision quality measures), or a measure of financial development (bank credit to the private sector as a share of GDP) did not improve the specification. These variables were excluded to achieve a parsimonious specification.
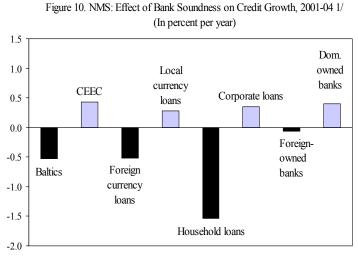
Table 7. Robustness Analysis: Alternative Measures of Bank Soundness—Nonperforming Loans and Loan Loss Reserves

	Nonperforming Loans			Bank Credit Growth	Loan Loss Reserves	
	1995-2000	2001-2004			1995-2000	2001-2004
	(1)	(2)			(3)	(4)
Bank credit growth	0.089	-0.011		Bank credit growth	0.085***	0.100***
	[1.28]	[0.17]			[2.70]	[3.66]
Nonperforming loans	-0.025	0.262***		Loan loss reserves	11.837***	59.944*
	[0.47]	[2.75]			[3.83]	[1.76]
Real GDP growth	3.129**	2.109**		Real GDP growth	1.970**	2.299***
	[2.15]	[2.23]			[2.07]	[3.28]
GDP per capita	-0.386**	-0.219*		GDP per capita	-0.235**	-0.002
	[2.02]	[1.86]			[2.20]	[0.03]
Net interest margin	2.506	5.397***		Net interest margin	2.607***	0.242
	[1.59]	[3.04]			[2.62]	[0.19]
Cost-to-income ratio	-0.099***	0.099		Cost-to-income ratio	-0.059***	0.192**
	[3.09]	[1.48]			[2.71]	[2.25]
Real interest rate	-1.674**	-1.245*		Real interest rate	-0.984	-0.839
	[2.00]	[1.84]			[1.49]	[1.35]
Real depreciation	13.587	-10.722**		Real depreciation	14.165**	-2.938
	[1.52]	[2.26]			[2.15]	[1.01]
Public ownership	-0.198*	-0.119		Public ownership	-0.177**	-0.158*
	[1.92]	[1.12]			[2.40]	[1.85]
Constant	28.711*	0.711		Constant	16.696*	5.478
	[1.73]	[0.05]			[1.84]	[0.51]
R-squared	0.24	0.46		R-squared	0.18	0.17
Observations	145	76		Observations	301	284

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 underlying model consists of two equations. The dependent variable in the first equation (reported in the table) is annual percent change in outstanding loans. In the second equation, the dependent variable is the ratio of nonperforming loans to total loans (loan loss reserves as a proportion of total loans). The latter is estimated based on bank accounts. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year.

The relationship between credit growth and bank soundness seems to have differed across different subgroups—the CEECs and the Baltics, foreign- and domestically owned banks, foreign currency and domestic currency loans, and household and corporate loans. For all subgroups, there is no strong statistical evidence that rapid credit growth has weakened bank soundness. However, the importance of bank soundness as a factor driving bank credit growth has varied across subgroups (Figure 10). The soundness of banks in the CEECs, domestically owned banks, and banks lending mostly in local currency or to corporates is found to have a positive and statistically significant effect on bank credit growth in recent years, implying that credit has been growing more

Figure 10. NMS: Effect of Bank Soundness on Credit Growth, 2001-04 1/
(In percent per year)

Source: IMF staff estimates.
1/ The effect of a one-unit increase in distance to default on bank credit growth, corresponding to the coefficient on distance to default in the credit growth equation. Distance to default is measured by the number of standard deviations a return realization would have to fall for equity to be depleted. See Tables 8 and 9 for details.

rapidly through sounder banks. The opposite is true of credit growth in the Baltics and lending in foreign currency, to households, or through foreign-owned banks: weaker banks seem to be expanding these types of loans at a faster rate. The negative correlation between bank soundness and credit growth seems to be the highest in household lending. The detailed econometric results underlying these conclusions are discussed in the next subsection.

Do Prudential Risks in the Baltics and the CEECs Differ?

