Cross-Border Banking and the International Transmission of Financial Distress during the Crisis of 2007-2008*

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Abstract

We study the effect of financial distress in foreign parent banks on local SME financing in 14 central and eastern European countries during the early stages of the 2007-2008 financial crisis. We use survey data on 9,360 applicant and non-applicant firms that enable us to disentangle effects driven by shocks to the banking system from recession-driven demand shocks that may vary across lenders. We find strong evidence that new bank lending tightened in the relatively early stages of the crises caused by the following types of bank financial distress: 1) low equity ratio; 2) low Tier 1 capital ratio; and 3) losses on financial assets. We also find that the size of the transmission of such shocks to Main Street increases with the degree of foreign bank presence. The observed decline in credit is greater among riskier firms and firms with fewer tangible assets.

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1 Introduction

The increasing integration of the European banking industry offers the prospect of important gains in terms of efficiency and diversification, but it also creates potential risks. One such risk is associated with the possibility that a shock to a cross-border bank's capital will result in a reduction in lending to firms and consumers in an economic environment that is uncorrelated with the origins of that shock. Given the size and penetration of a number of west European and U.S. banks in central and eastern Europe, their financial distress associated with the meltdown of subprime mortgages and securitized products in 2007 and 2008 and the run on banks by short-term creditors, counterparties, and borrowers concerned about the liquidity and solvency of the banking sector[1], may have led to such a realization.[2] The goal of this paper is to put this hypothesis to the test.

We investigate one key mechanism through which foreign financial distress may have been transmitted to local economic conditions, namely the supply of credit to small and medium enterprises. SMEs dominate the corporate landscape in central and eastern Europe, comprising up to 99% of all firms. Moreover, because of their opacity SMEs may be particularly vulnerable to contractions in the supply of credit. With this high dependency on the SME sector and with immature capital markets, banks are by far the main provider of funds for capital investment and expansion. An important feature of the central and eastern European banking market is its ownership structure. In particular, foreign ownership in the banking sector has grown so dramatically in the recent decade, that by 2008 foreign banks controlled around 80% of the assets in the region's banking industry.[3] The serious financial distress of pan-European banks like Erste, KBC, and Societe Gen-

[1]See Brunnermeier (2009), Gorton (2009), and Ivashina and Scharfstein (2009) for a timeline of the 2007-2008 global financial crisis. See Table 1 for developments concerning the financial sector in the countries covered by this paper.

[2]Signs of the negative effects of the global financial crisis on business firms in emerging Europe through the channel of bank lending were seen as early as the Fall of 2007. For instance, in October, the EBRD's chief economist Erik Berglof warned that "the crisis in the West will be a serious one which will last for some time and this means it will definitely have an impact on our countries [...] due to the difficulties and higher costs associated with obtaining credit" (EBRD (2007)). The euro zone Bank Lending Survey indicated that euro zone banks started tightening lending standards in Q3:2007 (ECB (2008)).

[3]For summaries of the literature on the motivations for foreign entry into banking markets and the relative performance/behavior of foreign versus domestic banks (including behavior in credit markets) see Degryse, Havrylchyrk, Jurzyk, and Kozak (2010) and Berger, DeYoung, Genay, and Udell (2000).

erale since 2007 stemming from economic circumstances unrelated to their operation in central and eastern Europe provides a natural experiment to study the channels through which the effects of the financial crisis that started in the U.S. spread through out the global economy.

Our key data come from a survey of a large group of SMEs in emerging Europe administered in April 2005 and April 2008. The data allow us to directly observe firms whose loan application was turned down over the course of the previous year, or which were discouraged from applying for bank credit by high rates and unfavorable collateral requirements. While we do not observe the bank which granted/denied the loan, we observe the extent of the operations of all banks present in the firm's city of incorporation. By using balance sheet data on the parent banks, foreign or domestic, we construct an index of financial distress at the level of each locality in 14 countries in the region, which we then map into data on loan rejection rates. The final data consist of $9,360$ firms in $1,803$ localities served by a total of 141 banks over the 2005-2008 period. The majority of localities, however, are served by just a handful of banks, with the degree of foreign ownership of those varying by both country and locality. This allows us to answer two important questions: 1) did banks transmit their financial distress by shrinking loans to business customers issued by their branches and subsidiaries in the early stages of the 2007–2008 crisis?, and 2) did foreign banks transmit to the corporate sector a larger share of their respective financial troubles than domestic banks?

The classic problem with identifying a credit crunch is that firms' demand shifts during a credit crunch following the deterioration of firms' balance sheets. This would not be an issue if we were studying the cross-border transmission of financial distress into an economic area insulated from that distress through all other channels but the bank lending channel. As the sub-prime mortgage crisis was associated since its very beginning with the expectations of a global recession, the measured effect of bank loan supply shocks will likely be contaminated by demand shifts. Some studies that identify demand use the decline in loan applications across differentially affected lenders to argue that there haven't been variations in the decrease in demand across lenders. One problem with that identification approach may be limited data availability on loan applications. However, even when one observes the universe of loan applications, applicant firms could be a systematically

truncated sub-sample of all firms: some firms do not apply because they do not need credit, while others do not apply because they are discouraged. Not accounting for discouraged firms results in a poor proxy for credit constraints, especially in the region of central and eastern Europe, where recent studies (Brown, Ongena, Popov, and Yesin (2010)) have shown that the share of firms discouraged from applying is up to twice as large as the share of firms which applied and had their loan application rejected. Then it could well be that for banks negatively affected by the crisis, it is the financially healthy borrowers that are selecting themselves out of the application process (firms that do well during a recession), while for other banks, it is the weak firms that do so, discouraged by news of a contraction in lending. Thus, at different types of banks, non-applicant firms may have systematically different reasons for selecting themselves out of the application process, confounding identification and making it difficult to separate the bank lending from the balance sheet channel.

We overcome this obstacle by employing observable survey information on firms that choose to select themselves out of the bank credit application process, be it because they were discouraged, or because they do not need credit. Thus we are able to account not just for the decrease in firms' demand, but also for the *composition* of firms that account for the decrease in demand. While there is already extensive evidence on the real effects of this financial crisis[4], our paper is the only one we know of which simultaneously 1) studies the international transmission of financial distress, 2) accounts for the changes in the level and composition of loan demand, and 3) is able to construct a proxy for credit constraint based on discouragement as well as on actual rejection. As such, our paper adds to a very scarce literature employing data on the selection process involved in the granting of business loans.[5]

This paper confirms the hypothesis that the contraction of banks' balance sheets caused by losses on financial assets and the deterioration of their equity positions was transmitted cross-border to central and eastern Europe in the relatively early stages of the 2007-2008 crisis. In particular, we find a higher probability of firms' being credit constrained in localities served by

[4]De Haas and van Horen (2009), Huang (2009), Ivashina and Scharfstein (2009), Jimenes, Ongena, Peydro, and Saurina (2009), Puri, Rochol, and Steffen (2009), and Santos (2009) all provide evidence on the credit crunch associated with the 2007-2008 financial crisis.

[5]The very few studies known to us that do so are Cerqueiro (2009), Chakravarty and Yilmazer (2009), and Ongena and Popov (2009).

foreign banks whose parents had 1) a low ratio of equity to total assets, 2) a low Tier 1 capital ratio, and 3) high losses on financial assets, including ABSs and MBSs. The result is strongest and most consistent for equity capital and for Tier 1 capital. The key results hold both when we assume equal access of each firm to all banks present in the firm's locality, or when we weigh access by the branch penetration of each bank. For example, we find that in foreign-dominated markets, a two-standard deviation deterioration in the respective proxy for financial distress results in a between 8% and 13% higher probability of rejection faced by an identical firm. We find that the probability of banks' shrinking their portfolio in response to financial distress, especially low Tier 1 capital ratios, the measure of financial distress that is most consistently associated with credit rationing, increases with the magnitude of foreign bank ownership. Finally, we find that financial distress is transmitted differently across firms and industries, in that firms that are high-risk and firms with fewer tangible assets suffer the most.

Our paper relates to a number of studies that have aimed at identifying the transmission of shocks from banks' balance sheets to lending activity in various economic circumstances. The bank lending channel has been studied extensively (e.g., Kashyap and Stein (2000)), and banks have been found to rely heavily on the use of internal capital markets in order to dampen domestic liquidity shocks (e.g., Stein (1997); Houston, James, and Marcus (1997)). The U.S. credit crunch in 1990-92 spawned a large literature that investigated its causes and its effects (e.g., Bernanke and Lown (1991); Berger and Udell (1994); Peek and Rosengren (1995); Wagster (1996); Hancock and Wilcox (1998)). Banking crises and liquidity shocks elsewhere in the world similarly generated considerable academic attention (e.g., Woo (1999); Kang and Stulz (2000); Hayashi and Prescott (2002); Khwaja and Mian (2008); Paravisini (2008)). Peek and Rosengren (1997) were one of the first to identify the international transmission of financial shocks when they investigated how the collapse of asset prices in Japan during the early 1990s affected the operations of Japanese bank subsidiaries abroad. In particular, they show that the decline in the parents' risk-based capital ratio translated into a significant decline in total loans by the U.S. subsidiaries. Chava and Purnanandam (2009) and Schnabl (2009) use the exogenous shock provided by the Russian crisis of 1998 to study the effect on lending to U.S. and Peruvian borrowers, respectively. Cetorelli and

Goldberg (2008) show that the existence of internal capital markets with foreign bank affiliates contributes to an international propagation of domestic liquidity shocks to lending by affiliated banks abroad. In the context of the financial crisis of 2007-2008, Ivashina and Scharfstein (2010) document that new loans to large borrowers declined by 79% by the end of 2008 relative to the peak of the credit boom (Q2:2007). They analyze the effect that the failure of Lehman Brothers had on the syndicated loan market to identify the reduction in new lending. Jimenez, Ongena, Peydro, and Saurina (2010) use the universe of bank loans by Spanish banks to identify separately the bank lending channel and the balance sheet channel, and find that they dampen each other: more liquid firms are less vulnerable to the contraction of bank lending, and if banks have ample liquidity, the balance sheet channel partially shuts down. Finally, Puri, Rocholl, and Steffen (2010) test the effect of deteriorating balance sheets of German banks hit by the crisis on lending to domestic retail customers. Our paper contributes to this emerging literature by presenting evidence for a cross-border transmission by foreign banks in a large cross-country setting, as well as by incorporating information on discouraged firms in the empirical proxy for credit constraint.

The paper proceeds as follows. Section 2 presents the data. Section 3 describes the empirical methodology and the identification strategy. Section 4 presents the empirical results. Section 5 concludes with the main findings of the paper.

2 Data

The data for our analysis come from three main sources. The core firm level data come from the 2008 version of the Business Environment and Enterprise Performance Survey (BEEPS), administered jointly by the World Bank and the European Bank for Reconstruction and Development. The survey was carried out between March 10th and April 20th 2008 among 12,010 firms from 27 countries in central and eastern Europe and the former Soviet Union. The survey response rate was 36.9%. Surveyees who declined to participate or were unavailable for interviews accounted for 38.3% of the original target group. Firms that were ineligible due to the necessity to fulfill industry quotas and firm size quotas accounted for the remainder. We narrowed that sample down

to the countries that were most relevant in terms of foreign bank penetration. We complement this data with analogical information on 11,399 firms operating in the same countries and localities, derived from the 2005 version of the survey. We reduce the initial sample of 27 countries to a sample of 14 countries for which foreign bank ownership is sufficiently relevant over the period in question. The final sample thus consists of 9,360 firms, observed either in 2005 or in 2008, in the following countries: Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Slovakia, and Slovenia.

