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## Interbank market integration, loan rates, and firm leverage

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EUROPEAN CENTRAL BANK

EUROSYSTEM

**WORKING PAPER SERIES**

**NO 1252 / OCTOBER 2010**

**EZB EKT EKP**

**INTERBANK  
MARKET  
INTEGRATION,  
LOAN RATES,  
AND FIRM  
LEVERAGE**

by Steven Ongena  
and Alexander Popov



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## WORKING PAPER SERIES

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# INTERBANK MARKET INTEGRATION, LOAN RATES, AND FIRM LEVERAGE<sup>1</sup>

by Steven Ongena<sup>2</sup> and Alexander Popov<sup>3</sup>



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## Abstract

We study the effect of interbank market integration on small firm finance in the build-up to the 2007-2008 financial crisis. We use a comprehensive data set that contains contract terms on individual loans to 6,047 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 less stringent borrowing constraints and in substantially lower loan rates. The decrease was strongest in markets with competitive banking sectors. We also find that in the most rapidly integrating markets, firms became substantially overleveraged during the build-up to the crisis.

**JEL classification:** E51, G15, G21, G34

**Keywords:** interbank markets, selection, loan rates, bank competition, firm leverage

## Non-technical summary

Financial integration is widely perceived to stimulate investment-based growth through a reduction in the cost of equity, bond, and bank financing. Little is known, however, about 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? And does rapid integration simply lead to cheaper firm financing, or does it also induce households and firms to take on excessive leverage? Given the freezing and subsequent partial disintegration of interbank markets after August 2007, and in order to make informed inferences about the effect of interbank market disfunctionality on the real economy, it is important to investigate how pre-crisis integration affected the financing of small and medium enterprises.

In this paper, we estimate the effect of interbank market integration on small firm finance while taking into account the structure of credit markets. We focus on a sample of 6,047 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). For the new EU member states, the sample period coincides with their rapid transition from "parochial" credit markets with mostly state-owned financial institutions to integrated credit markets populated by foreign-owned financial institutions with ready access to integrated euro-zone interbank markets. Interbank market integration in the euro area countries was almost complete at the beginning of the period, and so our data provides us with a control and a treatment group to estimate the effect of integration 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, and relate convergence to bank loan rates and to firm leveraging.

We find that interbank market integration alleviates credit constraints and decreases the loan rates charged to firms both in a statistically significant and economically relevant way. Numerically, a deepening of interbank market integration by two standard deviations would result in a decrease in loan rates by 121 basis points. If a euro zone country in the sample returns to its degree of interbank market integration in the last year prior to joining the euro, loan rates will, *ceteris paribus*, be almost 60 basis points higher. These results are stronger in countries with a considerable degree of credit market competition. Our estimates hold regardless of whether we look at integration measures based on the convergence of nominal yields, or at integration measures based on cross-border interbank lending.

At the same time, we find that lower loan rates may lead to excessive firm leverage. 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 between 10% and 13%. Our evidence thus points to one specific channel through which the European integration of the past decade contributed to both the growth and the vulnerability of the region's non-financial firms.

One methodological contribution of the paper to the empirical banking literature is the utilization of data on non-applicant firm and rejected applicant firms to purge imminent selection bias. In our sample, about one third of the firms are either rejected or discouraged. Therefore, estimating the effect of integration on the rates of loans to firms which obtained bank credit ignores the bias induced by the non-randomness of the subsample of credit receiving firms. To address this issue, we use survey data on firms that applied for bank credit but were turned down, and on firms that stayed out of the application process because they were discouraged by high interest rates, high collateral requirements, and high rejection rates, distinguishing the latter from firms which stayed out of the application process because they were in good financial health.

The paper serves to inform policy-makers further about the costs and benefits of the integration process. 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 suggests that many central and east European firms may have entered the 2007-2008 financial crisis overleveraged, partially due to the rapid pace of pre-crisis banking integration.



# 1 Introduction

Financial integration is widely perceived to stimulate investment-based growth through a reduction in the cost of equity, bond, and bank financing.<sup>1</sup> Little is known, however, about 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? And does rapid integration simply lead to cheaper firm financing, or also to excessive leverage? Given the freezing and subsequent partial disintegration of interbank markets after August 2007, and in order to make informed inferences about the effect of interbank market disfunctionality on the real economy, it is important to investigate how pre-crisis integration affected the financing of small and medium enterprises. By studying the mechanisms through which the integration of the interbank market works, our paper contributes to a growing literature on the benefits and costs of financial globalization.<sup>2</sup>

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.<sup>3</sup> 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. The 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 with bank loans.<sup>4</sup>

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<sup>1</sup>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.

<sup>2</sup>The real effects of financial integration that are investigated include its effect on economic growth (Edison, Levine, Ricci, and Slok (2002)), entrepreneurial activity (Giannetti and Ongena (2009)), and cross-country correlations in GDP growth (Imbs (2004)), among others.

<sup>3</sup>Regarding the latter, interbank market integration may have an impact that is independent of cross-border bank ownership. Demyanyk, Ostergaard, and Sørensen (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.

<sup>4</sup>Integration in interbank markets need not naturally arise, however. Freixas and Holthausen (2005) for example

However, there are two potential downsides to this process. First, 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 sizeable negative effect on firms if it is followed by a credit crunch of the type that was experienced globally after August 2007.<sup>5</sup>

One fundamental point should be made however. Prior research has suggested that the benefits of bank integration on small business finance are affected by the intensity of credit market competition. It is unclear however if competition fosters or slows integration. Competition lowers the surplus banks can extract from their borrowers and speeds up interest rate adjustments (Klein (1971)). 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. However, 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 of credit conditions for small firms.

Our paper contributes to the literature by estimating the effect of interbank market integration on small firm finance while taking into account the structure of credit markets. We focus on a sample of 6,047 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 countries

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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.

<sup>5</sup>See, for example, Ivashina and Scharfstein (2010) and Puri, Rocholl, and Steffen (2010) for global evidence on the reduction of business lending during the 2007-2008 financial crisis.

and over time.

For the new EU member states, the sample period coincides with their rapid transition from "parochial" credit markets with mostly state-owned financial institutions to integrated credit markets populated by foreign-owned financial institutions with ready access to integrated euro-zone interbank markets. Interbank market integration in the euro area countries was 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 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, and relate convergence to bank loan rates and to firm leveraging.

We address one important methodological point. 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.<sup>6</sup> 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 that such observed information 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 find that interbank market integration alleviates credit constraints and decreases the loan rates charged to firms both in a statistically significant and economically relevant way. After accounting for firm selection, a deepening of interbank market integration by two standard deviations would result in a decrease in loan rates by 121 basis points. If a euro zone country in the sample returns to its degree of interbank market integration in the last year prior to joining the euro,

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<sup>6</sup>One exception is Chakravarty and Yilmazer (2009). 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. None of these studies model the loan application and granting decisions.

loan rates will, *ceteris paribus*, be almost 60 basis points higher. However, these results are only observed in countries with a considerable degree of credit market competition. Our estimates hold regardless of whether we look at integration measures based on the convergence of nominal prices, or at integration measures based on cross-border interbank lending. Finally, lower loan rates may lead to excessive firm leverage. 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 between 10% and 13%. Our evidence thus points to one specific channel through which the European integration of the past decade contributed to both the growth and the vulnerability of the region's non-financial firms.

