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Post-crisis International Banking: An Analysis with New Regulatory Survey Data

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Post-crisis International Banking: An Analysis with New Regulatory Survey Data

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Abstract

Foreign bank lending has stopped growing since the global financial crisis. Changes in banks' business models, balance-sheet adjustments, as well as the tightening of banking regulations are potential drivers of this prolonged slowdown. The existing literature however suggests an opposite effect related to regulation, with tighter regulations encouraging foreign lending through regulatory arbitrage. We investigate this question using new survey data on regulations specific to banks' international operations. Our results show that regulatory tightening can explain about half of the decline in the foreign lending-to-GDP ratio between 2007 and 2013. Regulatory changes in home countries have had a larger effect than those in host countries.

JEL Classification Numbers: G21, G28, F34

Keywords: international banking, regulation

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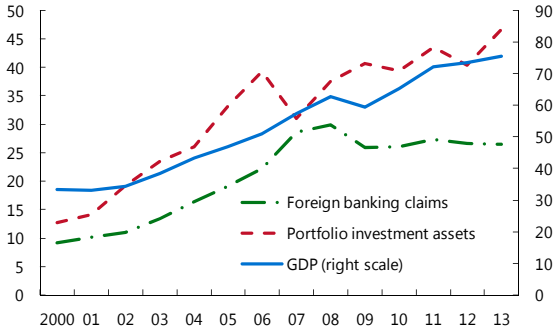
I. INTRODUCTION

The global financial crisis of 2008 has interrupted the expansion of foreign bank lending. Figure 1 shows that foreign banking claims grew until 2007, broadly in tandem with world GDP and portfolio investment assets. But, in contrast to portfolio investment assets, foreign banking claims as a share of world GDP have been declining since then.[2] The ratio of foreign banking claims to total banking assets of host countries, an indicator of host countries' dependency on foreign banks, also has declined from its peak of 24 percent in 2007 to 16 percent in 2013 (Figure 2).

Figure 1. Foreign Banking Claims

(Trillions of U.S. dollars)



Note: Foreign banking claims are from BIS, Consolidated Banking Statistics on an immediate risk basis. Statistical breaks were adjusted (see Section III for methodological details). Quarterly data until 2013Q3 were averaged for each year. Portfolio investment assets are from IMF, Coordinated Portfolio Investment Survey and include both equities and bonds. GDP is from the World Bank.

There are many potential drivers of this change. For instance, the prolonged process of deleveraging of banks has had a strong effect on credit supply. Large banks have been cleaning up their balance sheets and selling legacy assets while trying to reduce their reliance on less stable funding sources, such as short-term wholesale funding.

Another plausible driver is the tightening of banking regulations.[3] Banks have been pressed by supervisors to shore up capital and to avoid a decline in the domestic supply of credit.

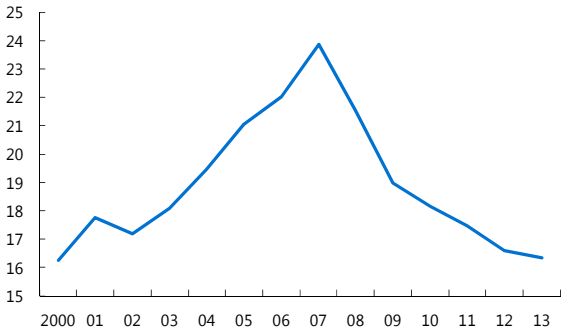
[2] This paper analyzes foreign bank lending using the Consolidated Banking Statistics compiled by the Bank for International Settlements (BIS). Foreign banking claims are defined as the sum of cross-border claims (for example, a loan of a bank in a given country to a non-affiliated bank, a firm, or a household in another country) and local claims (for example, a loan from a branch or a subsidiary of a foreign bank in a given country to a non-affiliated bank, a firm, or a household in that same country). Banking claims include not only loans, but also deposits with other banks, holdings of securities, and participations. As in many studies on the subject, however, this paper uses the terms of lending and claims interchangeably, since it is reasonable to consider that banking claims are primarily driven by lending.

[3] In this paper, as in several previous studies, regulations are defined as including supervision.

Financial reforms, such as those aiming at restricting certain types of operations by banks, as well as new capital and liquidity standards, may have curtailed bank activities and reduced foreign bank lending.

Figure 2. Foreign Banking Claims Relative to Total Banking Assets of Host Countries

(Percent)



Note: Foreign banking claims are from BIS, Consolidated Banking Statistics on an immediate risk basis. Statistical breaks were adjusted (see Section III for methodological details). Total banking assets are from IMF, International Financial Statistics. The data are used only when both foreign banking claims and total banking assets in a given country are available for each quarter. Quarterly data until 2013Q3 were averaged for each year. The ratio is calculated by dividing total foreign banking claims by total bank assets for all host countries.

The tighter regulations, however, may have induced an opposite effect through regulatory arbitrage: banks in countries that tightened banking regulations may have increased their claims on countries that are less regulated. In fact, Houston, Li, and Ma (2012) and Ongena, Popov, and Udell (2013) find evidence for regulatory arbitrage with data until 2007 or 2008. Bremus and Fratzscher (2015) show that regulatory arbitrage is still an important driver even in recent years.

We revisit this question using the results of a new regulatory survey. The survey was conducted by the International Monetary Fund in 2014. The answers were collected from bank supervisors in 40 countries. This new survey focused on regulations specific to banks' international operations, such as restrictions on foreign bank activities, while previous surveys (for instance, the World Bank's bank regulation and supervision surveys of 1999, 2002, 2006, and 2011) asked mainly about general financial regulations, such as capital requirements. The specificity of this new survey enables us to examine the effect of regulations that influence international banking activities more directly. We construct indexes of regulatory changes using the answers to this new survey.

Another novel feature of our analysis is the use of bilateral foreign claims data from the consolidated banking statistics on an ultimate risk basis. Although the consolidated banking statistics data on an immediate risk basis have been used in many studies, including Cetorelli and Goldberg (2011), Houston et al. (2012), and Bremus and Fratzscher (2015), these data do

not reflect risk transfers and have limitations in capturing bilateral exposures (McGuire and Wooldridge 2005).[4] A drawback of the ultimate-risk-basis data is that they are available only from 2005 onward. The problem of short time series, however, is not as important for our analysis, since we are particularly interested in international banking activities in the post-crisis period.[5]

To assess the importance of each potential driver of international banking, we estimate a cross-sectional regression model with the growth rate of bilateral foreign banking claims as the dependent variable, as in Cetorelli and Goldberg (2011) and Bremus and Fratzscher (2015).

Our baseline regressions show that regulatory changes can account for about a half of the decline in the ratio of foreign lending to GDP between 2007 and 2013. Changes in home regulations related to banks' international operations are a key driver, while regulatory changes in host countries have played a less important role. Home country banks with higher capitalization in 2007 were associated with smaller declines in foreign banking claims following the crisis. The more claims grew before the crisis, the larger their decline since then. Higher initial home country engagement in the host countries is associated with a lower drop in lending.

The analysis by subcategories of claims suggests that cross-border lending from banks' headquarters has been more affected by regulations on banks' international operations than local lending from banks' affiliates. The resilience of local lending relative to cross-border lending may thus be largely attributable to the limited response of local lending to changes in regulations on banks' international operations. The analysis also suggests that host country regulations played a significant role in reducing international bank borrowing.

The contribution of our research is not limited to the ongoing discussion on the post-crisis international banking activities and regulatory impacts. Rather, our study adds to a vast

[4] Some recent studies use bank-level balance-sheet data. To examine consolidated banking activities, these studies typically add ownership structures across banks by using information from other sources. This type of analysis has at least two important drawbacks. First, since the coverage of branches is very limited in most bank-level databases, those analyses miss most of bank activities conducted through branches. This problem is particularly serious when foreign banks transform their branches to subsidiaries or vice versa; for instance, a transformation from a branch to a subsidiary can be misstated as an increase in foreign claims. Second, over time, tracing ownership information has become more complicated with more banks raising equity through public capital markets offerings (Claessens and van Horen 2014). The BIS consolidated banking statistics are not affected by these issues, since global banks are asked to report the data of their own banking groups, including both subsidiaries and branches.

[5] Figures 1 and 2 are based on immediate-risk-basis data to show a longer time series. The issue of risk transfers is irrelevant for those figures, however, because they use aggregate claims from all countries, not bilateral claims.

literature on the determinants of foreign banks' presence (Goldberg and Johnson 1990; Cull and Martínez Pería 2010; De Haas and Van Horen 2012; Van Rijckeghem and Weber di Mauro 2013; Cerutti and Claessens 2014; Claessens and Van Horen 2014a and 2014b), which largely ignores the role played by regulatory changes.

The rest of this paper is organized as follows. Section II describes the new regulatory survey data. Section III and IV present the baseline econometric specifications and their results, respectively. Robustness checks are discussed in Section V. Subcategories of claims are analyzed in Section VI. Section VII concludes.

II. NEW REGULATORY SURVEY DATA

As noted, this paper uses results from a survey about the regulations applicable to banks' international operations. The survey was conducted in the fall of 2014 for the preparation of the April 2015 IMF's *Global Financial Stability Report*. Answers were confidentially collected from supervisors in 40 advanced and emerging economies that are among the top recipients of foreign banking claims according to BIS data.[6]

The survey asked 31 questions from the perspective of home and host countries (Table 1). The questions were classified into six categories for both home country and host country regulations. Questions covered possible restrictions on the presence of foreign banks and the type of activities they can conduct, supervisory discretion in limiting those activities, information sharing with foreign supervisors, depositor insurance, resolution powers over branches of foreign banks, and other structural measures that could affect banks' decision to operate in foreign countries. The survey asked about the regulations in place in 2014 and about changes between 2006 and 2014. Only the latter responses are used for the analysis in this paper.