The main purpose of the survey is to obtain information from firms about their experience with financial and legal constraints, as well as government corruption. In addition, however, BEEPS also included questions about firm ownership structure, sector of operation, industry structure, export activities, use of external auditing services, subsidies received from central and local governments, etc. Respondent firms come from 6 different sectors: construction; manufacturing (11 sub-sectors); transport; wholesale and retail; IT; and hotels and restaurants. The number of firms covered is roughly proportional to the number of firms in the country, ranging from 260 in Albania to 1,592 in Poland. The survey tried to achieve representativeness in terms of the size of firms it surveyed: between three quarters and nine tenths of the firms surveyed are "small" (less than 100 workers) and only around 5% of the firms surveyed are "large" (more than 500 workers).[6] The survey also aimed to achieve representativeness in terms of private vs. public firms, firms with access to foreign product markets, firms which receive government subsidies, etc. Table 2 provides the summary statistics on the number of firms and their size, ownership, and market characteristics by country. Appendix 1 explains the construction of all firm-level (as well as industry- and country-level) variables in the data.

For the purpose of estimating the effect of the financial crisis on business lending, we focus on the information on credit constraints faced by the firms in the past fiscal year. Question K16 asks: "Did the establishment apply for any loans or lines of credit in fiscal year 2007?"[7] For firms that answered

[6] See http://www.ebrd.com/country/sector/econo/surveys/beeps.htm for further detailed reports on the representativeness of the survey.

[7] Fiscal year 2007 refers to the calender year 2007. However, for tax purposes, in the countries in the sample firms can choose to extend it to March 31, 2008, which is precisely why the Survey was administered in March-April 2008. Given that signs of a credit crunch started emerging right after August 9, 2007, the data gives us at least two and at most three quarters of credit crunch effects potentially experienced by firms.

"No" to K16, Question K17 subsequently asks: "What was the main reason the establishment did not apply for any line of credit or loan in fiscal year 2007?". For firms that answered "Yes" to K16, Question K18a subsequently asks: "In fiscal year 2007, did this establishment apply for any new loans or new credit lines that were rejected?". Firms that answered "No need for a loan" to K17 were classified as firms that do not desire bank credit. Firms that answered "Yes" to K18a or "Interest rates are not favorable", "Collateral requirements are too high", "Size of loan and maturity are insufficient", or "Did not think it would be approved" to K17 were classified as constrained. The latter classification is in line with the unofficial definition by the US Federal Reserve of a credit crunch, i.e., a simultaneous increase in the price and decrease in the availability of credit.[8] This strategy of grouping firms that were turned down and firms that were discouraged from applying is also employed in Cox and Jappelli (1993) and in Duca and Rosenthal (1993), who find that rejected and discouraged borrowers are almost identical on observables, and is fairly standard in studies that rely on detailed questionnaires. Also, it is crucial given our empirical strategy to separate the firms that did not apply for credit because they didn't need it from those that did not apply because they were discouraged. Table 3 presents a summary by country of the shares of firms in need of bank loans and of constrained firms. As the data suggest, while fewer firms needed credit in fiscal year 2007 than in fiscal year 2004 (57% vs. 69%), a larger portion of the firms that needed credit were constrained (37% vs. 33%).

In addition to the information described above, BEEPS contains information on the locality of the operation of each firm. A total of $1,803$ localities are present in the data, for an average of 5.2 firms per locality. That geographic information was then matched with data on bank presence coming from the central banks of the 14 countries involved in the study.[9] Pursuing a trade-off between representativeness and manageability, we narrowed our focus to the banks that comprise at least 85% of the banking sector assets in each country. This gives us a range of between 4 banks in Estonia and 9 banks in Bulgaria. Given this criterion, it was determined that the localities in

[8]The origin can be traced to Bernanke and Lown (1991) who define a credit crunch as a "[...] significant leftward shift in the supply curve for loans, holding constant both the safe real interest rate and the quality of potential borrowers".

[9]The matching was made possible after an extensive research of the web pages of all banks involved. In quite a few cases, information was only available in the respective national language.

the sample were served by a total of 141 banks. Out of those, 26 are domestic banks, and 115 are branches or subsidiaries of 23 foreign banks. There is considerable variation in foreign bank penetration in the sample: in 2008, foreign ownership of banking sector assets ranges from 22.8% in Slovenia to 98.9% in Estonia. Finally, we performed an extensive internet search to determine which of these banks were present in which locality in the sample, and how many branches each had in each locality in which it was present. This allows us to determine not just which bank is present where, but also its market share at the unit of observation of the locality (city).

Next, we used Bankscope to extract balance sheet information on those 141 bank. We collected data from 2005 to 2008 in order to evaluate how the condition of the banks' balance sheets is associated with a potential reduction in credit. We chose our potential explanatory variables in the context of the main issues surrounding the financial crisis of 2007-2008. The bursting of the housing bubble forced banks to write down several hundred billion dollars in bad loans caused by mortgage delinquencies. At the same time, the stock market capitalization of the major banks declined by more than twice that amount. The total loss in financial assets globally is estimated in the trillions of dollars. Central banks around the world pumped hundreds of billions of dollars in short-term liquidity, alongside reducing discount rates at an unprecedented speed, in order to prop up illiquid and likely insolvent banks (Brunnermeier (2009)).

Hence, we focused primarily on banks' capital ratios (Tier 1 and total), equity capital, and gains/loss on financial assets. In the case of foreign ownership, we focused on the financial position of the parent bank in order to study, for example, how the investment allocation of UniCredit Group into MBSs and the loss of capital associated with this allocation affects business lending by international branches and subsidiaries of UniCredit. Table 4 summarizes the main variables of interest which were used in the final empirical tests. There are apparent cross-country differences - for example, in 2008 Latvian banks had a somewhat low average Tier 1 capital ratio (6.55), close to the 4% regulatory requirement, owing to the relative undercapitalization of their parent foreign banks, while Polish banks had an average Tier 1 capital ratio of 9.39, mostly due to the fact that the largest bank in Poland is the well-capitalized domestic bank PKO Bank Polski. Also, the banks present in Macedonia incurred almost no losses on financial assets in 2007-08, while in 2008 the

parents of the banks present in the Czech Republic had an average ratio of gains on financial assets to total assets of -0.12. In general, banks were making on average gains on financial assets in 2005 and losses on financial assets in 2008.

Appendix 2 illustrates the degree of foreign bank penetration in each country in the sample. Clearly, a group of 23 west European and U.S. banks controls the vast majority of assets in the region. These are Erste Group, Hypo Group, Reiffeisen, and Volksbank (Austria), Dexia and KBC (Belgium), Danske Pank (Denmark), Nordea Bank (Finland), Societe Generale (France), Bayerische Landesbank and Commerzbank (Germany), Alpha Bank, EFG Eurobank, Emporiki Bank, National Bank of Greece, and Piraeus Bank (Greece), AIB (Ireland), Intessa San Paolo and UniCredit Group (Italy), ING Bank (Netherlands), Swedbank and Skandinaviska Enskilda Bank (Sweden), and Citibank (U.S.). There is also substantial regional variation in the degree of penetration: for example, the Greek banks operate mostly in south-eastern Europe, the Scandinavian banks in the Baltic countries, and the Austrian banks in central Europe. In addition, there is one domestic "global" bank, the Hungarian OTP, as well as cross-border penetration by, for example, Parex Group - Latvia and Snoras Bank - Lithuania.

3 Empirical methodology and identification

3.1 Main empirical model

We want to estimate the international transmission of financial distress. We hypothesize that banks with a foreign owner are more likely to do so than domestic banks. For example, if bank-firm relationships are particularly strong and important, banks may be reluctant to reduce credit to their long-time domestic customers and shift more of the shock to overseas markets (Peek and Rosengren (1997)).

We first exclude all localities with zero presence by foreign banks in 2008 or 2005 (about 0.4% of the sample). Next, we use the 2008 cross-section data on bank balance sheets, firm characteristics, and credit constraints to check for a "credit crunch" by estimating the following basic model:

$$Y_{ijkl} = \beta_1 \cdot X_{ijkl} + \beta_2 \cdot Finance_{jk} + \beta_3 \cdot D_k + \beta_4 \cdot D_l + \varepsilon_{ijkl} \quad (1)$$

where Y_{ijkl} is a dummy variable equal to 1 if firm i in city j in country k in industry l is credit constrained in fiscal year 2007; X_{ijkl} is a matrix of firm characteristics; $Finance_{jk}$ is the index of bank health in city j in country k; D_k is a matrix of country dummies; D_l is a matrix of industry dummies; and ε_{ijkl} is an idiosyncratic error term. The firm-level co-variates control for observable firm-level heterogeneity. The two sets of dummy variables control for any unobserved market and industry variation. Essentially, they eliminate the contamination of the estimates by sectoral and macroeconomic circumstances, like growth opportunities, common to all firms in the same industry, or taxes, common to all firms in a particular country.

Next, we pool the 2005 and 2008 samples in order to be able to conduct a proper pre-post analysis using the full sample of firms that were observed either in 2007/2008 (the beginning of the financial crisis) or in 2004/2005 (the peak of the credit cycle). We estimate two different models on the pooled data. First, we estimate the model

$$Y_{ijkt} = \beta_1 \cdot X_{ijkt} + \beta_2 \cdot Post \cdot Finance_{jkt} + \beta_3 \cdot Post + \beta_4 \cdot Finance + \beta_5 \cdot D_k + \varepsilon_{ijkt} \quad (2)$$

In this model, we are able to capture the effect of financial distress after the crisis started relative to identical financial distress before the crisis started. We do not include year dummies, as the level effect over time is captured by the variable $Post$, a dummy equal to 1 if the year is 2008. We exclude the industry dummies because industries are classified differently in the two surveys.[10]

Because the above model pools the data for all localities, including such present only in 2005 or only in 2008, we also estimate a model which allows us to compare variations in rejection rates over time of "affected" vs. "non-affected" localities. In particular, we estimate the standard difference-in-difference model

[10]BEEPS 2005 uses a SIC 1-digit classification, while BEEPS 2008 uses a SIC 2-digit classification dominated by manufacturing.

$$Y_{ijkt} = \beta_1 \cdot X_{ijkt} + \beta_2 \cdot Non - Affected \cdot Post + \beta_3 \cdot Non - Affected + \beta_4 \cdot Post + \beta_5 \cdot D_k + \varepsilon_{ijkt} \quad (3)$$

where $Affected$ is a dummy variable equal to 1 if the respective finance variable decreased by at least 1 standard deviation between 2005 and 2008. Consequently, $Non - Affected$ is a dummy variable equal to 1 if the respective finance variable decreased by less than 1 standard deviation between 2005 and 2008.

The main parameter of interest in all three models is β_2, which measures the cross-section effect of financial distress (Models 1), the cross-section effect of financial distress in 2008 relative to 2005 (Model 2), and the effect of a change in financial distress (Model 3) of the banks in each locality on credit access by firms in that locality. As lower values of $Finance$ are associated with bigger bank distress, we expect the sign of β_2 to be negative in all models. We construct our bank distress index by aggregating balance sheet information from Bankscope after determining which banks were present in that locality, and the original ownership of each bank in that locality. The underlying assumption in the absence of a direct match of each loan to the lending bank and of each rejection to the rejecting bank is that if firms were granted/denied credit, then it was most likely the result of interaction with banks in the firms' locality of incorporation. We use two different weighting criteria in constructing the index, namely, giving equal weight to each bank in that particular locality, or weighting each bank's financial position by the number of branches it has in the locality.

Here is an example to clarify the above procedure. There are 4 banks in Estonia that hold close to 100% of the banking assets in the country: Swedbank, SEB, Sampo Pank, and Nordea. They are subsidiaries of Swedbank - Sweden, SEB - Sweden, Danske Pank - Denmark, and Nordea - Finland. In 2008, the 4 parent banks had Tier 1 capital ratios of 8.4, 8.4, 6.9, and 12, respectively. Consider the city Lihula in which only Swedbank has branches. We assign Lihula a Tier 1 capital ratio of 8.4, and then we match the index of financial distress in Lihula with all firms present in that city. Consider alternatively the city of Kuresaare, in which Swedbank, SEB, and Nordea are present.

