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The Great Cross-Border Bank Deleveraging: Supply Constraints and Intra-Group Frictions*

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Abstract

International banks greatly reduced direct cross-border and local affiliates' lending as the global financial crisis strained their balance sheets, lowered borrower demand, and altered government policies. Using bilateral lender–borrower data and controlling for demand, we show that reductions largely varied in line with markets' prior assessments of banks' vulnerabilities, with financial statements' and lender–borrower data playing minor roles. Those banking systems subject to less market discipline, however, were less sensitive to markets' perceptions. Moving resources within banking groups became more restricted as drivers of reductions in direct cross-border loans differed from those for local affiliates' lending, especially for more impaired banking systems.

JEL classification: E44, F23, F36, G21

1. Introduction

The global financial crisis (GFC) has seen a large retrenchment in cross-border banking, with aggregate gross foreign-banking claims, as of end-2013, some 20% below their pre-crisis peak in June 2008 of USD 30 trillion, with direct cross-border (i.e., lending by headquarters directly to borrowers in a different country) declining by 23%, and with local affiliates' (subsidiaries and branches) lending by only 5%. These developments reflect three groups of factors: (1) a weakening in loan demand, given worsened economic prospects, and increased default as well as other risks of borrowers; (2) deteriorating balance sheets of

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many advanced countries' international banks, including capital shortfalls and liquidity strains, especially so from 2008 to 2009 and notably for banks in advanced countries (as well as pressures from markets on these banks to improve their financial positions), and (3) increased regulatory constraints and greater uncertainty about the future shape of, and rules governing, the international banking system, including the ability to freely move resources within banking groups and across borders. These three factors led banks to not only rebalance their operations away from cross-border banking activities, but also to do so in specific ways, notably to reduce their direct cross-border bank lending more than their affiliate lending to the same countries.

This article analyzes the factors driving these developments with two objectives in mind. The first objective is to analyze the role of supply factors in driving changes in international bank lending. The second one is to identify the motivations and constraints driving banks' specific form of retrenchment—that is, direct cross-border or local foreign affiliates' lending.

In addressing the first objective, the role of supply factors, the challenge is not to use data that ex-post reflect the actual behavior of banks during the GFC. Financial statements from during or after the deleveraging period—for example, non-performing loans (NPLs) or capital adequacy—and market valuation of banks—that is, stock prices—would reflect, in part, the actual losses and deleveraging of banks and associated reductions in capital and (future) profitability. As such, many cannot be used to explain banks' behavior during the GFC. A more meaningful question to ask and seek to answer is: what ex-ante factors affect banks' decisions to deleverage during periods of financial stress? Specifically, what lender banking system and home country characteristics prior to a shock help explain subsequent reductions in cross-border bank lending? Also, do banks deleverage in response to weak pre-crisis accounting indicators, and possibly related regulatory actions, and are banks affected and incentivized by financial market pressures? And between financial statements and market indicators, which best capture the pressures and incentives that banks faced and acted on?

The second objective, of identifying the potential presence of frictions and limitations on intra-group lending, is more challenging. It starts with identifying whether similar supply factors drove the deleveraging of direct cross-border and local foreign affiliates' lending. In normal times, banks can move capital and liquidity relatively freely within the banking group, thus freely choosing between direct cross-border lending and local affiliates' lending to the same borrowers. This would also imply that direct cross-border and local foreign affiliates' lending respond similarly (but not necessarily proportionally) to supply shocks. In principle, this could remain the case in times of financial turmoil if there are no (more) frictions and limitations on intra-banking-group lending. But is this the case during an event like the GFC? Frictions involving heightened intra-group constraints and formal and informal regulatory actions limiting the transfers of funds are more likely during such periods of extreme financial turmoil. Did banks consequently chose one form over the other? And was this on the basis of their own internal choices, or because of regulatory and other changes at the lender- or borrower-country levels?

For both objectives, we need to control for the changes in the demand for cross-border loans and other borrower-related factors, as well as for general time-varying factors, such as changes in global financial markets and economic prospects. We do this using an event methodology and by exploiting the rich, bilateral cross-border banking dataset from the Bank of International Settlements (BIS), which we enhanced in several ways. We focus on the deleveraging episode around the peak of the GFC, when we can expect to see a large impact of supply factors. And we exploit the bilateral nature of our data to control for

changes in economic activities and prospects in the borrower country. Specifically, since various lender banking systems all face the same demand conditions in a given borrower country, relative differences in changes in bilateral lending must represent differences arising from the supply side or specific lender–borrower relationships. Controlling for changes in economic activity and prospects in the borrower country this way, that is, demand conditions, we can also study the role of lender–borrower characteristics: distance, trade links, and common institutions.

In terms of the second objective, we cannot directly test for the presence of frictions and limitations, since there are no data available on intra-group lending at the international level nor good indicators on (changes in) regulatory barriers for a large sample of countries. Studying differences in how direct cross-border lending and local affiliates' lending to a given borrower respond to the same set of factors, however, provides valuable insights. With no frictions, cross-border and local affiliate claims can be expected to react relatively similarly to supply shocks in home banking systems. With frictions, the two forms of lending could respond differently, as when capital and liquidity are "trapped" and/or "ring-fenced" within affiliates, leading to sharp(-er) declines in direct cross-border lending as affiliates cannot support their parent banks. Questions on intra-group transfers are of relevance as foreign bank presence has increased sharply around the world over the past two decades, with affiliate lending taking on greater importance (e.g., it increased from 40% of BIS foreign claims in 2007 to more than 50% in 2012). And evidence of barriers within banking groups or from regulatory actions is of current policy interest given the large ongoing changes in international banking and increased concerns about fragmentation.

In addressing the two sets of questions, we innovate relative to the existing literature, reviewed in the next section, in three ways. First, we analyze how banking systems adjust their international operations in response to ex-ante, that is, before a crisis period, vulnerabilities. The ex-ante data we use include accounting balance sheet indicators, as is standard in the literature, and also market-based measures. For the latter, we use the Systemic Risk Contribution (SRISK) measure developed by Acharya *et al.* (2010) and adapted to our context by expressing it as a ratio of banks' Tier I capital. Second, we are the first to directly exploit differences between the behavior of direct cross-border banking and local affiliates' (both subsidiaries' and branches') lending. This helps to better characterize the deleveraging process, since local lending has become much more important, and also to identify the potential presence of (additional) frictions in intra-group lending during the GFC. Third, based on the methodology developed by Cerutti (2015), we adjust the BIS data to take into account effects of breaks-in-coverage in time series and exchange rate variations, allowing for a more meaningful representation of the evolution of banks' foreign claims.

We find that reductions in cross-border and affiliates' lending largely vary with our ex-ante, market-based measures of creditor banks' vulnerabilities SRISK (with banking systems subject to less market discipline, being less sensitive to markets' perceptions), while pre-crisis financial statement indicators and creditor–borrower characteristics (e.g., geographical proximity, trade relationships, and historical relationships) play minor roles in explaining cross-country heterogeneity. Although we find lower power in explaining the overall heterogeneity in the deleveraging, some of the factors identified have large economic impact, notably for specific groups of borrower–lender characteristics. For example, having a colonial tie after 1945 implied, keeping other factors constant, about 25% higher direct cross-border lending, capturing mostly the situation of several French colonies. Similarly,

having one's lender in a contiguous country implied about 10–15% higher direct cross-border lending; having the same language implied 15–20% higher affiliates claims.

We also find evidence of some barriers to the movement of intra-group resources across borders in that those supply factors explaining the patterns in reductions in banks' cross-border lending do not explain movements in local affiliates' lending similarly. For example, for direct cross-border a move from the 25 percentile of SRISK to the 75 percentile would imply a drop in direct cross-border of about 7% but no statistically significant change for affiliate lending. And substitution between cross-border and affiliates' lending is less likely for those home banking systems with higher ex-ante market-based vulnerabilities, indicating that some affiliates may have been prevented from moving resources back to headquarters to compensate for cutbacks in direct cross-border lending. In those countries, where creditor banks' governments intervened during the systemic crisis, however, banks reduced both direct cross-border and affiliates lending equally, possibly reflecting a large induced home bias.

The article proceeds as follows. Section 2 reviews the literature that tries to identify the factors behind cross-border banking flows, relates the contribution of this article to the existing literature, and develops the hypotheses we test. Sections 3 and 4 describe the data and methodology, and the regression results and robustness tests, respectively. Section 5 concludes and provides avenues for possible further research.

2. Literature review, Contributions, and Hypotheses

2.1 Literature Review

This article relates to three main strands of research. The first and closest strand includes those papers that investigate changes in international bank activities (without fully distinguishing the types, cross-border versus affiliates) using BIS data around periods of financial stress. A key contribution is Cetorelli and Goldberg (2011), which shows that banks reduced their international activities in the fall of 2008 and the first part of 2009 in response, in part, to a shortage of dollar funding. McGuire and von Peter (2009) also show how dollar funding shortages help explain the behavior of cross-border banking flows during this period.

Other studies note that bank behavior can vary considerably, in part related to the importance and funding conditions of local subsidiaries, and the distance between creditor and borrower country. Cull and Martinez Peria (2012) show that in eastern Europe, foreign banks cut loans back more than domestic private banks did, but not so in Latin America with the difference argued to be driven by the fact that foreign banks in Latin America were mostly funded through domestic deposits, in part due to regulatory requirements (see also Kamil and Rai, 2010). Claessens and Van Horen (2013) show that foreign banks reduced credit more compared with domestic banks in countries where they had a small role, but not so when dominant or funded locally. Also Bremus and Fratzscher (2015) analyze the drivers of structural change in cross-border banking since the GFC and Van Rijckeghem and Weder di Mauro (2014) analyze the drivers of the "flight to home" observed for many banking systems during the GFC. And Claessens and Van Horen (2015) document the large changes in foreign bank presence since the GFC and review, using annual data, the differences in the behavior of aggregate cross-border and individual foreign banks' local subsidiaries lending (which thus do not include lending by branches).

A second set of papers uses detailed micro data, typically on large syndicated loans, to study the variation therein across creditor and borrower countries. This type of data allows controlling for many individual borrower and bank characteristics, including

changes in demand at the borrower level (e.g., using borrower fixed effects). Using these data, Giannetti and Laeven (2012) and De Haas and Van Horen (2013) report evidence of a "flight home" or "flight to core markets" effect—that is, after the GFC banks engaged less in cross-border lending, and rather lent to borrowers at home. Ongena, Peydro, and Van Horen (2013) find that foreign banks in eastern European countries reduced the supply of credit more compared with locally funded domestic banks but not compared with domestic banks that funded themselves more from international capital markets before the crisis.

In a related study, De Haas and Van Horen (2012) find that banks facing balance sheet constraints (such as losses on toxic assets or dependence on wholesale funding) reduced their cross-border syndicated loans but were more likely to stay committed to countries in which they had a subsidiary, especially in countries with weak institutions. This suggests that having local affiliates provides for specific information about borrowers, allowing them to continue to be willing to extend loans, presumably profitably. It also suggests that there are limits to moving funds intra-bank, perhaps because of (greater) internal frictions, regulatory and other barriers erected by the host country, or pressures from home country authorities. And Hale, Kapan, and Minoiu (2014) show the transformations in the global banking network of syndicated loans due to the crisis.

A third strand of literature investigates how internationally active banks altered their operations due to financial turmoil or in response to regulatory changes. Cetorelli and Goldberg (2012a, 2012b) show how US banks adjusted their inter-office funding and claims in response to variations in domestic liquidity. Using a broad set of international banks, De Haas and Van Lelyveld (2014) and Ivashina and Scharfstein (2010) show that banks reduced their cross-border and syndicated lending as a function of their pre-crisis exposure to wholesale funding shocks. And Kapan and Miniou (2013) find that this effect was smaller for well-capitalized banks. Aiyar *et al.* (2014) show that UK banks and UK-based subsidiaries curtailed foreign lending during the 2000s in response to higher capital requirements. Aiyar, Calomiris, and Wieladek (2014) find that in response to these same measures, UK-based branches of foreign banks increased their share of local lending, a sign of regulatory arbitrage. These last two studies thus show that the net effects of capital shocks or regulatory changes on overall cross-border and local lending can be ambiguous.

