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# The determinants of global bank lending: Evidence from bilateral cross-country data ☆

Uluc Aysun [a,*], Ralf Hepp [b]

[a] University of Central Florida, Orlando, FL, United States
[b] Fordham University, Bronx, NY, United States

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ABSTRACT

This paper finds that factors determined outside of a country, at the quarterly frequency and especially after 2008, are more closely related to the global bank loans it receives. These loans are generally more stable when global banks face more competition and have a higher presence in the recipient country. We obtain our results by using bilateral lending data from 15 countries and a unique methodology to identify and compare the independent effects of external and internal factors. We identify theoretical mechanisms that can explain our empirical findings and draw more detailed inferences for competition and global bank presence by solving a simple model of global banking.



## 1. Introduction

Over the past 15 years, banks have become more global, larger, and an important source of finance for countries.[1,2] These developments have sparked a rapid expansion in the literature on global banking (we discuss this literature below). While the expansion has been largely through papers investigating the effects of global banking on economic stability and international business cycles (especially after the key role that global banks played during the 2008–09 crisis), the number of studies that focus on the dynamic determinants of global bank flows remains small.

In this paper, we focus on the global loans of banks and use their country-specific lending behavior as a means of determining why loans flow in and out of countries.[3] Throughout the paper, our analysis revolves around a simple question: Are global bank loans determined mostly by internal or external factors? If internal factors are more important, this could suggest that an economy with a high, robust growth rate and healthy borrower balance sheets would receive more loans from global banks and that these loans would diminish in countries that are performing poorly; in other words, countries would have control over their own destinies. Conversely, if external factors are more important, the state of an economy may not be strongly related to the loans it receives and economies

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* Corresponding author at: University of Central Florida College of Business Administration, 4000 Central Florida Blvd., P.O. Box 161400, Orlando, FL 32816, United States. Tel.: +1 530 574 3951.

*E-mail address:* uaysun@bus.ucf.edu (U. Aysun).

[1] The foreign claims of Bank of International Settlements (BIS) reporting banks as a share of world GDP have increased from 25.9% to 43.9% from 1995 to 2011 and the Lerner index of bank competition has increased from 0.19 to 0.27 from 1996 to 2010, indicating a decrease in competition. We should note, however, that both variables have demonstrated different trends, a negative one after 2007 in particular. The foreign claims are obtained from BIS quarterly statistics and the annual ratios are the averages of quarterly variables. The Lerner index is from the Federal Reserve Bank Economic Data (FRED) database. Other indicators similarly reveal a deterioration of competitive conduct. The Boone indicator of bank competition in the world has increased from −0.060 to −0.043 from 1997 to 2010 and the 3-bank asset concentration has increased from 34.1% to 70.4% from 1995 to 2011.

[2] See Bruno and Shin (2013) and Cetorelli and Goldberg (2012) for similar evidence for bank globalization.

[3] While the global expansion of banks has been observed for all asset types, loans constitute the largest share. The share of loans amongst foreign claims for all BIS reporting banks, for example, was approximately 74% in 2011.

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may be more susceptible to external developments. The answers to our research question allow us to draw important conclusions for financial integration and the alignment of business cycles. If global bank flows are mainly determined by external factors, for example, this would suggest that economies are now more financially integrated and that global financial crises, such as the 2008–09 crisis, could be more frequently observed. For periods not characterized by a crisis, the importance of external factors could imply that global business cycles are becoming more aligned through global bank lending and that the stability of these banks is becoming a more critical concern for policymakers compared to macroeconomic imbalances across countries.[4] While our question is simple, it is very broad, and identifying and describing the effects of external and internal factors is far from straightforward. To meet these challenges we follow several steps and a unique identification strategy to draw empirical inferences and then we build a simple model to guide us in describing and comparing the effects of the two factors.

We begin the empirical analysis by narrowing down the scope of our investigation. We do so by focusing on the strength of borrower balance sheets, approximated by the borrowing country's real GDP growth and unemployment rates, and global banks' funding costs, measured by their local interbank borrowing and deposit rates, as the internal and external determinants of global bank lending, respectively. These are the most commonly used indicators of credit worthiness and the cost/ease of lending and they provide an accurate representation of borrowers' and lenders' financial strength (e.g. Ashcraft and Campello, 2007; Kashyap and Stein, 2000). Next, we construct a quarterly dataset that includes bilateral bank loans across 15 advanced economies (210 pairs). The data are from the Bank of International Settlements (BIS) consolidated banking statistics and span the 1999Q4–2014Q3 period. We combine these data with the balance sheet and funding cost variables to form a dynamic panel dataset, and investigate banks' lending behavior.

The main difficulty in our estimations lies in identifying the independent effects of internal and external factors on lending; i.e., do banks lend more in a specific country because its borrowers have stronger balance sheets or because the banks' cost of funding is lower? To find the answer, we follow a unique identification strategy, made possible only by the bilateral dimension of our dataset. Since we can observe a lending country's (or its banks') loans in the other 14 countries, we are able to measure its borrower-specific loan growth rates relative to its average global loan growth rate. Matching this variable with the balance sheet strength measures of the recipient countries then allows us to control for any external supply side factors that may facilitate or impede lending and allows us to identify the independent effects of a country's balance sheets (internal factors) on the amount of global loans it receives. We reverse this methodology to identify the effects of external factors (funding costs), and measure the lender-specific loan growth rates in a given country relative to the average loan growth rate across all global banks in that country. By doing so, we control for internal demand side factors since global banks lend in the same country.

Here we should mention three aspects of our methodology. First, when measuring the loan growth rates in deviational form, we implicitly assume that external supply side (lender-specific) restrictions apply symmetrically to all borrowers. This assumption is consistent with the usual findings of the internal capital markets literature; bank holding companies use their internal markets to allocate funds across their subsidiaries and thus face similar restrictions when allocating loanable funds to their subsidiaries.[5] It is, however, also true that a significant part of global banking activity is decentralized and banks are funded locally through their subsidiaries (c.f. Avdjiev and Takáts, 2014; Fiechter et al., 2011). In our analysis, we therefore incorporate local funding conditions as an alternative internal factor that may impact global bank lending. Second, since bank level data on country-specific loans are not publicly available, to the best of our knowledge, we use country level data. While this could potentially mask the different bank level sensitivities to the two factors, we find that banking sectors are, in general, highly concentrated in our sample countries and a few large global banks account for most of the loans. Third, our methodology that measures funding costs in deviational form does not allow us to assess the impact of transnational funding costs since these rates are the same for each lending country. In this paper, therefore, we are focusing on the funding costs that banks face in their home country. Throughout the text, we refer to these funding costs as external funding costs for brevity.

Our results indicate that global bank loans are positively related to the strength of borrower balance sheets. In other words, countries with relatively lower unemployment rates and higher real GDP growth rates receive more loans. Turning to banks' cost of funding in their local markets, we find a negative relationship between interbank borrowing rates and external lending and a positive relationship between deposit rates and external lending. Therefore, while banks that face higher interbank borrowing costs in their local markets restrict their lending by more, banks that face higher deposit rates are also the ones that expand their lending by more. We find that these relationships are economically important. To compare the two factors, we standardize the balance sheet and cost of funding variables so that they have a mean of zero and a standard deviation of one. The estimation results reveal a disparity between the two factors and indicate that the cost of funding, the external factor, is a more important determinant of global bank loans.

Next, we break up the sample into two periods and find that the strong negative impact of interbank borrowing rates on bank lending is only observed after 2008. Before 2008, this relationship is positive. While deposit rates are positively related to bank lending in each period, their impact on lending is much smaller after 2008 when compared to the impact of interbank rates. These results suggest that while in the absence of a crisis banks that lend more, become more leveraged and face higher borrowing costs, during and immediately after a crisis period the relationship is reversed for interbank borrowing rates so that banks that become more leveraged restrict their lending by more. The contrast between deposit and interbank rates during recessions is consistent with the financial frictions literature (e.g. Bernanke et al. 1999; Gertler and Kiyotaki, 2010) that explains the wedge between the two rates with financial leverage. Specifically, in these studies, while deposit rates are determined by the stance of monetary policy, borrowing rates are a function of financial leverage. The literature predicts that while deposit rates decrease during a recession (or a financial crisis) with slowing lending activity, as a result of countercyclical monetary policy, financial leverage, risk premium (the wedge) and borrowing rates increase, as a result of a decrease in asset prices and borrower net worth, further restraining bank loans.

As indicated above, at the same time that banks were becoming more global, they were also growing in size and causing deterioration in competitive conduct. Although it is uncertain whether the two developments are related, most economists would agree that

[4] While our analysis is closely related to economic stability, it does not have clear implications. For example, it is possible for a rapidly growing economy to be destabilized by external funding if these funds are allocated to inefficient investments. It is also possible for global bank lending to have a stabilizing effect when they are mostly determined by more stable external factors.

[5] See for example, Houston et al. (1997), Campello (2002), Cetorelli and Goldberg (2012) and De Haas and Van Lelyveld (2010).

banks would behave differently in markets with different degrees of competition (e.g. Beck et al., 2004). In an alternative set of regressions, we therefore investigate how the degree of competition in the recipient countries is related to the sensitivities to balance sheet strength and funding costs. Here, we also investigate how foreign bank presence (their share in total loans) is related to these sensitivities. Our results indicate that when there is less competition in banking, both sets of sensitivities are larger in magnitude; there is less stability in external funding when banks are larger. Foreign presence regressions reveal a mitigating effect. As foreign bank presence increases external loans become more stable. We find that both of these effects are economically important.[6]

Our main result is that external supply side factors (funding costs that banks face in their own country) have a larger impact on global bank lending than internal factors (borrower balance sheets). Given the significance of decentralized banking, we test whether this disparity between external and internal factors holds when we use local funding costs as an alternative measure of internal factors. Our results indicate that it does. Global banks' lending sensitivity to local funding costs is considerably smaller than their sensitivity to external funding costs.

In the second half of the paper, we build a simple model populated by overlapping generations (OLG) to identify the mechanisms that determine global banks' sensitivities to internal and external shocks and investigate the role of competition and foreign bank presence. In the model we include domestic and foreign banks, each group forming a Cournot oligopoly, and incorporate borrower balance sheets by following the investment-capital conversion framework in Cetorelli and Peretto (2012). In this framework investment is financed by bank loans and it can be successfully converted to capital with only a certain probability; there is default otherwise. This friction helps us generate balance sheet (default probability) shocks and analyze the reaction of foreign banks in a straightforward way. External shocks are the changes in foreign banks' funding costs and the default probability of another country that affects foreign banks' leverage.

The model's symmetric Nash equilibrium reveals several results. As expected, foreign banks lend more when their funding costs are lower and borrower balance sheets improve. The more insightful results are related to the interaction of banks. In particular, the two types of banks influence each other through their effects on the returns from lending and funding costs. Higher domestic (foreign) bank lending causes a decrease in the marginal returns and an increase in the marginal costs of foreign (domestic) banks. We find a weaker interaction when bank profits are more sensitive to shocks. If, for example, foreign banks' returns, relative to domestic banks, increase substantially in response to a decrease in default probability and their costs do not, they lend more not only because they face larger profit margins but also because domestic banks have a smaller negative impact on their profits. The disparity between the sensitivities to external and internal shocks thus depends on the shocks' direct impact on foreign banks' profits and their impact through domestic banks. If, for example, a default shock prompts a relatively large domestic bank response, foreign banks' sensitivity to funding costs can be larger.

Investigating the role of competition, we find that banks display higher sensitivity when they are large in number and thus more competitive. The reason is that these relatively small banks reach diminishing marginal returns and increasing marginal costs less quickly than they would if they were large. The effect of competition on foreign lending sensitivity is, however, not straightforward and it depends asymmetrically on the level of competition amongst foreign and domestic banks. If foreign banks are more competitive, their sensitivity to both external and internal shocks is higher. If domestic banks are more competitive, foreign sensitivities are lower. The latter effect is due to the mitigating impact that a higher domestic bank response has on foreign bank lending. Turning to foreign bank presence, we find that with a larger share of foreign banks, the mitigating effects of domestic banks are smaller and thus foreign lending is more sensitive. Here, a comparison of these theoretical inferences with our empirical results, recommends a more nuanced and detailed approach to studying the impact of competition and foreign bank presence on foreign lending stability. Specifically, a higher degree of competition brings more stability only if it is observed among domestic banks and if foreign bank presence is high. Conversely, higher foreign bank presence brings stability, as suggested by our empirical findings, only if foreign and domestic banks are less and more competitive, respectively.

