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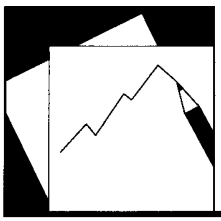

IMF Working Paper

Credit Growth and Bank Soundness:

Fast and Furious?

Deniz Igan and Marcelo Pinheiro

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Research Department

Credit Growth and Bank Soundness: Fast and Furious?

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Abstract

We examine the risks to bank soundness associated with credit booms in a large set of countries. Using bank-level data in 90 countries between 1995 and 2005, we analyze the relationship between credit growth and bank soundness taking into account the potential two-way causality. We find that, while sounder banks tend to grow faster at moderate-growth periods, credit growth becomes less dependent on soundness during booms. These findings shed some light on why credit booms are often associated with financial crises.

JEL Classification Numbers: G21, G28, P34

Keywords: Credit growth, credit boom, bank soundness, distance to default

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Contents Page

I. Introduction 3

II. Econometric Analysis Using Bank-Level Data 5
A. The Empirical Model 6
B. Data and Summary Statistics....8

III. Econometric Results 8
A. Does Rapid Credit Growth Worsen Bank Soundness?
Do Sounder Banks Grow Faster?....9
B. Do Risks Differ During Credit Booms?....10
C. Do Risks Depend on Bank Ownership?....12

IV. Concluding Remarks 13

References....24

Table
1a. Summary Statistics: Bank-Level Variables 18
1b. Summary Statistics: Country-Level Variables....19
2. Baseline Regression Result....20
3. Regression Results: Boom Effect 21
4. Regression Results: Rapid Bank Effect 22
5. Regression Results: Ownership Effect....23

Appendix
I. Distance to Default Measures....12
II. Data Sources and Definitions....13

Appendix Table
1. List of Countries in the Sample 17

I. INTRODUCTION

Episodes of rapid growth in bank credit to the private sector are rather frequent events (Terrones, 2004; Barajas et al., 2007). In the business cycle context, financial accelerator mechanisms can explain such episodes relatively well: favorable investment opportunities and vigorous economic activity push asset prices up, which in turn increase the creditworthiness of borrowers and let them borrow more against higher values of collateral. Hence, credit is pro-cyclical and grows in tandem with income. In addition, countries move up the ladder in terms of financial development, generating an upward trend in credit-to-GDP ratio. Several factors driving financial development can push the growth rate of credit far above the growth rate of income. For instance, financial deregulation (including lifting of capital account restrictions), increased competition, and financial innovation could cultivate credit booms, i.e., episodes of above-trend growth in credit-to-GDP ratio.

While increased credit availability often spurs economic growth helping savings to be channeled into investment, rapid credit growth also raises concerns about prudential risks. Prudential risks, defined as threats to financial stability stemming from the financial position of banks, can emerge both at the micro and macro levels. At the micro level, fast expansion of loan portfolios may lead to capacity constraints (to manage risks, gather information, or assess quality of applications) starting to bind and new loans being originated without adequate screening and risk management (Berger and Udell, 2004). At the macro level, expansion may involve strategic competition concerns whereby banks take on more risks or financial institutions become more interconnected and the system, as a whole, becomes riskier. Or, it may involve reliance on the same asset classes and marginal loans, i.e., loans made to borrowers that are riskier and potentially more exposed to shocks that may be correlated across borrowers. For instance, in the run-up to the recent global financial crisis, several studies identify the mortgage credit boom in the U.S. as one of the culprits because it increased the exposure of the financial system to a single shock, that is, a fall in house prices (see, for instance, Dell'Ariccia, Igan, and Laeven, 2008). Hence, rapid credit growth episodes can decrease loan quality, increase systemic risk, and deteriorate bank soundness.

This posited relationship between credit growth and bank soundness is a dynamic one. In other words, credit growth affects *and* is affected by bank soundness. While most theoretical models predict a negative relation running from credit growth to bank soundness (see Dell'Ariccia and Marquez, 2006, and references therein), the sign of the feedback effect is ambiguous. It could be the case that bank soundness feeds positively into credit growth because sounder banks have more capacity (to manage risks or to deploy additional employees) and they can expand faster than others. Or, the feedback effect may be negative because less sound banks become more aggressive and take more risks as they bet all their resources in a last effort to survive.

This paper examines the risks associated with rapid credit growth taking into account the role of bank soundness as a determinant of credit growth. The econometric analysis is based on a simultaneous equation framework, where credit growth and bank soundness are modeled as depending on lagged values of each other and various macroeconomic and bank-specific factors. Thus, the analysis tests two hypotheses about the risks associated with rapid credit growth. The first is that rapid credit growth weakens banks. The second is that credit grows more rapidly in sounder/less sound banks.

It has also been argued that there is a threshold effect linked to the speed of aggregate credit growth leading to an association between rapid credit growth and financial crises (see, for instance, Mendoza and Terrones, 2008). Hence, we define credit boom episodes as when credit-to-GDP ratio grows faster than what is implied by a backward-looking, country-specific, cubic time trend. This helps us identify 90 credit booms between 1995 and 2005, around 23 percent of which ended up in a systemic banking crisis (as classified by Laeven and Valencia, 2008) within two years of the end of the boom.

We then look into, using a detailed bank-level data set covering banks in 90 countries from 1995 to 2005, whether the relationship between credit growth and bank soundness differs between moderate-growth periods and credit booms. The reason for limiting our sample period to before 2006 is two-fold. First, in order to be able to derive policy implications applicable in real time, we only consider the information available to policymakers around 2007, that is, at the time when the first signs of the global financial crisis appeared. In other words, we ask whether varying degrees of home-grown vulnerabilities to a common shock could have been expected in real time leaving enough room for potential policy measures to be taken. Second, the credit booms identified in the sample are distributed such that it is possible to split the sample into two roughly even sub-periods, 1995-2000 and 2001-05, where the majority of the booms happen in the latter period.

By recognizing the potential two-way causality between credit growth and bank soundness, we bring together the different strands of the literature: macro-level studies examining the drivers of credit growth (Cottarelli, Dell'Ariccia, and Vladkova-Hollar, 2005; and Égert, Backé, and Zumer, 2006) and micro-level analyses focusing on the impact of credit growth on bank soundness (Maechler, Mitra, and Worrell, 2010; Igan and Tamirisa, 2008). We also draw 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). In addition, the paper contributes to the literature by documenting the characteristics of the relationship between credit growth and bank soundness distinguishing between boom and non-boom periods. This last feature helps uncover hints about why credit booms can be detrimental to financial and macroeconomic stability.

The first finding is that credit growth has a negative impact on bank soundness but this is significant only in the earlier part of the sample period, 1995-2000. Growth is driven mainly by sounder banks during the same period but becomes less strongly related to bank soundness in 2001-05. In other words, less sound banks have started to catch up with their sounder counterparts in terms of loan growth. The weakening of the relationship between credit growth and bank soundness may indicate increased risks associated with rapid credit growth as loan creation is equally likely to happen in less sound (and arguably vulnerable banks.[1] This finding is robust to using alternative measures of bank soundness and model specifications.