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

## 2 Measuring interbank market integration

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)).<sup>7</sup> In this paper, we choose as a proxy for interbank market integration a measure à la Engle and Granger (1987), 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 degree of integration in different subperiods over a longer time period, the simplest possible model that can be estimated is:

$$r_t^j = \alpha^j + \beta^j r_t^b + \varepsilon_t \quad (1)$$

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<sup>7</sup>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. Measures of financial integration based on the law of one price are therefore preferred. We will nevertheless in the robustness section also develop quantity measures of integration.

$r_t^j$  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  $\beta$  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 in Baele, Ferrando, Hördahl, Krylova, and Monnet (2004). Finally,  $\beta$  can be calculated over a rolling window of, for example, 18 months.

The problem with this simple approach is that the resulting time series of  $\beta_t^j$ 's for each country  $i$  will have serially correlated standard errors, resulting in inflated  $t$ -statistics. This is problematic given that the  $\beta_t^j$ '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:

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

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  $\beta_t^j$  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  $\beta_t^j$ 's, while integrated states of the world are characterized by  $\beta_t^j$ '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 (2) as well as the model:

$$\Delta r_t^j = \theta^j u_{jt-1} + (\eta_0^j + \eta_1^j t + \eta_2^j t^2) \cdot \Delta r_t^b + v_{jt} \quad (3)$$

$\Delta r_t^j$  is the difference in adjacent daily yields for country  $j$  and  $\Delta r_t^b$  is the difference in adjacent daily yields for the benchmark country Germany. Thus, Equation (2) reflects the long-run equilibrium adjustment, while Equation (3) 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  $\eta_t^j = \eta_0^j + \eta_1^j t + \eta_2^j t^2$ .

## 3 Data

### 3.1 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.<sup>8</sup> The sample features a control group of euro-zone countries for which integration was achieved as early as the beginning of the period, and a treatment group of central and eastern European countries which started at low level of integration and integrated at different speed over the period.

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  $\beta_t^j$  on interbank market rates on 6-month instruments for

<sup>8</sup>In 1998, the benchmark is the German interbank market, but that after 1 January 1999, the 6-month rate reflects the level of the euro area interbank market rate for that maturity.

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  $\beta_t^j$ '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. The reason for that is the very volatile fiscal and monetary policy during the sample period, resulting in high and variable inflation and consequently in very high initial values of nominal interest rates, and consequently very slow convergence. This motivates the exclusion of Romania in most of the empirical analysis.

## 3.2 Firm-level data

We match the data on interbank market integration, constructed using the 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 includes 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 8 different sectors: Mining and quarrying; Construction; Manufacturing; Transportation, storage and communication; Wholesale, retail, and repairs; Real estate, renting and business services; Hotels and restaurants; and Others. 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).<sup>9</sup> Table 1 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 (2) and (3) from daily yields in the Global Financial database. The  $\beta_t^j$ '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.<sup>10</sup>

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<sup>9</sup>See <http://www.ebrd.com/country/sector/econo/surveys/beeps.htm> for further detailed reports on the representativeness of the survey.

<sup>10</sup>Germany is excluded from the regression analysis as the benchmark country.



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 2 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 annualized rate of loans is 725 basis points, ranging from 235 basis points in Ireland to 1573 basis points 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. Also, in terms of development over time, most countries saw a decrease in the real loan rate between the first and the last quarter for which data is available, with the exception of Portugal where the average loan rate increased from 123 to 427 basis points, and of Romania where the real loan rate stayed flat at approximately 1000 basis points.

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 bank-level 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 3 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%),<sup>11</sup> it is above 50% in the rest of the central and eastern European 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 highly positively correlated ( $\rho = 0.59$ ). There is also a high correlation between foreign ownership and concentration in the commercial banking sector ( $\rho = 0.31$ ) and between foreign ownership and HHI ( $\rho = 0.32$ ).

## 4 Empirical method and results

We estimate a simple model of the effect of interbank market integration on business loan rates. The approach accounts for the fact that loan rates are only observed conditional on firms not being credit constrained, and firm's credit constraints are only observed conditional on firms' having positive demand for credit. The Appendix explains this three-stage Tobit scheme employed throughout the paper in detail.

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<sup>11</sup>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.

First, in a basic model, we do not account for credit market competition and estimate the following equation:

$$Y_{ijt} = \alpha_0 + \beta_t^j \alpha_1 + X_{it} \alpha_2 + D_j \alpha_3 + D_t \alpha_4 + \sigma_1 \rho_{13} \frac{\phi(c)}{\Phi(c)} + \varepsilon_{ijt} \quad (4)$$

where  $Y_{ijt}$  is either 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  $t$ , or the firm's capital structure (for example, firm leverage).  $\beta_t^j$  is interbank market integration in country  $j$  at time  $t$  from equation (2),  $X_i$  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  $\frac{\phi(c)}{\Phi(c)}$  is the inverse Mill's ratio from the firm-level probit estimate of credit constraint, which incorporates information on credit demand (See Appendix). The estimator of interest is  $\alpha_1$ , and given that lower  $\beta_t^i$  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 sector.  $BC_j$  is either the C3 or HHI, defined earlier. Formally, the model becomes:

$$Y_{ijt} = \alpha_0 + \beta_t^j \cdot BC_{jt} \alpha_1 + \beta_t^i \alpha_2 + BC_{jt} \alpha_3 + X_i \alpha_4 + D_j \alpha_5 + D_t \alpha_6 + \sigma_1 \rho_{13} \frac{\phi(c)}{\Phi(c)} + \varepsilon_{ijt} \quad (5)$$

As in the previous model, the estimator of interest is  $\alpha_1$ . In the empirical exercise, we proxy banking sector concentration with dummies which equal 1 (0) if the country during this time period is in the bottom (top) half of the distribution for bank concentration, or HHI. Again, we expect the sign of  $\alpha_1$  to be positive for the composite term with the dummy for low banking sector concentration.

#### 4.1 Unit roots and co-integration

Table 4 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 4 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  $\beta_t^j$  with a strong degree of confidence.

## 4.2 Selection estimation

Table 5 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. We concur that the interbank integration could affect loan desirability through the effect on interest rates firms expect to pay if they get a loan.<sup>12</sup> 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 selection will introduce a bias into the main estimates.

It needs to be pointed out that in all exercises from now on we control for nominal interbank rates. The level of the domestic interbank rate is an outcome of concurrent changes in monetary and economic conditions. By including the domestic interbank rate we try to isolate the effect of interbank market integration on the cost of funding from other conditions that may influence the

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<sup>12</sup>It could also be driven by expectations of future rates. In unreported regressions, we add one and two year leads of the interbank interest rate. While the coefficients on these two new terms are also negative and significant, the estimated coefficient on the contemporaneous interbank integration remains qualitatively unaffected. We also note that dropping the integration variable does not affect the other estimated coefficients.

level of domestic interbank rates.<sup>13</sup> We find that the probability of needing bank credit is also higher in markets where nominal interbank rates are lower.

Regarding the firm-level co-variates, the need for bank credit 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 larger internal capital markets in the case of foreign firms. 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 lower margins and fewer 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 6 presents the results of the probit equation for the absence of borrowing constraints. Because credit constraints are only observed conditional on positive demand for credit, we include the inverse Mill's ratio estimated from the loan desirability equation estimated in Table 5. The exclusion restriction is satisfied by excluding the variable "Competition" from the set of independent variables: firms in more competitive environments will likely demand more credit due to lower profit margins, but it is unlikely that credit decisions will be correlated with product market competition, making this variable a good identifier of demand. We again find that integration matters - this time, in more integrated markets firms are more likely to be constrained. Not surprisingly, the probability of being unconstrained is lower for small- and medium-size firms, as well as for companies which are individually-owned (these firms may be considered more opaque). Exporters and especially foreign-owned firms have easier access to bank credit, while recipients of subsidies are more constrained. 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, Jappelli, and Pagano (2009)). Importantly we find that selection matters: the coefficient on the inverse Mill's ratio is positive, implying that

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<sup>13</sup>We note that when dropping either one variable from the specification the coefficient on the other variable (and all other estimated coefficients) is mostly unaffected.

unobserved factors that increase the demand for a business loan tend to decrease the probability that the firm will be constrained.

