Interbank Market Integration, Bank Competition, Loan Rates, and Firm Leveraging*

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Abstract

We study the effect of interbank market integration on small firm finance in the build-up to the current financial crisis. We use a comprehensive data set that contains contract terms on individual loans to 6,000+ firms across 14 European countries between 1998:01 and 2005:12. We account for the selection that arises in the loan request and approval process. Our findings imply that integration of interbank markets resulted in substantially lower loan rates. The decrease was strongest in markets with competitive banking sectors. Our evidence further suggests that in the most rapidly integrating markets, firms were overleveraging early in the build-up to the crisis.

JEL classification: E51, G15, G21, G34

Keywords: interbank markets, selection, loan rates, bank competition, leveraging

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1 Introduction

Financial integration is widely perceived to stimulate investment-based growth through a reduction in the cost of equity, bond, and bank finance.[1] Little is known, however, of the effect the integration of interbank markets has on small firm finance. How does the degree and speed of interbank market integration affect the availability and cost of bank loans? What is the impact of credit markets competition on the size of this impact? And does rapid integration simply lead to cheaper firm financing, or also to excessive leveraging? These are the questions we set to investigate. By studying the mechanisms through which integration works, our paper fits in between two growing strands of literature, the one on the determinants of international financial integration and the one on the real effects of financial globalization.[2]

Theory suggests that interbank market integration increases the availability and reduces the cost of bank loans granted to firms through three different channels. Interbank market integration: 1) increases the competition to supply bank loans; 2) reduces the cost of external funding for banks; and 3) allows for greater diversification of risk.[3] As the interbank market provides banks with ready access to short- and long-term loans to finance their own investment operations and cushion liquidity shocks, interbank market integration allows banks to offer more and/or cheaper financing. The secured interbank market further allows for diversification without the risk of cross-regional financial contagion (Fecht, Grüner and Hartmann [2007]). Interbank market integration can therefore increase the benefits of integrating the retail banking markets (that occurs through cross-border lending and/or bank mergers). The

[1] The euro area has been a prime example of swift integration following the introduction of the common currency, with various estimates of the resulting increase in GDP ranging between 0.3% and 2%. See "Quantification of the Macro-Economic Impact of EU financial integration" by London Economics.

[2] For the most up-to-date study on the determinants of international financial integration, see Lane and Milessi-Ferretti [2008]. Among the real effects of financial integration investigated are its effect on economic growth (Edison, Levine, Ricci, and Slok [2002]), entrepreneurial activity (Giannetti and Ongena [2009], Alfaro and Charlton [2007]), cross-country correlations in GDP growth (Imbs [2004]), and consumer welfare (Fecht, Grüner and Hartmann [2007]), to cite but a few.

[3] It is important to note that interbank market integration may have an impact that is independent of cross-border bank ownership. Demyanyk, Ostergaard, and Sorensen [2007] for example find that the deregulation of the US banking sector affected the income insurance of small business owners without any significant multistate cross-ownership of banks.

more favorable conditions at which banks will borrow and share risks in principle should result in better loan terms for all firms, and more financing via bank loans. However, there are two potential downsides to this process. For one, if integration is accompanied by foreign bank entry, small firms may be rationed as foreign banks concentrate their lending on large firms that are involved in the production of tradeables (Agenor [2001]). Second, while integration is expected to improve financing conditions and increase leverage for the firms that have access to bank credit (Giannetti and Ongena [2009]), rapid integration might also result in excessive leveraging and/or dependence on bank loans. Such a process can have a palpable negative effect on firms if followed by a credit crunch of the type that has been experienced globally since 2007.

It is also not clear whether the benefits of interbank market integration are enhanced or diminished by credit market competition. Competition lowers the surplus banks can extract from their borrowers and speeds up interest rate adjustments (Klein [1971]; Monti [1972]; Herrmann and Jochen [2003]). In concentrated (and uncontested) markets the few operating banks may be slow to pass the decline in market interest rates to their clients. If competition is fierce, banks are forced to react quickly not to lose market share. Integration in the interbank markets may therefore make bank loan terms react more quickly and substantially to its changes.

In addition, competition and therefore integration may not benefit all firms at all times. Petersen and Rajan [1995] for example argue that when credit markets are concentrated banks are more likely to finance the opaque, i.e., small or young, firms because internalizing the benefits of assisting them is possible. International financial liberalization may therefore lead to a deterioration in the credit conditions for small firms. Moreover integration in interbank markets need not naturally arise. Freixas and Holthausen [2005] for example show that – when banks need to cope with liquidity shocks by borrowing or by liquidating assets – an equilibrium with market integration does not always exist; in their model integration may even coexist with segmentation.

Our paper contributes to these different strands of literature by estimating the combined

effect of interbank market integration and credit market competition on small firm finance. We construct measures of both the degree and speed at which yields in all national interbank markets converge relative to yields in Germany, the country we take as our benchmark market. We then estimate the effect of the convergence in interbank market rates on bank loan rates and on firm leveraging, accounting for the structure of credit markets.

Our second contribution is methodological. Business loans are only observed when firms apply for credit and banks grant it. Most studies analyzing the effect of market conditions on bank loan terms ignore this sequential selection process.[4] In contrast we account for the loan application and granting decision by estimating a double selection model. Our dataset contains detailed information on firms that did not apply for bank loans and information on firms that applied but were denied bank loans. Heckman [1979] shows such this observed information on all firms can be used to eliminate the bias induced by the left-truncation of the sample. Hence, while we are mostly interested in the loan terms for the group of firms that seek and obtain bank loans, we are able to eliminate the specification error resulting from the double sample selection by incorporating information from the other groups of firms in our estimation. Thus we are able to purge the bias stemming from the effect of integration on bank credit desirability and credit constraints.

We focus on a sample of $6,000+$ firms from 14 countries (10 new EU member states and 4 euro zone countries) between January 1998 and December 2005 taken from the Business Environment and Enterprise Performance Survey (BEEPS). BEEPS contains individual loan characteristics at a monthly frequency. The resulting comprehensive 96-month synthetic panel contains considerable variation across country and time. As interbank market integration in the euro area countries was indeed almost complete at the beginning of the period, our data provides us with a control and a treatment group to estimate the effect of integration

[4]Exceptions are Cerqueiro [2009] and Chakravarty and Yilmazer [2009]. Berger and Hannan [1991], Mojon [2001], Corvoisier and Gropp [2002], and van Leuvensteijn, Kok Sorensen, Bikker and van Rixtel [2008] use aggregate data to estimate the effect of credit market competition on market rate pass-through. These studies do not account for individual firm and loan characteristics. Degryse, Kim and Ongena [2009] review studies that employ individual loan contract data to assess the impact of banking market competition on bank loan rates.

on loan rates and firm leveraging.

We find that interbank market integration decreases the loan rates charged to firms both in a statistically significant and economically relevant way. A deepening of integration by two standard deviations, given our measure of interbank market integration, would see a decrease in loan rates by up to 130 basis points, when the bias from firm selection is eliminated. And if a euro zone country in the sample would return to the degree of interbank market integration in the last year prior to joining the euro, loan rates would be, ceteris paribus, almost 60 basis points higher. However, these results only hold in countries with a considerable degree of credit market competition. Finally, lower loan rates may lead to more firm leveraging. If for example integration increases by two standard deviations, the probability that a firm is overleveraged vis-à-vis the leverage of a similar benchmark firm increases by around 12%.

The rest of the paper proceeds as follows. Section 2 explains our empirical strategy. Section 3 describes the construction of our measure of interbank market integration. Section 4 summarizes the country-level (measures of credit market competition and interbank market rates) and firm-level data (individual bank loans and firm characteristics). Section 5 presents the empirical evidence. And finally Section 6 concludes.

2 The Empirical Strategy

The demand for any asset can be derived in a general portfolio choice model in which firms maximize their expected profits subject to a lifetime budget constraint. The supply of an asset can be derived from profit maximization by banks – subject to the constraint that the sum of assets and liabilities does not exceed net worth – accounting for the degree of competition. Dicks-Mireaux and King [1982] and Cox and Japelli [1993] for example estimate the demand for credit. The equilibrium firm debt is modelled conditional on the firm holding a positive amount of debt and being unconstrained in the credit market. The supply of funds is not explicitly modeled in these papers. We model the terms on the bank loans we observe conditional on firms holding some debt and being unconstrained. We control for

firm characteristics and account for the borrowing and lending conditions that banks face in interbank markets as well as for the structure of the banking sector.

We employ a three-equation generalized Tobit model. We assume that loan rates, Y_{it}^*, which are observable to us, are a linear function of firm i variables X_i and country j variables Z_j at time t:

$$Y_{it}^* = X_{1it}\beta_1 + Z_{jt}\beta_2 + \varepsilon_{1ijt} \tag{1}$$

ε_{1ijt} is a random component which varies at the firm, country and time level that is normally distributed with mean 0 and variance σ_1^2. Y_{it}^* is observed only if the demand for debt is positive and the firm is not credit constrained.

