Spillovers of prudential policy across borders: evidence for Portugal

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Abstract
When a (macro-)prudential authority implements tools available within its toolkit, its primary concern is with the domestic financial stability, independently of the domestic or foreign origin of the risks. However, an important aspect that is often neglected is that these decisions may have (positive or negative) cross-border spillovers. In this article we summarize the results for Portugal of a joint international research project involving central banks worldwide, to study cross-border effects of bank regulation using bank-level data. We confirm that credit developments in Portugal are affected by foreign bank regulation. This effect depends on the type of regulation and on the channel of transmission. We also show that the cross-border effects of capital requirements work differently through branches and subsidiaries of foreign banks operating in Portugal. (JEL: F42, G21, G28)

Introduction

The regulation of the financial system shapes its activity. For instance, tightening capital requirements will possibly constrain credit supply in the short run, even if the overall impact on financial stability and economic growth is positive (Cerutti *et al.* (2017), Dagher and Tong (2016), Gersbach. and Rochet (2017)). When a micro or macro-prudential authority decides to implement such a measure, it usually has at the core of its concerns the domestic financial system. However, it is not unlikely that prudential measures may have impacts that go beyond domestic borders, affecting credit growth elsewhere (Ayar and Wieladek 2014).

This article summarizes the main findings for Portugal of a joint research project involving central banks worldwide, with the goal of documenting cross-border spillovers of prudential regulation.[1] The International Banking

1. This article summarizes some of the main findings of Bonfim and Costa (2017).

Research Network (IBRN) involves researchers from central banks around the world, engaged in using proprietary confidential data available at each central bank to address a common research question in international banking, using a common methodological framework.[2] The most recent project evaluates how prudential policies generate cross-border spillovers.

To undertake this challenge, two approaches could be considered. On the one hand, it is possible to evaluate the impact of changes in domestic bank regulation on lending in other countries. On the other hand, we can examine the impact of changes in foreign regulation on lending in Portugal. In this article, we focus on the latter for two main reasons. First, there were not many changes in prudential regulation in Portugal during the last decades that could have had significant effects abroad. Second, from a practical view point, it is much harder to collect granular data to examine the outward influence of domestic prudential regulation than the opposite.

The Portuguese banking system provides an interesting setting to analyze the cross-border spillovers of prudential regulation. Domestic banks have important international activities, thus being exposed to foreign regulation through their branches and subsidiaries abroad. Furthermore, foreign banks have a meaningful (and increasing) presence in the Portuguese banking system. It is thus important to understand how foreign bank regulation can affect bank lending in Portugal. This is an increasingly relevant issue for policymakers, most notably when considering the large number of macroprudential policy measures being adopted worldwide.

Foreign banking regulation may have two opposing effects in domestic credit. On the one hand, we could expect that there are cross-border complementary effects arising from regulation: a tightening in foreign regulation targeted at constraining lending in the home country may also lead to less lending in other countries. On the other hand, there may be cross-border substitution effects: when facing a tightening in foreign regulation, banks may actually increase lending in other countries to diversify their exposures and to maximize profitability.

To analyze the effects of foreign regulation on domestic credit we consider two possible channels. First we analyze the effect of foreign regulation on the credit granted in Portugal by Portuguese banks with activity abroad. Second we analyze the influence of foreign regulation on the growth of credit granted in Portugal by the foreign banks operating in the country.

In this last case we zoom in on the cross-border transmission of regulation and ask whether the regulation implemented in the home countries of foreign banks operating in Portugal has different effects on the credit granted in Portugal through foreign branches and subsidiaries. This distinction is relevant if we consider the differences in the legal form of these two types

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2. For further details, please visit https://www.newyorkfed.org/ibrn.

of institutions: whereas branches are legally part of the parent foreign bank, subsidiaries are legally independent entities and might be allowed to fail on their own. This distinction has important regulatory consequences. For instance, deposits held at subsidiaries are guaranteed by the host country, while those of branches are guaranteed by the home country. Furthermore, and perhaps more relevant for the purposes of our study, branches of European Union banks are exempt from capital requirements in the host country.

This paper is organized as follows. First, we describe the international linkages of the banks located in Portugal. Next, we discuss our empirical approach. We also describe the data used. We then present the main results. We then explore in more detail possible distinctions between branches and subsidiaries in the cross-border spillovers of prudential policy. Finally, we present a few concluding remarks.

An overview of the international linkages of the Portuguese banking system

In the period under analysis credit granted in Portugal witnessed strong movements. While in the mid-2000s credit was expanding quickly, it started to decelerate in 2008-09 during the global financial crisis and has been declining since the beginning of the euro area sovereign debt crisis and the Economic and Financial Assistance Programme to Portugal. In this period, the behavior of domestic and foreign banks operating in Portugal has not always been alike (Figure 1). While in the years 2010-11 domestic institutions started to reduce credit, foreign banks continued to expand credit granted in Portugal (Costa and Farinha 2011). This heterogeneity was essentially explained by the increase in funding difficulties and the need to deleverage of domestic banks. However, in the most recent years, foreign banks have also cut their activity in Portugal. Nevertheless, their market share in the credit market remained around 25 per cent, which is slightly higher than what was observed before the crisis. The recent decline in activity by foreign banks was mostly determined by branches (Figure 2). The weight of credit granted by foreign subsidiaries has been increasing since 2010. On average, between 2006 and 2014, credit granted by subsidiaries represents around 15 per cent of total credit and almost 70 per cent of credit granted by foreign banks.