[1] These risks ultimately came to materialize in some countries, such as Bulgaria, Estonia, Latvia, Lithuania, and Romania, with the trigger of the global financial turmoil.

The threshold effect becomes apparent when the data are split based on the speed of aggregate credit growth. The finding that credit growth has weakened banks during 1995-2000 and that credit growth has become less dependent on bank soundness during 2001-05 is stronger at times of credit booms than it is for moderate-growth periods. Actually, there is evidence that weak banks might expand just as fast as sound banks during booms. Moreover, banks that grow faster than the average bank in a given country actually exhibit a negative relationship between bank soundness and credit growth. These could be interpreted as supporting the notion that weaker banks make riskier loans in order to survive. Interestingly, the feedback from credit growth to bank soundness is significantly negative over the whole sample period only during booms, giving support to the idea that banks are more likely to dip into marginal borrower pools, which could contribute to deterioration in loan quality, during credit booms and why, historically, credit booms are often associated with financial crises.

Finally, foreign-owned banks appear to be willing to take on more credit risks than domestically owned banks as their loan growth is not statistically related to their soundness level. This could be reflecting the generally more aggressive strategy of these banks, aiming to build up presence in new markets. Alternatively, one could argue that foreign banks tend to have better access to wholesale funding and superior risk management techniques through their parents, especially banks operating in emerging markets with parents in advanced economies. Given that credit growth appears to significantly weaken domestic banks but not foreign banks, this argument may have some merit. As such, the risks taken by foreign banks may be in line with the soundness level of their parents. In either case, this finding points to the importance of cross-border cooperation in bank supervision because foreign banks' accumulation of risks and/or reliance on parent bank resources could generate spillovers.

The rest of the paper is organized as follows. Section II describes the econometric approach and the data set. Section III presents the results. Section IV concludes.

II. Econometric Analysis Using Bank-Level Data

At a conceptual level, the relationship between credit growth and bank soundness could be positive or negative. 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. Hence, one could expect sounder banks to extend more credit. But if loan portfolios grow faster than banks' capacity to gauge and manage risks, credit risk might increase and loan quality decline, leading to higher non-performing loans and lower profits. One could also argue the opposite: weaker banks might be expected to extend credit aggressively in order to survive. In that case, the risks associated with rapidly growing loan portfolios would be more pronounced. All in all, the sign connecting credit growth and bank soundness to each other remains an econometric question. A simultaneous equation model allows the two-way relationship between bank credit growth and soundness to be explored.

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 measured by their distance to default.[2] These two variables enter the equation defining the other with a lag to capture the time necessary for the posited feedback mechanism to be completed. Lagged dependent variables are also included to allow for possible persistence in loan growth and distance to default. A parsimonious baseline specification is selected by testing, individually and in combination, the statistical relevance of various macroeconomic and bank-specific variables identified in the recent literature as structural determinants of credit growth and bank soundness.

The macroeconomic variables reflect 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,[3] 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 also affect its soundness.

Bank-specific variables likely to affect bank soundness and the rate at which banks expand their loan portfolios 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, 2010), measures of bank profitability (proxied by the net interest margin), liquidity (the liquidity ratio), bank size (log of total assets), and foreign and public ownership (the share of capital owned by foreigners and the government, respectively)[4] are also included as explanatory variables. The ownership variables might also indirectly capture the effect of financial and other institutional reforms on banks' incentives and their ability to lend to the private sector.

The baseline specification of the model is as follows:

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[2] See Appendix I for a discussion of the distance to default measure as well as potential shortcomings that may be associated with it.

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

[4] 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.

Equation 1: Credit Growth

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

Equation 2: Bank Soundness

$$DistanceToDefault_{ijt} = f(BankCreditGrowth_{ij,t-1}, GDPperCapita_{j,t-1}, DistanceToDefault_{ij,t-1}, Liquidity_{ij,t-1}, Size_{ij,t-1}, Foreign_{ijt});$$

where *i* denotes individual banks, *j* denotes countries, and *t* is the year.

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 auto-covariance 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, auto-covariances 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. We conduct several tests, explained in more detail below, for that purpose.

B. Data and Summary 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*. Macroeconomic data needed to calculate real GDP growth, GDP per capita, real interest rates, and real exchange rates come from the IMF's *International Financial Statistics*. The dataset covers 90 countries from 1995 to 2005.[5]

Sample statistics point to a significant dispersion in credit growth and distance to default at the bank level. In all country groups, banks were lending at higher rates on average during 2001–05 than 1995–2000 (Table 1a). Banks in the high-income, non-OECD group, on average, were growing faster than banks in the other countries in both periods. Distance to default on average increased in all country groups over time, but the improvement has been more significant in the high-income, non-OECD group. However, the variation in banks' distance to default has also increased in recent years, especially in the middle-income group. The increase in the variation of bank credit growth, on the other hand, has been limited only to high-income, OECD group whereas bank credit growth variation remained somewhat unchanged in other countries. Interestingly, aggregate credit growth has been higher in the upper middle income group, perhaps reflecting the catching-up and financial liberalization, yet the incidence of credit booms is almost as likely in high-income, non-OECD group (Table 1b). This seems to suggest that credit booms are not only an emerging markets phenomenon and analysis of the relationship between credit growth and bank soundness may depend more closely on whether there is a credit boom in effect rather than the income or development level of the country.

These basic comparisons imply that 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. The econometric analysis presented in the next section 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.

III. Econometric Results

We estimate the general specification of the model for the whole period as well as for two sub-periods, 1995–2000 and 2001–05 (Table 2).[6] The signs of coefficients are generally in line with

[5] For more information on data definitions and sources as well as a full list of the countries in the sample, see Appendix II.

[6] 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 non-stationarity problems due to the failure to capture persistence. These specification analyses confirm that the baseline specification is adequately specified by including lagged dependent variables.

expectations. After summarizing the results on the other variables, we shift the focus on the two-way relationship between credit growth and bank soundness.