### 4.3 Main results

In Table 7, we report the estimates for Equation (4) 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 of 6-month nominal yields as a proxy for interbank market integration, and do not yet account for the structure of the banking sector. We start by dropping all Romanian firms. As mentioned before, due to very volatile fiscal and monetary policy during the period, resulting in high and variable inflation, the integration series for Romania is an outlier relative to the rest of the sample, with very high initial values of nominal interest rates and very slow convergence.

We first estimate Equation (4) without and then with firm-level co-variates (Columns (1) and (2), respectively). We find that 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  $\alpha_1$  is positive and significant at the 1% level: firms operating in countries where interbank markets are more integrated obtain lower loan rates. Numerically, a two standard deviation increase in interbank market integration would lead to a decrease in real rates by about 123 basis points. The result 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 go back to the degree of interbank market integration in their last year prior to joining the euro zone,<sup>14</sup> loan rates would be *ceteris paribus* higher by 50 basis points on average.

Next, in Column (3) we account for the left-truncation of the sample by including the selection term estimated in the probit equation of the probability of a firm being unconstrained. The exclusion restriction is satisfied by excluding the variable "Subsidized" from the set of independent variables: firms with access to government subsidies will likely be rationed less often as they will

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<sup>14</sup>Ireland, Portugal and Spain joined the euro zone on January 1, 1999, and Greece on January 1, 2001.

be perceived to have access to a repayment technology, but it is unlikely that subsidies will have an effect on the loan rates themselves, making them a good instrument for credit supply. 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 121 basis points. Excluding the selection terms from the equation thus results in an underestimation of the true effect by around 2%.

In Column (4), we exclude all loans granted in foreign currency. Lending in foreign currency is an important phenomenon in many of the countries in the sample. For example, and similarly on the basis of the BEEPS dataset, Brown, Ongena and Yesin (2008) document that 39% of the loans reported in Romania are in foreign currency, and that more than 20% of the loans in Bulgaria, Estonia, Hungary, Latvia, Lithuania, and Slovenia are. We expect foreign currency lending to be less influenced by domestic interbank market integration. Indeed, lending in foreign currency makes it more likely that funds are obtained by the bank as a natural hedge in foreign currency in foreign financial markets, potentially making domestic market developments less relevant. The economic and statistical significance of our estimates remains little changed when we only focus on loans denominated in domestic currency.

The effect of integration on loan rates also remains unchanged when we exclude all loans granted before January 1, 2001 (Column (5)). The rationale for the latter test is that firms with loans granted a long period in the past might not provide reliable information. We also want to test if the results hold during the relatively more integrated period as well. Finally, the magnitude of the estimates increases substantially when we replace the country and year dummies with country-specific time trends in Column (6), implying that to some degree our measure of integration might be proxying for a common regional trend.

We also find that the economic effect of the integration measure is relatively larger than the economic effect of nominal yields. We hypothesize that access to international markets may matter relatively more than domestic interbank market rate levels that are an outcome of the interplay between demand and supply, of the degree of competition in the banking sector, etc. Nevertheless, we also note that integration and the level of nominal interbank yields tend to matter jointly for real loan rates (Columns (3) and (6)).

In the analysis that follows, we exclude all loans denominated in foreign currency, as well as all loans awarded before January 1, 2001, to make sure that our results are not contaminated by loans that respond little to integration and by the period of most rapid integration.

#### 4.4 Alternative measures of integration

Now we address the concern that a co-integration measure between the nominal yields on 6-month domestic money market instruments relative and the nominal yields on 6-month German money market instruments is a poor proxy for interbank market integration. In Table 8, we first test whether our results still hold when we replace the co-integration measure of 6-month instruments with a co-integration measure of instruments with lower maturities, namely 3-month and 1-months ones (Columns (1) and (2)). Our results remain unchanged.

More importantly, as constructed, our measures of interbank market integration might be driven by developments other than integration in interbank markets, like convergence of monetary policy and real economic performance. Admittedly, from the point of view of an individual bank the reasons behind convergence of interbank yields are irrelevant, as long as interbank funds are available at lower and more predictable rates. Nevertheless, our co-movement based measure of interbank market integration could be capturing more than simply integration in interbank markets.

In order to address this point, we look at measures of the intensity of cross-border interbank activity between banks situated in each country (domestic or foreign) and banks situated in the euro area. The BSI database of the European Central Bank contains information on total loans and deposits by host country credit institutions with respect to euro area credit institutions. We consider these data inferior (and do not use it as our main indicator of interbank market integration) for several reasons. First, the data do not contain a break-down of volumes by maturity. Second, for many of the countries the data are only available starting much later than our measure based on the co-integration of yields. For example, for the 4 euro area countries (Greece, Ireland, Portugal, and Spain) the data start as early as 1998, but for a number of countries (Bulgaria, Estonia, Lithuania, Poland and Slovenia) the data only start in 2004, for others (Hungary) they are only available for 2005, and yet for another (Slovakia) the data are missing altogether for our sample period (they



start in 2006). This leaves us with 1/4 less observations than in the main empirical exercises (1,124 instead of 1,503). Nevertheless, we undertake this exercise to assuage concerns that - as already mentioned - convergence of monetary policy and real economic performance, and not just interbank market integration, may have been the main driver of a stronger co-movement of nominal interbank rates across countries.

We take the data on the volume of interbank market deposits, interbank market loans, and interbank market deposits plus loans, and normalize these three measures by GDP. The average values over the sample period across all countries are 0.081, 0.064, and 0.139, respectively. The series also show large dispersion across countries; for example, the deposits plus loans series, normalized by GDP, ranges from a minimum of 0.017 in Lithuania in Q2:2004 to a maximum of 0.962 in Ireland in Q4:2005. Then we replace our measure of interbank market integration in Equation (4) with these three new measures of cross-country interbank market lending, one at a time. We confirm that a higher volume of interbank deposits (Column (3)), interbank loans (Column (4)), and interbank loans plus deposits (Column (5)) is associated with lower real rates on business loans, accounting for the same firm-level co-variates as before. While the estimates are only significant at the 10% level, we can still conclude that our previous results are not contaminated by developments other than the pure integration of domestic interbank markets into European interbank markets.

#### **4.5 Identification, foreign ownership, errors-in-variables, 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 more important role for firms in industries that for technological reasons are more dependent on external financing. Some of the key characteristics that make a firm or 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 that is being used by loan officers to assess the business, the ratio of tangible vs. intangible assets, follow-up investments, etc. Consequently, a manufacturing firm will respond more to changes in external financing than a hotel or a restaurant, and so would a small firm and an informationally opaque firm. The basic idea then is to rank firms and industries by their "natural" dependence on bank financing, their size, and information opacity, and use the industries which have low sensitivity to bank financing, as well as the firms with large projects and with high ratio of hard information, 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 "treatment" and "control" industries/firms.