The Portuguese banking system is highly concentrated. The five largest banking groups accounted for around 75 per cent of bank credit to non-financial residents in Portugal in the last quarter of 2014. One of these five groups is part of a large foreign banking group. The rest of the Portuguese banking system comprises many small and medium-sized banks. Most of these banks are small scale universal banks, competing directly with the five largest banking groups. A few of them have specialized business models,
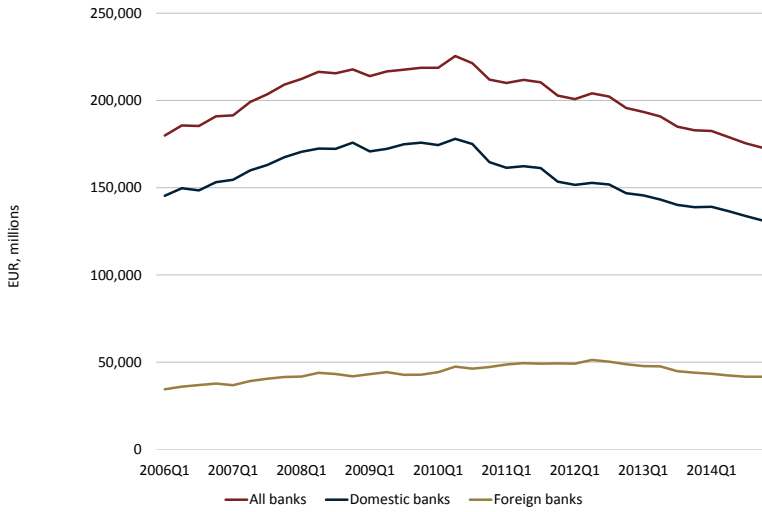
FIGURE 1: Credit granted by domestic and foreign banks in Portugal
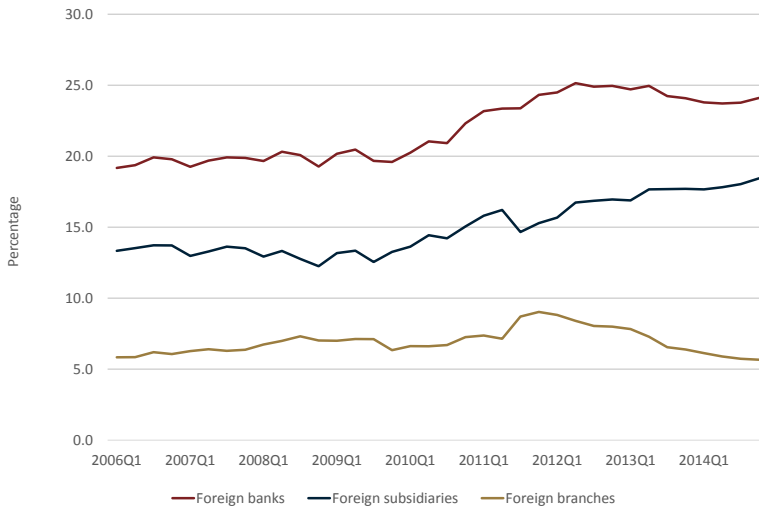Source: Banco de Portugal.

FIGURE 2: Credit granted by foreign banks in Portugal as a percentage of total credit
Source: Banco de Portugal.

offering only specific products such as consumer loans or asset management services.

By ownership nationality, Spanish banks dominate the market with a weight on the total credit granted by foreign banks of more than 65 per cent over the period under analysis. The other countries with a non-negligible presence in the Portuguese credit market are the United Kingdom, Germany and France (Figure 3).
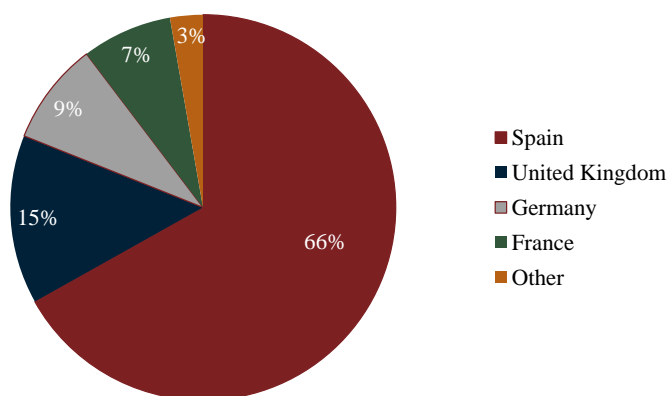

FIGURE 3: Distribution of the credit granted in Portugal by foreign banks, by country of the parent bank, over the period 2006-14

Source: Banco de Portugal.

Spain also has a dominant weight in the international activity of Portuguese banks, accounting for around 30 per cent of the total foreign exposure through affiliates over the period 2006-14 (Figure 4). Additionally, domestic banks were, during our sample period, significantly exposed to Poland and to a lesser extent to Greece, France, United States and some emerging market economies, such as Brazil, Angola and Mozambique. The activity of the Portuguese banks in non-European countries has increased during the crisis, being responsible for the increase in total exposures, while the activity in Europe remained broadly stable (Figure 5).

All this evidence shows that the Portuguese banking system has important international linkages, both through the exposures that Portuguese banks have abroad and through the operations of foreign banks in Portugal.
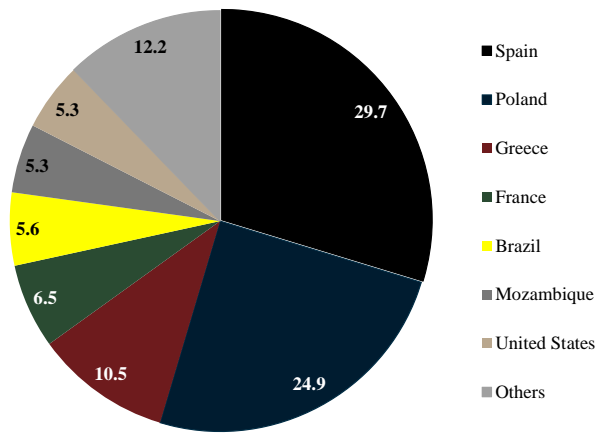
FIGURE 4: Distribution of the foreign exposures of the Portuguese banks over the period 2006-2014

Source: Banco de Portugal.
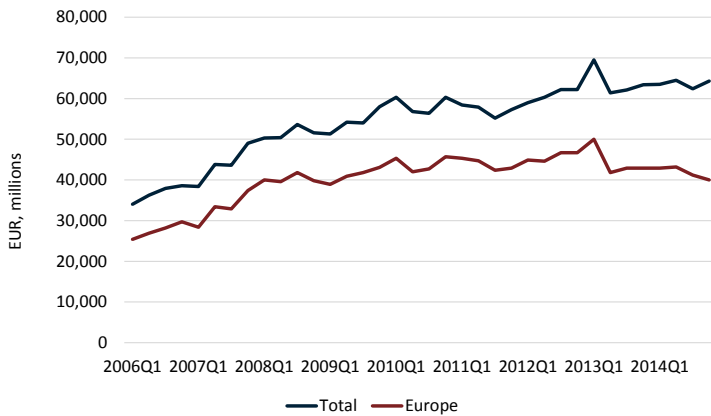
FIGURE 5: Exposures of the Portuguese banks abroad

Note: Claims plus liabilities of the branches and subsidiaries of the Portuguese banks abroad and on an immediate borrower basis.
Source: Banco de Portugal.

Empirical approach

The empirical approach we use to analyze the inward transmission of foreign regulation on loans granted by banks in Portugal is described in detail in Buch and Goldberg (2017) and includes two different specifications. In

the first specification (specification A), the objective is to understand how foreign regulation affects the evolution of credit granted by domestic banks in Portugal. The channel in focus in this specification comes from the exposures that domestic banks have abroad. In the second specification (specification B), the goal is to understand how foreign regulation affects the growth of credit granted in Portugal by branches and subsidiaries of foreign banks.