Related work on the internal capital markets of global banks has found that banks can, to some extent, reallocate funds and liquidity across locations in response to host country crises. This has been shown indirectly by comparing, in several countries, the performance of foreign affiliates and domestic banks (De Haas and Lelyveld, 2010), and directly for US banks using supervisory data (Cetorelli and Goldberg, 2012a). Evidence is not consistent, however, for the GFC. De Haas and Lelyveld (2014) do not find evidence of an active internal capital market. Furthermore, the evidence is not as strong using US data after the Lehman bankruptcy, possibly due to the expansion of dollar swaps by central banks (Cetorelli and Goldberg, 2012a, 2012b). This may be due to "ring-fencing" episodes during the GFC, for which Cerutti and Schmieder (2014) present anecdotal evidence and for which D'Hulster (2014) analyzes avenues of how it can be done. And banks that received government support may have been incentivized to reduce, including by selling, their international activities (further).[1]

1 As part of government support, banks were often asked to focus on domestic lending during the GFC. For example, French banks that tapped government assistance pledged to increase lending

2.2 Contributions

Our article expands on and complements these three strands of papers in several ways. First, we explore how banking systems adjust their international operations, both cross-border and affiliate lending, in response to ex-ante (i.e., before the crisis) vulnerabilities. We capture these vulnerabilities using both market-based and accounting indicators. Using pre-crisis data allows us to avoid endogeneity caused by the possibility that banks' actual actions are reflected in market assessments or their financial statements. This way we obtain behavioral responses and more forward-looking insights as to how banks adjust their operations in response to market and balance sheet pressures.

Second, we analyze changes in both cross-border banking and local affiliates' lending, using the fact that the sample contains many lender banking systems with direct cross-border and affiliates' lending to the same borrower countries.[2] With international banks today having a local presence in many countries—the market share of foreign banks increased from an average of 20% in the 1990s to more than 35% just before the financial crisis, with shares in some countries of more than 90% (Claessens and Van Horen, 2014)—many can choose how to lend to a given borrower. But we find evidence that internal market and regulatory frictions can prevent a smooth substitution between the two.

Third, we are very careful in correcting data for changes in coverage and exchange rate-related valuation effects when using BIS data. As shown by Cerutti (2015), such corrections are necessary for proper interpretation and analysis as they can make for large differences with the original series. One notable example is the change in coverage of BIS banking statistics as some investment banks in the USA became commercial banks in 2009:Q1, which boosted US foreign banking assets by USD 1.3 trillion. Another notable example is the large effect of the sharp movement in the dollar/euro exchange rate over 2008–09. BIS banking claims are reported in US dollars, so an important source of variation in claims during the period under study originates from exchange rate movements, and not from changes in underlying positions. Altogether, the aggregated amount of adjustments was some USD 1 trillion in each quarter during the period 2008–09, the distribution was far from uniform across lender–borrower country pairs.

Another advantage of using BIS data is that we fully capture on-balance-sheet international banking activities. Although data on individual syndicated loans provide more detail than BIS data in many dimensions (e.g., bank and borrower information which in turn allows to better control for demand conditions), it has some limitations, as Cerutti, Hale, and Minoiu (2015) show: (i) partial coverage of cross-border lending activity (specifically, syndicated loans represent only up to one-third of total cross-border lending); (ii) much of syndicated loan data refer to credit lines rather than actual disbursements (and information on whether credit lines are drawn is not available); and (iii) it is difficult to exactly identify individual participation shares for each syndicate member (individual loan shares are available for less than half of the loans). BIS data represent the universe of cross-border claims,

by 3–4% annually, and ING announced that it would extend €25 billion to Dutch businesses and consumers when it received another round of government assistance (World Bank, 2009).

2 We use the BIS consolidated banking statistics at ultimate risk basis, which, unlike the BIS data at immediate risk basis used in many other papers in the literature, provide a clean distinction between banks' direct cross-border lending and affiliates (both subsidiaries and branches) lending. As far as we know, our article has been the first one to use this important distinction in the analysis of cross-border deleveraging.

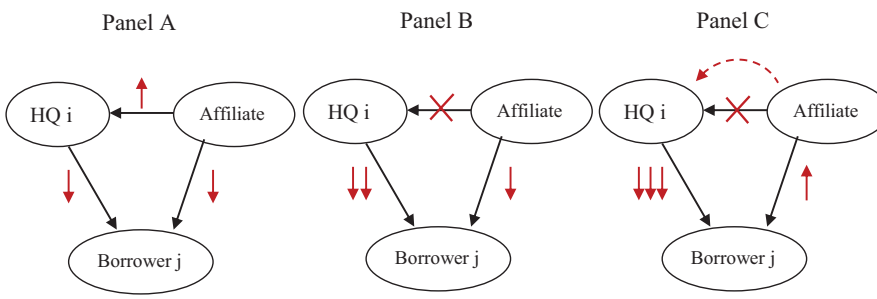
including local lending by subsidiaries as well as branches (coverage is complete from the lender source points of view). We also cover most (borrower) countries (about 120), allowing us to explore differences by both lender and borrowing country and their combinations.

2.3 Hypotheses

Our first hypothesis relates to the roles of ex-ante supply and lender–borrower factors in driving changes in international banking lending is relatively straightforward to test. It covers the following questions: To what extent, controlling for credit demand, do banks deleverage in response to ex-ante market pressures and to what extent do they deleverage to financial statement indicators? Which of these variables are the most important? What role do lender–borrower characteristics—such as distance, trade links, and common institutions—play in deleveraging?

Our second hypothesis relates to the motivations and constraints driving particular forms of deleveraging (i.e., direct cross-border versus affiliates' lending) and is more challenging to test, especially given the current lack of intra-banking group lending data at the international level. It involves analyzing how direct cross-border and affiliates' lending respond to shocks, to indirectly provide insights on the presence of barriers (or the lack thereof) on intra-group transfers. Specifically, it seeks evidence for any of the three scenarios to shocks to home banking systems that can be envisioned (see text chart 1).

Potential evolution of direct cross-border claims and affiliates' claims



Notes: Upward arrows denote increases and downward arrows denote decreases.

In the first scenario, depicted in panel A, the internal capital markets of banking groups are unconstrained and equally transmit shocks across all parts of the groups. In this case, as shown in panel A, a negative supply shock to lender home banking system *i* can be expected to lead not only to a reduction in direct cross-border lending to borrower *j*, but also to funds flowing from banks' affiliates in country *j* to headquarters *i* (through the internal capital market) with an associated reduction of affiliates' lending to borrower *j*. Note that while both direct cross-border and affiliates' lending are affected, responses do not need to be proportional. For example, if affiliates have special information on, and relationships with, local borrowers, they may adjust their lending (proportionally) less than direct cross-border lending in response to the same shock.

A second "ring fencing" scenario, depicted in panel B, is possible. Here, international banking groups might face limitations on how much liquidity and capital, especially from

subsidiaries, can be moved through their internal capital markets to other parts of the group. In this scenario, depicted in panel B, a supply shock to the parent bank can trigger a much larger response in terms of reduction in direct cross-border lending than the reduction in affiliates' lending as headquarter banks are not able to tap into the liquidity and capital of the affiliates. Another possibility is that banks are told during the crisis by their lender country authorities that, in exchange for support, banks need to "lend at home" and thus cut back more on their cross-border lending.

In a third scenario, depicted in panel C, there are also limits on moving capital and funds internally, but banks try to overcome these limits through their various lending operations. Here, the reduction in direct cross-border lending to borrowers *j* is even larger, but in this case, part of this reduction is "compensated" for by an increase in affiliates' lending to the same borrowers, as an indirect way of bypassing host countries' ring-fencing of affiliates (again, given informational and relationships, the two forms may respond differently). This is a way of explicitly mitigating the impact of internal market barriers in the presence of shocks to lender country banking systems.

In reality, any three of the scenarios (or combinations thereof) may prevail. Situations may differ, however, by characteristics of the lender- or borrower-country banking systems in ways that suggest one specific scenario to be more likely.[3] Studying therefore how direct cross-border and local affiliates' lending responds to various shocks and identifying differences by lender- and borrower-country characteristics can provide insights as to the presence (or lack) of barriers in internal financial markets and across regulatory regimes. Specifically, if banking systems with greater vulnerabilities saw greater differences in how the two forms responded, we can conjecture that, for these systems, intergroup transfers were more constrained—that is, faced a scenario more like the second scenario, panel B.

3. Data and Event Studied, Methodology, and Basic Statistics

This section presents the data and event studied; our approach for exploring the two sets of questions, which is based on a difference-in-difference approach; the variables included as explanatory factors in the empirical analysis and their expected sign; and the basic statistics.

3.1 Data and Episode Analyzed

Our main data source for the cross-border bank lending data is the BIS consolidated banking statistics (BIS CBS) on an ultimate risk basis (i.e., this allocates claims to the country where the ultimate risk resides in a manner consistent with banks' own systems of risk management). This dataset provides a breakdown of foreign claims into: (i) direct cross-border claims, capturing direct lending from banks to a foreign borrower without relying on any presence in the borrower country; and (ii) affiliates' claims, which includes lending by both branches and subsidiaries operating in the borrower countries. Both publicly available (from the BIS website) and restricted data (obtained through data requests to BIS) are used in the calculations.

3 See also Kerl and Niepmann (2014) for a model of how international banks may choose between international interbank lending, intra-bank lending to affiliates, and cross-border lending to foreign firms given, among others, impediments to foreign bank operations, with supportive evidence from German bank level data.

Following Cerutti (2015), the analysis is performed taking into account coverage break-in-series and exchange rate variations.[4] These corrections are important for a meaningful representation of the evolution of banks' claims, especially during the GFC, when the differences between adjusted and unadjusted series are visible even at aggregate levels, as seen from Figure 1a. The differences are even larger for many individual country-pairs, as Figure 1b makes clear (while break-in-series mostly drive the large deviations between adjusted and non-adjusted data, the overall appreciation of the US dollar during the GFC made many changes in the adjusted series exceed their respective non-adjusted ones).

Total (adjusted) foreign claims were about USD 25 trillion in mid-2012, down from above USD 30 trillion in mid-2008, for the reporting banking systems included in our sample. Local affiliate lending has become relatively more important, with greater foreign bank presence, and even more so following the financial crises. They represent about 50% of total foreign lending as of 2012, compared with a 40% share before the crisis. This growth in the local affiliates' lending shows up in Figure 1a in the form of the widening gap between the total—that is, foreign claims—and cross-border lending. See further Table I for data definitions.

We choose the GFC as the event to study because it represents the clearest shock to the international banking system in recent decades (Figure 1a). This largely unanticipated event started in mid-2008 with the takeover of the investment bank Bear Stearns and worsened after the bankruptcy of Lehman Brothers. We date this period to end of June 2009, as after that time-adjusted cross-border lending stabilized again (non-adjusted cross-border lending rebounds earlier due to break-in-series and the depreciation of the US dollar during 2009:Q2). There were other deleveraging periods afterwards (e.g., the second half of 2011 during the height of the European debt crisis), but they were not as severe as the GFC, and their timing and slower dynamics also complicate identification (e.g., agents and markets had time to anticipate and react to the shock).

There was much heterogeneity in the deleveraging process, with great variation among creditor, borrower, and bilateral patterns. This heterogeneity is clear from Figure 2, which depicts the bilateral percentage changes in direct cross-border (Panel A) and affiliates' claims (Panel B), with lenders in the columns and borrowers in the rows. Each cell of the panel displays the change in lending of the twenty analyzed lender banking systems (that report to the BIS) to each of the 120 borrower countries included in the analysis. The columns—that is, the lender country—are sorted from left to right by the overall degree of deleveraging of the country, and the rows are sorted from top to bottom by the overall degree of deleveraging experienced by each borrowing country.

The panels show that there is some general relationship, in that deleveraging increases more along the diagonal than off the diagonal, and notably so for cross-border claims.