Our paper is related to several strands of literature. Separating the effects of supply and demand side factors on bank lending empirically is, for example, a notorious problem in the credit channel literature of monetary economics, first mentioned by Bernanke and Gertler (1995). Given this difficulty, studies typically focus on either supply side (e.g. Kashyap and Stein, 2000) or demand side factors (e.g. Ashcraft and Campello, 2007; Alpanda and Aysun, 2012; Aysun and Hepp, 2011, 2013) and mostly investigate the transmission of U.S. monetary policy. A common finding is that while supply side factors have declined in importance due to financial innovation and the growing size of banks, demand side factors (i.e. borrower balance sheets) are still an important conduit for monetary policy. Our methodology allows us to not only measure the effects of the two factors but also to compare them. Our cross-country analysis indicates that external supply side factors are the primary determinants of lending. Therefore, while the effect of supply side factors may be declining in the U.S., it is still important globally. Here we should mention two studies, Cerutti et al. (2014) and Cerutti and Claessens (2014), that approach the problem from the borrowers' perspective and identify the relative importance of internal and external factors for global banking lending by using panel model with borrower fixed effects. In our paper, we approach the problem from both the borrowers' and the lenders' perspective and use separate identification strategies for the two, and we use an alternative strategy to control for internal and external effects by focusing on the deviations of lender and borrower specific factors from the average behavior of all lenders and borrowers, respectively.

Our paper is directly related to the literature on the relationship between business cycles and foreign bank lending. In this literature, the evidence for the importance of external and internal factors for foreign bank lending is mixed. On the one hand, studies such as Buch (2000), Dahl et al. (2002), De Haas and Van Lelyveld (2006), De Haas and Van Horen (2013), Goldberg (2002), Hernandez and Rudolph (1995), Jeanneau and Mieu (2002), Martinez Peria et al. (2002) and Morgan and Strahan (2004) find that banks destabilize economies by shifting funds from economies with weak balance sheets to those with strong balance sheets. This mechanism, referred to as the substitution effect in De Haas and Van Lelyveld (2010), is consistent with the usual finding that foreign banks extend loans with shorter maturity and do less house–bank/relationship lending which makes them more sensitive to borrower balance sheets. On the other hand, studies such as Cetorelli and Goldberg (2012), Crystal et al. (2002), De Haas and Van Lelyveld (2014), Dages et al. (2000), and Peek and Rosengren (2000) find that global banks help their subsidiaries

[6] For example, according to our results if U.S. banks' share in France (8.6%) were to reach their share in Germany (13.1%), their sensitivity to the GDP growth rate in France (relative to the growth rate in other countries) and deposit rates in the U.S. would decrease by 16% and 12%, respectively. We find similar effects in our estimations with competition.

across the world through their internal capital markets to equate returns. This mechanism, referred to as the support effect, favors external supply side factors as the primary determinants of bank flows. In this paper, we find that the support effect is more important and that foreign banks' loans are more stable when they have a higher presence in the borrowing country.[7] There is a evidence, however, indicating that this result may only apply to lending in advanced economies. Avdjiev and Takáts (2014), for example, conduct an analysis, similar in scope to ours, by using BIS bilateral data in emerging markets during the taper tantrum. The authors use a different methodology (ANOVA decomposition) to compare the importance of emerging market factors with lender-banking-system factors and draw the opposite conclusion; internal (i.e. emerging market) factors are more important.[8,9]

Given the crucial role that global banks played during the 2008–09 crisis, recent studies have included their balance sheets and the frictions they face into open economy models to improve performance (e.g. Gertler and Karadi, 2011; Kollmann, 2013; Kollmann et al., 2011; Meh and Moran, 2010).[10] These theoretical enrichments have allowed for a more accurate representation of international business cycles and have generated the much needed cross-country output correlation these models were lacking with the symmetric effects of global banks on the countries that they lend to (e.g. Alpanda and Aysun, 2014). Our results are consistent with this literature and imply that a higher frequency of global financial shocks (external shocks) can increase output correlation and align business cycles around the world.[11] These is consistent with the findings in Kalemli-Ozcan et al. (2013) that in the absence of major banking market shocks, internal factors become more important and that growth rates can diverge across countries as they gain higher access to international banking.

Turning to the literature on competition and financial stability we find that it is similarly divided. While theoretical findings and evidence from a more comprehensive set of countries suggest that less competition can bring more stability (Allen and Gale, 2000, 2004; Boot and Thakor, 1993; Keeley, 1990; Marcus, 1984), there is a considerable evidence suggesting otherwise (e.g. Boyd and De Nicolo, 2005; Johnson and Kwak, 2011). In this paper, we make a distinction between the competition among foreign and domestic banks, respectively, and find that they can have opposite effects on financial stability. We further conclude that the effects of competition critically depend on foreign bank presence and that a more nuanced approach is warranted. This conclusion is supported by the empirical findings of Anginer et al. (2012) and Claessens and Van Horen (2013, 2014). While the former study finds that the lack of competition only becomes destabilizing in countries with lower foreign bank presence, the latter finds that the two may be related; there may be more competition with larger foreign banks.

## 2. Empirical methodology and data

In this section we first describe the methodology that helps us identify the unique effects of internal and external factors on foreign lending and then we describe our dataset.

### 2.1. Local balance sheets and global bank loans

We begin by investigating the relationship between the strength of a country's balance sheets (the internal demand side factor) and the global bank flows it receives. In doing so, we control for the external supply side factors by measuring the loan growth rate and the balance sheet strength variables as deviations from the lender-specific averages. Specifically, let $l_{ijt}$ and $\bar{l}_{it}^{bs}$ denote the growth rate of loans that country *i's* banks make in country *j* and their average cross-country loan growth rate at time *t*, then the dependent variable, the relative loan growth rate $\tilde{l}_{ijt}^{bs}$, is given by,

$$\tilde{l}_{ijt}^{bs} = l_{ijt} - \bar{l}_{it}^{bs} \tag{1}$$

Similarly the main independent variable, the relative strength of local balance sheets, $\tilde{y}_{ijt}$, is measured as the difference between the output growth rate in country *j*, $y_{ijt}$, and the average output growth rate across all the countries that country *i*'s banks lend in, $\bar{y}_{it}$, so that

$$\tilde{y}_{ijt} = y_{ijt} - \bar{y}_{it} \tag{2}$$

After constructing the main variables, we include them in the following model:

$$\tilde{l}_{ijt}^{bs} = \alpha^{bs} + \sum_{k=1}^{4} \beta_k^{bs} \tilde{l}_{ijt-k}^{bs} + \sum_{k=1}^{4} \gamma_k^{bs} \tilde{y}_{ijt-k} + \sum_{k=1}^{4} \lambda_k^{bs} bs_{ijt-k} + \varepsilon_{ijt}^{bs} \tag{3}$$

where $bs_{ijt}$ is a vector of lender-specific control variables that help us account for any residual external supply side effects on the banks' ability to lend. Here, we follow the common parameterization and include four lags of both the dependent and independent variables on the right hand side (e.g. Ashcraft and Campello, 2007; Cetorelli and Goldberg, 2012; Kashyap and Stein, 2000).

Since lender-specific restrictions, as mentioned above, apply similarly across all the countries that they lend in, we can focus on the internal factors, i.e., the idiosyncratic fluctuations in the credit worthiness of borrowers, by constructing the variables in deviational form. It is important to reiterate here that global banks are also locally funded. In the next section, we compare the lending behavior of banks in a given country and control for these local funding conditions that affect each global bank and measure the unique effects of external funding costs on global banks' lending.

A simple thought experiment here can further clarify our identification in this section. Assume, for example, that the cost of obtaining loanable funds (outside of the borrowing country) for Belgian banks increases. This can either be a shock common to every country or specific to Belgium. Assume also that the German economy is growing faster than all the other economies that Belgian banks lend in. Then, by measuring the loans that Germany receives from Belgium and its economy's growth rate relative to the other economies that Belgian banks lend in, we can to identify the effect of German balance sheet strength on its loan inflows independent of Belgian banks' funding costs.

Although this methodology allows us to control for external supply side factors, we acknowledge that borrower credit worthiness is not the only internal determinant of global loans. There are recipient-country-specific, time-variant and time-invariant, factors that can potentially mitigate or amplify the withdrawal from or flows into these countries. To hone in on the dynamic effects of borrower balance sheets, we express the main variables

[7] There are additional findings that demonstrate the importance of the support effect. Niepmann and Schmidt-Eisenlohr (2014), for example, use bilateral trade and trade finance data and find that adverse shocks in the trade finance market have a strong negative impact on bilateral trade.

[8] We find that the strength of borrower balance sheets (captured by the main internal demand side variables) is more important when we use annual data.

[9] Brandão-Marques et al. (2013) additionally find that the impact of external factors may depend on emerging market specific factors such as the quality of institutions.

[10] These shifts in theory are also justified by empirical studies demonstrating the importance of financial frictions. Cerutti and Claessens (2014), for example, provide detailed empirical evidence indicating that the frictions that global banks face in intermediating credit through their foreign affiliates has substantially increased during the 2008 crisis.

[11] Fratzscher (2012) provides empirical evidence for the significance of external shocks for capital flows. Giannetti and Laeven (2012) and De Haas and Van Lelyveld (2014) demonstrate the importance of external shocks during the 2008 crisis by uncovering the flight-to-quality channel in global banking.

in log differences to eliminate time invariant effects and we use the most comprehensive measures that reflect balance sheet strength; i.e., the GDP growth rate and unemployment rate. We also consider three factors that are less volatile yet directly related to bank behavior (competition, lending share and foreign bank presence) and we measure the impact of local funding conditions in the next section.

### 2.2. Banks' cost of funding and global bank loans

We proceed by reconfiguring our model to investigate the relationship between banks' cost of capital and their global lending behavior. The challenge in this section, conversely, is to control for the recipient countries' balance sheets when measuring the effect of external supply side factors on the global bank loans that they receive. To continue with the thought experiment above, assume now that amongst all the banks that lend to Germany, Belgian banks are the ones that face the largest increase in the cost of obtaining loanable funds. To identify the unique effects of this funding shock on the amount of Belgian lending in Germany, we could then measure both the growth rate of Belgian loans in Germany and the Belgian banks' cost of capital relative to their average values measured across all the global banks that lend in Germany and quantify the relationship between the two variables. By doing so, we would be controlling for internal factors (e.g. German balance sheets) when measuring the impact of external funding shocks.

To conduct this analysis, we reconstruct our variables as follows: Let $\overline{l}^{l}_{jt}$ denote the average growth rate of all global loans in country $j$, then the relative growth rate of country $i$'s loans, $\tilde{l}^{l}_{ijt}$, is given by

$$\tilde{l}^{l}_{ijt} = l_{ijt} - \overline{l}^{l}_{jt} \tag{4}$$

Similarly, let $b_{ijt}$ and $\overline{b}_{jt}$ denote the cost of funding for country $i$'s banks and the average cost of funding across all the global banks that lend in country $j$, respectively. Then the relative cost of capital for country $i$'s banks, $\tilde{b}_{ijt}$, is constructed as

$$\tilde{b}_{ijt} = b_{ijt} - \overline{b}_{jt} \tag{5}$$

We include these two variables in the following model,

$$\tilde{l}^{l}_{ijt} = \alpha^{l} + \sum_{k=1}^{4} \beta^{l}_{k} \tilde{l}^{l}_{ijt-k} + \sum_{k=1}^{4} \gamma^{l}_{k} \tilde{b}_{ijt-k} + \sum_{k=1}^{4} \lambda^{l}_{k} cs_{jt-k} + \varepsilon^{l}_{ijt} \tag{6}$$

where the main focus is on the coefficients of $\tilde{b}_{ijt}$ and a vector of borrower specific variables, $cs_{jt}$, is included to account for the residual internal effects that are not shut off.

### 2.3. Data

In this section, we describe our dataset, report various descriptive statistics, and discuss our estimation methodology. The data definitions and sources are provided in Appendix A.

We obtain our data mainly from two sources: the Bank of International Settlements' (BIS) Consolidated Banking Statistics and the FRED database of the Federal Reserve Bank of St. Louis. The cross-country lending data are from the BIS database and they are available after 1984 for 26 reporting countries. We restrict our dataset to include quarterly observations between 1999Q4 and 2014Q3. We choose the period 1999Q4 as our cutoff point since prior to this period the data are reported semi-annually and there are many missing observations; we further restrict our dataset to 15 countries that have only a few missing observations. The countries in our panel dataset (Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, France, United Kingdom, Italy, Japan, Netherlands, Portugal, Sweden, United States) are also the larger economies in the world, and they account for an overwhelming share of the loans in the BIS database. The loans are in millions of the U.S. dollars, positive for each borrower–lender pair. The data track the consolidated claims (on an immediate borrower basis) of BIS reporting banks' outstanding amount of external loans vis-à-vis all sectors by the nationality of the banks.[12] The data include the loans of foreign offices under the banks' control so that total foreign loans are comprised of international claims, cross-country claims plus non-local currency claims on residents of the borrowing country by the banks' foreign affiliates in the borrowing country and local claims in local currency. These data allow us to track the condition of the lenders and the borrowers in global banking and it is this bilateral dimension of the data that allows us to follow our unique identification strategy.