In specification A we want to evaluate the impact of the prudential regulation implemented in the countries where the Portuguese banks have branches and subsidiaries. Thus, we construct for each Portuguese bank and prudential instrument, an index ($ExpP_{b,t}$) for the change of the host countries' regulation ($HostP_{i,t}$), weighted by the bank's foreign exposures to the host countries ($\theta_{b,i,t-1}$). In the calculation of weights we use data on the previous 4 quarters.

$$ExpP_{b,t} = \sum_i HostP_{i,t}\theta_{b,i,t-1} \tag{1}$$

$$\theta_{b,i,t-1} = \frac{\sum_{t=t-4}^{t-1} exposure_{b,i,t}}{\sum_i \sum_{t=t-4}^{t-1} exposure_{b,i,t}} \tag{2}$$

The exposure of the domestic bank b to country i is measured by the claims plus liabilities of the branches and subsidiaries of that bank on country i, denominated in local currency (i.e in the currency of country i) and on an immediate borrower basis.

In the construction of these exposure-weighted prudential policy indexes only exposures to countries with data available in the prudential database could be considered. In our sample, this means we are taking into account 87% of the total foreign exposures of the Portuguese banks, through their affiliates abroad.

With specification B we are interested in evaluating the impact of the regulation adopted in the home country of each foreign bank with branches and subsidiaries in Portugal. Thus, in this case the regulation variables used in the regressions correspond to the indexes of the prudential database for the change in the prudential instruments in the countries of the parent banks ($HomeP_{j,t}$), without any weighting.

The following regressions are estimated:

Specification A: Exposure-weighted inward transmission of regulation

$$\triangle Y_{b,t} = \sum_{k=o}^{2} \alpha_{k+1} ExpP_{b,t-k} + \alpha_4 X_{b,t-1} +$$
$$\sum_{k=o}^{2} \beta_{k+1} ExpP_{b,t-k} X_{b,t-k} + f_b + f_t + \varepsilon_{b,t} \tag{3}$$

Specification B: Inward transmission of home prudential policy via affiliates

$$\triangle Y_{b,j,t} = \alpha_o + \sum_{k=o}^{2} \alpha_{k+1} HomeP_{j,t-k} + \alpha_4 X_{b,j,t-1} + \alpha_5 Z_{j,t}$$
$$+ \sum_{k=o}^{2} \beta_{k+1} HomeP_{j,t-k} X_{b,j,t-k} + f_b + f_t + \varepsilon_{b,j,t} \tag{4}$$

In both specifications A and B, our dependent variable is $\triangle Y$, which is defined as the quarterly change in credit granted by bank b to non-financial residents in Portugal in quarter t, measured in log percentage points. However, there are important differences in the way the two specifications are estimated. While in specification A the regressions are estimated only for domestic banks, in specification B the regressions are estimated for the full sample, including foreign and domestic banks (thus adding the subscript j to refer to the country of origin of the bank).

$X_{b,t-1}$ is the vector of bank control variables. Its interaction with the regulation variables ($ExpP_{b,t-k}$ and $HomeP_{j,t}$) captures the degree to which a bank is exposed to changes in regulation through *ex-ante* balance sheet composition and market access.

In both specifications the following bank balance sheet characteristics ($X_{b,t-1}$) are considered: the percentage of a bank's portfolio of assets that is illiquid ($IlliquidAssetsRatio_{b,t-1}$), the percentage of the bank's balance sheet financed with core deposits ($CoreDepositsRatio_{b,t-1}$), bank's capital to asset ratio ($CapitalRatio_{b,t-1}$), the percentage of the bank's net external intragroup funding relative to its total liabilities ($NetIntragroupFunding_{b,t-1}$), and the log of total assets ($LogTotalAssets_{b,t-1}$). In order to take into account the degree of the foreign exposure, specification A includes also as control variable the percentage of the assets plus liabilities of bank's affiliates abroad relative to total assets plus total liabilities ($InternationalActivity_{b,t-1}$). These variables are defined in detail in Appendix A. Both specifications include bank and time fixed effects. Additionally, in specification B, standard errors are clustered by country. In this specification, we also control for macroeconomic and financial conditions in the home country of foreign banks: $Z_{(j,t)}$ represents the economic and credit cycle variables for country j. In specification B, the regulation variables and the financial and business cycle variables are set to zero for domestic banks. This allows all the identification on the regulation and cycle variables to come from foreign banks. Domestic banks enter the regressions to provide more strength on the conclusions regarding the effect of bank characteristics on credit growth.

Data

We collect data on bank balance-sheet characteristics at solo basis from quarterly supervisory reports. Our analysis period begins in 2006Q1 and ends in 2014Q4. Before 2005 banks used a different accounting system and using a longer period would imply important breaks in some series, which are hard to address without compromising the quality of the data. Furthermore, the quality of analysis could also be compromised if many more years were included, as the beginning of that decade was dominated by a merger wave that substantially changed the landscape in the Portuguese financial system (for details, please see Barros *et al.* (2014)). During the analysis period, the structure of the Portuguese banking system was relatively stable. Furthermore, most of the changes in foreign regulation affecting Portuguese banks were implemented during the sample period.

All financial institutions are classified as domestic or foreign, depending on their ownership status. Foreign institutions are classified as branches or subsidiaries and there is information on the country of origin. Our dataset only includes monetary financial institutions (i.e., banks in their classic definition, as these are the only institutions authorized to receive deposits from the public). We exclude non-monetary financial institutions from the analysis because there is no information on their exposures to foreign countries. Furthermore, there are important differences in their funding models and in their regulation that would hamper the interpretation of the results.

All bank control variables are defined in detail in Appendix A. Table 1 summarizes these indicators for the full sample of banks operating in Portugal, as well as for domestic and foreign banks separately. Domestic banks are larger, better capitalized, less illiquid, rely more on core deposits and less on net external intragroup funding than foreign banks.

In order to have data on the international activity of the Portuguese banks, we merge the supervisory bank database with the bank level data underlying the International Banking Statistics reported to the BIS. This data was used on a consolidated basis (i.e. excluding intragroup positions) and on immediate borrower basis, and it refers to the local claims and liabilities of the branches and subsidiaries of the Portuguese banks. Additionally, we use bank-level data collected for the construction of the Euro Area Monetary Financial Statistics to obtain information on assets and liabilities against the banks of the same banking group located abroad. The use of these two data sources implied the exclusion of the Mutual Agricultural Credit Banks from the sample, as in these sources the data for this type of institutions is aggregated at a consolidated level. In any case, given that these institutions are devoted mainly to local activities and have a small weight on the total credit (around 3.75 per cent over the sample period), we believe that their inclusion in the sample would not be relevant for the purpose of this study.

