The Two Faces of Cross-Border Banking Flows*†

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Abstract

We examine the determinants of cross-border interbank and intra-group funding across crisis and non-crisis periods. Using a previously unexplored data set spanning 25 banking systems, we find aggregate intra-group funding is unrelated to fluctuations in either global or local macroeconomic factors, while flightier interbank funding responds pro-cyclically to both worldwide and domestic economic trends. This feature of the data means intra-group funding remains comparatively stable when global conditions deteriorate – even during the global financial crisis. During 'normal' times we find intra-group funding responds counter-cyclically to global interest rate changes, with parent banks using affiliates to offset tighter global funding conditions. More generally, we find intra-group funding has a closer relationship with domestic banking system profitability and solvency, being used to support banks in weaker banking systems during the global financial crisis.

Keywords: Cross-border banking flows, global risk, parent banks and foreign affiliates.

JEL Classification: F32, F34, G21.

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1 Introduction

The globalization of financial markets has changed the landscape of international banking. Large and growing networks of foreign branches and subsidiaries now operate around the world, each centered around and controlled by a global parent bank (McCauley, McGuire, and Von Peter, 2010; Claessens and Van Horen, 2014). The cross-border funding activity between and within this international banking system can be divided into 'interbank' funding between unaffiliated banks and 'intra-group' funding between related banks within an internal capital market (Stein, 1997). Over time intra-group flows are large – indeed, comparable in size to interbank flows and hence form an important aspect of international banking and financial stability (Cetorelli and Goldberg, 2012b). But despite its importance, little is known about the systematic factors driving intra-group funding over time.

In this paper, we construct a novel panel data set of cross-border intra-group and interbank funding for 25 countries between 1998Q1 and 2011Q4. The data set allows us to be the first to directly explore the primary global and host-country banking and macroeconomic factors determining international intra-group flows across periods of crisis and non-crisis, and to contrast these factors with those driving interbank flows. We find intra-group funding, particularly to foreign affiliates, is largely unresponsive to the global and domestic macroeconomic environment but is instead sensitive to domestic banking conditions. We find, for example, that parent banks systematically substitute funding towards foreign affiliates resident in stronger banking systems where profitability is highest. In contrast, interbank funding is found to respond strongly and pro-cyclically to macroeconomic conditions in both the global and host economy.

We also document a link between banking system conditions and intra-group lending during the Global Financial Crisis (GFC). Parent banks resident in less profitable banking systems, or in banking systems with low solvency levels, are found to have required more liquidity support from their foreign affiliates during the GFC, while foreign affiliates were themselves the beneficiary of intra-group funding if resident in weaker banking systems.

The paper contributes to a growing literature studying the dynamics of international banking flows. This literature can be characterized by three broad strands. The first strand considers the behavior of aggregate cross-border bank-to-bank flows using the BIS's *International Banking Statistics* database (Cetorelli and Goldberg, 2011; Cerutti and Claessens,

2013; Bruno and Shin, 2015; Cerutti, Claessens, and Ratnovski, 2014; Shirota, 2015). In contrast to these studies, we explore the decomposition of aggregate funding between banks, split along the intra-group interbank dimension to provide more granular detail on the drivers of global banking flows.

The second strand of the literature uses micro-level banking data on intra-group funding to explore its behavior during specific episodes or for particular countries (Cetorelli and Goldberg, 2012a,b,c; Jeon and Wu, 2014; Schnabl, 2012). Instead, we are able to explore a broader set of countries across a longer time series, which includes both crisis episodes and 'normal' economic times. In doing so, we document a systematic set of observations on the factors driving intra-group funding.

The third strand of the literature again uses bank-level data to investigate intra-group funding *indirectly*, by inferring the behavior of intra-group flows between parents and foreign affiliates, by studying the determinants of local affiliate lending to the host economy. This time the studies use larger data sets with longer time-series of bank-level data covering dozens of countries (De Haas and Van Lelyveld, 2010, 2014; Jeon, Olivero, and Wu, 2013). The advantage of our study relative to this third strand of the literature is our ability to *directly* measure intra-group flows by being the first, to our knowledge, to construct an aggregate series of intra-group funding to parent and foreign affiliate banks.[1]

Understanding the similarities and differences in factors driving interbank and intra-group funding is important. We find the funding structure of banking systems around the world varies significantly, with the proportion of intra-group-to-interbank funding ranging from less than 0.05 to over 0.80 in some banking systems. In light of the contrasting determinants of interbank and intra-group funding which we document in this paper, these differences in funding structure could have real economic consequences for domestic credit expansion both during normal and crisis periods. The study is therefore relevant to policy makers concerned with the financial stability implications of cross-border bank funding as well as its likely behavior over time.[2]

[1] One study to also directly investigate intra-group flows across multiple countries is by Allen, Gu, and Kowalewski (2013). The authors hand collect data on intra-group transactions from the financial statements of European Union banks between 2007 and 2009. The main purpose of this study, however, is to evaluate the European Unions regulatory structure regarding internal capital market flows and evaluate its appropriateness in light of the transactions uncovered within the study. The main finding is that intra-group transactions could be significantly detrimental to a foreign affiliate to the extent that a country's financial stability could be affected.

[2] The results of our paper indicate that a fruitful area for future theoretical and empirical work could ex-

The investigation is also important for contributing to the debate on the future of global banking and the potential curbs on global bank operations. In particular, "ring-fencing" of foreign affiliate capital has been proposed in the aftermath of the GFC, in an attempt to mitigate the negative effects on host-country credit growth during crisis episodes, when foreign affiliates are potentially required to support their parent bank.[3] This debate, however, is largely one sided and overlooks the potentially stabilizing influence of intra-group funding flowing *to* foreign affiliates (Schnabl, 2012) and the potential costs of significantly higher capital buffers at the parent or subsidiary level (Cerutti, Ilyina, Makarova, and Schmieder, 2010). By providing a systematic set of observations on the behavior of intra-group funding, we show that while intra-group funding benefits strong banking systems, it also has little correlation with global or domestic macroeconomic conditions, making it comparably stable relative to other forms of cross-border finance which tend to fluctuate closely with global shocks (Forbes and Warnock, 2012a).

The remainder of the paper is organized as follows: in Section 2 we describe the data on cross-border bank funding and our empirical methodology. In Section 3 we document the empirical results on the main factors driving interbank and intra-group funding. In Section 4 we present additional robustness analysis. We conclude in Section 5.

2 Data and Methodology

2.1 Banking Flows Data and Dependent Variables

Banking flows data. We collect data on cross-border bank-to-bank funding for advanced and emerging market economies from the Bank for International Settlements' (BIS) *Locational Banking Statistics by Nationality* database (IBLN). While the BIS database has been used extensively by researchers in this literature, the novelty of our approach is to decompose aggregate cross-border bank flows between interbank and intra-group funding. Specifically,

plore why global banks adopt one type of cross-border funding structure over another and whether a possible optimal combination exists that maximizes firm value. Kerl and Niepmann (2014) make a recent theoretical contribution in this direction, finding that a bank's composition of interbank relative to intra-group lending is driven by the efficiency of the banking system, the return to capital and entry barriers which impede foreign bank operations. From an empirical perspective, De Haas and Kirschenmann (2013) investigate the determinants of internal capital market characteristics. Interviewing the CEOs of over 400 banks from emerging Europe, the authors find parent- and host-country characteristics are stronger determinants of the intra-group structure than either parent or foreign affiliate bank characteristics.

[3]See Goldberg and Gupta (2013) and Carney (2013) for recent discussions and the Federal Reserve Board (2014) for a description of the recently finalized rules that require large foreign affiliates operating in the US to adhere to US capital and liquidity rules.

we split funding between flows to (i) 'related foreign offices', which we categorize as intra-group flows, and (ii) 'other banks', which we categorize as interbank flows.[4] In total we consider 25 banking systems that report both interbank and intra-group cross-border banking flow data. The banking systems include: Austria, Australia, Belgium, Brazil, Canada, Chile, Cyprus, Denmark, Germany, France, India, Ireland, Italy, Japan, Luxembourg, Netherlands, Norway, South Africa, South Korea, Spain, Sweden, Switzerland, Turkey, United Kingdom, and the United States. All cross-border bank-to-bank flow data are adjusted for the effects of exchange rate movements and we exclude data on offshore banking centers.[5]

The aggregate stock of cross-border bank-to-bank funding is economically important. In Figure 1a, we see that cross-border bank-to-bank funding accounted for over 100% of GDP in five banking systems in 2011Q4: Luxembourg (654%), Cyprus (167%), Ireland (150%), United Kingdom (128%) and the Netherlands (124%). In Figure 1b, we decompose this aggregate cross-border bank-to-bank funding to assess the relative importance of interbank and intra-group funding across banking systems. To do so, we present each country's average share of intra-group funding between 1998 and 2011.[6] Funding models can be seen to have varied markedly across banking systems in this time frame. While intra-group funding accounted, on average, for over 80% of cross-border bank-to-bank funding in some countries, others have relied almost entirely on interbank funding. Moreover, there is no clear pattern in whether the stock of intra-group funding is held predominately by parent or foreign affiliate banks, providing an early indication that both interbank and intra-group funding are important sources of bank-to-bank funding and that no single universal funding model is adopted across banking systems.

[4]While the BIS makes some international banking data publicly available, due to confidentiality, the split between interbank and intra-group funding is part of a non-public restricted data set.

[5]While we exclude offshore banking centers, note that the funding *from* offshore banking centers to the 25 banking systems in our study *is* included. We choose not to study the funding *to* offshore banking centers for three reasons. First, our primary interest is the impact cross-border flows may have on domestic financial stability, independent of whether these flows were intermediated by offshore centers. Second, only sparse interbank and intra-group data is available for offshore centers. Specifically, only the Cayman Islands, Macao, Panama and Bermuda report such data, while there is no data for Hong Kong, Singapore, Guernsey or Jersey. Third, in our empirical setup, we choose to control for country and banking system characteristics. This data is only sparsely available for offshore banking systems, particularly for the few offshore centers which report data on the split between interbank and intra-group funding. Note also, that apart from excluding countries which do not report both interbank and intra-group flow data, we also exclude Finland as it only reports intra-group flows from 2010Q2 onwards.

[6]Due to data confidentiality, we are unable to report specific country details on intra-group funding and hence, for the purposes of the figure, we anonymize countries.

Dependent variables: interbank and intra-group funding. Our main dependent variables are the quarterly percentage changes in cross-border interbank and intra-group funding (F) flowing to the 25 banking systems we study between 1998Q1 and 2011Q4. To calculate cross-border intra-group funding, for example, we sum all cross-border intra-group flows to banks resident in the domestic economy and divide by the previous quarter stock of intra-group funding held by all domestic banks (both parents and foreign affiliates). Specifically, the dependent variables are calculated as:

$$\Delta F^{i}_{j,t} = \frac{\sum_{k=1}^{K} Flow^{i}_{k,j,t}}{\sum_{k=1}^{K} Stock^{i}_{k,j,t-1}}, \tag{1}$$

where $Flow$ and $Stock$ represent the *flow* and *stock* of interbank and intra-group funding. The superscript i denotes whether the funding is either interbank or intra-group, $i = \{interbank, intra\text{-}group\}$, while $j = 1, 2, .., 25$ is an index of host-country banking systems and $k = 1, 2, ..., K$, is an index of the K countries of ultimate bank origin with banking operations in the j^{th} banking system.[7] As a concrete example, take the case of intra-group funding to the United States ($i = intra\text{-}group$, $j = US$). In this case, we sum intra-group flows to all banks resident in the US, which includes US parent banks and all foreign affiliates – the parents of which are based in one of $K - 1$ other economies (i.e excluding the US). Finally, the flows to these US resident banks could be from *any* country, and is not limited to either the 25 banking systems studied in this paper, or the the K countries of ultimate bank origin (the flows could, for example, originate from an offshore banking center).

In Figure 2, we present an early visual depiction of interbank and intra-group funding. Either directly or indirectly, the potentially contrasting dynamics of interbank and intra-group funding have typically been investigated around times of crisis (Schnabl, 2012; Cetorelli and Goldberg, 2011), when cross-border capital flows are known to be volatile (Forbes and Warnock, 2012a). In Figure 2a, we therefore begin our visual inspection of interbank and intra-group flows, by charting the behavior of these flows during the GFC when we may anticipate the largest deviation in behavior. Indeed, we find that interbank funding fell, on average, by almost 30 percent between September 2008 and the end of 2009, while intra-group funding *increased* in the immediate aftermath of Lehman Brothers' collapse and was

[7] The countries $k = 26, 27, ..., K$, do not report banking statistics to the BIS but have resident global banks with operations abroad (significant examples include China and Russia).

stable for the remainder of the crisis period.[8] But the contrasting behavior between interbank and intra-group flows is not limited to the GFC. In Figure 2b, we present the distributional relationship across time between cross-border bank-to-bank funding and different periods of global economic uncertainty, as measured by changes in the realized volatility of global equity returns.[9] We find that, on average, interbank funding contracted during quarters when economic uncertainty was at an elevated level (upper-25^{th} percentile) between 1998 and 2011, while intra-group funding *expanded* by over two percent during the same quarters. In the quarters when economic uncertainty was particularly low (lower-25^{th} percentile), both interbank *and* intra-group funding expanded by over three percent.