Higher real GDP growth has a statistically significant positive impact on credit growth.[7] Catching-up, reflected in faster credit growth in poorer countries with less financial depth, is also important: the coefficient on GDP per capita is negative in all periods. Exchange rate appreciation and lower real interest rates are positively associated with credit growth, although their impact differs in sub-periods. During 1995–2000, real depreciation has a positive impact on credit growth while during 2001–05 real appreciation is linked to stronger credit growth, possibly due to the increased importance of foreign currency lending. Similarly, higher real interest rates are associated with faster credit growth between 1995 and 2000, potentially driven by the entry of foreign banks into markets presenting better profit opportunities, whereas lower real interest rates are found to boost credit growth in the latter period, potentially as a consequence of abundant global liquidity and high risk appetite in these years. There is a positive relationship between net interest margin and loan growth, suggesting more profitable banks can afford to grow faster. 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 bank stability equation, significant determinants of bank soundness appear to be liquidity and GDP per capita, with more liquid banks and banks in richer countries being sounder. The coefficients on foreign ownership variable and size are negative and statistically significant during 1995–2000. This suggests that larger, foreign banks take more risks. 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.[8]

A. Does Rapid Credit Growth Worsen Bank Soundness? Do Sounder Banks Grow Faster?

Credit growth had a negative impact on bank soundness in both sub-periods but this impact is statistically significant only in 1995-2000 (Table 2, Column 6, compared to Table 2, Column 4). On the flipside, sounder banks tend to grow faster throughout the period; however, in contrast to the late 1990s, the pace of credit growth during 2001–05 is less dependent on bank soundness (Table 2, Column 5, compared to Table 2, Column 3). In other words, sounder banks expanded credit faster in the 1990s but they were also weakened by the fast pace of growth. In the 2000s, the weakened banks continued to expand credit almost as fast as the ones that remained sound. Rapid expansion by weak banks could ultimately undermine the soundness of the banking system in later years, to the extent that weak banks have incentives to try to outgrow their initial

[7] The significance levels reported in the tables are based on robust standard errors. Significance levels are similar when standard errors are clustered by country.

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

problems by venturing into high-risk/high-return activities. Indeed, the global financial crisis that shook the markets in 2007-08 caught several banking systems exposed and unprepared. In general, a link between the pace of credit growth during the tranquil period of 2001-05 and the severity of the crisis impact has been established (Claessens and others, 2010).

These findings are robust to alternative specifications of the model such as controlling for time- and country-specific factors, using alternative measures of foreign and public ownership, and adding an explicit measure of financial development.[9] The results are also broadly robust to alternative ways of calculating distance to default. In particular, calculating the volatility of returns for the corresponding sub-periods rather than for the entire period renders a statistically significant negative coefficient on credit growth in the bank soundness for the period 2001–05. 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 the latter part of the sample in part owing to favorable global macroeconomic conditions. Results also do not change notably 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, 2010): the quadratic term is found to be statistically insignificant. Likewise, results are broadly robust to estimating the bank credit growth and soundness equations separately using the Arellano-Bond method, although the short time dimension of the data set precludes the sub-sample 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.

B. Do Risks Differ During Credit Booms?

Credit booms often precede financial crisis (Barajas, Dell'Ariccia, and Levchenko, 2009). This observation has led many to argue that prudential risks increase during credit booms as banks loosen lending standards in the upward stage of the credit cycle. We split our sample into boom and non-boom periods to assess whether there is a threshold effect associated with the growth rate of aggregate credit. Following Gourinchas, Valdes, and Landerretche (2001), we define a credit boom as an episode where the credit-to-GDP ratio deviates from a rolling, backward-looking, country-specific, cubic time trend. In other words, credit growth in each year *t* is compared with a trend estimated over the period starting at 1980 and ending at *t-1*. Such a trend represents the historical standard and summarizes the information about past credit growth

[9] 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) do not alter the results.

available in real time.[10] An episode of rapid credit growth becomes a boom if its deviation from the trend exceeds a country- and path-dependent threshold. Specifically, an episode is tagged as a boom if the credit-to-GDP ratio meets either of the two following conditions: (i) the deviation from trend is greater than 1.5 times its historical country-specific standard deviation and the annual growth rate of the credit-to-GDP ratio exceeds 10 percent; (ii) the annual growth rate of the credit-to-GDP ratio exceeds 20 percent. This definition takes into account country-specific conditions and reflects both the relative level and the speed of the credit-to-GDP ratio. Once a credit boom is identified, its starting point is the earliest year in which (i) the credit-to-GDP ratio exceeds its trend by more than three-fourths of its historical standard deviation and its annual growth rate exceeds 5 percent; or (ii) its annual growth rate exceeds 10 percent. A boom ends as soon as (i) the growth of the credit-to-GDP ratio turns negative; or (ii) the credit-to-GDP ratio falls within three-fourths of one standard deviation from its trend and its annual growth rate is lower than 20 percent.

Table 3 shows the regression results when the sample is split into credit boom episodes and moderate-growth (non-boom) periods. Most interestingly, the negative impact of credit growth on bank soundness is significant over the whole sample period only during booms (Table 3, Column 2 compared to Table 3, Column 8). In sub-periods, the feedback from credit growth to distance to default is much larger during credit booms than it is in non-booms (Table 3, Column 4, compared to Table 3, Column 10). Moreover, the finding that sounder banks expand credit faster than less sound banks applies more to non-boom periods than to credit boom episodes. Actually, in the latter part of the sample period, the coefficient on the bank soundness variable (distance to default) in the credit growth equation is negative, although statistically insignificant (Table 3, Column 5), suggesting that weak banks grow as fast as sound banks during booms that took place between 2001 and 2005. This finding is in line with the notion that credit booms bring about a decline in lending standards and, hence, a deterioration in bank soundness linking such episodes to incidences of financial instability. It is interesting to note that this is not a deterioration of the lending standards of individual banks, though. Rather, it seems to be a relative shift of credit from sound banks to un-sound banks. So, the system as a whole may behave as if it has more lax standards, but it is actually a matter of a change in the mix of lenders. It is possible to link this insight to the problems in the U.S. subprime mortgage market: loan originations shifted to non-traditional lenders, who had less experience with borrowers and were more exposed to funding risks (Dell'Ariccia, Igan, and Laeven, 2008).

Results so far demonstrate that credit growth may weaken banks and the threshold effect from the growth rate of aggregate credit comes into play as the negative impact on bank soundness is especially visible during credit booms, potentially because weak banks grow as fast as sound banks. Looking into the second level of the threshold effect by distinguishing rapidly-growing banks from slowly-growing banks may help one understand the mechanics behind these findings better. For this purpose, we split the sample into rapidly-growing banks and slowly-growing banks and compare their behavior. Table 4 shows the results of this exercise.

[10] Alternatively, the trend can be estimated over the entire sample period, as in Mendoza and Terrones (2008). However, this approach has two drawbacks. First, it is sensitive to start and end points. Second, it makes use of information not available at the time of the boom, and hence, is more difficult to utilize from a policy point of view.

The negative impact of credit growth on bank soundness is statistically significant only during credit booms and for banks expanding faster than the average bank in the country in a given year (Table 4, Column 2 compared to Table 4, Columns 4, 6, and 8). Furthermore, it is only the slowly-growing banks during non-boom periods that have a statistically significant positive relationship between bank soundness levels and credit growth rates. To put it differently, sounder banks expand their loan portfolio faster than less sound banks when there is no aggregate boom in credit markets and the individual bank's loan growth rate is not excessive. These findings are particularly striking as they suggest that the weaker banks "gamble to survive" in the sense that they extend their loan portfolios by making riskier loans in order to maintain their market share during rapid credit market expansion. This mechanism can explain why financial crises are often preceded by credit booms.