We calculate a benchmark industry-specific proxy for dependence on external finance based on information on German firms, which are also present in the BEEPS, but are excluded from the sample because we use the German interbank rate as our benchmark. We construct a capital usage benchmark utilizing information on the ratio of material input costs to total sales by German firms.<sup>15</sup> Then we interact this benchmark value with our measure of integration in Equation (4). We also interact with the integration variable a dummy variable equal to 1 if the firm is small (proxy for project scale), and a dummy variable equal to 1 if the firm is audited (proxy for transparency). The results, reported in Columns (1)-(3) of Table 9 confirm the validity of the procedure: namely, we find that only in industries that are dependent on external finance, as well as for small and informationally opaque firms, 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.

Second, we account for the fact that our measure of interbank market integration may be contaminated by banking sector integration in the sense of increasing foreign ownership. For instance, interbank market yields may be decreasing alongside banks being able to borrow in internal capital access from their parent banks. Thus, our measure may be capturing the effect of the acquisition of central and eastern European banks by euro zone-based banks rather than increased interbank

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<sup>15</sup>The respective mean industry ratios of total material costs to total sales are, as follows: 0.90 (Mining and quarrying); 0.86 (Construction); 0.87 (Manufacturing); 0.80 (Transportation, storage and communication); 0.88 (Wholesale, retail, repairs); 0.64 (Real estate, renting, and business services); 0.78 (Hotels and restaurants); and 0.66 (Other). We construct the level benchmark by assigning the respective industry value to all firms in that industry.

activity between the two types of banks, resulting in omitted variables bias. In principle, this concern should be alleviated by the fact that our sample is dominated by SMEs. Conventional wisdom argues that foreign banks do less often business with SMEs as they are relatively less capable of processing and quantifying soft information (Berger, Klapper, and Udell (2001)). However, recent research has shown that foreign banks are very much involved with SMEs (de la Torre, Martínez Pería, and Schmukler (2010)), including the region of central and eastern Europe (De Haas, Ferreira, and Taci (2010)), hence we need to formally address this concern.

To that end, in Column (4) we include alongside our measure of money markets integration a measure of the share of banking sector assets held by banks with at least 50% foreign ownership.<sup>16</sup> 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 internal market. The gist of our previous finding remains unchanged: all else equal, firms are charged lower loan rates in countries with a higher share of the banking sector in foreign hands.

Third, we account for errors-in-variables bias induced by the fact that our measure of interbank market integration comes from a first-stage regression and is thus measured within a confidence interval. Errors-in-variables tend to lead to an attenuation bias when the error is linearly related to the true observation, 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 (5) 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 5% level.

Finally, we account for the possibility that the rates on business loans are reported with an error. It is entirely conceivable that when responding to the question on the loan's annual cost, the company owners misreport 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

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<sup>16</sup>Our calculations are based on data from Bankscope and various Central banks.

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 (6), this doesn't change the main results, and neither do different choices of the cut-off for the dummy (unreported).

#### 4.6 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 10 presents the estimates from Equation (5). We find that the effect of interbank market integration is indeed transmitted differently via the channel of banking competition. In more competitive credit markets, firms face significantly lower costs of bank credit as interbank money market integration deepens (Column (1)). The estimates decrease marginally when we account for selection (Column (2)). 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 159 basis points. However, we find no effect of banking sector competition when instead of the low concentration dummy we interact our measure of integration with a low HHI dummy (Column (3)).

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 (4) and (5), 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 3- and 1-month yields, respectively. The economic effect increases 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" 132 basis points. Our results thus confirm previous findings that bank interest rates respond less strongly to lower market rates in concentrated banking sectors (Brown, Rueda, Pak, and Tynaev (2010)).

#### 4.7 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 or retained earnings 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). 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 11 presents evidence to that effect. We find that firms which received their last 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)), but a lower share from retained earnings (Column (2)). While these two results are only statistically significant at the 10%, both are a logical extension to our previous findings. However, we find no significant effect on the share of investment financed via trade credit (Column (3)). This result remains unchanged when we look instead at working capital instead (unreported).

What these findings imply is that integration has enabled firms to switch away 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, for each industry we calculate 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 (4). 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 (5)).

We also address the issue that high leverage may be optimal if firms operate in a high-growth environment, such as the one in central and eastern Europe in the late 1990s and early 2000s. Excess leverage can then either indicate the availability of profitable opportunities, or the desire of investors to prevent entrenched managers from making too risky investment decisions (see Jensen and Meckling (1976) for example)). To address that issue, we repeat the exercise after replacing the German benchmark with an industry benchmark based on the financing patterns of Irish firms (Columns (6)-(7)). Ireland was a similarly high-growth country over the same period, and in fact it had higher average GDP growth than all other countries in the dataset.

The results give some evidence to the "too-quickly-too-far" hypothesis. Namely, we find that excess leverage increases with integration, and that the probability of having a positive 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 10%, and by 13% vis-à-vis a similar Irish firm. Importantly, the firm and year fixed effect interactions in the regression make sure that these results are not driven by more shallow equity markets in central and eastern Europe. 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 to the 2007-2008 crisis. Rapid interbank market integration led to firm overleveraging even relative to similar firms in comparable high-growth countries. 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 the firms' woes during the crisis.

## 5 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 6,047 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. For robustness purposes, we also look at volumes of cross-country interbank loans and deposits. We pursue an identification strategy by distinguishing across firms' and 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 alleviates credit constraints and decreases loan rates. A deepening of integration by two standard deviations would decrease loan rates by 121 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 also provide food for thought for policy makers that devise 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 suggests that many central and east European firms may have entered the 2007-2008 financial crisis overleveraged, partially due to the rapid pace of pre-crisis banking integration.



## Appendix. A three-stage Tobit model

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 Jappelli (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,  $Y_{ijt}^*$ , on a loan to firm  $i$  in country  $j$  at time  $t$ , which are observable to us, are a linear function of firm  $i$  variables  $X_i$  and country  $j$  variables  $Z_j$  at time  $t$ :

$$Y_{ijt}^* = X_{1it}\beta_1 + Z_{jt}\beta_2 + \varepsilon_{1ijt} \quad (6)$$

$\varepsilon_{1ijt}$  is a random component which varies at the firm, country and time level that is normally distributed with mean 0 and variance  $\sigma_1^2$ .  $Y_{it}^*$  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:

$$q = X_{2it}\gamma_1 + Z_{jt}\gamma_2 + \varepsilon_{2it} \quad (7)$$

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  $\varepsilon_{2it}$  is normally distributed with mean 0 and variance  $\sigma_2^2$ .

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 (7) 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 Jappelli (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:

$$c = X_{3ijt}\delta_1 + Z_{jt}\delta_2 + \sigma_3\rho_{23}\frac{\phi(q)}{\Phi(q)} + \varepsilon_{3ijt} \quad (8)$$

$X_{3ijt}$  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.  $\frac{\phi(q)}{\Phi(q)}$  is the inverse Mill's ratio estimated from equation 7 (Heckman (1979)). The error  $\varepsilon_{3ijt}$  is normally distributed with mean 0 and variance  $\sigma_3^2$ .