To construct the dependent variable in Eq. (3), we measure, for each lending (reporting) country, the growth rate of its loans in each of the 14 other countries and the average value of these growth rates. We then compute the relative loan growth rate as the difference between the borrower-specific and the average loan growth rate. To construct the dependent variable in Eq. (6), we measure, for each borrowing country this time, the growth rate of its loans extended by the other 14 countries and the average value of these loan growth rates. We then similarly measure the relative loan growth rate as the difference between the two variables. One advantage of our methodology is that it allows us to draw inferences from a relatively large panel data set (especially since the data are at the country level) that includes approximately 9000 observations (210 country pairs and 47 quarters) for each regression.

The remaining data are from the FRED database.[13] From seasonally adjusted data we compute the quarterly real GDP growth rate and the quarterly change in the harmonized unemployment rate to obtain our baseline indicators of borrowers' balance sheet strength. We capture the banks' funding costs by their local 3-month and 24-h interbank rates and deposit rates. We also include other measures of funding costs and various bank balance sheet and income statement ratios to check the sensitivity of our results. The independent variables here are similarly measured as deviations from averages. In Eqs. (3) and (6) we use the lenders' and the borrowers' real GDP growth rates and the change in their 3-month interbank interest rates as control variables, respectively, to account for the residual lender and borrower specific effects. In the control variable matrices of both equations we also include the borrowing country's exchange rate vis-à-vis the U.S. dollar (expressed as U.S. dollars per foreign currency) to account for the effect of the fluctuations in the value of local currency loans on the loan growth rate.

Besides its relatively large size, our dataset accounts for an important share of the loans for the countries in our sample. In Panel A of Table 1 we illustrate this feature of our dataset by reporting the ratio of the BIS loan inflows and outflows to the total amount of local private credit (in U.S. dollars). The average ratios (computed from 2000 to 2014) are generally large and demonstrate a considerable amount of variation both across time (the standard deviation of the ratios across the sample period) and across countries.[14] As expected, we observe that some countries are net lenders and others are net borrowers during the sample period.

[12] We used the loans to all sectors since loans to the non-financial sectors were not available vis-à-vis individual countries.

[13] The data that we obtained from FRED are compiled from OECD and IMF statistics.

[14] The ratios can be greater than 100% since the local credit variable includes only private loans. The sample period was restricted to the period 2000–2012 since domestic credit data on the FRED database was only available before 2012.

**Table 1**
Descriptive statistics.

Panel A

| | Austria | Belgium | Canada | Switz. | Germany | Denmark | Spain | France | U.K. | Italy | Japan | Nether. | Portugal | Sweden | U.S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *BIS inflows/Local Credit* | | | | | | | | | | | | | | | |
| Average | 61.5 | 111.2 | 15.6 | 30.8 | 33.3 | 39.2 | 29.7 | 37.4 | 64.5 | 45.3 | 11.3 | 55.3 | 51.5 | 39.4 | 58.3 |
| Std. deviation | 9.4 | 13.0 | 4.3 | 3.3 | 8.1 | 8.3 | 3.9 | 3.9 | 5.4 | 6.4 | 3.5 | 7.2 | 4.4 | 14.5 | 9.1 |
| *BIS outflows/Local Credit* | | | | | | | | | | | | | | | |
| Average | 31.8 | 180.4 | 30.4 | 226.0 | 69.3 | 21.5 | 28.1 | 74.6 | 42.2 | 22.4 | 23.3 | 95.2 | 18.8 | 67.2 | 11.4 |
| Std. deviation | 10.5 | 74.7 | 5.8 | 58.1 | 8.8 | 7.8 | 4.3 | 15.1 | 5.6 | 8.5 | 7.2 | 34.1 | 2.6 | 19.2 | 4.8 |
| 3-Bank concentration | 67.7 | 83.0 | 58.2 | 88.5 | 71.1 | 81.7 | 74.1 | 59.2 | 48.4 | 57.7 | 38.8 | 82.6 | 78.6 | 94.5 | 27.6 |
| 5-Bank concentration | 77.3 | 92.1 | 73.4 | 91.4 | 85.1 | 89.5 | 84.5 | 71.4 | 62.2 | 70.8 | 51.6 | 90.0 | 88.9 | 98.0 | 36.6 |
| Foreign loans/GDP | 28.0 | 79.3 | 16.6 | 128.8 | 30.1 | 46.3 | 28.5 | 40.5 | 127.9 | 22.1 | 13.0 | 84.3 | 66.0 | 39.4 | 20.1 |
| Foreign/Dom. assets | 80.6 | 113.8 | 32.4 | 137.7 | 55.8 | 88.1 | 55.7 | 56.1 | 131.5 | 53.0 | 17.5 | 124.6 | 96.2 | 57.9 | 36.5 |
| % Foreign banks | 0.8 | 1.9 | 41.7 | 0.5 | 0.3 | 0.4 | 0.7 | 0.6 | 0.2 | 0.2 | 1.1 | 0.3 | 1.9 | 0.2 | 0.04 |
| Credit/deposits ratio | 125.0 | 86.9 | 96.5 | 121.4 | 119.4 | 242.1 | 133.8 | 136.3 | 126.6 | 148.2 | 61.5 | 148.4 | 147.4 | 233.9 | 77.4 |
| ROE | 6.0 | 7.5 | 8.3 | 7.5 | 2.9 | 8.7 | 9.6 | 8.4 | 11.5 | 6.8 | −1.5 | 8.1 | 7.0 | 17.4 | 11.0 |
| Capital-Asset ratio | 13.6 | 13.8 | 13.4 | 13.3 | 13.0 | 13.3 | 12.0 | 11.7 | 13.6 | 11.0 | 11.9 | 12.4 | 10.4 | 10.2 | 13.2 |
| % nonperforming loans | 2.5 | 2.4 | 1.0 | 1.9 | 4.1 | 1.5 | 2.0 | 4.2 | 2.4 | 7.9 | 3.8 | 2.3 | 3.2 | 1.4 | 2.0 |

Panel B

| | Loan growth | | GDP growth | | Unemployment rate (quarterly change) | | 3-month interbank rate (quarterly change) | | 24-h interbank rate (quarterly change) | | Deposit rate (quarterly change) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean |
| *Cross sectional variation* | | | | | | | | | | | | |
| 2000 | 0.24 | 0.01 | 0.62 | 0.66 | 0.14 | −0.18 | 0.18 | 0.16 | 0.20 | 0.47 | 0.23 | 0.27 |
| 2001 | 0.22 | −0.01 | 0.68 | 0.11 | 0.23 | 0.08 | 0.32 | −0.33 | 0.33 | −0.19 | 0.34 | −0.25 |
| 2002 | 0.30 | 0.04 | 0.66 | 0.24 | 0.24 | 0.12 | 0.13 | −0.10 | 0.18 | −0.15 | 0.16 | −0.11 |
| 2003 | 0.29 | 0.05 | 0.56 | 0.43 | 0.20 | 0.09 | 0.18 | −0.31 | 0.20 | −0.27 | 0.25 | −0.28 |
| 2004 | 0.26 | 0.05 | 0.50 | 0.52 | 0.27 | 0.00 | 0.13 | −0.08 | 0.14 | −0.06 | 0.10 | −0.04 |
| 2005 | 0.24 | 0.03 | 0.69 | 0.71 | 0.24 | −0.04 | 0.14 | 0.02 | 0.13 | 0.05 | 0.15 | 0.03 |
| 2006 | 0.21 | 0.05 | 0.79 | 0.84 | 0.23 | −0.15 | 0.13 | 0.26 | 0.16 | 0.26 | 0.13 | 0.20 |
| 2007 | 0.25 | 0.06 | 0.56 | 0.65 | 0.23 | −0.10 | 0.10 | 0.21 | 0.10 | 0.18 | 0.10 | 0.20 |
| 2008 | 0.21 | −0.04 | 0.79 | −0.64 | 0.41 | 0.16 | 0.48 | −0.35 | 0.55 | −0.01 | 0.49 | −0.18 |
| 2009 | 0.22 | 0.0001 | 0.98 | −0.55 | 0.36 | 0.47 | 0.59 | −1.91 | 0.63 | −1.16 | 0.64 | −1.44 |
| 2010 | 0.18 | −0.03 | 0.82 | 0.74 | 0.23 | −0.02 | 0.05 | −0.04 | 0.05 | −0.01 | 0.09 | −0.05 |
| 2011 | 0.18 | −0.03 | 0.89 | 0.20 | 0.31 | 0.04 | 0.14 | 0.08 | 0.14 | 0.11 | 0.18 | 0.15 |
| 2012 | 0.18 | 0.005 | 0.61 | −0.12 | 0.33 | 0.15 | 0.24 | −0.25 | 0.15 | −0.18 | 0.18 | −0.20 |
| 2013 | 0.22 | −0.008 | 0.61 | 0.22 | 0.23 | 0.16 | 0.02 | 0.00 | 0.06 | −0.01 | 0.27 | 0.06 |
| 2014 | 0.20 | −0.003 | 0.48 | 0.22 | 0.23 | −0.10 | 0.05 | 0.02 | 0.06 | −0.01 | 0.08 | −0.02 |
| *Time series variation (Standard deviation/sample average)* | | | | | | | | | | | | |
| Austria | 0.17 | 0.009 | 0.89 | 0.36 | 0.23 | 0.02 | 0.41 | −0.06 | 0.39 | −0.05 | 0.34 | −0.04 |
| Belgium | 0.14 | −0.01 | 0.58 | 0.33 | 0.38 | 0.02 | 0.41 | −0.06 | 0.39 | −0.05 | 0.37 | −0.06 |
| Canada | 0.05 | 0.02 | 0.62 | 0.53 | 0.26 | 0.00 | 0.42 | −0.07 | 0.42 | −0.06 | 0.29 | −0.05 |
| Switzerland | 0.07 | 0.007 | 0.58 | 0.46 | 0.18 | 0.01 | 0.32 | −0.03 | 0.40 | −0.02 | 0.34 | −0.04 |
| Germany | 0.06 | 0.01 | 0.93 | 0.28 | 0.23 | −0.06 | 0.41 | −0.06 | 0.39 | −0.05 | 0.39 | −0.08 |
| Denmark | 0.15 | 0.03 | 0.91 | 0.17 | 0.33 | 0.02 | 0.44 | −0.06 | 0.41 | −0.05 | 0.32 | −0.04 |
| Spain | 0.11 | 0.03 | 0.69 | 0.39 | 0.66 | 0.19 | 0.41 | −0.06 | 0.39 | −0.05 | 0.31 | −0.03 |
| France | 0.08 | 0.02 | 0.53 | 0.30 | 0.24 | −0.01 | 0.41 | −0.06 | 0.39 | −0.05 | 0.36 | −0.05 |
| U.K. | 0.20 | 0.02 | 0.67 | 0.44 | 0.23 | 0.00 | 0.44 | −0.09 | 0.52 | −0.07 | 0.45 | −0.09 |
| Italy | 0.17 | 0.02 | 0.74 | 0.02 | 0.31 | 0.04 | 0.41 | −0.06 | 0.39 | −0.05 | 0.39 | −0.03 |
| Japan | 0.05 | 0.02 | 1.15 | 0.19 | 0.17 | −0.02 | 0.09 | −0.003 | 0.07 | 0.001 | 0.09 | 0.00 |
| Netherlands | 0.13 | 0.02 | 0.69 | 0.28 | 0.24 | 0.05 | 0.41 | −0.06 | 0.39 | −0.05 | 0.18 | −0.035 |

**Table 1** (*continued*)

Panel B

| | Loan growth | | GDP growth | | Unemployment rate (quarterly change) | | 3-month interbank rate (quarterly change) | | 24-h interbank rate (quarterly change) | | Deposit rate (quarterly change) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean |
| Portugal | 0.09 | 0.01 | 0.83 | 0.07 | 0.43 | 0.14 | 0.41 | −0.06 | 0.39 | −0.05 | 0.49 | −0.04 |
| Sweden | 0.13 | 0.04 | 1.02 | 0.50 | 0.29 | 0.03 | 0.42 | −0.05 | 0.57 | −0.02 | 0.39 | −0.04 |
| U.S. | 0.10 | 0.03 | 0.66 | 0.46 | 0.35 | 0.03 | 0.50 | −0.10 | 0.50 | −0.09 | 0.53 | −0.11 |