C. Do Risks Depend on Bank Ownership?

For supervisors, an important question is who the banks with more risks are: is it the ones that are under their supervision or those under the supervision of their counterparts in other countries? Table 5 reports the results of the regressions separately for foreign and domestic banks.[11] In line with the results in Table 2, foreign-owned banks seem to be taking on somewhat greater risks than domestic banks as their loan growth is not statistically related to their soundness level (Table 5, Column 3 compared to Table 5, Column 9). This could be reflecting the generally more aggressive strategy of these banks as new-comers in a market. On the other hand, credit growth appears to significantly weaken domestic banks but not foreign banks (Table 5, Column 4 compared to Table 5, Column 10). This may suggest that, even if foreign banks take on more risks through rapid expansion of loan portfolio, they also possess the skills and resources to manage these risks as they tend to have better access to wholesale funding and superior risk management techniques through their parents.[12]

As such, the risks taken by foreign banks may be in line with the soundness level of their parents.[13] Cross-border cooperation in bank supervision, however, is still crucial as foreign banks' accumulation of risks and/or reliance on parent bank resources could generate spillovers.[14]

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[11] Ideally, the foreign bank organization mode, i.e., branch or subsidiary, should be used yet this information is not widely available in the data set.

[12] Aydin (2008) shows that foreign banks in some central and eastern European countries depended on interbank funding to finance their operations during the credit booms in the 2000s, although this was not the case in *all* countries. Moreover, their lending was independent of economic but not financial conditions in the foreign bank's home country.

[13] Igan and Tamirisa (2008) provide evidence that credit growth of foreign banks in a group of central and eastern European countries is statistically linked to distance to default of their parents.

[14] Detailing exact policy measures need to contain risks related to rapid credit growth is beyond the scope of the analysis presented here. For a discussion of policy options, see Hilbers and others (2005).

IV. CONCLUDING REMARKS

This study explores the risks posed by rapid credit growth recognizing the two-way causality between credit growth and bank soundness. In doing so, we bring together macro-level studies examining the drivers of credit growth and micro-level analyses focusing on the impact of credit growth on bank soundness. Additionally, the paper separately analyzes the relationship between credit growth and bank soundness during booms and non-boom periods, shedding light on why financial crises tend to be preceded by credit booms.

We show that rapid credit growth during the last decade weakened banks and it became less dependent on bank soundness—an effect that is most pronounced in banks that are growing particularly fast and during overall boom episodes in credit markets. Foreign banks also seemed willing to take on greater risks than domestic banks, suggesting that cross-border spillovers may be an issue. At the end, it appears to be essentially the rapid growth of weak banks during booms that drives the process linking credit booms to financial instability episodes. That is, a shift to more credit being provided by banks with less sound fundamentals begets crises.

The finding of higher risks at the higher end of the spectrum confirms the intuitive belief of many bank supervisors and policymakers that the faster is credit growth, the higher are the risks of macroeconomic and financial instability. In line with the findings reported here, the countries that had higher growth rates, such as Latvia and Bulgaria, have been caught in a much more vulnerable state than others during the recent financial crisis.

Appendix I. Distance to Default Measures

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 stock markets (of which arguably many exist in our sample of countries), this paper mainly uses a simpler annual measure of DD based only on balance sheet and income statement data.[15] 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 to obtain a sufficiently long-term view on the risks faced by a given bank.

There may be several shortcomings associated with the DD measure. First, as DD depends on the average return to assets, aggressive banks that expand their portfolios may appear to be sounder than they actually are. Second, DD is likely to perform better in countries where bank stocks are actively traded and the market value of equity reflects the investors' perceptions about bank risks. Finally, the assumption of normal returns may not reflect reality in full as bank returns may be skewed.

[15] 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 March 2007 version of the IMF's *International Financial Statistics*. Bank-level data were downloaded from the March 2007 version of BankScope[16] 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 data on bank ownership from various sources, such as *Euromoney* and banks' websites.

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 2002–05 were first downloaded using the March 2007 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, non-ranked 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 re-ranked to ensure that they were included in the data set, and the post-merger banks were de-ranked 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.

Excluding outliers. To ensure that the analysis is not affected by potential measurement errors and misreporting, 5 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 2005, the most recent

[16] 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).

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, 2004, and 2005.

Appendix Table. List of Countries in the Sample

	Observations	Region	World Bank classification		Observations	Region	World Bank classification
Algeria	32	North Africa	Upper middle income	Lebanon	568	Middle East	Upper middle income
Argentina	891	Latin America	Upper middle income	Lithuania	107	Eastern Europe	Upper middle income
Australia	299	Pacific	High income: OECD	Luxembourg	1,173	Western Europe	High income: OECD
Austria	1,546	Western Europe	High income: OECD	Malaysia	377	East Asia	Upper middle income
Bangladesh	268	South Asia	Low income	Malta	68	Western Europe	High income: non-OECD
Belgium	697	Western Europe	High income: OECD	Mauritius	74	Sub-Saharan Africa	Upper middle income
Bolivia	137	Latin America	Lower middle income	Mexico	421	Latin America	Upper middle income
Brazil	1,422	Latin America	Upper middle income	Morocco	118	North Africa	Lower middle income
Bulgaria	211	Eastern Europe	Upper middle income	Nepal	92	South Asia	Low income
Canada	507	North America	High income: OECD	Netherlands	502	Western Europe	High income: OECD
Chile	290	Latin America	Upper middle income	New Zealand	86	Pacific	High income: OECD
China	342	East Asia	Lower middle income	Nigeria	391	Sub-Saharan Africa	Lower middle income
Colombia	308	Latin America	Upper middle income	Norway	442	Western Europe	High income: OECD
Costa Rica	234	Latin America	Upper middle income	Oman	91	Middle East	High income: non-OECD
Croatia	344	Eastern Europe	High income: non-OECD	Pakistan	229	South Asia	Lower middle income
Cyprus	154	Eastern Europe	High income: non-OECD	Panama	623	Latin America	Upper middle income
Czech Republic	249	Eastern Europe	High income: OECD	Papua New Guinea	39	Pacific	Lower middle income
Denmark	1,021	Western Europe	High income: OECD	Paraguay	200	Latin America	Lower middle income
Dominican Republic	225	Caribbean	Upper middle income	Peru	182	Latin America	Upper middle income
Ecuador	250	Latin America	Lower middle income	Philippines	343	East Asia	Lower middle income
Egypt	326	North Africa	Lower middle income	Poland	442	Eastern Europe	Upper middle income
El Salvador	152	Latin America	Lower middle income	Portugal	335	Western Europe	High income: OECD
Estonia	47	Eastern Europe	High income: non-OECD	Romania	235	Eastern Europe	Upper middle income
Finland	104	Western Europe	High income: OECD	Russia	977	Eastern Europe	Upper middle income
France	3,244	Western Europe	High income: OECD	Saudi Arabia	104	Middle East	High income: non-OECD
Germany	18,703	Western Europe	High income: OECD	Singapore	152	East Asia	High income: non-OECD
Greece	180	Western Europe	High income: OECD	Slovak Republic	177	Eastern Europe	High income: OECD
Guatemala	338	Latin America	Lower middle income	Slovenia	199	Eastern Europe	High income: non-OECD
Honduras	178	Latin America	Lower middle income	South Africa	309	Sub-Saharan Africa	Upper middle income
Hong Kong	453	East Asia	High income: non-OECD	Spain	1,641	Western Europe	High income: OECD
Hungary	270	Eastern Europe	High income: OECD	Sri Lanka	91	South Asia	Lower middle income
Iceland	76	Western Europe	High income: OECD	Sweden	632	Western Europe	High income: OECD
India	751	South Asia	Lower middle income	Switzerland	2,196	Western Europe	High income: OECD
Indonesia	631	East Asia	Lower middle income	Thailand	180	East Asia	Lower middle income
Ireland	372	Western Europe	High income: OECD	Tunisia	139	North Africa	Lower middle income
Israel	197	Middle East	High income: non-OECD	Turkey	386	Eastern Europe	Upper middle income
Italy	6,021	Western Europe	High income: OECD	Ukraine	278	Eastern Europe	Lower middle income
Jamaica	108	Caribbean	Upper middle income	United Arab Emirates	197	Middle East	High income: non-OECD
Japan	5,076	East Asia	High income: OECD	United Kingdom	2,048	Western Europe	High income: OECD
Jordan	130	Middle East	Lower middle income	Uruguay	283	Latin America	Upper middle income
Kazakhstan	167	Central Asia	Upper middle income	USA	7,112	North America	High income: OECD
Kenya	315	Sub-Saharan Africa	Low income	Venezuela	400	Latin America	Upper middle income
Korea	197	East Asia	High income: OECD	Vietnam	182	East Asia	Low income
Kuwait	83	Middle East	High income: non-OECD	Zambia	90	Sub-Saharan Africa	Low income
Latvia	227	Eastern Europe	Upper middle income	Zimbabwe	105	Sub-Saharan Africa	Low income

