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MONETARY POLICY, BANK CAPITAL AND CREDIT SUPPLY

A ROLE FOR DISCOURAGED AND INFORMALLY REJECTED FIRMS

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In 2013 all ECB publications feature a motif taken from the €5 banknote.

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Abstract

This paper conducts the first empirical study of the bank balance sheet channel using data on discouraged and informally rejected firms in addition to information on the formal loan granting process. I take advantage of a unique survey data on the credit experience of firms in 8 economies that use the euro or are pegged to it over 2004-2007, and analyze the effect of monetary policy and the business cycle on bank lending and risk-taking. Identification rests on exploiting 1) the exogeneity of monetary policy to local business cycles, and 2) firm-level and bank-level data to separate the supply of credit from changes in the level and composition of credit demand. Consistent with previous studies, I find that lax monetary conditions increase bank credit in general and bank credit to ex-ante risky firms in particular, especially for banks with lower capital ratios. Importantly, I find that the results are considerably stronger when data on informal credit constraints are incorporated.

JEL classification: E32, E51, E52, F34, G21

Keywords: bank lending channel, monetary policy, business cycle, bank capital, cross-border lending.

Non-technical Summary

The period of low interest rates between 2002 and 2005 was followed first by a monetary contraction and then by a global recession, a wide-spread banking crisis, and the deepest credit crunch since the Great Depression. Many economists have argued for a causal link between these events. The mechanism suggested is as follows: prolonged periods of expansionary monetary policy induce banks to take on excessive credit risk (e.g., Rajan, 2006; Brunnermeier, 2009; Calomiris, 2009; Diamond and Rajan, 2009; and Taylor, 2011). When monetary policy contracts and economic conditions worsen, not only does the credit supply decrease (see Bernanke and Gertler, 1989, and Bernanke and Gertler, 1995), but also agency problems between investors and lowly capitalized banks are exacerbated (Holmstrom and Tirole, 1997; Diamond and Rajan, 2012), leading to an even sharper reduction in bank credit. As a result, under tight economic and monetary conditions, a capital crunch begets a credit crunch.

Taking this theoretical mechanism to the data poses a number of econometric challenges. First, monetary policy is often endogenous to the business cycle. For example, short-term interest rates may be determined by output growth expectations through a Taylor (1993)-like rule, or monetary policy may expand in response to increased macroeconomic risk, making it difficult to separate the effect of monetary policy on bank credit supply and risk taking from the effect of the business cycle. Second, contractionary monetary policy and adverse economic conditions may increase banks' agency costs and firms' agency costs at the same time, making it difficult to distinguish a credit supply effect from a credit demand effect and from a simple repricing of risk.

The third challenge deals with unobservable credit constraints. In particular, many customers are discouraged from applying for a loan, anticipating that they would not get one, and many loan applications are informally rejected, which keeps them out of official bank records (see Cavalluzzo and Wolken, 2005, for evidence on U.S. business firms; and Cox and Jappelli, 1993, and Duca and Rosenthal, 1993, for evidence on U.S. households). As a result, firms that do not apply for a loan because they do not need one become observationally equivalent to firms that are informally rejected, and so a potentially significant share of credit constrained firms becomes unobservable to the econometrician. If firms are more likely to be discouraged when economic conditions worsen, or

if informal rejections are higher at banks with lower capital, the sensitivity of the credit supply to monetary policy, to the business cycle, and to bank capital will be systematically underestimated.

This paper contributed to the literature by addressing all three identification problems simultaneously. In particular, I use a unique survey dataset to analyze firms' credit market experience between 2004 and 2007 in 8 central and eastern European countries which are either using the euro or have their currency pegged to the euro. The data come from the 2005 and 2008 waves of the World Bank-EBRD Business Environment and Enterprise Performance Survey (BEEPS) of SMEs in emerging Europe. They contain detailed information on firms whose loan application was granted or turned down by a bank during the previous year, as well as on firms which had a positive demand for loans but did not apply. This set-up is ideal to address the three identification challenges. First, monetary policy in the euro area is clearly exogenous to the business cycle in small economies which use (or are pegged to) the euro, but at the same time, by affecting the banks' borrowing costs, it should affect bank lending and risk taking in these markets. Second, the detailed firm-level characteristics contained in the survey allow me to separate changes in credit supply from changes in the level and composition in credit demand. Finally, by relying on survey data rather than on data from a credit register, I can include information from firms that did not formally apply for credit and do not appear in bank records, but are technically credit constrained as they are either discouraged by tight credit conditions, or informally rejected by the loan officer.

The key findings are as follows. First, controlling for the level and the composition of credit demand, I find that laxer monetary conditions reduce the share of credit constrained firms in the economy. Second, credit supply is more sensitive to monetary policy if the bank has a lower core capital ratio. Third, both effects are stronger when the firm that demands credit is ex-ante risky. Finally, all three effects are stronger when I analyze not only rejected loan applications, but also discouraged and informally rejected firms. This combined evidence suggests that lax monetary policy induces bank risk taking; that the sensitivity of credit supply and risk taking to monetary policy depends on bank balance-sheet strength; and that using information on credit applications and granted loans, ignoring information on discouraged firms, for identification purposes produces a lower bound for both effects. My results thus imply that the bank balance sheet channel is more

potent than previously thought.

My results imply that in terms of quantifying the effect of agency costs in the transmission of monetary policy, there is value added to analyzing survey data in addition to credit register data. However, the question of how generalized this result is remains. Albertazzi and Marchetti (2009) and Jimenez, Ongena, Peydro, and Saurina (2011a) argue that firm discouragement and informal rejection is an almost non-existing phenomenon in Italy and Spain, respectively. At the same time, Cavalluzzo, and Wolken (2005), Cox and Jappelli (1993), and Duca and Rosenthal (1993) report that discouragement is a non-negligible phenomenon in the case of US firms and households. Chakravarty and Xiang (2009) show that around 20% of all firms are discouraged from applying for a loan in a sample of emerging markets. If loan discouragement is an international phenomenon which varies by country, then identifying the bank balance sheet channel by observing the outcomes of formal loan applications only may under- or over-estimate the potency of that channel, depending on how the share of discouraged and informally rejected firms varies with the business cycle and with bank soundness. By incorporating survey data from other markets, future research can greatly contribute to our understanding of the transmission of monetary policy.

1 Introduction

The period of low interest rates between 2002 and 2005 was followed first by a monetary contraction and then by a global recession, a wide-spread banking crisis, and the deepest credit crunch since the Great Depression. Many economists have argued for a causal link between these events. The mechanism suggested is as follows: prolonged periods of expansionary monetary policy induce banks to take on excessive credit risk (see, e.g., Rajan, 2006; Brunnermeier, 2009; Calomiris, 2009; Diamond and Rajan, 2009; and Taylor, 2011). When monetary policy contracts and economic conditions worsen, not only does the credit supply decrease (see Bernanke and Gertler, 1989; 1995), but also agency problems between investors and lowly capitalized banks are exacerbated (Holmstrom and Tirole, 1997; Gambacorta and Mistrulli, 2004; Diamond and Rajan, 2011), leading to an even sharper reduction in bank credit. As a result, under tight economic and monetary conditions, a capital crunch begets a credit crunch.

Taking this theoretical mechanism to the data poses a number of econometric challenges. First, monetary policy is often endogenous to the business cycle. For example, short-term interest rates may be determined by output growth expectations through a Taylor (1993)-like rule, or monetary policy may expand in response to increased macroeconomic risk. Consequently, it is difficult to separate the effect of monetary policy on bank credit supply and risk taking from the effect of the business cycle. Second, contractionary monetary policy and adverse economic conditions may increase banks' agency costs and firms' agency costs at the same time; low-net worth firms may be borrowing from low-net worth banks (Gertler and Gilchrist, 1994); and the composition of credit applicants may be changing as economic conditions deteriorate. This makes it difficult to distinguish a credit supply effect from a credit demand effect and from a simple repricing of risk.

The third challenge deals with unobservable credit constraints. In particular, many customers are discouraged from applying for a loan, anticipating that they would not get one, and many loan applications are informally rejected, which keeps them out of official bank records (see Cavalluzzo and Wolken, 2005, for evidence on U.S. business firms; and Cox and Jappelli, 1993, and Duca and Rosenthal, 1993, for evidence on U.S. households). As a result, firms that do not apply for a loan because they do not need one become observationally equivalent to firms that are informally

rejected, and so a potentially significant share of credit constrained firms becomes unobservable to the econometrician. If firms are more likely to be discouraged when economic conditions worsen, or if informal rejections are higher at banks with lower capital, the sensitivity of the credit supply to monetary policy, to the business cycle, and to bank capital will be systematically underestimated. While the first two challenges are well understood, the third one is never addressed in empirical work due to the fact that standard datasets of the loan granting process - like a credit register - do not include data on discouraged and informally rejected firms.

This paper contributed to the literature by addressing all three identification problems simultaneously. In particular, I use a unique survey dataset to analyze firms' credit market experience between 2004 and 2007 in 8 central and eastern European countries which are either using the euro or have their currency pegged to the euro. The data come from the 2005 and 2008 waves of the World Bank-EBRD Business Environment and Enterprise Performance Survey (BEEPS) of SMEs in emerging Europe. They contain detailed information on firms whose loan application was granted or turned down by a bank during the previous year, as well as on firms which had a positive demand for loans but did not apply. While it is not known which bank gave (denied) the loan, the dataset contains information on each firm's town of incorporation. I construct the branching network of the banks holding at least 80% of each national market, allowing me to match each firm, based on geographic proximity, to the dominant bank(s) in each local market. The final dataset consists of $3,418$ firms incorporated in 596 local markets served by branches and subsidiaries of 57 banks.