They have 2, 1, and 1 branches in that city, respectively. Consequently, in the main analysis, where we assign equal probability of each firm in that city doing business with each bank present in that city, we assign a Tier 1 capital ratio of $9.6 = \frac{1}{3} \cdot 8.4 + \frac{1}{3} \cdot 8.4 + \frac{1}{3} \cdot 12$, which is then matched to all firms located in Kuresaare. And in the exercises where we weigh the probability of each firm doing business with each bank present in Kuresaare by the number of that bank's branches in that locality, we assign a Tier 1 capital ratio of 9.3 ($\frac{1}{2} \cdot 8.4 + \frac{1}{4} \cdot 8.4 + \frac{1}{4} \cdot 12$).

This procedure gives us considerable variation of our main financial variables of interest within each country, due to the fact that not all banks present in a country are present in each city, and whenever they are, not to the same extent. For example, in the 2008 sample of firms, there are $1,215$ localities in the 14 countries in the sample, characterized by 262 unique values of city-specific Tier 1 capital, when data on all banks in a locality are counted equally, and by 732 unique values of city-specific Tier 1 capital when data on all banks is branch-weighted. Consequently, there is little reason to worry that the country fixed effects in the regressions capture the same variation as locality-specific financial stress.

Next, we want to estimate how credit constraints vary with the degree of foreign bank presence. We estimate the following difference-in-differences specifications:

$$\begin{aligned} Y_{ijkl} = \quad & \beta_1 \cdot X_{ijkl} + \beta_2 \cdot Finance_{jk} \cdot Foreign_{jk} + \beta_3 \cdot Finance_{jk} + \beta_4 \cdot Foreign_{jk} + \\ & + \beta_5 \cdot D_k + \beta_6 \cdot D_l + \varepsilon_{ijkl} \end{aligned} \tag{4}$$

$$\begin{aligned} Y_{ijkt} = \quad & \beta_1 \cdot X_{ijkt} + \beta_2 \cdot Post \cdot Finance_{jkt} \cdot Foreign_{jkt} + \beta_3 \cdot Post + \beta_4 \cdot Finance + \\ & + \beta_5 \cdot Foreign_{jkt} + \beta_6 \cdot D_k + \varepsilon_{ijkt} \end{aligned} \tag{5}$$

$$\begin{aligned} Y_{ijkt} = \quad & \beta_1 \cdot X_{ijkt} + \beta_2 \cdot Non - Affected \cdot Post \cdot Foreign_{jkt} + \beta_3 \cdot Post + \\ & + \beta_4 \cdot Non - Affected + \beta_5 \cdot Foreign_{jkt} + \beta_6 \cdot D_k + \varepsilon_{ijkt} \end{aligned} \tag{6}$$

where $Foreign_{jk}$ is an indicator equal to 1 if city j in country k is in the top half of the

distribution of foreign bank ownership. The primary control group here is all firms incorporated in locations with little foreign bank penetration. Now β_2 measures whether for the same degree of financial distress, foreign banks translate more of it into loan application rejections than domestic banks. Consistent with our hypothesis, we expect the sign of β_2 to be negative.

While in our specifications so far we are capable of estimating the effect of financial distress net of industry-wide and country-wide recession developments that are common to all firms in the respective industry (country), they don't allow us to test whether financial distress differentially affects firms, and our estimates are prone to contamination by location-specific unobservables. Regarding the first point, it is generally predicted that riskier firms and firms with fewer tangible assets are more likely to be shut out of credit markets (see, for example, Berger, Ofek, and Swary (1996), Beck, Demirgüç-Kunt, and Maksimovic (2005), and Brown, Jappelli, and Pagano (2009)). Regarding the second one, macroeconomic circumstances like unemployment usually vary at the city level, and so our specification so far will be contaminated by this variation. To address both points, we employ one final specification on the 2008 cross-section:

$$Y_{ijkl} = \beta_1 \cdot X_{ijkl} + \beta_2 \cdot Finance_{jk} \cdot Z_l + \beta_3 \cdot D_l + \beta_4 \cdot D_{jk} + \varepsilon_{ijkl} \tag{7}$$

Now the location dummies in D_{jk} absorb the effect of locality-specific unobservables. The interaction term containing the industry-level benchmark for asset tangibility in Z_l allows us to measure whether the potential effect of the credit crunch is indeed strongest for those firms which theory predicts are most vulnerable to credit market shutdowns (firms with risky profit prospects, and firms with little collaterizable assets, for instance).

Finally, we need to emphasize that throughout the paper, it is implicitly assumed that the effect of bank financial distress is localized and realized predominately by firms headquartered in the locality in which the bank has operations. All our empirical specifications presume that firms borrow from banks located near their address of incorporation, which is identical to the approach in, for example, Gormley (2009). In general this is expected to hold as banks tend to derive market power ex ante from geographical proximity (e.g., Degryse and Ongena (2005)). Lending

support to that conjecture, empirical work regarding lending relationships in different countries has demonstrated that the average distance between SMEs and banks is usually very small. For example, Petersen and Rajan (2002) find that the median distance between a firm and its main bank over the 1973-1993 period was only four miles.

3.2 Isolating demand shocks

It is a common challenge of studies that analyze the association between financial distress and bank lending to isolate supply shocks satisfactorily. Namely, it is likely that not only does loan demand weaken for all firms in periods when bank capital declines, but the composition of firms that demand credit during recessions changes. The solutions to this problem vary in the literature. For example, Peek and Rosengren (1997) bypass this issue by claiming that the identification problem is rather weak in the case of the international transmission of financial shocks into a recession-free environment. However, the financial crisis of 2007-2008 was followed by one of the deepest global recessions in postwar history, and this recession was already being predicted as soon as the extent of the sub-prime mortgage meltdown became apparent in late summer 2007. Hence, as we observe the firms in our sample in late 2007 and early 2008, it is conceivable that they were already behaving in a way consistent with a global recession environment. Puri, Rocholl, and Steffen (2010) and Jimenez, Ongena, Peydro, and Saurina (2010) incorporate data on loan applications to account for the explicit weakening of the firm balance sheet channel. However, this strategy does not account for the changing composition across business lenders of firms that demand bank credit as these studies do not observe firms which select themselves out of the loan application process due to 1) weak own demand for loans, or to 2) being discouraged by the deteriorating lending environment. Failure to account for this changing composition will result in a bias in the estimation of the true extent of the transmission of financial distress.

As we explained in Section 2, we eliminate the contamination of the estimates induced by 2) by incorporating data on discouraged firms in the measure of credit constraint. As for 1), we eliminate the effect of the balance sheet channel by incorporating observable information on firms which did not apply for bank credit in fiscal year 2007 because they did not need it (see Section 2 for the exact

definition). We apply Heckman's (1979) selection procedure to eliminate the bias arising from the left-truncation of the sample in that sense. Thus, credit constraint is only observable when a firm actually applies for a loan, and the firm only does so if it needs one, or if it is not discouraged. Let the dummy variable Q equal 1 if the firm desires positive bank credit and 0 otherwise. The value of Q is in turn determined by the latent variable:

$$q = \zeta \cdot Z_{ijkl} + \varepsilon_{ijkl} \tag{8}$$

where Z_{ijkl} contains firm and location variables that may effect the firm's fixed costs and convenience associated with using bank credit. The variable $Q = 1$ if $q > 0$ and $Q = 0$ otherwise. The error ε_{ijkl} is normally distributed with mean 0 and variance σ^2. Models (1)-(7) are then updated by adding the term $\sigma\frac{\phi(q)}{\Phi(q)}$ to the RHS, where $\frac{\phi(q)}{\Phi(q)}$ is the inverse of Mill's ratio (Heckman (1979)). Identification rests on the exclusion restriction which requires that q has been estimated on a set of variables that is larger by at least one variable then the set of variables in models (1)-(7), respectively.

4 Empirical results

4.1 Bank credit application

Before considering our main empirical model, we first consider the bank credit application tests that we use for our Heckman selection correction. Table 5 presents the results from the first stage probit regression. The probability of needing bank credit is generally higher for firms in more financially distressed localities, and when financial distress is measured as high losses on financial assets, the effect is also significant. Not accounting for this selection would thus bias the estimates of the transmission of financial distress towards zero.

In terms of firm-level co-variates, the need for bank credit increases in the size of the firm. One potential explanation is that small firms face higher application costs (Brown, Ongena, Popov, and Yesin (2010)). Also, in a beginning-of-a-recession environment it might be that small firms are better equipped to finance investment with cash flows than - potentially - more highly leveraged

large firms. In addition, some of the size effects may be picked by ownership and structural characteristics, as sole proprietorships and public companies have a higher demand for loans. The probability of desiring credit is higher for exporters potentially due to their faster expansion, and for audited firms, which might simply imply that firms choose to be audited (i.e., they are willing to pay for transparency) when they plan to apply for bank credit.[11] It may also be the case that audited firms have access to financial statement lending which may be a cheaper lending technology.

In terms of the exclusion restriction, the variables "Competition" and "Subsidized" are included in this demand model, but excluded from the rest of the exercises. The rationale for using these particular variables as instruments for demand is the following. Firms in more competitive environments will likely have a higher demand for external credit due to lower profit margins, but it is unlikely that credit decisions will be correlated with product market competition. Analogically, having applied for state subsidies is likely a signal for external financial need. These considerations make both variables good firm demand shifters. Both variables are very positively correlated with the demand for loans, and the effect is statisticically significant at the 1% level. The F-statistics from a first-stage regression of loan demand on the two variables (unreported) is 20.77, satisfying the validity test.

4.2 International transmission of financial distress

4.2.1 Nonparametric difference-in-differences estimates

Table 6 gives a simple non-parametric illustration of the validity of our empirical strategy. We separate the data on geographic and financial dimensions. Specifically, we average the data on rejection rates across localities for the 2005 vs. the 2008 samples, and also for affected vs. non-affected localities. In determining which localities are affected, we use Tier 1 capital and define "affected" as localities where the average Tier 1 capital ratio of banks present in that locality decreased by at least one standard deviation between 2005 and 2008. The table implies that credit constraints vary over time, given different degrees of financial distress. In particular, average

[11] The results are broadly consistent with Ongena and Popov (2009) who apply a double selection technique to the BEEPS 2005 sample.

rejection rates for non-affected localities didn't change much between 2005 and 2008: they went from 31.9% to 33.2%, and this increase is not statistically significant. In comparison, in affected localities rejection rates went up to 40.2% in 2008, from 33.5% in 2005, with this increase being significant at the 1% level. Looking at the same development from another angle, while rejection rates were similar for all banks in 2005, in 2008 they were much higher in localities where banks experienced a large drop in capital in the meantime. This result is the first (albeit arguably imperfect) piece of evidence that foreign banks reacted to their respective financial troubles by shrinking their loan portfolios.

4.2.2 Cross-section results

Table 7 reports the estimates of the effect of parent banks' financial distress on credit constraints faced by local firms for all firms present in BEEPS 2008. We report the results of the model in equation (1) alongside the results from the Heckman selection-corrected version in order to contrast the two approaches. The three main explanatory variables of interest are: the ratio of equity over total assets; the Tier 1 capital ratio; and the gain on financial assets over total assets. We first report the results from the model in which each bank is given equal weight in each locality where the bank is present (Panel A). As expected, all else equal, small firms and sole proprietorships are more credit constrained, potentially indicating lower ability to tap alternative capital markets; audited firms are less constrained, implying gains from the reduction of informational opacity; and firms that export part of their production are less constrained, potentially signalling the willingness of banks to lend to firms with higher growth prospects. The variables of interest have a generally insignificant impact on the probability of firms being constrained in the credit market, with the sign of Tier 1 capital going in the expected direction.

