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2017

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Documentos de Trabajo
N.º 1736

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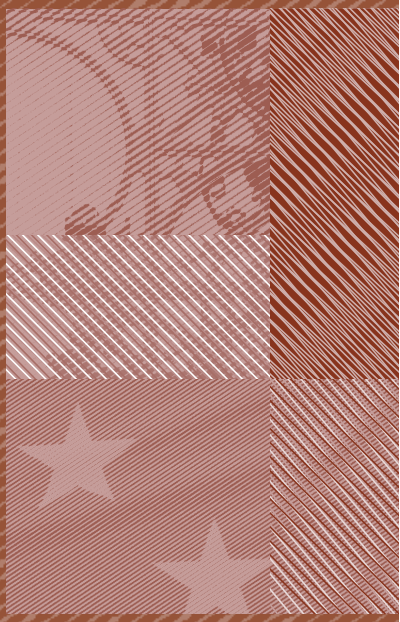
Eurosistema



CHANGING BUSINESS MODELS IN INTERNATIONAL BANK FUNDING (*)

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(*) We thank Stefan Avdjiev, Catherine Koch and participants to seminars at Banco de España, Bank for International Settlements, BBVA and Bocconi University for useful comments and suggestions. The views expressed in this paper are those of the authors only and do not necessarily reflect the views of Banco de España or the Bank for International Settlements.

Documentos de Trabajo. N.º 1736
2017

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ISSN: 1579-8666 (on line)

Abstract

This paper investigates the foreign funding mix of globally active banks. Using BIS international banking statistics for a panel of 12 advanced economies, we detect a structural break in international bank funding at the onset of the great financial crisis. In their post-break business model, banks rely less on cross-border liabilities and, instead, tap funds from outside their jurisdictions by making more active use of their subsidiaries and branches, as well as inter-office accounts within the same banking group.

Keywords: bank funding, global banking, cointegration analysis.

JEL Classification: C32, F65, G21.

Resumen

Este trabajo investiga la financiación internacional de los bancos activos a nivel mundial. Utilizando las estadísticas de banca internacional de BIS para un panel de 12 economías avanzadas, detectamos una ruptura estructural en esta financiación al comienzo de la gran crisis financiera. En su modelo comercial posterior a la quiebra, los bancos confían menos en las fuentes transfronterizas y, en cambio, aprovechan los fondos de fuera de sus jurisdicciones haciendo un uso más activo de sus subsidiarias y sus sucursales internacionales, así como de las cuentas entre oficinas dentro del mismo grupo bancario.

Palabras clave: financiación bancaria, banca global, análisis de cointegración.

Códigos JEL: C32, F65, G21.

1 Introduction

Global banking has expanded markedly during the past decades, in terms of both cross-border activities and local entry into banking sectors overseas (Merck et al., 2012). This process has occurred in parallel with the globalisation of international trade and was driven by changes in the regulatory environment and in macroeconomic and financial conditions (Lane and Milesi-Ferretti, 2008; Goldberg, 2009).[1]

The rapid advance of global banking has also had important repercussions for funding and liquidity management at the institutions involved. Financial globalisation has allowed banks to tap funding sources across borders, allowing them to diversify away from traditional funding sources to international interbank markets (Fender and McGuire, 2010). McGuire and Von Peter (2009) show that the rapid expansion of foreign claims of banks in general and of European banks in particular in the years prior to the 2007-2009 great financial crisis was mirrored in a sharp increase in foreign liabilities, reflecting a growing dependence on cross-border funding. Shin (2012) documents how European banks financed their global activities by tapping US wholesale funding markets and using their inter-office accounts to channel US dollar-denominated funding to their head offices.

The globalisation of banking was sharply interrupted by the great financial crisis, which prompted an important retrenchment in banks' international activities and exposures, especially in cross-border funding markets. The crisis led to major restructurings of banks' business and funding models and to changes in their international strategies. Moreover, cross-border bank linkages proved to be important transmission channels of the crisis, propagating funding shocks across borders (i.e. from one core funding market to others) and from advanced to emerging market economies (Cetorelli and Goldberg, 2011). Adjustments in business and funding models were, in many cases, reinforced by the subsequent 2010-2012 euro area financial crisis.

Foreign liabilities can be unstable as a funding source, because they are often used as an alternative to domestic funding. If domestic credit growth outstrips the growth in domestic retail deposits, banks may turn to foreign sources. But the ability of banks to raise cross-border funding fluctuates over time in line with "risk on/risk off" conditions in global credit markets. Moreover, banks' foreign liabilities play an important role as transmission channel in "boom-bust" global leveraging/deleveraging cycles, allowing banks to increase their debt rapidly during boom episodes and reducing it massively during busts. Shin (2012) shows that cross-border banking and the fluctuating leverage of global banks are the channels through which accommodative financial conditions are transmitted across the globe, while Bruno and Shin (2015a) highlight the link between exchange rates, bank leverage and financial stability.