Let the dummy variable Q equals 1 if the firm desires positive bank credit and equals 0 otherwise. The value of Q is in turn determined by the latent variable:

$$q = X_{2it}\gamma + \varepsilon_{2it} \tag{2}$$

where X_{2it} contains the values of X_{1it} and other supplementary variables that may effect the firm's fixed costs and convenience associated with using bank credit. The variable $Q = 1$ if $q > 0$ and $Q = 0$ otherwise. The error ε_{2it} is normally distributed with mean 0 and variance σ_2^2.

Bank loan rates are only observable when firms actually receive loans. Implicitly the model assumes that a loan is received if the firm needs a loan, applies for it, and the application is not rejected by the bank (i.e., the firm is not credit constrained). Equation (2) addresses the first part of this condition but not the second. Some firms may need to have a strictly positive amount of bank debt but are constrained in their access to bank financing. We assume that such credit constraints take the form of a binary constraint which is firm-specific. BEEPS makes it possible to directly estimate that constraint as the survey asks firms about their reasons for not applying and their experience in general with bank loans. Constraints on obtaining credit may be a function of firm and bank characteristics. As we

do not observe the bank that is actually granting the loan, we employ the characteristics of the country's banking sector as a proxy.

We define a firm to be credit constrained if it needs credit but did not receive any bank loan. If the firm obtains a bank loan, it is unconstrained. Unlike studies on consumer debt which are interested in the difference between desired and actual debt (Hayashi [1982]; Cox and Japelli [1993]), we are mainly interested in the loan rate, accounting for other loan terms such as maturity and collateral. Hence, we define a dummy variable C which equals 1 if the firm is unconstrained and equals 0 otherwise. The latent variable for C depends on the determinants of desired credit:

$$c = X_{3ijt}\delta + \varepsilon_{3ijt} \tag{3}$$

X_{3ijt} is a vector of firm-level variables that may determine the demand for debt and proxies for the time-variant relevant characteristics of the banking sector. $C = 1$ if $c > 0$, and $C = 0$ otherwise. The error ε_{3ijt} is normally distributed with mean 0 and variance σ_3^2.

In terms of timing of the game, we assume that the firm first applies for a loan, if it desires positive bank debt, and it receives one if it is unconstrained. This procedure allows us to distinguish between four different regimes specified by the latent variables q and c: (1) firms that do not need bank credit and are constrained ($Q = 0, C = 0$), (2) firms that do not need bank credit and are unconstrained ($Q = 0, C = 1$), (3) firms that need bank credit but are constrained ($Q = 1, C = 0$), and (4) unconstrained firms with (positive) bank credit ($Q = 1, C = 1$). The estimation strategy follows Heckman [1979]. We use the observed information for all firms in order to eliminate the bias induced by the left-truncation of our sample to firms that need and obtain bank credit. Hence, while it is the latter group that we are interested in, we incorporate information from the first three groups to eliminate the specification error induced by this sample selection bias. As to the exact estimation sequence, we first estimate the credit-desirability equation on the full sample, then the absence-of-borrowing-constraint equation on the sub-sample of firms that desire

strictly positive debt, and finally the loan-rate equation on the sub-sample of firms with strictly positive debt, incorporating the information from the two selection equations.

The expectation of the cost of bank credit for the fourth group of firms is:

$$E[Y_i^*|X_i, Z_j, Q = 1, C = 1] = X_{1i}\beta_1 + Z_j\beta_2 + E[\varepsilon_{1ij}|X_i, Z_j, Q = 1, C = 1] \tag{4}$$

Using the distribution of the error terms defined above and the standard probit normalization ($\sigma_1^2 = \sigma_2^2 = 1$), one can obtain consistent estimates of γ and δ up to a factor of proportionality. Let ρ_{12} and ρ_{13} indicate the simple correlation between ε_1 and ε_2 and between ε_1 and ε_3, respectively. Hence, the final estimation procedure employed can be written as:

$$Y_i^* = X_{1i}\beta_1 + Z_j\beta_2 + \sigma_1\rho_{12}\frac{\phi(q)}{\Phi(q)} + \sigma_1\rho_{13}\frac{\phi(c)}{\Phi(c)} \tag{5}$$

$\frac{\phi(q)}{\Phi(q)}$ and $\frac{\phi(c)}{\Phi(c)}$ are the inverse Mill's ratios (Heckman [1979]). The probability of being in the sample of observed loans is $\Phi(q) * \Phi(c)$.

Next, we specify the model in terms of our variables of interest. The credit-desirability equation contains firm variables which contain information about how likely it is that the firm will need bank credit: measures of integration in the banking sector, ownership structure (individual/family, private/government or domestic/foreign ownership), ownership history (privatized or originally private if not government owned), whether the firm exports, whether the firm receives subsidies from any branch of government, and whether it is subject to strong competition in product markets. We also use a proxy for firm size where the firm is defined as small if it has less than 50 employees, medium if it has between 50 and 250 employees, and large if it has more than 250 employees. Finally, year and country dummies are included to account for the possibility that desired bank credit is a function of (time-varying) macroeconomic and (constant) country characteristics.

The reduced form model for being unconstrained contains the same set of variables, but it also includes: (1) a proxy for whether the firm uses external auditing by a certified agency,

and (2) the degree of banking sector concentration as a measure of bank competition.

3 Measuring Interbank Market Integration

Scitovski [1969] was the first to formulate a comprehensive definition of financial market integration by pointing out that "the perfect integration of asset markets means [...] that the asset must be transferable and the portfolio preferences of individual asset holders are regionally unbiased" (op. cit., p. 89). Building upon that formulation, financial integration in general and interbank market integration in particular can be defined using two broad criteria: the volume of transactions and the efficiency of the markets (Obstfeld [1986]).[5]

In this paper, we choose as a proxy for interbank market integration a measure à la Engle and Granger [1979], namely, the measures of the co-integration between the rates in the domestic interbank markets and the rates in Germany, which we take as our benchmark market. Given that we want to compute the level of integration in different subperiods over a longer time period, the simplest possible model that can be estimated is:

$$r_t^j = \alpha^j + \beta^j r_t^b + \varepsilon_t \tag{6}$$

r_t^j represent the nominal yield to maturity observed on a daily basis at time t for country j and r_t^b represents the yield to maturity at time t for the benchmark German asset. In integrated markets, common shocks will be diversified away, prices are mainly driven by common factors, and hence the co-integration parameter β will be positive, and equal to 1. Working with nominal rather than real rates should be of no concern as with increasing coordination of monetary policy and real macroeconomic convergence, financial integration implies convergence in both nominal and real yields. In addition, working with nominal yields allows us to be consistent with the analysis of Baele, Ferrando, Hördahl, Krylova and

[5]Measuring the volumes of transactions has an innate appeal. But a smaller number of international financial transactions does not automatically imply market segmentation, if integration makes domestic and foreign investments equivalent for investors. On the other hand, capital flight in response to monetary and/or financial distress is hardly a sign of deepening integration (Herrmann and Jochem [2003]). Measures of financial integration based on the law of one price are therefor preferred.

Monnet [2004] and Baltzer, Cappielo, De Santis and Manganelli [2008]. Finally, β can be calculated over a rolling window of 18 months for example as in Baele, Ferrando, Hordahl, Krylova, and Monnet [2004].

The problem with this simple approach is that the resulting time series of β_t^j's for each country i will have serially correlated standard errors, resulting in inflated t-statistics. This is problematic given that the β_t^j's will be used as explanatory variables in the second stage where we study the effect of interbank sector integration on loan rates. For this reason, we employ a different specification, namely:

$$r_t^j = \alpha^j + (\beta_0^j + \beta_1^j t + \beta_2^j t^2) \cdot r_t^b + u_{jt}, \tag{7}$$

In this case the estimates are computed over the full time series for each country instead of within the rolling windows. This specification allows for a time-varying β_t^j for each country j, and at the same time the autocorrelation problem discussed above is eliminated. Because of the structure we have given to our model, "disintegrated" states of the world are characterized by large positive β_t^j's, while integrated states of the world are characterized by β_t^j's close to 1.

The relationship between non-stationary but co-integrated variables should preferably be based on an error-correction model (ECM), which allows to disentangle the long-run co-movement of the variables from the short-run adjustment towards the equilibrium. Therefore, a refinement of the approach above is to estimate the degree of convergence of the differenced series (or the speed of adjustment towards equilibrium) along with the level series. This second model has the advantage of converting what are usually non-stationary processes into stationary ones. Using a panel-econometric approach, we can then test for the impact of the benchmark interbank market rate on the country-level interbank market rate.

Formally, we estimate the model in Equation (7) as well as the model:

$$\Delta r_t^j = \theta^j u_{jt-1} + (\eta_0^j + \eta_1^j t + \eta_2^j t^2) \cdot \Delta r_t^b + v_{jt} \tag{8}$$

Δr_t^j is the difference in adjacent daily yields for country j and Δr_t^b is the difference in adjacent daily yields for the benchmark country Germany. Thus, Equation (7) reflects the long-run equilibrium adjustment, while Equation (8) represents the short-term adjustment of local interbank market rates to their long-run equilibrium. In all estimations, we include the market rates for the different countries separately in order to observe country-specific effects. The short-run model includes the error-correction term $\theta^j u_{jt-1}$. The final estimates of interest of the degree of interbank market integration for each country j are $\beta_t^j = \beta_0^j + \beta_1^j t + \beta_2^j t^2$ and $\eta_t^j = \eta_0^j + \eta_1^j t + \eta_2^j t^2$.