4 The exchange rate adjustments are three-fold. First, the domestic-currency denominated affiliates claims are corrected using bilateral US dollar domestic currency exchange rates, with the domestic-currency denominated affiliates' claims proxied by using its share of total BIS CBS foreign claims at immediate borrower basis. Second, at the same time, the identification of the amount of foreign-currency denominated affiliates' claims, which are assumed to be in euros in Europe and US dollars for other countries. Finally, bilateral CBS cross-border claims positions are adjusted using, as a proxy, the currency breakdown currency (US dollar, euro, British pound, Japanese yen, and Swiss francs) available from the BIS locational banking statistics. See Cerutti (2015) for more details.

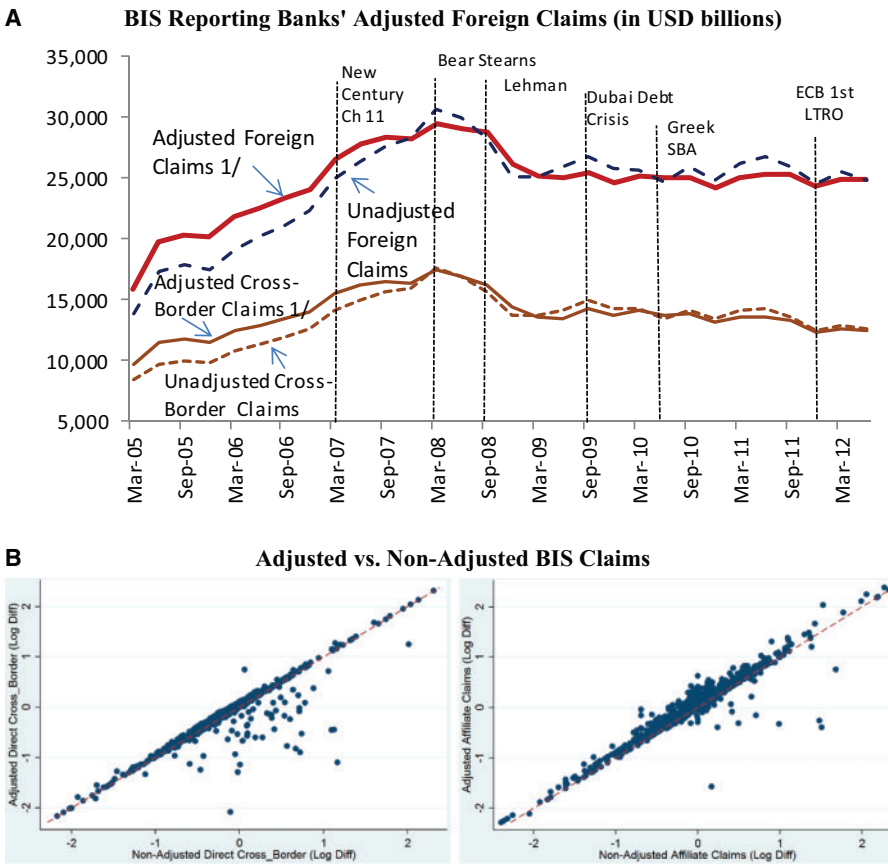


Figure 1. (**A**) BIS reporting banks' adjusted foreign claims (in USD billions) and (**B**) Adjusted versus non-adjusted BIS claims.
(**A**) *Source*: IFS and BIS banking statistics.
Note: 1/ Break-in-series and exchange rate changes adjusted data following Cerutti (2015).
(**B**) *Source*: IMF International Financial Statistics and BIS Banking Statistics.
Note: Dashed line denotes a 45 degree angle line.

Lenders, however, clearly did not adjust their claims uniformly across borrowers. Even lenders that greatly reduced their overall positions show increases in cross-border claims or affiliate lending with respect to some borrowers. Conversely, even borrower countries experiencing very large aggregate declines saw some heterogeneity at the bilateral level as not all home countries pulled back equally from them, with some even increasing their lending.

Although these patterns exist in both direct cross-border and affiliates' lending, there are differences between the two forms.[5] Overall, there are relatively sharper reductions in direct cross-border lending than in affiliates' lending, which already suggests some barriers.

5 Part of these differences relate to variations in samples. International banks cover more borrowers through direct cross-border lending than through their network of affiliates (not all banking systems have affiliates in every borrowing country). The number of observations for which we have

Table I. Summary statistics (period 2008Q2–09Q2) and correlation matrix

Panel A. Summary statistics (period 2008Q2–09Q2)

Variable	Description	Observation	Mean	Median	Standard deviation	Min	Max
Change in cross-border claims	FX-adjusted direct cross-border claims, log difference: 2009Q2 minus 2008Q1	1,858	−0.18	−0.16	0.83	−5.35	6.42
Change in affiliates claims	FX-adjusted foreign affiliate claims, log difference: 2009Q2 minus 2008Q1	846	0.00	0.04	0.89	−5.47	6.17
SRISK_Tier	Creditor country sum of positive SRISK (as % of Tier I Capital), measured as of December 2007; (CAR of 8% was used in all calculations)	2,478	707.32	564.79	746.21	0.00	3,124.96
Systemic crisis	Systemic banking crisis from Laeven and Valencia (2013)	2,478	0.45	0.00	0.50	0.00	1.00
ROA	Return on assets of domestically owned banks, as of December 07	2,478	0.80	0.74	0.46	0.10	1.83
NPL	Non-performing loans of domestically owned banks, as of December 07	2,478	1.65	1.10	1.52	0.20	5.30
RWA over assets	Risk weighted assets over total assets, as of December 07	2,478	0.50	0.51	0.14	0.19	0.77
Common language	1 for common language	2,478	0.12	0.00	0.33	0.00	1.00
Common legal origin	1 for common legal origin	2,478	0.31	0.00	0.46	0.00	1.00
Geographical contiguity	1 for geographical contiguity	2,478	0.02	0.00	0.15	0.00	1.00
Colony	1 for pairs in colonial relationship after 1945	2,478	0.02	0.00	0.15	0.00	1.00
Bilateral trade	Bilateral trade (normalized by home country GDP), measured as of December 2007	2,444	0.15	0.01	0.59	0.00	10.19
Distance	log of distance (most populated cities, km)	2,478	8.47	8.77	0.93	4.09	9.88
Share of cross-border claims	Share of cross-border claims on borrower *j* by lender *i*, wrt total cross-border claims by lender *i* (in percentage); as of December 07	2,944	0.78	0.02	2.72	0.00	43.87
Private monitoring	Measures whether there incentives/ability for the private monitoring of firms, with higher values indicating more private monitoring. Source: Barth, Caprio, and Levine (2013)	2,478	8.41	9.00	1.36	6.00	11.00
Accounting practices	Captures the type of accounting practices used. Higher values indicate better practices. Source: Barth, Caprio, and Levine (2013)	2,478	0.81	1.00	0.40	0.00	1.00
External monitoring	Captures the evaluations by external rating agencies and incentives for creditors of the bank to monitor bank performance. Higher values indicate better credit monitoring. Source: Barth, Caprio, and Levine (2013)	1,854	2.94	3.00	0.85	2.00	4.00
No_Deposit insurance	Measures whether there is an explicit deposit insurance scheme and whether depositors were fully compensated the last time a bank failed. Source: Barth, Caprio, and Levine (2013)	2,478	0.20	0.00	0.40	0.00	1.00

(continued)

Table I. Continued

Panel B. Correlation matrix

	Change in cross-border claims	Change in affiliates claims	SRISK_ Tier	Systemic crisis	ROA	NPL	RWA over assets	Common language	Common legal origin	Geographical contiguity	Colony	Bilateral trade	Distance	Share of cross-border claims	Private monitoring	Accounting practices	External monitoring	No_Deposit insurance
Change in cross-border claims	1.00																	
Change in affiliates claims	0.01	1.00																
SRISK_Tier	−0.08	0.01	1.00															
Systemic crisis	−0.15	−0.01	−0.21	1.00														
ROA	0.03	0.03	−0.74	0.20	1.00													
NPL	0.05	0.00	−0.19	−0.28	−0.27	1.00												
RWA over assets	−0.01	0.06	−0.75	0.29	0.78	0.07	1.00											
Common language	0.00	0.01	−0.06	0.13	0.21	−0.16	0.12	1.00										
Common legal origin	0.05	−0.01	−0.15	0.11	0.12	0.04	0.11	0.46	1.00									
Geographical contiguity	0.03	−0.04	−0.02	−0.04	−0.07	0.14	−0.04	0.25	0.18	1.00								
Colony	0.08	0.00	0.06	0.19	−0.03	−0.08	−0.07	0.26	0.22	−0.06	1.00							
Bilateral trade	−0.02	−0.09	−0.01	0.06	−0.08	0.03	−0.10	0.18	0.10	0.54	−0.07	1.00						
Distance	−0.01	−0.04	0.00	0.02	0.16	−0.14	0.16	0.05	−0.03	−0.48	0.12	−0.41	1.00					
Share of cross-border claims	−0.03	−0.05	−0.07	0.00	0.09	0.04	0.09	0.07	0.04	0.19	−0.09	0.44	−0.17	1.00				
Private monitoring	−0.01	0.00	−0.22	0.51	0.24	−0.05	0.38	0.11	0.11	−0.15	0.18	−0.12	0.23	−0.02	1.00			
Accounting practices	0.07	0.02	0.04	−0.04	0.26	−0.26	0.16	0.06	0.02	−0.01	0.06	−0.16	0.01	−0.05	0.25	1.00		
External monitoring	0.01	0.02	−0.19	0.38	0.09	0.24	0.33	0.06	0.08	−0.09	0.20	−0.15	0.22	−0.02	0.89	0.15	1.00	
No_Deposit insurance	0.01	−0.04	−0.13	0.29	0.17	−0.20	0.07	0.04	0.12	−0.06	−0.08	0.10	0.00	0.03	0.48	0.16	0.16	1.00

Notes: The following abbreviations are used: SRISK stands for systemic risk contribution (measure developed by Acharya *et al.* 2010); ROA for return on assets; NPL for non-performing loans; and RWA for risk weighted assets.