These factors clearly show that the funding models of globally active banks play an important role in banking crises and leverage cycles. Using the BIS international banking statistics, this paper tests for the existence of structural breaks in bank funding models. In

1 Regulatory arbitrage played a key role: tighter regulations in the home country incentivised banks to expand their activities to other less regulated countries (Houston et al, 2012; Fidrmuc and Hainz, 2013; Ongena et al, 2013; Bremus and Fratzscher, 2015). Macroeconomic and financial conditions were important drivers as well. Global banking developed because of profit opportunities in destination countries, interest rate differentials and search for yield (Focarelli and Pozzolo, 2005; Blank and Buch, 2010; Rey, 2013; Bremus and Fratzscher, 2015; Bruno and Shin, 2015a; 2015b; Cerutti et al, 2015).

particular, we analyse the evolution of bank funding across borders by distinguishing the two key components of foreign liabilities, i.e. cross-border liabilities and funding obtained by banks' overseas offices (local liabilities). Moreover, we break down cross-border liabilities by lending sector (bank-related or unrelated – and non-banks) in order to compare intragroup flows (i.e. cross-border liabilities from related banks) with liabilities obtained externally. Figure 1 gives a visual representation of these different types of foreign liabilities.

The empirical analysis is performed in two steps. First, we use a log-linearisation of the balance sheet identity that links local and cross-border liabilities in order to test for the presence of a structural break in bank funding models (Koch, 2014). Second, we study the adjustment dynamics of such a long-run relationship by means of a panel vector error correction model that includes a number of weakly exogenous economic determinants. Our main conclusions are as follows. Following the first episodes of turbulence in the interbank market (after 2007:Q2), globally active banks increased their reliance on funding from branches and subsidiaries abroad, and cut back on funding obtained directly by headquarters (cross-border funding). In particular, banks reduced cross-border funding from unrelated banks – e.g. those that are not part of the same banking group – and from non-bank entities. At the same time, they increased intragroup cross-border liabilities in an attempt to make more efficient use of their internal capital markets. Crucially, these changes are long-run phenomena, reflecting a shift in the funding model of banks.

The remainder of this paper is organised as follows. Section 2 provides an overview of the literature. We discuss business models of global banking (Section 2.1) and the determinants of international bank funding (Section 2.2). Section 3 presents the data, while Section 4 discusses the empirical methodology. Section 5 describes the empirical results and robustness checks. The last section concludes.

2 Literature review on global banking and its sources of funding

2.1 Business models of global banking

Business models in global banking are generally distinguished between multinational and international banking (McCauley et al., 2010; Gambacorta and Van Rixtel, 2013).[2] Multinational banks maintain sizeable foreign branches and subsidiaries in multiple jurisdictions, matching largely local assets and liabilities. In contrast, international banks conduct cross-border business predominantly from the country where they are headquartered or from international financial centres.[3]

Banks also differ in the degree to which they manage their funding in a centralised or decentralised fashion (CGFS, 2010b). The centralised model involves the use of cross-border funding sources managed from the banks' headquarters or their offices in major financial centres. These include the use of their internal capital markets (intragroup or inter-office funding), cross-border borrowing from other banks in international interbank markets (interbank funding) and cross-border funds obtained from non-banks, such as international retail deposits or debt issued in global capital markets. Internal capital markets are important funding channels for large and globally active banks and play an important role in their international management of liquidity by adjusting funding flows between the parent banks and affiliates overseas (Cetorelli and Goldberg, 2012a and 2012b; Buch and Goldberg, 2015; De Haas and Van Lelyveld, 2010). At the same time, unlike in previous crises, research suggests that parent banks were unable to support their foreign affiliates during the great financial crisis (De Haas and Van Lelyveld, 2014). Different centrally managed international funding sources may also adjust differently in reaction to episodes of severe market stress, such as for example cross-border intragroup funding and cross-border interbank funding, i.e. cross-border funding obtained from unrelated banks. Empirical evidence suggests that cross-border intragroup funding rises when global risk increases, while cross-border funding obtained from unrelated banks displays the opposite behaviour and is withdrawn during periods of elevated global risk (Reinhardt and Riddiough, 2014).

The decentralised funding model is based on banks funding their operations locally in the foreign countries where they operate. This model is characterised by a high degree of financial autonomy, in which every subsidiary raises financing under its own name and according to its own credit rating (Merck et al, 2012). As a consequence, this model makes it easier for markets to accurately assign and price the risk involved in the funding; generally, the decentralised funding model displayed greater stability during the great financial crisis than the centralised one. In fact, anecdotal evidence suggests that, since the crisis, globally active banks have gradually increased their funding through local sources in foreign markets where they operate (CGFS, 2010b).