Table 1a. Summary Statistics: Bank-Level Variables

	All countries			High income: OECD			High income: non-OECD			Upper middle income			Lower middle income			Low income		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Bank-level variables																		
1995-2005																		
Credit growth	49422	7.42	139.51	37710	5.52	156.42	1421	11.63	28.96	5788	14.59	74.00	3730	11.59	34.99	773	18.61	37.86
Distance to default	49422	18.53	22.29	37710	21.09	23.75	1421	14.82	17.31	5788	8.59	11.70	3730	11.06	15.11	773	10.54	12.09
Net interest margin	47819	0.04	0.16	36385	0.03	0.02	1245	0.04	0.02	5758	0.07	0.09	3697	0.04	0.56	734	0.06	0.06
Cost-to-income ratio	48639	66.94	38.90	37267	67.57	29.96	1253	56.52	38.67	5717	70.28	67.93	3666	61.67	54.35	736	53.36	29.00
Liquidity ratio	45092	0.23	0.18	36329	0.22	0.17	1175	0.22	0.18	3734	0.30	0.21	3322	0.29	0.17	532	0.31	0.17
Size	49422	6.77	1.83	37710	6.92	1.80	1421	7.12	1.95	5788	6.14	1.80	3730	6.51	1.89	773	5.14	1.23
Foreign ownership	49420	12.30	31.75	37709	8.43	27.29	1421	20.51	36.29	5787	33.58	45.45	3730	14.62	32.08	773	15.55	31.38
Public ownership	49420	3.69	17.70	37709	1.02	9.49	1421	11.40	26.50	5787	8.09	25.96	3730	19.26	37.03	773	11.78	29.06
1995-2000																		
Credit growth	25090	4.70	29.34	19497	3.15	25.37	741	8.31	28.61	2724	12.78	45.16	1794	6.78	35.69	334	10.36	32.56
Distance to default	25090	7.15	13.69	19497	8.07	14.81	741	5.82	10.42	2724	3.26	6.48	1794	4.06	8.51	334	4.69	7.87
Net interest margin	23828	0.04	0.04	18400	0.03	0.02	639	0.04	0.03	2711	0.07	0.09	1770	0.05	0.05	308	0.05	0.05
Cost-to-income ratio	24629	65.50	40.12	19234	66.05	28.75	639	57.59	46.57	2690	68.07	72.62	1756	60.05	66.35	310	56.06	30.96
Liquidity ratio	22691	0.23	0.18	18455	0.22	0.18	620	0.24	0.17	1755	0.31	0.22	1619	0.30	0.17	242	0.31	0.16
Size	25090	6.69	1.82	19497	6.84	1.81	741	6.85	1.91	2724	6.06	1.70	1794	6.28	1.76	334	4.84	1.17
Foreign ownership	25090	12.25	31.62	19497	8.77	27.72	741	19.01	35.34	2724	33.49	45.19	1794	14.28	31.56	334	16.19	31.14
Public ownership	25090	4.24	18.98	19497	1.41	11.13	741	12.48	28.26	2724	10.16	28.86	1794	20.98	38.30	334	12.86	30.36
2001-2005																		
Credit growth	24332	10.22	196.54	18213	8.05	223.52	680	15.24	28.93	3064	16.19	92.35	1936	16.06	33.72	439	24.88	40.36
Distance to default	24332	30.26	23.33	18213	35.04	23.60	680	24.64	17.98	3064	13.33	13.17	1936	17.56	16.88	439	14.99	12.83
Net interest margin	23991	0.03	0.22	17985	0.03	0.02	606	0.03	0.02	3047	0.07	0.09	1927	0.03	0.77	426	0.06	0.07
Cost-to-income ratio	24010	68.43	37.56	18033	69.19	31.12	614	55.41	28.20	3027	72.25	63.42	1910	63.15	40.24	426	51.39	27.36
Liquidity ratio	22401	0.23	0.18	17874	0.21	0.17	555	0.20	0.18	1979	0.30	0.21	1703	0.27	0.17	290	0.30	0.19
Size	24332	6.87	1.84	18213	7.00	1.78	680	7.41	1.95	3064	6.21	1.88	1936	6.73	1.98	439	5.37	1.23
Foreign ownership	24330	12.36	31.88	18212	8.07	26.82	680	22.15	37.25	3063	33.67	45.68	1936	14.93	32.55	439	15.06	31.59
Public ownership	24330	3.13	16.24	18212	0.61	7.31	680	10.23	24.41	3063	6.25	22.92	1936	17.68	35.74	439	10.96	28.03

Sources: BankScope, IMF *International Financial Statistics*.