In Table 1, we build on these visual representations by presenting descriptive statistics on interbank and intra-group funding. In Panel A, we confirm that external bank-to-bank funding is large and economically significant, with the median level of total external bank-to-bank funding exceeding 30% of GDP. Intra-group funding is a significant component of the total, accounting for over 40% on average, of which around 50%-60% is held by parent banks. This aggregate figure is partially dominated by large global parent banks and therefore, when we isolate foreign affiliates, we find intra-group funding accounts for around half (0.49) of their total external bank-to-bank funding needs. In fact, affiliates are seen to be, on average, net receivers of intra-group funding, borrowing around 10%-15% more than they lend back to the parent bank.

In Panel B, we present a breakdown of the dynamics of interbank and intra-group funding over our sample period. Between 1998 and 2006 intra-group funding grew on average at a substantially faster rate than interbank funding, recording a healthy growth of over 4% per quarter, compared to around 2.5% for interbank funding. The growth figures translate into a higher dollar value of intra-group funding of around $6.0bn per quarter compared to $3.8bn. But on the eve of the crisis in 2007, both forms of funding experienced significant surges in growth, with interbank funding growing by nearly 5.5% on average per quarter while intra-group funding surged to 9% quarterly growth. In US dollar terms, the flows equated to nearly $70bn more intra-group and interbank funding during the year. This surge in funding contrasts starkly with the rapid withdrawal of funding – particularly interbank funding –

[8]The numbers reflect the median change in interbank and intra-group funding across all 25 banking systems in the study. To calculate the change, we sum across flows (adjusted for exchange rate fluctuations) and divide by the stock of funding at the start of the crisis.

[9]More precisely, we measure realized volatility as the square-root of average squared daily returns to the MSCI Global Equity Index, a composite measure of returns across 23 developed market stock indices.

during the crisis period of 2008-2009. Interbank funding in fact, was withdrawn at a rate of over $17bn per quarter between 2008Q4 and 2009Q2 – quickly reversing the large build up of funding over the preceding year. Intra-group funding did not entirely avoid the crisis either, but the pace of funding withdrawal was far slower, while the impact was principally felt by affiliate banks. In fact intra-group funding to parent banks *increased*, on average, by nearly $0.7bn per quarter following Lehman Brothers' collapse between 2008Q4 and 2009Q2. Following the GFC, both forms of funding have displayed tentative signs of recovery, although considerably short of their pre-crisis average growth rates, with the European Sovereign Debt crisis likely being a major factor stemming the recovery in lending.

Dependent variables: parent and foreign affiliate funding. Our initial measure of intra-group funding is an aggregate, and comprises both the funding to parents and foreign affiliates. To provide more clarity on the dynamics of internal capital market funding, we investigate the behavior of intra-group funding at a deeper level by studying the (potentially contrasting) dynamics of aggregate funding to parent and foreign affiliate banks. Specifically, we define the intra-group funding to parents (P) and foreign affiliates (FA) as:

$$\Delta F^{P}_{j,t} = \frac{Flow_{k=j,t}}{Stock_{k=j,t-1}}, \qquad \Delta F^{FA}_{j,t} = \frac{\sum_{k=1,k\neq j}^{K} Flow_{k,j,t}}{\sum_{k=1,k\neq j}^{K} Stock_{k,j,t-1}}. \tag{2}$$

In the case of parent banks, we record the flow when $k = j$ (i.e. a bank is considered a parent when the bank's country of origin is the same as the bank's country of residence). We normalize the change in funding by dividing by the previous quarter stock of intra-group funding held by parent banks headquartered in the j^{th} banking system. For foreign affiliates, we sum across banks resident in banking system j but with a different country of origin.[10]

2.2 Empirical Methodology

The cross-border capital flows literature has famously distinguished between global 'push' factors and host-country 'pull' factors in driving capital flows (Calvo, Leiderman, and Reinhart, 1996). This distinction between 'push' and 'pull' factors has equally been applied to

[10]It is not known, however, if flows to a foreign affiliate are directly from the parent bank or from another foreign affiliate located outside the country. The BIS is currently expanding its data set to include bilateral interbank and intra-group flows (Committee on the Global Financial System, 2012), which will help provide further details on the dynamics of internal capital market funding.

cross-border bank-to-bank flows literature (De Haas and Van Lelyveld, 2010; Bruno and Shin, 2015; Shirota, 2015), and provides a natural framework for directly investigating interbank and intra-group flows which has clear parallels with the existing capital flows literature.

To investigate the main global and host-country determinants of interbank and intra-group funding we estimate a fixed-effects panel regression of the form:[11]

$$\Delta F^{i}_{j,t} = \alpha + \beta' Global_{t-1} + \gamma' Host_{j,t-1} + \lambda_j + \epsilon_{j,t} \tag{3}$$

where *Global* and *Host* are matrices of independent variables covering global and host-country macroeconomic and banking-system factors which are conjectured to be important determinants of cross-border bank-to-bank flows (full details of the global and host-country factors are provided below). We capture time-invariant country-level heterogeneity with country-specific fixed effects (λ_j). The dependent variables, as well as all country-specific independent variables, are winsorized at 2.5 percent to limit the impact of outliers, while standard errors are clustered at the time dimension.[12] Dependent variables are lagged by one quarter unless otherwise stated.

To investigate the impact of crisis periods on the main determinants of interbank and intragroup funding, we also estimate the model excluding the GFC period (defined to coincide with the large drop in cross-border bank-to-bank funding between 2008Q4 and 2009Q2) and excluding the entire post 2008Q3 period, to capture both the GFC and European sovereign debt crisis. Moreover, in addition to examining the behavior of explanatory variables around crisis and non-crisis periods, we also formally test if interbank and intra-group funding themselves behave differently during the GFC (as suggested by the preliminary visual inspection of the data) by including a crisis dummy variable (*Crisis*), equal to 1 between 2008Q4 and 2009Q2:

$$\Delta F^{i}_{j,t} = \alpha + \beta' Global_{t-1} + \gamma' Host_{j,t-1} + \lambda_j + \delta Crisis + \epsilon_{j,t} \tag{4}$$

We estimate analogous models for the percentage change in parent ($\Delta L^{P}_{j,t}$) and foreign affiliate ($\Delta L^{FA}_{j,t}$) funding. In these cases we also interact the crisis dummy variable with

[11] We estimate a Hausman test and find the null hypothesis (the random-effects estimator is consistent) is strongly rejected, indicating the appropriateness of a fixed-effects model.

[12] We examine the impact of two-way clustering in Section 4.

aggregate banking system conditions (as described below) to formally test if, during the GFC, the underlying strength of either the parent or foreign affiliates banking system was an important factor in determining the dynamics of intra-group funding.

2.2.1 Global and Host Country Factors

To identify potential systematic factors driving interbank and intra-group funding across crisis and non-crisis periods, we draw from the hypotheses of aggregate and micro-banking studies of cross-border banking flow behavior. In doing so, we aim to build from the specific-to-the-general in terms of the conclusions on the primary determinants of interbank and intra-group flows, which apply outside specific events or particular countries.

Global factors. Global factors linked to cross-border bank-to-bank flows span global economic uncertainty, interest rates and growth. Increases in global economic uncertainty have been linked theoretically and empirically with changes in global bank leverage to suggest a negative relationship with interbank funding (Adrian and Shin, 2010; Huang and Ratnovski, 2011; Forbes and Warnock, 2012a; Fratzscher, 2012; Bruno and Shin, 2015), while the relationship with intra-group funding is less clear and may be time- and or regime-dependent depending on the health of the parent bank (De Haas and Van Lelyveld, 2010; Schnabl, 2012; De Haas and Van Lelyveld, 2014). To capture global economic uncertainty, we use the average quarterly realized volatility of returns to the MSCI Global Equity Index, which combines the returns on 23 developed economy stock markets.[13]

Global interest rates have also been shown to affect bank-to-bank capital flows by making foreign investment increasingly attractive (portfolio channel) while changing the probability of bank default. Bruno and Shin (2015), for example, show that total cross-border funding should increase if interest rates fall in primary banking centers, increasing global banks' profit opportunities abroad while simultaneously reducing their probability of default. Global banks resident in major banking centers may, however, also use foreign affiliates to smooth domestic interest rate shocks at home (Cetorelli and Goldberg, 2012a).[14] We capture changes in global interest rates by the change in the average short-term money market rate across

[13]The measure provides a broad empirical proxy of global economic uncertainty, providing a more precise measure of 'global' uncertainty than the alternative US-centric VIX index of implied US stock market volatility.

[14]Given the natural link between short-term money market rates and broad money growth, changes in interest rates may capture fluctuations in global liquidity which have been linked with bank runs (Giannetti, 2007) and changes in global bank leverage (Brunnermeier, 2009).

four major banking centers: Germany, Japan, UK and US. Global growth shocks are also often embedded within the papers described above, and can be thought to drive cross-border banking flows by influencing the profitability, solvency and liquidity needs of global banks (Ongena, Peydró, and Van Horen, 2013). We measure global growth as the quarterly growth in world real GDP. Both short-term money market rates and real global growth are collected from the IMF's *International Financial Statistics* database.

Host-country factors. Host-country factors linked to cross-border bank funding can be distilled into domestic macroeconomic and banking system conditions. De Haas and Van Lelyveld (2010), for example, conjecture that intra-group funding to foreign affiliates may either be 'substituted' towards the banking systems with the greatest return potential or be 'supportive' and flow to banks most in need of liquidity support. The authors find indirect evidence that intra-group funding is actively redistributed among foreign affiliates towards the fastest growing economies, but is also used to support weaker foreign affiliates.[15] The hypothesis implies that factors which capture the current and or future strength of the domestic economy or health (profitability, solvency) of the local banking system, could be an important determinant of intra-group flows.

Bruno and Shin (2015) provide similar evidence for interbank funding. The authors distill the main factors driving cross-border bank-to-bank lending by global banks, finding that domestic interest rates (portfolio channel), exchange rates (default channel) and profitability of the local banking system should all be positively correlated with bank-to-bank funding. In general, when macroeconomic conditions improve at the domestic level, bank-to-bank funding levels should increase to respond to an increase in bank leverage and decrease in the risk of bank default.

We capture the health of the domestic banking system across two dimensions: profitability and solvency. To capture the relative profitability (or health) of the local banking

[15]Parent banks may purposefully adopt a counter-cyclical *intra-group* funding strategy to offset, for example, monetary policy shocks (Jeon and Wu, 2014) or the negative liquidity shock associated with a credit rating downgrade (Karam, Merrouche, Souissi, and Turk, 2014). De Haas and Van Lelyveld (2014) find parent banks provided less support to their foreign affiliates during the GFC implying that intra-group funding may also contribute to the international propagation of financial shocks, while Popov and Udell (2012) find that foreign affiliates whose parents had low equity ratios or suffered large financial asset losses, reduced their domestic credit expansion by more during the GFC. Cetorelli and Goldberg (2012b) also find the business purpose of the foreign affiliate is important. Specifically, during the 2008-09 crisis, US global banks reallocated intra-group funding back to the US according to an organizational pecking order: traditional funding locations were used more actively to buffer the domestic liquidity shock, while foreign affiliates viewed as key revenue generators were largely shielded from providing liquidity support.

system, we collect data on the average return on resident banks' book equity. The variable is measured as the median return on book equity across all banks resident in a particular economy, as compiled by Beck, Demirgüç-Kunt, and Levine (2000, 2009).[16] We also include data on the aggregate net interest margin of local banks as a second measure of local bank performance. The aggregate solvency of domestic banks is measured as the ratio of bank capital to total assets. Both the net interest margin and ratio of bank capital to total assets are collected from the World Bank's *Global Financial Development* database. We measure macroeconomic conditions based on domestic growth, inflation, interest rates and the exchange rate. Inflation and GDP data are collect from the IMF's *World Economic Outlook* database, while local money market and exchange rates are collected from the IMF's *International Financial Statistics* database. Summary statistics and correlations across all independent variables are presented in the Appendix.

3 Empirical Results

3.1 Intra-group and Interbank Funding

Baseline. We present our main baseline results on the determinants of interbank and intra-group funding in Table 2. In total we estimate eight specifications: four identical specifications for each form of funding, such that apart from different dependent variables, the first estimated model is equivalent to the fifth estimated model and so on. The dependent variables are the quarterly percentage changes in cross-border interbank and intra-group funding, as described in Section 2. We split explanatory variables between *Global Factors* (upper panel) and *Host Country Characteristics* (lower panel). The first baseline regression covers the entire sample from 1998 to 2011. The relationship between interbank funding and fluctuations in the *Global Factors* follows, as anticipated, a pro-cyclical pattern. The sign on the estimated coefficients indicates that an increase in global economic uncertainty, rise in global interest rates or slowdown in the global growth are all related with a fall in cross-border interbank funding. In the case of global economic uncertainty and interest rates the relationship is found to be especially strong, evidenced by the coefficients being statistically significantly different from zero at the 5% confidence level.