In practice, global banking business models vary considerably across countries (McCauley et al., 2010) and (2012); Gambacorta and Van Rixtel, 2013; Muñoz De La Peña and Van Rixtel, 2015). Among the major banking systems, the Spanish one is the most pronounced

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2 Another classification of the organisation of global banking departs from the choice between branches and subsidiaries. We do not discuss this. Dell'Ariccia and Marquez (2010) identify different sources of risk as important determinants of this choice when expanding into new (overseas) markets.

3 Dietrich and Vollmer (2010) show that capital requirements may affect a bank's choice of organisational structure, i.e. the choice between the cross-border international or multinational models.

exponent of the "multinational and decentralised funding" model, especially in their operations vis-à-vis the UK, US and emerging market economies. Spanish banks conduct their foreign operations to these countries almost completely on a local basis, relying on cross-border operations to only a minimal extent. Other examples of this business model are the foreign operations of US banks vis-à-vis the UK and those of euro area and UK banks vis-à-vis the US and emerging market economies. In contrast, Japanese banks are a clear example of international banks, with centralised funding concentrated on their headquarters or in international financial centres, which rely predominantly on cross-border funding. In the case of Japanese banks, funding is mainly distributed to offices across the globe through inter-office transfers from their head offices in Japan.

The great financial crisis, and the subsequent euro area financial strains, impacted severely upon the funding models employed in global banking. Since the onset of the crisis, global banking has retreated significantly,[4] as evidenced by a sharp decline particularly in cross-border positions, most notably in cross-border interbank funding markets (CGFS, 2010a; García-Luna and Van Rixtel, 2014). In contrast, local exposures overseas have remained much more stable. While cross-border funding has declined for most major banking systems since the first quarter of 2008, cross-border operations fell the most markedly for euro area banks (Avdjiev et al., 2012). The euro area financial turmoil put additional pressure on these banks to intensify their deleveraging, as access to short- and longer-term wholesale funding markets became strained (again) and regulators imposed new capitalisation targets (BIS, 2012; Van Rixtel and Gasperini, 2013). Overall, the shift from cross-border toward local operations in global banking was triggered by the financial crisis, but regulatory changes and weaknesses in bank balance sheets also contributed significantly (Goldberg and Gupta, 2013; IMF, 2015). The different adjustment patterns between changes in cross-border and local positions have been documented by several studies (De Haas and Van Lelyveld, 2006; McCauley et al., 2012; Schnabl, 2012).

The importance of the multinational model with decentralised funding increased especially with respect to operations vis-à-vis the UK, with the local UK operations of euro area, US and Japanese banks all increasing. Some of these changes may be explained by strategic responses to the great financial crisis, such as moves by foreign banks to acquire British banks that had been bailed out by the UK government (e.g. banks headquartered abroad) and by regulatory reform (Gambacorta and Van Rixtel, 2013).

2.2 Economic determinants of international bank funding

In this section, we analyse what are the main economic determinants of funding flows, distinguishing between pull and push factors. The distinction between pull and push factors for capital flows has been the dominant intellectual framework for classifying drivers since the focus of academic inquiry shifted to the role of external factors in the early 1990s. In particular, domestic economic performance, cost of funding, and country risk indicators for the borrowing country stand out as important pull variables. Similarly, mature economy interest rates and global risk aversion are unambiguously important push factors and have significant explanatory power for capital flows movements (Avdjiev et al., 2017; Cerutti et al., 2015).

In this paper, we define as borrowing country the country where the bank obtaining foreign liabilities is headquartered; in contrast we define as lending country the country that provides the funding, which may be supplied by the banking system and other non-banking sectors.

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4 A large body of research has concentrated on the explaining the drivers behind the sharp decline in global banking and the increased "home bias" of banks (Caruana and Van Rixtel, 2012; Giannetti and Laeven, 2012a and 2012b; De Haas and Van Horen, 2013; Van Rijckeghem and Weder di Mauro, 2014; Bremus and Fratzscher, 2015).

Among the "pull factors" we can consider domestic real output growth and the cost of funding in the borrowing country. Both are indicators of aggregate demand shifts that could influence bank activity. Moreover, the cost of funding in the borrowing country could also indicate a relative convenience to tap funds abroad. For example, Van Rixtel et al. (2015) show that cost considerations were a significant driver of debt issuance by European banks, especially in pre-crisis episodes. Hence, banks are expected to tap foreign funding markets when interest rates in those markets are lower than those in their home markets, in principle when hedged for exchange rate risk. Indeed, Blank and Buch (2010) find that larger interest rate differentials between countries increase the foreign liabilities of banks. Therefore, ceteris paribus, higher interest rates in the borrowing country represent an incentive for banks to seek more funding abroad.