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.<sup>17</sup> 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:

$$E(Y_{ijt}^* | X_i, Z_j, Q = 1, C = 1) = X_{1it}\beta_1 + Z_{jt}\beta_2 + E(\varepsilon_{1ijt} | X_{it}, Z_{jt}, Q = 1, C = 1) \quad (9)$$

Using the distribution of the error terms defined above and the standard probit normalization ( $\sigma_3^2 = \sigma_2^2 = 1$ ), one can obtain consistent estimates of  $\gamma$  and  $\delta$  up to a factor of proportionality. Let  $\rho_{12}$  and  $\rho_{13}$  indicate the simple correlation between  $\varepsilon_1$  and  $\varepsilon_2$  and between  $\varepsilon_1$  and  $\varepsilon_3$ , respectively. Hence, the final estimation procedure employed can be written as:

$$Y_{ijt}^* = X_{1it}\beta_1 + Z_{jt}\beta_2 + \sigma_1\rho_{13} \frac{\phi(c)}{\Phi(c)} \quad (10)$$

$\frac{\phi(c)}{\Phi(c)}$  is the inverse Mill's ratios. 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

<sup>17</sup>This may arise for example when "good" firms systematically select themselves out of the application process in more integrated markets. In this case, the OLS estimate of the true relationship between loan rates and integration will be biased towards zero.

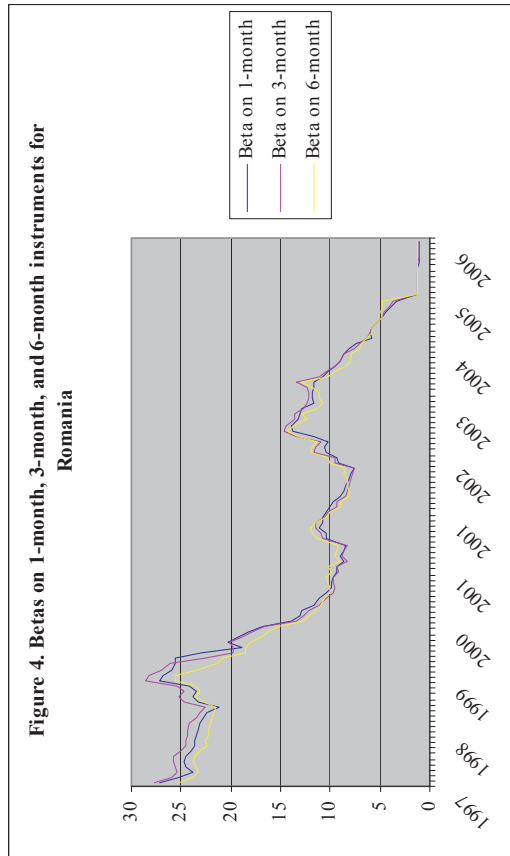
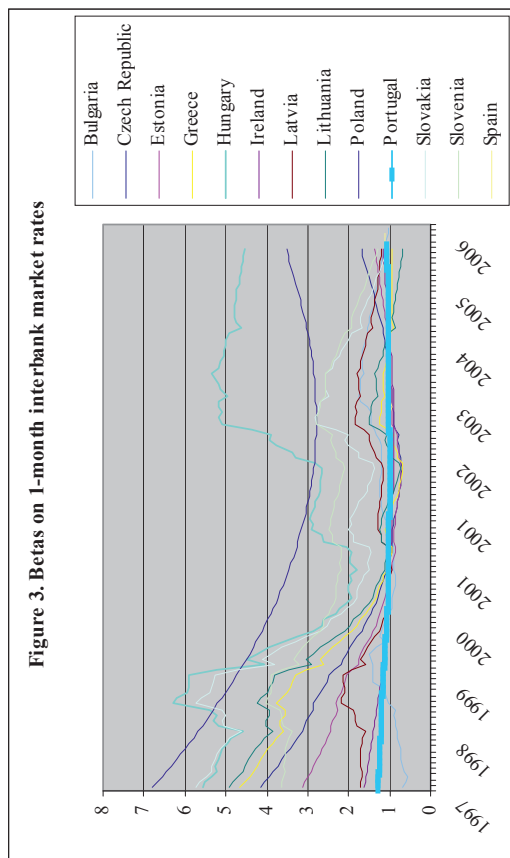
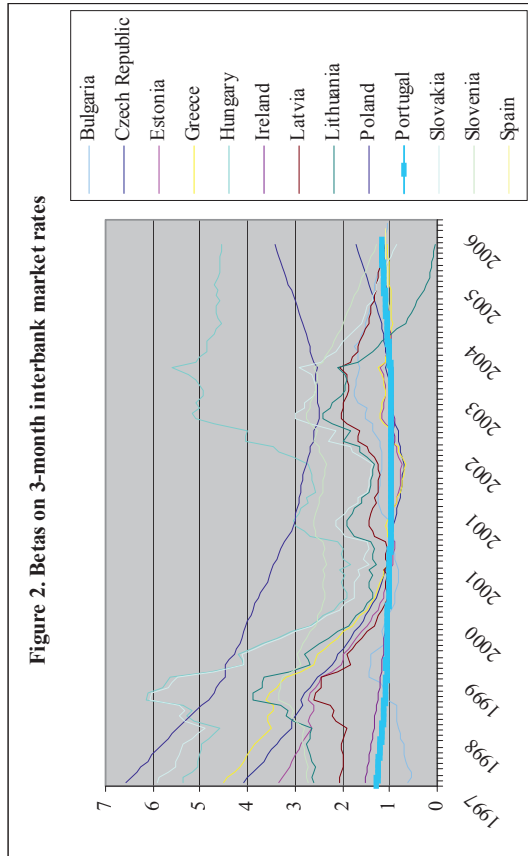
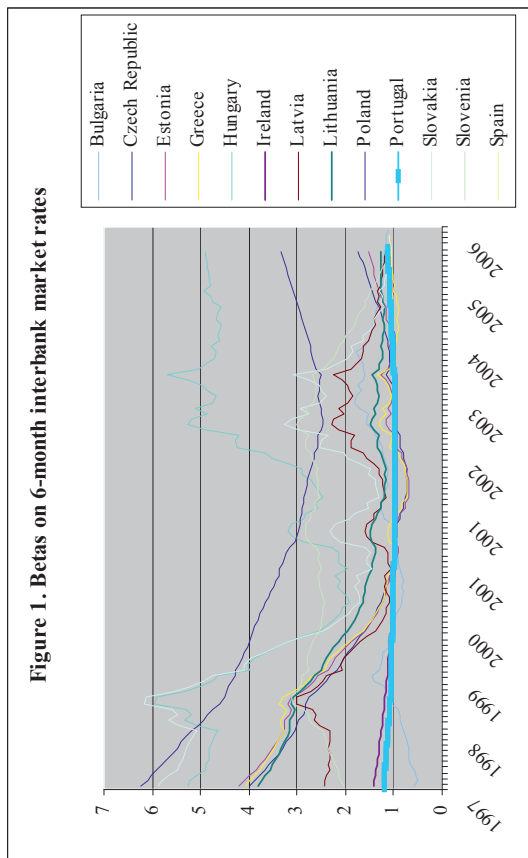
from any branch of government, and whether it is subject to strong competition in product markets. We also use a proxy for firm size where the firm is defined as small if it has less than 50 employees, medium if it has between 50 and 250 employees, and large if it has more than 250 employees. Finally, 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 exclusion restriction requires that there is at least one more variable in the set of independent variables in Equation (7) than in Equation (8), and at least one more variable in the set of independent variables in Equation (8) than in Equation (10).