In contrast, intra-group funding responds *counter*-cyclically to fluctuations in *Global*

[16] The figure is based on all foreign and domestic banks in an economy using data from *Bankscope*. While *Bankscope* data is comprehensive, it does not take into consideration the return on equity of foreign *branches*.

Factors. The covariances imply that higher global economic uncertainty or interest rates, as well as lower global economic growth, are linked with an increase in intra-group funding, although the general lack of strong statistical significance suggests an underlying *stability* in intra-group funding during deteriorating global economic conditions. The one statistically significant coefficient is on the change in global interest rates. The finding could be systematic evidence, consistent with the finding of Cetorelli and Goldberg (2012a), that global parent banks use their foreign affiliates to reduce the impact of negative monetary policy shocks at home. At this juncture, however, we cannot say whether the increased funding is principally to parent banks, foreign affiliates or both, and thus we return to the question in the next section.

Turning to the local macroeconomic variables within the *Host Country Characteristics*, we find a similar (albeit less pronounced) contrast in the behavior of interbank and intra-group funding. Stronger economic growth and lower inflation are both consistent with an inflow of interbank funding into the local banking system. This time around, the correlation between macroeconomic variables and intra-group funding goes in the same pro-cyclical direction as for interbank funding, but to a lesser and more variable extent such that the effect is not significant across countries. A possible reason why intragroup funding is less sensitive to macroeconomic conditions is offered by Cetorelli and Goldberg (2012b), who find intra-group funding may be determined by bank-specific factors, detached from short-term macroeconomic fluctuations, such as the affiliate's principal business activity or geographical distance from the parent bank.[17]

Interestingly, we find no evidence that changes in short-term domestic money market rates are important for determining either interbank or intra-group flows. The finding may be surprising, as bank's portfolio decisions may be thought to be a function of local interest rates. Indeed, the well-known currency carry trade has been linked to the balance sheet of global banks (Hattori and Shin, 2009). But the findings may not, in fact, be inconsistent. Interest rates are known to be relatively persistent, particularly with respect to the ranking of countries' interest rates. Some countries offer *permanently* high interest rates (Lustig et al., 2011; Hassan and Mano, 2014) and therefore small fluctuations in money market rates may not sufficiently impact the relative attractiveness of a country's assets to change a bank's

[17] De Haas and Van Horen (2013) also find that parent banks were more likely to maintain intragroup funding during the global financial crisis to affiliates in countries closest to the parent bank's headquarters.

asset allocation decision.

Fluctuations in exchange rates, on the other hand, *do* appear to be important for driving bank-to-bank funding, particularly intra-group funding. The negative and highly significant coefficient implies that when the local currency appreciates against the US dollar, the local banking system experiences an inflow of intra-group funding. The finding supports the mechanism proposed by Bruno and Shin (2015). In their model, an appreciation of the domestic currency against the US dollar reduces the value of domestic firms' US-denominated liabilities once expressed in local currency, and therefore strengthens the balance sheet of firms that hold more US liabilities than assets. The improved balance sheet position of domestic firms then reduces the default risk on loans issued by local banks to the domestic firms. The reduced banking system risk thus increases the borrowing capacity of local banks. A possible reason why intra-group funding is more sensitive to foreign exchange rate changes could be the lower information asymmetries that are inherent to internal capital market funding vis-a-vis arms-length interbank funding.

Intra-group funding does, however, appear to be strongly associated with fluctuations in domestic *banking* conditions. The most profitable banking systems, as measured by the average Return on Equity (ROE) of resident banks, experience the highest growth in intra-group funding. We find the same to be true for interbank funding, albeit to a marginally lesser extent. In contrast, we find an equally strong but *negative* relationship between intra-group funding and the average net interest margin of the domestic banking system. The net-interest margin provides a measure of bank performance based on the difference between the interest rates banks earn on their investments and pay on their borrowing. The negative and highly statistically significant coefficient implies that intra-group funding flows to banking systems with the smallest interest spreads (margins), suggestive of a supportive flow towards banking systems most sensitive to increased funding costs. Supporting this view, we find that the net interest margin is more highly correlated with our measure of solvency than the ROE. From the the correlation matrix presented in the Appendix, we see the correlation is just over 70%. Banking systems with low net interest margins tend to have lower capital-to-asset ratios and indeed, we also find a negative relationship with overall banking system solvency for intra-group funding.[18]

[18]Note that while ROE and the net interest margin are both linked to performance and profitability, they are not by definition highly correlated. A banking system with a high average ROE, for example, may also be highly leveraged, which amplifies even a small net interest margin and hence the two findings are not

The findings on intra-group funding appear consistent with the earlier study of De Haas and Van Lelyveld (2010), who find similar (indirect) evidence that parents increase funding to affiliates when affiliates' ROE is high and their solvency levels are low but also 'support' weaker affiliate banks.[19] To make stronger conclusions as to whether our findings *are* principally driven by funding to foreign affiliates, requires an investigation of disaggregated intra-group flows. But first, we continue our investigation of interbank and intra-group flows to ascertain if the baseline results we document are driven by episodes of crisis or whether they continue to hold during periods of relative economic calm.[20]

Crisis and non-crisis periods. The second and third specifications in Table 2 are equivalent to our baseline model but exclude the GFC and GFC plus European Sovereign Debt crisis respectively.[21] We are particularly interested in whether the main determinants of cross-border banking flows identified in our baseline regression change across crisis and non-crisis episodes.

Turning first to *Global Factors*, we see the main pattern of pro-cyclical interbank funding remains largely unchanged. While the impact of global economic uncertainty on interbank funding *was* higher in the sample including the GFC and its aftermath, we find this was offset by global economic growth playing a more important role in determining interbank funding prior to Lehman Brothers collapse. This finding is consistent with interbank funding being responsive to improved banking profit opportunities during 'normal' times, rather than fluctuations in the vaguer concept of global 'risk', which rose to prominence following the

incompatible. A possible concern associated with the high correlation between the net interest margin and solvency, is that the estimated coefficients are distorted by multicollinearity. To mitigate this concern, we remove the net interest margin and find the ROE and solvency coefficients remain qualitatively unchanged. These additional results are not reported in the interest of space but are available upon request.

[19]Note that the study investigates individual banks rather than aggregate banking system data as is done in this study. Moreover, the study excludes foreign branches, whereas we include data on *all* affiliates, including both foreign subsidiaries as well as foreign branches.

[20]The results presented in this section are also economically significant: a one standard deviation rise in the MSCI index of 0.43 reduces interbank funding growth by 1.52 percentage points (pp) (it rose by around 2 standard deviations following Lehman Brothers' collapse); and a level of the MSCI index of 53 in 2008 Q3 implies 8pp lower interbank funding growth compared to the calmest periods in the sample. A tightening in global interest rates of 50 basis points reduces interbank funding growth by 2.6pp but increases intragroup funding growth by 2.2%. Finally, a one standard deviation rise of around 10pp in a banking system's return on equity is associated with 1pp higher interbank funding growth and 1.7pp higher intragroup funding growth.

[21]Specifically, in the second specification we remove the period from 2008Q4 to 2009Q2 to coincide with the large drop in cross-border bank-to-bank funding documented in Figure 2 that followed the collapse of Lehman Brothers. In the third specification, we remove the period from 2008Q4 to the end of our sample in 2011Q4.

sudden and pronounced spike in global financial market volatility during the GFC.

Global interest rates are found to have been equally important in driving interbank funding pre-crisis, while the impact on intra-group funding was considerably larger. In fact, the size of the impact for intra-group funding more than doubles after removing the post-GFC period. This finding could reflect the earlier suspicion that intra-group funding is used to offset monetary policy shocks in the parent's home economy. This effect would have been less pronounced during and after the GFC, when global interest rates were already low or falling. Finally, the finding for interbank funding that global economic risk was a less significant driver of funding pre-GFC, while global growth was more important is echoed for intra-group funding. But in this case the coefficients continue to remain statistically insignificant, highlighting the stability of intra-group and lack of sensitivity to *Global Factors*.

Moving to *Host Country Characteristics*, we find only minor changes in coefficients. This is especially true for interbank funding. The sign and significance of coefficient estimates across the entire sample for domestic GDP, inflation, interest rates, FX returns, and solvency remain virtually unchanged. The coefficient on ROE falls slightly and becomes marginally statistically insignificant at the 10% confidence level for the pre-GFC period. But this result is most likely the outcome of there being no systematic or regional banking crisis in our sample during this period. Moreover, while the coefficient on the net interest margin switches sign, the effect remains small and insignificant, particularly when compared with the equivalent coefficient estimated for intra-group funding.

The magnitude of coefficient changes is larger for intra-group funding but without, in general, changing the statistical significance of the coefficient estimates. We find the net interest margin and domestic foreign exchange return to continue being important determinants of intra-group funding during non-crisis periods, although as in the case of interbank funding, the ROE effect diminishes and is no longer statistically significant. The latter finding is consistent with the results of De Haas and Van Lelyveld (2010), who find evidence in support of the hypothesis that before the GFC, parent banks supported their foreign affiliates in less profitable banking systems. Once again, intra-group funding is found to be relatively insensitive to fluctuations in the main domestic macroeconomic factors.

The final specification in Table 2 augments our baseline model with a GFC dummy variable. As such, we formally investigate the overall behavior of interbank and intra-group funding during the GFC. The earlier visual inspection implied that interbank funding was

significantly more affected by the crisis than intra-group funding, which remained relatively stable throughout. This finding is echoed by the coefficient estimates on each dummy variable. For interbank funding we find the coefficient is negative (-4.8) and statistically significant at the 5% confidence level. The result implies that, on average, around 5% of interbank funding was withdrawn each quarter during the crisis. Conversely the point estimate for intra-group funding is positive, again pointing to the underlying stability of intra-group funding flows during a period of enormous financial market stress. To better understand the dynamics of this internal capital market, and the extent to which parent banks support their foreign affiliates or otherwise, we turn now to the decomposition of intra-group funding.

3.2 Intra-Group Funding: Parents and Foreign Affiliates

In Table 3, we present the split between intra-group funding to parent and foreign affiliate banks. We present 12 specifications in total, six each for parent and foreign affiliate funding. The first four specifications mirror those estimated for aggregate interbank and intra-group funding.

Intra-group funding is found to be relatively insensitive to *Global Factors*, with the point estimates suggestive of a counter- rather than pro-cyclical behavior of flows. This finding is mirrored in funding to parent banks. Both during and outside the crisis periods, parents, in general, direct intra-group funding towards the head office when global economic conditions deteriorate.[22] That being said, the statistical significance of the coefficients is only minor, suggesting that intra-group flows are largely insensitive to changes in *Global Factors*. We do, however, find stronger evidence that a deterioration in global growth usually results in an increase in intra-group funding to the parent bank, while the earlier finding that prior to the GFC global interest rates were an important determinant of intra-group funding is evidently a parent bank effect. This finding confirms our earlier suspicion, in keeping with the literature on intra-group funding, that global parent banks use their foreign affiliates as a source of funding to offset monetary policy shocks at home.

The baseline point estimates for foreign affiliate banks, indicate that parents may in fact withdraw funding from their affiliates when global economic conditions deteriorate.

[22]The result supports a recent finding by Hoggarth, Hooley, and Korniyenko (2013), who show that gross cross-border intragroup lending by foreign affiliates, resident in the U.K., increased strongly following the run on the British bank, Northern Rock. Notably, the result is driven by the intragroup lending of foreign *branches*. The gross lending by foreign *subsidiaries* remained unchanged.

Indeed, we see opposite signs on the *Global Factors* coefficient estimates for parents and foreign affiliates, much as we did between aggregate interbank and intra-group funding. To conclude, however, that foreign affiliates are not supported by their parent banks would be wrong. While it is true that the point estimates all suggest pro-cyclical intra-group funding to foreign affiliates, none of the coefficients are statistically different from zero at the 90% confidence level, continuing to indicate that on average intra-group funding to foreign affiliates *also* remains stable across countries. Furthermore, when we exclude the entire post-GFC period to the end of 2011, we see that the sign on each coefficient reverses, which provides some tentative evidence that parents were less able to support their affiliates during the global economic crisis, although this did not translate into broad intra-group withdrawals.

The stability of intra-group funding to foreign affiliates, even during the GFC, is further emphasized in the fourth specification in which we include the crisis dummy variable. The coefficient on the crisis dummy for foreign affiliate funding is not statistically different from zero. Parent banks experienced slightly larger intra-group inflows, seemingly using their affiliates to meet liquidity shortfalls but, once again, the magnitude of these flows was relatively small, such that the coefficient (1.33) is statistically insignificant. In Figure 4, we explore the broader financial stability implications of different funding structures across banking systems during the GFC. Unsurprisingly given our earlier results, banking systems with a high share of interbank funding experienced the largest withdrawals of *total* cross-border bank-to-bank funding during the crisis. But of the banking systems with a high share of intra-group funding, it was those banking systems in which parent banks controlled the majority of this funding, that benefitted the most during the crisis. In fact on average, banking systems with a high share of intra-group funding mostly held by parent banks, were able to offset any interbank funding withdrawals such that the overall change in funding (across both interbank and intra-group funding) was effectively zero.