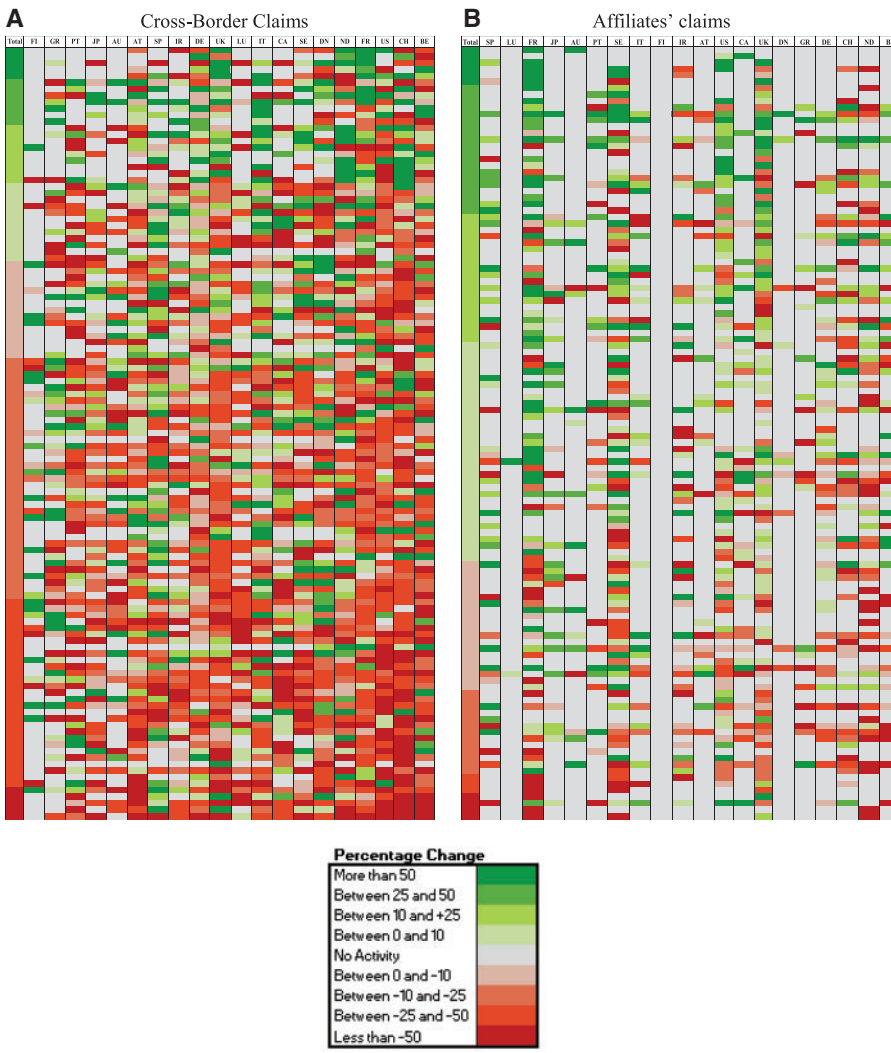


Figure 2. Bilateral evolution of banks' claims during 2008:Q2–09:Q2.
Source: BIS Banking Statistics and IMF International Financial Statistics.
Notes: Each cell depicts the bilateral—lender in the columns, and borrowers in the rows—percentage changes in cross-border claims (see legend for scale). The left-hand-side panel shows the bilateral evolution of cross-border claims. The right-hand-side panel displays the evolution of affiliates' claims. The first column of each panel displays banks' total lending to each borrower country. The columns are sorted from left to right by the overall degree of deleveraging of the creditor country and the rows are sorted from top to bottom by the overall degree of deleveraging at the borrowing country. Country abbreviations as follows: AU = Australia; AT = Austria; BE = Belgium; CA = Canada; DN = Denmark; FI = Finland; FR = France; DE = Germany; GR = Greece; IR = Ireland; IT = Italy; JP = Japan; LU = Luxembourg; ND = Netherlands; PT = Portugal; SP = Spain; SE = Sweden; CH = Switzerland; UK = United Kingdom; and US = United States

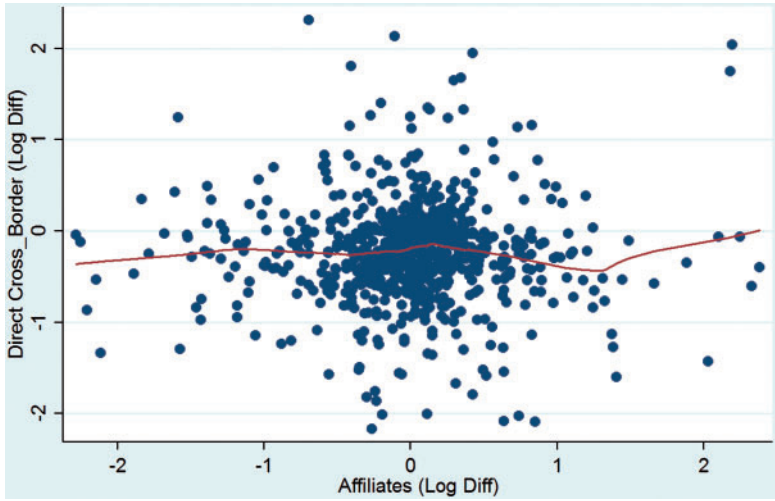


Figure 3. Evolution of cross-border and affiliates' claims.
Source: BIS Banking Statistics and IMF International Financial Statistics.
Notes: The line displays locally weighted regressions of direct cross-border on affiliate claims, using the *lowess smoothing* function in Stata (with bandwidth of 0.5). Only observations with both direct cross-border and affiliates claims are displayed.

Still, there is much heterogeneity in how the two forms change. This is clear from Figure 3, which plots the two forms against each other for the same lender–borrower pairs (using log differences).[6] The red line in Figure 3 shows a "lowess" smoother fit (locally weighted regressions of direct cross-border on affiliate claims). It displays some interesting nonlinearities. In the left-hand-side quadrants, it highlights a positive relationship between both declining direct cross-border and affiliates' claims. For observations with positive changes in affiliate claims (right-hand-side quadrants), however, it displays (at least in the beginning, where most observations fall) some substitution between direct cross-border and affiliate claims. The latter may indicate the presence of barriers, the focus of our second hypothesis.

3.2 Methodology

Observing and analyzing actual credit, domestic or cross-border, is not informative on the role of demand or supply conditions since any changes in lending patterns can just reflect changes in economic prospects or borrowers' risks rather than supply factors. Controlling for demand is difficult, however, as borrowers' economic and financial prospects can be as much driven by the availability of credit as that credit adjusts to these prospects. During a recession, for example, credit may be tight, but economic prospects may be poor as well. And during boom times, both supply of credit from banks and demand from borrowers are likely to be higher. Panel regressions using aggregate credit provided are therefore unlikely to provide meaningful insights.

affiliates lending is thus much smaller (some 800) than that for which we have direct cross-border loans (about 1,800). But even when using matched samples, differences remain, as we will show.

6 The non-linear lowess smoother line is robust to different bandwidth selections as well as plotting percentage differences instead of log differences.

Controlling for demand can be done, however, using a cross-sectional approach during a specific (deleveraging) period when banking systems, albeit to different degrees, are known to suffer shortages in funding and capital as they simultaneously face increases in risks which vary by individual borrower. Specifically, we use the identification strategy first proposed by Khwaja and Mian (2008) and used by others recently (Cetorelli and Goldberg, 2011; De Haas and Van Horen, 2012, 2013; Kapan and Minoiu, 2013). The approach exploits the fact that any difference in lending by different lenders to the same borrower must reflect variations in supply conditions among lenders (or specific creditor–borrower relationships), rather than demand conditions. It can thus identify the relative importance of various supply and other factors in determining changes in cross-border banking, while it controls for demand. Such bilateral data also allow one to study the role of lender–borrower factors.

We implement this approach by estimating the following cross-sectional specification:

$$\Delta L_{ij} = \beta_1 \text{BankSystem}_{i,t-1} + \beta_2 (\text{Lender} - \text{Borrower})_{ij} + \gamma_j + \varepsilon_{ij},$$

where the dependent variable ΔL_{it} is the log-difference between 2009:Q2 and 2008:Q1 in the stock of bilateral cross-border loans (or local affiliates' loans) of lender banking system i on borrower country j between the beginning and the end of the specific deleveraging episode (adjusted for both coverage break-in-series and exchange rate variations). We use differences in logs to account for the skewed distributions of the changes in both direct cross-border and affiliate lending (Figure 3). To control for borrower characteristics, including borrower-specific demand, we include fixed effects for borrower countries γ_j.

The two sets of explanatory variables used in the analysis refer to the state of the lender-country banking system and the bilateral relationships between individual lender and borrower countries. All these explanatory variables are measured at the end of 2007, half a year before the start of the period for which we measure changes in lending, to avoid the crisis and the deleveraging process itself from influencing them.

The first set of creditor country variables, BankSystem_i, captures the state of the home banking system fundamentals, both as perceived by financial markets and as captured in accounting variables, prior to the GFC. As such, we analyze how banking systems respond in their cross-border lending to a shock such as the GFC given their ex-ante vulnerabilities. Our main variable captures how financial markets perceived the riskiness of the creditor banking system prior to the deleveraging period. It is based on the SRISK measure, which uses an option-pricing model, with the behavior of bank's stock prices as inputs, as well as some key initial balance sheets variables, to derive the perceived riskiness of each bank at each point in time.[7]

7 The calculation of SRISK takes three steps (see http://vlab.stern.nyu.edu/doc/3?topic=apps for further documentation). First, the expected daily drop in equity value of a firm if the aggregate market falls more than 2% is estimated. This so-called Marginal Expected Shortfall incorporates both the volatility of the firm and its correlation with the market, as well as its performance in extremes. It is estimated using asymmetric volatility, correlation, and copula methods. In a second step, this is extrapolated to a financial crisis which involves a much larger fall over a much greater time period. Finally, these equity losses expected in a crisis are combined with prevailing equity market value and outstanding measures of debt to determine how much capital would be needed in such a crisis, where a bank is assumed to require at least 8% capital relative to its asset value. SRISK is the dollar value of capital shortfall experienced by this bank in the event of a crisis.

One article that describes and analyzes SRISK is Engle, Jondeau, and Rockinger (2015), which documents the relative contribution of industry groups, countries, and individual firms to SRISK in Europe. Consistent with its forward-looking nature of assessing the vulnerability of a banking system, including it being exogenous to the deleveraging process itself, Engle, Jondeau, and Rockinger (2015) also show that SRISK measures at the country level can help predict developments in industrial production and business confidence in most countries. Other papers using SRISK include Idier, Lamé, and Mésonnier (2014) and López-Espinos *et al.* (2012). As SRISK provides for a dollar amount of potential capital losses under some adverse scenario, we sum the positive amounts for all domestically owned banks in each creditor country to derive an overall measure of banking-system capital at risk. This we then scale using each banking system's initial, pre-crisis Tier 1 capital, to obtain an indicator of the ability of the system to sustain a large adverse shock.

In addition to this market-based measure, we explore a number of standard accounting, financial statement-based performance, portfolio quality, and solvency variables, again all calculated pre-GFC. Specifically, we include the banking system's 2007 return on assets (ROAs), and its end-of-2007 ratios of NPLs to total gross loans and risk-weighted assets to total assets. These measures also provide indications of banking-systems vulnerabilities, but at the same time are backward looking and can suffer from reporting problems and biases. To cover the (subsequent occurrence of) systemic banking crisis in the creditor country, we include a dummy based on the Laeven and Valencia (2013) dataset on whether the country had a systemic banking crisis as of mid-2009. Since this measure is based on the *de facto* amount of government support and is not highly correlated with the size of cross-border deleveraging in our sample, the findings for this dummy are best interpreted as how lender banking systems deleverage internationally depending on whether they received state support ex-post.[8] A negative coefficient can then be interpreted as a sign of home bias induced by the support.

We also include in some of our regressions measures of the degrees to which banks in lending countries were subject to various forms of market discipline. For this we include several indicators from the Barth, Caprio, and Levine (2013) supervisory dataset.[9] The specific variables used, all as of 2007, are Private Monitoring, capturing incentives for the private monitoring of firms; No Deposit Insurance, a dummy whether there is an explicit deposit scheme and whether depositors were fully compensated the last time a bank failed, both under the category Private Monitoring measures; and Accounting Practices, the quality of accounting practices, and External Monitoring, incentives for creditors to the bank to monitor bank performance, both under the category of External Governance measures. These measures are different from the market-based and accounting banking-system vulnerabilities as correlations are low. We expect that banking systems of countries with a lower market discipline and more (implicit) public sector safety nets would experience less sensitivity in their lending to the degree of their perceived market vulnerabilities.

8 Laeven and Valencia (2013) define a systemic banking crisis based on the presence of significant government intervention, which is measured through several criteria: significant nationalizations, significant bank guarantees, liquidity support, bank restructuring costs, deposit freeze and bank holidays, and asset purchases.

9 Many other variables specific to market discipline of banking systems are of course possible to include, but these are difficult to use and analyze because many cover a much smaller data sample.

In terms of bilateral characteristics—that is, the matrix Lender–Borrower$_{ij}$—we use variables that capture the nature of trade, financial, and other linkages between creditor banking system *i* and borrower country *j*. Here, we include the traditional "distance" variables: (i) the log distance between the capital cities of the lender and borrower country; (ii) a dummy of geographical adjacency; (iii) a dummy for common language; (iv) a dummy for similar type of legal origin; (v) a dummy for colonial past; and (vi) bilateral trade as proportion of the lender country's overall trade. These variables are proxies for both the severity of financial, informational, and other frictions between lender-country banks and the borrower country as well as for the presence of (historical) ties. We also include the direct cross-border exposure of lender banks to a particular country, measured as the share of the cross-border claims to a particular borrower as percentage of the lender overall cross-border claims. This last variable provides an indication whether, once faced with a shock, banks cut back more (or fewer) loans depending on the relative size of the exposure to a specific borrower.