4 Data

4.1 Interbank market integration indicators

To compute our main proxy for interbank market integration we employ interbank nominal yields on 1-, 3- and 6-month money market instruments from the Global Financial database for the period January 1, 1998 to December 31, 2005. We focus on the 6-month yields, but use 1- and 3-month series in robustness tests. The sample includes the same countries as in the firm-level dataset, and so features both euro-zone countries for which integration was achieved as early as the beginning of the period, as well as Central and Eastern European countries which remained unevenly integrated throughout.

Figures 1 to 3 show that integration has deepened between 1998 and 2005 in all countries in the sample but that the process of integration across countries has been uneven. While in January 1998 the average integration measure β_t^j on interbank market rates on 6-month instruments for the 8 central and east European countries was 5.82 (corresponding to a average spread of $2,058$ basis points), by December 2005 it declined to 2.21 (corresponding to an average spread of 188 basis points), and only 1.93 (corresponding to an average spread of 121 basis points) if the most non-integrated country (Romania) is excluded from the sample. The developments in the yields on 1-month and 3-month instruments have been very similar. The figures demonstrate the evolution of our measure of interbank market

integration over time: apart from Hungary and Poland, which show signs of divergence since 2003 and 2004, respectively, the β_t^j's for the rest of the countries in our sample have indeed converged towards 1. In addition, Figure 4 shows that in terms of both nominal yields and integration measures, Romania is an outlier - it only achieved in 2005 the level of integration that the rest of the central and east European countries already had in 1998. This motivates the exclusion of Romania in most of the empirical analysis.

4.2 Firm-level data

We match the data on interbank market integration, constructed using underlying data on interbank market rates from the Global Financial database, in monthly frequency, with the firm-level data from the 2004 and the 2005 version of BEEPS, the Business Environment and Enterprise Performance Survey that is collected jointly by the World Bank and the European Bank for Reconstruction and Development.

The two waves of BEEPS asked $9,655$ firms from 27 countries in Central and Eastern Europe and $4,453$ firms in 5 euro zone countries about their experience with financial and legal constraints, as well as government corruption. BEEPS also included questions about firm ownership structure, sector of operation, industry structure, export activities, use of external auditing services and/or International Accounting Standards (IAS), subsidies received from central and local governments, etc. The firms were interviewed over a 1.5-year period, between the end of 2004 and the middle of 2005. The survey response rate was 36.9%. Surveyees who refused to participate or were unavailable for interviews accounted for 38.3% of the original target group. Firms that were ineligible due to the necessity to fulfill industry quotas accounted for the remainder. As we are interested in the effects of integration we study the countries that were EU members at the end of the interview period. The final dataset used includes $6,047$ firms from 10 countries that became EU members after December 31, 1997 (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovenia and Slovakia) and 4 countries that were EU members from the start (Greece, Ireland, Portugal, and Spain). Respondent firms come from 7 different sectors:

mining; construction; manufacturing; transportation, storage and communication; wholesale and retail; real estate, renting and business services; and hotels and restaurants. The number of firms covered is roughly proportional to the number of firms in the country, ranging from 217 in Lithuania to 975 in Poland. The survey also tried to achieve representativeness in terms of the size of firms it surveyed: between two thirds and three quarters of the firms surveyed are "small" (less than 50 workers) and around 10% of the firms surveyed are "large" (more than 250 workers).[6] Table I provides the summary statistics on the number of firms and their size distribution by country.

Although the dataset is almost purely cross-sectional (for each firm answers are averaged over the period of the survey), there is a time dimension in the data on bank loans. Indeed, each firm is asked about the cost, maturity, currency denomination, and the time it took to negotiate the last bank loan - if any - as well as about the exact month and year in which the loan was received. Firms report to have received loans between January 1998 and December 2005. On the basis of this information we construct a synthetic panel covering 96 months. We then match this panel to our measures of financial integration. These measures are calculated as in Equations (7) and (8) from daily yields in the Global Financial database. The β_t^j's are then averaged for each month to give 96-month series. 2,609 of the non-German firms in the dataset obtained a loan during this period.[7]

Firms with outstanding bank credit provide many details on their most recent loan. Most important for our purposes, BEEPS includes information on the annualized cost of the loan. The survey further covers loan duration and collateralization (as a proportion of the loan amount). We focus on the loan rate and calculate the "real" rate as the spread between the nominal rate of the loan and the nominal yield on a German 6-month money market instrument in the same year:month. Table II provides the sample summary statistics by country for the most relevant loan characteristics. We exclude all observations for which loans were received earlier than January 1998. In the remaining sample, the real average

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

[7] Germany is excluded from the regression analysis as the benchmark country.

annualized rate of loans is 5.7%, ranging from 2.4% in Ireland to 15.7% in Romania. The overwhelming majority of loans in all countries are collateralized, but there is great deal of variation, with the share of collateralized loans ranging from 58% in Greece to 93% in Romania. Average loan duration ranges from 24 months in Spain to 69 months in Ireland. Within the sub-sample of central and east European countries, Lithuania has the lowest average spread at 337 basis points, and Estonia has the longest average maturity at 1 year.

Crucial for our selection correction, we can derive the firm's need for a bank loan and the tightness of its financial constraint directly from the answers to several BEEPS questions. Question 47a asks "If your firm does not currently have a loan, what was the reason?", while Question 47b asks "If your firm did not apply for a loan, what were the main reasons?" We classify firms as having no need for bank credit those choosing in 47b the answer "Does not need a loan" and firms as credit constrained those marking in 47a the answer "Because the application was turned down" or in 47b the answers "Application procedures for banks are too burdensome", "Collateral requirements for bank loans are too strict", "Interest rates are too high", "It is necessary to make informal payments to get bank loans", or "Did not think it would be approved". This strategy of grouping firms that were turned down and firms that were discouraged from applying is also employed in Cox and Jappelli [1993] and is standard in studies that rely on detailed questionnaires.

We further use country-level variables to account for the effect of interbank market integration. The propensity of banks to grant credit and the loan rate will depend on the official money market rates. For this reason, we include the contemporaneous monthly nominal rate in all regressions.

Finally, our second main variable of interest capturing banking competition is either the C3 measure of banking sector concentration taken from the 2008 update of Beck, Demirgüç-Kunt and Levine [2000] or the Herfindahl-Hirschman Index (HHI) of banking sector assets taken from Giannetti and Ongena [2009]. The C3 is calculated as the share of banking sector assets held by the 3 largest banks in the country. The HHI is calculated as the sum of the squared shares of total assets held by each individual bank in the country. Both measures

are only available at a yearly frequency. Table III summarizes interbank market integration, foreign ownership of bank assets, and the two banking sector competition variables averaged over the period 1998 to 2005 for the 14 countries in the dataset. While foreign ownership of bank assets is very low in Slovenia (17%),[8] it is above 50% in the rest of the sample countries, with a maximum of 97% in Estonia. Estonia also boasts the lowest level of banking sector competition (98% of banking sector assets are held by the 3 largest banks and the HHI equals 0.55), while the most competitive banking environment is found in Poland (C3 equals 42%) and Bulgaria (HHI equals 0.08). As expected, the C3 and the HHI measure are very positively correlated ($\rho = 0.59$). There is also high correlation between foreign ownership and concentration in the commercial banking sector ($\rho = 0.31$) and between foreign ownership and HHI ($\rho = 0.32$).

5 Empirical Results

We estimate a simple model of the effect of interbank market integration on business loan rates. First, in a basic model, we do not account for credit market competition and estimate the following version of Equation (5):

$$LR_{ijt} = \alpha_0 + \beta_t^j \alpha_1 + X_i \alpha_2 + D_j \alpha_3 + D_t \alpha_4 + \sigma_1 \rho_{12} \frac{\phi(q)}{\Phi(q)} + \sigma_1 \rho_{13} \frac{\phi(c)}{\Phi(c)} \tag{9}$$

LR_{ijt} is the real loan rate, i.e., the spread over the nominal benchmark money market rate, on a loan granted to firm i in country j at time t, β_t^j is the estimate of interbank market integration in country j at time t from (7), X_i is a vector of firm and loan characteristics, D_j is a matrix of country dummies, D_t is a matrix of time dummies, and $\frac{\phi(q)}{\Phi(q)}$ and $\frac{\phi(c)}{\Phi(c)}$ are the inverse Mill's ratios from the firm-level probit estimates. The estimator of interest is α_1, and given that lower β_t^i implies higher integration, we expect it to have a positive sign.