When we apply the second weighting criterion in Panel B, namely, weighting the probability of the firm doing business with each particular bank by the number of branches the bank has in that locality, we find a large and significant impact of a low bank Tier 1 capital ratio on rejection rates. The magnitude of the effect is also economically meaningful: a 2-standard deviation decrease in the average Tier 1 capital ratio for banks in a particular locality increases the probability of identical

firms in this locality being credit constrained by about 8%.

In both panels, the sign of the inverse of Mill's ratio is generally negative, implying that unobservables which increase the probability of needing bank credit, also decrease the probability of being constrained in credit markets.

Finally, recall that by looking at fiscal year 2007, we are capturing only the initial stages of the crisis up to March 31, 2008. In addition to that, our results are contaminated by months of pre-crisis experience before August 2007. In that sense, if there is bias in our estimates, it only goes against finding any transmission of crisis-related financial distress. The large and statistically significant effect of low Tier 1 capital on rejection rates could thus only be a lower bound of the true effect.

4.2.3 Transmission of shocks over time

We next repeat the empirical tests on the sample of firms that are present either in the 2008 and the 2005 BEEPS, employing the Heckman selection-corrected version of model (2). This allows us to account for the changing composition of firms that select themselves out of the application process, going from the peak to the trough of the credit cycle. In other words, the information on whether firms do not apply for credit because they don't need it, or because they are discouraged, and how that changes over time, is used to eliminate the potential contamination of our estimates by the correlation between credit needs and bank financial health. In addition, we can compare the effect of being financial distressed in 2008 vs. having financial problems in 2005.

These results are reported in Table 8, Panel A.[12] In this specification, we find again that Tier 1 capital affects rejection rates, regardless of whether we weight each bank's presence in a locality equally or by number of branches. The interpretation of the coefficient on the branch-weighted Tier 1 capital is that for the sample average degree of financial stress, an identical firm had a 9% higher chance of being constrained in fiscal year 2007 than in fiscal year 2004, and this probability increases with the level of distress. Importantly, we confirm that not accounting for selection introduces downward bias. The sign of the inverse of Mill's ratio is again generally negative, and

[12]In all tables to follow, only coefficients of interest are reported for brevity.

this time significantly so, implying that firms which did not apply for a loan would have faced a higher probability of being rejected.

In panel B of Table 8, we report the results from Model (3) where we only look at localities for which at least 1 firm is present both in 2005 and in 2008. Now instead of the level of distress, we look at the change in financial health over time. We define affected localities as ones in which average financial health (measured by our three financial variables of interest) declined by at least one standard deviation between fiscal 2005 and 2008.

In this specification, we find that equity capital matters for the transmission of shocks. For example, consider our measure of average equity capital constructed by weighting information on each bank present in a locality equally. We find that in localities where equity capital declined by at least one standard deviation between 2005 and 2008, the probability of a firm being rejected increased by 13% more than for an identical firm in a locality where equity capital did not decline as much. We find similar results for the branch-weighted measure of equity capital.

4.3 Robustness

4.3.1 The degree of foreign ownership

An important question that arises given the evidence so far is, does the magnitude of the transmission of financial shocks depend on the degree of foreign bank ownership. For example, given our empirical design, it could be that the results are driven by lower levels of foreign bank ownership, while there is no cross-border transmission of financial shocks in localities dominated completely by foreign banks. Table 9 reports the estimates from the difference-in-differences models (4)-(6) which allow us to estimate the transmission of financial distress by foreign bank presence. We find that our results are indeed driven by substantial foreign bank presence. With one exception, whenever significant, the interaction effect of interest implies that in localities with larger foreign bank presence, banks responded to shocks to their balance sheets by shrinking their portfolio more than banks in localities with lower foreign bank presence. This is most pronounced in the case of the banks' response to loss on financial assets, where the effect is consistently large and significant across model specifications. We also record the same direction of this effect in the case of a decline

in equity capital, albeit it is significant in one case only.

4.3.2 EU countries vs. non-EU countries

Another point to address is the heterogeneity of the sample. In particular, 10 out of the 14 countries in our sample are EU member states. The cross-border transmission of shocks in these countries is likely to have been affected by the regulatory architecture of the EU. For example, it is conceivable that banks in EU member countries have been less motivated to withhold new lending due to the anticipated cushion provided by EU-wide deposit insurance, or by recapitalization and bail-out programs agreed to in a co-ordinated fashion at the level of the EU. Conversely, foreign banks in EU non-member states may have anticipated that local governments would act outside of any co-operative agreements, mostly in the interest of domestic bank champions, and may have as a result had the motivation to withdraw from the market for new loans more forcefully. If this is the case, then our results may be mostly driven by the non-EU countries in our sample.

In Table 10, we test this hypothesis by performing our main empirical exercises on our sample after excluding the 4 countries that are not in the EU (namely, Albania, Croatia, Macedonia, and Montenegro). Taken as a whole, these new estimates strongly negate the hypothesis that our results are driven by the rapid decline in new lending by EU banks in non-EU countries. On the contrary, if anything our results are strengthened by the exclusion of the non-EU countries. For example, in the case of both Tier 1 capital and equity capital, we find that higher financial distress is associated with higher rejection rates across all three empirical specifications. The magnitude of the transmission effect also increases slightly after focusing on EU countries only.

4.3.3 Which firms are affected by the transmission of shocks?

Next, we ask which firms are most affected from the transmission of financial distress. There are clear arguments in the literature on which firms and industries should be most affected by credit rationing. Firm risk and the tangibility of the firm's assets, for example, are expected to play an important role in explaining differences in credit availability across firms. High-risk firms tend to suffer more from credit rationing, especially when foreign bank lending is involved (Berger,

Klapper, and Udell (2001)). Regarding asset tangibility, Berger, Ofek, and Swary (1996) show that firms with less tangible assets are more likely to lose access to credit when banks reprice risk. The rationale is that lenders rely more on collateral when making lending decision rather than investing in costly screening technologies, and this problem will tend to be exacerbated in an environment where risk is suddenly priced higher.

We proceed by collecting data on mature U.S. firms and using it to construct industry benchmarks for riskiness and asset tangibility. The rationale for doing so goes back to Rajan and Zingales (1998) who argued that the actual capital structure of small firms is a function of financial constraints, while the capital structure of large mature firms is more representative of the cross-industry variations in the scale of projects, gestation period, the ratio of hard vs. soft information, the ratio of tangible vs. intangible assets, follow-up investments, etc. In addition, doing so for large U.S. firms makes sure that what is taken as a "natural" industry feature is not contaminated by shallow financial markets.

Following Rajan and Zingales's (1998) original approach, we proceed by taking all Compustat firms between 1990 and 2000. We first exclude all firms that are young in the sense that they have gone public only recently (in the last 10 years) to make sure that we are not capturing the excessive appetite for funds exhibited during the early life of a public firm. For each firm, we sum across all years its ratio of research and development expenses over sales. We take the median industry value of that ratio and this value constitutes our industry benchmark for "R&D intensity". This is both a measure of risk and of asset tangibility: firms with a lot of R&D investment will simultaneously have riskier returns due to more uncertain profits, and less collaterizeable assets. Second, we sum across all years each firm's ratio of total physical capital used in production over the number of employees. The industry median value of that variable constitutes our industry benchmark for "Capital intensity", which again captures partially risk and partially asset tangibility. For each of the two benchmarks, we have an 18-industry variation.

Table 11 reports the estimates of equation (7) where each measure of financial distress has been interacted with a dummy variable equal to 1 if the firm's sector of operation is in the top 50% of the distribution of "R&D intensity", or alternatively in the bottom 50% of "Capital intensity".

In both cases, a dummy value of 1 implies higher risk and lower asset tangibility. We only focus on financial distress as measured by low Tier 1 capital ratios, as this is the one measure that is most consistently associated with higher loan rejection rates in the analysis so far. Importantly, this specification gives us interaction at the city and industry level, and thus we can include city dummies in the regression. The direct effect of financial distress is now fully absorbed by the city dummies, along with any unobservable variation in macroeconomic conditions at the location level. The effect on rejection rates of the sector-wide variation in growth opportunities is absorbed by the industry dummies, as before. The interpretation of the coefficient on the interaction term is in terms of a relative effect: a negative sign would imply that an increase in banking distress would increase credit constraints relatively more for riskier firms and for firms with fewer collaterizeable assets.

The results confirm the intuition: firms tend to suffer more from the transmission of financial distress when they have riskier growth prospects, or when they do not have enough assets to pledge as collateral. Numerically, the same branch-weighted Tier 1 capital ratio is associated with a 12.5% higher probability of loan rejection for firms in industries with high R&D intensity; and with a 20.4% higher probability of loan rejection for firms in industries with low per-worker capital.

4.3.4 Issues of measurement, geography, and monetary policy

Finally, we address issues of measurement, geography, and monetary policy. First, recall that our estimation method relies on constructing locality-specific average measures of bank distress, and then match all firms incorporated in a particular locality to this locality's measure of financial distress. One natural objection is that the more banks there are in this locality, the poorer the measure of financial distress will capture actual firm experience. Another is that many firms which can afford it could be doing business with banks outside of their locality of incorporation, in a hunt for better credit conditions. Finally, monetary policy and especially access to the same pool of central bank liquidity could play a role in explaining our findings.

We address these issues in Table 12. In order to alleviate the first two concerns, we would ideally restrict our sample to the localities where we could match firms and banks better, and to those

firms for which the cost of applying for credit far from their locality of incorporation is too high given the expected gain in loan terms (Degryse and Ongena (2005)). To address the former, we could look at localities with one bank only. As there is an insufficient amount of those, we look at the localities where there are at most two banks (first column of Table 12). This procedure does not eliminate the significance of our results, so we conclude that they are not driven by mismeasuring true financial distress. We also exclude all non-small firms in the sample (that is, firms with more than 100 employees). Small firms are the ones that are likely to find it most costly to do business with banks located far from their city of incorporation. The second column of Table 12 confirms that our main results survive this procedure. We also do the most stringent test, namely, focusing on small firms in localities with at most two banks (third column of Table 12). While there are only 76 such firms, our results still stand and are significant at the 5%.

Finally, we ask if our results are not contaminated by the fact that banks operating in euro zone member countries may behave differently than banks in non-euro zone countries, due to the fact that domestic banks also have access to the same pool of central bank liquidity, and so could be behaving in a similar fashion. Then, what we denote as cross-border transmission of distress would be indistinguishable from local behavior. In the fourth column of Table 12, we interact our measure of financial distress with a dummy equal to 1 if the country is in the euro zone (Slovakia and Slovenia), or has its currency pegged to the euro (Bulgaria, Estonia, Latvia, and Lithuania). We find that while the cross-border transmission of shocks is higher for euro countries, it is not statistically so.

4.4 Discussion of results

It is important to reconcile our findings with, for example, Cetorelli and Goldberg (2009) and Navaretti, Calzolari, Possolo, and Levi (2010), who find that total outstanding loans by foreign affiliates in central and eastern Europe did not decrease in the early stages of the crisis. Given that these papers look at total loans outstanding, while we look at new bank credit, our evidence does not necessarily contradict these other results. The two sets of findings can be reconciled by the simple difference between stocks and flows: a decline in new loans does not necessarily imply a decline

in total loans outstanding, if the unused portion of credit lines and overdraft facilities are utilized. The evidence suggests that this occurred in the early stages of the crisis in the U.S., as argued by Cohen-Cole, Duygan-Bump, Fillat, and Garriga (2008) in response to Chari, Christiano, and Kehoe (2008): while new bank credit declined dramatically after the collapse of Lehman Brothers, total credit outstanding remained almost flat as firms started drawing extensively on their existing credit lines.