We use the same specification to analyze changes in both direct cross-border and affiliate lending. To explore the relationship between the two forms of lending, we include in some specifications the change in the other form of lending. Coefficients on the other form will indicate to what extent, controlling for all other factors, there was substitution between the two forms. To explicitly explore the presence of barriers, we include an interaction between the change in affiliate lending (or direct cross-border) and our proxy for the vulnerabilities of the home-country banking systems. This will allow us to tell whether the substitution effects (or lack thereof) between the two forms may be less or more when the lender banking system is more vulnerable. A positive sign for this interaction effect would then suggest imperfect substitution because host country regulators were more likely to impose some restrictions on intra-group flows to protect the affiliates from more vulnerable parent banks.

3.3 Basic Statistics

Key statistics for the dependent and independent variables are provided in Table I, including the correlations among variables. Some of the patterns in variables are also shown in Figures 3 and 4. As noted, on aggregate and for most lender–borrower pairs, direct cross-border lending dropped much more than affiliate lending did. The median change in direct cross-border lending across lender–borrower-country pairs was large, negative 16%, while affiliates' lending saw a median 4% increase for the period from 2008:Q2 to 2009:Q2. These median percentage changes for the bilateral figures are very close to the mean of the log differences, as Table I shows. At a more disaggregated level, however, there was also a large variation in bilateral patterns as shown in Figures 2 and 3, something the regressions try to capture.

Figure 4 provides the distributions of the key independent variables. Our main explanatory variable is the SRISK variable, shown in the top panel as a share of Tier I capital. It shows a great deal of variation, with banking systems that are highly leveraged (such as many of the European systems, like Switzerland) perceived to be quite vulnerable to shocks already at end of 2007. Banks' ROA, NPLs, and risk-weighted assets as a proportion of total assets, also as of end of 2007, are depicted in the bottom panel of Figure 4. None of these accounting measures offer the same relative ranking across countries as SRISK does, confirming that backward-looking accounting measures can differ from forward-looking market-based assessments. In terms of market discipline (not shown), the US and

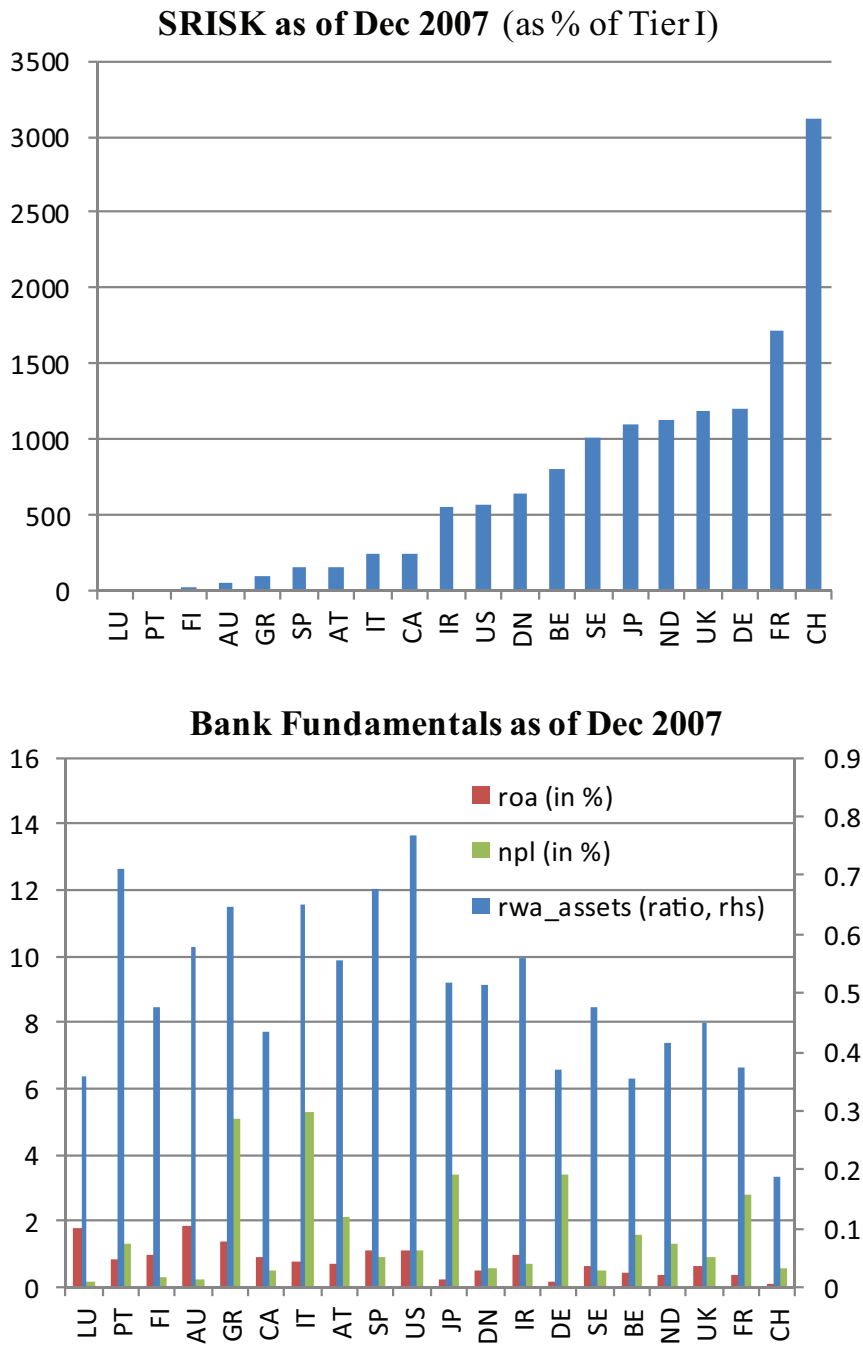


Figure 4. Supply-side variables.

Sources: NYU Stern, IMF International Financial Statistics, and central banks.

Notes: Country abbreviations as follows: AU = Australia; AT = Austria; BE = Belgium; CA = Canada; DN = Denmark; FI = Finland; FR = France; DE = Germany; GR = Greece; IR = Ireland; IT = Italy; JP = Japan; LU = Luxembourg; ND = Netherlands; PT = Portugal; SP = Spain; SE = Sweden; CH = Switzerland; UK = United Kingdom; and US = United States.

Australian banking systems stand out as having generally higher scores, whereas European banking systems, on average, generally score more poorly.

4. Empirical Results

This section presents our regression results, first analyzing the supply-side determinants and then exploring creditor–borrower dimensions. It also provides the various robustness tests.

4.1 Supply-Side Determinants

Table II provides the base regression results, with Panel A showing regression results for changes in cross-border lending and Panel B for changes in local affiliates lending. Panel A shows the importance of supply factors in driving the reduction in cross-border banking lending. Specifically, the SRISK variable is statistically significant and negative in the base regression (Column 1). The estimated effects are economically important. For example, the coefficient in Column 1 indicates that a one-unit increase in SRISK as percent of Tier I capital approximately translates into a 0.007% decline in direct cross-border lending; or, given that SRISK standard deviation is about 750, a one-standard-deviation increase in SRISK translates into a 5¼% decline in direct cross-border lending (as noted, the median bilateral decline was 16%).

Differentiating by regions (Column 2), we find that for the 2008–09 deleveraging episode, lender banking systems in North America (USA and Canada) adjusted their cross-border lending relatively more in response to perceived vulnerabilities before the crisis, followed by banking systems in Asia (Japan and Australia). European banks, the base case, adjusted the least. This likely reflects that because the shocks originated in the USA, other banking systems were, at the time, considered to be less at risk of (forthcoming) constraints, as well as possibly less subject to market discipline.

We next explore a number of accounting measures of banking systems' prior vulnerabilities. We find ratios of NPLs, ROA, and risk-weighted assets to total assets generally not to be statistically significant as predictors of subsequent deleveraging actions (Column 3).[10] When we add a dummy for countries that ran into subsequent systemic crises, we find that these did cut back their cross-border lending even more so (Column 4), but the coefficient is not statistically significant. When we combine market-based measures of banking systems' vulnerabilities with accounting measures and/or the systemic-crisis dummy (Columns 5–7), we find that market-based measures remain statistically significant and the other measures insignificant.[11] This indicates that banks' international deleveraging was largely driven by market pressures—that is, shareholders, creditors, and other stakeholders pressured those banks more exposed before the crisis to deleverage more.

In order to understand better what could be driving the results, we break the sample into two. The regression in Column 8 uses a subsample where only borrower–lender pairs

10 We also tried other accounting variables typically used to identify vulnerabilities, such as the Tier I capital ratio, size (log of assets), other profitability (e.g., return on equity), and funding structures (the ratio of deposit to loans in the creditor banking system *i*). These variables were not significant across specifications or displayed counterintuitive signs, often due to high correlations with variables already included.

11 The lack of significance of accounting variables is consistent with other work (e.g., Kapan and Miniou, 2013, using a subsample of forms of cross-border lending).

Table II. Deleveraging during 2008Q2–09Q2: Supply-side determinants

Panel A: Dependent variable: Log changes in direct cross-border claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	−0.00714**	−0.00854**			−0.00839	−0.00975***	−0.0108*	−0.00975	−0.00762
	(0.00341)	(0.00336)			(0.00716)	(0.00362)	(0.00642)	(0.00961)	(0.00664)
SRISK_TierI * WH		−0.0602***			−0.0661***	−0.0556***	−0.0601***	−0.0725***	−0.0514***
		(0.0104)			(0.0178)	(0.0116)	(0.0151)	(0.0278)	(0.0115)
SRISK_TierI * Asia		−0.00751**			−0.0131***	−0.0114***	−0.0161***	−0.0264***	0.000745
		(0.00293)			(0.00424)	(0.00290)	(0.00404)	(0.00539)	(0.00502)
ROA			0.996		−10.19		−11.20	−18.96*	5.427
			(8.104)		(9.248)		(9.132)	(10.04)	(13.46)
NPL			2.025		0.204		−0.233	−0.765	0.880
			(2.063)		(1.592)		(1.959)	(2.793)	(1.975)
RWA over assets			13.61		31.39		25.81	30.45	18.99
			(41.67)		(40.19)		(35.27)	(49.77)	(31.47)
Systemic crisis				−7.731		−9.620	−9.193	−1.983	−18.62***
				(7.437)		(6.747)	(6.696)	(11.92)	(4.688)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,027	831
R^2 with FE only	0.116	0.116	0.116	0.116	0.116	0.116	0.116	0.137	0.230
R^2	0.120	0.131	0.118	0.118	0.133	0.134	0.136	0.150	0.275

(continued)

Table II. Continued

Panel B: Dependent variable: Log changes in local affiliates claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	0.00213	0.00398			0.0120	0.00241	0.00869	NA	0.00878
	(0.00406)	(0.00413)			(0.0103)	(0.00393)	(0.00790)		(0.00784)
SRISK_TierI * WH		0.0305***			0.0134	0.0409***	0.0251	NA	0.0242
		(0.0114)			(0.0201)	(0.0143)	(0.0176)		(0.0177)
SRISK_TierI * Asia		0.0115**			0.0141*	0.00656**	0.00974	NA	0.00972
		(0.00483)			(0.00836)	(0.00314)	(0.00660)		(0.00688)
ROA			−5.299		11.75		7.651	NA	6.451
			(17.03)		(23.26)		(21.35)		(21.28)
NPL			−1.732		−0.795		−1.790	NA	−2.599
			(3.162)		(3.535)		(2.885)		(3.036)
RWA over assets			25.37		28.66		27.71	NA	34.28
			(38.04)		(56.10)		(39.10)		(39.85)
Systemic crisis				−10.77		−13.92*	−14.01*	NA	−15.60**
				(7.388)		(8.043)	(7.411)		(7.265)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	846	846	846	846	846	846	846	15	831
R^2 with FE only	0.166	0.166	0.166	0.166	0.166	0.166	0.166	NA	0.172
R^2	0.166	0.169	0.167	0.169	0.171	0.174	0.176	NA	0.184

Notes: Cross-sectional regression of lender–borrower pairs is estimated. The dependent variable changes were calculated as log differences between the end of the deleveraging episode and its start (coefficients are already reported in percentage). Column 8 shows regressions for a subsample, where only direct cross-border claims and affiliate claims are present in Panels A and B, respectively. Column 9 shows regressions where both direct cross-border claims and affiliate claims are present in Panels A and B. All standard errors are double clustered by creditor bank and borrower country. Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$. See Table I for definition of variables. The following abbreviations are used: WH stands for Western Hemisphere; SRISK for systemic risk contribution (measured developed by Acharya *et al.* 2010); ROA for return on assets; NPL for non-performing loans; and RWA for risk-weighted assets.

with direct cross-border lending are present (without having foreign affiliate lending at the same time). The coefficient on SRISK variable is similar to the full specification in Column 7 and again not significant. This is not the case for the interacted SRISK variables, which are significant (including when testing their joint significance with SRISK). We next run similar regressions using the subsample where creditor banking systems lend both cross-border and have local affiliates in each borrower country (column 9). The significance for European and Asian banks falls, but SRISK for banking systems in North America remains significant. Accounting variables continue to not be significant. The presence of a systemic crisis in the home bank country, however, implies significantly less cross-border lending, about 18%.