	All banks (n=57)			Portuguese banks (n=25)			Foreign banks (n=32)		
Variable	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Dependent variable									
Domestic credit (ln change) (in %)	0.318	-0.169	15.34	0.380	-0.293	14.13	0.266	-0.0720	16.30
Independent variables									
Log Assets	7.278	7.088	1.952	7.805	7.538	2.090	6.831	6.881	1.705
Capital Ratio (in %)	6.459	5.116	12.77	8.580	6.517	15.30	4.660	3.436	9.799
Illiquid Assets Ratio (in %)	79.95	89.88	24.13	78.61	88.16	24.04	81.09	92.57	24.17
International Activity (in %)	-	-	-	2.429	0	4.075	-	-	-
Net intragroup funding (in %)	25.36	4.763	42.48	1.297	0	9.798	45.77	56.42	48.45
Core Deposits Ratio (in %)	16.22	10.34	18.30	25.29	22.59	20.72	8.522	2.386	11.22

TABLE 1. Summary Statistics on Bank Credit and Characteristics

Notes: This Table provides summary statistics for bank balance sheet and credit data. Data are observed quarterly from 2006Q1-2014Q4. Banking data are reported at the solo level. All variables defined in Appendix A.

We merge the bank database with the IBRN Prudential Instruments Database (described in Cerutti and Laeven (2017)) and with economic and financial cycle data (obtained, respectively, from BIS (2014) and Drehmann *et al.* (2011)). The IBRN Prudential Instruments Database includes quarterly information on the timing of tightening or loosening of a number of prudential tools in 64 countries over the period 2000-14. For each prudential tool, the database includes one index for its change, where a negative value (-1) corresponds to a loosening, a positive value (+1) to a tightening and zero signals that no change has occurred in the quarter. In this paper, the prudential tools considered are capital requirements, sectoral specific capital buffers (for instance, for real estate and consumption) and loan-to-value ratio limits.[3]

In the construction of the exposure-weighted prudential policy indexes, used in specification A, only exposures to countries with data available in the prudential database could be considered. In our sample, this means we are taking into account 85 per cent of the total foreign exposures of the Portuguese banks, through their affiliates abroad. We also had to delete from our sample all banks belonging to Angolan banking groups (which have a weight on the domestic credit lower than 0.05 per cent), given that for this country we do not have data on the prudential measures. The final dataset includes 57 banks (25 domestic and 32 foreign), which account on average over the sample period for 96 per cent of the credit granted by banks in Portugal.

Table 2 and Figure 6 report some descriptive statistics on the prudential policy variables. As shown in the last column of Table 2, around 4-5 per

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3. In Bonfim and Costa (2017) the analysis also includes reserve requirements and concentration ratios. These instruments changed less often in the countries where banks in Portugal have stronger linkages, so they are excluded from this article.

cent of all the observations in the sample of Portuguese banks (used in specification A) and around 2-5 per cent in the sample of foreign banks (used in specification B) are associated with changes in the prudential measures analyzed.[4] In the case of capital requirements and sectoral specific capital buffers, the changes in our sample refer mostly to tightening movements (for capital requirements, as explained in Cerutti and Laeven (2017), all changes refer to the implementation of Basel). By contrast, in the loan-to-value ratio, the most relevant changes refer to loosening decisions (Figure 6).

Specification A: Changes in the countries where Portuguese banks have affiliates
(mean values of the weighted indexes of the Portuguese banks)

Specification B: Changes in the home countries of foreign banks located in Portugal
(mean values of the indexes among foreign banks)
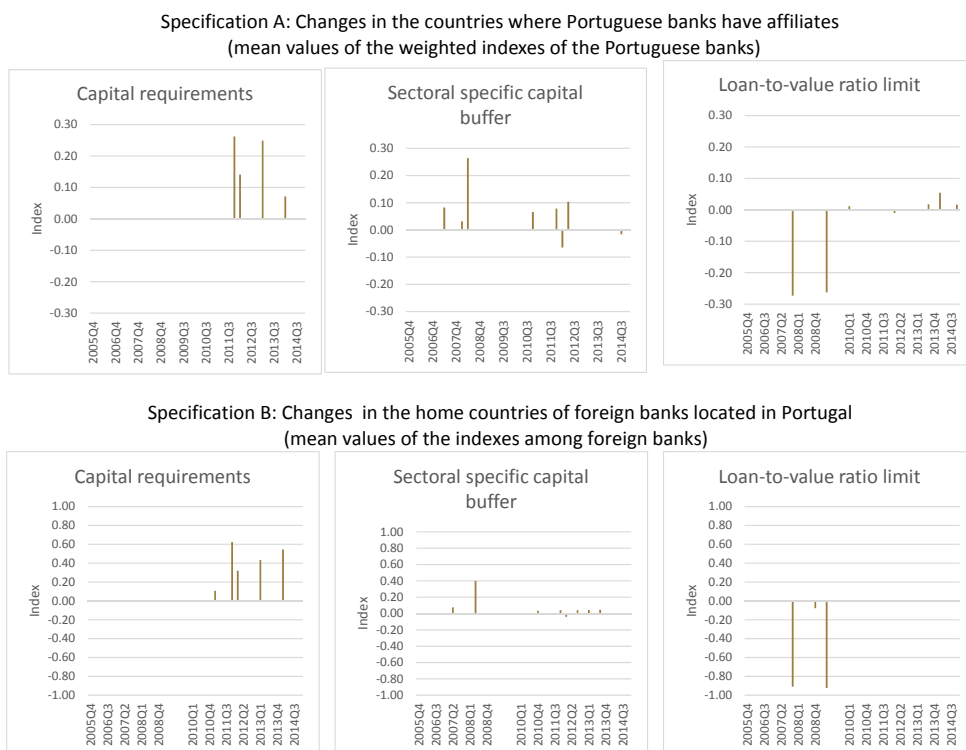
FIGURE 6: Changes in prudential tools

Source: IBRN and Banco de Portugal.

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4. The sample used in specification B includes both domestic and foreign banks, but the statistics for the incidence of regulation were calculated using only foreign banks. In fact, since we are interested in estimating the impact of foreign regulation, the regulation variable was set to zero for Portuguese banks in the regressions of specification B. This means regulation in Portugal is not explicitly included in the regressions, although its effects are embedded in the time fixed effects.