This set-up is ideal to address the three identification challenges. Regarding the first challenge, monetary policy in the euro area is clearly exogenous to the business cycle in small economies which use (or are pegged to) the euro, but at the same time, by affecting the banks' borrowing costs, it should affect bank lending and risk taking in these markets. With respect to the second challenge, the detailed firm-level characteristics contained in the survey allow me to separate the change in credit supply from the change in the level and composition in credit demand. Finally, by relying on survey data rather than on data from a credit register, I can include information from firms that did not formally apply for credit (i.e., they do not appear in any bank records), but are technically

credit constrained as they are either discouraged by tight credit conditions, or informally rejected by the loan officer. Due to reasons that are still poorly understood, considerably more firms in emerging Europe are discouraged and informally rejected than are formally rejected (see Brown, Ongena, Popov, and Yesin, 2011), making the identification of such firms crucial for an unbiased analysis.

My key findings are as follows. First, controlling for the level and the composition of credit demand, I find that laxer monetary conditions reduce the share of credit constrained firms in the economy. Second, credit supply is more sensitive to monetary policy if the bank has a lower core capital ratio. Third, both effects are stronger when the firm that demands credit is ex-ante and ex-post risky. Fourth, all of the above effects are stronger when discouraged and informally rejected firms are included in the analysis, in addition to formally rejected credit applications. The results are robust to controlling for a wide range of observable characteristics at the firm level. They are also robust to eliminating unobservable heterogeneity at the market and industry level, as well as to controlling for cyclical variations in credit demand and credit supply which are common to all banks and firms at the same stage of the business cycle. Finally, the main results of the paper survive when I analyze the credit experience of a panel of firms over time, which allows me to account for unobservable firm-level heterogeneity.

This combined evidence suggests that lax monetary policy induces bank risk taking and that the sensitivity of credit supply and risk taking to monetary policy depends on bank balance-sheet strength. Even more importantly, the evidence points to the fact that incorporating information on informally constrained firms is key to understanding the true nature of credit supply and the strength of the credit channel. My results imply that the credit channel is more potent than previously thought.

To my knowledge, this is the first paper to investigate the effect of monetary policy, the business cycle, and bank capital on bank credit supply and risk taking in a large cross-section of countries using data on both formal and informal credit constraints. Ioannidou, Ongena, and Peydro (2009) and Jiménez, Ongena, Peydro, and Saurina (2011) study the effect of monetary policy on bank risk taking in Bolivia and in Spain, respectively. This paper is similar to theirs in that it exploits the

fact that monetary policy is exogenous to the local markets (set by the US Federal Reserve Board in the case of dolarized Bolivia, and by the European Central Bank in Spain). The contribution of my paper relative to these studies is to look at the effect of monetary policy on bank risk taking in multiple markets at varying business cycle stages, which allows me to separate the effect of monetary policy and of economic conditions not only over time, but also in the cross-section. In the same vein, and relative to Altunbas, Gambacorta, and Marques (2010) and Maddaloni and Peydro (2011), who analyze the effect of monetary policy on risk taking, I use balance sheet information on actual lending to extract a measure of bank risk taking. In addition, a voluminous body of empirical work has looked at the transmission of monetary policy through the credit channel. Early analysis based on macro data (Bernanke and Blinder, 1992), on bank-level data (Kashyap and Stein, 2000; Jayaratne and Morgan, 2000; and Ashcraft, 2006, among others), or on firm-level data (Gertler and Gilchrist, 1994; Bernanke, Gertler, and Gilchrist, 1996) have found it difficult to fully disentangle supply and demand. More convincingly, Jiménez, Ongena, Peydro, and Saurina (2012) use information from a credit register on firms, banks, and loan applications to study how contractionary monetary policy interacts with bank capital to induce an over and above decline in the credit supply. Relative to their work, my paper does not use data on multiple credit applications by the same firm within the same time period to identify the bank lending channel. However, it is the first one to incorporate information on discouraged and informally rejected firms - in addition to formal loan applications - into the analysis of the effect of monetary policy, the business cycle, and bank capital on bank credit supply and risk taking.

This paper also offer insights into the role of foreign banks in emerging markets. Overall, 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, 2011). On the other hand, Berger, Klapper, and Udell (2001), Mian (2006), and Gormley (2010) show that foreign banks tend to finance only larger, established, and more profitable firms, and Peek and Rosengren (1997) and Popov and Udell (2012) show that foreign banks shrink their portfolios abroad in response to domestic shocks. This paper adds to

this line of research by providing evidence on how foreign-owned banks' credit supply responds to exogenous monetary policy in foreign markets.

The paper proceeds as follows. Section 2 summarizes the hypotheses and the data. Section 3 describes the empirical methodology and the identification strategy. Section 4 presents and discusses the results. Section 5 concludes and discusses policy implications.

2 Hypotheses and Data

I now summarize briefly the main theories on how loan supply and risk taking by banks responds to monetary policy and economic conditions, and on the role of bank capital in determining the magnitude of this response. I then summarize the dataset used in this paper.

2.1 Research Hypotheses

A number of theories have argued that adverse economic conditions and contractionary monetary policy reduce the bank credit supply. For example, in Kiyotaki and Moore (1997) loans are only made against collateral as financial intermediaries lack the knowledge to continue the investment project if the firm defaults on its debt. Consequently, economic conditions that reduce the value of the collateral decrease the amount of debt firms can acquire, depressing economic activity and pushing the value of the collateral even further. Alternatively, the reduction in credit may be amplified by worsening agency problems. In particular, banks demand that the firm pledge enough of its own wealth into investment projects in order to commit funds. Too little own pledgeable wealth reduces the incentives of the firm to behave diligently and forces banks to engage in costly monitoring, however, their own commitment to monitor is an increasing function of their capital.[1] Because borrower net worth is procyclical (Bernanke, Gertler, and Gilchrist, 1999), agency costs amplify the effect of monetary policy and adverse economic conditions on credit availability.

Expansionary monetary policy can also spur banks to take on more credit risk by reducing the threat of a bank run (Diamond and Rajan, 2006; 2011) and by improving banks' liquidity (Diamond and Rajan, 2011, Gennaioli, Shleifer, and Vishny, 2013), in addition to improving the

[1] See Bernanke and Gertler (1989), Holmstrom and Tirole (1997), Bernanke, Gertler, and Gilchrist (1999), Bernanke (2007), and Gertler and Kiyotaki (2010), among others.

banks' net worth (Fostel and Geanakoplos, 2008; Adrian and Shin, 2009). Combined with acute agency problems when banks have little own capital to pledge,[2] reliance on cheap short-term funding can spur banks to take on more credit risk. Finally, by making risk-free assets less attractive, low interest rates may lead financial intermediaries with short-termist agendas to a search-for-yield exemplified by riskier investments (Rajan, 2006).

Based on these and similar theories, the following three hypotheses can be formulated:[3]

H1. Lower interest rates and higher GDP growth lead to an expansion in the credit supply.

H2. Lower interest rates and higher GDP growth lead to more credit risk taking by banks.

H3. Both effects are stronger for banks with lower capital.

2.2 Data

The ideal dataset should contain data on: 1) granted loans, loan rejections, and discouraged and informally rejected firms; 2) the balance sheets of the banks that granted or refused the loans, informally rejected the loan applications, or discouraged firms from applying; and 3) the balance sheets of firms that applied for a loan or did not apply because they anticipated that they would not be given one. In addition, banks and firms should operate in a setting where monetary policy is exogenous to the business cycle; the same bank should operate in multiple markets, allowing to distinguish the effect of monetary policy and of the business cycle in the cross-section in addition to over time; and the same firm should have credit market experience with multiple financial intermediaries during the same time period in order to identify perfectly the supply of credit.

2.2.1 Firm-level data: Balance sheets

The core firm-level data come from the 2005 and the 2008 waves 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-April 2008 among 11,998 firms from 29 countries in central and eastern Europe and the former

[2] See Dewatripont and Tirole (1994) and Freixas and Rochet (2008) for surveys on the effect of bank capital on the bank's agency problem.

[3] See Ioannidou, Ongena, and Peydro (2009) and Jimenes, Ongena, Peydro, and Saurina (2012) for similar formulations.

Soviet Union, and among 11,399 firms operating in the same countries in March-April 2005. In order to be able to separate the effect of monetary policy from that of the business cycle, I focus on 8 countries whose currency is pegged to the euro or is the euro itself.[4] The BEEPS contains detailed information on the firm's size, age, ownership structure, sector of operation, industry structure, export activities, use of external auditing services, subsidies received from central and local governments, etc. The survey tries to achieve representativeness in terms of the distribution of firms across business activities, as well as in terms of firm size. For example, between three quarters and nine tenths of the firms surveyed are "small" (less than 20 workers) and only around 5% of the firms surveyed are "large" (more than 100 workers).[5] Table 1 provides the summary statistics on the number of firms and their main characteristics, by country.[6]

To tease out the effect of monetary policy and bank capital on bank risk taking, I focus on risky lending. In particular, I look at the firm's informational opacity, which I define as a dummy equal to 1 if the firm does not have its financial accounts verified by an external auditor, and to 0 if it does. This variable captures an important dimension of opacity in the sense that having an audit materially affects the informativeness of the financial statements. Audited statements allow banks to underwrite loans primarily based on financial statement ratios and covenants associated with those ratios (Berger and Udell, 2006). Information opacity is thus related to ex ante risk because unaudited statements (i.e., financial statements that have not been verified by an external auditor) have a much higher risk of material misstatement.