We show similar regressions for the behavior of affiliates' lending over this period in Panel B. As not all banking systems have local affiliate operations, and not necessarily in the same countries as those in which they engage in cross-border lending, the sample is smaller, only about 45% of the overall sample. The regression results show that supply factors are, in general, not as important in driving the reduction in local affiliate lending, as the SRISK variable is not statistically significant and even positive, suggesting some substitution effects as risky banking systems lend more through their affiliates.

Differentiating by regions (Column 2) shows that for lender banking systems from North America and Asia, local affiliate lending did adjust somewhat upwards in a response to the perceived capital shortfalls at home. For these systems, cross-border and local operations thus behaved more as if segmented, since facing capital constraints, local affiliate lending increased while cross-border lending declined. Regression results for other—that is, European—banking systems show less clear signs of a substitution effect. This could be because European banks operated at that time in more integrated banking markets, where shocks originating at home affected both cross-border and affiliated lending similarly.

The accounting measures of banking system vulnerabilities, NPLs, ROA, and risk-weighted assets over assets, are again not significant (Column 3). The case of the systemic crisis dummy is similar (Column 4). When combining all variables (Columns 5–7), we find SRISK again not to be significant in general, and accounting variables to remain insignificant. Lender banking systems that ran into subsequent systemic crises, however, do cut back more on affiliated lending (about 14% reduction). Columns 8 and 9 perform a subsample analysis similar to Panel A, but the subsample of affiliate lending without direct cross-border lending is too small to run a regression, with only about fifteen observations (Column 8). The sample of banking systems that lend to borrowers in the same country through both direct cross-border and affiliates activities is used in Column 9. Results are similar to the general results presented in Column 7.

The results so far imply that the impact of changes in SRISK (as a percent of Tier I capital) helps to explain the degree of cutbacks, but that the impact of SRISK was smaller for banking system in some regions, especially Europe, which constitutes the base group when interacting the regional (North American and Asian) dummies with SRISK. We explore next whether the degree of market discipline played a role and can explain these regional differences.

Table III shows the result of regressions that add to the general model the SRISK variable interacted with each of the four regulatory indicators described above, where higher values indicate more private or external oversight, and less expectations of support from a public safety net. For direct cross-border lending (top panel), the SRISK variables interacted with Private Monitoring, Accounting Practices, External Monitoring (for a smaller sample)

Table III. Deleveraging during 2008Q2–09Q2: Potential drivers of SRISK

Panel A: Dependent variable: Log changes in direct cross-border claims (in %)						Panel B: Dependent Variable: Log changes in affiliates claims (in %)				
	(IA) same as Table IIA (7)	(IIA)	(IIIA)	(IVA)	(VA)	(IB) same as Table IIB (7)	(IIB)	(IIIB)	(IVB)	(VB)
SRISK_TierI	−0.0108*	−0.0499***	−0.0453**	−0.0504***	−0.0109*	0.00869	0.0188	0.00105	0.0228	0.00830
	(0.00642)	(0.0182)	(0.0217)	(0.0166)	(0.00582)	(0.00790)	(0.0257)	(0.0352)	(0.0199)	(0.00849)
SRISK_TierI * WH	−0.0601***	−0.0220	−0.0298	−0.0139	−0.0402**	0.0251	0.0138	0.0320	−0.0211	0.0207
	(0.0151)	(0.0227)	(0.0235)	(0.0260)	(0.0159)	(0.0176)	(0.0320)	(0.0357)	(0.0399)	(0.0189)
SRISK_TierI * Asia	−0.0161***	0.00287	0.00600	−0.00620	−0.0145***	0.00974	0.00522	0.0143	0.0136	0.00913
	(0.00404)	(0.00900)	(0.0137)	(0.00522)	(0.00424)	(0.00660)	(0.0150)	(0.0236)	(0.0119)	(0.00672)
ROA	−11.20	−4.885	−18.36*	−25.01**	−3.013	7.651	6.834	6.099	14.95	5.455
	(9.132)	(8.151)	(10.44)	(9.761)	(7.967)	(21.35)	(21.77)	(23.53)	(24.21)	(22.04)
NPL	−0.233	2.577	1.486	−5.045*	1.568	−1.790	−2.513	−1.379	−0.933	−2.136
	(1.959)	(2.541)	(2.026)	(2.751)	(2.027)	(2.885)	(2.622)	(2.664)	(3.397)	(2.907)
RWA over assets	25.81	3.091	−14.58	0.680	7.190	27.71	30.07	18.56	110.7	30.71
	(35.27)	(36.77)	(47.52)	(38.07)	(32.87)	(39.10)	(42.27)	(48.39)	(72.09)	(41.16)
Systemic crisis	−9.193	−23.47***	−10.95*	−37.47***	−18.26***	−14.01*	−9.069	−14.47**	−0.890	−11.64
	(6.696)	(7.182)	(5.941)	(9.327)	(5.248)	(7.411)	(12.57)	(6.945)	(14.86)	(7.779)
Private monitoring *		0.0405**					−0.0109			
SRISK_TierI		(0.0170)					(0.0256)			
Accounting practices *			0.210*					0.0457		
SRISK_TierI			(0.110)					(0.205)		
External monitoring *				0.0884**					−0.000425	
SRISK_TierI				(0.0361)					(0.0418)	
No_Deposit insurance *					0.212***					−0.0577
SRISK_TierI					(0.0459)					(0.0936)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,858	1,858	1,858	1,408	1,858	846	846	846	674	846
R^2 with FE only	0.116	0.116	0.116	0.167	0.116	0.166	0.116	0.166	0.189	0.166
R^2	0.136	0.140	0.139	0.213	0.144	0.176	0.176	0.176	0.202	0.177

Notes: Cross-sectional regression of lender–borrower pairs is estimated. The dependent variable changes were calculated as log differences between the end of the deleveraging episode and its start (coefficients are already reported in percentage). Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$. See Table I for definition of variables. The following abbreviations are used: WH stands for Western Hemisphere; SRISK for systemic risk contribution (measured developed by Acharya *et al.* 2010); ROA for return on assets; NPL for non-performing loans; and RWA for risk-weighted assets.

show significantly positive coefficients. Importantly, these three indicators also seem to capture the heterogeneity explained by the regional interacted variables, as these are now no longer significant. Note, however, that there are some signs of multi-collinearity as the estimated coefficient for the systemic-risk dummy increases much in case of the External Monitoring index. And while the lack of Deposit Insurance is very significant and the regression has the highest R^2, perhaps because its variation captures mostly differences among European countries, it does not make the regional dummies insignificant.

These results suggest that some of the regional heterogeneity in changes in direct cross-border lending reflects the quality of private and/or external oversight or the presence of a large (implicit) safety net. Overall, this would indicate that, because of better private and/or external oversight and lower moral hazard, the impact of a given change in SRISK is greater in countries like the USA, which scores generally high in terms of private monitoring, and lower in Europe. The availability of variables covering these characteristics (sample coverage gets smaller) and difficulties in capturing market discipline in all aspects properly, however, imposes some limits on this interpretation. For affiliate lending (panel B), similar to before, SRISK does not play a statistically major role, nor does its interactions with our four indicators regarding the quality of private and external oversight and the presence of a public safety net in the home country. This is to be expected as the role of market discipline at home is less likely to be directly relevant for the lending behavior of an affiliate incorporated abroad, especially in the presence of barriers to moving resources.

In general, the results so far show that the supply-side drivers of direct cross-border loans differed somewhat from those for lending by local affiliates. While the evolution of cross-border lending was affected by prior market perceptions of risks (as captured by SRISK), the changes in affiliate lending were not driven by these factors, except that the home bias motive related to a systemic crisis was also present. We next run similar regressions using a sample where creditors both extended cross-border loans and had local affiliates in each borrower country (Table IV). This way we can formally analyze the interactions between the two forms and investigate whether there were barriers to moving resources across borders.

When using a sample of bilateral pairs where both cross-border and affiliates lending occurs, which contains 831 observations, we find most regression results to be qualitatively confirmed and quantitatively of similar magnitudes (compare Tables II and IV). Both market-based and accounting measures of vulnerabilities have the same signs and similar significance levels. Affiliate lending always remains positively sensitive with respect to SRISK, in contrast to the negative sign for direct cross-border lending, although coefficients are most often not significant (except for Asian banking systems). These differences suggest some forms of ring-fencing: The fact that affiliates are more insulated from shocks at home than direct cross-border lending is indicative that banks cannot freely allocate resources within the group. Interestingly, the systemic-crisis dummy is consistently significant for both direct cross-border lending and affiliate lending (Columns 6–9). Even though direct and affiliates' lending behave differentially with respect to SRISK, government interventions in systemic crises thus affect them equally when both are present, maybe because authorities called for (comparable) reductions in both as a quid pro quo for support extended.[12]

12 Also in some cases, the government support was conditional on selling of foreign affiliates, which is captured in our data as a reduction in affiliates' exposure.

Table IV. Deleveraging during 2008Q2–09Q2: Supply-side determinants with matched samples

Panel A: Dependent variable: Log changes in direct cross-border claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	−0.00667	−0.0102***			−0.00316	−0.0125***	−0.00762	−0.00731	−0.0133**
	(0.00418)	(0.00254)			(0.00965)	(0.00225)	(0.00664)	(0.00656)	(0.00635)
SRISK_TierI * WH		−0.0564***			−0.0660***	−0.0423***	−0.0514***	−0.0448***	
		(0.0107)			(0.0208)	(0.0131)	(0.0115)	(0.0107)	
SRISK_TierI * Asia		0.00865***			0.00667	0.00171	0.000745	0.00165	
		(0.00323)			(0.00635)	(0.00142)	(0.00502)	(0.00471)	
ROA			19.21		11.26		5.427	6.632	4.226
			(13.24)		(13.50)		(13.46)	(12.60)	(12.82)
NPL			4.872**		2.319		0.880	1.100	1.713
			(2.099)		(1.874)		(1.975)	(1.840)	(1.972)
RWA over assets			−28.86		18.74		18.99	15.43	−31.48
			(50.28)		(54.50)		(31.47)	(29.87)	(34.77)
Systemic crisis				−19.62***		−19.41***	−18.62***	−18.22***	−21.05***
				(5.675)		(4.705)	(4.688)	(4.326)	(4.836)
Change in affiliate claims								−0.0281	−0.0669*
								(0.0250)	(0.0341)
Change in affiliate claims * SRISK_TierI									0.000039**
									(0.000019)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	831	831	831	831	831	831	831	831	831
R^2 with FE only	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.235	0.235
R^2	0.235	0.256	0.238	0.251	0.259	0.274	0.275	0.283	0.277

(continued)

Table IV. Continued

Panel B: Dependent variable: Log changes in local affiliates claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	0.00206	0.00397			0.0125	0.00222	0.00878	0.00693	0.0110
	(0.00408)	(0.00415)			(0.0105)	(0.00397)	(0.00784)	(0.00749)	(0.00756)
SRISK_TierI * WH		0.0316***			0.0119	0.0426***	0.0242	0.0206	
		(0.0116)			(0.0209)	(0.0144)	(0.0177)	(0.0169)	
SRISK_TierI * Asia		0.0116**			0.0147*	0.00616**	0.00972	0.00998*	
		(0.00481)			(0.00867)	(0.00302)	(0.00688)	(0.00586)	
ROA			−6.283		11.34		6.451	11.08	9.426
			(16.93)		(23.26)		(21.28)	(18.03)	(17.00)
NPL			−2.335		−1.394		−2.599	−1.685	−1.846
			(3.358)		(3.788)		(3.036)	(3.025)	(2.963)
RWA over assets			29.18		34.07		34.28	28.21	56.76*
			(38.59)		(58.35)		(39.85)	(36.70)	(31.28)
Systemic crisis				−11.78		−15.12*	−15.60**	−17.60***	−17.21***
				(7.482)		(8.121)	(7.265)	(6.622)	(6.179)
Change in cross-border claims								−0.0642	−0.0978
								(0.0455)	(0.0706)
Change in cross-border claims * SRISK_TierI07									0.000037
									(0.000073)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	831	831	831	831	831	831	831	831	831
R^2 with FE only	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.162	0.162
R^2	0.172	0.176	0.174	0.176	0.178	0.182	0.184	0.180	0.179

Notes: Cross-sectional regression of lender–borrower pairs, with both lending through affiliates and direct cross-border, is estimated. The dependent variable changes were calculated as log differences between the end of the deleveraging episode and its start (coefficients are already reported in percentage). All standard errors are double clustered by creditor bank and borrower country. Robust standard errors in parentheses, ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$. See Table I for definition of variables. The following abbreviations are used: WH stands for Western Hemisphere; SRISK for systemic risk contribution (measured developed by Acharya *et al.* 2010); ROA for return on assets; NPL for non-performing loans; and RWA for risk-weighted assets.