In the main model of interest, we also account for the degree of competition in the banking

[8] Entry of foreign capital into the Slovenian banking sector only started in earnest in 2001. During the sample period none of the largest banks in Slovenia had more than 50% foreign ownership.

sector. BC_j is either the C3 or HHI, defined earlier. Formally, the model becomes:

$$\begin{aligned} LR_{ijt} = \quad & \alpha_0 + \beta_t^j \cdot BC_{jt}\alpha_1 + \beta_t^i \alpha_2 + BC_{jt}\alpha_3 + X_i\alpha_4 + \\ & + D_j\alpha_5 + D_t\alpha_6 + \sigma_1\rho_{12}\tfrac{\phi(q)}{\Phi(q)} + \sigma_1\rho_{13}\tfrac{\phi(c)}{\Phi(c)} \end{aligned} \tag{10}$$

As in the previous model, the estimator of interest is α_1. In the empirical exercise, we proxy banking sector concentration as dummies which equal 1 (0) if the country during this time period is in the bottom (top) half of the bank concentration, or the HHI, distribution. Again, we expect the sign of α_1 to be positive for the composite term with the dummy for low banking sector concentration.

5.1 Unit roots and co-integration

Table IV reports the within-country and panel unit root tests for benchmark and country-specific interbank market rates for 6-month instruments (the results are identical when we perform the exercise using the 1- and 3-month instruments). Table IV also reports the Engle-Granger co-integration test as applied to the long-run models of the interbank rates. The unit root tests estimates and statistics (Columns (1)-(4)) indicate non-stationarity of the series at the 5% level for all but 3 countries in the dataset. For the panel the null hypothesis of non-stationarity is rejected at the 5% level. We also apply the unit root test for the first-difference of the rates to test for second-order non-stationarity. The results overwhelmingly reject I(2) and hence, support the conclusion that the rate series are integrated of order 1. Given these findings, we proceed to test for co-integration between interbank market rates and the corresponding benchmark rates.

Columns (5) and (6) report the estimates and statistics from the Engle-Granger co-integration test as applied to the long-run models of the interbank rates. For 8 of the 14 countries, as well as for the full panel series, the hypothesis of no co-integration can be rejected at the 1% confidence level. Apparently, for some countries the adjustment of the domestic rates is slow and not even a long-run relationship can be detected in the sample. However, the results for the majority of the countries (the euro zone countries plus the three

Baltic states) as well as for the full series imply a strong long-run equilibrium relationship between domestic and benchmark rates. Hence we can proceed to construct and use our β_t^j with a strong degree of confidence.

5.2 Selection estimation

Table V presents the results from the first stage probit regression for bank loan desirability. The probability of needing bank credit is higher in more integrated markets and in markets where nominal interbank rates or lower. This result immediately justifies our selection procedure: integration not only (potentially) affects loan rates, but also the degree to which firms need loans. Not accounting for this will introduce bias into the main estimates. The need for bank credit also decreases in the size of the firm and is lower for government-owned and foreign-owned firms. The latter companies may face lower costs of internal funding either due to a soft budget constraint in the case of government ownership or to a higher supply of loans in the case of foreign ownership. The need for bank loans is higher for exporters potentially due to their faster expansion. It is also higher for subsidized firms, potentially implying that subsidies signal financial need more than they alleviate it, and for firms which face high competition, potentially implying slimmer profits and lower internal funds to finance investment. Whether the ownership of the firm changed hands from the state to the private sector doesn't matter for bank loan need.

Table VI presents the results of the probit equation for the absence of borrowing constraints. Because the probit for the desirability of bank debt and the probit for unconstrained status may have correlated errors (due to the econometrician not observing in both cases the same firm-level characteristics), we estimate a bivariate probit. In the second equation, we also account for characteristics of the business environment, notably the degree of competition in the banking sector. We again find that integration matters - this time, in more integrated markets firms are more likely to be unconstrained. Not surprisingly, the probability of being unconstrained is lower for small- and medium-size firms, as well as for companies which are government-owned (these firms may be considered less trustworthy counterparts

in the post-communist era). Exporters and recipients of subsidies have easier access to bank credit. Firms that use external auditors have a higher probability of being unconstrained. While we do not claim any causality – unconstrained firms may have a higher probability of employing costly external auditing services – auditing may reduce the informational opacity of the firm and thus may have a positive effect on the availability of credit (Brown, Ongena and Yesin [2008]). Finally, more competition in the banking sector is associated with a higher incidence of borrowing constraints, consistent with Petersen and Rajan [1995] and Inderst and Mueller [2006] for example.

5.3 Main results

In Table VII, we report the estimates for Equation (9) that assesses the effect of interbank market integration on real loan rates (the spread between the nominal rate of the loan and the nominal yield on a German 6-month money market instrument in the same year:month). We use the estimate of the degree of convergence in 6-month nominal yields as a proxy for interbank market integration,[9] and do not yet account for the structure of the banking sector. After an initial analysis in Column (1), we drop 168 Romanian firms due to the anomalous nature of the Romanian interbank market highlighted before.

Column (2) reports the main estimates on the full sample excluding Romania. Small firms face higher loan rates, as expected, while audited firms and exporters pay lower rates. Longer maturity loans carry lower loan rates. Importantly for us, the estimate of α_1 is positive and significant at the 1% level: firms operating in countries where interbank markets are more integrated obtain lower loan rates. This result holds in the full sample period and when we drop the most volatile sub-period (1998-2000) in Column (3). In that case, a two standard deviation increase in interbank market integration would lead to a decrease in real rates by about 156 basis points. The results even holds when we limit the sample to the euro zone countries only. The estimated coefficients then imply that if all euro zone countries were to

[9] As we report later, replacing the estimates of the integration of the 6-month yields with the 1- and 3-month yields doesn't change the basic results.

go back to the degree of interbank market integration in their last year prior to joining the euro zone,[10] loan rates would be ceteris paribus higher by 73 basis points on average.

Next, in Column (4) we account for the left-truncation of the sample by including the selection terms estimated in the two probit equations. Importantly, the sign pattern of the selection terms (when significant) confirms our intuition and justifies the application of a procedure correcting for the selection biases. The coefficient on the first selection term in Column (4) implies a negative correlation between unobservables in the equation for bank credit desirability and those in the real business loan rate equation. This negative correlation implies that unobserved factors that decrease the real cost of a business loan tend to increase the probability of the need for a bank loan. Conversely, the coefficient on the second selection term is positive, but nonsignificant. After accounting for selection, we estimate that a two standard deviation increase in interbank market integration would lead to a decrease in real rates by about 131 basis points. Excluding the selection terms from the equation thus results in an overestimation of the true effect by around 20%. Finally, the magnitude of the estimates increases substantially when we replace the country and year dummies with country-specific trends in Column (5), implying that to some degree our measure of integration might be proxying for a common regional trend.

5.4 Identification, errors-in-variables, foreign ownership, and misreporting

We now address four main issues with the data and our methodology. First, there is a potential endogeneity issue with our estimation strategy so far. Namely, if loan rates drop because of the opening of the domestic banking market, banks may seek cheaper financing on the interbank market spurring the integration of rates. In essence, this implies that our integration and loan rate measures could be determined simultaneously, resulting in a bias in the estimation. To address this problem which confounds identification, we proceed to implement the idea initially put forth by Rajan and Zingales [1998] that finance plays a

[10] Ireland, Portugal and Spain joined the euro zone on January 1, 1999, and Greece on January 1, 2001.

more important role for firms in industries that for technological reasons are more dependent on external financing. Some of the key characteristics that make an industry more or less dependent on external financing are variations in the scale of projects, gestation period, the ratio of hard vs. soft information, the ratio of tangible vs. intangible assets, follow-up investments, etc. Consequently, a manufacturing firm for example may be more dependent on external financing than a hotel or restaurant. The basic idea then is to rank industries by their "natural" dependence on bank financing, and use the industries which have low sensitivity to bank financing as a control group in a standard difference-in-differences empirical model. Identification is achieved by measuring the differential effect of interbank market integration between industries that are dependent on bank financing and those that are not.

Therefore, we calculate benchmark industry-specific dependence on bank financing by German firms (that are also present in the BEEPS, but were excluded in the empirical exercises because we use the German interbank rate as our benchmark). We calculate the share of capital investment financed with bank loans for large German firms (with more than 500 employees) in each industry. The rationale is that large firms are relatively unconstrained, and so their use of bank loans represents a good benchmark for the natural demand of the industry, free of credit supply considerations.[11] We take the median value for each industry and use it as a benchmark for the industry's natural dependence on bank debt. Then we interact this benchmark with the measure of integration in equation (9). The results, reported in Column (1) of Table VIII confirm the validity of the procedure: namely, we find that only in industries that are dependent on bank financing does interbank market integration affect loan rates in the direction recorded before. These results give us confidence that the effects we observe are not due to omitted variable bias or reverse causality.

Next, we account for errors-in-variables bias induced by the fact that our measure of

[11] The respective median shares of capital investment financed with bank loans are, as follows: 0 (Mining and quarrying); 0.35 (Construction); 0.23 (Manufacturing); 0.13 (Transportation, storage and communication); 0.30 (Wholesale, retail, repairs); 0.2 (Real estate, renting, and business services); 0.12 (Hotels and restaurants); and 0 (Other). Consequently, we take Construction, Manufacturing, Wholesale, retailn repairs, and Real estate, renting, and business services as a treatment group. This decision is unchanged when we calculate medians by taking all firms into account.

interbank market integration comes from a first-stage regression and is thus measured within a confidence interval. Errors-in-variables leads to an attenuation bias when the error is linearly related to the true observation (see, for instance, Wooldridge [2002]), implying that at worst we are measuring a lower bound for the effect in the OLS specification. Nevertheless, we still want to make sure that the significance of the results is not affected by the bias in the standard errors of the estimation. For that reason, in Column (2) we use an IV procedure where our measures of interbank market integration have been instrumented for with measures of nominal domestic interbank market yields observed with a 24-month lag. The magnitude of our estimates increases substantially, confirming that the OLS procedure may yield downward biased results. Importantly, our estimates stay significant at the 10% level.