In addition, for audits performed by an outside audit firm, risk assessment is a crucial stage before accepting an audit engagement. The auditor performs risk assessment procedures to obtain an understanding of the entity and its environment, including its internal control, and so audited risk includes detection risk, control risk, and inherent risk. Recent evidence suggests that many firms (especially SMEs) choose not to file a financial report when in distress, implying that firms which do not have their accounts verified by an external auditor, are more likely to default (Jacobson, Linde,

[4] These countries are: Bosnia and Herzegovina, Bulgaria, Estonia, Latvia, Lithuania, Montenegro, Slovakia, and Slovenia.

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

[6] While it is also important to control for firm foreign ownership (see Antras, Desai, and Foley, 2009), this information is only available for the firms in the 2005 wave, and so it is not used in the empirical exercises.

and Roszbach, 2013). As a consequence, information opacity also captures an important dimension of ex post risk. Lending based on information opacity is therefore directly related to risk taking by banks. Recent evidence has strongly linked firm opacity to bank risk taking. For example, in an expanded version of the dataset used in this paper, Ongena, Popov, and Udell (2012) show that tighter restrictions on bank activities in the bank's primary domestic market leads to more lending to informationally opaque firms by the bank's subsidiaries abroad, suggesting that banks shift risk across national markets in response to regulatory changes.

There is considerable variation across countries in this firm-level variable of interest. As implied by Table 1, for example, 81% of the SMEs in Estonia pay external auditors to verify their accounts, while only 40% of the firms in Lithuania do. On average in the sample, 45% of the firms are informationally opaque.

2.2.2 Firm-level data: Credit demand and credit supply

To define measures of credit access, I focus on the firms' self-reported credit experience. In both surveys the firms were asked if they have recently obtained a bank loan. If they have not, they are asked what is the main reason, to which the possible answers are "Applied and was rejected" or "Did not apply". Firms that did not apply were further asked for the reason why they did not apply. The possible answers to this question are "No need for a loan", "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".

This allows me to classify the firms as *Credit constrained* using two different criteria. According to the "Credit Register" criterion, *Rejected*, a firm is credit constrained if it applied for a loan and the loan application was rejected. According to the "Survey" criterion, *Rejected or discouraged*, a firm is constrained if it has a positive demand for a bank loan (i.e., it does not answer "Yes" to "No need for a loan"), but has no loan, either because it applied and was rejected, or because it was discouraged from applying (i.e., it answers "Yes" to any of "Interest rates are not favorable", or "Collateral requirements are too high", or "Size of loan and maturity are insufficient", or "Did not think it would be approved"). The first classification is in line with how studies using credit

register data define the loan supply (see Ioannidou, Ongena, and Peydro, 2009; and Jiménez, Ongena, Peydro, and Saurina, 2011; 2012), while the latter classification is used in studies that use survey data to define credit constraints (see Cox and Jappelli, 1993; Duca and Rosenthal, 1993; Popov and Udell, 2012; and Ongena, Popov, and Udell, 2012, among others). The rationale for the latter is that rejected and discouraged borrowers are identical, and discouraged borrowers either correctly anticipate that they will not be given credit, or are discouraged from applying by the loan officer without that information entering bank records. In that sense, discouragement is observationally equivalent to informal rejection.

Table 2 gives an idea of the relationship between credit demand, credit application, rejection, and discouragement. While in fiscal year 2007 on average 62% of the firms in the 8 economies declare positive demand for bank credit (column labeled "Need loan"), only 45% of the firms that do so actually applied for a bank loan. Out of the applicant firms, only 13% were rejected. However, out of all firms that declare a positive demand for credit, 35% did not have a bank loan either because they were rejected, or because they were discouraged from applying or informally rejected. The difference between rejection and discouragement is similar in 2004 when only 5% of applicant firms were rejected, but 26% of all firms with a positive demand for a loan did not have one. This implies that relative to countries where discouragement is almost non-existent (see Albertazzi and Marchetti, 2009, for evidence from Italy; and Jiménez, Ongena, Peydro, and Saurina, 2011; 2012 for evidence from Spain), in the 8 countries in the dataset used in this paper discouragement is an important phenomenon. An empirical analysis of the effect of monetary policy and the business cycle on bank credit and risk taking based on loan applications only would lump together, in the category of "non-applicant firms", firms that do not need credit and firms that are discouraged or informally rejected. Such analysis would produce biased results if the share of credit constrained non-applicant firms varies systematically with monetary policy and with the business cycle.

2.2.3 Bank branching network

The main drawback of the BEEPS is that it does not identify the bank that granted or refused to grant the loan. However, the BEEPS contains information on the locality in which each firm

is incorporated. The firms in the 8 sample countries are incorporated in a total of 596 localities, for an average of 5.7 firms per locality. To take advantage of this geographic information, I make use of a unique hand-collected dataset on the extent of foreign-owned banks' presence in these local markets.[7] In particular, pursuing a trade-off between representativeness and manageability, I narrow the focus on the banks that comprise at least 80% of the banking sector assets in each country. This gives me a range of between 4 banks in Estonia and 9 banks in Bulgaria.

Given this criterion, I then extract information from the banks' web-sites on which localities they are present in, and how many branches they have. The localities in the sample turn out to be served by a total of 57 banks. Out of those, 15 are domestic banks, and 42 are branches or subsidiaries of 17 foreign banks. Appendix 1 illustrates the degree of foreign bank penetration in each country in the sample.[8] The final dataset consists of $3,418$ firms incorporated in 596 local markets.[9]

Figure 1 presents a map of home countries (where the parent banks are domiciled) and of host countries (where the local firms and the branches and subsidiaries of foreign banks operate). In terms of home countries, some markets where large cross-border banks are domiciled, like Spain, Switzerland, and the UK, are excluded because the presence of banks such as Santander, UBS, and HSBC in the region is very limited.

2.2.4 Bank balance sheet data and macro data

Finally, I use Bankscope to extract balance sheet information on the banks in the sample. I collect data from 2005 to 2008 in order to evaluate how banks' balance sheet strength relates to credit availability credit. I focus on core capital (the Tier 1 capital ratio), which is the variable most often used in empirical work as a proxy for the bank's net worth (see Jiménez, Ongena, Peydro, and

[7] An expanded version (for 16 countries) of the same local branching data is used in in Popov and Udell (2012) and in Ongena, Popov, and Udell (2013).

[8] The 17 foreign banks in question are: Erste Group, Hypo Group, Raiffeisen, and Volksbank (Austria), Dexia and KBC (Belgium), Danske Bank (Denmark), Nordea Bank (Finland), Societe Generale (France), Alpha Bank, EFG Eurobank, National Bank of Greece, and Piraeus Bank (Greece), Intesa Sanpaolo and UniCredit Group (Italy), and Swedbank and Skandinaviska Enskilda Bank (Sweden). 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.

[9] Appendix 2 illustrates the representativeness of the bank sample used in this paper.

Saurina, 2011; 2012). While other bank-level characteristics - like liquidity and return on assets - are also relevant, I focus on bank capital as the most empirically sound description of the bank's agency problems (see Holmstrom and Tirole, 1997). Whenever Bankscope does not report data on a particular bank, I use data on the bank's parent instead.

In the absence of a direct match between a firm and a bank, I construct a locality-specific measure of average bank capital by weighting each parent bank's Tier 1 capital by the number of branches its subsidiary has in a particular locality. The underlying assumption is that if firms were granted/denied credit, or if they were discouraged or informally rejected, then it was most likely the result of interaction with the dominant banks in the firms' locality of incorporation. Alternatively, I match each firm with the single most prevalent bank in each locality (that is, the bank with the highest number of branches).

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. I 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 Kuressaare, 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 I 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, I assign a Tier 1 capital ratio of $9.3 = \frac{1}{2} \cdot 8.4 + \frac{1}{4} \cdot 8.4 + \frac{1}{4} \cdot 12$. And in the analysis where I assign each firm to the most dominant bank in the locality, I assign Kuressaare a Tier 1 capital ratio of 8.4.

This procedure gives me a considerable variation in Tier 1 capital 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, the 596 localities in the data are characterized by 451 unique values of locality-specific Tier 1 capital when data on all banks are branch-weighted, although there are only 57 banks involved. Consequently, there is little reason to worry that the country fixed

effects in the regressions capture the same variation as locality-specific financial stress.

This matching procedure implicitly assumes 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 (2010). 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; in Degryse and Ongena's (2005) sample, the median distance between a firm and it's main bank is 2.25 kilometers (1.6 miles); and in Agarwal and Hauswald's (2010) sample, the median distance between a firm and it's main bank is 0.55 miles.

I also determine, for each of the 8 countries, the annual rate of GDP growth during the past year. Table 3 summarizes core bank capital and GDP growth by country and year. Finally, given that all countries in the sample either use the euro, or have their currency pegged to the euro, central bank policy rates and changes in these do not vary by host-country. The ECB policy rate declined from 2.75 in Q4:2002 to 2.00 in Q4:2003, and it increased from 2.25 in Q4:2005 to 3.5 in Q4:2006, namely, the years immediately preceding the BEEPS sample years. Consequently, changes in the policy rate are calculated on an annual basis for the two periods, and so I assign a value of -0.75 to firms observed in 2004 and a value of 1.25 to firms observed in 2007.