Second, it could in principle be argued that our empirical methodology is deficient in one important way. Our identification strategy rests on estimating the transmission of shocks by foreign banks to small firms while accounting for changes in the level and composition of firm credit demand. In theory, however, our estimates could be contaminated by simultaneity if foreign bank entry was endogenous to the business characteristics of the localities in our sample. For example, if more risk-loving banks established branches in localities populated by risk-loving firms which ended up weak and discouraged from borrowing when the crisis started, our estimates of the transmission of shocks would be inflated. However, in practice the dominant form of entry of foreign banks in central and eastern Europe throughout the 1990s and 2000s has been the subsidiary form: foreign banks bought existing banking networks of largely predetermined size and outreach (EBRD Transition report 2008). Thus, if foreign banks were chasing particular customers, they did not just open a branch in a certain locality, but in fact had to buy a whole branching network. In our view, this fact largely eliminates any simultaneity concerns which could in theory be biasing our results.

Finally our results offer important insights into the role of foreign banks in emerging markets. In general, the effect of foreign banks on business lending in the literature is ambiguous. A large literature has found that foreign bank presence is associated with higher access to loans (Clarke, Cull, and Peria (2006)), higher firm-level sales (Giannetti and Ongena (2009)), and lower loan rates and higher firm leverage (Ongena and Popov (2009)). On the other hand, Berger, Klapper, and Udell (2001), Mian (2006), and Gormley (2009) show that foreign banks tend to finance only larger, established, and more profitable firms. Such evidence is mostly derived from experience during "good times". Our paper complements that picture by providing evidence that foreign banks tend to shrink their loan portfolio following a capital crunch, pointing to a certain trade-off

between efficiency and stability.

Managerial issues might be important here given the managerial challenges associated with cross border banking (e.g., Berger, DeYoung, Genay, and Udell (2000)). Managerial focus on solving problems at the headquarters level in the home country could reduce the ability of the parent bank to monitor lending activities in its foreign facilities. Given the organizational frictions associated with lending a la Stein (2002), this reduced monitoring ability could have a disproportional effect on the contraction of credit by foreign banks. Perhaps our results on foreign bank behavior are also related to the more general finding in the literature that lending tends to be pro-cyclical (e.g., Borio, Furfine, and Lowe (2001), Dell'Ariccia, Igan, and Laeven (2008), Pannetta et al. (2009)). Our finding that riskier borrowers are more affected might even suggest a link to the institutional memory explanations of pro-cyclical lending behavior (e.g., Berger and Udell (2004)) where eroded lending expertise is more problematic at foreign banks.

5 Conclusion

The financial crisis of 2007-2008, which started with the meltdown of sub-prime mortgages and securitized products and which has been characterized by severe losses and depletion of bank capital, has spurred unprecedented government recapitalization programs and liquidity injections by central banks. Since the inception of the crisis, it was feared that this depletion of capital may result in a severe credit crunch, especially to the corporate sector in countries populated by the hardest hit banks. Because the European economy is heavily bank-dependent and SMEs - usually the most vulnerable to a credit crunch due to their opacity - comprise up to 99% of the corporate sector, it was feared that European firms would be particularly heavily hit, despite the fact that the causal factors of the credit crunch originated elsewhere.

In this paper, we use data on $9,360$ SMEs to investigate empirically the international transmission of financial distress, from the loss in value of financial assets to the balance sheets of big European and U.S. banks to business lending in their foreign markets - specifically, central and eastern Europe. Several very recent studies have documented a credit crunch associated with weakened

capital positions, however, ours is the first one to simultaneously 1) demonstrate the cross-border dimensions of this phenomenon, and 2) eliminate the contamination of the lending channel by selection bias resulting from the changing composition of firms' demand for credit during recessions and by the failure to account for discouragement in the proxy for credit constraint.

We find that different types of financial distress at foreign (mostly western European) parent banks are associated with a significant impact on business lending to central and eastern European firms. While we do not observe an actual match between a bank and a firm, we match firms and banks by the locality of their respective operation. We find that as early as late 2007/early 2008, firms reported higher credit constraints in localities dominated by branches or subsidiaries of foreign-owned banks which in 2008 had low equity capital, low Tier 1 capital ratios, and had recorded severe losses on financial assets. The magnitude of this effect increases in the degree of foreign bank presence. Our results are not driven by the experience in non-EU countries where in theory banks could have been quicker to withdraw from the market due to the lack of local regulatory and policy cushions. We also find that high-risk firms and firms with fewer tangible assets were differentially more affected by this capital crunch. These results hold when we eliminate the effect of demand shifts in response to weakening firm balance sheets, as well as the bias resulting from the systematic selection of firms out of the application process. Our evidence implies that all else equal, firms in countries where major portions of the banking market were held by relatively undercapitalized foreign banks were 1) more credit constrained than identical firms in countries served by better capitalized foreign banks, and 2) more credit constrained than identical firms in countries where major portions of the banking market were held by equally undercapitalized domestic banks. This is direct evidence of the global transmission of financial distress in the relatively early stages of the 2007-2008 financial crisis, in a way unrelated to the demand for loans in local markets.

The financial crisis of 2007-2008 has finally laid to rest the idea that the effect of large financial shocks can be confined locally. We have shown how the collapse of housing values in the U.S. has affected the financing conditions of, for example, Slovak firms through the deteriorating capital positions of Austrian, Belgian, and Italian banks operating in Slovakia through their subsidiaries.

While the credit crunch only started in the third quarter of 2007, banks kept tightening credit standards until as late as the fourth quarter of 2009[13], and most likely after that. Thus, despite the coordinated actions of various national and supranational authorities, which kept the global financial system from collapsing after the fall of Lehman Brothers in September 2008, it is likely that the losses that the financial system endured have induced, and will continue to induce, a much larger impact on the real sector than the one estimated in this paper. The true extent of the credit crunch will only become clear with the availability of new, more comprehensive data.

[13]See ECB (2009) for details.

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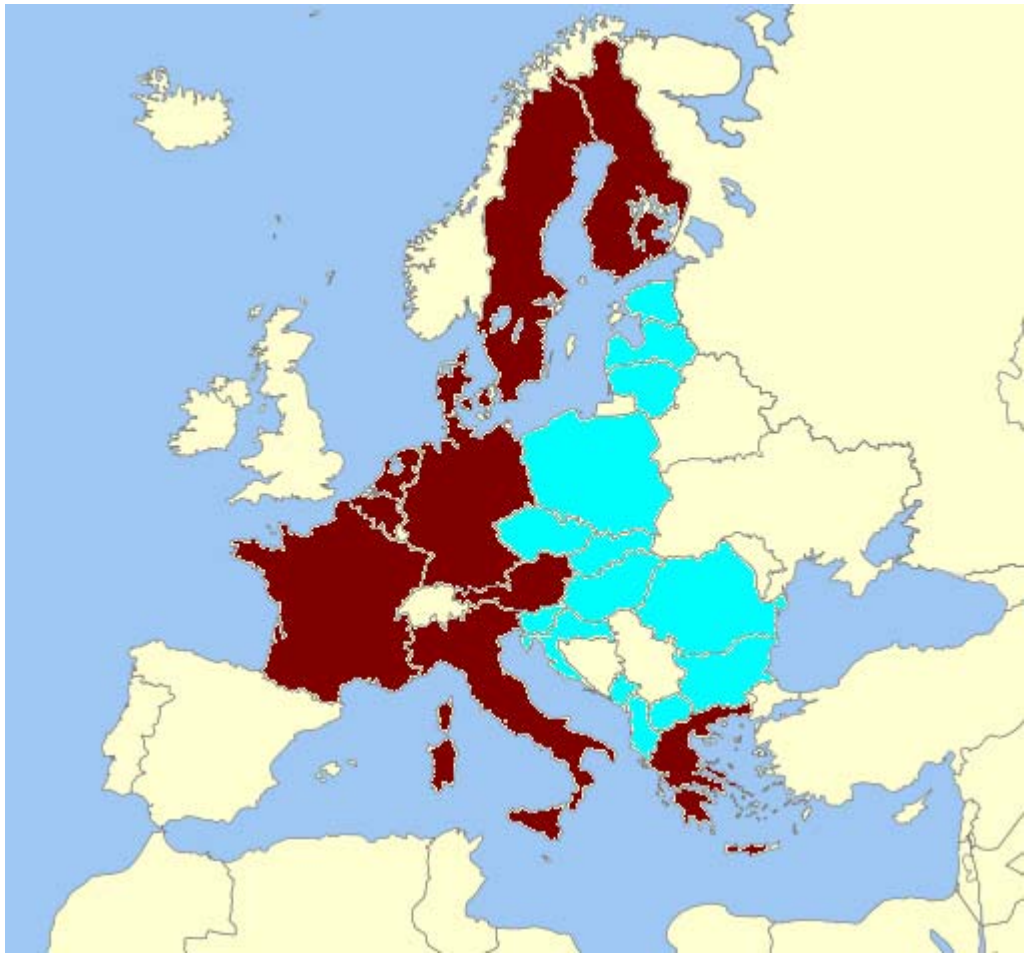
Figure 1. Origin and target countries in the data



The map shows the cross-border dimension of the underlying data. Countries in dark color (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Netherlands, and Sweden) are those in which the parent banks in the dataset are incorporated. Countries in light color (Albania, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Montenegro, Poland, Romania, Slovakia, and Slovenia) are those where the firms in the dataset are incorporated.

Table 1.
Timeline of events during the 2007-2008 crisis concerning banks and countries in the data

Timeline	Country	Event
Aug. 2007 – Aug. 2008	Germany	Bayerische LandesBank is one of three LandesBanken to receive capital injections, credit lines, and asset-backed securities loss guarantees.
Sept. 2008	France	The government recapitalizes Dexia.
	U.S.	Emergency Economic Stabilization Act, containing a commitment for up to 700 bln. USD to purchase bad assets from banks.
	Italy	The parliament approves a law granting the government the possibility to recapitalize distressed banks.
	Netherlands	The government announces that public funds can be used for bank recapitalization, of which 20 bln. EUR are immediately available.
Oct. 2008	France	The Government approves 320 bln. EUR to provide loans to banks and other financial firms, including a 40 billion euro recapitalization plan.
	Sweden	The government announces that it will guarantee up to 1.5 trillion SEK in new debt issues, and a 15 billion SEK stabilization fund.
	Germany	The government announces a 400 billion EUR plan to guarantee bank financing, including a 70 billion EUR recapitalization fund.
	US	The Treasury subscribes 20 bln. USD preferred shares at Citigroup and ring-fences its troubled assets worth up to 300 billion USD.
Nov. 2008	Italy	The government approves a law to inject capital into sound banks.
	Germany	Bayerische LandesBank receives 7 billion EUR of capital from the Bavarian state.
Dec. 2008	Germany	The Finance ministry provides Bayerische LandesBank with 15 billion EUR .
	Germany	The Finance ministry provides Commerzbank with a 8.2 billion EUR loan, and buys 1.8 trillion EUR worth of equity.
Jan. 2009	France	The government implements a second round of bank recapitalization for 10.5 billion EUR.
	Netherlands	The Dutch government provides a back-up facility to back up the risks of ING's securitized mortgage portfolio worth 35.1 billion EUR.