Third, we account for the fact that our measure of financial integration captures to a larger degree nominal convergence and to a lesser degree banking sector integration. That is, yields may have converged for reasons outside the banking sector, for example, because of monetary policy coordination, fiscal policy convergence, or broader macroeconomic stability. It is natural to argue that from the point of view of the individual bank, it doesn't matter why interbank yields converge, what matters is that they do. Nevertheless, our measure may be capturing unobservable macro-level developments which are correlated both with the cointegration between money market yields and with the rates charged by commercial banks, introducing omitted variables bias in our estimation. To address that issue, in Column (3) we replace our measure of money markets integration with the share of banking sector assets held by banks with at least 50% foreign ownership[12]. We assume that foreign bank presence is a good proxy for cross-country banking sector integration, and especially as it gives the individual bank access to a larger interbank market. The gist of the result remains unchanged: all else equal, firms are charged lower loan rates in countries with a higher share of the banking sector in foreign hands.

Finally, we account for the possibility that the rates on business loans are reported with

[12] Our calculations are based on data from Bankscope and various Central banks.

an error. It is entirely conceivable that when responding to the question on the loan's annual cost, the company owners misreported the true cost due to faulty records, rounding, or even bad memory. The sample exhibits quite a large variation in the first digit after the decimal point, pointing to a relative precision in the answers. Still, we prefer to account explicitly for measurement error. Our solution is to replace our measure of the real rate on business loans with a dummy equal to 1 if the real rate is bigger than 500 basis points, and to 0 otherwise. As indicated by the results reported in Column (4), this doesn't change the main results, and neither do different choices of the cut-off for the dummy.

5.5 The effect of banking competition

We now proceed to investigate the hypothesis that real business loan rates in more competitive banking markets show a stronger response to the long-run integration of interbank markets compared to less competitive markets. Table IX presents the estimates from Equation (10). We find that the effect of interbank market integration are indeed transmitted differently via the channel of banking competition. In competitive credit markets, firms face significantly lower costs of bank credit as interbank money market integration deepens. However, this effect holds only when we drop from the sample the initial volatile period and focus on the 2001-2005 sub-period (Columns (2)). The estimates decrease marginally when we account for selection (Column (3)). In this case, a doubling of our measure of interbank market integration in countries in the lower half of the banking sector concentration distribution leads to a decrease in real average annualized loan cost of 152 basis points. We find a similar effect when instead of the low concentration dummy we interact our measure of integration with a low HHI dummy (Column (4)).

In all equations, we interact both our measures of interbank market integration and the level of domestic nominal yields on the instruments in question with the dummy for banking sector concentration. While significant on its own, the interaction term which includes the level of nominal money market rates becomes insignificant once the interaction of concentration with our measure of integration is included. This implies that the bulk of the

effect on real rates is carried by the degree of convergence between domestic and international markets rather than by the nominal yields on assets traded in domestic interbank markets.

We then proceed to check whether our results on the effects of interbank money markets integration, accounting for banking sector concentration, are affected by the choice of proxy for money markets integration. In Columns (5) and (6), we repeat the estimations by replacing the estimate of the degree of integration based on yields on 6-month interbank market instruments with estimates based on 1- and 3-month yields, respectively. Both the statistical significance and the economic effect increase marginally for the shorter maturities. A doubling of the 1-month measure of interbank market integration for example in countries in the lower half of the banking sector concentration distribution leads to a decrease in real average annualized loan cost of "only" 138 basis points.

5.6 Firm finance and leveraging

Finally, we turn our attention to the effect of interbank market integration on the financing patterns and the capital structure of the firm. Our finding that interbank market integration has reduced the cost of credit leads us to expect that as a result of integration firms will finance a higher share of their investment from local commercial banks. Naturally, that should come at the expense of substitutes for bank financing. Firms are often forced to resort to trade credit when rationed in the credit market (see Cuñat [2007] for example). Empirical studies have found high sensitivity of investment to retained earnings and trade credit (see Fazzari, Hubbard, and Petersen [1988] for example).[13] Hence, the evidence so far implies that we should see investment being financed in larger part from banks and in lesser part from retained earnings and trade credit. However, we also want to study whether integration hasn't gone "too quickly too far", in the sense of leading to excessive leverage for firms in very integrated markets.

Table X presents evidence to that effect. We find that firms which received their last

[13] Although the point has also been made that firms dislike financing long-term assets with trade credit because of the maturity mismatch (Burkart, Ellingsen, and Giannetti [2009]).

business loan in an environment characterized by deeper interbank market integration financed a larger share of their investment in the past 12 months via borrowing from domestic commercial banks (Column (1)), and a lower share of their investment in the past 12 months via trade credit (Column (2)). While the second result is only statistically significant at the 10%, both are a logical extension to our previous findings.

What these findings imply is that integration has enabled firms to switch from (potentially) more expensive to cheaper forms of financing. However, we now wish to know whether integration hasn't gone too far, tempting firms with rapidly falling rates on loans to take on excessive bank debt. While there is no clear-cut definition of excessive debt, we again turn to our data on German firms to construct benchmark capital structures. In essence, we calculate for each size class the share of capital investment financed with bank loans, and subtract it from the share of capital investment financed with bank loans for the firms in our dataset. While this measure depends on other conditions of the German market, it gives us an approximate measure of "excess leverage". We then regress this measure on banking integration in Column (3). We also construct an indicator variable equal to 1 for firms for which excess leverage is strictly positive, and use a probit regression to evaluate how interbank market integration affects the probability of financing with bank debt a strictly higher share of capital expenses than a similar German firm (Column (4)).

The results give some evidence to the "too-quickly-too-far" hypothesis. Namely, we find that net excess leverage increases with integration, and that the probability of having a positive net excess leverage increases with integration as well. In particular, if integration increases by two standard deviations, the probability that a firm is overleveraged vis-à-vis the leverage of a similar German firm increases by 68%. We read this as evidence that indeed some firms were tempted into excess bank debt by rapidly falling rates on business loans. This is important evidence that many firms in central and eastern Europe were overleveraged and over-dependent on bank loans relatively early in the build-up of the 2008 crisis. Given the severity of the credit crunch in central and eastern Europe, our evidence points to one particular channel via which rapid pre-crisis integration may have contributed to firms' woes

during the crisis.

6 Conclusion

Using direct indicators of corporate needs for bank credit, constraints in obtaining it, and rates on actual loans, we investigate the effects of the integration in interbank markets on small firm finance. We employ a sample of $6,000+$ firms from 10 new EU member states and 4 euro zone countries. We construct a measure of the degree of long-run convergence of nominal yields in national interbank markets to yields in the German benchmark interbank market. We pursue an identification strategy by distinguishing across industries' natural dependence on bank finance. We account for any selection biases by using information on firms without bank loans. We also account for the structure of the banking sector.

Our findings imply that interbank market integration substantially cuts loan rates. For example, if a country had average sample loan rates and was at the mean of the distribution in terms of interbank market integration, a deepening of integration by two standard deviations would decrease loan rates by up to 130 basis points, after selection bias is accounted for. These effects only hold in countries with a considerable degree of credit market competition. Hence interbank market integration has a pronounced effect on real loan rates and credit market competition has a strong impact on the size of this effect. Our findings have important implications for current events and policy responses in the European financial markets which may have decreased the degree of financial integration. They may also provide food for thought for policy measures affecting banking sector consolidation.

We also find some evidence that the rapid convergence of interbank rates, resulting in a rapid decrease in rates on loans to business firms, may have induced firms to take on excess leverage. While the positive effect of integration in making bank loans cheaper and inducing firms to shift away from more expensive forms of finance is beyond doubt, our evidence also suggests that firms in markets which integrated too quickly may have taken on a higher share of bank debt than is natural, as implied by the financing pattern of benchmark firms.

This implies that many central and east European firms may have entered the 2008 financial crisis overleveraged, partially due to the rapid pace of pre-crisis banking integration.