A third potential pull factor that explains banks' foreign liabilities is their equity capital. Banks in the borrowing country can signal their strength by the amount of core (Tier 1) capital. Higher capital levels are associated with lower prices and higher levels of uninsured liabilities (see, for example, Ellis and Flannery, 1992, Flannery and Sorescu, 1996, Gambacorta and Shin, 2016). Hence, better capitalised banking systems should have better access to international funding markets – we expect a positive relationship between Tier 1 capital of banks in the borrowing country and their foreign liabilities. Along these lines, Berger and Bouwman (2009, 2013) provide evidence of the "risk absorption" hypothesis: larger and better capitalised banks have a greater capacity to absorb risk and hence have better access to wholesale funding markets. In particular, Altunbas et al. (2014) find that, other things being equal, banks with an equity-to-total assets ratio larger than 1 percentage point have their expected default probability reduced by 0.4%. Bank capital therefore reduces asymmetric information problems and increases banks' capacity to tap funding in foreign markets. Following a similar line, Shin (2012) argues that lending by banks and other financial intermediaries depends on their "balance sheet capacity". This capacity, in turn, depends on two things – the amount of bank capital and the degree of "permitted leverage" as implied by the credit risk of the bank's portfolio and the amount of capital that the bank keeps to meet that credit risk. Bank lending expands to fill up any spare balance sheet capacity when measured risks are low.

Among the "push factors" for banks' foreign liabilities, we consider global liquidity and risk conditions. Especially in the post-crisis period, international capital flows have been particularly sensitive to the low interest rate environment, including unconventional monetary policies. Avdjiev et al. (2017) proxy global liquidity conditions with the US federal funds target rate. More precisely, they use a combination of the effective US Federal Funds target rate prior to Q4 2008 and the Wu-Xia (2016) estimates of the shadow Federal Funds rate from Q1 2009 onwards.

A second push factor to be considered is global risk aversion, as proxied by the *VIX* calculated on the base of US implied stock market volatility. A higher value of the *VIX* is typically associated with lower funding in wholesale funding markets by banks. This can be driven both by demand (e.g. banks are more constrained in seeking funding in a higher-risk environment) and supply (e.g. investors are more reluctant to provide funding in a risky environment). Covitz et al. (2004) find that higher implied stock market volatility is negatively associated with subordinated debt issuance by US banks. Camba-Mendez et al. (2012) and Van Rixtel et al. (2015) also find a negative correlation between the VIX and European banks' bond issuance.[5]

5 The VIX plays a crucial role in investigations of the impact of risk on global financing flows. Forbes and Warnock (2012) show that a lower VIX is associated with a surge in capital flows. Rey (2013) finds that capital inflows are negatively correlated with the VIX even at a geographically disaggregated level, and that this pattern holds even when conditioned by other global factors such as the real interest rate and growth rate.

3 Data

We use quarterly data on foreign liabilities from the BIS international banking statistics (IBS). The IBS aggregate data on individual banks at the country level in different ways, resulting in four different databases: locational by nationality, locational by residence, consolidated on an immediate counterparty basis and consolidated on an ultimate risk basis (see Annex for more details).

In particular, we employ the locational by nationality data and, when available, consolidated data on an immediate counterparty basis. The logic driving our choice is that we want to distinguish between banking groups headquartered in different countries (i.e. nationality of reporting banks), as opposed to banking groups operating in different countries. For example, we focus on US headquartered banks which (a) in the locational data by nationality comprise US banks operating in the US and in other BIS locational reporting countries; (b) in the consolidated data comprise US banks operating in the US and in all other countries around the globe. This concept differs from resident banks that do business in the US. As both the locational and consolidated statistics follow a classification of reporting banks based on their nationality, we can combine these two datasets. At the same time, these statistics differ in several ways, most importantly due to the fact that intragroup positions are netted out and country coverage of banks' network is wider in the consolidated statistics.

We gather data on the two subcomponents of foreign liabilities: local and cross-border liabilities. Local liabilities in this context are defined as liabilities to a counterparty located in the same country where bank's foreign affiliates book the position. Local positions are reported both in foreign and local currencies. Local liabilities in foreign currencies include liability positions vis-à-vis a counterparty located in the same country as the banking office, denominated in a currency other than the domestic currency of that country. We obtain the data on these positions from the non-consolidated locational statistics but exclude domestic liabilities in foreign currency, i.e. liabilities to the residents of the parent country. Similarly, local liabilities in local currencies include liability positions vis-à-vis a counterparty located in the same country as the reporting foreign bank affiliate, denominated in the domestic currency of the country where the foreign office of the bank is located. We use data from the consolidated statistics on an immediate counterparty basis for these positions and, hence, inter-office positions are excluded. Thus, these data differ conceptually from those on local liabilities in foreign currencies, which include intragroup positions. We believe this is acceptable, as local positions in local currencies vis-à-vis related offices are very likely to be negligible. The main reason for this assumption is that local inter-office positions (or positions between related entities in the same country) are captured only if the respective counterparties are owned by the same consolidated banking parent.

Cross-border liabilities, instead, are defined as liabilities to a counterparty located in a country other than the country where the banking office that books the position is located.[6] Thus, local liabilities are held through branches and subsidiaries in foreign countries (i.e. other countries than the country where the bank is headquartered), while cross-border funding is gathered through inter-office transfers and directly from the bank's headquarters.