[6] Survey respondents were Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Croatia, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, Hungary, Indonesia, Ireland, Italy, Japan, Luxembourg, Malaysia, Mexico, the Netherlands, Norway, the Philippines, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovak Republic, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, United Kingdom, and United States.

Table 1. Survey on the Regulations of Banks' International Operations

Category		Questions
Home Country Regulations		
Presence	1	Are domestic banks prohibited from acquiring foreign banks?
	2	Do domestic banks need their domestic supervisor's approval to acquire a foreign bank?
	3	Are domestic banks prohibited from establishing branches overseas?
	4	Do domestic banks need their domestic supervisor's approval to establish a branch overseas?
	5	Are domestic banks prohibited from establishing subsidiaries overseas?
	6	Do domestic banks need their domestic supervisor's approval to establish a subsidiary overseas?
	7	Are the requirements to obtain permission to establish a branch stricter than those applicable to subsidiaries?
Activity	8	Are domestic banks prohibited from making cross-border loans?
	9	Are domestic banks prohibited from purchasing foreign securities?
	10	Are there restrictions on the type of activities (for example, corporate and retail lending, residential mortgage, trade finance, long-term infrastructure finance, investment banking) that domestic banks can conduct overseas that do not apply to domestic operations?
	11	Are there additional regulatory requirements for domestic banks operating outside their home country beyond what would be required for similar operations conducted domestically?
Depositor Insurance	12	Are foreign depositors covered by deposit insurance?
Information	13	Do banking secrecy laws in your country limit your ability to share information about banks' operations and balance sheets with foreign supervisors?
Supervisory Discretion	14	Can the supervisor limit the range of activities a consolidated group may conduct and/or the locations in which activities can be conducted (including the closing of foreign offices) in specific circumstances (as per Basel Core Principle 12.6)?
Other	15	Did the authorities introduce other structural measures (such as Volcker reform, Vickers proposals, and others) which could weigh on the decision of some banks to expand internationally?
Host Country Regulations		
Presence	1	Is foreign ownership of domestically incorporated banks prohibited?
	2	Do foreign banks need the host country supervisor's authorization to acquire a domestic bank?
	3	What is the maximum percentage of foreign ownership of a domestic bank legally allowed?
	4	Are foreign banks prohibited from operating in the form of branches?
	5	Are the requirements for establishing a branch stricter for foreign banks than for domestic banks?
	6	Are there additional and/or different regulatory requirements for foreign-owned banks versus domestic banks?
Activity	7	Are there restrictions on the type of activities (for example, corporate and retail lending, residential mortgage, trade finance, long-term infrastructure finance, investment banking) that foreign banks can conduct domestically and that do not apply to domestic banks?
	8	Are there restrictions on domestic currency cross-border borrowing by banks?
	9	Are there restrictions on foreign currency cross-border borrowing by banks?
	10	Are banks required to fund part or all of their domestic operations with local deposits?
	11	Are there restrictions on the share of funding a domestically incorporated bank can obtain from a foreign parent?
	12	Are there restrictions on lending by domestically incorporated banks to a foreign parent?
Supervisory Discretion	13	Can the supervisory authorities impose ring-fencing measures in a discretionary way?
Information	14	Do banking secrecy laws in your country limit your ability to share information about banks' operations and balance sheets with foreign supervisors?
Resolution	15	Does the resolution authority have resolution powers over local branches of foreign firms and the capacity to use its powers either to support a resolution carried out by a foreign home authority or, in exceptional cases, to take measures on its own initiative (as per Key Attribute 7.3)?
Other	16	Did the authorities introduce other structural measures (such as Volcker reform, Vickers proposals, and the othres) that could weigh on the decision of some banks to retrench from your country?

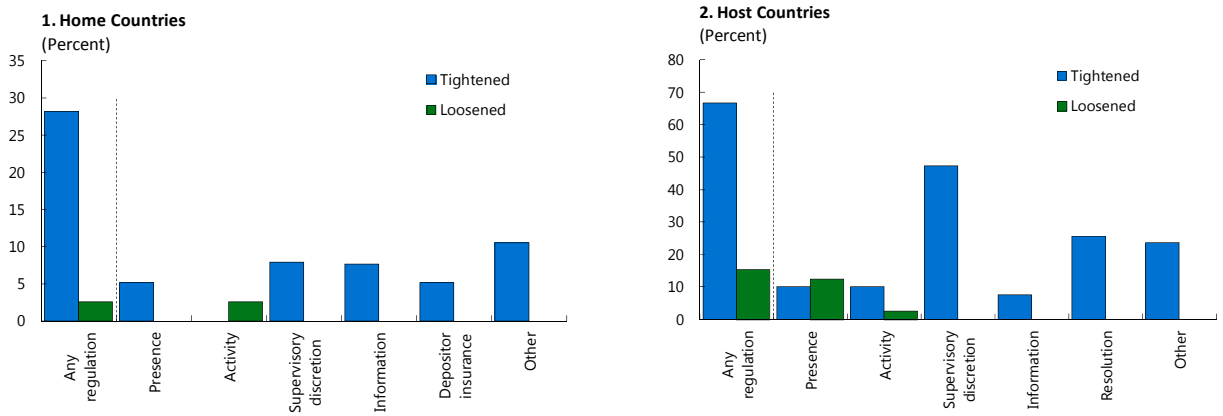
For most questions about regulatory changes, answers were generally restricted to three options, such as "prohibition introduced," "prohibition removed," and "no change," each of which is coded to "tightened," "loosened," and "no change," respectively, in this paper.[7] Indexes of changes are computed based on those answers. In each country and for each

[7] The exceptions are the home question numbered 15 in Table 1 and host questions numbered 13 and 16, which ask only whether regulations have been tightened or not.

category of questions, an index variable is set to 1, 0, and -1 when the number of answers reporting a tightening of regulations for questions in this category is, respectively, greater than, equal to, and smaller than the number of answers reporting a loosening. An overall index is calculated as the arithmetic mean of the scores for the six categories.

The survey results show that many countries tightened regulations on banks' international operations between 2006 and 2014, while only a few loosened them (Figure 3). In 2014, supervisory authorities in many countries were more likely than before to limit banks' activities—for instance, by imposing ring-fencing measures in a discretionary way. Also, many resolution authorities obtained more powers over local branches of foreign banks. Some countries amended banking secrecy laws to enhance information sharing about banks' operations and balance sheets with foreign supervisors. In contrast, a few countries loosened regulations regarding foreign banking presence (for example, conditions for foreign banks' acquisition of a domestic bank) and activity (for example, cross-border lending and borrowing).

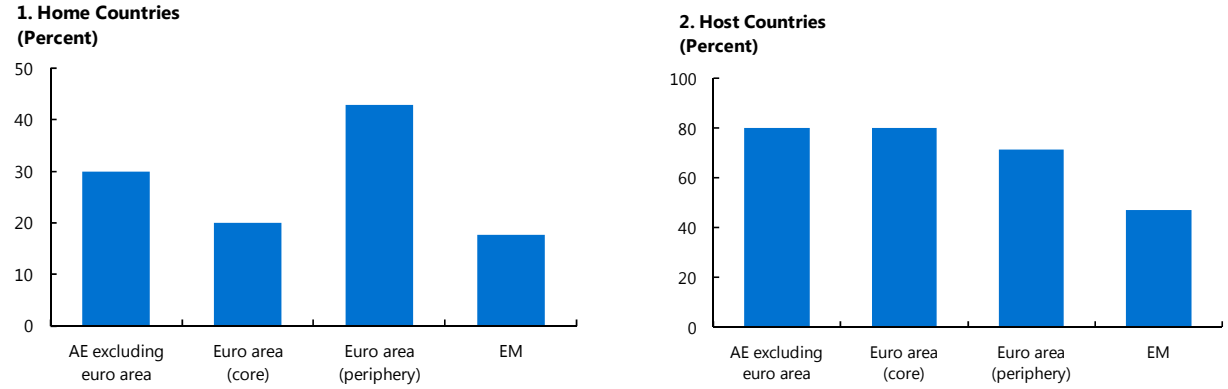
Figure 3. Share of Countries that Changed Regulations on International Banking Operations between 2006 and 2014, by Category of Regulations



Note: Shares are calculated from the results of a survey about regulations on banks' international operations. The "any regulation" bar represents the share of countries that have tightened (loosened) any regulation related to banks' international operations over the period 2006–14. The other bars correspond to the shares of countries that have tightened (loosened) any corresponding category of regulations.

Our overall regulatory index suggests that the share of countries that tightened their regulations on banks' international operations from 2006 to 2014 is higher in advanced economies than in emerging market economies (Figure 4). One might conjecture that countries that became aware of the vulnerabilities of their banking sector consistently tightened regulations more than other countries. The evidence in support of this hypothesis, however, is not very strong; for instance, euro area periphery countries, which faced serious banking stress, tightened their home country regulations less than other advanced countries during this period.