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Figure 1. Betas on 1-month interbank market rates

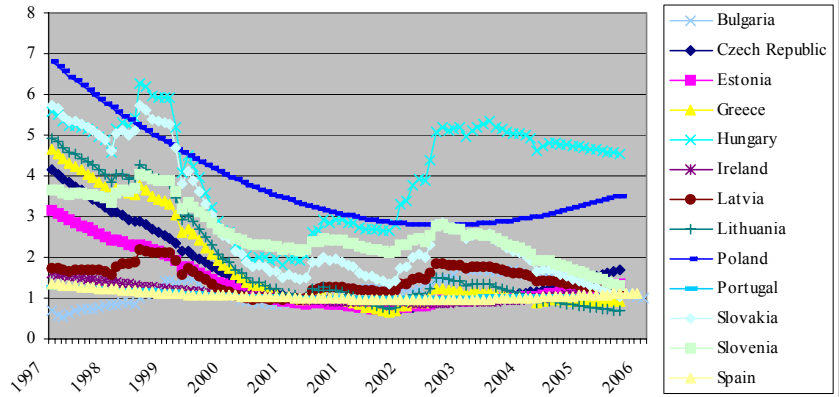


Figure 2. Betas on 3-month interbank market rates

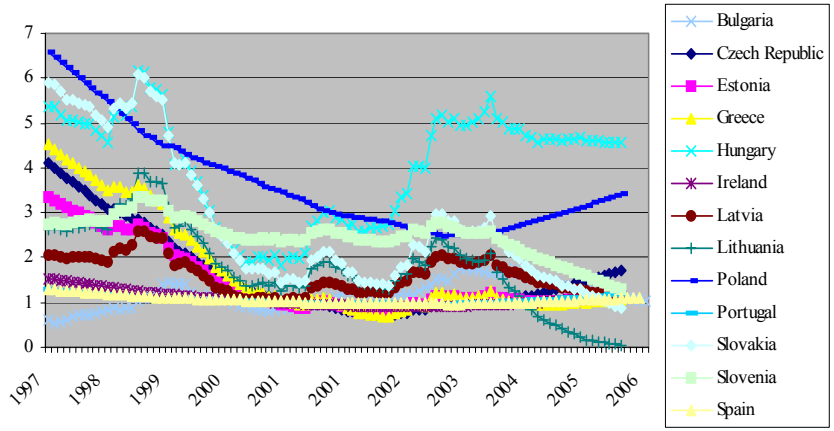


Figure 3. Betas on 6-month interbank market rates

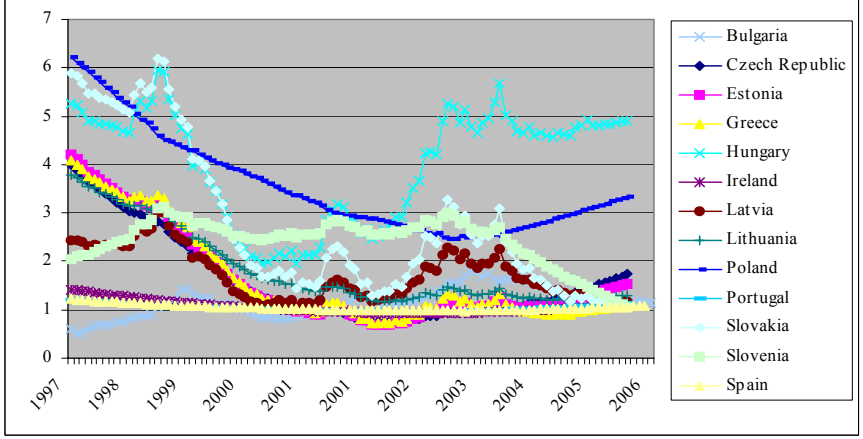
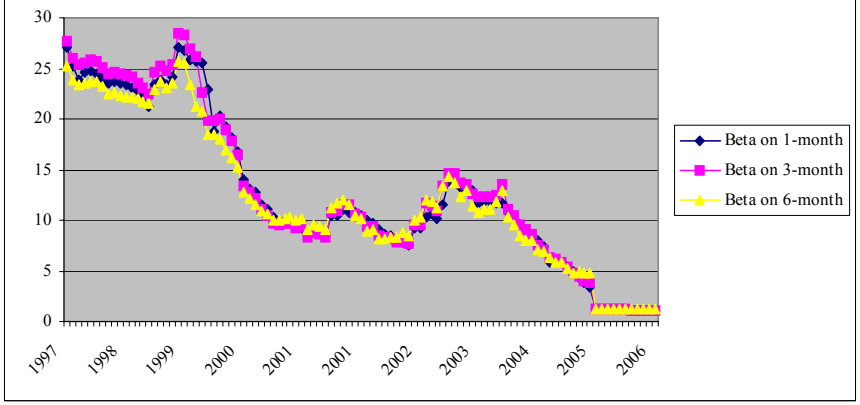


Figure 4. Betas on 1-month, 3-month, and 6-month instruments for Romania



Data source: Global Financial database and authors' calculations.

Table I
Firm Size Summary Statistics

The table presents statistics on the share of small, medium, and large firms in each country. 'Small firms' are defined as firms with 2 to 49 employees; 'Medium firms' are defined as firms with 50 to 249 employees; 'Large firms' are defined as firms with more than 250 employees. All data are averaged over the period 1998:01 and 2005:06. Source: BEEPS (2004, 2005).

Country	Number of firms	Share small firms	Share medium firms	Share large firms
Bulgaria	300	0.74	0.16	0.10
Czech Republic	343	0.76	0.16	0.08
Estonia	219	0.74	0.16	0.10
Greece	545	0.81	0.10	0.09
Hungary	610	0.72	0.20	0.08
Ireland	500	0.78	0.15	0.07
Latvia	205	0.74	0.16	0.10
Lithuania	205	0.68	0.22	0.10
Poland	975	0.75	0.18	0.07
Portugal	504	0.77	0.12	0.11
Romania	600	0.65	0.25	0.10
Slovakia	220	0.67	0.22	0.11
Slovenia	223	0.71	0.17	0.12
Spain	598	0.78	0.12	0.10
Total	6,047	0.73	0.18	0.09

Table II
Business Loan Characteristics

The table presents summary statistics on the cost, collateral and maturity associated with loans to business firms. 'Real loan cost' is calculated as the annualized rate of the loan minus the German interbank market benchmark rate. 'Share of un-collateralized loans' is calculated as the percentage of all loans that didn't require any collateral. 'Loan maturity' is the maturity of the loan in months. All data are averaged over the period 1998:01 and 2005:06. Source: BEEPS (2004, 2005).

Country	Real loan cost	Share of un-collateralized loans	Loan maturity
Bulgaria	8.73	0.13	37.6
Czech Republic	7.35	0.16	36.4
Estonia	4.30	0.11	51.7
Greece	4.54	0.42	52.0
Hungary	10.73	0.11	33.6
Ireland	2.35	0.38	69.3
Latvia	4.36	0.10	43.2
Lithuania	3.37	0.22	36.1
Poland	10.03	0.19	30.8
Portugal	4.01	0.40	40.7
Romania	15.73	0.07	27.1
Slovakia	5.08	0.22	41.8
Slovenia	3.82	0.41	45.4
Spain	3.87	0.31	23.6
Total	7.25	0.23	39.4

Table III
Banking Sector Characteristics

'Interbank markets, 1-month rate' is measured by the averaged monthly rate of a 1-month instrument. 'Interbank markets, 3-month rate' is measured by the averaged monthly rate of a 3-month instrument. 'Interbank markets, 6-month rate' is measured by the averaged monthly rate of a 6-month instrument. The country-month values are calculated as in equation (7), and the underlying data comes from the Global Financial Database. 'Foreign bank ownership' is measured by the percentage of banking sector assets held by foreign banks; source: Bankscope and various central banks. 'Banking sector C3' is measured as the percentage of banking sector assets held by the 3 largest banks; source: Beck, Demirguc-Kunt, and Levine (2000, updated 2008). 'Banking sector HHI' is measured as the sum of the squared shares of each individual bank's assets out of the total banking sector assets; source: Giannetti and Ongena (2009). All data are averaged over the period 1998:01 and 2005:06.

Country	Interbank markets, 1-month rate	Interbank markets, 3-month rate	Interbank markets, 6-month rate	Foreign bank ownership	Banking sector C3	Banking sector HHI
Bulgaria	3.38	3.40	3.43	0.755	0.485	0.082
Czech Republic	4.51	4.55	4.56	0.819	0.667	0.160
Estonia	3.96	4.29	3.91	0.972	0.975	0.550
Greece	4.46	4.41	4.27	--	0.675	0.304
Hungary	10.93	10.82	10.89	0.771	0.590	0.249
Ireland	2.70	2.71	2.72	--	0.556	0.214
Latvia	4.14	4.55	4.84	0.511	0.545	0.164
Lithuania	4.17	5.18	3.92	0.873	0.809	0.272
Poland	8.87	8.51	8.48	0.702	0.424	0.097
Portugal	3.01	2.94	2.94	--	0.880	0.089
Romania	26.70	27.51	26.70	0.795	0.598	0.193
Slovakia	7.96	8.13	8.14	0.793	0.719	0.122
Slovenia	5.15	6.45	6.12	0.172	0.692	0.289
Spain	2.63	2.65	2.66	--	0.641	0.157
Total	5.64	5.75	5.68	0.719	0.624	0.210

Table IV
Panel Unit Root Tests and Engle-Granger Cointegration Tests on Model Variables

The table presents results and statistics from panel unit root tests (Columns (1)-(4)) and from Engle-Granger cointegration tests (Columns (5)-(6)). The models estimated are $r_t^j = \alpha^j + \rho^j r_{t-1}^j + \sum_{k=1}^{N} \delta^j r_{t-k}^j + \varepsilon_t^j$ (Column (1)), $\Delta r_t^j = \alpha^j + \rho^j r_{t-1}^j + \sum_{k=1}^{N} \delta^j \Delta r_{t-k}^j + \varepsilon_t^j$ (Column (3)), and $r_t^j = \alpha^j + \sum_{k=1}^{N} \delta^j r_{t-k}^j + \varepsilon_t^j$ (Column (5)). The null hypothesis for the unit root tests is $H_0 : \rho^j = 0$ for all *j*, against the alternative $H_0 : \rho^j = 1$ for some countries. The null hypothesis for the cointegration test assumes a unit root in the residuals of the cointegration regression, which implies absence of cointegration. The alternative hypothesis assumes a root of less than one. Market rates are interbank rates on 6-month instruments, and inter-day differences in rates on 6-month instruments. The country-month values are calculated as in equation (7) and the underlying data comes from the Global Financial Database.