Specification A

Instrument	Base Data (Before Aggregating to Exposure-Weighted Measures)					Exposure-Weighted Observations
	# of Country-Time Changes	# of Country-Time Changes (Tightening)	# of Country-Time Changes (Loosening)	# of Bank-Time Changes	Proportion Base-MPP Nonzero on total observations	Proportion ExpP_t Nonzero on total observations
General capital requirements	30	30	0	55	0.003	0.035
Sector specific capital buffer	17	15	2	36	0.002	0.052
Loan-to-value ratio limits	18	11	7	36	0.002	0.049

Specification B

Instrument	# of Country-Time Changes	# of Country-Time Changes (Tightening)	# of Country-Time Changes (Loosening)	# of Bank-Time Changes	Proportion HomeP_t Nonzero on total observations
General capital requirements	15	15	0	48	0.050
Sector specific capital buffer	10	8	2	21	0.022
Loan-to-value ratio limits	3	0	3	23	0.024

TABLE 2. Summary Statistics on Changes in Prudential Instruments

Notes: These tables show summary statistics on the changes on general capital requirements, sector specific capital buffers and loan to value ratio limits. In the table for specification A, the data refers to changes in regulation in the countries where the branches and subsidiaries of the Portuguese banks are located over the period 2005q4-2014q4. In the table for specification B, the data refers to changes in regulation in the home countries of the foreign banks operating in Portugal over the period 2005q4-2014q4. Data on the prudential instruments come from the "Prudential Instruments Database" by Cerutti et al. (2015) and are on the quarter level. The number of changes in prudential instruments is reported on several dimensions, i.e. on the country-time level and on the bank-time level. The table also shows the share of prudential changes to total observations (i.e. the share of nonzero observations). In the first table, the column "Exposure weighted observations" is based on the underlying data on prudential changes in foreign countries (columns "base data"). The reported data is based on the regression sample.

Main results

In this section we discuss the results of our empirical estimations, trying to understand how foreign regulation affected the evolution of credit granted in Portugal. Table 3 presents the results of the estimation of equation (3). We consider contemporaneous effects and two lags for the regulation variable. In the first lines of the table we report the results for these three terms and in the bottom of the table the results for the sum of the three coefficients. Given space constraints, for the interactions of regulation with the bank control variables we report only the joint effect of these three coefficients, i.e., the results for sum of the interactions with the contemporaneous and lagged regulation. In order to have an idea of the impact of regulation when both the direct effect and the interactions effects are taken into account, at the bottom of the table

we also include the average marginal effects of changes in regulation. The magnitude of the marginal effects reflects the average impact (in percentage points) on the growth rate of credit of a simultaneous tightening in regulation in all countries where Portuguese banks have affiliates.

The columns report the results for each prudential tool individually, i.e., for the capital requirements, sector-specific capital buffer and for the loan-to-value ratio limits. By examining the lines of the table with the marginal effects, we can conclude that foreign regulation affects the evolution of loans granted domestically through the international exposures of domestic banks. The effect is statistically significant for the sector specific capital requirements and the loan-to-value ratio limits, but not for the general capital requirements.

Analyzing the statistical significance of the marginal effects allows us to establish that there are cross-border spillovers of regulation. However, it is also very important to understand in which direction do these spillovers go. Does a tightening in regulation abroad lead to more or less credit at home? We find that a tightening in the sector specific capital requirements yields an increase in the growth of loans granted by domestic banks in Portugal. This result suggests that Portuguese banks operating internationally divert their resources to internal markets when they face tougher sector specific capital requirements abroad. For the loan-to-value ratio the effect is the opposite: a tightening of this instrument abroad decreases credit growth domestically. For this instrument a tightening might imply a decline in the profitability of the affiliates (given that more risky borrowers for whom higher spreads are applied might be left out of the market), which can lead to a reduction in the domestic activity. It is also possible to argue that despite tighter loan-to-value limits banks still find it profitable to lend abroad, given that this instrument is usually tightened when credit and real estate markets are booming and hence (short-term) profitability might be very high. Assuming that resources are limited, this might imply a constraint in domestic credit. Cerutti and Laeven (2017) find that there is a positive correlation between credit growth and the decline of loan-to-value limits, thus supporting this hypothesis.

Though the signal of the effects of foreign regulation on the evolution of domestic credit is of primary interest, it is also relevant to understand exactly through which mechanisms these effects are transmitted across borders. Our specification allows us to do that through the analysis of the interaction terms. The substitution effects of foreign regulation leading to an increase in domestic credit growth, which work though sectoral capital buffers, are stronger for banks with more liquid assets and with lower core deposits ratio. In turn, the complementary effects arising from a tightening in the loan-to-value ratio are reinforced for smaller banks and for banks with more net external intragroup funding and a higher core deposits ratio. Banks' with a higher weight of their retail domestic activity, measured by core deposits ratio, thus seem to be more prone to contract domestic credit when facing tighter regulation on their foreign activity.

	(1)	(2)	(3)
	ExpP= Capital Requirements	ExpP= Sector-Specific Capital Buffer	ExpP= Loan To Value Ratio
ExpP_t	-58.08***	13.91	29.59
	(19.08)	(22.83)	(25.49)
ExpP_t-1	41.58	37.61	-156.3*
	(39.24)	(40.59)	(79.69)
ExpP_t-2	1.331	58.39**	-112.5**
	(21.62)	(27.30)	(47.77)
Log Total Assets_t-1	1.895	1.062	3.002
	(2.653)	(2.513)	(2.960)
Capital Ratio_t-1	0.0539	0.0768	0.0676
	(0.0534)	(0.0585)	(0.0625)
Illiquid Assets Ratio_t-1	0.0419	0.0543	0.0256
	(0.109)	(0.107)	(0.118)
International Activity_t-1	0.828**	0.347	0.763**
	(0.310)	(0.282)	(0.326)
Net intragroup funding_t-1	0.0955	0.0576	0.137**
	(0.0648)	(0.0683)	(0.0663)
Core Deposits Ratio_t-1	0.0768	0.108	0.0680
	(0.125)	(0.130)	(0.136)
Log Total Assets * ExpP	4.45***	-2.41	40.13***
	(11.2928)	(0.6192)	(5.0245)
Capital Ratio * ExpP	2.35***	-0.02	2.20
	(10.7245)	(0.0961)	(1.9921)
Illiquid Assets Ratio * ExpP	-0.48	-0.95**	-0.75
	(1.782)	(3.4517)	(1.1776)
International Activity* ExpP	1.41**	0.72	-0.92
	(3.9663)	(1.9943)	(1.1751)
Net intragroup funding * ExpP	0.48**	0.82	-3.44**
	(4.414)	(1.9257)	(3.1076)
Core Deposits Ratio * ExpP	-0.68***	-0.27***	-4.12**
	(7.725)	(9.2166)	(3.3567)
ExpP (ExpP_t+ExpP_t-1+ExpP_t-2)	-15.17	109.9069***	-239.2609*
F-Statistics	(0.0839)	(8.8012)	(4.2453)
P-Values	0.77	0.01	0.05
Average marginal effects of ExpP	-12.32	11.97*	-71.63**
Observations	703	703	703
Adjusted R-squared	0.04	0.02	0.03
Number of banks	25	25	25

TABLE 3. Inward Transmission of Policy through International Exposures of Domestic Banks

Notes: This table reports the effects of changes in regulation and firm characteristics and their interactions on log changes in domestic loans. The data are quarterly from 2006Q1 to 2014Q4 for a panel of domestic banks. Foreign exposure weighted regulation ExpP is calculated as the weighted average of changes in foreign regulation where the weights are assets and liabilities of the bank affiliates in the respective foreign country. For ExpP interaction effects, the reported coefficient is the sum of the contemporaneous term and two lags, with the corresponding F-statistics for joint significance in parentheses. For more details on the variables see Appendix A. Each column gives the result for the regulatory measure specified in the column headline. All specifications include time and bank fixed effects. Standard errors are not clustered. ***, **, and * indicate significance at the 1 per cent, 5 per cent, and 10 per cent level, respectively.