Although credit growth had a statistically insignificant effect on bank soundness in both subgroups during 1995–2000 and 2001–04, the role of weaker banks in credit expansion in the Baltics appears to have increased over time (Table 8). 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 consistent with trends in sample statistics (Table 4): the means for credit growth and distance to default increased over time in both subgroups, while the dispersion of banks by the degree of soundness increased primarily in the Baltics. These results are generally robust to excluding the lagged dependent variable and estimating regressions separately on the CEEC and Baltic subsamples. The finding that, in contrast to the CEECs, weaker banks in the Baltics have been expanding credit more rapidly in recent years implies that recent credit growth in the Baltics has been associated with greater prudential risks than in the CEECs.

Table 8. Are the Baltics and the CEECs Different?

	Bank Credit Growth		
	1995-2004	1995-2000	2001-2004
	(1)	(2)	(3)
Bank credit growth	0.096***	0.095***	0.094***
	[5.84]	[3.64]	[4.70]
Distance to default	0.313***	0.241	0.433***
	[2.59]	[1.23]	[3.01]
Distance to default of Baltic banks	-0.346	0.684	-0.961***
	[1.43]	[1.46]	[3.72]
Real GDP growth	2.522***	2.514***	1.790**
	[4.43]	[2.85]	[2.35]
GDP per capita	-0.118*	-0.293***	-0.05
	[1.74]	[2.84]	[0.56]
Net interest margin	0.703	1.758**	1.467**
	[1.50]	[2.25]	[2.47]
Cost-to-income ratio	-0.018	-0.035*	0.054*
	[1.17]	[1.87]	[1.78]
Real interest rate	-0.477	-0.944	-0.817*
	[1.30]	[1.53]	[1.82]
Real depreciation	-5.078**	15.087**	-8.315***
	[1.99]	[2.49]	[3.01]
Public ownership	-0.178***	-0.155**	-0.076
	[3.74]	[2.42]	[1.03]
Baltic banks	5.086	-6.839	18.209***
	[0.96]	[0.81]	[2.77]
Constant	15.241***	17.060**	7.321
	[2.91]	[2.15]	[1.04]
R-squared	0.13	0.16	0.17
Observations	881	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 underlying model consists of two equations. The dependent variable in the first equation (reported in the table) is annual percent change in outstanding loans. In the second equation, the dependent variable is distance to default. The latter is estimated based on bank accounts. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year.

Several factors might explain the finding of higher prudential risks in the Baltic banking systems. It could simply be that, in the context of more rapid Baltic credit growth—ten times higher in real terms than in the CEECs in recent years (Figure 5)—ensuring sound credit assessment and risk management at the individual bank level is much more challenging. The higher degree of foreign participation in the Baltic banking sectors might also be providing additional (but possibly false) comfort that the banking system can withstand larger shocks, as parent banks will provide capital or liquidity if their Baltic subsidiaries experience problems. This rationale might be flawed if the parent bank perceives the reputational risk associated with a failure of its NMS subsidiary or branch as insignificant and prefers to close the subsidiary. This might raise funding costs for all banks in the NMS in question and give

rise to contagion within the NMS banking sector. The fact that more foreign bank affiliates in the Baltics are branches than subsidiaries might also make supervision more difficult, as branches generally are subject to less host country regulation than subsidiaries.

Do Prudential Risks Depend on Bank Ownership and Type of Lending?

Foreign-owned banks in the NMS seem to be taking on somewhat greater risks than domestic banks. Less sound foreign-owned banks appear to be lending more aggressively in the NMS than domestically owned banks, possibly because of easy access to funding through their parent banks (Table 9). (Controlling for the distance to default of parent banks indeed shows that, although rapid credit growth in recent years has become uncorrelated with the distance to default of NMS affiliates of foreign banks, it remains positively correlated with the distance to default of their parent banks.) Separate regressions, using the samples of foreign- and domestically owned banks, also show that lending by foreign- owned banks does not depend on bank soundness; for domestically owned banks a positive relationship is identified between credit growth and bank soundness.[23] Among foreign-owned affiliates, Nordic banks stand out as the ones whose lending is the least related to bank soundness. This result is consistent with the earlier discussed finding of higher prudential risks in the Baltics, since Nordic banks are particularly active in the Baltic countries (Iossifov and Khamis, 2006).