At the aggregate level, intra-group funding displayed no clear response to domestic macroeconomic fluctuations. But once intra-group funding is decomposed, the situation changes slightly. Parent banks are seen to direct funding towards themselves when economic conditions as measured by either GDP or inflation improves in the local economy. In the case of GDP, however, this result is seen to be driven by the post-GFC period when economic growth rates fell universally. Prior to the GFC, domestic growth is seen to have been

virtually unrelated to parent intra-group funding, while for foreign affiliates the relationship is reversed (coefficient of -0.73 in the pre-GFC era), indicative of supportive intra-group flows to weaker affiliate economies, which global banks could not maintain during the GFC and its aftermath.

The pre- versus post-crisis divergence in Host Country determinants is also apparent for banking-system specific variables. Outside of the crisis, the ROE and solvency of the local banking system were only weakly related to intra-group funding of parent banks. But this changed with the inclusion of the GFC. Parents banks resident in banking systems with low solvency levels required significantly more liquidity support from their foreign affiliates, while parent banks in stronger banking systems, as measured by the average ROE, also used their affiliates more during the crisis period.

Finally, we find the strength of the result on the net interest margin for aggregate intra-group funding, is the primarily the product of funding flows to affiliate banks: foreign affiliates banks which are resident in banking systems with, on average, low net interest margins and hence, whose profitability is relatively more dependent on the *volume* of lending, were the affiliates which consistently received higher levels of intra-group funding both during and outside of the GFC.[23]

Crisis and interactions. In the final two specifications of Table 3, we further examine the behavior of intra-group lending around the GFC. Specifically, we interact measures of banking system profitability, solvency and the relative importance of intra-group funding, with the crisis dummy variable. In the fifth specification, we focus on profitability, as measured by the ROE and solvency as captured by the capital-to-asset ratio. The results provide confirmation that parent banks resident in either more profitable banking systems or banking systems with lower solvency levels, were the banks most likely to use their foreign affiliates for additional liquidity demands during the GFC. In particular, the estimated coefficient on the solvency interaction term is significant at the 1% confidence level.

We find less support that foreign affiliates, resident in riskier (lower solvency) banking

[23] Although not the focus of our paper, in Table A3 we present results on the behavior of *interbank* funding growth to parent and affiliate banks. Global factors matter for both sets of banks, but we find that global volatility and changes in global interest rates have a stronger impact on parent banks, whereas global growth seems to be the dominant driver of interbank funding to affiliates. We also find evidence that interbank funding to affiliates is more strongly associated with domestic macroeconomic cycles than parent funding, while the opposite is the case for the average profitability of the banking system as a whole.

systems, were supported during the GFC. Instead, we find affiliates resident in the least *profitable* banking systems were the recipients of additional intra-group liquidity support. The coefficient on the ROE interaction term is negative (-0.41) and highly statistically significant, making clear the dichotomy between ROE driven intra-group funding to foreign affiliates during crisis and non-crisis periods.

We introduce a new variable in the final specification of Table 3. *Intra Share* is a measure of the proportion of intra-group funding in a banking system's total cross-border bank-to-bank funding. By including the variable, we seek to examine, at a systematic level, a related conjecture to Cetorelli and Goldberg (2012b) that global parent banks support their affiliates according to a *locational pecking order*. In particular, if intra-group funding to a banking system is large in magnitude compared to interbank funding, we conjecture that foreign affiliates in the banking system are primarily net receivers of intra-group funding, and are therefore viewed as key sources of profitability by the parent bank. If true, these foreign affiliates are more likely to be supported through economic 'bad times' due to their status as strategically important affiliates.

Indeed we find, that the estimated coefficients on the interactions between *Intra Share* and both the crisis dummy and ROE are consistent with this view. In particular, the interaction with the ROE variable is negative and highly statistically significant, indicating that intra-group funding does flow to less profitable but, potentially, more strategically important banking systems and is a finding we investigate further in our extended analysis of *net* intra-group funding.

4 Further Analysis and Robustness

4.1 Net Funding

In Table 4, we present the results from an analogous fixed-effects regression to our baseline model for net intra-group funding (NF). We define net intra-group funding as the difference between the intra-group funding a banking system receives from abroad *minus* the intra-group lending the banking system provides to the rest-of-the-world. A positive net intra-group funding balance is therefore an indication that the banking system *as a whole* is a net recipient of internal capital market funding.

In total, we present eight specifications in Table 4: four each for the change in net intra-

group funding of parent and foreign affiliate banks. The first specification for parents and foreign affiliate banks is equivalent to our baseline regression but with the change in the dependent variable to growth in net intra-group funding. Strikingly, almost no variables are found to be statistically significant in driving *net* intra-group flows to either parents or foreign affiliates. The finding is not entirely surprising, and supports earlier studies by Forbes and Warnock (2012a,b) who find that net aggregate cross-border capital flows, as well as net portfolio equity and debt flows are unresponsive to fluctuations in either global or local macroeconomic and financial factors, which highlights the need for and trend towards focussing on *gross* capital flows within the capital flows literature (Obstfeld, 2012).

In fact, the *only* statistically significant variable across the two models is on the ROE variable for parent banks. On the one hand, the finding indicates that parent banks resident in strong banking systems reallocate funding within the banking group back towards the head office, and do not offset the improvement in profitability at home by increasing intra-group lending substantially abroad. But a broader implication is that impacts to a bank's funding are often mirrored by the bank's lending: a withdrawal of funding likely necessitates an offsetting retrenchment in lending, particularly when bank leverage is high. The lack of statistical significance associated with the estimated coefficients is not driven by the GFC. In fact, we find an almost equivalent result (albeit with a flip in significance on the ROE variable from parents to affiliates) in the second specification, when excluding the entire post-2008Q3 period from the sample. A lack of determinants driving net intra-group funding does not imply, however, that studying intra-group funding flows is unimportant. Even if the net position remains unaltered, a system-wide contraction in both sides of the balance sheet – that is, a period of banking system 'deleveraging' – can have significant and prolonged impacts on real-economy lending and growth, as illustrated during the GFC (Brunnermeier, 2009).

In fact, a primary reason for investigating the behavior of net intra-group funding is to focus specifically on the GFC. A natural concern for policy makers is the extent to which internal capital market funding may lead to the international propagation of a financial shock. Foreign affiliates resident in small, non-crisis-hit economies, may be adversely affected by either a retrenchment in parent bank funding or a forced reallocation of lending from the foreign affiliate to the parent bank, which results in a domestic growth shock. The concern is not, therefore, that foreign affiliates resident in crisis-hit economies will be unsupported.

Evidence shows in fact, that these affiliates *are* supported by the parent bank (De Haas and Van Lelyveld, 2010; Schnabl, 2012). But instead, that during a larger crisis, such as the GFC, which negatively affects the liquidity position of global parent banks, foreign affiliates will be unsupported in *net* terms, even in the face of quickly evaporating interbank market funding (Allen et al., 2013; Jeon et al., 2013; De Haas and Van Lelyveld, 2014).

To investigate the behavior of net intra-group funding to foreign affiliate banks during the crisis, we include two additional specifications. The first specification augments the baseline regression with the crisis dummy variable. The main coefficients remain virtually unchanged from the baseline and, while negative, the crisis dummy variable is not significant for either parent or foreign affiliate banks, suggesting a high variation in the response of intra-group funding to the crisis without a common theme across parents or affiliates. To explore the issue further and assess whether banking system specific conditions were important, we include two crisis interaction terms with the ROE and solvency of the local banking system.

We find the interaction terms are important. Supporting the earlier evidence that affiliates in less profitable banking systems benefitted from increased funding during the GFC, we find that this result applies also to *net* funding, suggesting affiliates in these banking systems were less likely to repatriate funds to their parent bank. Interestingly, we find evidence that banking system solvency was important for foreign affiliates. In gross funding terms, while lower banking system solvency was associated with increased affiliate funding during the GFC, it was not statistically significant. But in *net terms* the result becomes clearer. Foreign affiliates in the least solvent banking systems were less likely to lend back to their parent or even withdrew funding from their parent bank, making them the net recipients of internal capital market funding.

4.2 Robustness

Specification Choice. In Table A4, we explore the robustness of our baseline results. We do so by exploring alternative specifications, with a special focus on our measure of global volatility and the role of central bank and financial policies. In columns 1-4, we include the contemporaneous log value of realized MSCI World Equity index volatility, in addition to the lagged value. In doing so, we assess whether there is additional information in the time profile of global volatility. The results indicate that high global volatility today (conditional on past global volatility), is significantly and positively related to intragroup funding growth

of parent banks. The result strengthens our overall finding that global factors have markedly different effects on interbank and intragroup funding. The size and significance of other global and host country factors remains broadly unchanged.

In columns 5-8, we use an alternative measure of global volatility. Specifically, we include the VIX Equity index from the Chicago Board Options Exchange (CBOE). The VIX index is a measure of US stock market volatility, compiled from the prices of short-dated options on the S&P 500 index, and is often considered in academic and policy circles as an empirical proxy for global risk (which incorporates both economic uncertainty and a premium for risk).[24] Our results are robust to including the VIX index as an alternative to our main global volatility measure. The estimated coefficient for the VIX is marginally less significant than for MSCI-based measure but this may not be surprising, given that the MSCI World Equity index is a broader measure of global equity performance and arguable more relevant a global factor for our sample of BIS reporters.

In columns 9-12, we replace our measure of global short-term money market rates with central bank policy rates, averaged across major banking systems (the US, UK, Euro Area and Japan). Changes in these two types of interest rates are closely related, with an in-sample correlation of 89%. While the point estimate is somewhat smaller than in our baseline regression, changes in global interest rates remain negative and significant for interbank funding and positive but not significant for intragroup funding, supporting the conjecture that global banks may have used their internal capital markets to insulate themselves from changes in monetary policy (Cetorelli and Goldberg, 2012a). The negative effect of tightening global policy rates on interbank flows is also consistent with studies such as Rey (2015), who finds that US monetary policy is an important determinant of global capital flows.

Other central bank and treasury policies may also have impacted cross-border bank funding, with the GFC in particular triggering large interventions in the banking system (see e.g. Drechsler, Drechsel, Marques, and Schnabl (2014)). In columns 13-16, we therefore attempt to account for the degree of liquidity support extended to banks by the central bank or Treasury. Specifically, we employ the database by Laeven and Valencia (2013), which records the degree of liquidity support extended to a country's banks in times of banking crisis for all countries in our sample. We find in a pooled regression, without fixed effects,

[24] Recent papers which use the VIX index as a measure of global risk include, *inter alia*, Longstaff, Pan, Pedersen, and Singleton (2011), Bacchetta and Van Wincoop (2013), Forbes and Warnock (2012a), and Fratzscher (2012).

that more liquidity support is related to less intragroup funding for affiliates, which could be driven by affiliates being more likely to access liquidity support in their host economy.[25][26]

Extended Time Series. Our baseline sample starts in 1998Q1 because of the availability of consistent cross-country data on host country banking system characteristics. In Table A5, we exclude these variables and explore whether our baseline results on global and host macroeconomic factors change when extending the time series backwards, exploiting all interbank and intragroup funding data available from 1985Q1 onwards [27]. The first observation is that results on global factors are consistent with our baseline results: high global volatility, higher global interest rates and lower global growth are all significantly associated with lower interbank funding growth, while intragroup funding growth remains stable in such periods. In the longer sample, we now estimate a negative and significant coefficient on local currency appreciations vis-a-vis the USD for both interbank and intragroup funding. Finally, while interbank funding continues to be associated with domestic macroeconomic factors, there is now stronger evidence that intragroup funding was also positively associated with domestic macroeconomic cycles. One important caveat is, however, that the longer sample does not allow us to control for banking system characteristics, found to be important determinants of cross-border bank funding in our baseline sample, which captures a period when banking was considerably more global than in the 1980s and early 1990s.

Econometric specification. In columns 1-4, we exclude country fixed effects from the analysis to evaluate the importance of this estimator for the identification of our results. We find that most host country factors change little when excluding fixed effects. This is, however, not true for the relationship between a banking system's net interest margin and the intra-group funding of affiliate banks, or for the relationship between banking system solvency and the intra-group funding of parent banks, both of which take their identification

[25] Results for including fixed effects are similar but significant only at the 10% level. Because most instances of liquidity support occurred during the GFC, we think it is more instructive to also exploit the cross-sectional variation in the size of liquidity support. See Table A6 for further discussion on the effect of excluding fixed effects.

[26] Our regressions accounts for the health of a country's banking system. However, one important caveat of including liquidity support, is that more liquidity support could be a measure of how intense the banking crisis had been, making it hard to estimate its overall effect. Definitive answers on the impact of liquidity support on interbank and intragroup funding are thus beyond the scope of this paper, most likely requiring micro-banking data such as in Drechsler et al. (2014) to provider crisper answers.