2.2.5 Discussion of the data

Early studies of the monetary transmission mechanism and the credit channel relied either on firm-level data, but no bank-level data (Gertler and Gilchrist, 1994; Bernanke, Gertler, and Gilchrist, 1996), or on bank-level data but no firm-level data (Kashyap and Stein, 2000; Jayaratne and Morgan, 2000; and Ashcraft, 2006). Relative to these studies, I use both firm- and bank-level information which provides a crucial step towards identifying credit supply. In that respect the

paper is similar to recent identification efforts using detailed firm- and bank-level information from the Bolivian (Ioannidou, Ongena, and Peydro, 2009) and the Spanish (Jiménez, Ongena, Peydro, and Saurina, 2012) credit registers. Relative to these studies, however, my dataset has two advantages. First, it uses data on 8 countries rather than on one. This allows me to not only investigate the international dimensions of the working of the credit channel, but also to separate the effect of monetary policy and of the business cycle *in the cross section* by studying the transmission of the same monetary policy (changes in ECB policy rates) into markets which in the same moment in time are at different stages of the business cycle. Second, it uses data on discouraged and informally rejected firms, in addition to formally rejected ones, to construct a measure of credit constraints associated with bank lending. In this way, I manage to capture a potentially significant portion of firms that are relevant for identifying bank credit supply, but are not captured by official bank records and hence by credit registers.

On the cons side, relative to the just quoted studies, my data are based on a survey of firms, therefore it includes a sample of firms that formally applied for bank credit rather than the universe of applicant firms.[10] In addition, the survey data contain no information on multiple banking relationships in the same moment in time, which would allow me to eliminate the unobserved component of firm-level demand, and so I rely on observable firm-level characteristics to identify the credit supply. Finally, a credit register contains a direct match between the firm that applied for a loan and the bank that gave or refused it. In comparison, in the dataset I have constructed firms and banks are matched imperfectly, based on geographic proximity, and all firms in a locality are matched either to a locality-average measure of bank balance sheet items (in particular, the capital-to-assets ratio) or to the balance sheet items of the dominant bank in the locality. While this procedure is clearly inferior to having a direct match, it is partially justified by the fact that there are 3.4 times as many discouraged firms in the dataset as there are formally rejected firms (526 discouraged/informally rejected vs. 154 formally rejected), and in the case of discouraged/informally rejected firms, there is no exact firm-bank match by default. Nevertheless, in robustness exercises I partially correct this drawback by determining the dominant bank (i.e., the bank with the highest

[10] For example, the Spanish credit register captures all loans above 6000 euros, and so it contains up to 80% of all loans at any point in time. See Jimenez, Ongena, Peydro, and Saurina (2011; 2012) for details.

number of branches) in each locality and matching to that bank all firms in that locality.

3 Empirical methodology and identification

The goal of this paper is to evaluate how monetary policy and the business cycle interact with bank capital to determine bank lending and risk taking. The immediate approach would be to map short-term rates and GDP growth into loan rejection and the firm risk associated with granted loans, accounting for bank capital. However, this strategy would fail to account for the changing composition across business lenders of firms that demand bank credit, or in other words, for the fact that the sample of firms that apply for credit is not a random sub-sample of the population of firms.[11]

I address this problem by incorporating information on non-applicant firms in a standard 2-step Heckman procedure. The idea is that credit constraints are only observable when a firm demands bank credit: 1) when it applies for one, according to the "Credit Register" criterion; or 2) when it says it needs credit, according to the "Survey" criterion). Let the dummy variable Q equal 1 if the firm applies for credit (expresses a need for credit), and 0 otherwise. The value of Q is in turn determined by the latent variable:

$$q = \zeta \cdot Z_{ijklt} + \varepsilon_{ijklt}$$

where Z_{ijklt} contains variables pertinent to firm i in city j in country k in industry l in year t 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_{ijklt} is normally distributed with mean 0 and variance σ^2. The second stage regression can now be updated by adding the term $\sigma \frac{\phi(q)}{\Phi(q)}$ to the RHS, where $\frac{\phi(q)}{\Phi(q)}$ is the inverse of Mills' ratio (Heckman, 1979) derived from the first step. 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 than the set of variables in the second stage.

Thus, in the second stage regression in which I determine the effect of monetary policy, the business cycle, and bank capital on bank lending and risk taking in foreign markets, I estimate the

[11] See Popov and Udell (2012) for a detailed discussion.

following model:

$$\begin{aligned} Constrained_{ijklt} = \quad & \beta_1 \cdot \Delta IR_t + \beta_2 \cdot \Delta GDP_{kt} + \beta_3 \cdot Capital_{jkt} \\ & + \beta_4 \cdot \Delta IR_t \cdot Capital_{jkt} + \beta_5 \cdot \Delta GDP_{kt} \cdot Capital_{jkt} \\ & + \beta_6 \cdot X_{ijklt} + \beta_7 \cdot D_{bklt} + \beta_8 \sigma \frac{\phi(q)}{\Phi(q)} + u_{ijklt} \end{aligned} \tag{1}$$

where $Constrained_{ijklt}$ is a dummy variable equal to 1 if firm i in city j in country k in industry l in year t is constrained (according to one of the two different criteria outlined before); ΔIR_t is the change in monetary policy over the past year, for all countries; ΔGDP_{kt} is the change in GDP over the past year, for each country k; $Capital_{jkt}$ is the average (or the dominant bank's) Tier 1 capital ratio in each city j in country k in year t; X_{ijklt} is a matrix of firm characteristics; D_{bklt} is a matrix of bank, country, industry, and time dummies; $\sigma \frac{\phi(q)}{\Phi(q)}$ is the selection term from the first-stage regression; and ε_{ijklt} is an idiosyncratic error term. The firm-level co-variates control for observable firm-level heterogeneity. The four sets of dummy variables control for any unobserved bank, market, industry, and business cycle variation. Essentially, they eliminate the contamination of the estimates by time-invariant bank characteristics, like appetite for risk; sectoral characteristics, like growth opportunities; macroeconomic factors, like host-country bank regulation or taxes; and by time-varying developments common to all sample countries, like the business cycle or the credit cycle. In additional regressions, I also interact bank dummies with time dummies to eliminate the effect of unobservable time-varying bank heterogeneity. The selection term is included because both applicant firms and firms that declare a positive need for credit are a non-random sub-sample of the population of firms.

H1 implies that $\beta_1 > 0$ and $\beta_2 < 0$. H2 implies that $\beta_1^r > \beta_1^s$ and $\beta_2^r > \beta_2^s$ where I have split the sample in ex-ante risky (r) and ex-ante safe (s) firms. H3 implies that $\beta_4 < 0$ and $\beta_5 > 0$.

4 Empirical results

4.1 First stage regressions

Table 4 presents the results from the first stage probit regressions. I cluster the standard errors at the level of the locality, which is where the variable $Capital_{jkt}$ varies. In column labeled 'Applied', I study what determines the probability of a firm applying for credit, and in column labeled 'Need loan' I evaluate the probability of a firm having a strictly positive demand for bank credit. The probability of applying for a loan, or for declaring positive demand for bank credit, are generally lower for firms in localities dominated by higher capitalized banks, albeit the effect is never significant. Turning to the firm-level co-variates, the demand for bank credit is in both cases higher for informationally transparent firms, possibly indicating a reverse correlation (firms that need credit employ external auditors to make their financial statements transparent to the bank). It may also be the case that audited firms have access to financial statement lending which may be a cheaper lending technology (Berger and Udell, 2006). Demand for credit also increases in the size of the firm. One potential explanation is that small firms face higher application costs (Brown, Ongena, Popov, and Yesin, 2011), or that small firms are better equipped to finance investment with cash flows than more highly leveraged large firms. Some of the size effects may also be picked by ownership and structural characteristics, as sole proprietorships have a higher demand for loans. Credit demand is higher for exporters and for innovative firms, potentially due to their faster expansion.[12]

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. Analogously, 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 bank credit, and the effect is statistically significant at the 1% level. The

[12] The results are broadly consistent with Ongena and Popov (2011), Ongena, Popov, and Udell (2012), and Popov and Udell (2012), who apply versions of this selection model to various sub-samples of the BEEPS.

F-statistics from these first-stage regressions of loan demand on the two variables (unreported) is between 15 and 24, which satisfies the relevance test.

Finally, due to information limitations in the data I use at most $3,237$ firms in these regression rather than the $3,418$ reported in Table 1, because 150 firms lack various firm-level information.

4.2 Monetary policy, business fluctuations, and bank lending and risk taking: Evidence from formal loan rejections

In this section, I report the estimates from Model 1 where a firm is defined as credit constrained if it applied for credit and was rejected by the bank. Consequently, information is not used on firms that did not apply for a bank loan. I do so regardless of whether these firms selected themselves out of the application process because they did not need credit or because they were rejected (informally rejected) for the purpose of consistency with studies based on the analysis of credit register data. The empirical analysis is performed on the sample of $1,625$ firms that formally applied for bank credit, out of which 154 (about 9.5%) were rejected and the rest received a loan.

The regressions control for country, industry, time, and bank fixed effects, in various combinations, and they incorporate information on firms that did not apply for a loan by including the inverse of Mills' ratio from the first-stage regression in column (1) of Table 4. All firm-level covariates from Table 4 are included with the exception of "Competition" and "Subsidized" whose omission from the regressions is meant to satisfy the exclusion restriction.

Finally, all regressions control for a variety of observable firm-level characteristics. In later tests, I also control for firm-level heterogeneity by including firm fixed effects, which however reduces the sample substantially as only 373 firms are observed both in fiscal year 2004 and in fiscal year 2007. All percentage differences that are reported from now on are based on the marginal effects at the sample means.

4.2.1 Bank lending

In Table 5, I report the estimated coefficients for the baseline probit regression model. As in the previous sub-section, I cluster the standard errors at the level of the locality, which is where the

interaction terms ($\Delta IR_t \cdot Capital_{jkt}$ and $\Delta GDP_{kt} \cdot Capital_{jkt}$) vary.

I start by analyzing in column (1) the effect of changes in monetary policy and in business cycle conditions on bank lending. As changes in both types of macroeconomic conditions are annual, the regressions do not make use of year dummies. I find that a reduction in the policy rate spurs loan granting, while an increase in GDP growth has an insignificant (albeit positive) effect on the supply of credit. A 100-basis-point reduction in the policy rate is associated with a 4.5% lower probability that a loan application will be rejected.