The rapid growth of foreign-currency-denominated lending and household lending seems to pose greater prudential risks to NMS banks than other types of lending. Credit growth through banks with large and rapidly expanding foreign currency loan portfolios is negatively correlated with bank soundness, suggesting that weaker banks are expanding at a faster rate (Table 10). The opposite is true of banks that are not actively engaged in foreign currency lending: loans are growing more rapidly through sounder banks. A similar result is found for banks with large and rapidly growing loan exposures to the household sector (Table 10).[24] These findings point to greater prudential risks in banks that are aggressively lending in foreign currency and to the household sector. Such banks seem willing to take on greater risks for the sake of increasing their market share.

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[23] These results are not included for sake of brevity, but are available from the authors upon request.

[24] Data limitations preclude examining credit growth broken down by both the currency of denomination and the type of borrower.

Table 9. Are Foreign-Owned Banks Different from Domestically Owned Banks?

	Bank Credit Growth		
	1995-2004	1995-2000	2001-2004
	(1)	(2)	(3)
Bank credit growth	0.097***	0.104***	0.096***
	[5.91]	[4.03]	[4.75]
Distance to default	0.429***	0.456**	0.398**
	[3.10]	[2.15]	[2.26]
Distance to default of foreign-owned banks	-0.448**	-0.380	-0.466**
	[2.12]	[0.96]	[1.96]
Real GDP growth	2.665***	2.436***	2.485***
	[5.54]	[2.89]	[4.42]
GDP per capita	-0.134**	-0.293***	-0.094
	[2.18]	[2.88]	[1.17]
Net interest margin	0.652	1.874**	1.158*
	[1.36]	[2.27]	[1.94]
Cost-to-income ratio	-0.016	-0.036*	0.048
	[1.01]	[1.88]	[1.57]
Real interest rate	-0.539	-0.900	-0.947**
	[1.60]	[1.64]	[2.13]
Real depreciation	-5.123**	15.275**	-7.924***
	[2.02]	[2.52]	[2.82]
Public ownership	-12.897***	-9.254	-5.129
	[2.75]	[1.43]	[0.72]
Foreign ownership	8.069**	8.709	5.85
	[2.09]	[1.31]	[1.29]
Constant	12.857**	10.782	11.156
	[2.31]	[1.19]	[1.51]
R-squared	0.14	0.16	0.16
Observations	881	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 underlying model consists of two equations. The dependent variable in the first equation (reported in the table) is annual percent change in outstanding loans. In the second equation, the dependent variable is distance to default. The latter is estimated based on bank accounts. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year.

Table 10. Does Type of Lending Matter?

	Bank Credit Growth					
	Exposure to Foreign Exchange Risk			Bank Credit Growth	Exposure to Household Sector	
	1995-2004	1995-2000	2001-2004	1995-2004	1995-2000	2001-2004
	(1)	(2)	(3)	(4)	(5)	(6)
Bank credit growth	0.105***	0.157***	0.073**	0.127***	0.180***	0.086***
	[4.40]	[4.25]	[2.51]	[6.42]	[5.45]	[3.80]
Distance to default	0.346***	0.422**	0.279*	0.417***	0.613***	0.355**
	[2.70]	[2.44]	[1.68]	[3.36]	[3.33]	[2.38]
Distance to default of exposed banks	-0.680*	0.006	-0.794*	-0.791**	-0.886**	-1.889***
	[1.66]	[0.01]	[1.74]	[2.28]	[2.16]	[2.86]
Real GDP growth	2.681***	3.497***	3.495***	2.483***	3.991***	3.585***
	[4.46]	[3.91]	[4.27]	[4.31]	[4.49]	[4.64]
GDP per capita	-0.123*	-0.225***	-0.118	-0.154***	-0.375***	-0.065
	[1.96]	[2.77]	[1.32]	[2.59]	[4.68]	[0.79]
Net interest margin	0.881	3.754***	1.242	0.955	2.318***	1.830**
	[1.28]	[4.54]	[1.00]	[1.62]	[3.00]	[2.05]
Cost-to-income ratio	0.011	0.007	-0.037	0.023	0.006	0.03
	[0.49]	[0.36]	[0.52]	[1.20]	[0.30]	[1.01]
Real interest rate	-0.638	-0.133	-1.015*	-0.725*	-0.447	-0.766
	[1.55]	[0.23]	[1.94]	[1.84]	[0.76]	[1.57]
Real depreciation	-3.919	26.407***	-4.679	-2.586	26.291***	-4.706
	[1.54]	[4.98]	[1.51]	[1.06]	[5.04]	[1.61]
Public ownership	-0.160***	-0.075	-0.079	-0.172***	-0.103*	-0.059
	[3.16]	[1.28]	[0.96]	[3.49]	[1.76]	[0.76]
Exposed bank dummy	33.429***	23.238	29.541***	33.672***	50.436***	28.312***
	[3.69]	[1.48]	[2.80]	[4.22]	[4.35]	[2.68]
Constant	9.808*	-20.243***	18.981*	10.593**	-8.001	7.025
	[1.78]	[2.85]	[1.90]	[2.02]	[1.16]	[0.93]
R-squared	0.21	0.41	0.22	0.24	0.45	0.24
Observations	455	197	258	500	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 underlying model consists of two equations. The dependent variable in the first equation (reported in the table) is annual percent change in outstanding loans. In the second equation, the dependent variable is distance to default. The latter is estimated based on bank accounts. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year. Banks that are exposed to foreign exchange risk 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 that are exposed to households 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. The sample is composed of Czech, Estonian, Lithuanian, Polish, Slovak, and Slovenian banks.