Figure 4. Share of Countries that Tightened Regulations on International Banking Operations between 2006 and 2014, by Region



Note: AE = advanced economies; EM = emerging market economies. Euro area core countries include Austria, Belgium, Finland, France, Germany, Luxembourg, and the Netherlands. Euro area periphery countries include Greece, Ireland, Italy, Portugal, and Spain. Countries that tightened regulations are defined as countries with a positive index of changes in regulations on banks' international operations.

III. BENCHMARK SPECIFICATIONS

The benchmark regression model uses the growth in bilateral claims as the dependent variable. This helps to separate the effects of home and host variables, and is standard in the recent literature. In addition to the regulatory information from the survey, the benchmark models use regressors commonly found in the empirical literature.

The baseline specification takes the following form:

$$\Delta claims_{ij} = \alpha + \boldsymbol{\beta} \cdot \mathbf{home}_i + \boldsymbol{\gamma} \cdot \mathbf{host}_j + \boldsymbol{\delta} \cdot \mathbf{bilateral}_{ij} + \varepsilon_{ij}, \quad (1)$$

where $\Delta claims_{ij}$ denotes the growth rate of claims from home country i to host country j between 2007 and 2013. $\mathbf{home}_i$ and $\mathbf{host}_j$ are vectors of variables specific to home and host countries, respectively. Each of them includes one or two indexes of regulatory changes, the change in the exchange rate against the U.S. dollar, and the U.S. dollar-denominated GDP growth rate. $\mathbf{home}_i$ additionally includes the aggregate bank capital-to-total assets ratio in 2007 as an indicator of initial banking sector health. $\mathbf{bilateral}_{ij}$ is a vector of bilateral variables, which comprise the log distance between the home and host countries, a common language dummy, two variables capturing the importance of the claims from the home country in the host country and of the claims in a given host country from the home country perspective in 2007, as well as the pre-crisis growth rate of bilateral claims.[8] Initial values of

[8] Classens and van Horen (2014a) also include as regressor a variable measuring the importance of the claims from the home country in the host country, but they do not include a variable measuring the importance of the claims in a given host country from the home country perspective.

the variables measuring banking sector health and bilateral importance are used to mitigate endogeneity problems. Table 2 provides a definition of all the variables used in the regressions, including those used for robustness checks. α, $\boldsymbol{\beta}$, $\boldsymbol{\gamma}$, and $\boldsymbol{\delta}$ are parameters or vectors of parameters, and ε_{ij} is the residual.

We estimate two benchmark models with and without the capital regulatory indexes constructed by Barth, Caprio, and Levine (2013). These regulatory indexes were based on the Bank Regulation and Supervision Survey, conducted by the World Bank, which gathered information regarding bank regulations in 1999, 2002, 2006, and 2011. We use as regressors the change in the capital regulatory index between 2006 and 2011 in the second benchmark model. Although it is desirable to control for other financial regulations, such as capital requirements, the number of observations falls when these variables are added.[9] This is the main reason why we run the regression without this variable in our first benchmark model.

The data on foreign banking claims come from the BIS consolidated banking statistics on an ultimate risk basis. The BIS data have two problems that are rarely tackled. The first is that the data are subject to statistical breaks, many of which are due to technical reasons, such as improvements in reporting practices. We identify those statistical breaks following Cerutti (2013) and correct for them.[10] The second problem is that the BIS data are reported in U.S. dollars by converting claims in other currencies using end-of-period exchange rates. Changes in claims from one period to another may then only reflect valuation effects with the actual underlying position remaining unchanged. To deal with this problem, our regression models control for the changes in the exchange rates of home and host currencies against the U.S. dollar. After cleaning the data and adjusting statistical breaks, we construct annual claims series by averaging quarterly data over the period 2005Q2-2013Q3.[11] The growth rate is computed from the annual data by dividing the change in bilateral claims between the two periods by the average of claims in these periods.[12] To be consistent, the growth rate of GDP,

[9] For instance, since Japan did not participate in the latest World Bank survey, its observations are excluded when adding a general financial regulatory variable.

[10] The BIS reports statistical breaks for different types of claims with their reasons. Statistical breaks are reported only by home country, generally without any details about the host countries. In such cases, we adjust bilateral claims from a given home country to each host country by the same rate as the aggregate claims from that home country to all host countries.

[11] We use unpublished BIS series provided to the IMF. We checked the consistency across foreign, cross-border, and local claims and re-calculated total foreign claims as the sum of cross-border and local claims. Although data on an ultimate risk basis are available from 2005Q1, we use the data only from 2005Q2 because of large changes in the data between 2005Q1 and 2005Q2. We also drop the observations with negative values of claims.

[12] The literature often uses log differences to calculate growth rates. However, such a method naturally discards data when claims are zero at the start or end of the period and cannot capture global banks' entry to or exit from host countries, which may actually be an important consequence from changes in regulations or other factors.

the rate of change in exchange rates, and the pre-crisis claims growth are calculated in the same way.

Table 2. Definition of the Variables

Variable	Description	Source
Post-crisis claims growth	The growth rate of bilateral claims from 2007 to 2013, which is calculated by dividing the change in claims by the average of claims in 2007 and 2013.	BIS, CBS
International operations regulatory index	An index constructed from answers to survey questions about regulation changes for 2006–14. See Section II for more detail.	IMF
Capital regulatory index	Difference beween Barth et al.'s (2013) indexes in 2006 and 2011. This is normalized so that the index can take a value from -1 to 1.	Barth et al. (2013)
Exchange rate	The percent change in the exchange rate against the U.S. dollar between 2007 and 2013. This is calculated with the method used for post-crisis claims	IMF, IFS
GDP	The growth rate from 2007 to 2013. This is calculated with the method used for post-crisis claims growth.	IMF, WEO
Bank capital ratio	The bank capital-to-total assets ratio of the home country in 2007.	World Bank, GFDD
Distance	Log distance between two cities, mostly capitals, in home and host countries. The distance to/from Hong Kong SAR is proxied by the distance to/from Taipei. See Gleditsch and Ward (2001).	http://privatewww.essex.ac.uk/~ksg/data-5.html
Common language dummy	The variable is equal to one when the home and host countries use a common language and zero otherwise. See Rose (2004).	https://www.aeaweb.org/articles.php?doi=10.1257/000282804322970724
Importance of host in the claims from home	The ratio of bilateral claims from a home country to a host country to total claims from the home country to all host countries in 2007.	BIS, CBS
Importance of home in the claims on host	The ratio of bilateral claims from a home country to a host country to total claims from all home countries to the host country in 2007.	BIS, CBS
Pre-crisis claims growth	The growth rate of bilateral claims between 2005 and 2007. This is calculated with the method used for post-crisis claims growth.	
Alternative general financial regulatory	Difference beween Barth et al.'s (2013) indexes in 2006 and 2011. This is normalized so that the index takes a value from -1 to 1.	Barth et al. (2013)
Banking crisis dummy	The variable is equal to one when the home country is in a banking crisis and zero otherwise. The change between 2007 and 2013 is used.	Laeven and Valencia (2012)
Sovereign rating index	Improvement in notches of Standard and Poor's foreign currency long-term sovereign debt rating in the home country from 2007 to 2013.	Bloomberg, L.P.
Real short-term interest rate	Change in the policy rate (or an alternative interest rate if not available) minus the 1-year-ahead expected inflation rate between 2007 and 2013.	Central banks, Consensus Forecasts
Real long-term interest rate	Change in the long-term interest rate minus the 1-year-ahead expected inflation rate between 2007 and 2013.	OECD, Consensus Forecasts
Financial openness	The change in Chinn and Ito's (2006) index between 2007 and 2013.	http://web.pdx.edu/~ito/Chinn-Ito_website.htm
Imports	The growth rate of imports from 2007 to 2013. This is calculated with the method used for post-crisis claims growth.	IMF, DOTS
Trade	The growth rate of the sum of imports and exports from 2007 to 2013. This is calculated with the method used for post-crisis claims growth.	IMF, DOTS
Government-owned bank share	Percentage of banking system's assets in banks that are 50% or more government owned in 2006.	Barth et al. (2013)

Note: CBS = Consolidated Banking Statistics; DOTS = Direction of Trade Statistics; GFDD = Global Financial Development Database; IFS = International Financial Statistics; OECD = Organisation for Economic Co-operation and Development; WEO = World Economic Outlook.

IV. BENCHMARK RESULTS

Regulations on banks' international operations in home and host countries are found to have significant negative effects on foreign lending. Table 3 reports the baseline results with *p*-values calculated with White's (1980) robust standard errors. The size of the coefficient on the international operations regulatory index in home countries (177.6) is large. This implies that the tightening of one type of regulations (which would increase the index by one-sixth) in the home country is, on average, associated with a 30 percentage-point drop in foreign claims between 2007 and 2013. The second column shows that the coefficient on the capital regulatory index of the home country is also significantly negative, although that of the host country is not. These results suggest that tighter regulations, represented by indexes with higher values, reduced international banking activities following the 2008 financial crisis, rather than encouraged them through regulatory arbitrage.

Looking at non-regulatory variables, the growth of foreign claims is positively associated with an appreciation of the currency of home countries vis-à-vis the U.S. dollar. As noted earlier, this may be capturing a valuation effect; for instance, if the euro appreciates against the U.S. dollar, the dollar value of euro-denominated loans increases. An alternative explanation is that the appreciation of the home currency makes foreign assets denominated in U.S. dollar or local currencies cheaper for banks in the home country. In contrast, an appreciation of the host country currency does not have a significant effect on the growth of claims. This result may reflect that the positive valuation effect on local-currency-denominated claims is offset by a negative effect on foreign bank lending due to higher costs.