Panel C

% share of lenders' total loans by borrowing countries

| Lenders | Austria | Belgium | Can | Switz. | Ger. | Den. | Spain | France | U.K. | Italy | Japan | Nether. | Port. | Sweden | U.S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Borrowers* | | | | | | | | | | | | | | | |
| Austria | – | 1.3 | 0.8 | 4.7 | 22.5 | 0.8 | 1.9 | 4.9 | 10.1 | 7.4 | 0.4 | 6.0 | 0.6 | 0.6 | 6.8 |
| Belgium | 0.5 | – | 0.6 | 0.9 | 6.8 | 0.4 | 3.4 | 11.3 | 12.2 | 6.0 | 0.5 | 14.8 | 0.6 | 0.3 | 8.8 |
| Canada | 0.2 | 0.4 | – | 0.3 | 1.9 | 0.2 | 0.3 | 1.5 | 8.6 | 0.5 | 1.2 | 1.1 | 0.1 | 0.2 | 43.1 |
| Switzerland | 0.8 | 1.0 | – | 4.0 | 0.4 | 0.6 | 3.4 | 12.0 | 1.3 | 4.5 | 1.8 | 0.1 | 0.3 | 30.4 | |
| Germany | 1.8 | 1.6 | 1.2 | 2.2 | – | 1.0 | 4.1 | 6.5 | 15.9 | 5.1 | 2.5 | 5.0 | 0.8 | 0.8 | 14.5 |
| Denmark | 0.2 | 1.3 | 0.3 | 2.0 | 8.1 | – | 0.9 | 2.3 | 19.8 | 0.7 | 0.1 | 2.2 | 0.1 | 18.2 | 4.9 |
| Spain | 0.2 | 1.5 | 0.3 | 0.7 | 6.7 | 0.3 | – | 5.1 | 22.5 | 4.8 | 0.2 | 3.0 | 6.5 | 0.2 | 10.8 |
| France | 0.3 | 4.7 | 1.1 | 2.4 | 7.6 | 0.3 | 3.6 | – | 9.2 | 9.5 | 5.5 | 4.3 | 0.6 | 0.4 | 14.9 |
| U.K. | 0.3 | 1.5 | 4.1 | 1.5 | 5.9 | 0.4 | 2.7 | 8.0 | – | 2.7 | 3.7 | 4.0 | 0.5 | 0.5 | 29.9 |
| Italy | 4.7 | 3.1 | 0.5 | 1.8 | 22.6 | 0.3 | 2.8 | 8.2 | 11.0 | – | 1.4 | 3.8 | 1.2 | 0.3 | 6.7 |
| Japan | 0.2 | 0.9 | 2.5 | 0.9 | 6.5 | 0.3 | 1.0 | 4.8 | 7.4 | 1.8 | – | 2.8 | 0.1 | 0.5 | 32.3 |
| Netherlands | 7.3 | 2.1 | 1.4 | 11.3 | 0.6 | 3.7 | 5.8 | 11.3 | 4.3 | 1.7 | – | 0.4 | 0.6 | 14.2 | |
| Portugal | 0.4 | 1.3 | 0.6 | 2.3 | 4.6 | 0.7 | 17.0 | 9.7 | 10.1 | 4.0 | 0.2 | 7.8 | – | 0.3 | 6.9 |
| Sweden | 0.2 | 0.8 | 0.4 | 0.8 | 18.5 | 19.7 | 0.7 | 1.8 | 9.3 | 0.5 | 0.3 | 1.9 | 0.1 | – | 10.0 |
| U.S. | 0.4 | 1.8 | 6.5 | 2.3 | 9.5 | 1.0 | 2.0 | 6.4 | 19.7 | 2.8 | 10.0 | 5.2 | 0.2 | 0.8 | – |

Panel D

Lenders'% share of the total loans in borrowing countries

| Borrowers | Austria | Belgium | Can | Switz. | Ger. | Den. | Spain | France | U.K. | Italy | Japan | Nether. | Port. | Sweden | U.S. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Lenders* | | | | | | | | | | | | | | | |
| Austria | – | 2.7 | 0.8 | 5.2 | 46.5 | 0.1 | 1.5 | 6.4 | 4.7 | 25.2 | 2.8 | 4.3 | 0.3 | 0.7 | 3.8 |
| Belgium | 0.6 | – | 0.7 | 4.6 | 14.0 | 0.5 | 2.5 | 28.0 | 8.2 | 3.6 | 4.4 | 25.2 | 0.3 | 0.8 | 5.7 |
| Canada | 0.4 | 1.3 | – | 6.4 | 11.8 | 0.1 | 0.6 | 8.3 | 22.9 | 0.8 | 14.3 | 9.5 | 0.1 | 0.5 | 25.9 |
| Switzerland | 3.0 | 0.9 | – | 26.3 | 1.0 | 1.9 | 19.7 | 12.2 | 3.5 | 6.2 | 6.5 | 0.7 | 1.2 | 11.8 | |
| Germany | 3.0 | 4.2 | 1.1 | 6.8 | – | 0.9 | 3.8 | 14.6 | 10.8 | 11.3 | 10.6 | 13.1 | 0.3 | 6.0 | 10.3 |
| Denmark | 0.7 | 2.4 | 0.7 | 4.2 | 18.2 | – | 1.0 | 4.2 | 5.6 | 0.9 | 3.5 | 5.1 | 0.3 | 43.4 | 7.0 |
| Spain | 0.7 | 4.5 | 0.4 | 3.0 | 27.4 | 0.3 | – | 19.0 | 13.3 | 3.4 | 4.2 | 11.4 | 2.9 | 0.6 | 6.3 |
| France | 0.9 | 7.7 | 1.1 | 7.2 | 22.3 | 0.4 | 3.8 | – | 19.2 | 4.6 | 9.9 | 8.8 | 0.9 | 0.8 | 10.1 |
| U.K. | 0.7 | 3.9 | 2.7 | 11.3 | 22.6 | 1.3 | 9.0 | 9.6 | – | 2.4 | 6.5 | 7.0 | 0.3 | 1.6 | 12.6 |
| Italy | 1.7 | 5.8 | 0.4 | 3.8 | 22.3 | 0.1 | 4.2 | 32.3 | 8.0 | – | 4.7 | 8.2 | 0.4 | 0.3 | 5.0 |
| Japan | 0.1 | 0.6 | 1.2 | 15.9 | 14.0 | 0.0 | 0.2 | 21.7 | 13.7 | 1.0 | – | 4.5 | 0.0 | 0.2 | 25.3 |
| Netherlands | 16.3 | 1.0 | 4.9 | 21.9 | 0.4 | 2.9 | 14.4 | 12.7 | 3.1 | 7.6 | – | 0.8 | 1.1 | 10.0 | |
| Portugal | 0.8 | 3.6 | 0.5 | 1.5 | 20.1 | 0.1 | 37.7 | 11.0 | 9.6 | 4.8 | 1.2 | 4.9 | – | 0.2 | 2.2 |
| Sweden | 0.7 | 1.6 | 1.3 | 5.4 | 21.2 | 22.9 | 1.3 | 7.4 | 9.5 | 1.2 | 8.1 | 7.4 | 0.2 | – | 8.4 |
| U.S. | 0.3 | 1.8 | 8.7 | 17.5 | 12.7 | 0.2 | 2.4 | 9.7 | 18.7 | 0.9 | 17.5 | 5.9 | 0.1 | 1.2 | – |

*Note:* The average ratios (and the standard deviations for the first two variables) in Panel A are computed by using annual data for the 2000–2014 period. The cross sectional variables in Panel B are obtained by first measuring the standard deviations and the means across the sample countries in each quarter and then averaging these quarterly measures to obtain the annual variables. The time series variation ratios in Panel B are obtained by measuring the standard deviation and the mean of the variables for each country and then dividing the two variables. Panels C and D display the compositions of each reporting and borrowing country's loans in our dataset. In panel C, the columns display the shares borrowing countries in the total loans of all reporting countries. In panel D, the columns display the share of a lending country in the total global banking loans in a borrowing country.

The 3-bank and 5-bank concentration ratios are the share of the top 3 and 5 banks' assets in their local banking sector, respectively. Notice that for a majority of the countries these ratios are above 50% and demonstrate a considerable amount of variation across countries (for example, the 3-bank concentration is 27.6% for the U.S. and 94.5% for Sweden). The next row in Panel A indicates a significant foreign bank presence in the sample countries. Consistent with the ratios in the first two rows, the total amount of outstanding foreign loans to GDP ratios are certainly not negligible. The next two variables show that foreign banks are few in number and they are large (foreign banks' assets to domestic banks' assets ratios are greater than 100% for some countries).

We should reiterate the importance of the latter observation for our paper. Since we do not have bank-level data on country-specific lending, our estimations may mask the different sensitivities that banks exhibit and lead to misleading inferences. Since the cross-country loans in our sample are mostly made by a very few large banks, however, it is unlikely that a bank could behave differently without impacting country-level sensitivities.[15]

The structural banking variables in the last four rows of panel A similarly reveal a significant degree of variation across countries. The difference between the credit/deposit ratio of Japan and Sweden, for example, is over 100%, and while Swedish banks' return on equity was 17.4%, Japanese banks incurred losses. The credit/deposit ratios also show that deposits are an important source of funding. In our analysis, we thus include the deposit interest rate as an alternative indicator of funding costs.

In our panel model estimations we consider the time series and cross sectional variation in cross-country lending. This analysis would not be informative if the lending, balance sheet, and funding cost variables behaved similarly across time and countries. In panel B of Table 1 we report the time series and cross sectional variation of our key variables. The standard deviations for both dimensions are large and often greater than the mean values thus demonstrating a considerable amount of variation in our panel dataset. Below, we utilize this variation to measure and compare the sensitivities of global bank lending to the strength of balance sheets and funding costs.

Panels C and D of Table 1 show that while country pairs that include the U.S., U.K. and Germany account for the largest shares in the composition of lending and borrowing countries' loans, respectively, other countries' shares are positive and not negligible for the most part.

To estimate Eqs. (3) and (6) we use the General Method of Moments strategy of Arellano and Bond (1991). We use this method since it is designed for dynamic panel models that, similar to ours, have a larger cross-sectional dimension. The methodology also accounts for the unobserved panel-level fixed/random effects, endogeneity of the independent variables, nonstationarity of the dependent variable and helps us obtain heteroskedasticity-consistent standard errors. In our estimations we use the $t-1$ dated independent variables as instruments.

## 3. Results

We report our estimation results in Table 2. The central result here is that global bank loan flows are positively related to the strength of borrower balance sheets, negatively related to the interbank funding costs and positively related to deposit rates. The positive (negative) value of the GDP growth rate (the unemployment rate) coefficient, reported in the first (second) column, implies that if a country's GDP increases (unemployment rate decreases) more than that of the other countries in the sample, it receives more loans. On the external side, the negative coefficients of the 3-month and 24-h interbank, reported in columns 3 and 4, imply that if a country's banks face higher costs of raising loanable funds in the interbank market relative to banks in other countries, they withdraw their loans at a higher rate. These conclusions are reversed when we use deposit rates and an increase in deposit rates is positively related to global bank lending. This disparity between deposit and interbank rate coefficients is consistent with the financial frictions literature that demonstrates the procyclical and countercyclical nature of deposit and interbank rates, respectively. In other words, according to these studies, as economic activity increases and bank lend more, deposit rates increase and borrowing rates decrease.[16] In addition to the country-specific interest rates, we use the average rates for the 57 banks most actively borrowing euros.[17] The results in the last column show that these rates are also negatively related to global bank lending but they are not significant. This is partially due to the fact that the dependent variable is expressed as deviations from mean and the euro rate is not.

The sum of the lagged dependent variable coefficients, $\sum_{k=1}^{4}\beta_k$, indicates a negative relationship between the current loan growth rate and the loan growth rate in the past four quarters. The coefficients of the control variables (GDP growth rates and 3-month interbank rates) are in general insignificant, suggesting that measuring the main variables in deviational form is allowing us to effectively control for lender and borrower specific effects in estimating Eqs. (3) and (6), respectively. The significance of the exchange rate in the balance sheet regressions is also consistent with this; while the lending countries face different borrowing country exchange rates in Eq. (3), they face the same exchange rate in Eq. (6). The positive sign of the exchange rate coefficient, as expected, indicates that if a borrowing country's currency appreciates, the U.S. dollar loan growth rate to this country (relative to the other countries) increases by more. For all our regressions, diagnostic tests support the validity of the instruments (captured by the Sargan test statistic) and do not reveal any evidence for second order serial correlation in the error term.

### 3.1. Comparing the sensitivity coefficients and the impact of 2008 crisis

In addition to being statistically significant, the sensitivity coefficients in Table 2 are also not negligible economically. To uncover the economic importance of the GDP growth coefficient in Table 2, for example, let's assume that Belgium experiences a one percent growth rate in the past four quarters and that the remaining economies do not grow. The aggregate coefficient value of 0.7709 then implies that global bank loans in Belgium grow 0.7709 percentage points more (quarterly) than the average growth rate of loans to all countries. Given that the average quarterly loan growth rate in our sample is 1.22%, this implies that the loans in Belgium increase approximately 65% more than the average rate across all countries. A similar thought exercise reveals a larger economic impact for funding costs. Assume that among the countries lending to Belgium, Canada is the only one that experiences a one percent increase in its interbank borrowing rates in the past 4 quarters. Then the coefficient value of −0.0241 implies that Canada's loan growth rate in Belgium is −2.41 percentage points lower than Belgium's average loan inflow rate, which is 1.22% for the whole sample. In other words, while the average country increases its

[15] Assigning the source of this behavior to external or internal factors would depend on whether cross-border lending is characterized by a centralized or a decentralized model.