IV. POLICY IMPLICATIONS

The econometric results suggest that rapid credit growth in the NMS has not had a significant negative effect on bank soundness so far, but it has become ubiquitous in recent years—with relatively weak and sound banks lending at an equally rapid pace. A significant buildup of financial risks in the weaker banks risks undermining their soundness over time. Even if the weaker banks are nonsystemic, distress in these institutions might lead to contagion within the financial system and have systemic consequences. The econometric findings thus point to three main policy priorities in the NMS:

- close supervision of rapidly growing banks to ensure that these banks have adequate risk management systems in place and are pricing risks properly, in conjunction with the strengthening of prudential guidance for banks;

- improvements in market infrastructure and institutions supporting sound credit growth, such as credit bureaus and disclosure of information about financial risks to customers; and

- better understanding of the implications of credit growth for financial stability in the context of financial sector surveillance and macroprudential risk assessments (for specific measures in this area, see Box 1).

The upcoming implementation of the Basel II capital framework in major banks should help strengthen risk-based supervision; however, the benefits of Basel II are likely to come only over time, and the short-term impact is ambiguous. (Box 2 discusses prudential responses to rapid credit growth in the context of Basel II).

The econometric results point to the need for a stronger prudential policy response in the Baltics than in the CEECs. In the Baltics, there is either evidence that weaker banks are expanding more rapidly (Latvia and Lithuania) or that rapid credit growth has already weakened banks (Estonia). A stronger prudential policy response might involve, for example, using such risk-based measures as higher capital requirements and tighter loan classification and provisioning rules, differentiated on the bank-by-bank basis depending on the underlying risks.[25] There is also a need to calibrate the prudential policy response to individual country circumstances in the CEECs. The strongest case for strengthening prudential regulations exists in the Czech Republic, Hungary, and Slovenia, where credit growth recently has become independent of bank soundness. In Poland and the Slovak Republic, sounder institutions are expanding at a faster rate, suggesting that the prudential response can be less intense than in the above countries, all other things equal.

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[25] See Hilbers and others (2005) for a classification of policy options in responding to rapid credit growth.

Box 1. Strengthening Financial Sector Surveillance in the NMS 1/

Specific measures that could be taken to strengthen financial sector surveillance include the following:

Financial Soundness Indicators—NMS central banks and supervisory agencies already monitor a range of aggregate financial soundness indicators pertaining to the corporate and household sectors. It is important to monitor the distribution of these indicators, as aggregate data can conceal significant weaknesses in certain groups of households or enterprises. It might be useful to consider if the set can be expanded further to cover a broadest possible range of indicators (Sundararajan and others., 2002).

Sectoral Models—An econometric model of the household and corporate sector can help elaborate on the interaction among asset prices, household loans, private consumption expenditures, and housing investments. Evaluating the effect of macroeconomic conditions on the debt-servicing capacity of households and enterprises, and thereby on the credit risk of banks, is a critical complement of financial soundness indicators.

Stress Testing—Judging by published Financial Stability Reports and discussions with selected country authorities, most NMS have made significant progress recently in developing stress tests. Further improvements might be needed in stress testing household loan portfolios, for example, by (i) using disaggregated data on household debt to model the distribution of household indebtedness; and (ii) linking credit risk scenarios to changes in the underlying macroeconomic variables, based on country-specific models or other countries' experiences.