GDP growth in both home and host countries is associated with an increase in foreign claims. The coefficient on GDP growth in the host country is very close to one, which suggests that foreign claims and economic activity in host countries have a one-to-one relationship. The positive effect of GDP growth in home countries may reflect the lower risk of non-performing loans and increasing net worth, both of which support banks' ability and willingness to lend in foreign countries.

A higher bank-capital-to-total-assets ratio in the home country in 2007 (a proxy for the health of the home country banking system) is associated with higher growth in foreign claims in the following years.[13] This result suggests that tighter capital requirements may contribute to stabilizing banking flows over time once banks have built capital buffers.

[13] This result is consistent with those of a previous study on syndicated lending that finds that banks with strong balance sheets were better able to maintain lending during the crisis (Kapan and Minoiu 2013).

Table 3. Results of the Benchmark Regressions

	(1)	(2)
International operations regulatory index (home, change)	-177.60***	-190.54***
	(0.00)	(0.00)
International operations regulatory index (host, change)	-35.23**	-43.52**
	(0.04)	(0.02)
Capital regulatory index (home, change)		-82.94***
		(0.00)
Capital regulatory index (host, change)		7.93
		(0.57)
Exchange rate (home, % appreciation)	1.09***	0.83**
	(0.00)	(0.03)
Exchange rate (host, % appreciation)	0.21	0.13
	(0.41)	(0.67)
GDP (home, % change)	0.98***	1.05***
	(0.00)	(0.00)
GDP (host, % change)	0.99***	0.96***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	4.85***	3.15**
	(0.00)	(0.04)
Distance (log, km)	-4.03	-4.19
	(0.23)	(0.27)
Common language dummy	-8.40	-4.25
	(0.37)	(0.65)
Host country's share of claims from home (% in 2007)	0.73	0.81*
	(0.10)	(0.09)
Home country's share of claims on host (% in 2007)	1.40***	0.90***
	(0.00)	(0.01)
Claims (% change from 2005 to 2007)	-0.17**	-0.14*
	(0.02)	(0.09)
Observations	726	597
R-squared	0.172	0.202

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Higher home country engagement in the host countries at the start of the sample is associated with a smaller decline in lending. The coefficient on the home country's share of claims on the host country in 2007 is positive and statistically significant. The coefficient on the host country's share of claims from the home country is also significant although only at the 10 percent level in column (2) of Table 3 (and marginally insignificant in column (1)). These results suggest that initially strong bilateral relationships may have motivated foreign banks to support lending to certain countries, due, for example, to smaller information asymmetries,

higher sunk costs, or larger market impacts. In other words, international banking networks have shrunk in the post-crisis period as bilateral claims have become more concentrated on important counterpart countries.

Finally, as suggested by the significantly negative coefficient on the pre-crisis claims growth, bilateral claims with higher pre-crisis growth rates overall experienced a larger subsequent contraction.

To gauge the relative size of the impacts of the regressors, we conduct two exercises. In the first one, we estimate the benchmark specifications after standardizing the explanatory variables (that is, after subtracting the mean and dividing by the standard deviation). This allows to compare the sensitivities of foreign claims to a one-standard-error change in the regressors. Table 4 reports the results; it shows that the effect of home regulatory changes is of the same magnitude as that of GDP growth and larger than that of the other variables, including host regulatory changes.

The second exercise computes the contributions of regulatory and non-regulatory factors to the growth in the claims-to-GDP ratio by multiplying the estimated coefficient by the average value of the regressor. Concretely, we use the following equation:

$$\overline{\Delta claims_{ij}} - \overline{\Delta gdp_j} = \hat{\alpha} + \hat{\boldsymbol{\beta}} \cdot \overline{\mathbf{home}_i} + \hat{\boldsymbol{\gamma}} \cdot \overline{\mathbf{host}_j} + \hat{\boldsymbol{\delta}} \cdot \overline{\mathbf{bilateral}_{ij}} - \overline{\Delta gdp_j}, \quad (2)$$

where the variables are averages across all observations used for each regression, $\overline{\Delta gdp_j}$ denotes average GDP growth in host country j, and the coefficients (or vectors of coefficients) are the estimates reported in Table 3. The left-hand side of the equation approximately represents the growth rate of the claims-to-GDP ratio.

The results of this calculation are reported in Table 5. According to them, the overall effect of regulatory changes on foreign banking claims is comparable to that of non-regulatory factors. Among regulatory changes, those directly targeted at the international operations of banks have a larger effect than capital requirements. In addition, as in the first exercise, the effects of regulations in home countries are larger than those of regulatory changes in host countries.

Table 4. Results of the Benchmark Regressions with Standardized Explanatory Variables

	(1)	(2)
International operations regulatory index (home, change)	-17.17***	-19.08***
	(0.00)	(0.00)
International operations regulatory index (host, change)	-7.09**	-8.91**
	(0.04)	(0.02)
Capital regulatory index (home, change)		-21.78***
		(0.00)
Capital regulatory index (host, change)		2.15
		(0.57)
Exchange rate (home, % appreciation)	14.14***	10.53**
	(0.00)	(0.03)
Exchange rate (host, % appreciation)	3.29	2.05
	(0.41)	(0.67)
GDP (home, % change)	17.67***	19.85***
	(0.00)	(0.00)
GDP (host, % change)	24.93***	24.32***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	11.09***	7.50**
	(0.00)	(0.04)
Distance (log, km)	-4.45	-4.74
	(0.23)	(0.27)
Common language dummy	-2.67	-1.45
	(0.37)	(0.65)
Host country's share of claims from home (% in 2007)	4.02	4.58*
	(0.10)	(0.09)
Home country's share of claims on host (% in 2007)	12.26***	8.00***
	(0.00)	(0.01)
Claims (% change from 2005 to 2007)	-10.50**	-8.60*
	(0.02)	(0.09)
Observations	726	597
R-squared	0.172	0.202

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Contributions of Regulatory and Non-regulatory Factors to Foreign Claims/GDP Growth from 2007 to 2013

(Percentage Points)

	(1)	(2)
Foreign claims/GDP	-43.7	-47.5
Regulatory changes	-16.9	-27.7
International operations regulatory index (home, change)	-10.5	-12.7
International operations regulatory index (host, change)	-6.4	-8.4
Capital regulatory index (home, change)		-7.2
Capital regulatory index (host, change)		0.5
Other drivers	-26.8	-19.7

Note: The contribution of other drivers is calculated by subtracting that of regulatory changes from the growth rate of the foreign claims-to-GDP ratio. The average growth rate of foreign claims/GDP is different between the two specifications, as the capital regulatory index is not available for some countries covered in the first regression.

V. Robustness Checks

We conducted several robustness checks to our baseline specification. They can be classified into four categories. First, we use alternative financial regulatory indexes, instead of the capital regulatory index. Second, we use instrumental variables to address the potential endogeneity of regulatory variables. Third, we exclude data of bilateral claims from euro area countries to see if our results are unduly influenced by actions of euro area banks. Finally, we include additional control variables. The methods and results of the first three categories are described in the following subsections. Results using additional control variables are discussed in the Appendix.

A. Alternative Measures of Regulatory Changes

In addition to the capital regulatory index, which we used in one benchmark specification, Barth et al.'s (2013) report three other indexes of regulations, which some studies have used. The first is an index of official supervisory power, which measures the extent to which supervisors have the authority to take specific actions to prevent and correct problems. The second is a financial statement transparency index, which measures the transparency of banks' financial statements practices. The third is an index of overall restrictions on banking activities, which measures the extent to which banks are restricted from engaging in securities trading, insurance, and real estate activities.[14] In addition to the three indexes, we computed an

[14] Houston el al. (2012) use the indexes of official supervisory power and financial statement transparency in its empirical analysis. Bremus and Fratzscher (2014) use the supervisory power index. Ongena et al. (2013) use the index of overall restrictions on banking activities. The three papers also use the capital regulatory index.

average that included the capital regulatory index. In all cases, an increase in the index means that regulations are tightened.

The estimated coefficients on the international operations regulatory indexes both in home and host countries remain statistically significant and negative in all regressions using the four alternative indexes (Table 6). The results for the other variables are also broadly robust. Note that the R^2 of columns (1)-(3) is lower than that of column (1) in Table 3. This suggests that the capital regulatory index contains more information than the other three indexes and supports its widespread use in the literature. Although the R^2 of the specification including the average of the four indexes is slightly higher, the number of observations is much lower than for the baseline model.

Although the main purpose of the exercise is to check the robustness of the estimated coefficients in the benchmark models, some results provide additional insights. For example, columns (2) and (4) in Table 6 show that a tightening of general financial regulations is significantly associated with a decline in foreign banking claims, as in the benchmark regression. However, column (1) shows that stronger supervisory power in home countries is associated with a higher growth of banking claims abroad. This result has been found by others and often interpreted as evidence of regulatory arbitrage by banks expanding their operations in countries with less supervisory power.[15] The coefficients on general financial regulatory indexes in host countries are insignificant in all four regressions, as in the baseline model.

[15] In principle, stronger supervisory power in home countries should not increase outflows from these countries if the home supervisors monitor global banks on a consolidated basis and are as cautious about foreign claims as about domestic claims. One interpretation of this result is that supervisors have less information on the risks stemming from foreign claims.