[16] In studies such as Bernanke et al. (1999) and Gertler and Kiyotaki (2010) deposit rates increase due to tightening monetary policy reaction and borrowing rates decrease since borrowers are less leveraged.

[17] Since the euro rate is not country-specific, we measure the loan growth rate in levels when including this rate in our regressions.

**Table 2**
Baseline results.

| | Local balance sheets | | External funding costs | | | |
|---|---|---|---|---|---|---|
| | GDP growth rate | Unemployment rate | 3-month rates | 24-h rates | Deposit rates | Euro rates |
| $\sum_{k=1}^{4}\gamma_k$ | 0.7709 | −0.0119 | −0.0241 | −0.0252 | 0.0061 | −0.0396 |
| | (17.373)*** | (495.136)*** | (808.566)*** | (512.822)*** | (128.064)*** | (1.687) |
| $\sum_{k=1}^{4}\beta_k$ | −0.577 | −0.563 | −0.492 | −0.503 | −0.492 | −0.476 |
| | (19,832.8)*** | (24,989.2)*** | (22,457.4)*** | (18,730.1)*** | (11,836.3)*** | (10983.1)*** |
| Lender's GDP growth | −3.419 | 1.720 | | | | |
| | (1.764) | (2.942) | | | | |
| Lender's 3 month interbank rate | 0.022 | −0.011 | | | | |
| | (2.194) | (2.672) | | | | |
| Borrower's GDP growth | | | 4.717 | 3.860 | 3.802 | 4.057 |
| | | | (1.583) | (4.265) | (2.079) | (2.263) |
| Borrower's 3 month interbank rate | | | −0.052 | −0.031 | −0.042 | −0.003 |
| | | | (1.517) | (1.662) | (2.93) | (10.642)** |
| Exchange rate | 0.358 | 0.389 | −0.057 | −0.074 | 0.005 | −0.005 |
| | (668.1)*** | (1,920.8)*** | (0.543) | (0.839) | (0.003) | (0.004) |
| Number of obs. | 10,911 | 10,911 | 10,911 | 10,911 | 10,839 | 10,524 |
| AR test, *p*-value | 0.755 | 0.721 | 0.739 | 0.838 | 0.745 | 0.846 |
| Chi2, Sargan | 202.6 | 192.0 | 196.0 | 196.5 | 198.7 | 201.1 |
| Chi2, 10% | 10,705.3 | 10,705.3 | 10,705.3 | 10,705.3 | 10,633.9 | 10,321.7 |

*Notes:* This table reports the results obtained from the estimation of Eqs. (3) and (6). The dependent variable in each regression is the bilateral, relative loan growth rate. The numbers in parentheses are the F-statistics corresponding to joint significance tests. Significance levels: *** = 1%; ** = 5%.

**Table 3**
Sensitivity comparison.

| | Local balance sheets | | Banks' funding costs | | |
|---|---|---|---|---|---|
| | GDP growth rate | Unemployment rate | 3-Month rates | 24-h rates | Deposit rates |
| *Whole Sample* | | | | | |
| $\sum_{k=1}^{4}\gamma_k$ | 0.0023 | −0.0025 | −0.0182 | −0.0218 | 0.0082 |
| | (8.273)*** | (44.884)*** | (347.657)*** | (601.122)*** | (90.771)*** |
| Number of obs. | 10,911 | 10,911 | 10,911 | 10,911 | 10,839 |
| AR test, *p*-value | 0.825 | 0.787 | 0.720 | 0.776 | 0.762 |
| Chi2, Sargan | 188.2 | 199.2 | 195.4 | 192.2 | 198.4 |
| Chi2, 10% | 10,705.3 | 10,705.3 | 10,705.3 | 10,705.3 | 10,633.9 |
| *2000–2007* | | | | | |
| $\sum_{k=1}^{4}\gamma_k$ | 0.00322 | −0.00316 | 0.0024 | 0.0037 | 0.0513 |
| | (36.728)*** | (54.637)*** | (634.395)*** | (7.093) | (1,221.453)*** |
| Number of obs. | 5555 | 5555 | 5555 | 5555 | 5555 |
| AR test, p-value | 0.839 | 0.844 | 0.771 | 0.851 | 0.789 |
| Chi2, Sargan | 193.2 | 196.6 | 199.1 | 193.4 | 197.7 |
| Chi2, 10% | 5403.6 | 5403.6 | 5403.6 | 5403.6 | 5403.6 |
| *2008–2014* | | | | | |
| $\sum_{k=1}^{4}\gamma_k$ | −0.00326 | −0.00149 | −0.0147 | −0.0517 | 0.0065 |
| | (4.272) | (29.905)*** | (805.769)*** | (536.372)*** | (302.81)*** |
| Number of obs. | 4351 | 4351 | 4351 | 4351 | 4279 |
| AR test, *p*-value | 0.928 | 0.865 | 0.954 | 0.963 | 0.974 |
| Chi2, Sargan | 190.7 | 195.3 | 193.5 | 196.4 | 183.8 |
| Chi2, 10% | 4215.1 | 4215.1 | 4215.1 | 4215.1 | 4144.1 |

*Notes:* This table reports the results obtained from the estimation of Eqs. (3) and (6). The dependent variable in each regression is the bilateral, relative loan growth rate. The independent variables in this table are the same as in Table 2. We report only the coefficients for the (now standardized) main independent variables. The numbers in parentheses are the F-statistics corresponding to joint significance tests. Significance levels: *** = 1%.

loans to Belgium by 1.22%, Canada decreases its loans by 1.19%. For the median economy in our sample (Spain, in terms of GDP), 2.41% and 0.7709% of the BIS loans correspond to approximately 0.24% and 0.07% of quarterly GDP.[18]

Notice that although the results so far point to a larger external supply side effect, the comparison can be misleading if the indicators of balance sheet strength and funding costs have different means and volatilities. Specifically, the coefficient value for the indicator with a higher mean and standard deviation would be smaller. To correct for this potential bias, we standardize all the indicators so that they all have a mean of zero and a standard deviation of one and estimate our models by using these standardized variables. The coefficient values reported in the first row of Table 3, by construction, represent the loan growth response to a one standard deviation change in the balance sheet and funding cost variables. These results reveal that the sensitivity to funding costs is higher compared to the sensitivity to borrowers' balance sheets. The magnitude of the response to a one standard deviation change in the borrowers' relative GDP growth rate and the lenders' 3-month interbank borrowing rate, for example, are 0.23% and

[18] We used GDP by expenditure in constant prices (2005 Dollars) and total BIS loans to and from Spain in our calculations.

1.82%, respectively. The same disparity is observed when we use the unemployment rate and the other interest rate variables.

Next, we split the sample period into two periods, before and after 2008Q1, and make a similar comparison. Before 2008, we find that deposit rates have a considerably larger impact on global bank lending than balance sheet variables. Comparing the coefficients of the balance sheet variables and interbank borrowing rates, however, we do not find a similar disparity during this period. We also observe that the interbank rate coefficients are either much smaller in magnitude or insignificant compared to the results from the full sample and to the coefficient of the deposit rate. After 2008, by contrast, we find that interbank rates are more strongly related to global bank lending than deposit rates. Similar to our results obtained from the full sample, this relationship is much stronger than that between the balance sheet variables and global bank lending. Notice also that after 2008, the GDP growth coefficient is insignificant and the unemployment rate coefficient is smaller in magnitude implying that the relationship between the balance sheet variables and global bank lending is weaker during this period.

### 3.2. The effect of competition and foreign presence

We proceed by investigating three potential determinants of the lending sensitivities estimated above. First, we investigate the role of bank competition in the borrowing countries and ask whether global banks become more or less sensitive to the strength of balance sheets and their funding costs when they face more/less competition. Second, we include country-specific lending shares to determine whether countries with a larger share of the recipient country's loan market exhibit higher or lower sensitivity to internal and external variables. We conduct a similar experiment as a third step and test whether borrowing countries with a higher global bank presence (higher global bank loans to GDP ratio) face higher lending sensitivity.

To incorporate competition into our analysis of balance sheet effects, we interact different measures of competition with our balance sheet variables, and include the interaction term in our model as follows:

$$\tilde{l}^{bs}_{ijt} = \alpha^{bs} + \sum_{k=1}^{4} \beta^{bs}_{k} \tilde{l}^{bs}_{ijt-k} + \sum_{k=1}^{4} \gamma^{bs}_{k} \tilde{y}_{ijt-k} + \sum_{k=1}^{4} \gamma^{bs}_{k} \tilde{y}_{ijt-k} com\tilde{p}_{jt-5} + \sum_{k=1}^{4} \lambda^{bs}_{k} bs_{ijt-k} + \varepsilon^{bs}_{ijt} \tag{7}$$

We follow the same methodology to extend our analysis of the external effects:

$$\tilde{l}^{l}_{ijt} = \alpha^{l} + \sum_{k=1}^{4} \beta^{l}_{k} \tilde{l}^{l}_{ijt-k} + \sum_{k=1}^{4} \gamma^{l}_{k} \tilde{b}_{ijt-k} + \sum_{k=1}^{4} \gamma^{l}_{k} \tilde{b}_{ijt-k} com\tilde{p}_{jt-5} + \sum_{k=1}^{4} \lambda^{l}_{k} cs_{jt-k} + \varepsilon^{l}_{ijt} \tag{8}$$

In Eqs. (7) and (8), the variable $com\tilde{p}_{jt}$ measures the degree of competition in the banking industry of borrowing country $j$ and the other variables are constructed similarly.

Our competition measure, the Lerner index, is a markup-based measure that is constructed by comparing output pricing and marginal costs. The higher values of this index imply a lower degree of competition and the index is available at the annual frequency. By construction, therefore, an increase in $com\tilde{p}_{jt}$ implies deterioration in competitive conduct. We measure this variable also in deviational form so that it represents a country's level of competition relative to the average level across all the countries. Since this variable is available at the annual frequency, we interact the quarterly balance sheet and funding cost variables with the level of competition observed in the previous year.

The results in the top panel of Table 4 suggest a negative relationship between the degree of competition and the sensitivity to balance sheets and funding costs. In particular, if the degree of competition in the borrowing country is high, global bank loans in this country become less sensitive to local borrowers' balance sheets and global banks' funding costs. Comparing the different factors, we observe a weaker impact of competition in the regressions with the interbank borrowing rates.

Next, we replace the competition variable in Eqs. (7) and (8) with the share of the lending countries' loans in the total BIS loans made in the borrowing countries. We measure this ratio quarterly and interact it with the balance sheet and funding cost variables in the same quarter. The estimation results are reported in the middle panel of Table 4. The results imply that banks/countries with a higher share in the borrowers' loan market are less sensitive borrowers' balance sheets and to their funding costs. These relationships are significant and economically important. For example, the interaction term coefficient value of −2.1728, implies that if a lender's share increases by 1 percentage point, its sensitivity to the borrower's relative GDP growth rate decreases by 3.6% (−2.1728 divided by 0.6011). A stronger observation can be made for the unemployment rate (a 17.5% decrease). A similar, albeit a weaker, observation can be drawn from the external results (with a corresponding impact of 0.6, 1.5 and 2.6 for 3-month and 24-h interbank rates, and deposit rates, respectively).

We find a similar mitigating effect of foreign bank presence on the sensitivity to the internal variables and external deposit rates when we replace the country-specific lending share variable with an indicator of foreign banks' presence in the borrowers' loan market (displayed in bottom panel of Table 4). Foreign bank presence, by contrast, amplifies the impact of interbank borrowing rates on lending. We should note, however, that these effects are considerably smaller than the effects of country specific lending shares.[19]

The descriptive statistics in Section 2 indicate that the United States, Germany and the United Kingdom are the largest borrowers and lenders in our sample. In an alternative set of regressions, we test whether our results are driven by observations from these countries. In so doing, we exclude the three countries from the set of lenders in the balance sheet regressions, and we exclude them from the set of borrowers in the cost of funding regressions. Our results, displayed in the bottom panel of Table 4, imply that our conclusions remain the same. External factors, captured by the banks' home-country borrowing rates, are more closely related to their global lending behavior. A comparison with our baseline results does not reveal any fundamental difference.[20]

### 3.3. Local versus external funding costs

So far, our analysis has focused on borrower balance sheets as the only internal factor that can impact global bank lending. Given that global banks also borrow locally, however, it is likely that local (host-country) interbank borrowing rates would be another internal factor that could impact banks' lending behavior.[21] To test this hypothesis and assess whether the prominence of external factors in our baseline results remains unaltered, we estimate Eq. (3) by using

[19] We capture foreign bank presence with the total outstanding loans by nonresident banks to borrower's GDP ratio. Since this ratio is available only at the annual frequency, the estimation methodology is the same as the one we used for the competition regressions.

[20] While the size of the GDP growth rate coefficient becomes larger in the restricted sample, the size of the unemployment coefficient becomes smaller. Similarly, while the size of the deposit rate and 3-month borrowing rate coefficients becomes larger, the size of the 24-h borrowing rate coefficient becomes smaller.