	6-month rate		Δ 6-month rates		6-month rate	
Country	*Z*	*p-value*	*Z*	*p-value*	*Z*	*p-value*
Bulgaria	-2.55	0.10	-8.32	0.00	-5.67	0.00
Czech Republic	-0.97	0.76	-8.38	0.00	-1.28	0.64
Estonia	-4.05	0.00	-2.01	0.28	-4.46	0.01
Greece	-5.15	0.00	-5.53	0.00	-5.37	0.00
Hungary	-0.21	0.94	-8.33	0.00	-0.35	0.92
Ireland	-2.12	0.24	-5.18	0.00	-3.72	0.00
Latvia	-3.64	0.01	-14.07	0.00	-4.24	0.00
Lithuania	-1.21	0.67	-5.68	0.00	-3.49	0.01
Poland	-0.73	0.84	-5.88	0.00	-2.21	0.20
Portugal	-1.54	0.51	-5.92	0.00	-6.19	0.00
Romania	-0.73	0.84	-8.38	0.00	-1.18	0.68
Slovakia	-0.65	0.86	-6.42	0.00	-0.86	0.80
Slovenia	-0.13	0.95	-4.43	0.00	-1.30	0.63
Spain	-1.46	0.55	-5.55	0.00	-7.59	0.00
all countries	-3.24	0.02	-7.32	0.00	-3.76	0.00

Table V
Probit Estimates: Desirability of Bank Credit

The dependent variable is the desirability of bank credit. It is equal to 1 if the firm desires bank credit, and to 0 otherwise. β_{6t} is the estimate of interbank markets integration for rates on 6-month money instruments at time *t* from equation (7). In the case of firms without a loan, it is equal to the within-country average over 1998-2005. '6 month interbank rate' is the nominal rate of 6-month interbank market money instruments. In the case of firms without a loan, it is equal to the within-country average over 1998-2005. 'Small firm' is a dummy equal to 1 if the firm has 2 to 24 employees. 'Medium firm' is a dummy equal to 1 if the firm has from 50 to 249 employees. 'Individual owner' is a dummy equal to 1 if the firm is owned by an individual or a family. 'Government owner' is a dummy equal to 1 if the firm is owned by a government agency. 'Foreign owner' is a dummy equal to 1 if the owner of the firm is a foreign entity. 'Exporter' is a dummy equal to 1 if the firm exports to non-local markets. 'Privatized' is a dummy equal to 1 if the firm is a former state-owned company. 'Subsidized' is a dummy equal to 1 if the firm has received in the last 3 years subsidies from central or local government. 'Competition' is a dummy equal to 1 if the firm faces fairly, very, or extremely strong competition. Ommited category in firm size is 'Large firm'. Source: BEEPS (2004, 2005).

Variable	Coefficient	Variable mean
β_{6t}	-0.201	2.71
	(0.046)***	
6-month interbank rate	-0.095	7.37
	(0.009)***	
Small firm	-0.365	0.75
	(0.074)***	
Medium firm	-0.201	0.16
	(0.077)***	
Individual owner	0.056	0.78
	(0.059)	
Government owner	-0.423	0.05
	(0.096)***	
Foreign owner	-0.439	0.07
	(0.086)***	
Exporter	0.169	0.28
	(0.043)***	
Privatized	0.096	0.06
	(0.079)	
Subsidized	0.418	0.12
	(0.063)***	
Competition	0.173	0.48
	(0.039)***	
Constant	1.149	1.00
	(0.128)***	
Country dummies	Yes	
Year dummies	Yes	
Observations	6,047	
Firms desiring bank loan	4,507	
Log likelihood	-3,593.0	

Table VI
Probit Estimates: Absence of Borrowing Constraint

The dependent variable is the absence of a borrowing constraint. It is equal to 1 if the firm is unconstrained, and to - otherwise. β_{6t} is the estimate of interbank markets integration for rates on 6-month money instruments at time *t* from equation (7). In the case of firms without a loan, it is equal to the within-country average over 1998-2005. '6 month interbank rate' is the nominal rate of 6-month interbank market money instruments. In the case of firms without a loan, it is equal to the within-country average over 1998-2005. 'Banking sector C3' is measured as the percentage of banking sector assets held by the 3 largest banks; source: Beck, Demirguc-Kunt, and Levine (2000, updated 2008). 'Small firm' is a dummy equal to 1 if the firm has 2 to 24 employees. 'Medium firm' is a dummy equal to 1 if the firm has from 50 to 249 employees. 'Individual owner' is a dummy equal to 1 if the firm is owned by an individual or a family. 'Government owner' is a dummy equal to 1 if the firm is owned by a government agency. 'Foreign owner' is a dummy equal to 1 if the owner of the firm is a foreign entity. 'Exporter' is a dummy equal to 1 if the firm exports to non-local markets. 'Privatized' is a dummy equal to 1 if the firm is a former state-owned company. 'Subsidized' is a dummy equal to 1 if the firm has received in the last 3 years subsidies from central or local government. 'Competition' is a dummy equal to 1 if the firm faces fairly, very, or extremely strong competition. Ommited category in firm size is 'Large firm'. Source: BEEPS (2004 and 2005).

Variable	Coefficient	Variable mean
β_{6t}	-0.092	2.86
	(0.045)**	
	-0.125	7.75
6-month interbank rate	(0.011)	
	0.08	0.62
Banking sector $C3_t$	(0.011)***	
Small firm	-0.637	0.71
	(0.129)***	
Medium firm	-0.381	0.18
	(0.131)**	
Individual owner	-0.093	0.76
	(0.085)	
Government owner	-0.699	0.05
	(0.137)***	
Foreign owner	-0.053	0.06
	(0.148)	
Exporter	0.292	0.31
	(0.062)***	
Privatized	0.269	0.08
	(0.114)**	
Subsidized	0.391	0.14
	(0.09)***	
Competition	-0.062	0.47
	(0.052)	
Audited	0.42	0.55
	(0.059)***	
Constant	-2.22	1.00
	(0.505)***	
Country dummies	Yes	
Year dummies	Yes	
Observations	4,507	
Unconstrained firms	3,603	
Log likelihood	-1,656.6	

Table VII
Interbank Market Integration and Bank Loan Rates

The dependent variable is the spread of the individual loan rate over the benchmark money market rate. All estimates are from OLS regressions. Columns (2)-(5) exclude all Romanian firms. β_{6t} is the estimate of interbank markets integration for rates on 6-month money instruments at time *t* from equation (7). '6 month interbank rate' is the nominal rate of 6-month interbank market money instruments. Data comes from the Global Financial Database. 'Loan maturity' is the duration of the loan. 'Small firm' is a dummy equal to 1 if the firm has 2 to 24 employees. 'Medium firm' is a dummy equal to 1 if the firm has from 50 to 249 employees. 'Individual owner' is a dummy equal to 1 if the firm is owned by an individual or a family. 'Government owner' is a dummy equal to 1 if the firm is owned by a government agency. 'Foreign owner' is a dummy equal to 1 if the owner of the firm is a foreign entity. 'Exporter' is a dummy equal to 1 if the firm exports to non-local markets. 'Privatized' is a dummy equal to 1 if the firm is a former state-owned company. 'Subsidized' is a dummy equal to 1 if the firm has received in the last 3 years subsidies from central or local government. Ommited category in firm size is 'Large firm'. Source: BEEPS (2004 and 2005). 'Mills1' is the estimate from the credit desirability regression (Table V). 'Mills2' is the estimate from the borrowing constraint regression (Table VI).