Table 6. Adding Regressors on Other General Regulatory Changes

	(1)	(2)	(3)	(4)
International operations regulatory index (home, change)	-125.44***	-133.37***	-295.15***	-286.72***
	(0.00)	(0.00)	(0.00)	(0.00)
International operations regulatory index (host, change)	-40.69**	-46.51**	-54.71**	-46.90**
	(0.04)	(0.02)	(0.02)	(0.03)
Official Supervisory Power (home, change)	35.60**			
	(0.03)			
Official Supervisory Power (host, change)	-4.14			
	(0.82)			
Financial Statement Transparency (home, change)		-79.08***		
		(0.00)		
Financial Statement Transparency (host, change)		-0.82		
		(0.97)		
Overall Restrictions (home, change)			-2.86	
			(0.51)	
Overall Restrictions (host, change)			3.59	
			(0.34)	
Average of general financial regulations (home, change)				-175.40***
				(0.00)
Average of general financial regulations (host, change)				37.75
				(0.39)
Exchange rate (home, % appreciation)	2.02***	0.98**	1.29***	2.28***
	(0.00)	(0.02)	(0.00)	(0.00)
Exchange rate (host, % appreciation)	0.30	0.15	0.12	0.21
	(0.34)	(0.60)	(0.71)	(0.52)
GDP (home, % change)	0.89***	1.07***	0.94***	1.10***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP (host, % change)	1.06***	0.97***	0.84***	0.87***
	(0.00)	(0.00)	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	8.78***	4.05**	6.35***	7.91***
	(0.00)	(0.02)	(0.00)	(0.00)
Distance (log, km)	-9.74**	-4.28	-4.62	-6.89
	(0.02)	(0.27)	(0.29)	(0.13)
Common language dummy	-12.64	-2.38	-2.15	-2.88
	(0.23)	(0.81)	(0.85)	(0.81)
Host country's share of claims from home (% in 2007)	0.67	0.72	0.76	0.76
	(0.25)	(0.16)	(0.14)	(0.31)
Home country's share of claims on host (% in 2007)	0.46	1.20***	1.45***	0.95**
	(0.26)	(0.00)	(0.00)	(0.01)
Claims (% change from 2005 to 2007)	-0.14*	-0.15*	-0.11	-0.12
	(0.09)	(0.07)	(0.19)	(0.17)
Observations	544	597	527	477
R-squared	0.182	0.168	0.155	0.210

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

B. **Instrumental Variables**

A concern about the estimates of our benchmark regressions stems from the potential endogeneity of the regulatory variables. For instance, the vulnerabilities revealed during the global financial crisis may have caused both bank deleveraging and regulatory reforms in the post-crisis period. In contrast, it is also possible that harder-hit countries are more hesitant to tighten regulations, to avoid an additional brake on banking activity. As discussed in Section II, Figure 4 provides some support for this conjecture. The endogeneity concern in the benchmark regression is somewhat mitigated by the presence of control variables, such as the banks' initial capital-to-assets ratio and the pre-crisis growth rate of international claims, which are to some extent correlated with the vulnerabilities revealed by the crisis. Instrumental variables estimation is another way to address the endogeneity issue.

We use as instruments the pre-crisis levels of the four general financial regulatory indexes. Concretely, we use levels of the indexes in 2003 and 2006 in both home and host countries. This choice of instruments can be justified by regulatory contagion. As Demirguc-Kunt and Detragiache (2002) point out, policy makers and regulators are influenced by the choices of policy makers in other countries. In this case, countries with looser regulations are more likely to tighten them. Although we do not have data on the pre-crisis regulations applicable to banks' international operations, this may not be a serious issue because there is a lot of cross-country heterogeneity in the types of regulations adopted by countries and a country with loose regulations in one domain could deal with the problem by tightening regulations beyond that specific domain.

The results of the instrumental variables estimation are broadly similar to those of the benchmark regressions (Table 7). In particular, the coefficients on home regulatory variables remain negative and statistically significant. The size of the coefficient on the international operations regulatory index in home countries is larger in absolute values than the baseline in column (2), but slightly smaller in column (1). This suggests that our baseline results do not seriously overestimate the impact of regulatory changes on foreign claims because of an endogeneity problem.

Table 7. Estimation with Instrumental Variables

	(1)	(2)
International operations regulatory index (home, change)	-157.99***	-291.57***
	(0.00)	(0.00)
International operations regulatory index (host, change)	31.95	28.92
	(0.27)	(0.37)
Capital regulatory index (home, change)		-113.71***
		(0.00)
Capital regulatory index (host, change)		-2.33
		(0.91)
Exchange rate (home, % appreciation)	1.07***	0.96**
	(0.00)	(0.02)
Exchange rate (host, % appreciation)	-0.07	-0.14
	(0.81)	(0.67)
GDP (home, % change)	0.97***	1.11***
	(0.00)	(0.00)
GDP (host, % change)	0.97***	0.95***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	5.24***	2.77*
	(0.00)	(0.09)
Distance (log, km)	-3.85	-5.07
	(0.27)	(0.21)
Common language dummy	-7.58	-4.09
	(0.42)	(0.66)
Host country's share of claims from home (% in 2007)	0.02	-0.01
	(0.97)	(0.99)
Home country's share of claims on host (% in 2007)	1.42***	1.12***
	(0.00)	(0.00)
Claims (% change from 2005 to 2007)	-0.16**	-0.12
	(0.03)	(0.14)
Observations	690	565
R-squared	0.134	0.142

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

C. **Excluding Claims from Euro Area Countries**

The analysis in IMF (2015) shows that foreign claims from euro area countries declined by more than those from other regions in the post crisis period. Bouvatier and Delatte (2015) found the same pattern. Euro area core countries tightened regulations in the post-crisis period

in a relatively aggressive manner (see Panel 1 of Figure 4). There is therefore the possibility that our benchmark results are driven by the behavior of euro area banks. To investigate this, we re-estimate the benchmark regressions after excluding the claims data from all euro area countries, at a cost of losing a large number of observations.

The results show that our conclusions hold even when we exclude euro area observations (Table 8). The size of many estimated coefficients in the specification including capital regulatory indexes, however, are substantially different from those in Table 3 and look unreasonably high, possibly due to the large drop in the number of observations. In addition, the coefficient on home countries' GDP is significantly negative. That said, the results still show that the coefficient on international operations regulatory index in home countries is significantly negative. The specification excluding the capital regulatory indexes, which does not seem to be seriously affected by the small sample problem, also shows that this coefficient remains significantly negative.

Table 8. Excluding Euro Area Countries as Home Countries

	(1)	(2)
International operations regulatory index (home, change)	-261.51***	-1,037.60***
	(0.00)	(0.00)
International operations regulatory index (host, change)	-20.51	-28.53
	(0.39)	(0.34)
Capital regulatory index (home, change)		-76.57
		(0.12)
Capital regulatory index (host, change)		7.11
		(0.73)
Exchange rate (home, % appreciation)	0.90**	6.35***
	(0.04)	(0.01)
Exchange rate (host, % appreciation)	0.57	0.38
	(0.14)	(0.47)
GDP (home, % change)	0.04	-2.84***
	(0.92)	(0.01)
GDP (host, % change)	1.15***	1.23***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	0.02	23.11**
	(0.99)	(0.02)
Distance (log, km)	6.26	0.50
	(0.21)	(0.95)
Common language dummy	1.74	0.64
	(0.87)	(0.96)
Host country's share of claims from home (% in 2007)	0.97*	1.02**
	(0.06)	(0.05)
Home country's share of claims on host (% in 2007)	0.46	-0.66
	(0.25)	(0.27)
Claims (% change from 2005 to 2007)	-0.25**	-0.18
	(0.02)	(0.14)
Observations	328	230
R-squared	0.227	0.245

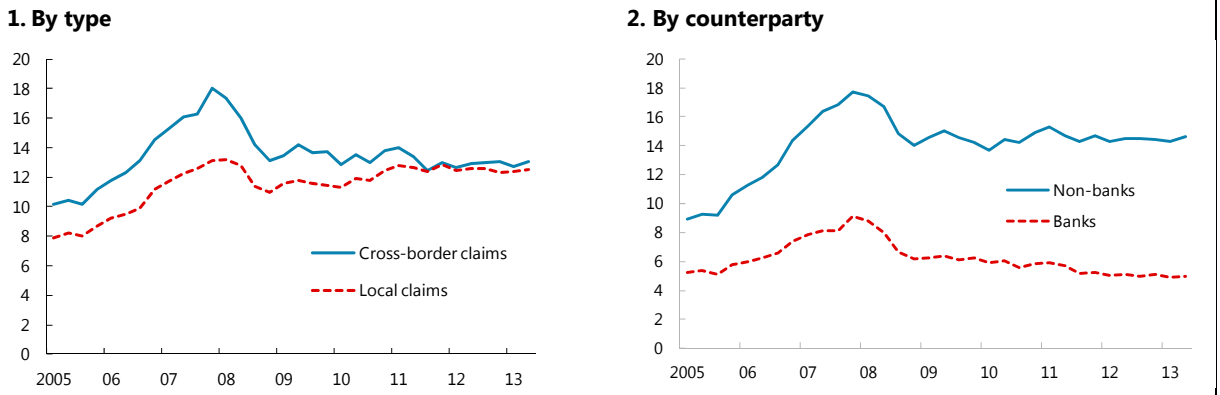
Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VI. Analysis by Subcategories

Cross-border claims have been falling since 2007 and by 2013 were much below their peak level, but local claims have recovered (Figure 5, Panel 1). Looking at counterparty sectors, Panel 2 of Figure 5 shows that foreign claims on (non-affiliated) banks have continued to decline while claims on non-banks have stabilized. These facts motivate a more detailed analysis by subcategories of claims and counterparty sectors, although the smaller number of available observations makes the robustness of the results harder to confirm.