Early Warning Systems—The early warning systems based on backward-looking CAMEL (capital, asset quality, management, earnings, and liquidity) indicators can be enhanced further by including indicators that help predict bank failures. These can include credit growth rates, deposit rates, interbank market indicators (for example, spreads and access levels), indicators of banks' resilience (for example, postshock capital adequacy ratios from stress tests), and market-based measures (for example, if available, distance to default measures, or spreads on bank-issued bonds).

Contagion Models— Interbank contagion stress tests could provide insights into the possibility of contagion through various channels, including reputational effects.

Loan Databases—NMS central banks and supervisory agencies already collect data from a broad variety of sources. The immediate priority in many countries is collecting disaggregated data on household and corporate credit, for example, from a credit registry or large borrowers' registry, which would help refine stress testing. Further improvements in data collection might also be needed in such areas as (i) market indicators, especially housing prices; (ii) bankers' opinions; and (iii) flow of funds data.

Balance Sheet Analysis—Constructing national balance sheet accounts for the NMS might provide insights into balance sheet risks associated with rapid credit growth and the intersectoral distribution of these risks.

1/ This box is based on Tamirisa and Čihák (2005).

Box 2. Basel II and Prudential Risks Associated with Rapid Credit Growth 1/

Will the introduction of the Basel Committee on Banking Supervision (BCBS)'s new "International Convergence of Capital Measurements and Capital Standards—A Revised Framework" (Basel II) help to address the risks associated with the rapid credit growth?

The adoption of Basel II will bring more attention to risk management practices, disclosure, and market discipline. Implementation of Basel II should align the prudential regulations closer with good risk management practices and encourage banks to develop their risk management systems. While much of the debate on Basel II has centered on Pillar 1 (capital adequacy), countries may benefit more, in the medium term, from implementation of Pillars 2 (supervisory practices) and 3 (expanded market discipline and disclosure).

The role of Basel II in dampening the macroprudential risks should not be overstated, however. The impact depends substantially on the implementation of the framework in individual banks. Basel II offers banks a number of options, while giving the new framework the necessary flexibility, also create challenges for microprudential and macroprudential surveillance. The framework also gives flexibility to supervisors (for example, under Pillar 2, they can differentiate capital requirements across banks, depending on the underlying risks). At least in the short term, before more experience is gained in implementing the new prudential framework, there may be a need for additional prudential measures, as per the discussion in the main text of this paper. A number of considerations are important in this respect:

- Basel II is by construction a microprudential framework that does not explicitly take into account macroprudential and macroeconomic concerns. Banks' risk management systems may therefore not be able to factor in the second- or further-round impacts of their actions on other market players.

- The EU Capital Requirements Directive (CRD; 2006/48/EC), through which the EU has implemented Basel II, will effectively limit member countries' scope to introduce rules that are stricter than the directive. The Brussels authorities seek to achieve as much convergence across the EU as possible in implementing the CRD and to avoid using the right to be stricter. Nevertheless, the use of bank-specific capital requirements under Pillar 2 will be the responsibility of the home supervisor (that is, supervisors from other EU countries in the case of the NMS, since many large banks in the NMS are foreign banks from those countries). The fact that the implementation of Basel II is likely to limit policy options available to the NMS supervisors for tightening prudential requirements reinforces the need for cooperation with foreign bank supervisors and regulators.

- The implications of Basel II for credit growth remain to be seen. Banks may tend to increase their holding of low-risk assets (with lower capital charges) and may reduce their holdings of those assets, which under Basel II generate a higher capital charge and put upward pressure on lending rates. These factors could shift the flow of credit from higher-risk sectors (for example, commercial real estate) to less risky sectors (for example, residential housing). The quantitative impact studies performed so far suggest that, at least in the short term, the implementation of Basel II will on average mean lower, rather than higher, capital requirements. These results need to be interpreted cautiously, but at the minimum they suggest that, in the short term, the scope for credit expansion is likely to increase rather than decrease.

1/ The main contributor to this box is Martin Čihák. For a more detailed discussion of Basel II and its implications, see "Implementation of Basel II—Implications for the World Bank and IMF" (2005), available at www.imf.org.