[27] As many countries started to report their data only later to the BIS, the sample starting from 1985Q1 is less balanced than for baseline sample.

from the within variation - i.e. these variables are only negative and statistically different from zero when including country fixed effects.

In columns 5-8, we show our results with standard errors clustered at both the country and time dimension.[28] In columns 5 and 6, we have 25 clusters at the country level and 56 at the time dimension, while in columns 7 and 8 we are left with only 20 clusters at the country level. Results are largely similar to our baseline results in Tables 2 and 3, especially for aggregate interbank and intragroup funding. Notably global growth is found to be a more significant determinant of intragroup flows to parent banks when adopting a two-way clustering approach to calculate standard errors. We prefer, however, to report our results with standard errors clustered only at the time level, due to an insufficient number of country-level clusters for obtaintaining accurate estimates of the covariance matrix when two-way clustering. Cameron and Miller (2015) summarize the literature on cluster-robust standard errors and offer the rule of thumb that around 50 clusters are enough in a state/year panel, while Cameron et al. (2011) discuss two-way clustering, and suggest that limited clusters in one dimension raises similar issues to the situation of including only a small number of clusters when single clustering.[29]

5 Conclusions

The propensity for global banks to propagate financial shocks across borders was emphatically displayed during the global financial crisis. This period of heightened uncertainty went hand in hand with quickly evaporating trust among banks, resulting in the large withdrawal of funding *from* banks *by* banks around the world. Understandably, policy makers are concerned. Such withdrawals could be potentially ruinous for the afflicted bank and the entire financial system.

But the ways in which global banks may propagate these shocks contain an element of nuance. While focus, particularly during the GFC, was on the evanescence of arms-length interbank funding, an at times larger and potentially equally important form of cross-border bank funding went comparatively unnoticed. *Intra-group* funding, that takes place between

[28] The covariance matrix was adjusted using the procedure proposed by Cameron, Gelbach, and Miller (2011).

[29] We have also explored the robustness of our main results to increasing the level of winsorization to 5% and find that large observations do not drive any of the key results. We omit these results in the interest of space but they are available upon request.

banks within the same banking group is large, volatile and heavily relied upon around the world. Were intra-group funding to vanish overnight, the results would likely be no less severe than with interbank funding.

In spite of this importance, there is little systematic evidence on how intra-group funding behaves across countries – not only during times of crisis but during any economic regime, whether it be 'normal' or not. While some progress has been made in understanding intra-group flows during a particular event or for a certain country, no study has been able to provide a clear systematic set of observations across a large cross-section of countries and over a long time-series of observations. We contribute by being the first study, to our knowledge, to do so.

Using previously unexploited data on international banking flows from the BIS, we construct quarterly series of interbank and intra-group funding from 1998 to 2011 for 25 banking systems around the world. From this large panel of cross-country data, we examine the main determinants of both forms of funding. We focus in particular on *Global* and *Host-Country* factors, which have been proposed in the literature as being strong contenders to explain these forms of cross-border funding. We find interbank funding is flighty, not just during the GFC, but over time - correlating positively with movements in both global and macroeconomic conditions. Intra-group funding behaves very differently. These flows are not consistently related over time to either global or macroeconomic fluctuations. We find stronger evidence that intra-group funding is related to domestic banking system conditions, which supports the view that to understand the full details of intra-group funding will require a next stage in the research process - large cross-border micro-banking studies for which bank-level variables are available. Nonetheless, even at the aggregate level, we find the net interest margin and return on equity of the banking system *as a whole*, are related to intra-group funding.

We split intra-group funding flows between parent and foreign affiliate banks and find differences with the aggregate funding regressions. Banking *and* macroeconomic conditions are important for influencing the funding to global parent banks, while during the GFC the solvency of the local banking system was especially important for whether the parent borrowed from their affiliates abroad. But we also document a support effect for foreign affiliates during the GFC, particularly for those resident in the least profitable banking systems, while affiliates resident in banking systems with tight investment margins were also more likely to benefit from parent bank inflows.

The greater stability of intragroup funding compared to interbank funding in the face of adverse fluctuations of global factors has implications for policy. The results indicate a need to monitor the decomposition of cross-border funding between banks. Considering only the behavior of aggregate flows misses the contrasting behaviour of interbank and intragroup funding and the knock-on consequences it may have on financial stability.

The possible next stage empirically is the inclusion of more micro-level data to provide richer systematic evidence on intra-group funding, while theoretically the challenge is to decipher *why* intra-group funding behaves the way it does and when intra-group funding is or *should be* preferred to interbank funding.

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Table 1: ***Interbank and Intragroup Funding over time.*** *This table compares, for various subperiods of our 1998 to 2011 sample period, summary statistics on interbank funding and intragroup funding, both in aggregate and separately for intragroup funding of parent banks and affiliate banks. All variables are discussed in Section 2 and data sources are given in Table A1. 'Intra Share (Parents)' refers to the share of intragroup funding in total funding for domestic-owned parent banks. 'Intra Share (Affiliates)' refers to the share of intragroup funding in total funding for foreign-owned affiliate banks. 'Net affiliate borrowing' refers to the net stock of related liabilities divided by the sum of related assets and related liabilities.*

	Panel A					
Interbank, Intragroup Shares	Mean	Median	Std.dev.	Min	Max	Obs.
Total external bank funding/GDP (%)	89.86	33.53	188.36	1.26	1,101.97	1,098
Intragroup funding/total funding (%)	42.80	40.33	25.62	0.07	97.38	1,098
Intragroup funding of parents/intragroup funding (%)	57.65	60.76	30.00	0.00	100.00	947
Net affiliate borrowing	0.15	0.08	0.39	-1.00	1.00	921
Intra Share (parents)	0.39	0.35	0.27	0.00	1.00	947
Intra Share (affiliates)	0.47	0.49	0.28	0.00	0.98	952

	Panel B							
Time Period	1998-2006	2007	2008-2009	2010-2011	07Q1-08Q3	08Q4-09Q2	09Q3-11Q4	All
Interbank Funding								
Growth Rate (%), Mean	2.55	5.53	-0.79	1.36	4.86	-5.10	0.74	2.02
Growth Rate (%), Median	1.71	4.79	-1.30	1.04	4.39	-4.92	0.62	1.41
Flows USD bn, Mean	3.76	16.90	-6.84	1.57	10.58	-17.21	-0.03	2.61
Flows to GDP (%), Mean	1.20	1.97	-1.50	-0.52	1.25	-3.79	-0.58	0.53
Growth Rate (%), SD	10.74	11.06	12.20	10.76	11.55	12.21	10.56	11.13
Intragroup Funding								
Growth Rate (%), Mean	4.13	8.69	2.64	2.49	6.95	0.98	2.37	3.97
Growth Rate (%), Median	2.88	5.54	0.98	1.26	4.07	-0.23	1.18	2.46
Flows USD bn, Mean	5.95	17.43	-3.10	1.86	8.14	-3.43	0.87	4.65
Flows to GDP (%), Mean	0.73	2.71	0.35	-0.55	1.88	0.55	-0.57	0.62
Growth Rate (%), SD	16.89	16.24	17.73	14.45	17.02	17.97	15.10	16.69
Parent banks								
Growth Rate (%), Mean	4.72	10.69	2.38	2.47	7.56	0.94	2.46	4.48
Growth Rate (%), Median	2.32	8.58	-0.03	2.07	3.10	0.29	1.59	2.16
Flows USD bn, Mean	2.98	8.13	-0.21	-2.22	3.73	0.68	-1.44	2.17
Flows to GDP (%), Mean	0.35	1.50	-0.14	-0.49	0.80	-0.18	-0.40	0.25
Growth Rate (%), SD	22.00	18.56	26.22	21.36	23.16	25.09	22.54	22.50
Foreign Affiliates								
Growth Rate (%), Mean	4.42	9.85	0.82	2.19	7.10	-0.24	1.29	3.99
Growth Rate (%), Median	2.80	4.08	-0.09	0.38	4.27	-1.79	-0.53	2.24
Flows USD bn, Mean	3.57	10.86	-3.84	4.54	5.20	-4.97	2.33	3.07
Flows to GDP (%), Mean	0.44	1.40	0.04	0.37	1.26	-1.01	0.28	0.44
Growth Rate (%), SD	19.58	22.24	18.38	17.50	21.34	17.86	17.38	19.45

Table 2: ***Baseline Results.***

*The table presents the estimated parameter values from fixed-effects panel regressions. The dependent variable is the quarterly percentage change in either interbank or intragroup funding. In columns (1) to (4) we report results for interbank funding, while in columns (5) to (8) we do the same for intragroup funding. In columns (2) and (6), we exclude the 2008 Q4 to 2009 Q2 period. In columns (3) and (7), we exclude the 2008Q4 to 2011 Q4 period. The Crisis Dummy is equal to 1 in the 2008 Q4 to 2009 Q2 period and 0 otherwise. 'L' behind a variable name indicates that this variable is based on quarterly data and lagged by one quarter; all other variables are recorded at the annual level. Variables are discussed in Section 2 with summary statistics provided in Table A1. Standard errors, clustered at quarter level, are reported in brackets. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Interbank				Intragroup			
Global Factors								
Global Volatility (L)	-3.64**	-2.93*	-1.87	-2.76*	1.50	1.36	1.00	1.24
	(1.54)	(1.67)	(2.05)	(1.61)	(2.33)	(2.60)	(3.14)	(2.55)
ΔGlobal Interest Rates (L)	-5.17**	-4.39*	-6.73**	-6.20***	4.48*	4.92	9.46**	4.79*
	(2.02)	(2.61)	(3.22)	(1.81)	(2.46)	(3.53)	(4.25)	(2.41)
Global Growth (L)	0.64	0.41	1.47**	0.67	-0.19	-0.05	-0.97	-0.19
	(0.49)	(0.51)	(0.72)	(0.45)	(0.47)	(0.53)	(0.85)	(0.46)
Crisis				-4.76**				1.42
				(1.97)				(2.29)
Host Country Characteristics								
Domestic GDP Growth (L)	0.45**	0.44**	0.57**	0.37**	0.23	0.10	-0.46	0.26
	(0.18)	(0.19)	(0.27)	(0.18)	(0.26)	(0.27)	(0.43)	(0.26)
Inflation (L)	-0.22***	-0.21**	-0.18*	-0.23***	-0.17	-0.21	-0.30	-0.17
	(0.08)	(0.08)	(0.10)	(0.08)	(0.18)	(0.18)	(0.23)	(0.18)
Δ Interest Rates (L)	-0.48	0.20	-0.18	-0.47	-0.11	0.55	1.24	-0.12
	(0.82)	(0.82)	(0.94)	(0.78)	(1.32)	(1.58)	(1.63)	(1.33)
FX Return (L)	-0.15	-0.05	-0.09	-0.10	-0.24***	-0.24**	-0.30**	-0.26***
	(0.12)	(0.12)	(0.11)	(0.11)	(0.08)	(0.10)	(0.12)	(0.09)
Return on Equity	0.10**	0.10**	0.07	0.11**	0.17***	0.15***	0.09	0.17***
	(0.05)	(0.05)	(0.05)	(0.05)	(0.04)	(0.05)	(0.07)	(0.05)
Solvency	0.19	0.00	0.18	0.11	-0.42	-0.22	0.10	-0.40
	(0.45)	(0.44)	(0.61)	(0.44)	(0.44)	(0.45)	(0.49)	(0.45)
Net interest margin	0.06	-0.25	-0.27	-0.07	-3.13**	-3.31**	-3.18*	-3.09**
	(0.48)	(0.49)	(0.51)	(0.46)	(1.26)	(1.28)	(1.63)	(1.27)
Constant	6.04	6.92	-0.41	4.63	7.18	6.04	11.61	7.60
	(5.52)	(5.90)	(8.17)	(5.59)	(8.00)	(8.29)	(11.26)	(8.19)
Observations	1,099	1,028	811	1,099	1,099	1,028	811	1,099
R-squared	0.09	0.07	0.07	0.09	0.07	0.07	0.07	0.07
Countries	25	25	23	25	25	25	23	25