In column (2), I interact macroeconomic changes with the locality-specific measure of bank capital. The estimates suggest that the negative effect of a positive change in the policy rate on loan granting does not depend, in a statistical sense, on bank balance sheet strength. This result is broadly inconsistent with Jiménez, Ongena, Peydro, and Saurina (2012) who find that bank credit supply is more sensitive to changes in monetary policy if banks have lower capital.

In columns (3) and (4), I repeat the two regressions by replacing the locality-average measure of bank capital with the Tier 1 capital ratio of the dominant bank in a particular locality. This allows me to compare directly the effect of lending by subsidiaries of, for example, UniCredit in Bulgaria and in Slovenia. I can thus separate the effect on lending of the business cycle from the effect on lending of monetary policy in the cross-section too, and is one of the empirical contributions of the paper. These regressions also include bank fixed effects. The results from columns (1) and (2) are broadly confirmed: A 100-basis-point reduction in the policy rate is associated with a 5.4% lower probability that a loan application will be rejected (column (3)), but the effect is uniform across banks and does not depend on how well capitalized they are (column (4)).

In all regressions, the estimates of the regression coefficients on the non-excluded firm-level variables imply that small firms, sole proprietorships, and non-innovative firms tend to be more constrained in credit markets. Regarding my main proxy for ex-ante risk, namely informational opacity, I find that non-audited firms also tend to be more credit constrained.

4.3 Bank risk taking

I now turn to investigating the effect of monetary policy and business cycle fluctuations on bank risk taking. Given my baseline model (1), the empirical test boils down to comparing statistically $\beta_1, \beta_2, \beta_3$ and β_4 for two sets of firms, one comprised of ex-ante risky ones, and one comprised of ex-ante safe firms.[13] Therefore, I split the samples along the lines of informational transparency, with non-audited (informationally opaque) firms considered ex-ante risky, and audited (informationally transparent) firms considered ex-ante safe.

Table 6 reports that a reduction in the policy rate spurs loan granting both for ex-ante risky firms (columns (1) and (3)) and for ex-ante safe firms (columns (5) and (7)). It makes it clear that the effect of monetary policy on bank credit supply does depend - in a statistical sense - on ex-ante risk. In the preferred specification with bank fixed effects, a 100-basis-point reduction in the policy rate is associated with a 2.8% lower probability that a loan application by a non-audited firm is rejected (column (3)), and with a 5.4% lower probability that a loan application by an audited firm is rejected (column (7)). This difference is also significant statistically.

Given the linearity of the model, my results also imply that a non-audited firm is more likely to be rejected than an otherwise identical audited firm in response to an *increase* in the policy rate. This suggests that to the extent that lending to opaque firms is ex ante risky, bank risk taking declines when monetary policy is tight.

Turning to the effect of bank balance sheet strength, I find that core bank capital does not affect the sensitivity of bank credit supply to monetary policy. In particular, while the reduction in bank credit is higher for lower capitalized banks when the applicant firm is informationally opaque (columns (2) and (4)), the effect is not significant, and there is no statistical difference in that sensitivity between audited and non-audited firms.

I conclude that when looking at applicant firms only (an analysis consistent with studies that have relied on credit register-type data), there is strong evidence of a decrease in bank lending in response to contractionary monetary policy. However, the data provide evidence neither of bank-risk taking, nor of the role of agency costs in bank lending and risk taking.

[13] Another approach would be to interact the "non-audited" dummy with monetary policy change and with bank capital, but this would run into the intrinsic problems associated with interpreting coefficients on triple interactions.

4.4 Monetary policy, business fluctuations, and bank lending and risk taking: Evidence from formal and informal loan rejections

In this section, I report the estimates from Model 1 where a firm is defined as credit constrained if it a) applied for credit and was rejected by the bank, or 2) did not apply because it was informally rejected or because it was discouraged by unfavorable credit conditions. Consequently, in addition to the 1,625 firms that formally applied for credit, in this section I also use information on 526 firms which declare a positive need for a bank credit, but were discouraged from applying (informally rejected). Thus, I analyze a sample of 2,151 firms that formally applied for bank credit, out of which 680 (about 31.6%) were rejected or discouraged, and the rest have a bank loan.

All regressions incorporate information on firms that do not demand a bank loan by including the inverse of Mills' ratio from the first-stage regression in column (2) of Table 4. As before, *Competition* and *Subsidized* are omitted from the regressions in order to satisfy the exclusion restriction, and all regressions control for various combinations of country, industry, time, and bank fixed effects.

4.4.1 Bank lending

Table 7 replicates the analysis from Table 5 on the expanded sample of firms where discouraged and informally rejected firms are treated not as invisible to the econometrician, but as credit constrained firms. In column (1), I analyze the effect of changes in monetary policy and in business cycle conditions on bank lending. Consistent with column (1) in Table 5, I find that a reduction in the policy rate spurs loan granting, while an increase in GDP growth again no statistically significant effect on the supply of credit. A 100-basis-point reduction in the policy rate is associated with a 6.6% lower probability that a firm will be credit constrained (formally rejected, informally rejected, or discouraged).

Now I turn to analyzing the role of bank balance sheet strength in the transmission of monetary policy by interacting macroeconomic changes with the locality-specific measure of bank capital. As indicated in column (2), in this sub-set of firms the results markedly diverged from what I recorded in column (2) of Table 5. In particular, the estimates suggest that the negative effect of a positive change in the policy rate on loan granting strongly depends - both economically and statistically -

on bank agency costs. In particular, the same increase in the policy rate is associated with a 3.9% higher probability of a firm being credit constrained if it is incorporated in a locality at the 25th rather than the 75th percentile of the distribution of locality-average bank capital.[14] Importantly, this specification controls for year fixed effects, so it nets out the effect of unobservable time-varying macroeconomic conditions. This result is fully consistent with theoretical predictions outlined in Section 2, as well as with recent empirical investigations (see Jiménez, Ongena, Peydro, and Saurina, 2011; 2012).

In columns (3) and (4), I repeat the analysis from columns (1) and (2), respectively, but this time use each locality's dominant bank's core capital, instead of a locality-average one, and I include bank fixed effects in the regressions. This allows me to eliminate unobserved bank-level heterogeneity, as well as to separate the effect of the business cycle and of monetary policy in the cross-section too (given that the same parent bank has subsidiaries in different foreign markets). The results remain qualitatively unchanged: a 100-basis-point reduction in the policy rate is associated with a 7.3% lower probability that a loan application will be credit constrained (column (3)), and this reduction is 3.3% larger if the firm is incorporated in a locality whose dominant bank is at the 25th rather than the 75th percentile of the distribution of locality-average bank capital (column (4)).

This set of tests makes it obvious that when discouraged and informally rejected firms are included in the analysis - in addition to firms that participate in the formal application process - the bank credit supply becomes more sensitive to monetary policy. In particular, there is strong evidence of a decrease in bank lending in response to contractionary monetary policy, and in addition to that, the transmission of monetary policy to the real sector is much stronger for undercapitalized banks.

4.4.2 Bank risk taking

I now replicate the analysis from Table 6 on the sample of firms where discouraged and informally rejected firms are treated as formally rejected instead of invisible to the econometrician. I therefore estimate equation (1) on the two subsets of ex-ante risky and ex-ante safe firms, using information opacity as a proxy for ex-ante riskiness, and then compare statistically the estimates from the

[14] The difference between the 25th and the 75th percentile in terms of locality-average bank capital is 1.14.

relevant terms.

Focusing on my preferred specification where I control for bank fixed effects, the data suggest that the overall transmission of monetary policy is stronger when firms are of lower ex-ante risk. A 100-basis-point reduction in the policy rate is associated with a 3.2% decrease in the probability that a non-audited firm is credit constrained (column (3)), and with a 8.5% decrease in probability that an audited firm is credit constrained (column (7)). In addition, this effect is significant at the 1% in the latter case, and statistically insignificant in the former case.

Turning to the effect of bank balance sheet strength, this time I find that core bank capital strongly affects the sensitivity of credit supply to monetary policy. In particular, the same expansion in monetary policy is associated with a 4.6% larger decline in the probability that an ex-ante risky firm is credit constrained if the firm is incorporated in a locality whose dominant bank is at the 25th rather than the 75th percentile of the distribution of locality-average bank capital (column (4)), and this effect is significant at the 1% statistical level. The same expansion in monetary policy, however, is associated with only a 0.9% larger decline in the probability that an ex-ante safe firm is credit constrained if the firm is incorporated in a locality whose dominant bank is at the 25th rather than the 75th percentile of the distribution of locality-average bank capital (column (8)), the effect being statistically insignificant. The difference between the two coefficients is also significant at the 5% level, and the evidence is robust to employing a locality-specific measure of capital instead of a bank-specific one (columns (2) and (6)).

The estimates thus imply that the sensitivity of credit supply to monetary policy and the impact of bank capital to that sensitivity depends crucially on whether discouraged and informally rejected firms are used in the analysis. When they are, the data suggest that credit supply responds more forcefully to changes in monetary policy, and there is much stronger evidence of bank-risk taking in response to expansionary monetary policy. When credit constrained firms are properly accounted for, the credit channel turns out to be even more potent than previously thought.[15]

[15] In unreported regressions, I reduce the sample to the 373 firms which are observed both in 2004 and in 2007. This allows me to include firm fixed effects in the analysis in addition to all firm-level co-variates and fixed effects used so far. While this procedure controls for unobserved firm-level heterogeneity over time, it is not identical to Kwaja and Mian (2008) and to Jiménez, Ongena, Peydro, and Saurina (2012) who use firm-level fixed effects to eliminate the unobservable component of firm demand *within the same time period*, that is, when a firm simultaneously borrows from multiple banks. Given my empirical strategy, I constrain each firm to borrow from the same bank (set of banks) in all time periods, therefore, I simply eliminate the unobservable component of firm demand over time. In this

5 Conclusion

In this paper, I conduct the first empirical analysis of the credit channel incorporating information on discouraged and informally rejected firms which standard analysis based on credit register data excludes by definition. Paying attention to such firms is crucial: if credit-unworthy applicants systematically drop out of the application process when bank capital is high, when monetary policy is expansive, or when economic conditions improve, the effect of monetary policy, of the business cycle, and of agency costs on bank lending and risk taking, will be systematically over-estimated.