Table 2.
Summary statistics: Firm characteristics

Country	# firms	Small firm	Big firm	Public company	Private company	Sole proprietorship	Privatized	Exporter	Audited	Subsidized	Competition
Albania	260	0.90	0.03	0.01	0.19	0.74	0.06	0.31	0.74	0.04	0.74
Bulgaria	609	0.84	0.03	0.05	0.38	0.51	0.12	0.24	0.42	0.06	0.62
Croatia	372	0.79	0.05	0.06	0.41	0.44	0.23	0.36	0.47	0.18	0.79
Czech Republic	670	0.79	0.04	0.04	0.48	0.41	0.08	0.35	0.43	0.16	0.82
Estonia	557	0.79	0.03	0.13	0.55	0.27	0.11	0.34	0.80	0.14	0.77
Hungary	992	0.80	0.04	0.01	0.32	0.63	0.12	0.36	0.74	0.22	0.88
Latvia	529	0.73	0.04	0.01	0.56	0.36	0.13	0.31	0.68	0.12	0.79
Lithuania	544	0.77	0.02	0.02	0.68	0.24	0.16	0.37	0.40	0.15	0.78
Macedonia	611	0.81	0.03	0.05	0.48	0.32	0.16	0.39	0.54	0.04	0.84
Montenegro	151	0.86	0.01	0.04	0.25	0.71	0.12	0.15	0.48	0.04	0.69
Poland	1,592	0.83	0.02	0.05	0.12	0.78	0.09	0.26	0.37	0.13	0.84
Romania	1,247	0.73	0.04	0.04	0.73	0.17	0.13	0.20	0.37	0.09	0.71
Slovakia	610	0.74	0.05	0.06	0.29	0.54	0.11	0.34	0.55	0.13	0.79
Slovenia	616	0.74	0.05	0.08	0.50	0.29	0.21	0.56	0.43	0.22	0.79
Total	9,360	0.79	0.03	0.05	0.42	0.46	0.12	0.32	0.51	0.13	0.79

Note: The table presents statistics on the number of firms and the share of firms by size, ownership, privatization history, access to foreign product markets, access to international auditing, subsidies from central and local governments, and degree of competition, by country. See Appendix 1 for exact definitions. Source: BEEPS (2008 and 2005).

Table 3.
Summary statistics: Credit demand and access

	BEEPS 2008		BEEPS 2005	
Country	Need loan	Constrained	Need loan	Constrained
Albania	0.29	0.47	0.68	0.30
Bulgaria	0.58	0.52	0.65	0.36
Croatia	0.59	0.42	0.78	0.14
Czech Republic	0.53	0.32	0.56	0.41
Estonia	0.54	0.27	0.60	0.23
Hungary	0.41	0.31	0.78	0.28
Latvia	0.59	0.48	0.70	0.27
Lithuania	0.60	0.23	0.71	0.30
Macedonia	0.59	0.50	0.68	0.56
Montenegro	0.78	0.48	---	---
Poland	0.53	0.41	0.68	0.45
Romania	0.61	0.33	0.72	0.32
Slovakia	0.53	0.40	0.62	0.21
Slovenia	0.64	0.15	0.72	0.12
Total	0.57	0.37	0.69	0.33

Note: The table presents statistics on the share of firms who declare bank loans desirable, and the share of firms out of those that need a loan that have been formally rejected or did not apply because they found access to finance too difficult, by country. The data are for the fiscal year 2007 (until March 31, 2008) and for fiscal year 2004 (until March 31, 2005). See Appendix 1 for exact definitions. Source: BEEPS (2008 and 2005).

Table 4.
Bank ownership balance sheet data

	2005	2008	2005	2008	2005	2008	2005	2008
Country	% foreign owned bank assets		Equity/assets		Tier 1 capital ratio		Gain on financial assets	
Albania	0.92	0.94	0.065	0.053	8.39	7.88	0.016	-0.067
Bulgaria	0.75	0.82	0.069	0.064	10.10	8.89	0.049	-0.044
Croatia	0.91	0.90	0.067	0.061	7.33	7.59	0.039	-0.027
Czech Republic	0.82	0.86	0.041	0.042	7.74	8.29	0.120	-0.117
Estonia	0.99	0.99	0.047	0.038	8.88	8.71	0.051	-0.029
Hungary	0.83	0.64	0.068	0.065	8.89	8.51	0.021	-0.081
Latvia	0.58	0.64	0.076	0.049	7.98	6.55	-0.004	-0.057
Lithuania	0.92	0.92	0.058	0.054	8.14	8.19	0.041	-0.035
Macedonia	0.51	0.86	0.076	0.071	10.37	8.60	0.052	-0.012
Montenegro	0.88	0.79	0.144	0.094	16.91	9.45	0.197	-0.030
Poland	0.74	0.76	0.082	0.081	10.32	9.39	0.015	-0.041
Romania	0.59	0.87	0.059	0.053	8.31	7.81	0.075	-0.049
Slovakia	0.97	0.99	0.058	0.055	7.93	8.12	0.018	-0.083
Slovenia	0.23	0.29	0.058	0.050	8.83	8.81	0.063	-0.158

Note: The table reports summary statistics on the share of the domestic banking system owned by branches and subsidiaries of foreign banks, of the average ratio of equity financing to total bank assets, of the average Tier 1 capital ratio, and of average gains on financial assets by the parent of the banks operating in each country, by country. The data are averaged for 2005 and 2008, respectively. See Appendix 1 for exact definitions. Source: EBRD Transition Report (2008) and Bankscope (2005 and 2008).

Table 5.
Probability of desiring bank credit

	Finance = Equity/assets		Finance = Tier 1 capital ratio		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Finance	-0.027	-0.022	-0.029	-0.003	-0.011	-0.003
	(0.020)	(0.020)	(0.025)	(0.025)	(0.005)**	(0.004)
Small firm	-0.147	-0.147	-0.149	-0.149	-0.145	-0.145
	(0.046)***	(0.046)***	(0.047)***	(0.046)***	(0.046)***	(0.046)***
Big firm	0.100	0.099	0.102	0.099	0.087	0.088
	(0.095)	(0.095)	(0.096)	(0.096)	(0.096)	(0.096)
Public company	-0.047	-0.045	-0.045	-0.045	-0.057	-0.053
	(0.091)	(0.081)	(0.081)	(0.081)	(0.082)	(0.082)
Sole proprietorship	0.165	0.167	0.168	0.167	0.159	0.160
	(0.038)***	(0.038)***	(0.038)***	(0.039)***	(0.038)***	(0.039)***
Privatized	0.113	0.113	0.115	0.114	0.122	0.121
	(0.052)**	(0.052)**	(0.052)**	(0.052)**	(0.053)**	(0.053)**
Exporter	0.191	0.191	0.191	0.190	0.187	0.189
	(0.036)***	(0.036)***	(0.036)***	(0.036)***	(0.036)***	(0.036)***
Audited	0.113	0.112	0.111	0.111	0.107	0.108
	(0.035)***	(0.035)***	(0.035)***	(0.035)***	(0.036)***	(0.036)***
Competition	0.176	0.176	0.176	0.176	0.174	0.175
	(0.039)***	(0.039)***	(0.038)***	(0.038)***	(0.039)***	(0.039)***
Subsidized	0.313	0.315	0.313	0.313	0.314	0.316
	(0.050)***	(0.050)***	(0.050)***	(0.050)***	(0.050)***	(0.050)***
Country fixed effects	Yes					
Year fixed effects	Yes					
Observations	7,004	7,004	7,002	7,002	6,948	4,948
Pseudo R-squared	0.04	0.04	0.04	0.04	0.04	0.04

Note: The dependent variable is a dummy variable equal to 1 if the firm desires bank credit. 'Finance' is one of the three financial variables from Table 4. Each finance variable is locality-specific and is constructed by weighting equally (Columns labelled "Equally-weighted") or by number of branches (Columns labelled "Branch-weighted") the respective financial variable for each parent bank which has at least one branch or subsidiary in that locality. 'Small firm' is a dummy equal to 1 if the firm has from 2 to 49 employees. 'Big firm' is a dummy equal to 1 if the firm has more than 250 employees. 'Public company' is a dummy equal to 1 if the firm is a shareholder company, or its shares traded in the stock market. 'Sole proprietorship' is a dummy equal to 1 if the firms is a sole proprietorship. 'Privatized' is a dummy equal to 1 if the firm is a former state-owned company. 'Exporter' is a dummy equal to 1 if the firm exports to non-local markets. 'Audited' is a dummy equal to 1 if the firm employs external auditing services. 'Competition' is a dummy equal to 1 if the firm faces fairly, very, or extremely strong competition. 'Subsidized' is a dummy equal to 1 if the firm has received in the last 3 years subsidies from central or local government. Omitted category in firm size is 'Medium firm'. Omitted category in firm ownership is 'Private company'. Only localities with non-zero foreign bank presence included. All regressions include country and year fixed effects. White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2005 and 2008) and Bankscope (2005 and 2008).

Table 6.
Affected vs. non-affected banks: Rejection rates pre- vs. post-

	2005	2008	Difference
Affected localities	0.335	0.402	-0.067***
Non-affected localities	0.319	0.332	-0.013
Difference	0.016	0.070***	-0.054***

Note: The table reports a difference-in-differences estimate from a Mann-Whitney two-sided test. 'Affected' are localities where the average Tier 1 capital ratio of all banks present decreased by at least 1 standard deviation between fiscal year 2004 and fiscal year 2007. The statistical significance of the difference-in-differences estimate can be found next to the difference, where *** indicates significance at the 1% level. Only localities with non-zero foreign bank presence included. Source: BEEPS (2005 and 2008) and Bankscope (2005 and 2008).

Table 7.
Probability of being constrained (2008 sample)

Panel A. Equally weighted bank data for each locality

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
Finance	0.030	0.021	-0.05	-0.059	0.012	0.009
	(0.035)	(0.035)	(0.066)	(0.066)	(0.011)	(0.011)
Small firm	0.349	0.343	0.349	0.346	0.35	0.33
	(0.082)***	(0.092)***	(0.082)***	(0.093)***	(0.083)***	(0.093)***
Big firm	-0.073	-0.074	-0.062	-0.065	-0.106	-0.105
	(0.188)	(0.190)	(0.188)	(0.190)	(0.192)	(0.194)
Public company	0.404	0.405	0.408	0.411	0.391	0.386
	(0.141)***	(0.142)***	(0.140)***	(0.142)***	(0.142)***	(0.144)***
Sole proprietorship	0.162	0.172	0.16	0.168	0.157	0.177
	(0.082)**	(0.088)*	(0.082)*	(0.089)*	(0.082)*	(0.089)**
Privatized	-0.063	-0.047	-0.07	-0.056	-0.068	-0.043
	(0.097)	(0.102)	(0.097)	(0.102)	(0.098)	(0.104)
Exporter	-0.225	-0.216	-0.223	-0.218	-0.218	-0.196
	(0.075)***	(0.088)**	(0.075)***	(0.088)**	(0.076)***	(0.088)**
Audited	-0.264	-0.239	-0.263	-0.24	-0.265	-0.233
	(0.069)***	(0.073)***	(0.069)***	(0.073)***	(0.070)***	(0.074)***
Inverse Mill's ratio		-0.045		-0.032		-0.088
		(0.141)		(0.140)		(0.144)
Country fixed effects			Yes			
Industry fixed effects			Yes			
Observations	1,951	1,926	1,950	1,925	1,924	1,899
Pseudo R-squared	0.09	0.09	0.09	0.09	0.09	0.09

Note: The dependent variable is a dummy variable equal to 1 if the firm is credit constrained. 'Finance' is one of the three financial variables from Table 4. Each finance variable is locality-specific and is constructed by weighting equally the respective financial variable for each parent bank which has at least one branch or subsidiary in that locality. 'Small firm' is a dummy equal to 1 if the firm has from 2 to 49 employees. 'Big firm' is a dummy equal to 1 if the firm has more than 250 employees. 'Public company' is a dummy equal to 1 if the firm is a shareholder company, or its shares traded in the stock market. 'Sole proprietorship' is a dummy equal to 1 if the firms is a sole proprietorship. 'Privatized' is a dummy equal to 1 if the firm is a former state-owned company. 'Exporter' is a dummy equal to 1 if the firm exports to non-local markets. 'Audited' is a dummy equal to 1 if the firm employs external auditing services. 'Inverse Mill's ratio' is the inverse of Mill's ratio from the probit model in Table 5 for each respective financial variable. Omitted category in firm size is 'Medium firm'. Omitted category in firm ownership is 'Private company'. Omitted categories from the probit equation in Table 5 are 'Competition' and 'Subsidized'. The analysis is performed on all firms present in the 2008 survey. Only localities with non-zero foreign bank presence included. All regressions include country and industry fixed effects. White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2008) and Bankscope (2008).