Designing an effective prudential policy response to rapid credit growth is challenging. Overly intrusive measures would unduly penalize rapidly expanding banks that are managing risks properly and might hinder financial deepening and economic convergence of the NMS. While creating additional distortions, overly intrusive policy measures might be ineffective, as banks may simply transfer business to the nonbank sector or offshore. Together with the lack of statistically significant evidence that rapid credit growth has weakened banks in the NMS, the above considerations suggest the need for giving priority to risk-based supervision as a way to contain the risks associated with rapid credit growth.

In all NMS, priority needs to be given to strengthening the supervision of banks actively engaged in household and foreign currency lending. Although, like corporate lending, lending to households has not yet had any identifiable adverse effect on bank soundness, and there are no statistically significant differences between the soundness of banks with large and rapidly growing household portfolios and that of other banks, the finding that weaker banks are expanding credit to households at a faster rate than other banks is a cause for concern. The same result holds for banks with large and rapidly growing foreign currency loan portfolios. This points to the need for close monitoring of household and foreign currency loan exposures and management practices of banks actively engaged in these types of lending. If supervisors identify weaknesses in this area, consideration might need to be given to introducing stronger provisioning or capital requirements for riskier banks or changing the risk weight on foreign currency or household lending.

Other policy measures might also help manage prudential risks in the area of household lending. Creating a regulatory framework conducive to the development of mortgage-backed instruments can help banks offload from their balance sheets some of the risks associated with household loans. Yet another policy approach would be to reduce or remove subsidies and tax incentives, which exist in some countries for real estate borrowing. Designing an effective policy framework in the area of household and foreign currency lending is particularly important, given the ample scope for a further expansion of this lending: market penetration in household lending remains considerably below the EU average, and investors expect NMS currencies to continue to appreciate as income convergence continues.

Ensuring strong supervision of foreign-owned banks is also important. The econometric results in this paper show that rapidly expanding foreign-owned banks, especially Nordic banks, are taking on more financial risks than domestically owned banks, although the strength of their parent banks compensates for the greater risk taking. This finding underscores the need for strong cross-border cooperation with foreign supervisors to ensure that any emerging signs of weaknesses are addressed in a timely and effective manner. Besides regular exchanges of supervisory information, which reportedly are already taking place in most NMS, cross-border cooperation with foreign supervisors might include tripartite meetings on the findings of NMS supervisory inspections (including not only representatives of NMS subsidiaries and NMS supervisors but also home country

supervisors), joint inspections by home and host country supervisors of NMS foreign affiliates, and joint crisis management exercises. The challenge in implementing this recommendation is providing sufficient incentives for home country supervisors (and foreign bank owners) to get involved in cases where NMS subsidiaries account for only a small fraction of the parent bank's balance sheet or income statement.

V. CONCLUSION

This study has explored the prudential aspects of credit growth in the NMS using a regional bank-level data set and recognizing the two-way causality between credit growth and bank soundness. The econometric analysis shows that credit growth in the NMS during the last decade has reflected financial deepening and various macroeconomic factors, such as strong economic growth, declining real interest rates, and exchange rate appreciation. Bank-specific factors, such as efficiency, profitability, soundness, and the degree of state ownership, have also influenced credit growth. Bank soundness has largely been a function of bank-specific factors (history, size, liquidity, and the degree of foreign ownership) and the level of economic and institutional development of the country where the bank is located.

Rapid credit growth in the NMS does not appear to have weakened banks significantly so far but it has recently become less dependent on bank soundness—an effect that is most pronounced in banks and credit markets that are growing particularly strongly. Rapid expansion by weaker banks, some of which might have small distances to default and thus also be weak in the absolute sense, raises prudential concerns. Based on the econometric analysis using bank-level data, increased prudential risks are most apparent in lending to households or in foreign currency and in the Baltic countries, where weaker banks are found to be expanding at a faster rate. Foreign banks seem willing to take on greater risks than domestic banks, and credit growth through the NMS affiliates of foreign-owned banks has been unrelated to their soundness; however, it is comforting that it has remained positively correlated with the soundness of their parent banks. These findings imply that, in the probabilistic sense, the prudential risks associated with rapid credit growth in the NMS have risen in recent years. Traditional financial soundness indicators are not pointing to such emerging prudential risks, because they are largely based on system-wide statistics and do not take into account the dispersion of soundness indicators across individual banks.