Table 4 presents the results of the estimation of equation (4), i.e. specification B. In this case, the goal is to understand how foreign regulation

affects credit granted in Portugal by branches and subsidiaries of foreign banks. As shown in equation (4), we consider contemporaneous effects and two lags for the foreign regulation variable. As in the previous table, the reported coefficients for interaction effects are the sum of the contemporaneous term and two lags. For the direct effects we report both the coefficients of the three HomeP terms (in the first lines of the table) and their sum (at the bottom of the table). The table also includes the average marginal effects of changes in regulation and their significance, calculated for all the foreign banks.

These results also suggest that changes in regulation abroad have an impact on the growth of credit granted in Portugal. In this case the marginal effects reported at the bottom of the table show that the effect comes from the capital requirements and the loan to value limits. While for the loan-to-value ratio a tightening abroad is associated with more credit growth in Portugal, for the general capital requirements we find the opposite.

To better understand these results, it is important to discuss our expectations about this transmission channel. When regulation is tightened in the home country of a given bank, this might affect the whole activity of the banking group, including its affiliates abroad, if the regulation is applied at the consolidated level. So, while in the previous specification domestic banks could to some extent substitute between foreign and domestic credit when regulation was tightened or loosened abroad, in this specification this substitution might be more likely to occur in the case of regulations that are not applied at the consolidated level. The results we obtain are in line with this reasoning. In fact, capital requirements are usually applied at the consolidated level, while limits to the loan-to-value ratio are most often applied at the local level, when specific risks are building up in the home country of the bank, where most of its activity is usually concentrated. To be more effective, these instruments are typically targeted to the vulnerabilities they want to address and thus do not cover the international activity of banks.

As before, our empirical strategy allows us to understand through which channels these mechanisms are working by exploring the interaction terms in the regressions. The negative effect of tighter capital requirements on credit growth in Portugal by foreign banks is mitigated when banks have less intra-group external net debt. Other indicators of banks' financial strength and business models are not statistically significant. Looking at the positive effect of a tightening in the loan-to-value ratio, we find that this effect is stronger when the affiliate becomes better capitalized and more liquid. This suggests that foreign banks with better financial standing substitute some of the credit granted abroad by domestic loans when lending requirements become tighter at home. Additionally, the substitution effect is stronger for the affiliates that rely more on intra-group funding and less on deposits from residents in the host country.

	(1)	(2)	(3)
	HomeP= Capital Requirements	HomeP= Sector-Specific Capital Buffer	HomeP= Loan To Value Ratio
HomeP_t	-10.19	13.78	82.47***
	(12.15)	(10.62)	(22.66)
HomeP_t-1	24.61*	34.93**	18.43***
	(11.28)	(13.15)	(3.501)
HomeP_t-2	-12.66**	31.46*	18.15**
	(5.555)	(15.82)	(6.553)
Log Total Assets_t-1	-1.300	-1.709	-1.514
	(1.557)	(1.581)	(1.558)
Capital Ratio_t-1	0.0835*	0.0798*	0.0753**
	(0.0374)	(0.0396)	(0.0329)
Illiquid Assets Ratio_t-1	-0.0577	-0.0436	-0.0739
	(0.0774)	(0.0744)	(0.0775)
Net intragroup funding_t-1	-0.0408	-0.0578	-0.0376
	(0.0448)	(0.0484)	(0.0410)
Core Deposits Ratio_t-1	0.0842	0.0922	0.0973*
	(0.0651)	(0.0643)	(0.0492)
Financial cycle (Home country)	-0.0405*	-0.0438	-0.0350
	(0.0209)	(0.0256)	(0.0209)
Business cycle (Home country)	1.375**	1.489**	1.246**
	(0.470)	(0.506)	(0.495)
Log Total Assets * HomeP	0.23	1.51	1.10
	(0.0124)	(0.7981)	(2.1151)
Capital Ratio * HomeP	-0.54	-0.91**	2.44***
	(1.2924)	(7.3717)	(28.9896)
Illiquid Assets Ratio * HomeP	0.16	-1.09***	-1.51***
	(0.7227)	(24.3021)	(17.74)
Net intragroup funding * HomeP	-0.37*	0.24*	0.31***
	(3.9579)	(4.8046)	(14.68)
Core Deposits Ratio * HomeP	-0.41	-0.43	-0.54***
	(1.6546)	(0.6513)	(87.823)
HomeP (HomeP_t+HomeP_t-1+HomeP_t-2)	1.75	80.17***	119.05***
F-Statistics	(0.0171)	(43.432)	(20.3492)
P-Values	0.90	0.00	0.00
Average marginal effects of HomeP	-7.1*	4.87	24.91***
Observations	1,619	1,619	1,619
Adjusted R-squared	0.046	0.046	0.052
Number of banks	57	57	57

TABLE 4. Inward Transmission of Policy via Affiliates of Foreign-Owned Banks

Notes: This table reports the effects of changes in regulation and firm characteristics and their interactions on log changes in domestic loans. The data are quarterly from 2006Q1 to 2013Q4. HomeP refers to the changes in regulation in the home (i.e. parent bank) country of foreign affiliates. For HomeP interaction effects the reported coefficient is the sum of the contemporaneous term and two lags with the corresponding F-statistics for joint significance in parentheses. For the Portuguese banks the regulation variables and the financial and business cycle variables are zero. For more details on the variables see Appendix A. Each column gives the result for the regulatory measure specified in the column headline. All specifications include time and bank fixed effects. Standard errors are clustered by country. ***, **, and * indicate significance at the 1 per cent, 5 per cent, and 10 per cent level, respectively.