Using the matched sample, we can also formally test for different conjectures regarding which scenario best describes the interactions between the two lending forms and our hypothesis of barriers preventing movements of capital. More specifically, we first investigate how changes in cross-border (affiliate) lending relate to the evolution of affiliate (cross-border) lending for the same creditor–borrower pair. The negative (but not significant) coefficients for the changes in affiliate and cross-border lending in Column 8 of Panels A and B, respectively, show that there were some substitution effects.

When next interacting changes in lending with SRISK, we find that the interaction with the change in affiliate lending is now positive and significant in the regression for cross-border lending (Column 9 in Table IV panel A). Also the coefficient for the change in affiliate lending is now negative and significant. Together this shows that, while there was some substitution, it was smaller for banking systems with greater vulnerabilities—that is, with a high SRISK.[13] The size of the coefficient indicates that for a banking system with SRISK at the high 75th percentile, a one-standard-deviation increase in affiliates' lending would reduce direct cross-border lending by 2%, whereas for banking systems with SRISK at the low 25th percentile, it would reduce lending by 5½%. This is consistent with the notion that resources moved less easily for bank lenders perceived more vulnerable, perhaps as restrictions (whether regulatory or supervisory) in borrower countries affected their ability to bypass any form of host-country ring-fencing.

4.2 Regression Results for Creditor–Borrower Determinants

We next explore the role of bilateral factors in explaining the deleveraging patterns, while controlling for lender banking systems' vulnerabilities. Specifically, we investigate the role of the exposure of the banking system to the specific country, cultural similarity (common language, legal, and colonial origin), bilateral distance, geographical contiguity, and institutional environment. The first variable is of risk management relevance; the other variables are commonly used to explain bilateral patterns in cross-border capital flows (and trade). We explore the role of these factors by adding them to the base regression.

To investigate the role of exposures, we include the share of direct cross-border lending to a particular borrower out of the total banking system's direct cross-border claims, all prior to the episode. Unlike the bank-level analysis of De Haas and Van Horen (2013), we find evidence that banks decreased more their direct cross-border lending to countries where they had high pre-episode exposures (Table V panel A, Column 1). This "rebalancing" may reflect that banks had previously overextended themselves to these markets and they set tighter risk limits during the crisis. It could also be that it was relatively easier to deleverage in markets where they had larger exposures, either as these may have been less affected by the financial turmoil or because other banks, including local banks, were more willing to take up the slack. The effect is, however, not present for affiliate lending, confirming again that these risk-management concerns do not apply equally to both forms of lending (Table V panel B, Column 1).

In terms of bilateral relationships, we find few statistically significant relationships. The exceptions are lower reductions in cross-border claims to borrower countries where a

13 Unreported regression results show a negative sign for the interaction between the changes in cross-border (and affiliate claims) and the aggregate host-country banking system deposit to loan ratios, implying that the substitution effect was larger for affiliates with larger deposit funding, but the coefficient was not statistically significant.

Table V. Deleveraging during 2008Q2–09Q2: Creditor–borrower determinants

Panel A: Dependent variable: Log changes in direct cross-border claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	−0.00851**	−0.00842**	−0.00862**	−0.00859**	−0.00874***	−0.00891***	−0.00906***	−0.00925***	−0.00946***
	(0.00336)	(0.00334)	(0.00343)	(0.00335)	(0.00326)	(0.00327)	(0.00333)	(0.00328)	(0.00334)
SRISK_TierI * WH	−0.0585***	−0.0563***	−0.0589***	−0.0579***	−0.0576***	−0.0526***	−0.0494***	−0.0542***	−0.0501***
	(0.0102)	(0.00967)	(0.0103)	(0.0103)	(0.0103)	(0.00994)	(0.0103)	(0.00981)	(0.0102)
SRISK_TierI * Asia	−0.00748**	−0.00815***	−0.00768**	−0.00704**	−0.00747**	−0.00806***	−0.00603*	−0.00812***	−0.00537
	(0.00294)	(0.00301)	(0.00307)	(0.00297)	(0.00297)	(0.00308)	(0.00340)	(0.00312)	(0.00354)
Share of cross-border claims	−0.789*	−0.689	−0.731	−0.944*	−0.828*	−0.880*	−0.941*	−0.717	−0.758
	(0.466)	(0.451)	(0.457)	(0.491)	(0.469)	(0.471)	(0.490)	(0.483)	(0.501)
Common language		−7.870				−13.57*	−13.61*	−12.68*	−12.62*
		(6.633)				(7.242)	(7.171)	(7.323)	(7.292)
Common legal origin			−1.886			−1.215	−1.346	−1.790	−1.941
			(4.387)			(4.604)	(4.718)	(4.609)	(4.698)
Geographical contiguity				10.91		17.06**	13.34	22.21**	18.70
				(7.337)		(8.335)	(11.37)	(10.83)	(12.68)
Colony					18.00***	26.23***	26.22***	25.97***	26.04***
					(6.318)	(7.162)	(7.108)	(7.308)	(7.250)
Distance							−2.648		−3.613
							(4.196)		(4.272)
Bilateral trade								−3.199	−4.193*
								(2.491)	(2.471)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,858	1,858	1,858	1,858	1,858	1,858	1,858	1,830	1,830
R^2 with FE only	0.116	0.116	0.116	0.116	0.116	0.116	0.116	0.114	0.114
R^2 with FE and supply	0.131	0.131	0.131	0.131	0.131	0.131	0.131	0.129	0.129
R^2	0.131	0.132	0.131	0.132	0.133	0.135	0.135	0.133	0.134

(continued)

Table V. Continued

Panel B: Dependent variable: Log changes in local affiliates claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	0.00395	0.00426	0.00407	0.00395	0.00391	0.00405	0.00385	0.00434	0.00393
	(0.00411)	(0.00407)	(0.00406)	(0.00411)	(0.00407)	(0.00412)	(0.00425)	(0.00422)	(0.00435)
SRISK_TierI * WH	0.0323***	0.0311***	0.0328***	0.0323***	0.0341***	0.0300***	0.0380***	0.0258***	0.0377***
	(0.0116)	(0.0112)	(0.0117)	(0.0108)	(0.0125)	(0.0106)	(0.0122)	(0.00869)	(0.0122)
SRISK_TierI * Asia	0.0116**	0.0138***	0.0118**	0.0117***	0.0115**	0.0133***	0.0164***	0.0110**	0.0161***
	(0.00486)	(0.00477)	(0.00503)	(0.00413)	(0.00479)	(0.00427)	(0.00565)	(0.00462)	(0.00613)
Share of cross-border claims	−0.603	−0.783	−0.649	−0.607	−0.636	−0.667	−0.790	−0.308	−0.390
	(0.634)	(0.714)	(0.687)	(0.597)	(0.645)	(0.619)	(0.697)	(0.641)	(0.644)
Common language		14.50*				16.99**	17.29*	18.84**	19.93**
		(8.283)				(8.604)	(8.864)	(8.453)	(8.672)
Common legal origin			1.651			−3.573	−3.712	−2.357	−2.428
			(6.375)			(6.635)	(6.722)	(6.389)	(6.538)
Geographical contiguity				0.310		−4.724	−14.42	7.598	−3.696
				(16.71)		(18.12)	(19.59)	(14.39)	(17.97)
Colony					10.27	3.870	3.536	1.121	0.739
					(11.61)	(10.88)	(10.90)	(10.35)	(10.43)
Distance							−7.049		−11.52*
							(7.064)		(6.840)
Bilateral trade								−8.602	−11.62*
								(6.639)	(6.115)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	846	846	846	846	846	846	846	829	829
R^2 with FE only	0.166	0.166	0.166	0.166	0.166	0.166	0.166	0.165	0.165
R^2 with FE and supply	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169	0.169
R^2	0.170	0.172	0.170	0.170	0.170	0.173	0.174	0.175	0.180

Notes: Cross-sectional regression of lender–borrower pairs is estimated. The dependent variable changes were calculated as log differences between the end of the deleveraging episode and its start (coefficients are already reported in percentage). All standard errors are double clustered by creditor bank and borrower country. Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$. See Table I for definition of variables. The following abbreviations are used: WH stands for Western Hemisphere; SRISK for systemic risk contribution (measured developed by Acharya *et al.* 2010); ROA for return on assets; NPL for non-performing loans; and RWA for risk-weighted assets.

Table VI. Deleveraging during 2008Q2–09Q2: Creditor–borrower determinants with matched samples

Panel A: Dependent variable: Log changes in direct cross-border claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	−0.0102***	−0.0103***	−0.00992***	−0.0103***	−0.0103***	−0.0102***	−0.0102***	−0.0112***	−0.0112***
	(0.00255)	(0.00258)	(0.00263)	(0.00259)	(0.00250)	(0.00260)	(0.00261)	(0.00241)	(0.00244)
SRISK_TierI * WH	−0.0554***	−0.0553***	−0.0540***	−0.0542***	−0.0532***	−0.0493***	−0.0497***	−0.0527***	−0.0511***
	(0.0109)	(0.0109)	(0.0111)	(0.0109)	(0.0111)	(0.0113)	(0.0108)	(0.0111)	(0.0111)
SRISK_TierI * Asia	0.00873***	0.00854***	0.00924***	0.00987***	0.00857**	0.00890***	0.00873***	0.00827***	0.00893***
	(0.00327)	(0.00322)	(0.00313)	(0.00328)	(0.00347)	(0.00339)	(0.00337)	(0.00280)	(0.00317)
Share of cross-border claims	−0.339	−0.323	−0.455	−0.508	−0.379	−0.580*	−0.574*	−0.382	−0.393
	(0.400)	(0.401)	(0.379)	(0.393)	(0.387)	(0.346)	(0.333)	(0.400)	(0.395)
Common language		−1.273				−9.747	−9.767	−8.385	−8.231
		(8.608)				(8.966)	(8.985)	(9.009)	(9.078)
Common legal origin			4.107			4.239	4.243	3.619	3.625
			(4.555)			(3.597)	(3.608)	(3.795)	(3.787)
Geographical contiguity				13.38*		15.56*	16.08*	22.09**	20.64**
				(7.254)		(8.832)	(9.120)	(10.83)	(10.52)
Colony					12.51	15.11	15.12	14.76	14.73
					(13.38)	(13.54)	(13.57)	(13.76)	(13.71)
Distance							0.381		−1.467
							(3.511)		(3.971)
Bilateral trade								−4.255*	−4.640*
								(2.381)	(2.748)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	831	831	831	831	831	831	831	814	814
R^2 with FE only	0.230	0.230	0.230	0.230	0.230	0.230	0.230	0.226	0.226
R^2 with FE and supply	0.256	0.256	0.256	0.256	0.256	0.256	0.256	0.254	0.254
R^2	0.256	0.256	0.257	0.258	0.258	0.261	0.261	0.261	0.261