[21] In an alternative set of regression we consider external balance sheets (strength of borrower balance sheets in the lending country) as an alternative external factor. A comparison between external and internal balance sheet coefficients does not allow us to conclude that one factor is more important than the other. We do, however, find that external balance sheet coefficients are considerably smaller compared to the external funding cost coefficients.

**Table 4**
The impact of competition and lending shares.

| | Local balance sheets | | Banks' funding costs | | |
|---|---|---|---|---|---|
| | GDP growth rate | Unemployment | 3-Month rates | 24-h rates | Deposit rates |
| *competition* $*\sum_{k=1}^{4}\gamma_k$ | 0.0027 | −0.0084 | −0.0023 | −0.0038 | −0.0036 |
| | (30.257)*** | (328.277)*** | (223.685)*** | (436.492)*** | (145.171)*** |
| $\sum_{k=1}^{4}\gamma_k$ | 0.0029 | −0.0027 | −0.0230 | −0.0359 | 0.0012 |
| | (25.840)*** | (23.935)*** | (281.297)*** | (347.031)*** | (74.954)*** |
| Number of obs. | 8115 | 8115 | 8115 | 8115 | 8115 |
| AR test, *p*-value | 0.6323 | 0.6322 | 0.538 | 0.555 | 0.562 |
| Chi2, Sargan | 194.6 | 188.5 | 195.7 | 200.0 | 202.8 |
| Chi2, 10% | 7932.4 | 7932.4 | 7932.4 | 7932.4 | 7932.4 |
| *lending share* $*\sum_{k=1}^{4}\gamma_k$ | −2.1728 | 0.2753 | 0.0387 | 0.0217 | −0.0177 |
| | (37.622)*** | (95.406)*** | (7.739) | (1.361) | (42.664)*** |
| $\sum_{k=1}^{4}\gamma_k$ | 0.6011 | −0.0157 | −0.0249 | −0.0316 | 0.0068 |
| | (38.981)*** | (312.141)*** | (63.055)*** | (141.964)*** | (74.703)*** |
| Number of obs. | 10,248 | 10,248 | 10,248 | 10,248 | 9974 |
| AR test, *p*-value | 0.687 | 0.648 | 0.473 | 0.463 | 0.450 |
| Chi2, Sargan | 189.2 | 194.0 | 191.1 | 202.3 | 196.8 |
| Chi2, 10% | 10,045.1 | 10,045.1 | 10,045.1 | 10,045.1 | 7912.6 |
| *foreign share* $*\sum_{k=1}^{4}\gamma_k$ | −0.0460 | 0.0008 | −0.0002 | −0.0003 | −0.0003 |
| | (83.319)*** | (107.248)*** | (13.919)*** | (186.281)*** | (56.257)*** |
| $\sum_{k=1}^{4}\gamma_k$ | 3.9127 | −0.0515 | −0.0122 | −0.0158 | 0.0220 |
| | (90.214)*** | (144.64)*** | (36.382)*** | (42.803)*** | (42.986)*** |
| Number of obs. | 8,915 | 8,915 | 8,915 | 8,915 | 8,915 |
| AR test, *p*-value | 0.660 | 0.638 | 0.496 | 0.675 | 0.589 |
| Chi2, Sargan | 190.7 | 195.6 | 199.2 | 197.9 | 201.5 |
| Chi2, 10% | 8724.5 | 8724.5 | 8724.5 | 8724.5 | 8724.5 |
| *Sample excluding U.S., U.K. and Germany* | | | | | |
| $\sum_{k=1}^{4}\gamma_k$ | 0.0070 | −0.0005 | −0.0254 | −0.0258 | 0.0090 |
| | (255.003)*** | (392.248)*** | (308.229)*** | (150.461)*** | (33.026)*** |
| Number of obs. | 7968 | 7968 | 8689 | 8689 | 8629 |
| AR test, *p*-value | 0.828 | 0.793 | 0.698 | 0.774 | 0.687 |
| Chi2, Sargan | 132.2 | 135.5 | 158.9 | 155.7 | 157.5 |
| Chi2, 10% | 7786.9 | 7786.9 | 8500.7 | 8500.7 | 8441.3 |

*Notes:* This table reports the results obtained from the estimation of Eqs. (7) and (8). The dependent variable in each regression is the bilateral, relative loan growth rate. The regression results in the bottom panel of the table are obtained by standardizing the independent variables. The numbers in parentheses are the F-statistics corresponding to joint significance tests. Significance levels: *** = 1%.

local interbank borrowing rates, in deviational and standardized form, as the main independent variable. It is true that, local funding is not limited to interbank lending and there other forms of local funding for banks. Due to data limitations, however, we focus on local interbank lending in this section.

The results are displayed in the first three columns of Table 5. For convenience, the next three columns display the baseline results obtained by using banks' external (home-country) interbank rates as the main independent variable. The results, in general, demonstrate that external interbank rates are much more important in the full sample and in the subsample that spans the period after 2008.[22] While the external deposit rate coefficient is smaller than its internal counterpart after 2008, it is much larger before 2008 and in the full sample. Notice here that besides the size of the local funding cost coefficients, their sign is also different from their external counterparts implying, for example, that global banks lend more in an economy that has increasing funding costs. When we consider the impact of lending shares, we find a similar decline in sensitivity to local funding costs when banks have a larger share in a borrowing country's market.

[22] We reach a similar conclusion when we exclude data from the U.S., Germany and U.S. as in the previous section.

## 4. Inferences from a simple OLG model

So far, we uncovered a disparity between the sensitivity of global bank lending to borrower balance sheets and to funding costs and found that a higher degree of bank competition and foreign bank presence in the borrowing countries have a mitigating effect on the sensitivities. In this section, we investigate the mechanisms that may explain these empirical results by building and solving a model of global bank lending.

### 4.1. The consumers and the production process

The economy is represented by a 2-period OLG model. The young agents in the model are endowed with a unit of labor and they do not own capital. Their labor supply is inelastic (equal to one) and the share of their labor income that is not consumed in period 1 finances their period 2 consumption, when they are old. Old agents do not work. In each group, the number of agents is finite and constant and the agents are identical. The maximization problem of a representative agent in this economy in period $t$ is then given by,

$$\max_{s_t} u(c_t, c_{t+1}) = c_t^{\varepsilon} + c_{t+1}^{\varepsilon} \tag{9}$$

$$c_t = w_t - s_t \tag{10}$$

**Table 5**
Local versus external funding costs.

| | Local funding costs | | | External funding costs | | |
|---|---|---|---|---|---|---|
| | 3-Month rates | 24-h rates | Deposit rates | 3-Month rates | 24-h rates | Deposit rates |
| *Whole Sample* | | | | | | |
| $\sum_{k=1}^{4}\gamma_k$ | 0.0059 | 0.0076 | 0.0020 | −0.0182 | −0.0218 | 0.0082 |
| | (931.671)*** | (295.577)*** | (461.03)*** | (347.657)*** | (601.122)*** | (90.771)*** |
| Number of obs. | 10,911 | 10,911 | 10,831 | 10,911 | 10,911 | 10,839 |
| AR test, *p*-value | 0.810 | 0.824 | 0.834 | 0.720 | 0.776 | 0.762 |
| Chi2, Sargan | 195.8 | 191.0 | 188.2 | 195.4 | 192.2 | 198.4 |
| Chi2, 10% | 10,705.3 | 10,705.3 | 10,626.0 | 10,705.3 | 10,705.3 | 10,633.9 |
| *2000–2007* | | | | | | |
| $\sum_{k=1}^{4}\gamma_k$ | 0.0033 | 0.0048 | −0.0002 | 0.0024 | 0.0037 | 0.0513 |
| | (405.718)*** | (547.235)*** | (107.825)*** | (634.395)*** | (7.093) | (1,221.453)*** |
| Number of obs. | 5555 | 5555 | 5555 | 5555 | 5555 | 5555 |
| AR test, *p*-value | 0.815 | 0.819 | 0.868 | 0.771 | 0.851 | 0.789 |
| Chi2, Sargan | 190.4 | 192.2 | 194.1 | 199.1 | 193.4 | 197.7 |
| Chi2, 10% | 5403.6 | 5403.6 | 5403.6 | 5403.6 | 5403.6 | 5403.6 |
| *2008–2014* | | | | | | |
| $\sum_{k=1}^{4}\gamma_k$ | −0.0010 | 0.0035 | 0.0198 | −0.0147 | −0.0517 | 0.0065 |
| | (1,070.013)*** | (661.953)*** | (1,137.102)*** | (805.769)*** | (536.372)*** | (302.81)*** |
| Number of obs. | 4,351 | 4,351 | 4,271 | 4,351 | 4,351 | 4,279 |
| AR test, *p*-value | 0.836 | 0.855 | 0.968 | 0.954 | 0.963 | 0.974 |
| Chi2, Sargan | 189.7 | 192.5 | 189.9 | 193.5 | 196.4 | 183.8 |
| Chi2, 10% | 4,215.1 | 4,215.1 | 4,136.2 | 4,215.1 | 4,215.1 | 4,144.1 |
| *lending share* $*\sum_{k=1}^{4}\gamma_k$ | −0.0604 | −0.0692 | −0.0760 | 0.0387 | 0.0217 | −0.0177 |
| | (156.552)*** | (193.597)*** | (148.741)*** | (7.739) | (1.361) | (42.664)*** |
| $\sum_{k=1}^{4}\gamma_k$ | 0.0214 | 0.0200 | 0.0172 | −0.0249 | −0.0316 | 0.0068 |
| | (555.096)*** | (465.393)*** | (364.7)*** | (63.055)*** | (141.964)*** | (74.703)*** |
| Number of obs. | 10,248 | 10,248 | 10,168 | 10,248 | 10,248 | 9,974 |
| AR test, *p*-value | 0.6061 | 0.6058 | 0.655 | 0.473 | 0.463 | 0.450 |
| Chi2, Sargan | 194.7 | 193.2 | 199.0 | 191.1 | 202.3 | 196.8 |
| Chi2, 10% | 10,045.1 | 10,045.1 | 9965.9 | 10,045.1 | 10,045.1 | 7912.6 |

*Notes:* This table reports the results obtained from the estimation of Eqs. (3) and (6). The independent variables in each regression except the regressions with lending share are standardized. The numbers in parentheses are the F-statistics corresponding to joint significance tests. Significance levels: *** = 1%; ** = 5%; * = 10%.

$$c_{t+1} = s_t r_t^d \tag{11}$$

where $c_t$, $w_t$, $s_t$ and $r_t^d$ denote the amount of consumption, labor income, savings and the rate of return on savings, respectively, and $\xi$ is the power function parameter that is less than 1.[23]

Substituting Eqs. (10) and (11) into the utility function and maximizing with respect to the amount of savings yields the following savings supply condition:

$$r_t^d = \left(\frac{s_t}{w_t - s_t}\right)^{(1-\xi)/\xi} \tag{12}$$

where the young agents require a higher deposit rate to save more. The labor services of the young agents, $h_t$, are hired by a representative, competitive firm that combines labor with capital, $k_t$, to produce the final output according to the standard neoclassical function,

$$y_t = k_t^{\alpha} h_t^{1-\alpha} \tag{13}$$

Given that $h_t = 1$, the wage rate (labor income), $w_t$, and returns to capital, $r_t^k$, can be derived from the maximization problem of the firm as,

$$w_t = (1-\alpha)k_t^{\alpha} \tag{14}$$

$$r_t^k = \alpha k_t^{\alpha-1} \tag{15}$$

[23] We follow Cetorelli and Peretto (2012) by setting the discount factor to 1 and by using a power function to streamline the exposition. We reach similar conclusions with a discount factor less than 1 and a more standard function.

### 4.2. The entrepreneurs and the financial market

The young agents in the economy are also the entrepreneurs. They borrow from the financial market, convert their loans into capital and then supply this capital to a competitive firm. The financial market consists of a finite and constant number of domestic and foreign/global banks ($n^d$ domestic and $n^f$ foreign) so that there is no entry or exit. Hereafter, we refer to the latter as foreign banks to simplify the exposition, although, it should be noted that foreign banks operate/lend globally in our model. In channeling funds to the entrepreneurs, both types of banks face frictions. Specifically, a unit of credit can be converted to a unit of capital with probability $\phi$. The conversion is unsuccessful with probability $1-\phi$ and the banks cannot recover any of their loans. This credit shock is *i.i.d.* across the entrepreneurs so that $k_{jt} = \varepsilon_j l_{jt}$, where $k_{jt}$, $\varepsilon_j$ and $l_{jt}$ represent the amount of capital, the idiosyncratic credit shock, and the amount of loans for entrepreneur $j$. The firms are indifferent to domestic and foreign bank loans as long as they face the same lending rate and capital is divisible so that both types of banks lend to the entire population and diversify the entrepreneur-specific credit risk. It is important to note here that the parameter $\phi$ is analogous to the borrower balance sheet strength in the empirical section. If borrowers have stronger balance sheets, they are less likely to default on their loans and $\phi$ is high.