6 Cross-border liabilities include foreign affiliates' liabilities to the parent country.

We define foreign liabilities as the sum of local and cross-border liabilities[7]. Finally, we break down cross-border liabilities by lending sector, i.e. banks and non-banks. Moreover, we break down cross-border liabilities obtained from banks into inter-office liabilities and liabilities from unrelated banks.

We obtain our economic determinants of bank liabilities from Datastream and Bankscope. Having a push-pull model in mind, we gather data on country-specific (real GDP, three-month interbank rate, Tier 1 capital requirements) and global variables (VIX and Fed funds rate). In particular, we obtain yearly total assets and Tier 1 capital of the major banks based in each country from Bankscope. We interpolate these data to a quarterly frequency by using the total assets of banks operating in a given country as an indicator (Denton, 1971). These data are available quarterly and are published by the national central banks, as well as gathered by the BIS. Moreover, we use effective Fed funds rates until 2008:Q4 and Wu and Xia's (2016) shadow rates from 2009:Q1 to 2013:Q4.

Our sample includes 12 advanced economies (Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Spain, Sweden, Switzerland, the UK and the US for the period 2000:Q1 – 2013:Q4. Figure 2a gives an idea of the importance of foreign liabilities in global banks' balance sheets. It shows the ratio of foreign liabilities to total liabilities over time for the median of the sample, as well as for the 25^{th} and 75^{th} percentiles. Foreign liabilities represent a large percentage of the liabilities held by global banks, roughly 50%. Moreover, this proportion increased over time before the great financial crisis and it has steadily been reverting to pre-crisis levels afterwards, with the exception of a few quarters during the height of the Eurozone crisis.

Table 1 shows some descriptive statistics for the pooled data. It includes the different types of foreign liability used in the analysis (expressed in US dollars), as well as country-specific and global determinants.

Table 2 shows the Maddala and Wu (1999) and Pesaran (2007) tests for the presence of unit roots in panel time series. Both tests are valid under the null hypothesis of non-stationarity of the series. The main difference between the two is that the Pesaran test allows for cross-sectional correlation among the panel units. Both tests show that all the balance sheet variables that we consider have a unit root. The results of Table 2 are obtained with one lag, and no trend in the ADF regressions used to construct the test statistics, but they are robust to the inclusion of a deterministic trend and of more lags.

7 Foreign liabilities, as defined by the BIS IBS Guidelines, exclude foreign affiliates' liabilities to parent country. However, we include them in our measure of cross-border flows and we call the total of local and cross-border liabilities "foreign liabilities".

4 Methodology

Exploiting the non-stationary nature of the data, we divide the analysis into a long-run and a short-run perspective using a panel vector error correction model (VECM). The long-run analysis captures banks' equilibrium business models and we will look for endogenous breaks in them. The short run captures the economic determinants of any (temporary) shifts away from the equilibrium business model, as well as the adjustment dynamics.

4.1 Long-run analysis

We capture business models in foreign funding as the equilibrium percentage of foreign liabilities that banks obtain locally as opposed to cross-border, as well as the equilibrium lender breakdown of cross-border liabilities. We consider the following balance sheet identity:

$$FL_{i,t} = LL_{i,t} + XBL_{i,t} \tag{1}$$

where FL stands for foreign liabilities, LL for local liabilities and XBL for cross-border liabilities; the suffix *i* denotes the borrowing country. *XBL* can be further decomposed in the following way:

$$XBL_{i,t} = XBL_{i,t}^{b,rel} + XBL_{i,t}^{b,unrel} + XBL_{i,t}^{b,CB} + XBL_{i,t}^{nb} \tag{2}$$

where XBL^{b} is cross-border liabilities acquired from banks (related - $XBL^{b,rel}$, unrelated - $XBL^{b,unrel}$ or the central bank - $XBL^{b,CB}$), while XBL^{nb} is cross-border liabilities acquired from non-banks. By construction, for every country *i* and in every quarter *t*, local liabilities and cross-border liabilities must sum up to the total amount of foreign liabilities that banks hold.

If banks targeted fixed long-run proportions of local and cross-border liabilities, then we could log-linearize the balance sheet identity in (1) around those long-run proportions. We follow Koch (2014) and, for the moment, we assume that this is the case. We will be able to confirm this in the results section, by using cointegration tests. Differentiating the equation above and dividing both sides by the steady-state value of foreign liabilities yields (or FL_i^{SS}):

$$\frac{d\,FL_{i,t}}{FL_i^{SS}} = \frac{1}{FL_i^{SS}}\left(d\,LL_{i,t} + dXBL_{i,t}\right) \tag{3}$$

We multiply and divide local liabilities by its steady state value and we do the same for cross-border liabilities to obtain:

$$\frac{d\,FL_{i,t}}{FL_i^{SS}} = \frac{LL_i^{SS}}{FL_i^{SS}}\,\frac{d\,LL_{i,t}}{LL_i^{SS}} + \frac{XBL_i^{SS}}{FL_i^{SS}}\,\frac{dXBL_{i,t}}{XBL_i^{SS}} \tag{4}$$

In the neighbourhood of a steady state, we can write the above differentials as differences between the variable at time t and the steady state so that, for instance, the left-hand side will read: $\frac{FL_{i,t}-FL_i^{SS}}{FL_i^{SS}}$ or $\frac{FL_{i,t}}{FL_i^{SS}} - 1$.