## References

- [1] Agenor, P.-R., 2003. Benefits and costs of international financial integration: Theory and facts. *The World Economy* 26, 1089-1118.
- [2] Baele, L., Ferrando, A., Hördahl, P., Krylova, E., Monnet, C., 2004. Measuring financial integration in the euro area. *Oxford Review of Economic Policy* 20, 509-30.
- [3] Beer, C., Ongena, S., Peter, M., 2010. Borrowing in foreign currency: Austrian households as carry traders. *Journal of Banking & Finance* 34, 2198-2211.
- [4] Berger, A., Klapper, L., Udell, G., 2001. The ability of banks to lend to informationally opaque small businesses. *Journal of Banking & Finance* 25, 2127–2167.
- [5] Brown, M., Ongena, S., Yesin, P., 2008. Currency denomination of bank loans: Evidence from small firms in transition countries. Discussion Paper 2008-16, Tilburg University.
- [6] Brown, M., Jappelli, T., Pagano, M., 2009. Information sharing and credit: Firm-level evidence from transition countries. *Journal of Financial Intermediation* 18, 151-172.
- [7] Brown, M., Rueda Maurer, M., Pak, T., Tynaev, N., 2009. Banking sector reform and interest rates in transition economies: Bank-level evidence from Kyrgyzstan. *Journal of Banking & Finance* 33, 1677-1687.
- [8] Chakravarty, S., Yilmazer, T., 2009. A multistage model of loans and the role of relationships. *Financial Management* 38, 781-816.
- [9] Cox, D., Jappelli, T., 1993. The effect of borrowing constraints on consumer liabilities. *Journal of Money, Banking and Credit* 25, 197-213.
- [10] Cuñat, V., 2007. Trade credit: suppliers as debt collectors and insurance providers. *Review of Financial Studies* 20, 491-527.
- [11] de la Torre, A., Martínez Pería, M.S., Schmukler, S., 2010. Bank involvement with SMEs: Beyond relationship lending. *Journal of Banking & Finance* 34, 2280–2293.

- [12] De Haas, R., Ferreira, D., Taci, A., 2010. What determines the composition of banks' loan portfolios? Evidence from transition countries. *Journal of Banking & Finance* 34, 388-398.
- [13] Degryse, H., Kim, M., Ongena, S., 2009. *Microeconometrics of Banking*. Oxford University Press: New York.
- [14] Demyanyk, Y., Ostergaard, C., Sørensen, B., 2007. U.S. banking deregulation, small businesses, and interstate insurance of personal income. *Journal of Finance* 62, 2763-2801.
- [15] Dicks-Mireaux, L., King, M., 1982. Asset holdings and the life cycle. *Economic Journal* 92, 247-267.
- [16] Edison, H. J., Levine, R., Ricci, L., Slok, T., 2002. International financial integration and economic growth. *Journal of International Money and Finance* 21, 749-776.
- [17] Engle, R., Granger, C., 1987. Cointegration and error correction: Representation, estimation and testing. *Econometrica* 55, 251-276.
- [18] Fazzari, S., Hubbard, R., Petersen, B., 1988. Financing constraints and corporate investment. *Brooking Papers on Economic Activity* 19, 141-206.
- [19] Fecht, F., Grüner, H.P., Hartmann, P., 2007. Welfare effects of financial integration. CEPR Discussion Paper No. 6311.
- [20] Freixas, X., Holthausen, C., 2005. Interbank market integration under asymmetric information. *Review of Financial Studies* 18, 459-490.
- [21] Giannetti, M., Ongena, S., 2009. Financial integration and entrepreneurial activity - evidence from foreign bank entry in emerging markets. *Review of Finance* 13, 181-223.
- [22] Hayashi, F., 1982. The permanent income hypothesis: Estimation and testing by instrumental variables. *Journal of Political Economy* 90, 895-916.
- [23] Heckman, J., 1979. Sample selection bias as specification error. *Econometrica* 47, 153-161.

- [24] Imbs, J., 2004. The real effects of financial integration. *Journal of International Economics* 68, 296-324.
- [25] Ivashina, V., Scharfstein, D., 2010. Bank lending during the financial crisis of 2008. *Journal of Financial Economics* 97, 319-338.
- [26] Jensen, M., Meckling, W., 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3, 305-360.
- [27] Klein, M., 1971. A theory of the banking firm. *Journal of Money, Credit, and Banking* 3, 205-218.
- [28] Obstfeld, M., 1986. Capital mobility in the world economy: Theory and measurement in the National Bureau method. In *The National Bureau Method, International Capital Mobility, and Other Essays*, K./Meltzer A. H., eds. North Holland: Amsterdam.
- [29] Petersen, M., Rajan, R., 1995. The effect of credit market competition on lending relationships. *The Quarterly Journal of Economics* 110, 407-443.
- [30] Puri, M., Rocholl, J., Steffen, S., 2010. Global retail lending in the aftermath of the US financial crisis: Distinguishing between demand and supply effects. *Journal of Financial Economics*, Forthcoming.
- [31] Rajan, R., Zingales, L., 1998. Financial dependence and growth. *American Economic Review* 88, 559-586.



Figures 1-3 plot the evolution of the main measure of interbank market integration of 6-month (Figure 1), 3-month (Figure 2), and 1-month (Figure 3) interbank instruments used in the paper for all countries in the sample except Romania. Figure 4 plots the measure of interbank market integration of 6-month, 3-month, and 1-month interbank instruments in the case of Romania. The integration measures are derived from an error correction model of co-integration of domestic yields and German yields over the whole sample period, as in Equation (2) in the text. Data source: Global Financial database and authors' calculations.



Table 1  
Firm size summary statistics

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

This 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 2005:12. Source: BEEPS (2004, 2005).

Table 2  
Business loan characteristics

Country	Real loan rate	Real loan rate start	Real loan rate end	Share of un-collateralized loans	Loan maturity
Bulgaria	8.73	8.24	6.85	0.13	37.6
Czech Republic	7.35	6.40	5.35	0.16	36.4
Estonia	4.30	5.44	3.99	0.11	51.7
Greece	4.54	5.73	3.52	0.42	52.0
Hungary	10.73	11.6	9.85	0.11	33.6
Ireland	2.35	2.40	1.32	0.38	69.3
Latvia	4.36	7.50	3.55	0.10	43.2
Lithuania	3.37	5.32	2.98	0.22	36.1
Poland	10.03	9.91	6.85	0.19	30.8
Portugal	4.01	1.23	4.27	0.40	40.7
Romania	15.73	10.07	10.14	0.07	27.1
Slovakia	5.08	3.55	2.85	0.22	41.8
Slovenia	3.82	5.43	3.23	0.41	45.4
Spain	3.87	3.46	2.62	0.31	23.6
Total	7.25	6.16	4.81	0.23	39.4

This table presents summary statistics on the cost, collateral and maturity associated with loans to business firms. 'Real loan rate' is calculated as the annualized rate of the loan minus the German interbank market benchmark rate. 'Real loan rate start' denotes the average real loan rate for the first quarter in the sample for which data is available. 'Real loan rate end' denotes the average real loan rate for the last quarter in the sample for which data is available. '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 2005:12. Source: BEEPS (2004, 2005).

Table 3  
Banking sector characteristics

Country	Interbank markets,		Interbank markets,		Foreign bank ownership	Banking sector C3	Banking sector HHI
	1-month rate	3-month rate	6-month rate	Interbank markets, 6-month rate			
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	0.153	0.675	0.304	
Hungary	10.93	10.82	10.89	0.771	0.590	0.249	
Ireland	2.70	2.71	2.72	0.343	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	0.214	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	0.044	0.641	0.157	
Total	5.64	5.75	5.68	0.719	0.624	0.210	

This table presents summary statistics for the bank sector data. '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 (2) 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 by the percentage of banking sector assets held by the 3 largest banks; source: Beck, Demirguc-Kunt, and Levine, "A new database on financial development and structure". 'Banking sector HHI' is measured by 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 2005:12.