(continued)

Table VI. Continued

Panel B: Dependent variable: Log changes in local affiliates claims (in %)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
SRISK_TierI	0.00394	0.00431	0.00401	0.00395	0.00393	0.00409	0.00392	0.00438	0.00401
	(0.00413)	(0.00409)	(0.00409)	(0.00414)	(0.00410)	(0.00418)	(0.00431)	(0.00429)	(0.00442)
SRISK_TierI * WH	0.0336***	0.0326***	0.0339***	0.0334***	0.0350***	0.0303***	0.0385***	0.0263***	0.0385***
	(0.0119)	(0.0115)	(0.0119)	(0.0110)	(0.0129)	(0.0109)	(0.0127)	(0.00908)	(0.0127)
SRISK_TierI * Asia	0.0117**	0.0141***	0.0118**	0.0115***	0.0116**	0.0135***	0.0166***	0.0111**	0.0163***
	(0.00483)	(0.00471)	(0.00502)	(0.00413)	(0.00478)	(0.00423)	(0.00569)	(0.00457)	(0.00618)
Share of cross-border claims	−0.643	−0.838	−0.667	−0.617	−0.668	−0.671	−0.798	−0.325	−0.413
	(0.650)	(0.735)	(0.693)	(0.589)	(0.663)	(0.615)	(0.689)	(0.646)	(0.648)
Common language		15.49*				19.69**	20.05**	21.49**	22.70***
		(8.345)				(8.896)	(9.129)	(8.599)	(8.744)
Common legal origin			0.861			−4.444	−4.520	−3.261	−3.220
			(6.878)			(7.057)	(7.154)	(6.795)	(6.951)
Geographical contiguity				−2.018		−7.783	−17.52	4.048	−7.199
				(18.31)		(19.66)	(21.01)	(16.83)	(19.90)
Colony					8.096	1.264	0.994	−1.547	−1.755
					(12.85)	(11.90)	(11.88)	(11.41)	(11.48)
Distance							−7.056		−11.46*
							(7.231)		(6.952)
Bilateral trade								−8.255	−11.26*
								(6.746)	(6.193)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	831	831	831	831	831	831	831	814	814
R^2 with FE only	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172	0.172
R^2 with FE and supply	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176	0.176
R^2	0.176	0.179	0.176	0.176	0.177	0.180	0.182	0.183	0.187

Notes: Cross-sectional regression of lender–borrower pairs, with both lending through affiliates and direct cross-border, is estimated. The dependent variable changes were calculated as log differences between the end of the deleveraging episode and its start (coefficients are already reported in percentage). All standard errors are double clustered by creditor bank and borrower country. Robust standard errors in parentheses, $^{***}p < 0.01$, $^{**}p < 0.05$, and $^{*}p < 0.1$. See Table I for definition of variables. The following abbreviations are used: WH stands for Western Hemisphere; SRISK for systemic risk contribution (measured developed by Acharya *et al.* 2010); ROA for return on assets; NPL for non-performing loans; and RWA for risk-weighted assets.

recent (after 1945) colonial relationship exists (Table V panel A, Columns 5–9), or when a common language is present in the case of affiliates' lending (Table V panel B, Column 2, and 6–9). The sizes of the coefficients are also large, suggesting important economic effects about −13% and +26% for common language and colonial relationship, respectively. Regression results change somewhat when including all bilateral variables at the same time (Columns 6–9). The statistically significant negative sign for common language in the evolution of cross-border lending indicates that with closer cultural ties, lending had actually grown too large before the financial crisis. The positive sign for affiliate lending is consistent with the notion that transaction costs with local presence are lower as (relationship-based) lending was more maintained. Comparable to the presence of a post-1945 colonial relationship, contiguous borders make for less reduction in direct cross-border lending. Distance is usually considered in the literature as another proxy for the degree of transaction costs and information asymmetries. Although most often not significant, the greater the distance between the lender and borrower countries, the larger are the reductions in direct and affiliate lending (Table V, panels A and B, Columns 7 and 9).

We also include bilateral trade, measured as a share of lender banking system's GDP before the crisis episode, for two different reasons. The reduction in cross-border lending could be due to the drop in trade around the crisis periods as banks did cut back in general on trade finance (Chor and Manova, 2012). At the same time, bilateral trade can reflect familiarity of the lender banking system with the specific borrower country and fewer information asymmetries. Higher trade intensity can then mean fewer cutbacks in cross-border lending. Including the bilateral trade variable first alone and then also the distance variable (Table V, panels A and B, Columns 8 and 9), we find that trade has a negative effect on both direct cross-border and affiliates' lending, but only significantly so when distance is also included for affiliate lending. This suggests that the trade finance channel is more important since the distance variable captures more directly the absence of information asymmetries.

Regression results in the matched sample (Table VI), for which banking systems' lending occurs through both direct cross-border and affiliates activities, show similar results with respect to most variables. The main differences is that a colonial relationship after 1945 is no longer highly significant in the evolution of cross-border lending—reflecting that several French colonies are no longer in the sample—and now having contiguous borders is more consistently significant, lowering the reduction in direct cross-border lending. In general, the results in Tables V and VI show that lender–borrower characteristics (e.g., proximity, trade relationships, and historical relationships) help explain banking systems' deleveraging but much less than supply-side characteristics do, with the contribution of lender–borrower characteristics to the total R^2s especially substantially less for direct cross-border loans.[14] This lower power to explain the overall heterogeneity during the leveraging process, however, as shown before, does not imply that some of these factors might not be large in economic terms for specific borrower–lender characteristics and smaller group of countries.

14 As shown in the working paper version (IMF WP/14/180), even when including credit bank country-fixed effects instead of the systemic capital risk variables, the recent-colony dummy remains significant for the sample of direct cross-border lending, and common language, distance, and bilateral trade are significant for the sample of affiliate lending.

4.3 Robustness Tests

We conduct a number of robustness tests. We estimated regressions with winsorized data and single clustering, instead of the double clustering shown, and results do not change qualitatively.[15] As another robustness test, we scaled SRISK with the creditor country's GDP to capture the overall ability of the country to support its banking system as of end of 2007 (this scaling is also used by Engle, Jondeau, and Rockinger, 2015). These regressions (reported in the working paper version) provide almost identical results to those when scaling with Tier I capital. We also scaled SRISK by the creditor country's overall banking system assets. Here, regression results are largely the same, but are statistically significant less often. This is to be expected as SRISK itself also captures the differences in the size of banking systems, making SRISK scaled by assets less meaningful as an indicator of banking system vulnerability.

Furthermore, we checked whether including some other supply variables made a difference. Besides being confronted with capital shocks, banking systems also suffered from unanticipated liquidity and funding shocks. Especially being unable to easily fund assets in US dollars, banks had to adjust their lending dramatically during the crisis. To measure dollar liquidity, we use the McGuire and von Peter (2009) creditor country banking system gross short-term dollar funding need measure (as also used by Cetorelli and Goldberg, 2011). While the data reduce our sample considerably—by about one-half—the regression results remain similar in terms of coefficient signs. Interestingly, dollar shortfall variables themselves are not statistically significant (especially if double clustering is used). Similar results, also with a considerable drop in sample sizes, are obtained if we use as a proxy of funding conditions the change in the market-to-book ratio of equity of banks of country *i* (as sued by Giannetti and Laeven, 2012, and De Haas and Van Horen, 2012), or the average spread in the overnight swap rate in banking system *i* during the deleveraging episode (similar to Giannetti and Laeven, 2012). We also test for the importance of local funding conditions for affiliate lending, but found this not to be statistically significant either.

5. Conclusions

We analyze the role of supply, borrower, and lender–borrower factors in driving changes in international banking claims during the deleveraging episode triggered by the GFC, considering both direct cross-border loans and local affiliates' lending. Relative to the existing literature, we innovate in three ways. First, we explore the role of ex-ante supply conditions—including market-based measures through the use of SRISK—and lender–borrower factors in driving the degree of international deleveraging, avoiding the risks of explaining developments with measures that are endogenous. Second, we exploit differences between direct cross-border banking and affiliated lending, allowing us to analyze both their different potential drivers and the role of frictions in banks' ability to move resources

15 As a further robustness test, we also split the sample following the geographical location of the borrowers into four regional groups (Asian borrowers, European borrowers, Western Hemisphere borrowers, and other borrowers). The results continue to highlight the role of market perceptions of vulnerabilities as captured by SRISK across regions for the evolution of direct cross-border lending. The main difference compared with the total sample is that for the "other" borrowers group—countries in the Middle East and Africa—balance sheet characteristics of lenders before the deleveraging episode played a role. Results are available on request.

within the banking group during the GFC. Third, we use data that take into account exchange rate variations and coverage-related break-in-series in cross-border bank claims, allowing a better representation of how banks change their international activities.

Our findings confirm the importance of supply factors in driving international capital flows, in particular those intermediated by global banks. Controlling for demand and other borrower-related factors, we find that deleveraging largely varied with ex-ante, market-based measures of vulnerabilities of banking systems to shocks, with traditional accounting variables consistently displaying no significant effects. Creditor–borrower characteristics (e.g., concentration of exposure, cultural and geographical proximity, trade relationships) play some roles as well, but not as large as supply factors do. Importantly, we find indirect evidence of barriers to the cross-border movement of resources within banking groups, as supply-side factors explaining the reduction in direct cross-border loans differ from those explaining the reduction in lending by local affiliates. We find also direct evidence that substitution between cross-border and affiliates' lending is less likely for those home banking systems with greater perceived vulnerabilities, indicating that some affiliates may have been prevented from moving resources back to headquarters to compensate for cuts to direct cross-border lending. Where creditor banks' governments intervened, however, banks reduced both direct cross-border and affiliates lending equally, possibly reflecting a larger induced home bias. Finally, we find evidence that the degree to which banking systems were subject to market discipline affected the degree and nature of deleveraging.

Our findings, notably those related to supply factors, and also those related to the bilateral relationships between lender and borrower countries, matter for policy. First, they highlight that backward-looking financial statement measures can be very poor, real-time proxies to the risk of deleveraging and indicate that forward-looking market-based measures, in some combination with financial statement measures, can be more informative. As such, our findings suggest that financial stability and other assessments should incorporate more such measures. Second, the findings have implications for borrower countries in that they should also consider the type and origin of cross-border lending. Since we find, controlling for demand and lender–borrower characteristics, that direct cross-border lending is more sensitive to supply factors than lending by foreign affiliates is, also in ways that varies by characteristics of the home country banking system, countries have to consider from whom and how they borrow. Third, the results indicate that government support and lack of market discipline can affect the speed of deleveraging. Fourth, the evidence of the presence of frictions to the movement of resources within banking groups across borders during times of financial turmoil, with frictions greater the larger the vulnerabilities in home banking systems has regulatory implications. Through more ex-ante coordination, bank regulators could avoid the risks of ring-fencing and other unilateral regulatory measures, and thereby help limit the sharp contraction in direct cross-border lending during periods of financial turmoil.

In terms of future research, our work suggests a large agenda, much of which, however, will depend on the future availability of appropriate data, especially covering a number of banking systems.[16] With additional cross-border data, especially if bank-specific, further analyses of the drivers of the specific forms of retrenchment will be very useful. Do banks reduce their cross-border banking claims in response to their own liquidity positions or do solvency concerns play a larger role? Does the supply of official liquidity or availability of

16 See Cerutti, Claessens, and McGuire (2014) for a more detailed discussion on the developments in this area.

recapitalization funds affect the degrees and forms of retrenchments? Are there large differences between banks that use different internal structures, for example, centralized versus decentralized treasury systems and subsidiaries? What specific types of regulatory actions, including macroprudential and capital flow management policies, could be most closely associated with differences in how direct cross-border loans and lending by local affiliates responded to various supply factors? Answers to these and other questions will be very useful both for international bankers themselves and for policy makers.

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