The international results

As mentioned before, this article summarizes the results for Portugal obtained under an international collaborative project, hosted by the International Banking Research Network (IBRN). This network was launched in 2012 and involves researchers from central banks around the world, working on issues related to the role of international banks. The goal of the network is to overcome important data and research gaps identified during the global financial crisis. The use of micro-level data has proven to be of critical importance, in particular to look at cross-border linkages of individual banks. However, much of this data is confidential and cannot be publicly assessed or merged for a joint analysis of different countries, thereby undermining the possibility of having a broad picture of international financial linkages. To overcome this, the IBRN sets up country teams that work in parallel on the same topics. The network jointly defines a common research question, a common methodological approach and a similar data and research design. Each country team uses their own bank-level data to arrive at comparable cross-country evidence, which is then used to derive joint conclusions using a meta-data approach. This allows to overcome the limitations of data confidentiality, by arriving at comparable cross-country results that can be of high relevance to inform policy-making. The first IBRN project focused on the transmission of liquidity shocks through global banks and the joint results of the project are summarized in Buch and Goldberg (2015).

This article summarizes the results obtained for Portugal in the second IBRN project. The joint results are described in Buch and Goldberg (2017). The main conclusion that emerges from the analysis of all the country-specific results is that sometimes prudential instruments have cross-border effects. Still, the direction and magnitude of these spillovers varies significantly across instruments and across banks. Bank-specific financial ratios and business models have an influence on the way these cross-border spillovers affect bank lending. Across the board, the cross-border spillovers do not seem to be very large in magnitude, though the results refer to a period when the changes in prudential instruments were more subdued than what is foreseen in the future, given the ample macro-prudential toolkit that authorities can now use.

Cross-border spillovers through branches and subsidiaries

A bank might be present in a foreign country through two different legal forms: a branch or a subsidiary. A branch is not a legally autonomous entity and belongs directly to the parent bank. In turn, a subsidiary is a legally independent institution in the host country. In legal terms, it works in a very similar way to the domestic banks operating in that country, with the main difference being that its capital is held by a foreign bank. For an uninformed

customer the differences between a branch and a subsidiary would not be perceptible as the management of their operations and their relationships with customers have no reason to differ. However, important differences apply in regulatory terms due to legal nature of each institution. For instance, deposits held by customers in a branch are guaranteed by the deposit guarantee scheme of the home country, while for the subsidiary the responsibility lies entirely with the host country. More importantly for the purposes of our study, some prudential instruments are applied differently for branches and subsidiaries. Cerutti *et al.* (2007), Dell'Ariccia and Marquez (2010), Focarelli and Pozzolo (2005) and Goldberg and Saunders (1981) discuss in more detail some of the differences between branches and subsidiaries and the way banks choose to expand internationally, while Peek and Rosengren (1997, 2000) analyze the implications on the transmission of shocks.

The most relevant example in the European Union is perhaps the case of capital requirements: branches of EU banks are exempt from fulfilling capital requirements in the host country, but are directly subject to capital requirements in the home country. In this setting, the cross-border implications of regulations may be differentiated. While both branches and subsidiaries are affected by the capital requirements implemented in the home country, only subsidiaries are affected by changes in capital requirements in the host country. In contrast, loan-to-value ratios limits are usually applied directly to exposures in markets in which there are concerns regarding the buildup of risks in real estate markets. Thus, if the regulator applies this measure in the home country, the loans granted by home country affiliates abroad should not be directly affected.

Given these important differences, in this section we extend our previous analysis to understand how the cross-border transmission of prudential policy works through different types of foreign banks. More specifically, we look separately at the transmission through foreign branches and subsidiaries located in Portugal, as their legal form has implications for the way regulation is applied. In this analysis we will focus on the prudential tools for which we find evidence of transmission through foreign banks to the domestic economy: capital requirements and loan-to-value limits.

To analyze this, we adapt equation (4) and estimate the following regression:

Specification B1: Inward transmission of home prudential policy via branches and subsidiaries

$$\triangle Y_{b,j,t} = \alpha_0 + \sum_{k=o}^{2} \alpha_{k+1} HomeP_{j,t-k} Branch_{b,t}$$

$$+ \sum_{k=o}^{2} \alpha_{k+4} HomeP_{j,t-k} Subsidiary_{b,t} + \alpha_7 X_{b,j,t-1} + \alpha_8 Z_{j,t}$$

$$+ \sum_{k=o}^{2} \beta_{k+1} HomeP_{j,t-k} X_{b,j,t-k} Branch_{b,t}$$

$$+ \sum_{k=o}^{2} \beta_{k+4} HomeP_{j,t-k} X_{b,j,t-k} Subsidiary_{b,t} + f_b + f_t + \varepsilon_{b,j,t}$$

(5)

All the variables and estimation restrictions are the same as in equation (4). The only difference is that the prudential variable is interacted with a categorical variable for branches and subsidiaries. The omitted category is the one referring to domestic banks. These regressions include bank and time fixed effects. Standard errors are clustered by country.

The results are presented in Table 5.[5] The results in the previous section (Table 4) show that tighter capital requirements in the home country of a foreign bank are associated with less credit growth in the host country. By looking at the marginal effects in Table 5 we are able to find that this cross-border spillover of regulation works only through branches. As discussed above, the impact of foreign regulation should in theory affect both types of foreign banks. One possible explanation for this difference might be the different way branches and subsidiaries are affected by capital regulation. Branches are only affected by their home country regulation and so it makes sense to find this statistically significant spillover. In turn, subsidiaries are simultaneously affected by home and host regulation. Capital requirements were higher in Portugal than in most other European countries during a large part of the sample period. These measures were taken to strengthen the resilience of the Portuguese banking system amidst an environment of erosion of trust. Given this backdrop, when capital requirements were tightened in the home countries, their effect on subsidiaries was possibly not felt as they were already subject to more demanding capital requirements due to host regulation.

Regarding the loan-to-value ratio, in Table 4 we reported that a tightening in the home country implies more credit growth in the host country through foreign banks. In Table 5, we report positive marginal effects both for branches

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5. Given space constraints, we do not report the coefficients of the direct effects of bank control variables.