Figure 5. Foreign Banking Claims by Type and Counterparty Sector

(Trillions of U.S. dollars)



Note: Data are from BIS, Consolidated Banking Statistics on an ultimate risk basis. Statistical breaks were adjusted (see Section III for methodological details). Quarterly data were averaged for each year.

Home country regulations on banks' international operations only affect cross-border claims, while tighter home country capital regulations are negatively associated with the growth of both cross-border and local claims (Table 9). The resilience of local lending compared to cross-border lending could thus be partially due to the unresponsiveness of local lending to regulations on banks' international operations. Home countries' GDP growth only affects cross-border claims, which suggests a weaker relationship between local lending and economic conditions in home countries. The physical distance between home and host countries is negatively associated with growth of local lending.[16] This result may suggest a trend toward banking regionalization in the post-crisis period; banks appear to have decreased exposures to far-away countries likely because of larger operating costs or information asymmetries. Local claims are also significantly affected by the two indicators of importance of bilateral claims. In contrast, cross-border claims are not significantly affected by the physical distance and the initial bilateral relationships, which could reflect that cross-border positions may be confined to counterparties with less information asymmetries, relatively

[16] The aggregation of cross-border and local claims makes it harder to detect a relationship between claims and distance, so that the coefficient on distance was statistically significant in only one of the previous specifications (Table 6).

small sunk costs, and/or to host countries where home country banks play a small role with negligible market impacts.

Table 9. Results by Type of Claims

	(1) Cross-border	(2) Cross-border	(3) Local	(4) Local
International operations regulatory index (home, change)	-189.15***	-251.54***	26.07	-133.89
	(0.00)	(0.00)	(0.71)	(0.15)
International operations regulatory index (host, change)	-23.76	-34.03	12.17	-10.81
	(0.23)	(0.12)	(0.65)	(0.70)
Capital regulatory index (home, change)		-64.78***		-79.98***
		(0.00)		(0.00)
Capital regulatory index (host, change)		15.11		-15.30
		(0.33)		(0.50)
Exchange rate (home, % appreciation)	0.90**	0.87*	1.88***	1.25*
	(0.02)	(0.09)	(0.00)	(0.05)
Exchange rate (host, % appreciation)	0.45*	0.33	0.57	0.82*
	(0.10)	(0.33)	(0.13)	(0.08)
GDP (home, % change)	1.24***	1.25***	-0.21	0.75
	(0.00)	(0.00)	(0.63)	(0.12)
GDP (host, % change)	1.02***	0.92***	1.33***	1.37***
	(0.00)	(0.00)	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	1.18	1.88	4.07*	0.60
	(0.53)	(0.35)	(0.10)	(0.82)
Distance (log, km)	-5.02	-3.68	-16.91***	-19.09***
	(0.17)	(0.40)	(0.00)	(0.00)
Common language dummy	-1.67	2.35	24.22*	17.80
	(0.86)	(0.82)	(0.07)	(0.18)
Host country's share of claims from home (% in 2007)	0.29	0.32	0.77**	0.48
	(0.62)	(0.63)	(0.05)	(0.18)
Home country's share of claims on host (% in 2007)	0.47	0.36	0.84***	0.72**
	(0.20)	(0.35)	(0.00)	(0.03)
Claims (% change from 2005 to 2007)	-0.20**	-0.16*	-0.10	-0.21**
	(0.01)	(0.07)	(0.30)	(0.04)
Observations	608	488	429	340
R-squared	0.176	0.180	0.136	0.173

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

International bank borrowing has been negatively affected by regulatory reforms in host countries (Table 10). Regulations specific to banks' international operations in host countries are negatively associated with the growth of foreign claims on banks, but not on non-banks. This can be related to attempts by some host countries to limit the reliance of their banks on wholesale funding, after seeing the consequences of such reliance in increasing contagion.[17]

[17] On the role played by interbank funding during the crisis, see Reinhardt and Riddiough (2014).

Regulations on banks' international operations in home countries have had an effect on lending to non-banks. The results also suggest that the distance between home and host countries and the host country's importance for banks from a given home country respectively only affect claims to non-banks and claims to banks. This result may reflect that distance is an important determinant of operational costs for lending to non-banks, while sunk costs may be larger for interbank lending.

Table 10. Results by Sector of Counterparty

	(1) Non-banks	(2) Non-banks	(3) Banks	(4) Banks
International operations regulatory index (home, change)	-178.57***	-278.17***	40.70	36.02
	(0.00)	(0.00)	(0.50)	(0.64)
International operations regulatory index (host, change)	20.46	26.67	-44.46**	-56.75**
	(0.24)	(0.14)	(0.04)	(0.02)
Capital regulatory index (home, change)		-89.64***		-39.78**
		(0.00)		(0.04)
Capital regulatory index (host, change)		19.45		-9.47
		(0.23)		(0.57)
Exchange rate (home, % appreciation)	-0.04	-0.11	0.88**	0.56
	(0.92)	(0.85)	(0.04)	(0.30)
Exchange rate (host, % appreciation)	0.27	0.04	0.14	0.06
	(0.34)	(0.91)	(0.68)	(0.88)
GDP (home, % change)	1.53***	1.66***	0.80***	0.83**
	(0.00)	(0.00)	(0.01)	(0.01)
GDP (host, % change)	0.80***	0.85***	1.38***	1.25***
	(0.00)	(0.00)	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	3.92**	4.28**	3.69*	3.21
	(0.04)	(0.04)	(0.10)	(0.18)
Distance (log, km)	-7.25*	-9.99**	-1.94	-0.28
	(0.06)	(0.03)	(0.65)	(0.95)
Common language dummy	-0.83	9.29	-3.57	1.54
	(0.94)	(0.41)	(0.73)	(0.88)
Host country's share of claims from home (% in 2007)	-0.54	-0.60	1.85***	1.69***
	(0.18)	(0.19)	(0.00)	(0.01)
Home country's share of claims on host (% in 2007)	0.40	-0.03	0.75	0.22
	(0.12)	(0.93)	(0.16)	(0.65)
Claims (% change from 2005 to 2007)	-0.20***	-0.17**	-0.14*	-0.11
	(0.00)	(0.03)	(0.08)	(0.23)
Observations	584	466	590	472
R-squared	0.151	0.212	0.164	0.154

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VII. CONCLUSION

Using new data on changes in regulations specific to banks' international operations, this paper shows the importance of regulatory tightening in accounting for the post-crisis

sluggishness in international banking. In particular, our empirical analysis suggests that regulatory tightening can explain half of the decline in the foreign lending-to-GDP ratio between 2007 and 2013. Regulatory changes in home countries seem to have been more important than changes in host countries to explain this decline; also regulations targeted at banks' international operations seem to have mattered more than general financial regulatory changes.

The findings suggest that regulatory reforms can affect banks' behavior. The analysis by subcategories of claims suggests that cross-border lending from banks' headquarters has been more affected by changes in regulations on banks' international operations than local lending from banks' affiliates. To the extent that local lending by foreign banks is less pro-cyclical than cross-border lending, the shift in the composition of foreign claims toward more local lending could positively affect financial stability in host countries.[18]

[18] IMF (2015) provides evidence that cross-border banking tends to aggravate adverse domestic and global shocks in host countries while local lending by foreign banks is less sensitive to global shocks than cross-border lending.

APPENDIX: ADDITIONAL ROBUSTNESS CHECKS

Other robustness checks consist of the addition of other regressors, including a banking crisis dummy, a sovereign rating index, real interest rates, a financial openness index, bilateral trade variables, and the share of government-owned banks.

The main results are robust to the inclusion of a home-country banking crisis dummy (Laeven and Valencia, 2012). Banking crises, particularly prevalent in euro area countries since 2007, may have caused both a drop in foreign claims and the implementation of new regulations. Controlling for this variable may thus help to mitigate the potential endogeneity problem and euro area bias. Table A.1 shows that all coefficients that are significant in the baseline models remain significant when the banking crisis dummy is added. The estimated coefficient on the banking crisis dummy is negative although significant only in the first specification.

Table A.1. Controlling for Banking Crises in Home Countries

	(1)	(2)
International operations regulatory index (home, change)	-185.09***	-191.96***
	(0.00)	(0.00)
International operations regulatory index (host, change)	-35.27**	-43.38**
	(0.04)	(0.02)
Capital regulatory index (home, change)		-78.59***
		(0.00)
Capital regulatory index (host, change)		7.88
		(0.57)
Exchange rate (home, % appreciation)	1.25***	0.89**
	(0.00)	(0.02)
Exchange rate (host, % appreciation)	0.22	0.13
	(0.38)	(0.67)
GDP (home, % change)	1.05***	1.07***
	(0.00)	(0.00)
GDP (host, % change)	1.05***	0.98***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	3.80**	2.76*
	(0.02)	(0.10)
Distance (log, km)	-6.45*	-5.19
	(0.06)	(0.19)
Common language dummy	-12.12	-5.91
	(0.19)	(0.53)
Host country's share of claims from home (% in 2007)	0.98**	0.90*
	(0.03)	(0.06)
Home country's share of claims on host (% in 2007)	0.82***	0.69**
	(0.01)	(0.03)
Claims (% change from 2005 to 2007)	-0.17**	-0.14*
	(0.02)	(0.09)
Banking crisis dummy (home, change)	-37.67***	-14.76
	(0.00)	(0.16)
Observations	726	597
R-squared	0.182	0.204

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Including as a regressor an index of sovereign rating changes in home countries also does not

change the results (Table A.2). The index represents the number of notches the sovereign rating improved between 2007 and 2013. The motivation for including this variable is the same as for the banking crisis dummy, i.e., controlling for the potential endogeneity of regulations and bias due to euro area countries, which experienced sovereign debt crises associated with banking crises. The coefficient on the rating index is insignificant in both specifications.