Table 3: ***Intragroup Funding: Parents and Affiliates.*** *The table presents the estimated parameter values from fixed-effects panel regressions. The dependent variable is the quarterly percentage change in intragroup funding of either domestic-owned parent banks or foreign-owned affiliate banks. In columns (1) and (6) we report results for funding of parents, while in columns (7) and (12) we report the same for funding of affiliates. In columns (2) and (8), we exclude the 2008 Q4 to 2009 Q2 period. In columns (3) and (9), we exclude the 2008Q4 to 2011 Q4 period. The Crisis Dummy is equal to 1 in the 2008 Q4 to 2009 Q2 period and 0 otherwise. In column (6), 'Intra Share' refers to the share of intragroup funding of parent banks in their total funding while the measure is calculated for affiliates in column (12). 'L' behind a variable name indicates that this variable is based on quarterly data and lagged by one quarter; all other variables are recorded at the annual level. Variables are discussed in Section 2 with summary statistics provided in Tables 1 and A1. Standard errors, clustered at quarter level, are reported in brackets. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Parents						Foreign Affiliates					
Global Factors												
Global Volatility (L)	2.02	1.01	2.21	1.77	1.64	1.59	-0.86	-0.65	0.24	-0.82	-0.50	-0.78
	(3.48)	(4.09)	(4.74)	(3.97)	(3.98)	(3.76)	(1.93)	(2.22)	(2.76)	(2.15)	(2.15)	(2.11)
ΔGlobal Interest Rates (L)	2.98	6.66	10.62**	3.26	3.07	3.46	-0.96	-2.46	2.61	-1.00	-2.16	-0.65
	(3.70)	(4.70)	(5.17)	(3.57)	(3.64)	(3.66)	(2.73)	(3.56)	(4.39)	(2.77)	(2.65)	(2.96)
Global Growth (L)	-0.71	-1.12*	-1.10	-0.72	-0.69	0.05	0.27	0.48	-0.27	0.28	0.33	0.46
	(0.56)	(0.60)	(1.03)	(0.56)	(0.56)	(0.54)	(0.55)	(0.67)	(1.01)	(0.56)	(0.56)	(0.50)
Crisis				1.33	12.14**					-0.24	5.16	
				(3.93)	(5.64)					(2.86)	(11.89)	
Host Country Characteristics												
Domestic GDP Growth (L)	0.71*	0.89**	-0.12	0.74**	0.70*	0.25	0.25	-0.01	-0.73	0.24	0.14	0.32
	(0.36)	(0.40)	(0.63)	(0.36)	(0.37)	(0.37)	(0.35)	(0.39)	(0.47)	(0.36)	(0.34)	(0.33)
Inflation (L)	-0.46*	-0.44*	-0.60*	-0.45*	-0.47*	-0.62**	0.11	0.06	-0.04	0.10	0.11	0.35*
	(0.25)	(0.26)	(0.32)	(0.25)	(0.25)	(0.27)	(0.18)	(0.19)	(0.23)	(0.18)	(0.18)	(0.18)
Δ Interest Rates (L)	-0.29	-0.14	-0.15	-0.29	-0.08	-0.66	1.17	1.04	0.47	1.18	1.65	1.07
	(1.82)	(2.01)	(2.03)	(1.83)	(1.84)	(1.76)	(1.56)	(1.79)	(1.86)	(1.56)	(1.57)	(1.55)
FX Return (L)	-0.31*	-0.33*	-0.36	-0.33*	-0.33*	-0.32*	-0.15	-0.20	-0.29*	-0.14	-0.13	-0.16
	(0.16)	(0.19)	(0.22)	(0.18)	(0.18)	(0.17)	(0.12)	(0.13)	(0.16)	(0.13)	(0.13)	(0.13)
Return on Equity	0.21***	0.17**	0.11	0.21***	0.20***	-0.06	0.15**	0.22***	0.24***	0.15*	0.21***	0.48**
	(0.06)	(0.07)	(0.09)	(0.06)	(0.07)	(0.14)	(0.07)	(0.07)	(0.08)	(0.08)	(0.07)	(0.20)
Solvency	-1.49**	-1.30*	-0.65	-1.47**	-1.32*	-0.90	0.04	0.09	0.09	0.03	0.07	-0.19
	(0.67)	(0.70)	(0.81)	(0.68)	(0.69)	(0.64)	(0.52)	(0.54)	(0.62)	(0.53)	(0.53)	(0.52)
Net interest margin	-1.01	-1.45	-1.19	-0.99	-1.00	-0.99	-3.32**	-3.37**	-2.92*	-3.32**	-3.56**	-3.68***
	(1.70)	(1.71)	(2.01)	(1.72)	(1.73)	(1.66)	(1.35)	(1.39)	(1.62)	(1.37)	(1.39)	(1.29)
Interactions												
Return on Equity*Crisis					0.19*						-0.41***	
					(0.10)						(0.08)	
Solvency*Crisis					-1.80***						-0.89	
					(0.66)						(1.97)	
Intra Share (L)						-57.48***						-19.89***
						(12.12)						(5.47)
Intra Share*Crisis						2.86						0.65
						(7.08)						(3.63)
Intra Share*ROE						0.32						-0.80**
						(0.25)						(0.34)
Constant	12.09	14.54	12.01	12.52	12.18	12.92	2.93	1.61	2.56	2.86	1.84	5.76
	(11.30)	(12.37)	(14.95)	(11.80)	(11.76)	(11.92)	(6.67)	(7.04)	(8.95)	(6.79)	(6.71)	(6.83)
Observations	916	859	692	916	916	916	925	873	709	925	925	925
R-squared	0.05	0.06	0.06	0.05	0.05	0.09	0.05	0.05	0.07	0.05	0.06	0.10
Countries	20	20	20	20	20	20	20	20	20	20	20	20

Table 4: ***Net Intragroup Funding*** *The table presents the estimated parameter values from fixed-effects panel regressions. The dependent variable is the quarterly percentage change in net intragroup funding of either domestic-owned parent banks or foreign-owned affiliate banks. In columns (1) to (4), we report results for for net intragroup funding of parents, while in columns (5) and (8) we report results for net intragroup funding of affiliates. In columns (2) and (6), we exclude the 2008Q4 to 2011 Q4 period. The Crisis Dummy is equal to 1 in the 2008 Q4 to 2009 Q2 period and 0 otherwise. 'L' behind a variable name indicates that this variable is based on quarterly data and lagged by one quarter; all other variables are recorded at the annual level. Variables are discussed in Section 2 with summary statistics provided in Table A1. Standard errors, clustered at the quarter level, are reported in brackets. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Parents				Foreign Affiliates			
Global Factors								
Global Volatility (L)	3.90	0.92	5.00	5.05	0.80	2.24	0.90	1.31
	(3.88)	(4.73)	(4.10)	(4.12)	(2.98)	(4.20)	(3.25)	(3.23)
ΔGlobal Interest Rates (L)	-3.21	-4.49	-4.39	-5.25	2.94	0.57	2.84	0.84
	(5.24)	(7.64)	(5.67)	(6.43)	(3.62)	(6.02)	(3.81)	(3.70)
Global Growth (L)	-0.34	0.11	-0.31	-0.24	-0.53	-0.39	-0.53	-0.43
	(0.99)	(1.45)	(0.94)	(0.96)	(0.70)	(1.35)	(0.71)	(0.71)
Crisis			-5.76	9.18			-0.54	16.23**
			(6.51)	(14.74)			(4.37)	(6.24)
Host Country Characteristics								
Domestic GDP Growth (L)	-0.41	0.34	-0.50	-0.61	0.34	-0.32	0.33	0.14
	(0.68)	(1.35)	(0.69)	(0.69)	(0.52)	(0.87)	(0.54)	(0.51)
Inflation (L)	-0.04	0.64	-0.06	-0.07	0.22	0.21	0.22	0.22
	(0.66)	(0.76)	(0.66)	(0.66)	(0.34)	(0.38)	(0.34)	(0.34)
Δ Interest Rates (L)	0.33	1.43	0.35	0.87	-1.68	-1.00	-1.68	-0.78
	(3.44)	(3.76)	(3.40)	(3.42)	(1.97)	(2.32)	(1.97)	(1.96)
FX Return (L)	-0.17	-0.17	-0.11	-0.11	-0.04	0.02	-0.04	-0.02
	(0.22)	(0.33)	(0.23)	(0.23)	(0.19)	(0.26)	(0.20)	(0.20)
Return on Equity	0.19*	0.12	0.19*	0.22**	0.11	0.26*	0.11	0.20*
	(0.10)	(0.14)	(0.10)	(0.09)	(0.10)	(0.14)	(0.11)	(0.11)
Solvency	-0.57	-0.38	-0.66	-0.47	0.44	0.54	0.43	0.58
	(0.89)	(1.10)	(0.95)	(0.93)	(0.77)	(1.06)	(0.77)	(0.79)
Net interest margin	-4.16	-4.18	-4.28	-4.44	-1.05	-2.00	-1.06	-1.45
	(3.03)	(3.79)	(3.04)	(3.04)	(1.49)	(1.77)	(1.50)	(1.54)
Return on Equity*Crisis				-0.03				-0.50***
				(0.45)				(0.12)
Solvency*Crisis				-2.50				-2.79***
				(2.60)				(0.92)
Constant	5.36	7.09	3.47	2.47	-5.42	-8.80	-5.60	-7.43
	(14.08)	(17.32)	(14.03)	(14.04)	(9.82)	(15.90)	(10.38)	(10.24)
Observations	912	688	912	912	921	705	921	921
R-squared	0.04	0.04	0.04	0.04	0.04	0.06	0.04	0.05
Countries	20	20	20	20	20	20	20	20

Appendix

Table A1: ***Data Sources and Summary Statistics.***

Variable	Description	Source	Mean	Std.dev.	Min	Max	Obs.
Cross-Border Bank-to-Bank Flows							
Interbank Funding	Estimated exchange rate adjusted flow in cross-border interbank funding scaled by the stock of interbank funding (Quarterly (Q), %).	International Banking Statistics (BIS)	2.02	11.13	-22.80	32.65	1,099
Intragroup Funding	Estimated exchange rate adjusted flow in cross-border intragroup funding scaled by the stock of intragroup funding (Q, %).	International Banking Statistics (BIS)	3.97	16.69	-29.70	58.27	1,099
Intragroup Funding: Parent banks	Estimated exchange rate adjusted flow in parent cross-border intragroup funding scaled by the stock of parent intragroup funding (Q, %).	International Banking Statistics (BIS)	4.48	22.5	-40.73	100	916
Intragroup Funding: Foreign Affiliates	Estimated exchange rate adjusted flow in affiliate cross-border intragroup funding scaled by the stock of affiliate intragroup funding (Q, %).	International Banking Statistics (BIS)	3.99	19.45	-41.81	72.50	925
Global Factors							
Global Volatility	Volatility of the MSCI World Index (Q). Realized volatility is calculated as the square root of the average of the sum of squared log daily returns. To convert to an annualized value this measure is then multiplied by the square root of 252 divided by the number of trading days in a given month.	Datastream	2.63	0.42	1.84	3.98	1,099
Global Interest Rate	Quarterly change in the money market rate averaged across the US, the UK, Germany and Japan (%)	IFS (IMF)	-0.08	0.33	-1.40	0.55	1,099
Global Growth	Real Quarterly GDP Growth (%)	IFS (IMF)	3.38	1.74	-1.80	5.80	1,099
Host Country Characteristics							
FX Return	Quarterly change in log end-of-period nominal exchange rate. US dollar numéraire (%)	IFS (IMF)	-0.37	5.27	-10.87	12.58	1,099
GDP Growth	Quarterly GDP growth (yoy, %).	WEO (IMF)	2.37	3.08	-12.90	14.62	1,099
Δ Interest Rates	Quarterly change in the domestic money market rate	IFS (IMF)	-0.12	0.63	-2.75	1.26	1,099
Inflation	Quarterly inflation rate (yoy, %)	WEO (IMF)	2.95	5.11	-2.75	71.02	1,099
Return on Equity	Average Annual Return on Equity (Net Income/Total Equity) (%).	Beck, Demirgüç-Kunt and Levine (2000)	9.12	10.97	-35.01	27.55	1,099
Solvency	Annual Bank Capital to Total Assets (%)	GFD (World Bank)	6.11	2.10	3.10	11.60	1,099
Net interest margin	Annual Net interest margin (%)	GFD (World Bank)	1.93	1.50	0.45	7.54	1,099

Table A2: ***Correlations*** *The table presents correlations across independent variables used in the panel regression analysis.*

Variables	Glob. Vol.	Glob. IR	Glob. Growth	ROE	FX Return	Growth	Δ IR	Infl.	Solvency	Net IR marg.
Glob. Vol.	1.00									
Glob. IR (Change)	-0.62	1.00								
Glob. Growth	-0.56	0.68	1.00							
ROE	-0.32	0.24	0.25	1.00						
FX Return	0.15	-0.12	-0.02	-0.07	1.00					
Growth	-0.37	0.45	0.59	0.34	0.02	1.00				
Δ IR	-0.29	0.51	0.47	0.07	-0.04	0.307	1.00			
Infl.	0.06	-0.07	-0.01	-0.03	0.06	0.10	-0.27	1.00		
Solvency	0.01	-0.00	0.01	0.21	0.01	0.18	-0.20	0.38	1.00	
Net IR marg.	-0.03	0.02	0.03	0.24	-0.02	0.15	-0.21	0.50	0.73	1.00

Table A3: ***Interbank Funding: Flows to Parent and Foreign Affiliate Banks.*** *The table presents the estimated parameter values from fixed-effects panel regressions. The dependent variable is the quarterly percentage change in interbank funding to either parent or foreign affiliate banks. In columns (1) and (2), we report results for parents banks, while in columns (3) and (4), we do the same for foreign affiliates. 'L' behind a variable name indicates that this variable is based on quarterly data and lagged by one quarter; all other variables are recorded at the annual level. Variables are discussed in Section 2, with summary statistics presented in Table A1. Standard errors, clustered at country level, are reported in brackets. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