	(1)	(2)
	HomeP= Capital Requirements	HomeP= Loan To Value Ratio
HomeP_t*Subsidiaries	-54.73	-43.82***
	(39.71)	(4.802)
HomeP_t*Branches	11.66	25.66***
	(26.87)	(7.122)
HomeP_t-1*Subsidiaries	-81.43*	26.55***
	(44.36)	(4.560)
HomeP_t-1*Branches	28.41	34.83***
	(16.16)	(8.106)
HomeP_t-2*Subsidiaries	-81.46***	-14.57
	(22.70)	(10.21)
HomeP_t-2*Branches	-8.625	46.35***
	(7.357)	(8.019)
Financial cycle (Home country)	-0.0348	-0.0286
	(0.0232)	(0.0234)
Business cycle (Home country)	1.398**	1.235**
	(0.492)	(0.508)
Log Total Assets * HomeP*Subsidiaries	24.7664***	2.768
	(39.8632)	(1.4382)
Log Total Assets * HomeP*Branches	-2.801	13.9214***
	(1.5096)	(61.3848)
Capital Ratio* HomeP*Subsidiaries	4.4552***	6.6972***
	(10.9829)	(28.8127)
Capital Ratio* HomeP*Branches	-0.787	-0.7752**
	(0.9531)	(7.3751)
Illiquid Assets Ratio* HomeP*Subsidiaries	-0.125	-0.120
	(0.0443)	(0.0799)
Illiquid Assets Ratio* HomeP*Branches	0.125	-2.2814***
	(0.2071)	(89.1302)
Net intragroup funding * HomeP*Subsidiaries	-0.045	0.111
	(0.8222)	(0.2571)
Net intragroup funding* HomeP*Branches	-0.4185*	0.2852*
	(4.6719)	(4.9366)
Core Deposits Ratio * HomeP*Subsidiaries	-0.6817*	-0.6982***
	(3.3879)	(20.8261)
Core Deposits Ratio * HomeP*Branches	-1.226	0.364
	(3.2624)	(2.0952)
HomeP (HomeP_t+HomeP_t-1+HomeP_t-2)*Subsidiaries	-217.6286***	-31.847
F-Statistics	(15.244)	(3.088)
P-Values	0.004	0.113
HomeP (HomeP_t+HomeP_t-1+HomeP_t-2)*Branches	31.448	106.8409***
F-Statistics	(1.2814)	(34.985)
P-Values	0.287	0.000
Average marginal effects of HomeP for foreign banks		
For subsidiaries	1.038	44.2201***
For branches	-12.222***	27.8768***
Observations	1,619	1,619
Adjusted R-squared	0.047	0.055
Number of banks	57	57

TABLE 5. Inward Transmission of Policy via Affiliates of Foreign-Owned Banks – branches versus subsidiaries

Notes: This table reports the effects of changes in regulation and firm characteristics and their interactions on log changes in domestic loans. The data are quarterly from 2006Q1 to 2014Q4. HomeP refers to the changes in regulation in the home (i.e. parent bank) country of foreign affiliates. For HomeP interaction effects with bank characteristics the reported coefficient is the sum of the contemporaneous term and two lags with the corresponding F-statistics for joint significance in parentheses. For the Portuguese banks the regulation variables and the financial and business cycle variables are zero. For more details on the variables see Appendix A. Each column gives the result for the regulatory measure specified in the column headline. All specifications include time and bank fixed effects. Standard errors are clustered by country. ***, **, and * indicate significance at the 1 per cent, 5 per cent, and 10 per cent level, respectively.

and subsidiaries, which supports our hypothesis that this instrument should affect in the same way the two types of institutions.

Concluding Remarks

In this paper we offer a contribution to understand the cross-border impacts of prudential regulation. Our results suggest that the cross-border effects of regulation depend on the prudential tool considered as well as of the channel of transmission. When the channel of transmission are the domestic banks with international activity, we find that a tightening abroad of sector specific capital buffers leads to an increase in credit growth in Portugal which suggests the presence of substitution effects. For the loan to value ratio, we obtain the opposite sign, thus suggesting the existence of complementary effects. Indeed, a tightening of the loan-to-value ratio limit is associated with a decrease in the growth of domestic loans granted by Portuguese banks. This result might stem from the reduction in profits for the banking group as a whole. Alternately it might reflect the conditions under which this instrument is usually applied, i.e. periods of booms in real estate markets. Having limited resources, banks may prefer to limit domestic lending to continue to lend abroad if this market still yields high profitability despite the tighter regulation.

When we analyze the influence of foreign regulation on the growth of credit granted in Portugal by the foreign banks operating in the country, it is interesting to note that the cross-border spillovers for the loan-to-value limits work in a different way – after a tightening in this instrument in the country of the parent bank, foreign banks increase credit growth in Portugal. One possible explanation for positive effect in the case of foreign banks (as opposed to domestic banks) is that foreign banks might be more worried with the building up of risks in the home country (where most of their activity is concentrated) and thus increase credit growth abroad. For the capital requirements, we find that foreign banks decrease credit in Portugal, after a tightening in the home country. The opposite effects obtained for capital requirements and loan to value ratio are in line with what could be expected given that when regulation is tightened in the home country of a given bank, substitution effects are more likely to occur if regulation is applied at the local level, than if it is applied at the consolidated level.

We also try to understand whether the transmission of foreign prudential policy through foreign banks operating in a given country works differently through branches or subsidiaries. We find as expected that in the case of the loan-to-values ratio the positive effect works both through branches and subsidiaries. By contrast, the negative effect of tighter capital requirements, in the home country of a foreign bank, on credit in the host country work only through branches. One possible explanation for this difference might be the fact when capital requirements were tightened in the home countries, their

effect on subsidiaries was possibly not felt as these banks were already subject to more demanding capital requirements due to Portuguese regulation. These results show that the legal form of credit institutions plays an important role of the cross-border transmission of prudential regulation, most notably due to differences in the scope and perimeter of application of the instruments.

With increasingly harmonized regulation across the world, this project contributes to understand how changes in prudential tools in one country might affect the evolution of credit granted in another country. This is relevant to think about intended and unintended international spillovers when designing regulation. With increased pressure for international reciprocity between regulators (as set out for instance in the countercyclical capital buffer framework), having at hand empirical evidence on the way regulation affects lending in other countries will certainly be highly valuable for policymakers.

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Appendix

Variable Name	Description	Data Source
Illiquid Assets Ratio	(1-(Cash and claims on central banks and credit institutions/Total assets)) (in %)	Supervisory data (Banco de Portugal)
Log Assets	Ln (Total assets/GDP deflator 2012)	Supervisory data (Banco de Portugal) and National accounts (Statistics Portugal)
Core Deposits Ratio	(Time deposits from residents + deposits redeemable at notice from residents + savings deposits from residents)/Total assets (in %)	Supervisory data (Banco de Portugal)
Capital Ratio	Equity capital/Total assets (in %)	Supervisory data (Banco de Portugal)
Net intragroup funding	(Deposits of banks of the same banking group located abroad - credit, debt securities shares and other equity to banks of the same banking group located abroad)/Total liabilities (in %)	Montlhy balance sheet statistics and supervisory data (Banco de Portugal)
International Activity	Local claims plus liabilities (denominated in local currency) of the branches and subsidiaries (of the Portuguese banks) located outside Portugal/(Total assets and total liabilities of the parent bank + Local claims and liabilities of the branches and subsidiaries located outside Portugal) (in %)	Bank level data on a consolidated basis underlying the report to the International Banking Statistics of the BIS and Supervisory data (Banco de Portugal)

TABLE A.1. Construction of Balance Sheet Variables