Table A.2. Controlling for Sovereign Ratings in Home Countries

	(1)	(2)
International operations regulatory index (home, change)	-180.51***	-195.46***
	(0.00)	(0.00)
International operations regulatory index (host, change)	-41.06**	-43.91**
	(0.02)	(0.02)
Capital regulatory index (home, change)		-86.13***
		(0.00)
Capital regulatory index (host, change)		7.68
		(0.58)
Exchange rate (home, % appreciation)	1.41***	1.40**
	(0.00)	(0.01)
Exchange rate (host, % appreciation)	0.18	0.12
	(0.50)	(0.69)
GDP (home, % change)	0.56	0.41
	(0.16)	(0.40)
GDP (host, % change)	0.97***	0.94***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	5.78***	4.74**
	(0.00)	(0.01)
Distance (log, km)	-4.03	-3.45
	(0.24)	(0.36)
Common language dummy	-6.76	-2.92
	(0.48)	(0.76)
Host country's share of claims from home (% in 2007)	0.76	0.88*
	(0.10)	(0.07)
Home country's share of claims on host (% in 2007)	1.26***	0.67**
	(0.00)	(0.05)
Claims (% change from 2005 to 2007)	-0.17**	-0.13
	(0.03)	(0.11)
Sovereign rating index (home, change)	2.42	3.28
	(0.17)	(0.12)
Observations	687	597
R-squared	0.175	0.206

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The inclusion of real interest rates in both home and host countries do not change the main results, though the sign of the estimated coefficients is counterintuitive (Table A.3). Columns (1) and (2) correspond to the results with real short-term rates while columns (3) and (4) show the results with real long-term rates. The inclusion of these regressors tries to control for the effects of accommodative monetary policies adopted in the wake of the crisis (see Bremus and Fratzscher, 2015). The results, particularly those regarding the effect of the regulatory indexes in home countries, are robust. Interest rates in host countries are negatively associated with the changes in foreign claims; this is inconsistent with the view that higher interest rates would attract foreign lending but which confirms previous findings in the literature (Bremus and Fratzscher 2015; IMF 2014). The coefficient on the short-term interest rate in home

countries is positive in the first specification—column (1)—which also contradicts a prevailing view. These counter-intuitive signs may reflect the unwinding of carry trades positions, which were taken before the crisis.[19] Another possible explanation would be the endogeneity of interest rates to international banking flows.[20]

Table A.3. Controlling for Real Interest Rates

	(1)	(2)	(3)	(4)
International operations regulatory index (home, change)	-176.56***	-188.83***	-184.23***	-160.37***
	(0.00)	(0.00)	(0.00)	(0.00)
International operations regulatory index (host, change)	-37.84**	-43.63**	-35.47	-29.26
	(0.03)	(0.02)	(0.11)	(0.25)
Capital regulatory index (home, change)		-76.80***		-44.35***
		(0.00)		(0.01)
Capital regulatory index (host, change)		7.23		7.40
		(0.59)		(0.63)
Exchange rate (home, % appreciation)	0.08	0.12	-0.21	-0.92
	(0.89)	(0.86)	(0.68)	(0.23)
Exchange rate (host, % appreciation)	0.22	0.10	-0.50	-0.65
	(0.37)	(0.73)	(0.11)	(0.12)
GDP (home, % change)	1.44***	1.38***	1.61***	1.84***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP (host, % change)	1.12***	1.08***	1.25***	1.11***
	(0.00)	(0.00)	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	6.33***	4.57**	10.53***	8.98***
	(0.00)	(0.01)	(0.00)	(0.00)
Distance (log, km)	-4.72	-5.26	-5.02	-7.46*
	(0.19)	(0.20)	(0.14)	(0.07)
Common language dummy	-10.34	-5.91	-21.25**	-15.05
	(0.29)	(0.55)	(0.03)	(0.13)
Host country's share of claims from home (% in 2007)	0.36	0.47	0.63	0.48
	(0.43)	(0.34)	(0.23)	(0.38)
Home country's share of claims on host (% in 2007)	1.63***	1.15***	1.13***	0.84**
	(0.00)	(0.00)	(0.00)	(0.04)
Claims (% change from 2005 to 2007)	-0.16**	-0.14*	-0.26***	-0.22**
	(0.03)	(0.09)	(0.01)	(0.05)
Real short-term interest rate (home, % points)	6.85**	5.08		
	(0.04)	(0.18)		
Real short-term interest rate (host, % points)	-4.82***	-4.63***		
	(0.00)	(0.00)		
Real long-term interest rate (home, % points)			-1.05	0.25
			(0.65)	(0.93)
Real long-term interest rate (host, % points)			-4.84***	-4.55***
			(0.00)	(0.01)
Observations	674	566	441	359
R-squared	0.208	0.228	0.268	0.255

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[19] Ichiue and Koyama (2011) suggest that carry trade positions were unwounded after the bankruptcy of Lehman Brothers in September 2008 to a greater extent than explained by the changes in interest rate differentials.

[20] Empirically examining the effect of monetary policies on capital flows is challenging, in part because interest rates are endogenous to capital flows.

The results remain broadly unaltered when controlling for financial openness (Table A.4). An increase in host country financial openness (measured by the Chinn and Ito 2006 index) is associated with a stronger growth of foreign claims, which is an intuitive result.

Table A.4. Controlling for Financial Openness

	(1)	(2)
International operations regulatory index (home, change)	-174.15***	-187.99***
	(0.00)	(0.00)
International operations regulatory index (host, change)	-30.62*	-42.75**
	(0.07)	(0.02)
Capital regulatory index (home, change)		-79.45***
		(0.00)
Capital regulatory index (host, change)		1.54
		(0.91)
Exchange rate (home, % appreciation)	0.79**	0.67
	(0.02)	(0.11)
Exchange rate (host, % appreciation)	0.22	0.19
	(0.36)	(0.51)
GDP (home, % change)	1.01***	1.06***
	(0.00)	(0.00)
GDP (host, % change)	1.14***	1.10***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	5.41***	3.18*
	(0.00)	(0.05)
Distance (log, km)	-1.50	-1.43
	(0.68)	(0.74)
Common language dummy	-7.38	-3.71
	(0.43)	(0.69)
Host country's share of claims from home (% in 2007)	0.71	0.83*
	(0.11)	(0.09)
Home country's share of claims on host (% in 2007)	1.41***	0.96***
	(0.00)	(0.00)
Claims (% change from 2005 to 2007)	-0.20***	-0.17**
	(0.00)	(0.03)
Chinn-Ito index (home, change)	-22.81*	-7.56
	(0.08)	(0.61)
Chinn-Ito index (host, change)	32.15***	30.55***
	(0.00)	(0.00)
Observations	707	580
R-squared	0.202	0.224

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results are also robust to adding bilateral trade variables to the regression (Table A.5.). Columns (1) and (2) report the results controlling for imports growth while columns (3) and (4) report the results controlling for the growth rate of trade (the sum of imports and exports). Both the theoretical and empirical literatures show a positive relationship between bilateral equity holdings and bilateral imports (Obstfeld and Rogoff 2001; Coeurdacier 2009). The trade growth variable is added following Lane and Milesi-Ferretti (2008), who examine the determinants of equity holdings. Our results, however, do not confirm a strong relationship between foreign banking claims and these trade variables.