Table 7.
Probability of being constrained (2008 sample)

Panel B. Branch-weighted bank data for each locality

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
Finance	-0.041	-0.047	-0.188	-0.189	0.012	0.01
	(0.035)	(0.035)	(0.065)***	(0.066)***	(0.010)	(0.010)
Small firm	0.346	0.343	0.347	0.343	0.349	0.338
	(0.082)***	(0.092)***	(0.082)***	(0.093)***	(0.083)***	(0.093)***
Big firm	-0.071	-0.076	-0.051	-0.055	-0.107	-0.108
	(0.187)	(0.189)	(0.187)	(0.189)	(0.192)	(0.194)
Public company	0.411	0.414	0.415	0.417	0.392	0.39
	(0.140)***	(0.142)***	(0.141)***	(0.142)***	(0.142)***	(0.143)***
Sole proprietorship	0.163	0.172	0.165	0.174	0.16	0.174
	(0.082)**	(0.089)*	(0.082)**	(0.089)*	(0.082)*	(0.089)*
Privatized	-0.067	-0.052	-0.07	-0.055	-0.066	-0.046
	(0.097)	(0.102)	(0.097)	(0.102)	(0.098)	(0.103)
Exporter	-0.225	-0.22	-0.218	-0.213	-0.218	-0.204
	(0.075)***	(0.088)**	(0.075)***	(0.088)**	(0.076)***	(0.088)**
Audited	-0.266	-0.243	-0.266	-0.242	-0.264	-0.236
	(0.069)***	(0.073)***	(0.069)***	(0.073)***	(0.070)***	(0.074)***
Inverse Mill's ratio		-0.032		-0.033		-0.062
		(0.141)		(0.141)		(0.143)
Country fixed effects			Yes			
Industry fixed effects			Yes			
Observations	1,951	1,926	1,950	1,925	1,924	1,899
Pseudo R-squared	0.09	0.09	0.09	0.09	0.09	0.09

Note: The dependent variable is a dummy variable equal to 1 if the firm is credit constrained. 'Finance' is one of the three financial variables from Table 4. Each finance variable is locality-specific and is constructed by weighting by number of branches the respective financial variable for each parent bank which has at least one branch or subsidiary in that locality. 'Small firm' is a dummy equal to 1 if the firm has from 2 to 49 employees. 'Big firm' is a dummy equal to 1 if the firm has more than 250 employees. 'Public company' is a dummy equal to 1 if the firm is a shareholder company, or its shares traded in the stock market. 'Sole proprietorship' is a dummy equal to 1 if the firms is a sole proprietorship. 'Privatized' is a dummy equal to 1 if the firm is a former state-owned company. 'Exporter' is a dummy equal to 1 if the firm exports to non-local markets. 'Audited' is a dummy equal to 1 if the firm employs external auditing services. 'Inverse Mill's ratio' is the inverse of Mill's ratio from the probit model in Table 5 for each respective financial variable. Omitted category in firm size is 'Medium firm'. Omitted category in firm ownership is 'Private company'. Omitted categories from the probit equation in Table 5 are 'Competition' and 'Subsidized'. The analysis is performed on all firms present in the 2008 survey. Only localities with non-zero foreign bank presence included. All regressions include country and industry fixed effects. White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2008) and Bankscope (2008).

Table 8.
Probability of being constrained, 2005 and 2008 samples

Panel A. Difference-in-differences 1

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Post × Finance	0.088	-0.044	-0.118	-0.243	-0.015	-0.018
	(0.064)	(0.032)	(0.063)*	(0.049)***	(0.016)	(0.015)
Finance	-0.076	-0.025	0.008	0.086	0.015	0.015
	(0.054)	(0.034)	(0.039)	(0.036)**	(0.014)	(0.011)
Post	-0.377	0.282	1.039	2.115	0.074	0.074
	(0.549)	(0.210)	(0.548)*	(0.425)***	(0.111)	(0.095)
Inverse Mill's ratio	-0.309	-0.304	-0.294	-0.300	-0.331	-0.321
	(0.078)***	(0.076)***	(0.077)***	(0.077)***	(0.776)***	(0.076)***
Country fixed effects	Yes					
Observations	4,338	4,338	4,337	4,337	4,309	4,309
Pseudo R-squared	0.11	0.10	0.10	0.10	0.10	0.10

Panel B. Difference-in-differences 2

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Post × Non-Affected	-0.391	-0.225	0.045	0.031	0.586	-0.094
	(0.126)***	(0.098)**	(0.103)	(0.100)	(0.584)	(0.398)
Non-Affected	0.163	0.190	0.062	-0.063	-0.865	-0.518
	(0.105)	(0.081)**	(0.103)	(0.086)	(0.347)**	(0.208)**
Post	0.152	0.183	0.047	0.043	0.044	0.055
	(0.075)**	(0.087)**	(0.082)	(0.090)	(0.073)	(0.073)
Inverse Mill's ratio	-0.313	-0.320	-0.329	-0.334	-0.346	-0.337
	(0.083)***	(0.083)***	(0.085)***	(0.085)***	(0.083)***	(0.084)***
Country fixed effects	Yes					
Observations	3,656	3,656	3,655	3,655	3,640	3,640
Pseudo R-squared	0.11	0.11	0.11	0.11	0.11	0.11

Note: The dependent variable is a dummy variable equal to 1 if the firm is credit constrained. 'Finance' is one of the three financial variables from Table 4. Each finance variable is locality-specific and is constructed by weighting equally (Columns labelled "Equally-weighted") or by number of branches (Columns labelled "Branch-weighted") the respective financial variable for each parent bank which has at least one branch or subsidiary in that locality. 'Post' is a dummy variable equal to 1 if the observation is in 2008, and to 0 if it is in 2005. 'Non-Affected' is a dummy variable equal to 1 if the respective finance variable declined by less than 1 standard deviation between 2005 and 2008. 'Inverse Mill's ratio' is the inverse of Mill's ratio from the probit model in Table 5 for each respective financial variable. The regressions also include the rest of the independent variables from Table 7. Omitted categories from the probit equation in Table 5 are 'Competition' and 'Subsidized'. The analysis is performed on all firms present either in the 2005 or in the 2008 survey (Panel A), and on all firms present in localities which appeared both in the 2005 and the 2008 survey (Panel B). Only localities with non-zero foreign bank presence included. All regressions include country and year fixed effects (Panel A) and country fixed effects (Panel B). White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2005 and 2008) and Bankscope (2005 and 2008).

Table 9.
Probability of being constrained, by degree of foreign ownership

Panel A. 2008 sample

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Finance × Foreign	-0.159	-0.062	0.097	0.310	-0.034	-0.029
	(0.068)***	(0.055)	(0.158)	(0.137)**	(0.019)*	(0.020)
Country fixed effects			Yes			
Industry fixed effects			Yes			
Observations	1,926	1,926	1,925	1,925	1,899	1,899
Pseudo R-squared	0.09	0.09	0.09	0.10	0.09	0.09

Panel B. 2005 and 2008 samples, difference-in-differences 1

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Post × Finance	-0.006	-0.004	0.001	0.002	-0.026	-0.025
× Foreign	(0.016)	(0.015)	(0.011)	(0.011)	(0.012)**	(0.013)*
Country fixed effects			Yes			
Observations	4,288	4,288	4,287	4,287	4,259	4,259
Pseudo R-squared	0.10	0.10	0.10	0.10	0.10	0.10

Panel C. 2005 and 2008 samples, difference-in-differences 2

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Post × Non-Affected	-0.013	0.116	0.257	0.130	-0.521	-0.490
× Foreign	(0.405)	(0.108)	(0.232)	(0.119)	(0.281)*	(0.182)***
Country fixed effects			Yes			
Observations	3,606	3,606	3,605	3,605	3,587	3,587
Pseudo R-squared	0.11	0.11	0.11	0.11	0.11	0.11

Note: The dependent variable is a dummy variable equal to 1 if the firm is credit constrained. 'Finance' is one of the three financial variables from Table 4. Each finance variable is locality-specific and is constructed by weighting equally (Columns labelled "Equally-weighted") or by number of branches (Columns labelled "Branch-weighted") the respective financial variable for each parent bank which has at least one branch or subsidiary in that locality. 'Post' is a dummy variable equal to 1 if the observation is in 2008, and to 0 if it is in 2005. 'Non-Affected' is a dummy variable equal to 1 if the respective finance variable declined by less than 1 standard deviation between 2005 and 2008. 'Foreign' is a dummy variable equal to 1 if the locality is in the top half of the distribution of foreign ownership. The regressions also include the rest of the independent variables from Table 7, including the inverse of Mill's ratio. Omitted categories from the probit equation in Table 5 are 'Competition' and 'Subsidized'. The analysis is performed on all firms present in the 2008 survey (Panel A), on all firms present either in the 2005 or the 2008 survey (Panel A), and on all firms present in localities which appeared both in the 2005 and the 2008 survey (Panel B). Only localities with non-zero foreign bank presence included. All regressions include country and industry fixed effects (Panel A), country and year fixed effects (Panel B), and country fixed effects (Panel C). White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2005 and 2008) and Bankscope (2005 and 2008).

Table 10.
Probability of being constrained: EU countries

Panel A. 2008 sample

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Finance	0.021	-0.078	-0.062	-0.218	0.007	0.010
	(0.040)	(0.043)*	(0.071)	(0.078)***	(0.012)	(0.011)
Country fixed effects			Yes			
Industry fixed effects			Yes			
Observations	1,587	1,587	1,586	1,586	1,565	1,565
Pseudo R-squared	0.09	0.09	0.09	0.10	0.10	0.10

Panel B. 2005 and 2008 samples, difference-in-differences 1

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Post × Finance	0.064	-0.056	-0.061	-0.225	-0.017	-0.028
	(0.069)	(0.033)*	(0.066)	(0.053)***	(0.019)	(0.016)*
Country fixed effects			Yes			
Observations	3,658	3,658	3,657	3,657	3,634	3,634
Pseudo R-squared	0.10	0.10	0.10	0.10	0.10	0.10

Panel C. 2005 and 2008 samples, difference-in-differences 2

	Finance = Equity/assets		Finance = Tier 1 capital		Finance = Gains on fin assets	
	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Post × Non-Affected	-0.409	-0.162	-0.108	-0.152	0.691	0.105
	(0.130)***	(0.097)*	(0.111)	(0.089)*	(0.615)	(0.430)
Country fixed effects			Yes			
Observations	3,072	3,072	3,071	3,071	3,056	3,056
Pseudo R-squared	0.11	0.11	0.11	0.11	0.11	0.11

Note: The dependent variable is a dummy variable equal to 1 if the firm is credit constrained. 'Finance' is one of the three financial variables from Table 4. The sample excludes firms from non-EU countries (Albania, Croatia, Macedonia, and Montenegro). Each finance variable is locality-specific and is constructed by weighting equally (Columns labelled "Equally-weighted") or by number of branches (Columns labelled "Branch-weighted") the respective financial variable for each parent bank which has at least one branch or subsidiary in that locality. 'Post' is a dummy variable equal to 1 if the observation is in 2008, and to 0 if it is in 2005. 'Non-Affected' is a dummy variable equal to 1 if the respective finance variable declined by less than 1 standard deviation between 2005 and 2008. The regressions also include the rest of the independent variables from Table 7, including the inverse of Mill's ratio. Omitted categories from the probit equation in Table 5 are 'Competition' and 'Subsidized'. The analysis is performed on all firms present in the 2008 survey (Panel A), on all firms present either in the 2005 or the 2008 survey (Panel A), and on all firms present in localities which appeared both in the 2005 and the 2008 survey (Panel B). Only localities with non-zero foreign bank presence included. All regressions include country and industry fixed effects (Panel A), country and year fixed effects (Panel B), and country fixed effects (Panel C). White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2005 and 2008) and Bankscope (2005 and 2008).