The finding that rapid credit growth in the NMS has not significantly weakened banks but has been associated with rising prudential risks underscores the importance of forward-looking and risk-based supervision. Such supervision can help keep the risks associated with rapid credit growth at manageable levels, while maximizing the benefits of rapid credit growth for financial development and economic growth. The results in this paper imply the need for a differentiated supervisory response across countries, depending on how significant the prudential risks associated with rapid credit growth are. A stronger policy response might be justified in countries where rapid credit expansion has weakened banks or weak banks are expanding rapidly.

Appendix I. Distance to Default Measures[26]

Distance to default (DD) has become an increasingly popular measure of bank soundness (see, for example, Danmarks Nationalbank, 2004; and De Nicoló and others, 2005). Its popularity stems from the fact that it is directly related to the probability of default, that is the probability that the value of assets becomes smaller than the value of debt. It can be summarized as $DD \equiv (k+\mu)/\sigma$, where k is equity capital as percent of assets, μ is average return as percent on assets, and σ is the standard deviation of return on assets as a proxy for return volatility. DD measures the number of standard deviations a return realization has to fall in order to exhaust equity, assuming that banks' returns are normally distributed. Because a higher DD corresponds to a lower upper bound of insolvency risk, a higher DD therefore implies a lower probability of insolvency risk.

Typically, market values of equity are used to calculate this index (see, for example, De Nicoló and others, 2005). In particular, daily market data on equity are combined with annual accounting data to calculate the market value and the volatility of assets, based on the option-pricing model by Black and Scholes (1973) and Merton (1974). Advantages of using stock market data include the fact that they aggregate information dispersed among market agents and potentially can provide forward-looking assessments of risks. However, this approach is also based on relatively strong assumptions; in particular, it requires bank stocks to be traded in well-functioning and liquid markets. Since this assumption might not hold in relatively illiquid NMS stock markets, this paper mainly uses a simpler annual measure of DD based only on balance sheet and income statement data.[27] We calculate the measure using annual data on equity capital (valued at end-year market prices) and return on assets. The standard deviation of returns is calculated for the entire sample period (7 observations per bank on average) to obtain a sufficiently long-term view on the risks faced by a given bank.

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[26] This discussion is based on Tamirisa and Čihák (2006).

[27] This measure is sometimes called *z*-score, to differentiate it from the option price-based measure of distance to default.

Appendix II. Data Sources and Definitions

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[28] 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 NMS, 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 the NMS 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.

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[28] The Bankscope data set for 1995–2002 was provided by Ugo Panizza. These data were used in an econometric 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 NMS 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 NMS 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	
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	Bankscope
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		Annual percentage change in total loans	Bankscope
Bank size		Logarithm of total assets	
Foreign ownership	Bank risk	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		Real GDP per capita, in hundreds of USD	
Real GDP growth		Annual growth rate of real GDP	IFS and WEO
Real interest rate	Market risk	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.

References

Arellano, Manuel, 1990, "Testing for Autocorrelation in Dynamic Random Effects Models," *Review of Economic Studies*, Vol. 57 (No. 1), pp. 127–34.

Arellano, Manuel, and Stephen Roy Bond, 1991, "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations," *Review of Economic Studies*, Vol. 58 (No. 2), pp. 277–97.

Aydin, Burcu, 2006, "The Impact of Foreign Bank Ownership on Credit Growth in Eastern European Countries," forthcoming, IMF Working Paper (Washington: International Monetary Fund).

Black, F., and M. Sholes, 1973, "The Pricing of Options and Corporate Liabilities," *Journal of Political Economy*, Vol. 81 (No. 3), pp. 14, 637–54.

Čihák, Martin, 2006, "How Do Central Banks Write on Financial Stability?" IMF Working Paper No. 06/163 (Washington: International Monetary Fund).

Coricelli, Fabrizio, and Igor Masten, 2004, "Growth and Volatility in Transition Countries: *The Role of Credit*," a paper presented at the IMF conference in honor of Guillermo Calvo, Washington, April 15–16, 2004.

Cottarelli, C., G. Dell'Ariccia, and I. Vladkova-Hollar, 2005, "Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and in the Balkans," *Journal of Banking and Finance*, Vol. 29 (January), pp. 83–104.

Danmarks Nationalbank, 2004, "Market-Based Risk Measures for Banks," in *Financial Stability 2004* (Copenhagen: Danmarks National Bank).

de Haas, Ralph, and Iman van Lelyveld, 2005, "Foreign Banks and Credit Stability in Central and Eastern Europe," *Journal of Banking and Finance*, Vol. 30 (July), pp. 192-52.