I analyze a detailed firm-level survey dataset on small central and eastern European markets which are either using the euro or their currency is pegged to the euro. This allows me to separate the effect of monetary policy from that of the business cycle, and to identify the effect of credit supply by observing changes in the level and composition of credit demand. Importantly, while I do not observe the universe of applications, I do observe data on discouraged and informally rejected firms that do not appear in official bank records and credit registers. Because I do not observe a direct match between a firm and a bank, I match firms to banks on the basis of their locality of incorporation. My main finding is that the credit channel is much more potent when such firms are included in the analysis. In particular, when I analyze loan granting to formal applicants only, I find strong evidence that a monetary policy expansion results in more granted loans, but bank risk taking does not seem to depend on bank balance sheet strength. However, when I include discouraged and informally rejected firms in the analysis, I find evidence of both higher lending and higher credit risk taking by banks in response to monetary loosening, and both effects are amplified when banks are undercapitalized.

While my results imply that in terms of quantifying the effect of agency costs in the transmission of monetary policy, there is value added to analyzing survey data in addition to credit register data, the question of how generalized this result is remains. For example, Albertazzi and Marchetti (2009) and Jiménez, Ongena, Peydro, and Saurina (2011) argue that firm discouragement and informal rejection is an almost non-existing phenomenon in Italy and Spain, respectively. At the same time,

reduced sample, one of the two main result of the paper survives, namely that the increase in credit supply to ex-ante risky firms in response to expansionary monetary policy is stronger for weakly capitalized banks. This provides some evidence that the risk taking effect I registered before is not driven by a failure to control for unobserved firm-level heterogeneity.

using data from the 1993 National Survey of Small Business Finance in the U.S., Cavalluzzo, and Wolken (2005) report that half of all small business owners that needed credit reported that they did not apply for credit in the past 3 years because they believed that they would not be able to obtain it. Cox and Jappelli (1993) and Duca and Rosenthal (1993) report that discouragement is a non-negligible phenomenon in the case of households as well. Chakravarty and Xiang (2009) show that around 20% of all firms are discouraged from applying for a loan in a sample of Latin American, Asian, and African countries.

If loan discouragement is an international phenomenon which varies by country, then identifying the credit channel by observing the outcomes of formal loan applications only may under- or over-estimate the potency of that channel, depending on how the share of discouraged and informally rejected firms varies with the business cycle and with bank soundness. While my results suggest that informal rejections increase when monetary policy is tight and when bank are undercapitalized, implying that the credit channel is in reality even more potent than analysis based on credit register data would suggest, this need not be the case at all times and in all markets. For example, the firms in my dataset come from countries in transition from communism where credit markets are relatively less developed. In such markets, discouragement may be prevalent because it takes a firm longer to develop a reputation, or because it is more difficult to tap into household sources of credit, such as home equity, and so firms have more to lose from a rejection. By incorporating survey data from other markets, future research can greatly contribute to our understanding of the transmission of monetary policy and the effect of bank capital on the credit supply and on bank risk taking.

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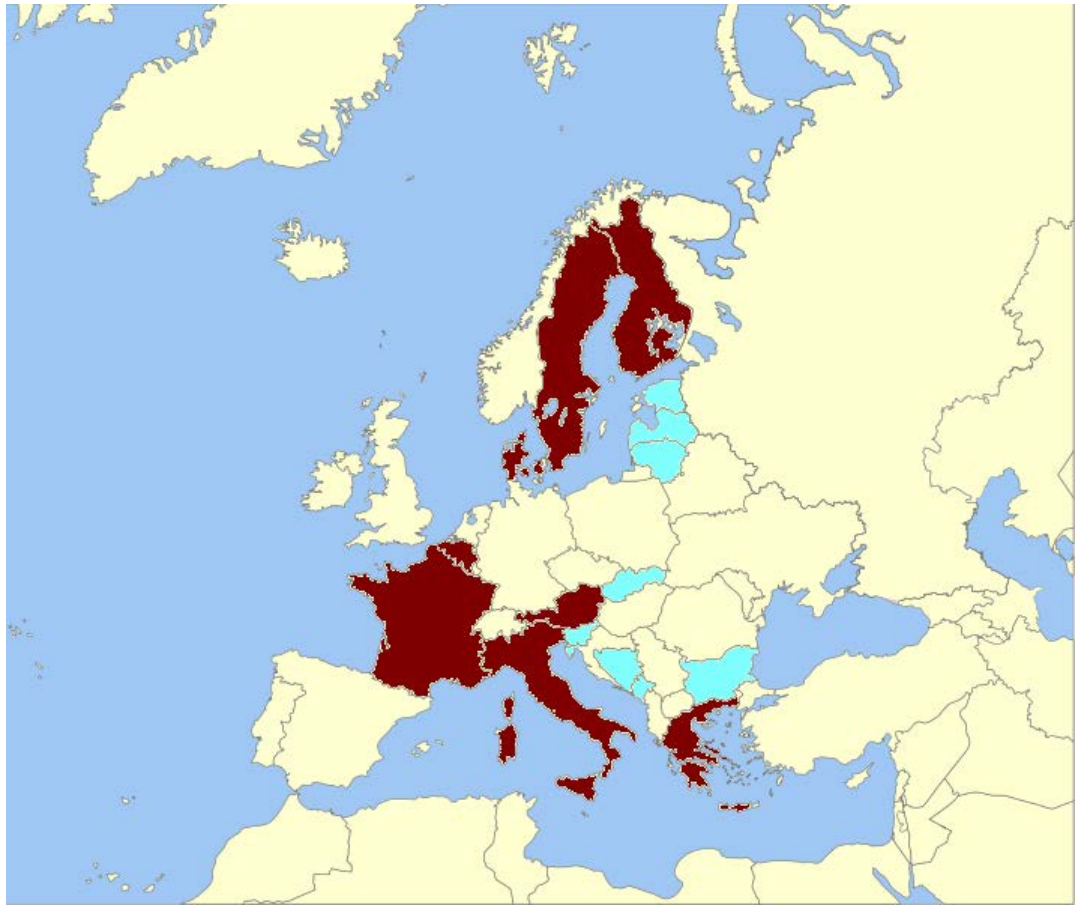
Figure 1. Origin and target countries in the data



The map shows the cross-border dimension of the underlying data. Countries in dark color (Austria, Belgium, Denmark, Finland, France, Greece, Italy, and Sweden) are those in which the parent banks in the dataset are incorporated (home countries). Countries in light color (Bosnia and Herzegovina, Bulgaria, Estonia, Latvia, Lithuania, Montenegro, Slovakia, and Slovenia) are those where the firms in the dataset are incorporated (host countries).

Table 1. Summary statistics: Firm characteristics

Country	# Firms	Opaque	Small firm	Big firm	Public company	Sole pro-prietorship	Privatized	Non-exporter	Firm age	Innovative	Subsidized	Competition
Bosnia and Herzegovina	530	0.47	0.78	0.03	0.15	0.38	0.22	0.65	21.27	0.53	0.11	0.81
Bulgaria	524	0.56	0.83	0.03	0.06	0.47	0.12	0.74	17.83	0.39	0.06	0.63
Estonia	479	0.19	0.78	0.03	0.13	0.26	0.11	0.65	16.16	0.49	0.15	0.76
Latvia	419	0.27	0.70	0.05	0.01	0.33	0.13	0.68	15.83	0.53	0.11	0.79
Lithuania	463	0.60	0.76	0.03	0.02	0.24	0.15	0.62	15.41	0.61	0.15	0.78
Montenegro	132	0.51	0.86	0.01	0.04	0.70	0.12	0.86	12.75	0.52	0.04	0.69
Slovakia	481	0.45	0.73	0.06	0.06	0.54	0.12	0.67	15.88	0.45	0.13	0.79
Slovenia	390	0.57	0.73	0.04	0.11	0.20	0.19	0.40	23.78	0.55	0.22	0.83
Total	3,418	0.45	0.77	0.04	0.08	0.37	0.15	0.65	17.77	0.51	0.13	0.76

Note: The table presents firm statistics, by country. 'Opaque' is a dummy equal to 1 if the firm does not employ external auditing services to verify its external accounts. '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. 'Non-exporter' is a dummy equal to 1 if the firm does not have access to foreign markets. 'Firm age' is the firm's age in years. 'Innovative' is a dummy equal to 1 if the firm has introduced a new product line in the past 3 years. 'Subsidized' is a dummy equal to 1 if the firm has received subsidies from central or local government in the past 3 years. 'Competition' is a dummy equal to 1 if the firm faces fairly strong, very strong, or extremely strong competition. Omitted category in firm size is 'Medium firm'. Omitted category in firm ownership is 'Private company'. See Appendix 3 for exact definitions and data sources.