Table 11.
Probability of being constrained: Differential effects

	Equally-weighted	Branch-weighted	Equally-weighted	Branch-weighted
Tier 1 capital × Asset tangibility 1	-0.359	-0.325		
	(0.217)*	(0.137)**		
Tier 1 capital × Asset tangibility 2			-0.673	-0.527
			(0.170)***	(0.119)***
City fixed effects			Yes	
Industry fixed effects			Yes	
Observations	1,210	1,210	1,210	1,210
Pseudo R-squared	0.16	0.16	0.16	0.16

Note: The dependent variable is a dummy variable equal to 1 if the firm is credit constrained. 'Tier 1 capital' is the ratio of Tier 1 capital to total assets. It is locality-specific and is constructed by weighting equally (Columns labelled "Equally-weighted") or by number of branches (Columns labelled "Branch-weighted") the Tier 1 capital ratio for each parent bank which has at least one branch or subsidiary in that locality. 'Asset tangibility 1' is a dummy equal to 1 if the industry is in the top 50% of the distribution of industry medians of the ratio of research and development expenses to sales for mature Compustat firms over the period 1990-2000. 'Asset tangibility 2' is a dummy equal to 1 if the industry is in the bottom 50% of the distribution of industry medians of capital usage per worker with external funds for mature Compustat firms over the period 1990-2000. The regressions also include the rest of the independent variables from Table 7, including the inverse of Mill's ratio. Omitted categories from the probit equation in Table 5 are 'Competition' and 'Subsidized'. The analysis is performed on all firms present in the BEEPS 2008 survey. Only localities with non-zero foreign bank presence included. All regressions include city and industry fixed effects. White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2008) and Bankscope (2008).

Table 12. Probability of being constrained: Geography issues

	2008 sample			
	<3 banks	small firms only	<3 banks and small firms only	euro
Tier 1 capital	-0.321	-0.209	-0.746	
	(0.172)*	(0.079)***	(0.277)***	
Tier 1 capital * euro				-0.196
				(0.138)
Country fixed effects		Yes		
Industry fixed effects		Yes		
Observations	103	1,358	63	1,925
Pseudo R-squared	0.29	0.07	0.36	0.09

Note: The dependent variable is a dummy variable equal to 1 if the firm is credit constrained. 'Tier 1 capital' is the ratio of Tier 1 capital to total assets. It is locality-specific and is constructed by weighting by number of branches the Tier 1 capital ratio for each parent bank which has at least one branch or subsidiary in that locality. The sample is restricted to localities with a maximum of 2 banks (Columns labelled "<3 banks"), to the sub-sample of small firms only (Columns labelled "small firms"), and to the sub-sample of small firms in localities with a maximum of 2 banks (Columns labelled "<3 banks and small firms"). 'euro' is a dummy equal to 1 if the country is in the euro zone or has its currency pegged to the euro (Bulgaria, Estonia, Latvia, Lithuania, Slovakia, Slovenia). The regressions also include the rest of the independent variables from Table 6. The analysis is performed on firms present in the 2008 and 2005 BEEPS surveys. Only localities with non-zero foreign bank presence included. All regressions include country and industry fixed effects. White (1980) robust standard errors are reported in parentheses, where *** indicates significance at the 1% level, ** at the 5% level, and * at the 10% level. See Appendix 1 for exact definitions. Source: BEEPS (2008) and Bankscope (2008).

Appendix 1. Variables – definitions and sources

Variable Name	Definition	Source
	Firm characteristics	
Small firm	Dummy=1 if firm has less than 99 employees	BEEPS 2005 & 2008
Medium firm	Dummy=1 if the firm has between 100 and 499 employees	BEEPS 2005 & 2008
Big firm	Dummy=1 if firm has more than 500 employees	BEEPS 2005 & 2008
Public company	Dummy=1 if firm is a shareholder company / shares traded in the stock market	BEEPS 2005 & 2008
Private company	Dummy=1 if firm is a shareholder company / shares traded privately if at all	BEEPS 2005 & 2008
Sole proprietorship	Dummy=1 if firm is a sole proprietorship	BEEPS 2005 & 2008
Privatized	Dummy=1 if the firm went from state to private ownership in the past	BEEPS 2005 & 2008
Subsidized	Dummy=1 if the firm has received state subsidized in the past year	BEEPS 2005 & 2008
Exporter	Dummy=1 if firm's production is at least partially exported	BEEPS 2005 & 2008
Competition	Dummy=1 if pressure from competitors is "fairly" or "very" severe	BEEPS 2005 & 2008
Audited	Dummy=1 if the firm has its financial accounts externally audited	BEEPS 2005 & 2008
	Credit demand and credit access	
Need loan	Dummy=1 if the firm doesn't need a loan because it has sufficient capital	BEEPS 2005 & 2008
Constrained	Dummy=1 if the firm was refused a loan or didn't apply for one because of adverse loan conditions	BEEPS 2005 & 2008
	Industry benchmarks	
R&D intensity	Median proportion of the ratio of research and development expenses to sales for mature Compustat firms over the period 1990-2000	Compustat
Capital intensity	Median proportion of capital usage per worker for mature Compustat firms over the period 1990-2000	Compustat

Bank-level variables		
% foreign owned bank assets	Share of banking sector assets owned by branches or subsidiaries of foreign banks	EBRD Transition report 2008
Foreign	Dummy=1 if the locality is in the top half of the distribution of foreign bank ownership.	Bankscope 2005 & 2008
Equity/assets	Ratio of total equity to total assets	Bankscope 2005 & 2008
Tier 1 capital	Ratio of Tier 1 capital to total risk-weighted assets	Bankscope 2005 & 2008
Gain on financial assets	Gain on financial assets held by the bank	Bankscope 2005 & 2008

Appendix 2. Domestic and parent banks in the sample

Country	Bank	Parent bank and country of incorporation
Albania	Alpha Bank	Alpha Bank - Greece
	Raiffeisen	Raiffeisen - Austira
	Banka Kombetare Trektare	domestic
	Tirana Bank	Pireus Bank - Greece
	Intessa San Paolo Bank Albania	Intessa San Paolo - Italy
	National Bank of Greece	National Bank of Greece
	Emporiki	Emporiki Bank - Greece
	Banka Credins	domestic
Bulgaria	Alpha bank	Alpha Bank - Greece
	Unicredit Bulbank	UniCredit Group - Italy
	DSK	OTP - Hungary
	First Investment Bank	domestic
	PostBank	EFG Eurobank - Greece
	Expressbank	Societe Generale - France
	United Bulgarian Bank	National Bank of Greece
	Reiffeisen	Raiffeisen - Austira
	Piraeus	Piraeus Bank - Greece
Croatia	Zagrebaska Bank	UniCredit Group - Italy
	Privredna Bank Zagreb	Intessa San Paolo - Italy
	Erste & Steiermarkische Bank	Erste Group - Austria
	Raiffeisen Bank	Raiffeisen - Austria
	Societe Generale - Splitska Banka	Societe Generale - France
	Hypo Alde Adria Bank	Hypo Group - Austria
	OTP Banka Hrvatska	OTP - Hungary
	Slavonska Banka	domestic
	Hrvatska Postanska Banka	domestic
Czech Republic	Ceska Sporitelna	Erste Group - Austria
	CSOB	KBC - Belgium
	Komercni Banka	Societe Generale - France
	UniCredit Bank CR	UniCredit Group - Italy
	Citibank	Citibank - US
	Ceskomoravska zarucni a rozvojova banka	domestic
	GE Money Bank	GE Money - US
	Hypotecni Banka	KBC - Belgium
	Raiffeisenbank	Raiffeisen - Austira
Estonia	Swedbank Estonia	Swedbank - Sweden
	SEB	Skandinavska Enskilda Banken - Sweden
	Sampo Pank	Danske Pank - Denmark
	Nordea	Nordea Bank - Finland
Hungary	OTP Bank	domestic
	K&H Commercial and Credit Bank	KBC - Belgium
	MKB Bank	Bayerische Landesbank - Germany
	CIB Bank	Intessa San Paolo - Italy
	Raiffeisen Bank	Raiffeisen - Austira
	Erste Bank Hungary	Erste Group - Austria
	KDB Bank	KDB Seoul - Korea
	UniCredit Bank Hungary	UniCredit Group - Italy
Latvia	Parex	domestic
	Hansabank	Swedbank - Sweden

	Latvijas Krajbanka	Snoras Bank - Lithuania
	SMP Bank	domestic
	Rietumu Banka	domestic
	Trasta Komercbanka	domestic
Lithuania	SEB	Skandinavska Enskilda Banken - Sweden
	Sampo Pank	Danske Pank - Denmark
	Nordea	Nordea Bank - Finland
	Snoras Bank	domestic
	Ukio Bankas	domestic
	Hansabankas	Swedbank - Sweden
	Parex Bankas	Parex Group - Latvia
Macedonia	Alpha Bank	Alpha Bank - Greece
	Stopanska Banka	National Bank of Greece
	Komercijalna Banka	domestic
	NLB Tutunska Banka	NLB - Slovenia
	Ohridska Banka	Societe Generale - France
	Pro Credit Bank	Pro Credit Group
Montenegro	AtlasMont Bank	domestic
	Crnogorska Komercijalna Banka	OTP - Hungary
	Hypo-Alpe-Adria Bank	Hypo Group - Austria
	Komercijalna Banka ad Budva	domestic
	NLB Montenegro Banka	NLB - Slovenia
	Prva Banka Crne Gore	domestic
	Invest Banka Montenegro	domestic
	Podgoricka Banka SG	Societe Generale - France
	Opportunity Bank	domestic
Poland	PKO Bank	domestic
	Bank Pekao	UniCredit Group - Italy
	Bank BPH	UniCredit Group - Italy
	Bank Zachodni WBK	AIB - Ireland
	ING Bank Slaski	ING Bank - Netherlands
	Bank Pocztowy	domestic
	Kredyt Bank	KBC - Belgium
	mBank	Commerzbank - Germany
	Getin Bank	domestic
Romania	BCR	Erste Group - Austria
	BRD Group Societe General	Societe Generale - France
	Volksbank Romania	Volksbank - Austria
	Raiffeisen Bank	Raiffeisen - Austira
	Alpha Bank Romania	Alpha Bank - Greece
	UniCredit Tiriac Bank	UniCredit Group - Italy
	Banca Transilvania	domestic
	Bancpost	EFG Eurobank - Greece
	CEC Bank	domestic
Slovakia	Vseobecna Uverova banka	Intessa San Paolo - Italy
	Slovenska Sporitelna	Erste Group - Austria
	Tatra Banka	Raiffeisen - Austira
	OTP Banka Slovensko	OTP - Hungary
	Dexia Banka Slovensko	Dexia - Belgium
	UniCredit Bank Slovakia	UniCredit Group - Italy
	Volksbank Slovensko	Volksbank - Austria
	CSOB Slovakia	KBC - Belgium

Slovenia	Nova Ljubljanska Banka	KBC - Belgium
	Nova Kreditna Banka Maribor	domestic
	Abanka	domestic
	SKB	Societe Generale - France
	UniCredit	UniCredit Group - Italy
	Banka Koper	Intessa San Paolo - Italy
	Banka Celje	domestic
	Reiffeisen Krekova banka	Raiffeisen - Austira

Appendix 3. Bank data coverage

Country	Ratio assets of the banks in the data set to total assets of the country's banking sector
Albania	0.982
Bulgaria	0.857
Croatia	0.887
Czech Republic	0.913
Estonia	0.956
Hungary	0.948
Latvia	0.851
Lithuania	0.896
Macedonia	0.877
Montenegro	0.862
Poland	0.859
Romania	0.904
Slovakia	0.925
Slovenia	0.862

Source: Bankscope (2008).