Table 4  
Panel unit root tests and engle-granger cointegration tests on model variables

Country	6-month rate		$\Delta$ 6-month rates		6-month rate	
	Z	p-value	Z	p-value	Z	p-value
	(1)	(2)	(3)	(4)	(5)	(6)
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

This 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

$$r_t^j = \alpha^j + \rho^j r_{t-1}^j + \sum_{k=1}^N \delta^j r_{t-k}^j + \varepsilon_t^j \text{ (Column (1))}, \Delta r_t^j = \alpha^j + \rho^j r_{t-1}^j + \sum_{k=1}^N \delta^j \Delta r_{t-k}^j + \varepsilon_t^j \text{ (Column (3))},$$

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 (2) and the underlying data comes from the Global Financial Database.

Table 5  
 Probit estimates: desirability of bank credit

Variable	Coefficient	Variable mean
$\beta_6$	-0.201 (0.046)***	2.71
6-month interbank rate	-0.095 (0.009)***	7.37
Small firm	-0.365 (0.074)***	0.75
Medium firm	-0.201 (0.077)***	0.16
Individual owner	0.056 (0.059)	0.78
Government owner	-0.423 (0.096)***	0.05
Foreign owner	-0.439 (0.086)***	0.07
Exporter	0.169 (0.043)***	0.28
Privatized	0.096 (0.079)	0.06
Subsidized	0.418 (0.063)***	0.12
Audited	0.059 (0.042)	0.53
Competition	0.173 (0.039)***	0.48
Constant	1.149 (0.128)***	1.00
Observations	5,929	
Country dummies	Yes	
Year dummies	Yes	
Firms desiring bank loan	4,507	
Log likelihood	-3,592.0	

This table presents the estimates of the probability of credit desirability based on firm- and country-level characteristics. The dependent variable is a dummy equal to 1 if the firm desires bank credit.  $\beta_6$  is the estimate of interbank markets integration for rates on 6-month money instruments from Equation (2). 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 from 2 to 49 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. 'Audited' is a dummy equal to 1 if the firm employs external auditing services. 'Competition' is a dummy equal to 1 if the firm faces fairly, very, or extremely strong competition. Omitted category in firm size is 'Large firm'. Source: BEEPS (2004, 2005).

Table 6  
 Probit estimates: absence of borrowing constraint

Variable	Coefficient	Variable mean
$\beta_6$	0.085 (0.050)*	2.86
6-month interbank rate	-0.007 (0.018)	7.75
Small firm	-0.109 (0.150)	0.71
Medium firm	-0.118 (0.147)	0.18
Individual owner	-0.194 (0.088)**	0.76
Government owner	0.040 (0.166)	0.05
Foreign owner	0.571 (0.175)***	0.06
Exporter	0.012 (0.074)	0.31
Privatized	0.111 (0.122)	0.08
Subsidized	-0.363 (0.129)***	0.14
Audited	0.318 (0.060)***	0.55
Mills1	0.737 (0.105)***	2.69
Constant	-2.22 (0.505)***	1.00
Observations	4,507	
Country dummies	Yes	
Year dummies	Yes	
Unconstrained firms	3,697	
Log likelihood	-1,650.7	

This table presents the estimates of the probability of credit constraint based on firm- and country-level characteristics. The dependent variable is a dummy equal to 1 if the firm is unconstrained.  $\beta_6$  is the estimate of interbank markets integration for rates on 6-month money instruments from Equation (2). 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 from 2 to 49 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. 'Audited' is a dummy equal to 1 if the firm employs external auditing services. 'Mills1' is the selection term from the credit desirability regression (Table 5). Omitted category in firm size is 'Large firm'. Source: BEEPS (2004 and 2005).

Table 7  
Interbank market integration and bank loan rates

	Real loan rate					
	(1)	(2)	(3)	(4)	(5)	(6)
$\beta_6$	0.447 (0.164)***	0.647 (0.219)***	0.639 (0.220)***	0.488 (0.250)**	0.782 (0.251)***	1.553 (0.405)***
Interbank rate		-0.102 (0.061)*	-0.101 (0.061)*	-0.066 (0.066)	-0.071 (0.075)	-0.297 (0.124)**
Loan maturity		-0.007 (0.002)***	-0.007 (0.002)***	-0.006 (0.002)***	-0.007 (0.002)***	-0.007 (0.002)***
Small Firm		0.872 (0.179)***	0.868 (0.179)***	1.012 (0.192)***	0.880 (0.184)***	0.916 (0.183)***
Medium Firm		0.211 (0.236)	0.217 (0.236)	0.108 (0.259)	0.189 (0.241)	0.104 (0.249)
Individual owner		0.012 (0.198)	0.017 (0.198)	0.092 (0.210)	0.048 (0.203)	0.083 (0.201)
Govern. owner		0.520 (0.382)	0.527 (0.382)	0.129 (0.425)	0.495 (0.492)	0.485 (0.391)
Foreign owner		-0.120 (0.310)	-0.113 (0.310)	-0.463 (0.361)	-0.020 (0.317)	0.022 (0.316)
Privatized		-0.437 (0.248)*	-0.447 (0.249)*	-0.490 (0.277)*	-0.436 (0.254)*	-0.433 (0.253)*
Exporter		-0.392 (0.141)***	-0.394 (0.141)***	-0.428 (0.151)***	-0.418 (0.144)***	-0.432 (0.143)***
Audited		-0.434 (0.160)***	-0.433 (0.160)***	-0.315 (0.170)*	-0.443 (0.166)***	-0.420 (0.163)***
Mills2			0.001 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Observations	1,988	1,894	1,894	1,624	1,788	1,894
Fixed effects			Country Year			Country ×Year
R <sup>2</sup>	0.54	0.58	0.58	0.59	0.58	0.58

This table presents the estimates of the rate on business loans based on firm- and country-level characteristics. The dependent variable is the spread of the individual nominal loan rate over the benchmark nominal money market rate. All estimates are from OLS regressions.  $\beta_6$  is the estimate of interbank markets integration for rates on 6-month money instruments from Equation (2). ‘Interbank rate’ is the nominal rate of a 6-month interbank market money instrument. ‘Loan maturity’ is the duration of the loan. ‘Small firm’ is a dummy equal to 1 if the firm has from 2 to 49 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. ‘Audited’ is a dummy equal to 1 if the firm employs external auditing services. Omitted category in firm size is ‘Large firm’. ‘Mills2’ is the selection term from the borrowing constraint regression (Table 6). The regressions exclude all Romanian firms. In Column (4), all loans in foreign currency are excluded from the sample. In Column (5), all loans granted before January 1, 2001 are excluded. Source: BEEPS (2004 and 2005).