Exploiting the fact that, in a neighbourhood of 1, $x - 1 \approx \log(x)$, we can finally write the log-linearised version of the balance sheet identity in (1) as follows, using lower-case letters to denote logarithms:

$$fl_{i,t} = g_i + \alpha_i^{l} ll_{i,t} + \alpha_i^{xb} xbl_{i,t} + \nu_{i,t} \tag{5}$$

where α_i^l is the long-run ratio of local liabilities to foreign liabilities, α_i^{xb} is the long-run ratio of cross-border liabilities to foreign liabilities, g_i is a constant and formally equal to $fl_i^{SS} - \alpha_i^l ll_i^{SS} - \alpha_i^{xb} xbl_i^{SS}$ and $\nu_{i,t}$ is a random deviation from the long-run ratios in period t.

In order to make the analysis feasible, we further assume homogeneity in the long-run ratios, while allowing for heterogeneous fixed effects. The resulting long-run equation we aim to test is:

$$fl_{i,t} = g_i + \alpha^l ll_{i,t} + \alpha^{xb} xbl_{i,t} + \nu_{i,t} \tag{6}$$

This equation captures the equilibrium proportion of local and cross-border liabilities in banks' balance sheets. We can extend the analysis using the breakdown of cross-border liabilities in equation (2), thus obtaining a more complete relationship:

$$\begin{gathered} fl_{i,t} = g_i + \alpha^l ll_{i,t} + \alpha^{xb,b,rel} xbl_{i,t}^{b,rel} + \\ \alpha^{xb,b,unrel} xbl_{i,t}^{b,unrel} + \alpha^{xb,b,cb} xbl_{i,t}^{b,cb} + \alpha^{xb,nb} xbl_{i,t}^{nb} + \nu_{i,t} \end{gathered} \tag{7}$$

The next step is to verify the possible presence of structural breaks in this long-run relationship. Following Koch (2014), we proceed as follows:

a) we test for the possible presence of a long-run relationship among the variables in equation (7);

b) we look for the presence of an endogenous break in the long-run relationship;

c) we estimate the long-run relationship with the break found above;

d) we run cointegration tests using the sample up to the break and after the break, in order to confirm the presence of cointegration.

In order to test for the presence of an endogenous break in the long-run relationship – point b) above – we employ the tools developed in Bai (1994, 1997), Kurozumi (2002), and Carrion-i-Silvestre and Sansó (2006), and used by Koch (2014) in the context of long-run balance sheet ratios. Furthermore, we use dynamic OLS (Stock and Watson, 1993) to alleviate short-sample bias concerns.

For each date T in our sample, we estimate the following long-run equation:

$$\begin{gathered} fl_{i,t} = g_i + \alpha^l ll_{i,t} + \alpha^{xb} xbl_{i,t} \\ fl_{i,t} = g_i + \alpha^l ll_{i,t} + \alpha^{xb} xbl_{i,t} \\ + \sum_{s=-3}^{3} \theta_s^l \Delta ll_{i,t-s} + \sum_{s=-3}^{3} \theta_s^{xb} \Delta xbl_{i,t-s} + \nu_{i,t} \end{gathered} \tag{8}$$

where $xbl_{i,t} = \left(xbl_{i,t}^{b,rel}\ xbl_{i,t}^{b,unrel}\ xbl_{i,t}^{b,cb}\ xbl_{i,t}^{b,nb}\right)$ and $\mathbb{I}(t \geq T)$ is an indicator function that takes the value of 1 when $t \geq T$ and 0 otherwise. For each T we can compute the sum of squared residuals of the regression in order to derive a sequence $\{SSR\}_T$. The most likely candidate for the break is given by:

$$T_{break} = argmin_T \{SSR\}_T \tag{9}$$

We then estimate the long-run relationship using the break date found above:

$$fl_{i,t} = g_i + \alpha^{l} ll_{i,t} + \alpha^{xb} xbl_{i,t} + \kappa \mathbb{I}(t \geq T_{break}) + \varphi^{l} ll_{i,t} \mathbb{I}(t \geq T_{break}) + \varphi^{xb} xbl_{i,t} \mathbb{I}(t \geq T_{break}) + \sum_{s=-m}^{m} \theta_s^{l} \Delta ll_{i,t-s} + \sum_{s=-m}^{m} \theta_s^{xb} \Delta xbl_{i,t-s} + \nu_{i,t} \quad (10)$$

and we use a Wald test on κ, φ^{l} and φ^{cb} to determine whether the break is statistically significant.