Table 2. Credit demand and credit access

	2004				2007			
Country	Need loan	Applied	Rejected	Rejected or discouraged	Need loan	Applied	Rejected	Rejected or discouraged
Bosnia and Herzegovina	0.77	0.60	0.01	0.23	0.77	0.55	0.16	0.37
Bulgaria	0.68	0.47	0.08	0.36	0.58	0.32	0.16	0.52
Estonia	0.60	0.50	0.05	0.21	0.54	0.43	0.12	0.27
Latvia	0.69	0.54	0.10	0.29	0.59	0.38	0.19	0.50
Lithuania	0.71	0.51	0.05	0.31	0.60	0.49	0.10	0.00
Montenegro	0.50	0.31	0.00	0.38	0.78	0.44	0.14	0.22
Slovakia	0.61	0.49	0.02	0.22	0.53	0.34	0.10	0.39
Slovenia	0.66	0.61	0.04	0.12	0.64	0.59	0.09	0.14
Total	0.67	0.52	0.05	0.26	0.62	0.45	0.13	0.35

Note: The table presents statistics on various aspects of credit demand and credit supply. The columns labeled 'Need loan' summarize, by country, the share of firms that declare positive demand for bank credit. The columns labeled 'Applied' summarize, by country, the share of firms that applied for a bank loan out of those firms that declare positive demand for bank credit. The columns labeled 'Rejected' summarize, by country, the share of firms whose loan application was rejected, out of those firms that applied for a bank loan. The columns labeled 'Rejected or discouraged' summarize, by country, the share of firms that applied for a bank loan, or did not apply because they were discouraged, out of those that declare positive demand for bank credit. The data are for the fiscal year 2004 and for the fiscal year 2007. See Appendix 3 for exact definitions and data sources.

Table 3. Bank and country characteristics

	Bank capital		GDP growth	
Country	2004	2007	2004	2007
Bosnia and Herzegovina	7.26	7.85	0.050	0.068
Bulgaria	10.10	8.89	0.062	0.064
Estonia	8.88	8.69	0.081	0.069
Latvia	7.98	6.52	0.088	0.100
Lithuania	8.14	8.19	0.085	0.098
Montenegro	9.89	9.45	0.036	0.107
Slovakia	7.93	8.21	0.055	0.106
Slovenia	8.86	8.82	0.039	0.068
Total	8.45	8.33	0.062	0.085

Note: The table reports summary statistics on the average locality-specific Tier 1 capital ratio of the banks in the respective country, weighted by the number of branches a bank has in a particular locality, and of annual GDP growth in the respective country. The data are for the fiscal year 2004 and for the fiscal year 2007. See Appendix 3 for exact definitions and data sources.

Table 4. Determinants of firm demand for bank credit

	(1)	(2)
	Applied	Need loan
Bank capital	-0.005	-0.035
	(0.030)	(0.022)
Opaque	-0.175***	-0.013
	(0.051)	(0.051)
Small firm	-0.339***	-0.241***
	(0.065)	(0.070)
Big firm	0.131	0.258*
	(0.133)	(0.135)
Public company	-0.053	0.074
	(0.089)	(0.092)
Sole proprietorship	0.044	0.105*
	(0.053)	(0.056)
Privatized	0.052	-0.019
	(0.075)	(0.079)
Non-exporter	-0.213***	-0.108**
	(0.055)	(0.053)
Firm age	-0.036	0.058
	(0.157)	(0.158)
Innovative	0.219***	0.114**
	(0.058)	(0.054)
Competition	0.106**	0.126**
	(0.054)	(0.053)
Subsidized	0.200**	0.353***
	(0.081)	(0.073)
Country fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Number of observations	3,237	3,213
Pseudo R-squared	0.07	0.05

Note: The dependent variable is a dummy variable equal to 1 if the firm applied for bank credit (column labeled 'Applied') and a dummy equal to 1 if the firm needs bank credit (column labeled 'Need loan'). 'Bank capital' is the weighted average of the Tier 1 capital ratio of the banks present in a particular locality. The variable is locality-specific and is constructed by weighting by number of branches the Tier 1 capital ratio for each bank which has at least one branch or subsidiary in that locality. 'Opaque' is a dummy equal to 1 if the firm does not have its financial accounts verified by an external auditor. '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. 'Non-Exporter' is a dummy equal to 1 if the firm does not export to foreign markets. 'Firm age' is the firm's age in years. 'Innovative' is a dummy equal to 1 if the firm has introduced a new product line in the past 3 years. '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 subsidies from central or local government in the last 3 years. Omitted category in firm size is 'Medium firm'. Omitted category in firm ownership is 'Private company'. All regressions include country, industry, 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 3 for exact definitions and data sources.

Table 5. Home-country monetary policy, host-country GDP growth, bank capital, and credit application rejection

	(1)	(2)	(3)	(4)
	Rejected			
Δ CB rate	0.045***		0.054***	
	(0.012)		(0.011)	
Δ CB rate × Bank capital		-0.009		-0.001
		(0.008)		(0.007)
Δ GDP	1.194		0.712	
	(0.911)		(0.816)	
Δ GDP × Bank capital		0.127		0.020
		(0.104)		(0.072)
Bank capital	-0.012	-0.020	-0.005	-0.006
	(0.011)	(0.014)	(0.005)	(0.005)
Opaque	0.033*	0.034*	0.039**	0.038**
	(0.018)	(0.018)	(0.018)	(0.018)
Small firm	0.059***	0.061***	0.061***	0.061***
	(0.019)	(0.019)	(0.018)	(0.018)
Big firm	0.031	0.030	0.024	0.025
	(0.039)	(0.039)	(0.039)	(0.039)
Public company	0.111***	0.111***	0.112***	0.111***
	(0.042)	(0.043)	(0.043)	(0.042)
Sole proprietorship	0.031*	0.032*	0.042**	0.046**
	(0.019)	(0.019)	(0.019)	(0.020)
Privatized	-0.009	-0.009	-0.004	-0.003
	(0.018)	(0.018)	(0.018)	(0.019)
Non-exporter	0.017	0.018	0.021	0.021
	(0.020)	(0.020)	(0.021)	(0.021)
Firm age	0.029	0.033	0.045	0.046
	(0.038)	(0.038)	(0.037)	(0.036)
Innovative	-0.032**	-0.032**	-0.032**	-0.032**
	(0.015)	(0.015)	(0.014)	(0.014)
Inverse Mills' ratio	0.027	0.029	0.035	0.035
	(0.027)	(0.027)	(0.026)	(0.026)
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes
Bank fixed effects	No	No	Yes	Yes
Number of observations	1,549	1,549	1,493	1,493
Pseudo R-squared	0.08	0.08	0.10	0.10

Note: The dependent variable is a dummy variable equal to 1 if the firm applied for a bank loan and its application was rejected. The tests are performed on the subset of firms that applied for a bank loan. 'ΔCB rate' is the change in the core policy rate over the past year. 'Δ GDP' is the change in host-country GDP over the past year. 'Bank capital' is the weighted average of the Tier 1 capital ratio of the banks present in a particular locality. The variable is locality-specific and is constructed by weighting by number of branches the Tier 1 capital ratio for each bank which has at least one branch or subsidiary in that locality. 'Opaque' is a dummy equal to 1 if the firm does not have its financial accounts verified by an external auditor. '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. ‘Non-exporter’ is a dummy equal to 1 if the firm does not export to foreign markets. ‘Firm age’ is the firm’s age in years. ‘Innovative’ is a dummy equal to 1 if the firm has introduced a new product line in the past 3 years. ‘Inverse Mills’ ratio’ is the inverse of Mills’ ratio from the probit model in Table 4 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 4 are ‘Competition’ and ‘Subsidized’. All regressions include fixed effects as specified. 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 3 for exact definitions and data sources.

Table 6. Home-country monetary policy, host-country GDP growth, bank capital, and credit application rejection: Distinguishing between opaque and transparent firms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Rejected							
	Opaque = 1				Opaque = 0			
Δ CB rate	0.021		0.028		0.048***		0.054***	
	(0.024)		(0.026)		(0.011)		(0.011)	
Δ CB rate × Bank capital		-0.010		0.006		-0.002		-0.001
		(0.012)		(0.011)		(0.008)		(0.008)
Δ GDP	2.617*		2.178		0.731		0.580	
	(1.506)		(1.554)		(0.857)		(0.893)	
Δ GDP × Bank capital		0.284*		0.292**		0.115		-0.065
		(0.157)		(0.143)		(0.120)		(0.079)
Bank capital	0.006	-0.014	-0.004	-0.011	-0.024*	-0.032*	-0.005	-0.005
	(0.014)	(0.017)	(0.009)	(0.010)	(0.013)	(0.017)	(0.005)	(0.005)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Bank fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Number of observations	610	610	577	577	939	939	896	896
Pseudo R-squared	0.08	0.08	0.13	0.13	0.13	0.13	0.14	0.14

Note: The dependent variable is a dummy variable equal to 1 if the firm applied for a bank loan and its application was rejected. The tests are performed on the subset of firms that applied for a bank loan. The analysis is performed on the subset of informationally opaque firms (columns labeled 'Opaque = 1') and on the subset of informationally transparent firms (columns labeled 'Opaque = 0'). 'ΔCB rate' is the change in the core policy rate over the past year. 'Δ GDP' is the change in host-country GDP over the past year. 'Bank capital' is the weighted average of the Tier 1 capital ratio of the banks present in a particular locality. The variable is locality-specific and is constructed by weighting by number of branches the Tier 1 capital ratio for each bank which has at least one branch or subsidiary in that locality. The regressions include all firm-level variables from Table 5. Omitted category in firm size is 'Medium firm'. Omitted category in firm ownership is 'Private company'. Omitted categories from the probit equation in Table 4 are 'Competition' and 'Subsidized'. All regressions include fixed effects as specified. 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 3 for exact definitions and data sources.