	Real loan rate				
	All countries	Excluding Romania			
	1998-2005, no Heckman correction	1998-2005, no Heckman correction	2001-2005, no Heckman correction	2001-2005, Heckman correction	2001-2005, Heckman correction
β_{6t}	-0.009	0.646	0.789	0.663	1.477
	(0.091)	(0.219)***	(0.251)***	(0.267)***	(0.439)***
6-month	0.039	-0.103	-0.074	-0.076	-0.294
interbank rate	(0.034)	(0.061)	(0.074)	(0.074)	(0.13)**
Loan maturity	-0.007	-0.007	-0.007	-0.007	-0.007
	(0.002)***	(0.002)***	(0.002)***	(0.002)***	(0.002)***
Small Firm	1.147	1.081	1.064	1.057	0.988
	(0.248)***	(0.236)***	(0.241)***	(0.241)***	(0.244)***
Medium Firm	0.327	0.211	0.182	0.184	0.103
	(0.248)	(0.236)	(0.241)	(0.242)	(0.246)
Indiv. owner	-0.124	-0.014	0.044	0.047	0.089
	(0.202)	(0.198)	(0.202)	(0.204)	(0.206)
Govt owner	0.593	0.522	0.49	0.52	0.513
	(0.398)	(0.382)	(0.392)	(0.392)	(0.398)
Foreign owner	-0.502	-0.119	-0.026	-0.039	0.062
	(0.326)	(0.31)	(0.317)	(0.318)	(0.327)
Privatized	-0.234	-0.439	-0.427	-0.46	-0.473
	(0.255)	(0.248)*	(0.254)*	(0.256)*	(0.259)*
Exporter	-0.473	-0.393	-0.416	-0.406	-0.404
	(0.15)***	(0.141)***	(0.145)***	(0.145)***	(0.147)**
Audited	-0.358	-0.434	-0.445	-0.45	-0.458
	(0.167)**	(0.16)***	(0.166)***	(0.166)**	(0.168)**
Mills1				-0.243	-0.299
				(0.146)**	(0.175)*
Mills2				0.241	0.166
				(0.23)	(0.243)
Observations	2,062	1,894	1,789	1,789	1,789
Fixed effects		Country			Country ×
		Month-Year			Month-Year
R^2	0.56	0.58	0.58	0.58	0.59

Table VIII
Identification, Errors-in-Variables, and Robustness

The dependent variable is the spread of the individual loan rate over the benchmark money market rate (columns (1)-(3)) and a dummy equal to 1 if the the spread of the individual loan rate over the benchmark money market is larger than 500 basis points (column (4)). OLS regression in column (1) and (3), IV regression in column (2), and probit regression in (4). In (2), the measure of integration is instrumented for, using the 24-month lagged value of domestic nominal interbank yields. β_{6t} is the estimate of interbank markets integration for rates on 6-month money instruments at time *t* from equation (7). 'Bank dependence' is an indicator variable constructed using the BEEPS (2004) and equal to 1 if the firm is in an industry which is in the top 50% of the distribution of industries in Germany based on median share of capital expences financed with bank loans. 'Bank foreign ownership' is the share of bank sector assets held by banks with more than 50% foreign ownership, and comes from Bankscope and various central banks. 'Mills1' is the estimate from the credit desirability regression (Table V). 'Mills2' is the estimate from the borrowing constraint regression (Table VI) The regressions also include the rest of the variables from Table VII.

	Real loan rate			Loan rate dummy
$\beta_{6t} \times$ Bank dependence	0.291			
	(0.146)**			
β_{6t}	0.696	1.409		0.069
	(0.306)**	(0.783)*		(0.03)**
Bank foreign ownership			-0.053	
			(0.028)**	
6-month interbank rate	0.015	-0.192	0.025	0.001
	(0.066)	(0.152)	(0.056)	(0.01)
Bank dependence	0.034			
	(0.056)			
Mills1	-0.323	-0.208	-0.331	
	(0.141)**	(0.109)**	(0.191)*	
Mills2	0.202	0.262	0.6	
	(0.231)	(0.232)	(0.667)	
Observations	1,789	1,789	1,789	1,789
Fixed effects	Industry			
		Country		
		Month-Year		
R^2	0.57	0.56	0.43	0.49

Table IX
Interbank Market Integration and Bank Loans Rates: Accounting for Credit Market Competition

The dependent variable is the spread of the individual loan rate over the benchmark money market rate. β_t is the estimate of interbank markets integration for rates on 6-month money instruments at time *t* in columns (1)-(4), on 1-month instruments in column (5), and on 3-month instruments, in Column (6), all estimated as in equation (7). 'Bank competition' is a dummy equal to 1 if the country is in the bottom half of the banking sector C3 distribution at time *t* (Columns (1)-(3) and (5)-(6)); source: Beck, Demirguc-Kunt, and Levine (2000, updated 2008), and a dummy equal to 1 if the sum of the squared shares of each individual bank's assets out of the total banking sector assets is in the bottom half of the bank HHI distribution at time *t* (Column (4)); source: Giannetti and Ongena (2009). The regressions also include the rest of the variables from Table VII.

	Real loan rate					
	No Heckman correction			Heckman correction		
	Full sample			2001-2005		
β_t * Bank competition$_t$	0.361	0.829	0.739	0.545	0.54	0.512
	(0.275)	(0.358)**	(0.364)**	(0.306)*	(0.31)*	(0.252)**
Bank competition$_t$	-0.525	-2.842	-2.662	-0.372	-2.44	-2.579
	(0.768)	(1.409)**	(1.427)**	(0.64)	(1.463)*	(1.412)*
β_t	0.457	0.375	0.281	0.886	0.402	0.258
	(0.27)*	(0.32)	(0.328)	(0.303)***	(0.335)	(0.293)
Observations	1,865	1,759	1,759	1,759	1,759	1,759
Fixed effects			Country			
			Month-Year			
R^2	0.58	0.58	0.58	0.58	0.58	0.58

Table X
Interbank Market Integration, Sources of Firm Investment, and Capital Structure

The table presents estimates of the effect of integration on the sources of firm finance. In column (1), the dependent variable is the share of new investment in the last 12 months financed via borrowing from local private commercial banks. In Column (2), the dependent variable is the share of new investment in the last 12 months financed via trade credit from suppliers or from customers. In Column (3), the dependent variable is the share of new investment financed via borrowing from banks minus the share of new investment financed via borrowing from banks by firms in the same industry in Germany. In Column (4), the dependent variable is the probability that the share of new investment financed via borrowing from banks minus the share of new investment financed via borrowing from banks by firms in the same industry in Germany is bigger than 1. β_{6t} is the estimate of interbank markets integration for rates on 6-month money instruments at time *t* from equation (7). 'Bank concentration low' is a dummy equal to 1 if the country is in the lower half of the bank concentration distribution at time *t*. The regressions also include the rest of the variables from Table VII. Data on those come from the BEEPS (2004, 2005)

	Share new investment financed by domestic banks	Share new investment financed by trade credit	Share new investment financed by banks – benchmark	
β_{6t}	-0.058	0.014	-0.061	-0.169
	(0.029)**	(0.008)*	(0.03)**	(0.088)*
Observations	1,164	1,074	1,164	1,151
R^2	0.18	0.15	0.17	0.14

Appendix. Variable Definitions and Data Sources

Data sources: Business Environment and Enterprise Performance Survey (BEEPS), 2004 and 2005 versions; Global Financial Database (GFD); Beck, Demirguc-Kunt, and Levine (2000, updated 2008); Giannetti and Ongena (2009); Bankscope; and various Central banks.

Variable	Definition	Source
Loan and firm finance characteristics		
Real loan cost	The spread of the individual loan rate over the benchmark money market rate at time *t*	BEEPS
Loan maturity	The maturity of the individual loan	BEEPS
Share new investment financed with bank loans	Proportion of the firm's new fixed investment that has been financed via borrowing from commercial banks in the last 12 months	BEEPS
Share new investment financed with trade credit	Proportion of the firm's new fixed investment that has been financed via borrowing from suppliers or customers in the last 12 months	BEEPS
Firm characteristics		
Small Firm	=1 if the firm has from 2 to 49 employees, =0 otherwise	BEEPS
Medium Firm	=1 if the firm has from 50 to 249 employees, =0 otherwise	BEEPS
Large Firm	=1 if the firm has more than 250 employees, =0 otherwise	BEEPS
Individual owner	=1 if the owner of the firm is an individual or a family, =0 otherwise	BEEPS
Government owner	=1 if the owner of the firm is the government, =0 otherwise	BEEPS
Foreign owner	=1 if the owner of the firm is a foreign corporation, =0 otherwise	BEEPS
Privatized	=1 if the firm was originally state-owned, =0 otherwise	BEEPS
Exporter	=1 if the firm exports a portion of its products, =0 otherwise	BEEPS
Subsidized	=1 if the firm has received any subsidies from national, regional or local governments over the last three years, =0 otherwise	BEEPS
Competition	=1 if the firm faces "fairly", "very", or "extremely" strong competition in product markets	BEEPS
Audited	=1 if the firm has its annual financial statement reviewed by an external auditor, =0 otherwise	BEEPS
Market characteristics		
6-month rate	The nominal rate of a 6-month interbank market instrument in each country at time *t*	GFD
3-month rate	The nominal rate of a 3-month interbank market instrument in each country at time *t*	GFD
1-month rate	The nominal rate of a 1-month interbank market instrument in each country at time *t*	GFD
Bank foreign ownership	Share of bank assets in each country owned by foreign banks	Bancscope, CBs
Banking sector C3	The share of bank assets in each country owned by the biggest 3 banks	Beck, Demirguc-Kunt, and Levine
HHI	The sum of the squared shares of each individual bank's assets out of the total banking sector assets in each country	Giannetti and Ongena