Table A.5. Controlling for Trade

	(1)	(2)	(3)	(4)
International operations regulatory index (home, change)	-193.25***	-199.63***	-185.89***	-198.75***
	(0.00)	(0.00)	(0.00)	(0.00)
International operations regulatory index (host, change)	-32.57*	-42.88**	-31.68*	-42.70**
	(0.07)	(0.03)	(0.08)	(0.03)
Capital regulatory index (home, change)		-77.59***		-77.63***
		(0.00)		(0.00)
Capital regulatory index (host, change)		6.16		6.40
		(0.66)		(0.65)
Exchange rate (home, % appreciation)	1.10***	0.85**	1.06***	0.83**
	(0.00)	(0.03)	(0.00)	(0.03)
Exchange rate (host, % appreciation)	0.16	0.08	0.14	0.07
	(0.52)	(0.79)	(0.59)	(0.82)
GDP (home, % change)	0.96***	1.00***	0.99***	1.05***
	(0.00)	(0.00)	(0.00)	(0.00)
GDP (host, % change)	0.90***	0.95***	1.03***	0.99***
	(0.00)	(0.00)	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	4.39***	2.85*	4.41***	2.78*
	(0.01)	(0.07)	(0.01)	(0.07)
Distance (log, km)	-2.71	-2.70	-3.08	-2.85
	(0.44)	(0.50)	(0.38)	(0.48)
Common language dummy	-7.85	-4.60	-8.81	-5.21
	(0.39)	(0.62)	(0.34)	(0.58)
Host country's share of claims from home (% in 2007)	0.77*	0.93*	0.84*	0.95**
	(0.09)	(0.05)	(0.06)	(0.05)
Home country's share of claims on host (% in 2007)	1.57***	1.08***	1.57***	1.09***
	(0.00)	(0.00)	(0.00)	(0.00)
Claims (% change from 2005 to 2007)	-0.20***	-0.16**	-0.19***	-0.16**
	(0.01)	(0.04)	(0.01)	(0.04)
Imports (% change)	0.09	-0.00		
	(0.42)	(0.97)		
Trade (% change)			-0.04	-0.05
			(0.78)	(0.71)
Observations	694	569	694	569
R-squared	0.182	0.205	0.181	0.205

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Finally, the results are robust to controlling for the share of government-owned banks (see Huston et al., 2012 ; and Bremus and Fratzscher, 2015). To mitigate the endogeneity problem arising from the behavior of government-owned banks in response to the crisis, we only add the share of these banks in the system in 2006. The expected results are theoretically ambiguous. Government-owned banks benefitted from government's support during the crisis, making them more likely to maintain their foreign exposures (home country perspective) or reducing their riskiness as counterparty for foreign lenders (host country perspective).[21] At the same time, government-owned banks may have been instructed to prioritize lending in their own country over lending abroad (home country perspective) and this behavior may have crowded out lending from foreign banks (host country perspective). Our results provide some

[21] Cull and Martínez Pería (2013) find that government-owned banks in Eastern Europe did not act counter-cyclically. In contrast, Hawkins and Mihaljek (2001) show that, during the financial crises in Asia and Latin America in the 1990s, government-owned banks did expand credit faster (or cut it less) than domestic and foreign private banks. In the recent crisis, government banks in some of the Central Asian economies were better able to maintain credit growth rates than private banks, especially foreign-owned ones (de Haas et al., 2012).

support to the view that a large presence of government-owned banks in the home country has a positive effect on the growth rate of claims, although the coefficient is only significant at the 10 percent level in the first specification (Table A.6). The results for the other variables, particularly the regulatory indexes, continue to hold.

Table A.6. Controlling for the Presence of Government-Owned Banks

	(1)	(2)
International operations regulatory index (home, change)	-246.73***	-244.55***
	(0.00)	(0.00)
International operations regulatory index (host, change)	-41.11**	-43.07**
	(0.02)	(0.03)
Capital regulatory index (home, change)		-44.45***
		(0.01)
Capital regulatory index (host, change)		17.78
		(0.27)
Exchange rate (home, % appreciation)	1.34***	1.13***
	(0.00)	(0.01)
Exchange rate (host, % appreciation)	0.25	0.12
	(0.38)	(0.71)
GDP (home, % change)	0.32	0.51*
	(0.24)	(0.08)
GDP (host, % change)	0.84***	0.84***
	(0.00)	(0.00)
Bank capital to total assets (home, % in 2007)	2.89*	2.25
	(0.06)	(0.15)
Distance (log, km)	-1.86	-2.60
	(0.62)	(0.51)
Common language dummy	8.35	4.14
	(0.40)	(0.68)
Host country's share of claims from home (% in 2007)	0.65	0.60
	(0.19)	(0.23)
Home country's share of claims on host (% in 2007)	0.94***	0.79**
	(0.00)	(0.02)
Claims (% change from 2005 to 2007)	-0.13*	-0.12
	(0.08)	(0.15)
Government-owned bank share (home, % in 2006)	0.70*	0.40
	(0.07)	(0.30)
Government-owned bank share (host, % in 2006)	0.08	-0.03
	(0.75)	(0.90)
Observations	613	545
R-squared	0.141	0.158

Robust p-value in parentheses
*** p<0.01, ** p<0.05, * p<0.1

REFERENCES

Barth, James R., Gerard Caprio, and Ross Levine. 2013. "Bank Regulation and Supervision in 180 Countries from 1999 to 2011." Working Paper 18733, National Bureau of Economic Research, Massachusetts.

Bernanke, Ben S. 2005. "The Global Saving Glut and the U.S. Current Account Deficit." Remarks at the Sandridge Lecture, Virginia Association of Economists, Richmond, Virginia, March 10.

Bouvatier, Vincent and Anne-Laure Delatte. 2015. "Waves of International Banking Integration: A Tale of regional Differences." European Economic Review, 80: 354–373.

Bremus, Franziska, and Marcel Fratzscher. 2015. "Drivers of Structural Change in Cross-Border Banking since the Global Financial Crisis." *Journal of International Money and Finance*: 52(C), 32–59.

Cerutti, Eugenio. 2013. "Banks' Foreign Credit Exposures and Borrowers' Rollover Risks: Measurement, Evolution and Determinants." Working Paper 13/9, International Monetary Fund, Washington.

Cerutti, Eugenio and Stijn Claessens. 2014. "The Great Cross-Border Bank Deleveraging: Supply Side Characteristics." Working Paper 14/180, International Monetary Fund, Washington.

Cetorelli, Nicolas, and Linda S. Goldberg. 2011. "Global Banks and International Shock Transmission: Evidence from the Crisis." *IMF Economic Review* 59 (1): 41–76.

Claessens, Stijn, and Neeltje Van Horen. 2014a. "The Impact of the Global Financial Crisis on Banking Globalization." Working Paper 14/197, International Monetary Fund, Washington.

Claessens, Stijn, and Neeltje Van Horen. 2014b. "Location Decisions of Foreign Banks and Competitor Remoteness," *Journal of Money Credit and Banking* 46(1): 145–170.

Coeurdacier, Nicolas. 2009. "Do trade costs in goods market lead to home bias in equities?" *Journal of International Economics* 77(1): 86–100.

Cull, Robert, and María Soledad Martínez Pería. 2010. "Foreign Bank Participation in Developing Countries. What Do We Know about the Drivers and Consequences of this Phenomenon." Policy Research Working Paper 5398, World Bank, Washington.

De Haas, Ralph, and Neeltje Van Horen. 2012. "International Shock Transmission after the Lehman Brothers Collapse: Evidence from Syndicated Lending." *American Economic Review: Papers & Proceedings* 102(3): 231–237.

Demirgüç-Kunt, Asli, and Enrica Detragiache. 2002. "Does Deposit Insurance Increase Banking System Stability? An Empirical Investigation." *Journal of Monetary Economics* 49 (7): 1373–1406.

Goldberg, Lawrence G. and Denise Johnson. 1990. "The determinants of US banking activity abroad" *Journal of International Money and Finance* 9 (2): 123–137.

Hawkins, John and Dubravko Mihaljek. 2001. "The Banking Industry in the Emerging Market Economies: Competition, Consolidation and Systemic Stability: an Overview." BIS Papers Chapters (4): 1–44.

Houston, Joel, Chen Lin, and Yue Ma. 2012. "Regulatory Arbitrage and International Bank Flows." *Journal of Finance* 67 (5): 1845–895.

Ichiue, Hibiki and Kentaro Koyama. 2011. "Regime switches in exchange rate volatility and uncovered interest parity." *Journal of International Money and Finance*: 30(7), 1436–1450.

International Monetary Fund (IMF). 2014. "Global Liquidity—Issues for Surveillance." IMF Policy Paper, International Monetary Fund, Washington.

———. 2015. "International Banking After the Crisis: Increasingly local and Safer?" *Global Financial Stability Report*, Chapter 2, April: 55–91.

Kapan, Tümer, and Camelia Minoiu. 2013. "Balance Sheet Strength and Bank Lending during the Global Financial Crisis." Working Paper 13/102, International Monetary Fund, Washington.

Laeven, Luc, and Fabian Valencia. 2013. "Systemic Banking Crises Database." *IMF Economic Review* 61 (2): 225–70.

Lane, Philip R., and Gian Maria Milesi-Ferretti. 2008. "International Investment Patterns." *The Review of Economics and Statistics* 90 (3): 538–549.

McGuire, Patrick and Philip Wooldridge. 2005. "The BIS Consolidated Banking Statistics: Structure, Uses and Recent Enhancements." BIS Quarterly Review, September: 73–86.

Obstfeld, Maurice, and Kenneth Rogoff. 2001. "The Six Major Puzzles in International Macroeconomics: Is There a Common Cause?" NBER Chapters, in: *NBER Macroeconomics Annual 2000* (15): 339–412.

Ongena, Steven, Alexander Popov, and Gregory F. Udell. 2013. "'When the Cat's Away the Mice Will Play': Does Regulation at Home Affect Bank Risk-taking Abroad?" *Journal of Financial Economics* 108 (3): 727–50.

Reinhardt, Dennis, and Steven J. Riddiough. 2014. "The Two Faces of Cross-Border Banking Flows: An Investigation into the Links between Global Risk, Arms-length Funding and Internal Capital Markets." Bank of England Working Paper 498.

Rose, Andrew K. 2004. " Do We Really Know that the WTO Increases Trade?" *American Economic Review* 94 (1): 98–114.

Van Rijckeghem, Caroline, and Beatrice Weder di Mauro. 2014. "Deglobalization of Banking: The World is Getting Smaller." Discussion Paper 10139, Center for Economic Policy and Research, London.

White, Halbert. 1980. "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica* 48 (4): 817–38.