	(1)	(2)	(3)	(4)
	Parents		Foreign Affiliates	
Global Volatility (L)	-4.51**	-3.22	-2.85	-2.55
	(1.82)	(1.93)	(1.95)	(2.07)
ΔGlobal Interest Rates (L)	-5.21**	-6.63***	-3.27	-3.61
	(2.55)	(2.14)	(2.96)	(3.01)
Global Growth (L)	0.45	0.49	1.79***	1.81***
	(0.56)	(0.50)	(0.56)	(0.55)
Crisis		-6.87***		-1.75
		(2.46)		(2.66)
Domestic GDP Growth (L)	0.27	0.15	0.71**	0.68**
	(0.21)	(0.21)	(0.34)	(0.34)
Inflation (L)	-0.15*	-0.17**	-0.34*	-0.35*
	(0.08)	(0.08)	(0.19)	(0.19)
Δ Interest Rates (L)	-0.36	-0.34	-3.16**	-3.15**
	(0.98)	(0.97)	(1.53)	(1.51)
FX Return (L)	-0.18	-0.11	-0.06	-0.05
	(0.12)	(0.12)	(0.11)	(0.11)
Return on Equity	0.14***	0.15***	0.06	0.06
	(0.05)	(0.05)	(0.07)	(0.07)
Solvency	0.61	0.51	0.30	0.28
	(0.49)	(0.47)	(0.68)	(0.69)
Net interest margin	-0.53	-0.67	-0.91	-0.94
	(0.61)	(0.58)	(1.24)	(1.25)
Constant	7.27	5.05	0.54	-0.01
	(5.99)	(6.22)	(8.18)	(8.16)
Observations	916	916	925	925
R-squared	0.08	0.09	0.08	0.08
Countries	20	20	20	20

Table A4: ***Different specifications*** *The dependent variable is the quarterly percentage change in either interbank or intragroup funding. In columns (1) to (4), we add the contemporaneous log level of Global Volatility to our baseline specification. In columns (5) to (8), we replace the our baseline measure of Global Volatility with the VIX index. In columns (9) to (12), we measure Global Interest Rates using central bank policy rates rather than short-term money market rates. 'L' behind a variable name indicates that this variable is based on quarterly data and lagged by one quarter; all other variables are recorded at the annual level. All variables are discussed in Section 2 with summary statistics provided in Table A1. Standard errors, clustered at the quarter level, are reported in brackets. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

	(1) Inter	(2) Intra	(3) Parents	(4) Affil.	(5) Inter	(6) Intra	(7) Parents	(8) Affil.	(9) Inter	(10) Intra	(11) Parents	(12) Affil.	(13) Inter	(14) Intra	(15) Parents	(16) Affil.
Global Factors																
Global Volatility (L)	-3.46**	-0.65	-1.35	-2.28	-4.08*	2.31	3.40	-1.70	-3.81**	1.80	2.34	-1.33	-3.48**	2.01	2.44	-0.02
	(1.72)	(2.45)	(3.96)	(2.29)	(2.34)	(3.16)	(4.60)	(2.73)	(1.63)	(2.51)	(3.81)	(1.97)	(1.50)	(2.37)	(3.63)	(2.12)
Global Volatility	-0.29	3.49**	5.54**	2.31												
	(1.59)	(1.62)	(2.52)	(1.95)												
ΔGlobal Interest Rates (L)	-5.14**	4.15*	2.42	-1.18	-5.27**	4.84*	3.60	-1.36	-4.02**	3.90*	2.91	-2.03	-4.83**	4.43	4.26	-1.55
	(1.98)	(2.48)	(3.70)	(2.61)	(2.17)	(2.65)	(4.01)	(2.91)	(1.78)	(2.19)	(3.69)	(2.21)	(2.01)	(2.68)	(3.92)	(2.93)
Global Growth (L)	0.64	-0.09	-0.58	0.34	0.59	-0.12	-0.59	0.20	0.47	-0.05	-0.63	0.30	0.78	-0.06	-0.55	0.53
	(0.49)	(0.45)	(0.56)	(0.54)	(0.54)	(0.49)	(0.56)	(0.57)	(0.45)	(0.46)	(0.55)	(0.53)	(0.47)	(0.41)	(0.52)	(0.53)
Host Country Characteristics																
Domestic GDP Growth (L)	0.45**	0.23	0.72**	0.25	0.50***	0.20	0.67*	0.27	0.42**	0.26	0.73**	0.24	0.34*	0.09	0.61*	0.10
	(0.18)	(0.25)	(0.34)	(0.35)	(0.18)	(0.25)	(0.36)	(0.35)	(0.18)	(0.26)	(0.36)	(0.35)	(0.17)	(0.23)	(0.32)	(0.29)
Inflation (L)	-0.22***	-0.19	-0.48*	0.10	-0.22***	-0.17	-0.46*	0.11	-0.22***	-0.17	-0.46*	0.10	-0.18**	-0.02	-0.18	0.08
	(0.08)	(0.18)	(0.25)	(0.18)	(0.08)	(0.18)	(0.25)	(0.18)	(0.08)	(0.18)	(0.25)	(0.18)	(0.07)	(0.13)	(0.19)	(0.11)
ΔInterest Rates (L)	-0.45	-0.38	-0.62	1.03	-0.62	-0.07	-0.25	1.16	-0.69	0.02	-0.26	1.31	-0.71	-0.43	-1.37	1.40
	(0.82)	(1.32)	(1.83)	(1.58)	(0.83)	(1.30)	(1.80)	(1.54)	(0.80)	(1.30)	(1.81)	(1.48)	(0.80)	(1.29)	(1.89)	(1.56)
FX Return (L)	-0.15	-0.27***	-0.36**	-0.16	-0.16	-0.24***	-0.31*	-0.15	-0.14	-0.25***	-0.32*	-0.15	-0.15	-0.23***	-0.28*	-0.17
	(0.12)	(0.09)	(0.16)	(0.13)	(0.13)	(0.08)	(0.16)	(0.12)	(0.12)	(0.09)	(0.16)	(0.12)	(0.12)	(0.09)	(0.15)	(0.13)
Return on Equity	0.10**	0.20***	0.25***	0.16**	0.10**	0.18***	0.22***	0.15*	0.10**	0.18***	0.21***	0.15*	0.08*	0.12**	0.19**	0.11
	(0.05)	(0.04)	(0.06)	(0.08)	(0.05)	(0.04)	(0.06)	(0.08)	(0.05)	(0.04)	(0.06)	(0.07)	(0.04)	(0.05)	(0.07)	(0.07)
Solvency	0.19	-0.44	-1.58**	0.01	0.21	-0.44	-1.54**	0.06	0.21	-0.44	-1.52**	0.05	0.18	0.82**	0.03	0.37
	(0.45)	(0.43)	(0.65)	(0.51)	(0.46)	(0.46)	(0.68)	(0.52)	(0.46)	(0.44)	(0.67)	(0.52)	(0.24)	(0.40)	(0.53)	(0.47)
Net interest margin	0.05	-2.98**	-0.79	-3.22**	0.14	-3.17**	-1.06	-3.29**	0.04	-3.11**	-1.00	-3.31**	0.00	-1.29*	-0.15	-0.76
	(0.46)	(1.27)	(1.74)	(1.34)	(0.49)	(1.26)	(1.70)	(1.37)	(0.47)	(1.26)	(1.70)	(1.35)	(0.32)	(0.73)	(0.86)	(0.83)
Liquidity support													-0.41	-1.83**	-0.86	-1.57**
													(0.56)	(0.80)	(1.44)	(0.67)
Constant	6.38	3.05	5.82	0.29	8.78	4.10	7.04	5.88	7.16	5.91	11.05	3.96	6.11	-3.82	-2.13	0.66
	(5.43)	(8.05)	(11.37)	(7.25)	(8.28)	(10.59)	(15.10)	(9.23)	(5.57)	(8.49)	(12.02)	(6.94)	(4.35)	(6.18)	(9.37)	(5.89)
Observations	1,099	1,099	916	925	1,099	1,099	916	925	1,099	1,099	916	925	1,099	1,099	916	925
R-squared	0.09	0.07	0.06	0.05	0.09	0.07	0.05	0.05	0.09	0.07	0.05	0.05	0.08	0.04	0.03	0.02
Countries	25	25	20	20	25	25	20	20	25	25	20	20	25	25	20	20

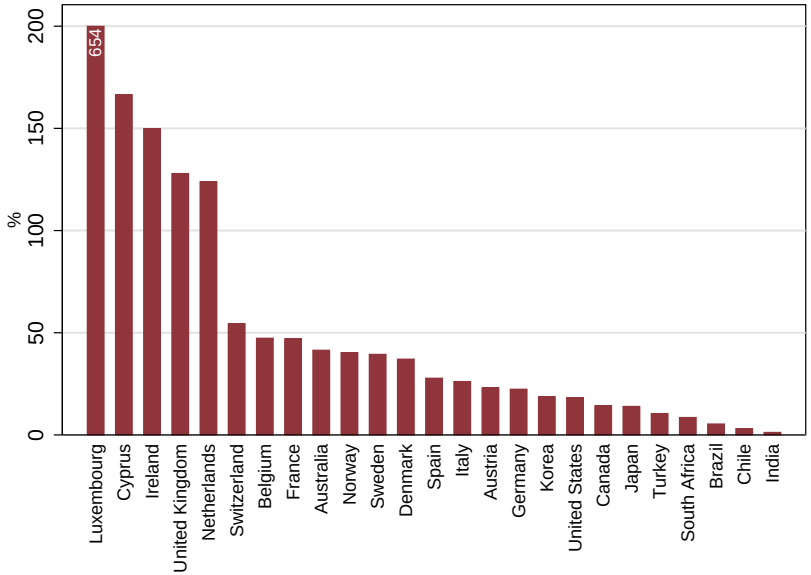
Table A5: ***Robustness: longer time series*** *The dependent variable is the quarterly percentage change in either interbank or intragroup funding. Variables are discussed in Section 2 with summary statistics provided in Table A1. 'L' behind a variable name indicates that this variable is based on quarterly data and lagged by one quarter; all other variables are recorded at the annual level. Standard errors, clustered at the quarter level, are reported in brackets. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1985Q1 to 2011Q4.*

	(1)	(2)	(3)	(4)
	Interbank	Intragroup	Parents	Affiliates
Global Factors				
Global Volatility (L)	-2.48**	0.42	0.29	-0.79
	(1.06)	(1.18)	(1.60)	(1.07)
ΔGlobal Interest Rates (L)	-2.42*	2.27	0.16	0.94
	(1.43)	(1.39)	(1.75)	(1.39)
Global Growth (L)	0.70*	0.00	0.05	0.23
	(0.37)	(0.34)	(0.44)	(0.39)
Host Country Characteristics				
Domestic GDP Growth (L)	0.52***	0.41**	0.68**	0.45**
	(0.15)	(0.19)	(0.27)	(0.22)
Inflation (L)	-0.26***	-0.21	-0.33*	-0.04
	(0.07)	(0.15)	(0.19)	(0.15)
Δ Interest Rates (L)	-0.48	0.16	0.22	-0.22
	(0.38)	(0.57)	(0.73)	(0.61)
FX Return (L)	-0.16*	-0.24***	-0.29***	-0.09
	(0.09)	(0.07)	(0.11)	(0.09)
Constant	4.32	1.87	3.81	0.80
	(2.98)	(3.94)	(5.33)	(3.57)
Observations	1,637	1,637	1,404	1,361
R-squared	0.07	0.04	0.03	0.03
Countries	25	25	25	25