Notes: Data cover 90 countries in total (See appendix for a full list of countries). Bank-level variables are calculated using data from BankScope. Credit growth is the percent change in total loans. Distance to default shows the number of standard deviations by which return on assets should fall to completely deplete equity. The data set is trimmed of potential outliers by dropping 5 percent of the observations on the tails of the distributions of these two main variables (bank-level credit growth and distance to default). Net interest margin is interest income less interest expense divided by average earning assets. Size is calculated as the logarithm of total assets. Foreign (public) ownership is the percent of equity held by foreign (public) entities. Country-level variables are calculated using data from IMF *International Financial Statistics*. Credit boom is an indicator variable that takes on the value of 1 if the deviation of credit-to-GDP ratio from the backward-looking, country-specific, cubic time trend exceeds 1.5 times the historical standard deviation and the growth rate of credit-to-GDP ratio is greater than 10 percent or the growth rate of credit-to-GDP ratio is greater than 20 percent. The five groups of countries are based on the World Bank classification.

Table 1b. Summary Statistics: Country-Level Variables

	All countries			High income: OECD			High income: non-OECD			Upper middle income			Lower middle income			Low income		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Country-level variables																		
1995-2005																		
Credit growth	985	20.86	359.23	297	8.99	21.68	132	11.13	11.67	275	50.37	678.91	220	8.00	25.49	61	13.04	30.88
Credit boom	985	0.13	0.34	297	0.08	0.27	132	0.16	0.37	275	0.18	0.39	220	0.11	0.32	61	0.18	0.39
Real GDP growth	990	3.90	6.19	297	3.25	2.82	132	5.92	7.30	275	4.25	6.32	220	3.30	7.97	66	3.31	6.69
Real interest rate	690	11.46	14.07	201	5.46	4.03	91	5.98	3.74	192	17.98	17.77	163	11.90	11.96	43	20.32	25.26
Real depreciation	607	0.85	14.44	184	-0.75	10.30	91	0.07	6.00	157	0.87	16.71	138	2.20	13.64	37	5.67	30.30
GDP per capita	990	109.21	126.21	297	256.22	120.03	132	143.41	68.11	275	36.42	15.46	220	12.59	6.10	66	4.54	3.05
Credit-to-GDP ratio	985	56.98	42.16	297	90.29	40.26	132	68.76	40.16	275	34.68	30.10	220	42.44	29.97	61	22.33	12.08
1995-2000																		
Credit growth	540	30.25	484.92	162	9.89	25.40	72	11.15	11.21	150	81.86	919.23	120	8.86	32.51	36	16.43	36.66
Credit boom	540	0.13	0.34	162	0.09	0.28	72	0.18	0.39	150	0.13	0.34	120	0.13	0.34	36	0.22	0.42
Real GDP growth	540	3.37	6.78	162	3.78	3.20	72	5.71	7.34	150	3.07	6.48	120	1.68	9.63	36	3.69	6.00
Real interest rate	336	14.29	14.82	110	6.53	4.58	43	7.92	4.11	89	24.32	19.09	75	16.72	15.69	19	17.06	11.43
Real depreciation	276	3.63	11.64	85	5.95	7.76	41	2.07	4.73	74	0.29	10.22	62	4.73	17.92	14	6.82	13.90
GDP per capita	540	106.17	121.78	162	246.49	114.51	72	142.91	74.32	150	36.25	16.98	120	12.70	6.17	36	4.20	1.50
Credit-to-GDP ratio	540	52.78	40.43	162	81.07	38.60	72	64.69	41.61	150	32.80	30.83	120	42.41	32.01	36	19.53	7.87
2001-2005																		
Credit growth	445	9.46	17.29	135	7.92	16.14	60	11.11	12.29	125	12.58	22.19	100	6.96	12.81	25	8.17	19.55
Credit boom	445	0.13	0.34	135	0.07	0.26	60	0.13	0.34	125	0.24	0.43	100	0.09	0.29	25	0.12	0.33
Real GDP growth	450	4.54	5.32	135	2.62	2.13	60	6.17	7.30	125	5.67	5.82	100	5.26	4.69	30	2.85	7.51
Real interest rate	354	8.77	12.77	91	4.17	2.77	48	4.24	2.27	103	12.50	14.54	88	7.79	4.47	24	22.89	32.36
Real depreciation	331	-1.46	16.07	99	-6.51	8.61	50	-1.57	6.46	83	1.40	20.92	76	0.13	8.30	23	4.97	37.24
GDP per capita	450	112.85	131.37	135	267.90	125.76	60	144.01	60.43	125	36.63	13.46	100	12.46	6.03	30	4.95	4.22
Credit-to-GDP ratio	445	62.08	43.68	135	101.35	39.54	60	73.64	38.12	125	36.93	29.15	100	42.47	27.49	25	26.36	15.67

Sources: BankScope, IMF *International Financial Statistics*.

Notes: Data cover 90 countries in total (See appendix for a full list of countries). Bank-level variables are calculated using data from BankScope. Credit growth is the percent change in total loans. Distance to default shows the number of standard deviations by which return on assets should fall to completely deplete equity. The data set is trimmed of potential outliers by dropping 5 percent of the observations on the tails of the distributions of these two main variables (bank-level credit growth and distance to default). Net interest margin is interest income less interest expense divided by average earning assets. Size is calculated as the logarithm of total assets. Foreign (public) ownership is the percent of equity held by foreign (public) entities. Country-level variables are calculated using data from IMF *International Financial Statistics*. Credit boom is an indicator variable that takes on the value of 1 if the deviation of credit-to-GDP ratio from the backward-looking, country-specific, cubic time trend exceeds 1.5 times the historical standard deviation and the growth rate of credit-to-GDP ratio is greater than 10 percent or the growth rate of credit-to-GDP ratio is greater than 20 percent. The five groups of countries are based on the World Bank classification.

Table 2. Baseline Regression Results

	1995-2005		1995-2000		2001-2005	
	Equation 1: Credit Growth (1)	Equation 2: Bank Soundness (2)	Equation 1: Credit Growth (3)	Equation 2: Bank Soundness (4)	Equation 1: Credit Growth (5)	Equation 2: Bank Soundness (6)
Credit growth	0.067**	-0.017	0.627***	-0.122***	-0.001	-0.003
	[0.032]	[0.011]	[0.105]	[0.047]	[0.033]	[0.005]
Distance to default	0.091***	0.951***	0.254***	0.847***	0.018*	0.987***
	[0.007]	[0.002]	[0.065]	[0.029]	[0.010]	[0.002]
Real GDP growth	0.688***		1.168***		0.234**	
	[0.062]		[0.085]		[0.092]	
GDP per capita	-0.038***	0.003***	-0.010***	0.002*	-0.057***	0.002***
	[0.002]	[0.001]	[0.003]	[0.001]	[0.003]	[0.0003]
Net interest margin	31.43***		28.05***		33.29***	
	[4.448]		[9.103]		[5.000]	
Real interest rate	-0.203***		0.104**		-0.347***	
	[0.029]		[0.041]		[0.044]	
Real depreciation	-0.069***		0.185***		-0.227***	
	[0.016]		[0.025]		[0.022]	
Public ownership	-0.062***		-0.049***		-0.062***	
	[0.011]		[0.014]		[0.016]	
Liquidity ratio		1.014***		1.800***		0.198
		[0.333]		[0.598]		[0.232]
Size		-0.165***		-0.374***		0.061***
		[0.032]		[0.061]		[0.021]
Foreign ownership		-0.016***		-0.031***		0.000
		[0.002]		[0.004]		[0.001]
Constant	13.68***	2.958***	-0.570	5.566***	23.61***	-0.125
	[0.780]	[0.276]	[1.195]	[0.512]	[1.053]	[0.188]
Observations	28409	28409	14138	14138	14271	14271
R-squared	0.39	0.85	0.25	0.71	0.59	0.96