Finding evidence in favour of cointegration justifies the view that banks have well-defined international funding models and that they do target long-run proportions of local and cross-border liabilities. Pedroni (1999) proposes different statistics for testing for the presence of cointegration in a panel setting. Of these statistics, some are based on pooling along the "within" (panel) dimension and some are based on pooling along the "between" (group) dimension. All test for the presence of a unit root in the regression residuals. The statistics have different small-sample behaviour, but all have an asymptotically standard normal distribution under the null hypothesis of no cointegration.

4.2 Short-run analysis

Despite the long-run relationship between local and cross-border liabilities, banks' foreign funding mix could also be influenced by short-term determinants. We seek to detect the characteristics of the adjustment dynamics of the shocks to these determinants.

For each breakdown, we have two long-run equilibria, one for each of the pre- and post-break subsamples. We follow Koch (2014) in selecting the second breakdown because it offers a finer distinction of cross-border liabilities, and hence richer adjustment dynamics. In particular, we select the post-break period as 2007:Q2 – 2013:Q4.

Then we follow Beckmann et al. (2011) and test whether an economic determinant *x* (characterised by a unit root process) is weakly exogenous with respect to the cointegrating relationship found above. To do so, we regress each economic determinant x in first differences on the lagged cointegrating vector with fixed effects:

$$\Delta x_{i,t} = c_i^{x} + \eta^{x} \, Coint\_resid_{i,t-1} + \zeta_{i,t} \quad (11)$$

For each variable x, finding an insignificant η^{x} means that we cannot reject the null hypothesis that x is weakly exogenous.

Second, we set up a conditional panel VECM (Jacobs and Wallis, 2010) as follows:

$$\Delta y_{i,t} = \gamma_i + \lambda \, Coint\_resid_{i,t-1} + \sum_{s=0}^{p} \Psi_s \Delta x_{i,t-s} + \sum_{s=1}^{p-1} \Pi_s \Delta y_{i,t-s} + \varepsilon_{i,t} \quad (12)$$

where $\Delta y_{i,t} = \left(\Delta fl_{i,t} \; \Delta ll_{i,t} \; \Delta xbl_{i,t}^{b,rel} \; \Delta xbl_{i,t}^{b,unrel} \; \Delta xbl_{i,t}^{b,cb} \; \Delta xbl_{i,t}^{b,nb}\right)'$ is the vector of the endogenous variables and $\Delta x_{i,t-s}$ is the vector of the weakly exogenous economic determinants. γ_i is a country-specific constant, λ is a vector of speeds of adjustment, Ψ_s are matrices containing the short-term effects of a change to x on the endogenous variables and Π_s are matrices containing the dynamics of the endogenous variables. $p-1$ is the optimal lag length, as determined by the appropriate information criteria.

In our main specification we assume that the heterogeneity of the panel is entirely captured by fixed effects. This means that we allow fixed effects both in the long-run relationship and in the VECM representation of the system, but we always assume (for the sake of econometric tractability) homogeneous slopes across countries. However, we also conduct a robustness estimation where we allow the slopes to be heterogeneous, using a mean group estimator (Pesaran and Smith, 1995).

5 Empirical results

5.1 Long-run analysis: business models and structural change

Figure 2b shows the sequence of *SSR* from the estimation of equation (8) for different possible break points T, starting in 2001:Q1 and until the end of the sample. The sequence of SSR has a sharp trough in 2007:Q2 and provides strong evidence in favour of the presence of a structural break in the initial period of the great financial crisis. In order to test whether there is indeed a break, and to assess the effect of the break on the variables involved, we estimate long-run equation (8) with a break dummy in 2007:Q2.

Table 3 shows the equilibrium proportions of the components of foreign liabilities, as well as the post-break increases or decreases. The first column considers a simplified version of the model that does not disentangle the various components of cross-border liabilities. After the break, the equilibrium proportion of foreign liabilities that banks get through local funding increases by more than 5 percentage points, at the expense of cross-border funding. This finding is in line with the presence of a structural change in equilibrium business models of bank funding in line with the literature reviewed in Section 2. This result is important as it identifies such a structural break in a more formal way, as an equilibrium phenomenon. What we detect is that the reduction in cross-border liabilities relative to local ones seems not to be a temporary phenomenon, but more the effect of a readjustment towards a new equilibrium. Moreover, we are able to identify the structural break endogenously. Interestingly, our result indicates that the break occurred prior to the default of Lehman Brothers and the announcement of the Basel III reforms. It was probably reinforced by such events and the discussion or implementation of regulatory reforms.