Dell'Ariccia, Giovanni, Enrica Detragiache, and Raguram Rajan, 2005, "The Real Effect of Banking Crises," IMF Working Paper No. 05/63 (Washington: International Monetary Fund).

De Nicoló, Gianni, and others, 2005, "European Financial Integration, Stability and Supervision," in *Euro Area Policies; Selected Issues*, by Anthony Annett and others, IMF Country Report No. 05/266 (Washington: International Monetary Fund).

Égert, Balázs, Peter Backé, and Tina Zumer, 2006, "Credit Growth in Central and Eastern Europe: New (Over)Shooting Stars?" unpublished (Vienna: Oesterreichische Nationalbank).

European Central Bank, 2005, *Banking Structures in the New EU Member States* (Frankfurt: European Central Bank).

Fitch Ratings, 2005, "CEE Housing Finance: Rapid Growth, But at What Risk?" November 7.

Fitch Ratings, 2005, "Sovereigns: Bank Systemic Risk Report," July 26.

Fitch Ratings, 2006, "Sovereigns: Bank Systemic Risk Report," September 6.

Hall, S.G.,1987 "A Forward Looking Model of the Exchange Rate." *Journal of Applied Econometrics*, Vol. 2 (No. 1), pp. 47–60.

Hernández, Leonardo and Oscar Landerretcher, 2001, "Capital Inflows, Credit Booms and Macroeconomic Vulnerability: the International Experience," in *Banking, Financial Integration and International Crises,* Hernández, L. and K. Schmidt-Hebbel (editors). Central Bank of Chile.

Hilbers, Paul, and others, 2005, "Assessing and Managing Rapid Credit Growth and the Role of Supervisory and Prudential Policies," IMF Working Paper No. 05/151 (Washington: International Monetary Fund).

Iossifov, Plamen, and May Khamis, 2006, "Credit Growth in the Nordic-Baltic Countries— Sources, Risks, Supervisory Responses, and Coordination Among Nordic and Baltic Countries," forthcoming, IMF Working Paper (Washington: International Monetary Fund).

Kónya, István and Hiroshi Ohashi, 2005, "International Consumption Patterns among High-Income Countries: Evidence from the OECD Data," CIRJE Discussion Papers, CIRJE-F-327 Tokyo: Center for International Research on the Japanese Economy.

Levine, Ross, 1997, "Financial Development and Growth: Views and Agenda," *Journal of Economic Literature*, Vol. 35 (June), pp. 688–726.

Maechler, Andrea, Srobona Mitra, and DeLisle Worrell, 2006, "Exploring Financial Risks and Vulnerabilities in New and Potential EU Member States," forthcoming, IMF Working Paper (Washington: International Monetary Fund).

Merton, R. C., 1974, "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates," *Journal of Finance*, Vol. 29 (No. 2), pp. 14, 449–70.

Micco, Alejandro, Ugo Panizza, and Monica Yañez, 2004, "Bank Ownership and Performance," IADB Working Paper No. 518 (Washington: Inter-American Development Bank).

Neir, Erlend, and Lea Zicchino, 2006, "*Bank Weakness, Loan Supply and Monetary Policy*," IMF Seminar Series No 2006-11 (Washington: International Monetary Fund).

Sab, Randa, and Stephen C. Smith, 2002, "Human Capital Convergence: A Joint Estimation Approach", *Staff Papers*, IMF Vol. 49 (No 2), pp. 200–11.

Schadler, S., and others, 2004, *Adopting the Euro in Central Europe: Challenges of the Next Step in European Integration*, IMF Occasional Paper No. 234 (Washington: International Monetary Fund).

Sundararajan, V., and others, 2002, *"Financial Soundness Indicators: Analytical Aspects and Country Practices,"* IMF Occasional Paper No. 212 (Washington: International Monetary Fund).

Tamirisa, Natalia, and Martin Čihák, 2005, "Household Credit in the Czech Republic: Macro and Microprudential Analysis, Cross-Country Experiences, and Implications for Financial Sector Policy and Surveillance," unpublished (Washington: International Monetary Fund).

———, 2006, "Credit, Growth, and Stability," in *Poland—Selected Issues*, Country Report 06/392 (Washington: International Monetary Fund).