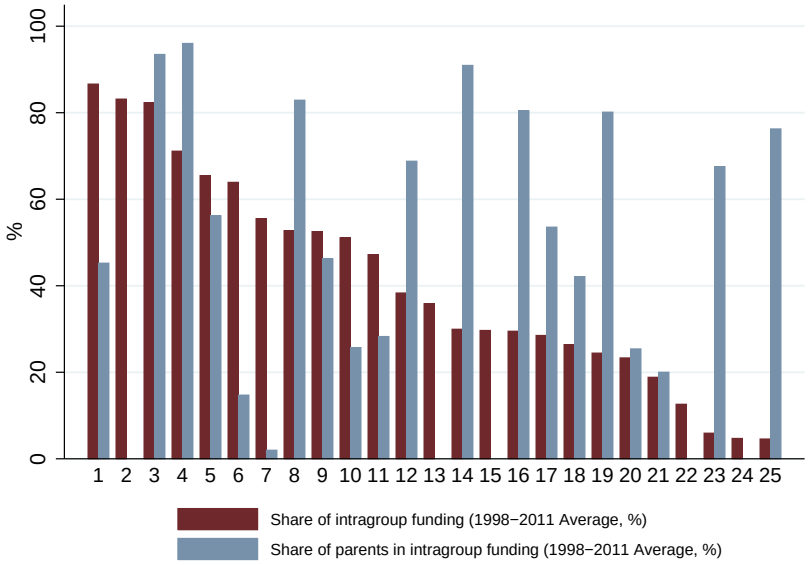
Table A6: ***Robustness: excluding fixed effects and two-way clustering*** *The dependent variable is the quarterly percentage change in either interbank or intragroup funding. In columns (1) to (4), we exclude fixed effects from the baseline specifications in Table 2 (cols. 1 and 5) and Table 3 (cols. 1 and 7). In columns (5) to (8), we double-cluster standard errors by quarters and by countries. 'L' behind a variable name indicates that this variable is based on quarterly data and lagged by one quarter; all other variables are recorded at the annual level. Variables are discussed in Section 2 with summary statistics provided in Table A1. Standard errors, clustered at the quarter level, are reported in brackets. *** is significant at the 1% level, ** at the 5% level and * at the 10% level. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Interbank	Intragroup	Parents	Affiliates	Interbank	Intragroup	Parents	Affiliates
Risk (L)	-3.64**	1.29	2.05	-0.71	-3.64**	1.50	2.02	-0.86
ΔGlobal Interest Rates (L)	-4.84**	4.38*	4.24	-1.62	-5.17***	4.48	2.98	-0.96
	(2.02)	(2.55)	(3.94)	(2.81)	(1.81)	(3.24)	(3.90)	(2.19)
Global Growth (L)	0.73	-0.25	-0.64	0.36	0.64	-0.19	-0.71**	0.27
	(0.47)	(0.41)	(0.52)	(0.54)	(0.49)	(0.42)	(0.26)	(0.49)
Domestic GDP Growth (L)	0.37**	0.27	0.70**	0.25	0.45**	0.23	0.71**	0.25
	(0.16)	(0.21)	(0.33)	(0.28)	(0.20)	(0.18)	(0.28)	(0.29)
Inflation (L)	-0.18**	-0.03	-0.18	0.07	-0.22***	-0.17	-0.46***	0.11
	(0.08)	(0.12)	(0.19)	(0.11)	(0.06)	(0.10)	(0.13)	(0.13)
Δ Interest Rates (L)	-0.72	-0.48	-1.39	1.35	-0.48	-0.11	-0.29	1.17
	(0.79)	(1.28)	(1.90)	(1.58)	(0.70)	(0.91)	(1.29)	(1.05)
FX Return (L)	-0.15	-0.24***	-0.28*	-0.18	-0.15	-0.24**	-0.31*	-0.15
	(0.12)	(0.09)	(0.15)	(0.13)	(0.12)	(0.10)	(0.16)	(0.15)
Return on Equity	0.09*	0.17***	0.21***	0.16**	0.10*	0.17***	0.21***	0.15*
	(0.04)	(0.04)	(0.05)	(0.07)	(0.05)	(0.04)	(0.05)	(0.08)
Solvency	0.16	0.72*	-0.02	0.27	0.19	-0.42	-1.49**	0.04
	(0.24)	(0.39)	(0.53)	(0.46)	(0.49)	(0.31)	(0.57)	(0.41)
Net interest margin	0.03	-1.18	-0.09	-0.67	0.06	-3.13***	-1.01	-3.32**
	(0.32)	(0.72)	(0.85)	(0.81)	(0.18)	(1.02)	(1.22)	(1.18)
Observations	1,099	1,099	916	925	1,099	1,099	916	925
R-squared	0.08	0.03	0.03	0.02	0.09	0.07	0.05	0.05
Countries	25	25	20	20	25	25	20	20

Figure 1: ***Cross-Border Bank Funding Across Countries*** *Panel (a) shows the ratio of cross-border bank-to-bank funding relative to GDP in 2011Q4. Panel (b) shows the average share of intragroup funding as a percentage of total cross-border bank-to-bank funding, between 1998 and 2011, for the 25 banking systems within our sample. The figure also shows the average share of intragroup funding held by domestically-owned parent banks, between 1998 and 2011. Country specific data are confidential and hence anonymized. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

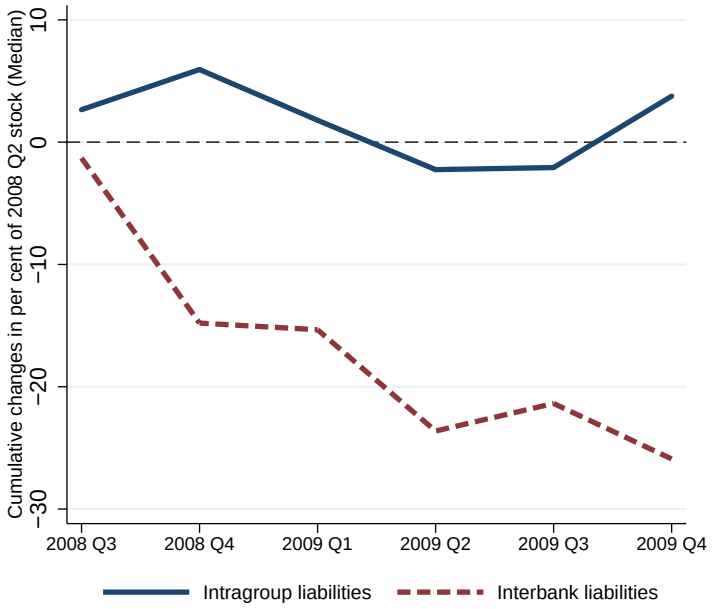


(a) Ratio of Cross-Border Funding to GDP (%)

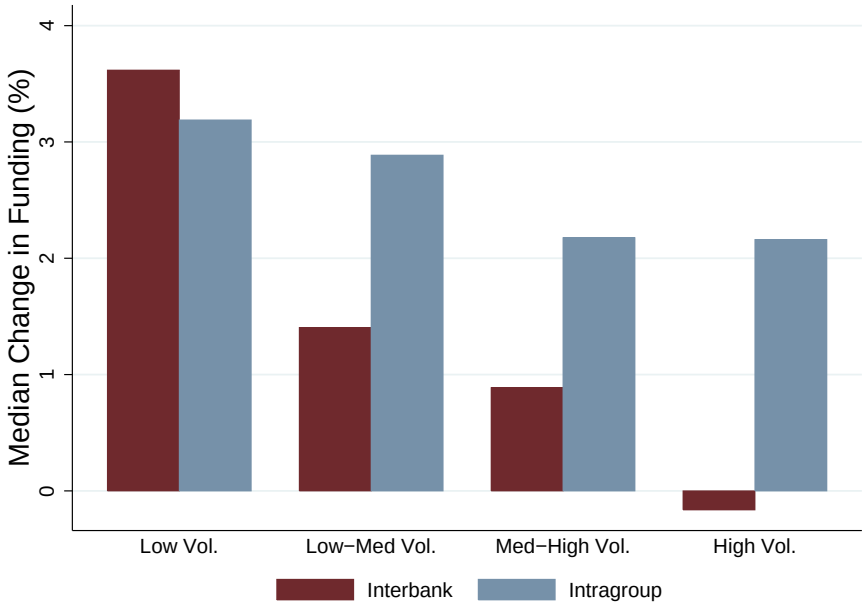


(b) Share of Intragroup Funding (%)

Figure 2: ***A First Look at Interbank and Intragroup Funding.*** *Figure (a) shows the cumulative median change in aggregate cross-border interbank and intragroup funding, across 25 advanced and emerging market banking systems, following the collapse of Lehman Brothers in September 2008, i.e. the largest negative move in global factors over our sample period. The change is measured relative to the stock of cross-border funding in 2008Q2. In Figure (b) quarterly funding is split into four groups, conditional on the average level of global volatility (measure by the volatility of the MSCI global index) in each quarter between 1998 and 2011. Each bar represents the median quarterly percentage change in interbank or intragroup funding if global volatility is low (below the 20^{th} percentile), at a medium level (between the 20^{th} and 50^{th} percentiles), at an elevated level (between the 50^{th} and 80^{th} percentiles) or at a high level (above the 80^{th} percentile). Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*

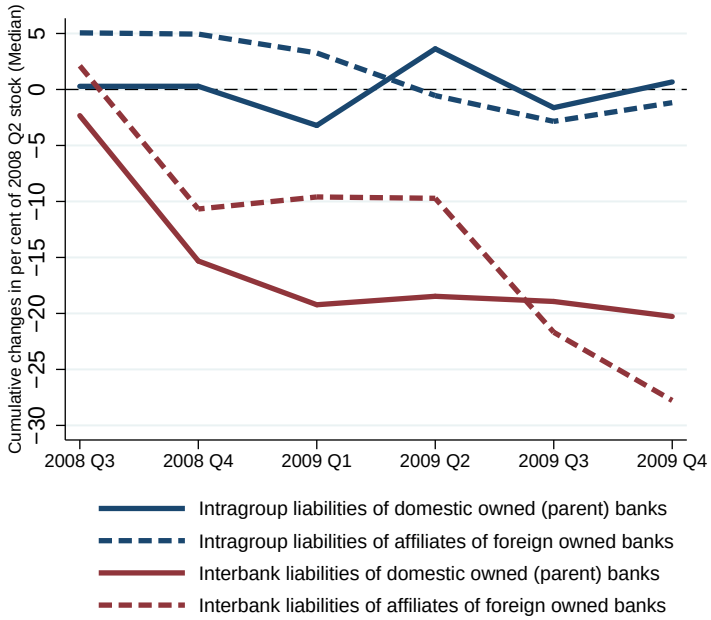


(a) Global Financial Crisis

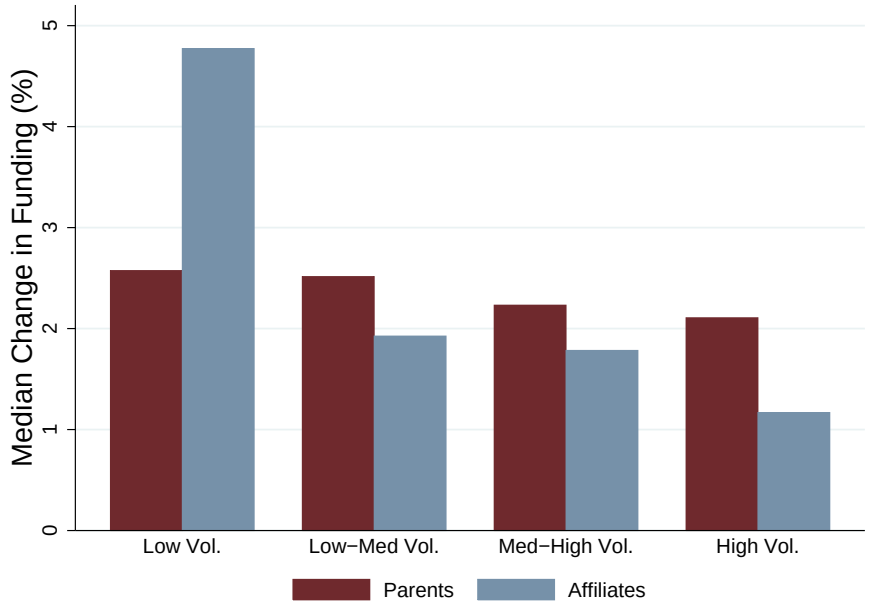


(b) Whole Sample

Figure 3: ***Intragroup Funding of Parents and Affiliates.*** *Figure (a) shows the cumulative median change in aggregate cross-border interbank and intragroup funding of domestic-owned parent banks as well as foreing affiliates following the collapse of Lehman Brothers in September 2008, i.e. the largest negative move in global factors over our sample period. The change is measured relative to the stock of cross-border funding in 2008Q2. In Figure (b) quarterly funding is split into four groups, conditional on the average level of global volatility (measure by the volatility of the MSCI global index) in each quarter between 1998 and 2011. Each bar represents the median quarterly percentage change in intragroup funding of parents or affiliates if global volatility is low (below the* 20^{th} *percentile), at a medium level (between the* 20^{th} *and* 50^{th} *percentiles), at an elevated level (between the* 50^{th} *and* 80^{th} *percentiles) or at a high level (above the* 80^{th} *percentile). Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*



(a) Global Financial Crisis



(b) Whole sample

Figure 4: ***Aggregate funding and the share of intragroup*** *The figure shows the cross-country median, exchange rate adjusted change of total (interbank plus intragroup) cross-border bank funding between 2008Q3 and 2009Q4. The values are scaled by the stock of funding at 2008Q2. Countries are classified as having a high share of intragroup funding if their 2008Q2 share of intragroup funding, as a proportion of total cross-border bank-to-bank funding, exceeds the cross-country median. Within the group of countries with a high share of intragroup funding, we further classify them as having intragroup funding 'mainly held by parents', if the share of intragroup funding held by parents, as a proportion of total intragroup funding, exceeds the cross-country median. Data on banking flows are collected from the Bank for International Settlements' International Banking Statistics database. The sample period is from 1998Q1 to 2011Q4.*