We proceed by describing the banks' optimization problem and explaining how the two types of banks are different. At this point, however, we should mention that the banks in the economy are Cournot competitors. Each bank (domestic and foreign), therefore, simultaneously chooses its amount of loans, and when it does, it

knows the total amount of lending by the other banks. We choose to use Cournot competition because it allows us to consider the entire spectrum of competitive practices in a straightforward way; by changing the number of banks from 1 to $\infty$, we can capture any degree of competition from monopoly to perfect competition.

#### 4.2.1. Domestic banks

Domestic banks are owned by the domestic savers, i.e., generation $t-1$ young agents (generation $t$ old agents), and the savings finance the capital expenditure of generation $t$ young agents (the entrepreneurs). The bank owners transfer their ownership to the next generation young agents when they die and they maximize next period's profits. Here, we assume that the bank owners collect banking profits and that their return is represented by both the return on equity (profits plus the change in the price of equity) and the deposit rate as there is perfect arbitrage between the two. Let $n^e$ and $l^d_{ijt}$ denote the number of entrepreneurs and domestic bank $i$'s loans to entrepreneur $j$, then the profit maximization problem of bank $i$ is given by,

$$\max_{l^d_{ijt}} \sum_{j=1}^{n^e} (\phi \alpha k_t^{\alpha-1} l^d_{ijt} - r^d_t l^d_{ijt}) \; s.t \tag{16}$$

$$k_t = \phi(l^d_t + l^f_t) \tag{17}$$

$$r^d_t = l^d_t/(w_t - l^d_t) \tag{18}$$

where $l^d_t$ and $l^f_t$ represent the total amount of domestic and foreign bank lending, respectively, and the total capital stock in the economy is given by Eq. (17). Solving the problem and aggregating over the entrepreneurs yields the following optimality condition:

$$r^k_t = \frac{1}{\phi}\left[r^d_t + \left(\frac{\partial r^d_t}{\partial l^d_t} - \phi \frac{\partial r^k_t}{\partial l_t}\right) l^d_{it}\right] \tag{19}$$

where $l^d_{it} = \sum_{j=1}^{n^e} l^d_{ijt}$ and $l_t = l^d_t + l^f_t$.[24] According to Eq. (19), the markup that domestic banks apply on their loans depends on the probability of success, $\phi$, and the effect of their loans on the deposit rate and the aggregate returns to capital. This wedge between the lending and the deposit rate increases when there is a higher probability of default and when bank $i$'s loans substantially increase the deposit rate and decrease the returns to capital, respectively.

#### 4.2.2. Foreign banks

Foreign banks obtain all of their funding from outside of the borrowing country and similarly use these funds to finance entrepreneurs' capital expenditures. Although foreign/global banks are also funded locally, allowing foreign banks to accept and compete for domestic deposits considerably confounds the analysis. To make the model more tractable, we thus assume that the foreign banks raise all of their funding externally.[25]

Each foreign bank lends globally and has positions in $n^c$ countries. In choosing country-specific markups, foreign banks consider the other banks' loans in the recipient country and their loans in other countries. Let $l^f_{ijmt}$ and $r^f_{it}$ denote foreign bank $i$'s loans to entrepreneur $j$ in country $m$ and its funding rate, respectively, then its profits, $\pi^f_{it}$, can be represented by,

$$\pi^f_{it} = \sum_{m=1}^{n^c}\sum_{j=1}^{n^e_m} (\phi_m \alpha k_{mt}^{\alpha-1} l^f_{ijmt} - r^f_{it} l^f_{ijmt}) \tag{20}$$

where $m$ indexes the countries and $n^e_m$ denotes the number of entrepreneurs in country $m$. In maximizing profits, foreign banks face constraints that are similar to those faced by domestic banks. As in Eq. (17) the amount of capital in country $m$ is the sum of total foreign and domestic bank loans ($l^d_{mt}$ and $l^f_{mt}$) that are successfully converted to capital so that,

$$k_{mt} = \phi_m(l^d_{mt} + l^f_{mt}) \tag{21}$$

Unlike Eq. (18), however, the funding costs of foreign banks do not directly depend on the amount of domestic savings. These banks obtain funding from a transnational capital market where borrowing rates depend on financial leverage:

$$r^f_{it} = r^w_t f\left(\sum_{m=1}^{n^c}\sum_{j=1}^{n^e_m} l^f_{ijmt} \Big/ \sum_{m=1}^{n^c}\sum_{j=1}^{n^e_m} \phi_m \alpha k_{mt}^{\alpha-1} l^f_{ijmt}\right) \tag{22}$$

where $r^w_t$ is a global, risk free rate. In the literature, the wedge between $r^f_t$ and $r^w_t$ is usually generated by an idiosyncratic net worth shock that can cause banks to default.[26] To simplify the analysis, we assume that the borrowing premium function $f(\cdot)$ is linear in leverage.[27]

The formulation in Eq. (22) allows for a realistic representation of international shock transmission. Specifically, a shock to country $m$'s economy affects the other economies as well and since the profit function is separable and capital cannot be transferred across countries, the transmission in our model operates through foreign banks' funding rates. Foreign bank $i$'s profit maximization yields a participation condition in country $m$ (after aggregating over entrepreneurs):

$$r^k_{mt} = \frac{1}{\phi_m}\left[r^f_{it} + \left(\frac{\partial r^f_{it}}{\partial l^f_{mt}} - \phi \frac{\partial r^k_{mt}}{\partial l_{mt}}\right) l^f_{imt}\right] \tag{23}$$

### 4.3. Sensitivity to internal shocks

In this section, we derive the sensitivity of foreign banks' loans in a given country to the default probability $(1-\phi)$ of its borrowers. We approach this section from the perspective of a borrowing country. The returns to capital in Eqs. (19) and (23) are, thus, identical and the $m$ subscripts can be dropped. We further simplify notation by dropping the time subscript.

To derive the sensitivity to default probability, we begin by differentiating the optimality conditions in Eqs. (19) and (23) with respect to $l^d$, $l^f$ and $\phi$. In these equations, we impose symmetry across domestic and foreign banks so that $l^d = n^d l^d_i$, $l^f = n^f l^f_i$, $r^f_i = r^f$. The differentiations of Eqs. (19) and (23) yield the following two conditions, respectively:

$$d_1 \frac{dl^d}{d\phi} + d_2 \frac{dl^f}{d\phi} = d_3 \tag{24}$$

[24] To simplify notation, we omit the $d$ superscript from the derivative of the returns to capital on the right hand side since the derivatives with respect to domestic bank and total loans are identical. We do the same for foreign loans. Notice also that since the returns to capital expression is linear in entrepreneur-specific loans, the aggregation over the entrepreneurs is straightforward.

[25] We should note that it is possible to obtain similar conclusions when foreign banks accept local deposits. Under this formulation, internal factors become more important and the impact of competition on lending sensitivity increases.

[26] Since we do not attempt to close the model or draw quantitative inferences, the derivation of Eq. (22) is not critical to our analysis. One can, albeit, conceive a set of risk neutral global investors who pool their funds and lend to banks. These investors can be few in number and thus their consumption could be very small and negligible compared to total consumption.

[27] In models with credit frictions, borrowing spreads are usually derived from the optimization problem of the lender and the functional forms are often complicated (e.g. Bernanke et al., 1999). Here, we simplify the analysis by using a linear form.

$$f_1 \frac{dl^d}{d\phi} + f_2 \frac{dl^f}{d\phi} = f_3 \tag{25}$$

where the coefficients $d_1, d_2, d_3, f_1, f_2, f_3$ are given by,

$$d_1 = \left(1 + \frac{1}{n^d}\right)\left(\frac{\partial r^d}{\partial l^d} - \phi\frac{\partial r^k}{\partial l}\right) + \chi_1^d, \quad d_2 = \frac{\partial r^d}{\partial l^f} - \phi\frac{\partial r^k}{\partial l} + \chi_2^d,$$

$$d_3 = r^k + \frac{\partial r^k}{\partial \phi}\phi - \frac{\partial r^d}{\partial \phi} + \frac{\partial r^k}{\partial l}\frac{l^d}{n^d} + \chi_3^d,$$

$$f_1 = \frac{\partial r^f}{\partial l^d} - \phi\frac{\partial r^k}{\partial l} + \chi_1^f, \quad f_2 = \left(1 + \frac{1}{n^f}\right)\left(\frac{\partial r^f}{\partial l^f} - \phi\frac{\partial r^k}{\partial l}\right) + \chi_2^f,$$

$$f_3 = r^k + \frac{\partial r^k}{\partial \phi}\phi - \frac{\partial r^f}{\partial \phi} + \frac{\partial r^k}{\partial l}\frac{l^f}{n^f} + \chi_3^f,$$

and $\chi$ represents the second order terms in the expressions.[28] We assume that these second order terms are relatively small to simplify the exposition.

Before we proceed, it is convenient at this point to provide an interpretation of the coefficients above. These coefficients have symmetric implications for domestic and foreign banks' profits and loans. $f_3$ and $d_3$, both positive, measure the effect of $\phi$ on foreign and domestic banks' profits from a unit of loans, respectively. In response to an increase in $\phi$ (a decrease in the probability of default), the banks' returns increase not only because the higher percentage of successful investment projects increases the amount of capital and thus the returns from capital but also because the banks recover a higher share of their loans. On the cost of funding side, an increase in $\phi$ prompts a decrease in deposit rates since it affects wages and the amount of savings positively. A similar negative effect is observed for foreign banks since a higher value of $\phi$ decreases leverage by increasing revenues. The last term in the expressions for $f_3$ and $d_3$ represent the decrease in returns caused by additional lending. These negative effects are larger when $\phi$ is large and the number of banks is small. The latter observation is critical for our analysis of competition and it implies that as the number of banks increase, each bank has a smaller impact on the profitability of the project. Lending decisions in markets with different degrees of competition are therefore formulated under different circumstances.

The coefficients $d_1$ and $f_2$ capture the marginal impact of domestic and foreign banks' lending on their costs. Both coefficients are positive and as banks lend more, their costs increase for two reasons: they have to offer higher deposit rates to attract the necessary funding and their marginal returns from the project decrease with each additional unit of lending. These effects are stronger when the market is less competitive since with fewer banks additional loans have a more substantial effect on banks' funding costs and their returns from the project.

The off-diagonal coefficients $f_1$ and $d_2$ capture the marginal impacts of domestic and foreign bank lending on foreign and domestic banks' profits, respectively. The cross-bank transmission operates similarly through funding costs and marginal returns. As domestic bank loans increase, for example, foreign banks' returns from the project decrease, they become more leveraged and face higher funding costs ($f_1 > 0$). By contrast, when foreign bank loans increase, domestic banks funding costs (deposit rates) decrease since wages are higher. But domestic banks' returns similarly decrease. For reasonable values, the former effect dominates ($d_2 < 0$).[29]

We obtain the symmetric equilibrium by equating the returns from an additional unit of lending to the costs incurred as in Eqs. (24) and (25). The sensitivity of foreign bank lending to domestic default shocks can then be solved for from these equations as,

$$\frac{dl^f}{d\phi} = \frac{f_3 - f_1\frac{d_3}{d_1}}{f_2 - f_1\frac{d_2}{d_1}} \tag{26}$$

First, notice that if lending decisions of foreign and domestic banks were formed independently, the second terms in the numerator and the denominator would equal zero. The sensitivity of foreign lending to default shocks would then be higher, for example, if a decrease in default probability substantially increased the returns net of funding costs, (i.e. if $f_3$ was large), and the incremental amount of lending did not cause a large drop in the net marginal returns (i.e. if $f_2$ was small).

With a positive denominator, the second term in the numerator implies that the domestic banks' reaction to the default shock has a mitigating effect on foreign banks' sensitivity. If this effect is large enough, foreign bank lending and the strength of local balance sheets (represented by $\phi$) can even be negatively related. Domestic banks have a greater impact on foreign banks' default sensitivity when their lending has a large effect on foreign banks' funding costs and marginal returns from the project ($f_1$ is high), when the sensitivity of their net returns to default shocks is large relative to the sensitivity of their returns to the amount of lending ($d_3/d_1$ is high) and when foreign banks' effect on their marginal cost of lending (both in terms of returns and funding costs) is small compared to their effects on their own costs ($d_2/d_1$ is low).

To summarize, foreign banks become more sensitive to the strength of domestic balance sheets if their returns, net of funding costs, are more sensitive to the probability of default and less sensitive to the additional amount of lending compared to domestic banks. In other words, if foreign banks have more to gain and less to lose when there is a positive balance sheet shock, their response is larger in magnitude (opposite conclusions are drawn for an adverse shock). This model response depends on the market share of domestic banks. For example, if domestic banks also expect a substantial increase in profits after a drop in default probability, and if their loans constitute a large share of the market, the sensitivity of foreign banks would be smaller. The reason is that an increase in domestic bank loans, combined with their large share, would cause the economy to reach diminishing returns quickly and hinder foreign bank lending.