Notes: Robust standard errors are in brackets; *** denotes significance at 1 percent, ** denotes significance at 5 percent, and * denotes significance at 10 percent. Regressions are estimated by 3SLS in a two-equation system. The dependent variable in the first equation is annual percentage change in outstanding loans. The dependent variable in the second equation is distance to default. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year.

Table 3. Regression Results: Boom Effect

	Boom						Non-Boom					
	1995-2005		1995-2000		2001-2005		1995-2005		1995-2000		2001-2005	
	Equation 1: Credit Growth (1)	Equation 2: Bank Soundness (2)	Equation 1: Credit Growth (3)	Equation 2: Bank Soundness (4)	Equation 1: Credit Growth (5)	Equation 2: Bank Soundness (6)	Equation 1: Credit Growth (7)	Equation 2: Bank Soundness (8)	Equation 1: Credit Growth (9)	Equation 2: Bank Soundness (10)	Equation 1: Credit Growth (11)	Equation 2: Bank Soundness (12)
Credit growth	0.032**	-0.605**	0.031**	-0.632*	0.087**	-0.289	0.063**	-0.015	0.601***	-0.111**	-0.002	-0.003
	[0.013]	[0.271]	[0.013]	[0.364]	[0.035]	[0.312]	[0.032]	[0.011]	[0.104]	[0.048]	[0.032]	[0.005]
Distance to default	0.056	0.951***	1.014*	0.897***	-0.167	0.970***	0.088***	0.951***	0.248***	0.849***	0.021**	0.987***
	[0.085]	[0.017]	[0.578]	[0.159]	[0.118]	[0.012]	[0.007]	[0.002]	[0.065]	[0.029]	[0.009]	[0.002]
Real GDP growth	2.659***		3.419***		1.915***		0.554***		1.029***		0.094	
	[0.328]		[0.471]		[0.452]		[0.063]		[0.087]		[0.096]	
GDP per capita	-0.082***	0.023***	-0.015	0.033***	-0.087***	0.003	-0.036***	0.002***	-0.011***	0.000	-0.054***	0.002***
	[0.012]	[0.002]	[0.016]	[0.003]	[0.028]	[0.003]	[0.002]	[0.001]	[0.003]	[0.001]	[0.003]	[0.000]
Net interest margin	51.42**		-47.86		49.09		32.96***		37.97***		33.27***	
	[24.67]		[50.47]		[30.68]		[4.514]		[9.242]		[5.052]	
Real interest rate	-0.791***		0.196		-1.003***		-0.190***		0.067		-0.300***	
	[0.170]		[0.250]		[0.246]		[0.300]		[0.041]		[0.045]	
Real depreciation	0.0331		-0.007		0.576**		-0.070***		0.192***		-0.243***	
	[0.141]		[0.203]		[0.239]		[0.016]		[0.025]		[0.022]	
Public ownership	-0.053		-0.047		-0.169**		-0.062***		-0.051***		-0.052***	
	[0.048]		[0.057]		[0.080]		[0.011]		[0.014]		[0.016]	
Liquidity ratio		-2.403*		-5.320***		2.051*		1.205***		2.317***		0.131
		[1.333]		[1.943]		[1.212]		[0.343]		[0.622]		[0.237]
Size		-0.380***		-0.600***		-0.025		-0.150***		-0.358***		0.062***
		[0.132]		[0.195]		[0.119]		[0.033]		[0.063]		[0.021]
Foreign ownership		0.001		0.017		-0.009		-0.018***		-0.033***		0.000
		[0.008]		[0.014]		[0.006]		[0.002]		[0.004]		[0.001]
Constant	6.785	2.692**	-16.69**	2.840*	23.56***	0.468	13.58***	3.046***	0.343	5.778***	22.87***	-0.124
	[4.732]	[1.064]	[7.297]	[1.560]	[6.850]	[0.935]	[0.796]	[0.286]	[1.213]	[0.534]	[1.080]	[0.194]
Observations	1095	1095	684	684	411	411	27287	27287	13454	13454	13833	13833
R-squared	0.13	0.75	0.11	0.20	0.13	0.95	0.04	0.85	0.23	0.72	0.52	0.97

Notes: Robust standard errors are in brackets; *** denotes significance at 1 percent, ** denotes significance at 5 percent, and * denotes significance at 10 percent. Regressions are estimated by 3SLS in a two-equation system. The dependent variable in the first equation is annual percentage change in outstanding loans. The dependent variable in the second equation is distance to default. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year. Columns (1) to (6) show regression results during credit booms, columns (7) to (12) show regressions results during periods of moderate aggregate credit growth. Credit booms are identified as the years during which the deviation of credit-to-GDP ratio from the backward-looking, country-specific, cubic time trend exceeds 1.5 times the historical standard deviation and the growth rate of credit-to-GDP ratio is greater than 10 percent or the growth rate of credit-to-GDP ratio is greater than 20 percent.