Table 7. Home-country monetary policy, host-country GDP growth, bank capital, and credit constraints

	(1)	(2)	(3)	(4)
	Rejected or discouraged			
Δ CB rate	0.066***		0.073***	
	(0.019)		(0.019)	
Δ CB rate × Bank capital		-0.039***		-0.028**
		(0.012)		(0.012)
Δ GDP	1.952*		1.550	
	(1.078)		(1.087)	
Δ GDP × Bank capital		0.170		0.080
		(0.115)		(0.107)
Bank capital	-0.014	-0.039***	-0.014	-0.018**
	(0.015)	(0.015)	(0.011)	(0.008)
Opaque	0.104***	0.103***	0.108***	0.106***
	(0.023)	(0.023)	(0.024)	(0.024)
Small firm	0.167***	0.171***	0.162***	0.168***
	(0.029)	(0.030)	(0.029)	(0.030)
Big firm	0.022	0.023	0.017	0.015
	(0.065)	(0.065)	(0.064)	(0.064)
Public company	0.138***	0.138***	0.134***	0.132***
	(0.049)	(0.050)	(0.049)	(0.050)
Sole proprietorship	0.035	0.042	0.050*	0.058**
	(0.027)	(0.027)	(0.028)	(0.027)
Privatized	-0.034	-0.036	-0.019	-0.020
	(0.033)	(0.033)	(0.033)	(0.034)
Non-exporter	0.086***	0.087***	0.090***	0.092***
	(0.028)	(0.028)	(0.029)	(0.029)
Firm age	0.082	0.091	0.117*	0.125*
	(0.071)	(0.071)	(0.070)	(0.070)
Innovative	-0.095***	-0.095***	-0.092***	-0.094***
	(0.023)	(0.023)	(0.023)	(0.023)
Inverse Mills' ratio	0.030	0.033	0.025	0.032
	(0.025)	(0.025)	(0.026)	(0.026)
Country fixed effects	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes
Bank fixed effects	No	No	Yes	Yes
Number of observations	2,044	2,044	1,974	1,974
Pseudo R-squared	0.10	0.11	0.11	0.12

Note: The dependent variable is a dummy variable equal to 1 if the firm applied for a bank loan and its application was rejected, or it was discouraged from applying. The tests are performed on the subset of firms with positive demand for bank credit. 'ΔCB rate' is the change in the core policy rate over the past year. 'Δ GDP' is the change in host-country GDP over the past year. 'Bank capital' is the weighted average of the Tier 1 capital ratio of the banks present in a particular locality. The variable is locality-specific and is constructed by weighting by number of branches the Tier 1 capital ratio for each bank which has at least one branch or subsidiary in that locality. 'Opaque' is a dummy equal to 1 if the firm has its financial accounts verified by an external auditor. '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. 'Non-exporter' is a dummy equal to 1 if the firm does not export to foreign markets. 'Firm age' is the firm's age in years. 'Innovative' is a dummy equal to 1 if the firm has introduced a new product line in the past 3 years. 'Inverse Mills' ratio' is the inverse of Mills' ratio from the probit model in Table 4 for each respective financial variable. Omitted categories from the probit equation in Table 4 are 'Competition' and 'Subsidized'. All regressions include fixed effects as specified. 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 3 for exact definitions and data sources.

Table 8. Home-country monetary policy, host-country GDP growth, bank capital, and credit constraints: Distinguishing between opaque and transparent firms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Rejected or discouraged							
	Opaque = 1				Opaque = 0			
Δ CB rate	0.033		0.032		0.065***		0.085***	
	(0.032)		(0.035)		(0.020)		(0.019)	
Δ CB rate × Bank capital		-0.064***		-0.053***		-0.011		-0.001
		(0.020)		(0.018)		(0.015)		(0.015)
Δ GDP	4.650**		4.148**		1.332		1.262	
	(1.972)		(2.096)		(1.234)		(1.363)	
Δ GDP × Bank capital		0.478**		0.428**		0.155		-0.097
		(0.204)		(0.208)		(0.162)		(0.127)
Bank capital	0.007	-0.052**	-0.006	-0.028**	-0.060***	-0.070***	-0.030***	-0.029***
	(0.017)	(0.022)	(0.014)	(0.013)	(0.020)	(0.026)	(0.007)	(0.008)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	No	Yes	No	Yes	No	Yes	No	Yes
Bank fixed effects	No	No	Yes	Yes	No	No	Yes	Yes
Number of observations	902	902	874	874	1,142	1,142	1,095	1,095
Pseudo R-squared	0.11	0.12	0.13	0.14	0.09	0.09	0.10	0.10

Note: The dependent variable is a dummy variable equal to 1 if the firm applied for a bank loan and its application was rejected, or it was discouraged from applying. The tests are performed on the subset of firms with positive demand for bank credit. The analysis is performed on the subset of informationally opaque firms (columns labeled 'Opaque = 1') and on the subset of informationally transparent firms (columns labeled 'Opaque = 0'). All tests are performed on the subset of firms with positive demand for bank credit. 'ΔCB rate' is the change in the core policy rate over the past year. 'Δ GDP' is the change in host-country GDP over the past year. 'Bank capital' is the weighted average of the Tier 1 capital ratio of the banks present in a particular locality. The variable is locality-specific and is constructed by weighting by number of branches the Tier 1 capital ratio for each bank which has at least one branch or subsidiary in that locality. The regressions include all firm-level variables from Table 5. Omitted category in firm size is 'Medium firm'. Omitted category in firm ownership is 'Private company'. Omitted categories from the probit equation in Table 4 are 'Competition' and 'Subsidized'. All regressions include fixed effects as specified. 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 3 for exact definitions and data sources.

Appendix 1. Domestic and parent banks in the sample

Country	Bank	Parent bank and country of incorporation
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 - Greece
	Reiffeisen	Raiffeisen – Austira
	Piraeus	Piraeus Bank – Greece
Bosnia and Herzegovina	Raiffeisen Bank Bosna i Hercegovina	Raiffeisen – Austira
	UniCredit Bank	UniCredit Group – Italy
	Hypo Alpe-Adria-Bank Mostar	Hypo Group - Austria
	Intesa Sanpaolo Banka Bosna i Hercegovina	Intesa Sanpaolo – Italy
	NLB Tuzlanska Banka	KBC - Belgium
	Volksbank Sarajevo	Volksbank - Austria
Estonia	Swedbank Estonia	Swedbank - Sweden
	SEB	Skandinavska Enskilda Banken - Sweden
	Sampo Bank	Danske Bank - Denmark
	Nordea	Nordea Bank - Finland
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 Bank	Danske Bank - Denmark
	Nordea	Nordea Bank - Finland
	Snoras Bank	domestic
	Ukio Bankas	domestic
	Hansabankas	Swedbank - Sweden
	Parex Bankas	Parex Group - Latvia
Montenegro	AtlasMont Bank	domestic
	Crnogorska Komercijalna Banka	OTP - Hungary
	Hypo-Alpe-Adria Bank	Hypo Group - Austria
	Komercijalna Banka ad Budva	domestic
	NLB Montenegro Banka	KBC - Belgium
	Prva Banka Crne Gore	domestic
	Invest Banka Montenegro	domestic
	Podgoricka Banka SG	Societe Generale - France
	Opportunity Bank	domestic
Slovakia	Vseobecna Uverova banka	Intesa Sanpaolo – 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	Intesa Sanpaolo – Italy
	Banka Celje	domestic
	Reiffeisen Krekova banka	Raiffeisen - Austira

Appendix 2. Bank data coverage

Country	Ratio assets of the banks in the data set to total assets of the country's banking sector
Bosnia and Herzegovina	0.842
Bulgaria	0.857
Estonia	0.956
Latvia	0.851
Lithuania	0.896
Montenegro	0.862
Slovakia	0.925
Slovenia	0.862

Source: Bankscope (2008).

Appendix 3. Variables – definitions and sources

Variable Name	Definition	Source
	Firm characteristics	
Opaque	Dummy=1 if the firm does not subject its financial accounts to external audit.	BEEPS 2005 & 2008
Small firm	Dummy=1 if firm has less than 20 employees.	BEEPS 2005 & 2008
Medium firm	Dummy=1 if the firm has between 20 and 100 employees.	BEEPS 2005 & 2008
Big firm	Dummy=1 if firm has more than 100 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
Non-exporter	Dummy=1 if no part of the firm's production is exported to foreign markets.	BEEPS 2005 & 2008
Competition	Dummy=1 if pressure from competitors is "fairly" or "very" severe.	BEEPS 2005 & 2008
Firm age	The number of years since the firm was officially incorporated.	BEEPS 2005 & 2008
Innovative	Dummy=1 if the firm has introduced at least one new credit line in the past 3 years.	BEEPS 2005 & 2008
	Credit demand and credit access	
Need loan	Dummy=1 if the firm needs a loan because it cannot cover operating expenses with retained earnings.	BEEPS 2005 & 2008
Applied	Dummy=1 if the firm applied for bank credit.	BEEPS 2005 & 2008
Rejected	Dummy=1 if the firm's application for a bank loan was rejected.	BEEPS 2005 & 2008
Rejected or discouraged	Dummy=1 if a) the firm's application for a bank loan was rejected, or b) the firm does not have a loan because it was discouraged from applying for one of the following reasons: "Interest rates are not favorable", or "Collateral requirements are too high", or "Size of loan and maturity are insufficient", or "Did not think it would be approved".	BEEPS 2005 & 2008

	Bank-level variables	
Tier 1	The bank's risk-adjusted capital ratio.	Bankscope
	Country variables	
Δ CB rate	The change, in terms of basis points, in the ECB's policy rate over the previous year.	ECB
Δ GDP	The percentage change in GDP over the previous year.	Penn Tables