Table 8  
Interbank market integration and bank loan rates: Alternative measures of integration

	Real loan rate				
	(1)	(2)	(3)	(4)	(5)
$\beta_3$	1.026 (0.502)**				
$\beta_1$		1.178 (0.596)**			
MM deposits / GDP			-4.647 (2.733)*		
MM loans / GDP				-1.895 (1.106)*	
MM deposits + loans / GDP					-1.147 (0.630)*
Observations	1,503	1,503	1,124	1,124	1,124
Fixed effects			Country Year		
$R^2$	0.58	0.58	0.54	0.54	0.54

This table presents the estimates of the rate on business loans based on firm- and country-level characteristics. The dependent variable is the spread of the individual nominal loan rate over the benchmark nominal money market rate. All estimates are from OLS regressions.  $\beta_3$  is the estimate of interbank markets integration for rates on 3-month money instruments from Equation (2).  $\beta_1$  is the estimate of interbank markets integration for rates on 1-month money instruments from Equation (2). ‘MM deposits / GDP’ is the quarterly outstanding volume of interbank deposits of all banks in the respective country with respect to the euro area, normalized by GDP, both euro denominated. ‘MM loans / GDP’ is the quarterly outstanding volume of interbank loans of all banks in the respective country with respect to the euro area, normalized by GDP, both euro denominated. ‘MM deposits + loans / GDP’ is the sum of the quarterly outstanding volumes of interbank deposits and interbank loans of all banks in the respective country with respect to the euro area, normalized by GDP, both euro denominated. The regressions also include the other variables from Table 7, including Mills2 (unreported). The regressions exclude all Romanian firms, all loans in foreign currency, and all loans granted after January 1, 2001. Source: BEEPS (2004 and 2005).



Table 9  
Identification, errors-in-variables, and robustness

	Real loan rate				Loan rate dummy
	(1)	(2)	(3)	(4)	(6)
$\beta_6$	1.036 (0.485)**	1.241 (0.490)**	0.316 (0.809)	1.083 (0.486)***	0.116 (0.065)*
$\beta_6 \times \text{Small}$	0.212 (0.125)*				
$\beta_6 \times \text{Audited}$		-0.273 (0.146)*			
$\beta_6 \times \text{Capital}$			0.010 (0.006)*		
Bank foreign ownership				0.037 (0.050)	
Fixed effects				Country Year	
Observations	1,531	1,531	1,509	1,520	1,531
R <sup>2</sup>	0.59	0.59	0.59	0.59	0.48

This table presents estimates of the rate on business loans based on firm- and country-level characteristics. The dependent variable is the spread of the individual loan rate over the benchmark money market rate (Columns (1)-(5)) and a dummy equal to 1 if the spread of the individual loan rate over the benchmark money market is larger than 500 basis points (Column (6)). OLS regression in Columns (1)-(4), IV regression in Column (5), and probit regression in Column (6). In Column (5) the measure of integration is instrumented for using the 24-month lagged value of domestic nominal interbank yields.  $\beta_6$  is the estimate of interbank markets integration for rates on 6-month money instruments from Equation (2). 'Capital' equals the industry mean ratio of total material input costs over sales by German firms in BEEPS 2004. '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. The regressions also include the other variables from Table 7, including Mills2, as well as the variables 'Capital' (unreported). The regressions exclude all Romanian firms, all loans in foreign currency, and all loans granted after January 1, 2001. Source: BEEPS (2004 and 2005).

Table 10

## Interbank market integration and bank loans rates: accounting for credit market competition

	Real loan rate				
	(1)	(2)	(3)	(4)	(5)
$\beta_t$ * Bank competition	0.854 (0.402)**	0.838 (0.403)**	-0.314 (0.374)	0.656 (0.393)*	0.776 (0.389)***
Bank competition	-2.954 (1.550)*	-2.890 (1.554)*	1.006 (0.688)	-2.377 (1.489)*	-2.652 (1.543)*
$\beta_t$	0.077 (0.363)	0.096 (0.365)	0.603 (0.296)***	0.141 (0.384)	0.142 (0.332)
Heckman correction	No	Yes	Yes	Yes	Yes
Observations	1,503	1,503	1,531	1,503	1,503
Fixed effects			Country Year		
R <sup>2</sup>	0.59	0.59	0.59	0.58	0.59

This table presents estimates of the rate on business loans based on firm- and country-level characteristics. The dependent variable is the spread of the individual loan rate over the benchmark money market rate.  $\beta_t$  is the estimate of interbank markets integration for rates on 6-month money instruments in Columns (1)-(3), on 3-month instruments in Column (4), and on 1-month instruments in Column (5), all estimated as in Equation (2). ‘Bank competition’ is a dummy equal to 1 if the country is in the bottom half of the banking sector C3 distribution (Columns (1)-(2) and (4)-(5)), source: Beck, Demirguc-Kunt, and Levine, “A new database on financial development and structure”; 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 (Column (3)), source: Giannetti and Ongena (2009). The regressions also include the other variables from Table 7, including Mills2 (unreported). The regressions exclude all Romanian firms, all loans in foreign currency, and all loans granted after January 1, 2001. Source: BEEPS (2004 and 2005).

Table 11  
Interbank market integration, capital structure, and firm leverage

	Share new investment financed by banks	Share new investment financed with internal funds	Share new investment financed by trade credit	Difference in share new investment financed by banks between firm and benchmark		
	(1)	(2)	(3)	German benchmark (4)	(5)	Irish benchmark (7)
$\beta_6$	-0.048 (0.027)*	0.094 (0.057)*	-0.008 (0.025)	-0.047 (0.028)*	-0.354 (0.191)*	-0.048 (0.027)*
Observations	1,688	873	1,688	1,688	1,631	1,425
Fixed effects						1,354
$R^2$	0.14	0.14	0.14	0.14	0.06	0.14

This table presents estimates of the firm's capital structure based on firm- and country-level characteristics. The table presents estimates of the effect of integration on the sources of firm finance.  $\beta_6$  is the estimate of interbank markets integration for rates on 6-month money instruments from Equation (2). In Column (1) the dependent variable is the share of new investment in the last 12 months financed via borrowing from commercial banks. In Column (2) the dependent variable is the share of new investment in the last 12 months financed with internal funds / retained earnings. In Column (3) the dependent variable is the share of new investment in the last 12 months financed by trade credit from suppliers or customers. In Column (4) 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 (5) 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 in Germany is bigger than 1. In Column (6) 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 Ireland. In Column (7) 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 Ireland is bigger than 1. The regressions also include the other variables from Table 7, including Mills2 (unreported). The regressions exclude all Romanian firms, all loans in foreign currency, and all loans granted after January 1, 2001. In Columns (6) and (7), the Irish firms are also excluded from the sample. Source: BEEPS (2004 and 2005).

Appendix. Variable definitions and data sources

Data sources: Business Environment and Enterprise Performance Survey (BEEPS), 2004 and 2005; Global Financial Database (GFD); ECB-BSI database; Beck, Demirgüç-Kunt, and Levine, "A new database on financial development and structure" (BDKL); Giannetti and Ongena (2009) (GO); Bankscope (BS); and Central Banks (CB).

Variable	Definition	Source
<i>Loan and firm finance characteristics</i>		
Real loan rate	The spread of the nominal 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 by banks	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 by trade credit	Proportion of the firm's new fixed investment that has been financed by trade credit from suppliers and customers in the last 12 months	BEEPS
Share new investment financed with internal funds	Proportion of the firm's new fixed investment that has been financed with internal funds / retained earnings in the last 12 months	BEEPS
<i>Firm characteristics</i>		
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
Subsitized	=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, =0 otherwise	BEEPS
Audited	=1 if the firm has its annual financial statement reviewed by an external auditor, =0 otherwise	BEEPS
<i>Market characteristics</i>		
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
MM deposits	Interbank deposits by all banks, by host country, euro-denominated	ECB-BSI
MM loans	Interbank loans by all banks, by host country, euro-denominated	ECB-BSI
Bank foreign ownership	Share of bank assets in each country owned by foreign banks	BS, CB
Banking sector C3	The share of bank assets in each country owned by the biggest 3 banks	BDKL
HHI	The sum of the squared shares of each individual bank's assets out of the total banking sector assets in each country	GO