To understand the relationship between competition and foreign bank lending, we separately consider the effects of $n^f$ and $n^d$. Lower $n^f$, or less competition amongst foreign banks, implies a smaller $f_3$ and a larger $f_2$ and a lower sensitivity to borrower balance sheets. The reason is that when foreign banks are smaller in number, and larger in size, their loans have a bigger impact on the returns to capital and their cost of funding. Thus any positive impact of a drop in default probability, for example, would erode away faster when there are a few large foreign banks. Conversely, a lower $n^d$ (low $d_3$ and a high $d_1$) would imply higher foreign sensitivity. The mechanism is similar. Domestic banks, when small in number, do not increase their loans significantly when default probability is lower since they face diminishing returns and high funding costs more quickly. This allows foreign banks to extend a

[28] $\chi_1^d = -\frac{l^d}{n^d}\left(\frac{\partial^2 r^d}{(\partial l^d)^2} - \frac{\partial^2 r^k}{\partial l^2}\right)$, $\chi_2^d = -\frac{l^d}{n^d}\left(\frac{\partial^2 r^d}{\partial l^d \partial l^f} - \frac{\partial^2 r^k}{\partial l^2}\right)$,

$\chi_3^d = \frac{l^d}{n^d}\left(\frac{\partial^2 r^d}{\partial l^d \partial \varphi} - \frac{\partial^2 r^k}{\partial l \partial \varphi}\right)$

$\chi_1^f = -\frac{l^f}{n^f}\left(\frac{\partial^2 r^f}{\partial l^f \partial l^d} - \frac{\partial^2 r^k}{\partial l^2}\right)$, $\chi_2^f = -\frac{l^f}{n^f}\left(\frac{\partial^2 r^f}{(\partial l^f)^2} - \frac{\partial^2 r^k}{\partial l^2}\right)$,

$\chi_3^f = \frac{l^f}{n^f}\left(\frac{\partial^2 r^f}{\partial l^f \partial \varphi} - \frac{\partial^2 r^k}{\partial l \partial \varphi}\right)$

[29] $d_2$ is negative if $(r^d)^2 > l^d/(l^d + l^f)$. This condition holds for any positive value of deposit rates and loans.

larger amount of loans. Overall, the effect of competition on foreign lending is not straightforward and it depends asymmetrically on the level of competition amongst foreign and domestic banks.

### 4.4. Sensitivity to external shocks

We proceed by measuring the sensitivity of foreign lending to two types of external shocks: An exogenous change in foreign interest rates, $r^f$, and a change in the default probability of another country. The former can be interpreted as a global liquidity shock (or a change in $r^w$) that makes it easier or harder for global banks to raise loanable funds. In response to the latter shock, investment becomes more (less) profitable in another country and foreign banks increase (decrease) their lending in a given country even if the strength of its balance sheets remains unchanged.

Differentiating Eqs. (19) and (23) with respect to $l^d$, $l^f$ and $r^f$, and solving for the sensitivity of foreign lending yields the following expression:

$$\frac{dl^f}{dr^f} = -\left[1 \Big/ \left(f_2 - f_1 \frac{d_2}{d_1}\right)\right] \tag{27}$$

where $d_1, d_2, f_1$ and $f_2$ have the same definitions. Notice first that an increase in foreign interest rates, as expected, prompts a decrease in lending. Since foreign interest rates are not directly related to the returns from the project, the size of the sensitivity coefficient depends on how much the change in lending affects profits. For example, if the negative lending response to a positive interest rate shock generates a substantial increase (decrease) in the foreign banks' returns (costs), or if $f_2$ is large, then its amplitude would be smaller. The magnitude of the sensitivity, similarly, depends negatively on the effect of domestic banks on foreign bank profitability ($f_1$) and the relative impact of foreign banks on the domestic banks' marginal cost of lending (the $d_2/d_1$ ratio).

When we investigate the effects of a default shock in a different country, we find a similar expression for the sensitivity to external shocks,

$$\frac{dl^f}{d\phi_m} = -\left[f_4 \Big/ \left(f_2 - f_1 \frac{d_2}{d_1}\right)\right] \tag{28}$$

where $f_4 = \frac{\partial r^f}{\partial \phi_m}$ and country $m$ is any country except the baseline domestic country in our analysis. Since $f_4 < 0$, the sensitivity coefficient is positive. Therefore, if there is an increase in country $m$'s default probability (a decrease in $\phi_m$), for example, $r^f$ would increase and lending in every country, including the baseline domestic country, would decrease. For both types of shocks, the degree of competition amongst foreign banks and domestic banks is similarly related negatively and positively to the lending sensitivity in Eq. (28), respectively. In particular, as foreign banks become less competitive (as $n^f$ decreases) their lending becomes less sensitive to external shocks.

Comparing Eqs. (27) and (28) with Eq. (26), we observe that the disparity between the sensitivity to internal and external shocks depends on the shocks' relative impact on the profitability of investment (the numerator of Eq. (26)) and external funding costs (the numerators of (26) and (28)). For example, if a default shock increases the foreign banks' net returns much more than an external funding shock (a unit change for the interest rate shock), then foreign banks are more sensitive to internal shocks. While a decrease in $n^f$ mitigates the disparity by causing a larger drop in marginal profits, a decrease in $n^d$ reinforces it by decreasing the impact of domestic banks on foreign bank profits. The magnitude of the disparity also depends on the denominator of the three expressions. In particular, the disparity is larger when foreign and domestic bank lending responses do not have a large effect on the profits of foreign banks. This is, similarly, consistent with having a large number of foreign banks.

The sensitivity expressions also reveal a negative relationship between the share of domestic lending and the sensitivity to both internal and external shocks. If domestic banks have a large share, their responses have a larger impact on both the returns and the costs of foreign banks ($f_1$ is higher). This, in turn, decreases the sensitivity of foreign bank lending.

## 5. Conclusion

In this paper, we uncover an empirical disparity between the external and internal determinants of the international flow of loanable funds. By using cross-country data, we find that factors determined outside of a country are more important determinants of the foreign/global bank loans it receives. This relationship, though, is only observed at the quarterly frequency and it is mostly generated during the post 2008–09 crisis period. We additionally find that foreign loans are more stable when banks are more competitive and there is a higher foreign bank presence in the borrowing countries. Investigating the theoretical mechanisms that may explain these empirical findings, we find that the disparity between the sensitivities to internal and external shocks depends on the shocks' relative impact on the profits of foreign and domestic banks. If foreign banks have more to gain and less to lose from a positive internal shock compared to domestic banks, for example, internal factors become a more determinant of foreign loans. These loans are more stable and thus less sensitive to both types of shocks if foreign banks are less competitive and they have a higher share in the lending market. The theoretical results, especially when compared with our empirical findings, suggest that the effects of competition and foreign bank presence on the stability of funding are not independent from each other and a more nuanced approach is warranted.

To identify the impact of external factors on global bank lending, we computed the deviations of country specific funding costs from sample averages. This methodology does not allow us to consider transnational funding cost variables, such as the Intercontinental Exchange London Interbank Offered Rate that does not correspond to a specific borrowing or lending country, since these measures would be identical for every lending country. Given that global banks raise a significant amount of loanable funds from transnational financial markets, our results underestimate the impact of external factors on global banks' lending. It would be informative to measure the significance of this channel by modifying our analysis to incorporate the impact of transnational markets.

There are two other directions in which our analysis could be expanded. Since bank loans are more directly related to economic activity and the strength of borrower balance sheets and since they constitute the largest share of global banks' assets, we used data on global banks' cross-country loans in our analysis. To make broader predictions for financial stability, one could expand our analysis to cover total global bank assets and examine how these holdings depend on internal and external shocks. Another way to draw more detailed inferences would be to use bank-level data and replicate our estimations. This analysis could help in determining the type of global banks that provide stable funding for countries (e.g. sectors they lend in, their sources of funding, capital structure, ownership type) and in designing policies to attract and promote these banks.

## Appendix A. Data

Table A.1. Data sources and definitions.

| Variables | Source | Description |
|---|---|---|
| Bilateral loans | BIS | Consolidated, immediate borrower basis, claims by bank nationality. The statistics track consolidated foreign claims of banks headquartered in individual reporting countries. The data are from the creditors' perspective and include the exposures of foreign offices under banks' control. Data are for end-of-quarter and they are expressed in millions of the U.S. dollars. Claim amounts are allocated to the country of residence of the immediate borrower. Claims of domestic banks are those with a head office in the respective reporting country. Banks' total foreign claims on borrowers in a particular country are broken down into international claims and local claims in local currency on the country. International claims are comprised of cross-border claims in all currencies booked by all offices worldwide plus non-local currency claims on residents of the borrowing country booked by banks' foreign affiliates located in the country. Local claims in local currency are claims on residents of the borrowing country booked by the foreign affiliates in the country in the domestic currency of this country |
| Real gross domestic product | FRED | Gross Domestic Product by Expenditure in Constant Prices. Quarterly, seasonally adjusted index, 2010 = 1 |
| Unemployment rate | FRED | Harmonized unemployment rate. All Persons, seasonally adjusted. We used the total registered unemployment rate for Switzerland since the harmonized unemployment rate data were only available at the annual frequency prior to 2010 |
| 24-h interest rate | FRED | Immediate Rates: Less than 24 Hours: Call Money/Interbank Rate |
| 3-month interest rate | FRED | 3-Month or 90-day Rates and Yields: Interbank Rates. Either the three month interbank offer rate attaching to loans given and taken amongst banks for any excess or shortage of liquidity over several months or the rate associated with Treasury bills, Certificates of Deposit or comparable instruments, each of three month maturity |
| Euro rate | FRED | 3-Month, average lenders' rates supplied by a sample of the 57 most active banks trading in euros. Calculated on a 360 day basis, it is released at 11.00 a.m. providing at least 50% of banks in the sample have submitted data. The average is calculated after elimination of 15% of the extreme values and expressed to 3 decimal places |
| Deposit rate | FRED, ECB, IFS, central banks | *Austria, Belgium, Switzerland, Germany, Denmark France, Italy, Netherlands, Portugal*: MFI deposit rates, euro deposits with agreed maturity. Non-financial corporations, source ECB. *Spain*: Tipos interés (medio ponderado). Saldos vivos. ENTIDADES DE DEPOSITO. Crédito a las sociedades no financieras, source: Banco de Espana. *Japan*: Deposit interest rate is the rate paid by commercial or similar banks for demand, time, or savings deposits, source: IFS. *United Kingdom*: Quarterly average of sterling certificates of deposit interest rate, 3 months, mean offer/bid, source: Bank of England. *Sweden*: Banks' deposit rates, period ending stock, percentage, nonfinancial corp, source: Riksbank. *United States*: 3-Month Certificate of Deposit: Secondary Market Rate |
| Local bad loans | FRED | Ratio of defaulting loans (payments of interest and principal past due by 90 days or more) to total gross loans (total value of loan portfolio). The loan amount recorded as nonperforming includes the gross value of the loan as recorded on the balance sheet, not just the amount that is overdue |
| Return on Equity | FRED | Commercial banks' net income to yearly averaged equity. |
| Net interest margin | FRED | Accounting value of bank's net interest revenue as a share of its average interest-bearing (total earning) assets |
| Cost to income ratio | FRED | Operating expenses of a bank as a share of sum of net-interest revenue and other operating income |
| Liquid assets to deposits and short term funding | FRED | The ratio of the value of liquid assets (easily converted to cash) to short-term funding plus total deposits. Liquid assets include cash and due from banks, trading securities and at fair value through income, loans and advances to banks, reverse repos and cash collaterals. Deposits and short term funding includes total customer deposits (current, savings and term) and short term borrowing (money market instruments, CDs and other deposits) |
| Regulatory capital to risk-weighted assets | FRED | The capital adequacy of deposit takers. It is a ratio of total regulatory capital to its held assets, weighted according to risk of those assets. (International Monetary Fund, Global Financial Stability Report) |

**Appendix A** (*continued*)

| Variables | Source | Description |
|---|---|---|
| 3 and 5 bank asset concentration ratios | | Assets of the three and five largest banks as a share of total commercial banking assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax, discontinued operations and other assets |
| Lerner index | FRED | A measure of market power in the banking market. It compares output pricing and marginal costs (that is, markup). An increase in the Lerner index indicates a deterioration of the competitive conduct of financial intermediaries |
| Foreign bank share | FRED | Percentage of non-resident, foreign bank loans to the GDP ratio. A foreign bank is a bank where 50% or more of its shares are owned by foreigners |

*Note:* FRED: Federal Reserve Bank of St. Louis, Federal Reserve Economic Data database. IFS: International Monetary Fund, International Financial Statistics database. BIS: Bank of International Settlements. A more detailed description of the bilateral lending data is available at: http://stats.bis.org/bis-stats-tool/org.bis.stats.ui.StatsApplication/StatsApplication.html.

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