Table 4. Regression Results: Rapid Bank Effect

	Rapid, Boom		Rapid, Non-Boom		Slow, Boom		Slow, Non-Boom	
	1995-2005		1995-2005		1995-2005		1995-2005	
	Equation 1: Credit Growth (1)	Equation 2: Bank Soundness (2)	Equation 1: Credit Growth (3)	Equation 2: Bank Soundness (4)	Equation 1: Credit Growth (5)	Equation 2: Bank Soundness (6)	Equation 1: Credit Growth (7)	Equation 2: Bank Soundness (8)
Credit growth	0.087***	-0.012**	0.214***	-0.012	0.984	-0.474	-0.021	-0.017
	[0.023]	[0.005]	[0.058]	[0.014]	[1.040]	[0.312]	[0.024]	[0.015]
Distance to default	-0.201	0.924***	-0.083***	0.979***	0.092	0.960***	0.087***	0.941***
	[0.153]	[0.034]	[0.013]	[0.003]	[0.066]	[0.020]	[0.006]	[0.004]
Real GDP growth	-0.117		1.771***		1.950***		1.058***	
	[0.487]		[0.117]		[0.282]		[0.051]	
GDP per capita	-0.119***	0.028***	0.0158***	0.001	-0.007	0.022***	-0.008***	0.002***
	[0.020]	[0.004]	[0.004]	[0.001]	[0.010]	[0.003]	[0.002]	[0.001]
Net interest margin	50.02*		22.80***		-77.67***		35.12***	
	[29.95]		[6.794]		[24.30]		[3.912]	
Real interest rate	-0.110		1.171***		-0.479***		-0.078***	
	[0.252]		[0.062]		[0.144]		[0.023]	
Real depreciation	-0.512**		-0.294***		-0.381***		-0.079***	
	[0.253]		[0.028]		[0.114]		[0.013]	
Public ownership	-0.193**		-0.014		0.033		-0.015*	
	[0.077]		[0.021]		[0.039]		[0.008]	
Liquidity ratio		2.565		0.147		-4.515***		1.868***
		[2.209]		[0.406]		[1.642]		[0.474]
Size		-0.211		-0.039		-0.488***		-0.193***
		[0.267]		[0.038]		[0.152]		[0.046]
Foreign ownership		-0.005		-0.006**		0.003		-0.025***
		[0.013]		[0.003]		[0.010]		[0.003]
Constant	46.80***	0.836	18.14***	1.327***	-9.279**	3.780***	-6.363***	3.889***
	[8.094]	[1.963]	[1.442]	[0.338]	[3.936]	[1.273]	[0.631]	[0.395]
Observations	284	284	9429	9429	811	811	17858	17858
R-squared	0.26	0.72	0.11	0.94	0.16	0.76	0.06	0.81

Notes: Robust standard errors are in brackets; *** denotes significance at 1 percent, ** denotes significance at 5 percent, and * denotes significance at 10 percent. Regressions are estimated by 3SLS in a two-equation system. The dependent variable in the first equation is annual percentage change in outstanding loans. The dependent variable in the second equation is distance to default. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year. Columns (1), (2), (5), (6) show regression results during credit booms, columns (3), (4), (7), (8) show regressions results during periods of moderate aggregate credit growth. Credit booms are identified as the years during which the deviation of credit-to-GDP ratio from the backward-looking, country-specific, cubic time trend exceeds 1.5 times the historical standard deviation and the growth rate of credit-to-GDP ratio is greater than 10 percent or the growth rate of credit-to-GDP ratio is greater than 20 percent. Columns (1) to (4) show results for rapidly-growing banks, defined as those with loan growth exceeding the average in a particular country in a particular year. Columns (5) to (8) show results for slowly-growing banks, defined as those with loan growth below the average in a particular country in a particular year.

Table 5. Regression Results: Ownership Effect

	Foreign						Domestic					
	1995-2005		1995-2000		2001-2005		1995-2005		1995-2000		2001-2005	
	Equation 1: Credit Growth (1)	Equation 2: Bank Soundness (2)	Equation 1: Credit Growth (3)	Equation 2: Bank Soundness (4)	Equation 1: Credit Growth (5)	Equation 2: Bank Soundness (6)	Equation 1: Credit Growth (7)	Equation 2: Bank Soundness (8)	Equation 1: Credit Growth (9)	Equation 2: Bank Soundness (10)	Equation 1: Credit Growth (11)	Equation 2: Bank Soundness (12)
Credit growth	-0.141	-0.009	0.019***	-0.050	-0.240**	-0.008	0.120***	-0.019	0.458***	-0.131**	0.069**	-0.003
	[0.110]	[0.014]	[0.005]	[0.051]	[0.116]	[0.017]	[0.033]	[0.013]	[0.104]	[0.052]	[0.034]	[0.006]
Distance to default	0.113**	0.961***	0.760	0.890***	0.068	0.945***	0.093***	0.950***	0.276***	0.843***	0.013	0.988***
	[0.057]	[0.007]	[0.526]	[0.058]	[0.079]	[0.011]	[0.707]	[0.003]	[0.062]	[0.031]	[0.009]	[0.002]
Real GDP growth	1.375***		1.596***		0.887**		0.517***		1.067***		0.066	
	[0.250]		[0.330]		[0.394]		[0.063]		[0.087]		[0.092]	
GDP per capita	-0.007	-0.002**	-0.005	-0.001*	-0.001	-0.0002	-0.046***	0.004***	-0.010***	0.002**	-0.067***	0.003***
	[0.006]	[0.001]	[0.009]	[0.001]	[0.011]	[0.002]	[0.002]	[0.001]	[0.003]	[0.001]	[0.003]	[0.001]
Net interest margin	9.505		-1.325		18.36		38.47***		40.13***		37.76***	
	[19.86]		[30.49]		[26.62]		[4.411]		[9.526]		[4.840]	
Real interest rate	0.008		0.291**		-0.142		-0.233***		0.066		-0.276***	
	[0.094]		[0.145]		[0.135]		[0.032]		[0.042]		[0.053]	
Real depreciation	-0.264***		-0.125		-0.402***		-0.038**		0.261***		-0.193***	
	[0.071]		[0.087]		[0.131]		[0.016]		[0.026]		[0.021]	
Public ownership	0.095		-0.064		0.337		-0.070***		-0.041***		-0.086***	
	[0.194]		[0.259]		[0.287]		[0.010]		[0.013]		[0.015]	
Liquidity ratio		1.642***		1.671***		1.971**		1.024***		1.980***		-0.145
		[0.453]		[0.526]		[0.774]		[0.383]		[0.697]		[0.245]
Size		0.065		-0.048		0.218**		-0.178***		-0.398***		0.057***
		[0.064]		[0.076]		[0.108]		[0.035]		[0.068]		[0.021]
Foreign ownership		-0.001		-0.013		0.009		-0.020		-0.0316		-0.014
		[0.009]		[0.010]		[0.016]		[0.014]		[0.025]		[0.010]
Constant	4.798*	0.448	1.244	2.308**	3.002	-1.297	15.91***	2.857***	-1.955	5.550***	27.77***	-0.169
	[2.893]	[0.974]	[4.143]	[1.111]	[4.338]	[1.678]	[0.813]	[0.312]	[1.248]	[0.594]	[1.083]	[0.193]
Observations	2570	2570	1429	1429	1141	1141	25839	25839	12709	12709	13130	13130
R-squared	0.32	0.88	0.44	0.16	0.51	0.87	0.47	0.85	0.25	0.61	0.77	0.97

Notes: Robust standard errors are in brackets; *** denotes significance at 1 percent, ** denotes significance at 5 percent, and * denotes significance at 10 percent. Regressions are estimated by 3SLS in a two-equation system. The dependent variable in the first equation is annual percentage change in outstanding loans. The dependent variable in the second equation is distance to default. All variables, except foreign and public ownership, on the right-hand side of both equations are lagged by one year. Columns (1) to (6) show regression results for foreign banks, columns (7) to (12) show regressions results for domestic banks. A bank is treated as foreign (domestic) when the equity share of foreigners (domestic investors) exceed 50 percent.

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