In the second column of Table 3, we use the breakdown between the different components of cross-border liabilities to get further insight into the mechanism of adjustment towards the new funding business model equilibrium. Banking groups increased liabilities booked through branches and subsidiaries abroad at the expense of cross-border liabilities (i.e. funding acquired directly from headquarters) following a precise pattern. In particular, headquarters reduced borrowing from external cross-border sources in favour of internal ones, with the exception of liabilities vis-à-vis central banks. The proportion of cross-border liabilities from related banks over foreign liabilities increased by 2.7%, while cross-border liabilities from unrelated banks and from non-banks decreased by 3.7% and 5.7%, respectively. Cross-border liabilities vis-à-vis central banks also increased by 2.9%. It is worth remembering that these are absolute increases of ratios. For instance, cross-border liabilities from related banks were 24.7% of foreign liabilities before the break. They increase by 2.7% after the crisis; hence, they now represent 27.4% of foreign liabilities. These results show that banks adjusted to a new equilibrium foreign funding mix after the crisis. They now rely more on intragroup transfers and on transfers from the central bank and less on private sector external sources. The results do not hinge upon the assumption of homogeneous slopes. In the last column of Table 3 we use a mean group estimator that allows the coefficients of the regression to be heterogeneous among the different countries. These results are qualitatively similar to those obtained in column II where the slopes are, instead, assumed homogeneous.

So far, we just have postulated that foreign liabilities and their components in Breakdowns I and II are cointegrated. Having identified the break, we are in a position to test for the presence of a long-run relationship between foreign funding components by using the

sample up to the break (pre-crisis period) and the sample after the break (crisis period). Table 4 shows the p-values under the null hypothesis of no cointegration of the tests in the four different cases. The results always support the presence of cointegration among the variables if one considers the two different period separately. These results suggest that banks do indeed target long-run business models in term of specific ratios of local and cross-border liabilities and in terms of ratios of cross-border liabilities gathered from different lenders. However, this long run relationship was subject to a structural break in 2007:Q2.

5.2 Short-run dynamics and economic determinants

In this section, we evaluate the adjustment dynamics to the equilibrium found in Section 5.1. We consider a number of economic determinants and we evaluate whether they are weakly exogenous to the long-run equilibrium. If they are, we can assess their short-run effects on foreign liabilities and their components.

Keeping in mind the literature on push and pull factors of international capital flows, we consider both country-specific and global determinants. The country-specific determinants are: borrowing -country real GDP, the short-term interest rate and banks' Tier 1 capital. The global determinants are global volatility, proxied by the VIX, and global liquidity, proxied by the US monetary policy stance. As for the latter, we use the effective Fed funds rate until 2008:Q4 and Wu and Xia's (2016) shadow rate from 2009:Q1 to 2013:Q4.

Table 5 shows the results of the tests for weak exogeneity of each of the variables with respect to the long-run relationship, estimated from 2007:Q2 to 2013:Q4. We run regressions (10) for each of the economic variables and report the coefficient estimates for η^x, together with their standard errors (in brackets).

Short-term interest rates, Tier 1 capital and US monetary policy are weakly exogenous to our cointegrating relationship. This allows us to include them in a conditional VECM and get consistent estimates of the short-run effects of changes in these determinants on changes to the endogenous variables, i.e. foreign liabilities and their components. The other two variables (changes in real GDP and VIX) cannot be included as they influence the cointegrating vector.

Before estimating the VECM, we need to determine the optimal lag length. We follow Lütkepohl and Krätzig (2004) who show that Hannan and Quinn's information criterion (HQIC) and Schwarz's Bayesian information criterion (SBIC) are preferred to other statistical methods in computing the optimal lag length. We compute these information criteria for each of the cross-sectional units and we find that the optimal lag length is 1 for all the countries and according to both information criteria, with the single exception of the HQIC for the UK. Therefore, we estimate the following conditional VECM:

$$\Delta y_{i,t} = \gamma_i + \lambda \, cointresid_{i,t-1} + \Psi \Delta x_{i,t} + \varepsilon_{i,t} \tag{13}$$

Each of the weakly exogenous economic determinants has a significant short-run effect on foreign liabilities or one of their components. An increase in a borrowing country's short-term rates is associated with a short-term increase in foreign liabilities and their components. An increase in regulatory capital in banks headquartered in the borrowing country is also associated with an increase in their foreign liabilities (and respective components). This result is consistent with Gambacorta and Shin (2016), who find that an increase in bank capital is associated with an increase in debt funding. As strongly capitalised banks are deemed more trustworthy by providers of funding, they can increase their liabilities, including foreign liabilities,

to a greater extent than weakly capitalised banks can. Finally, US monetary policy has a negative effect on foreign liabilities through its effect on cross-border liabilities gathered from related banks and from non-banks. The negative effect of a reduction in global liquidity (proxied by a tightening of the US monetary policy stance) on cross-border flows is a recurring finding in the literature (Avdjiev et al., 2017). A hike in global rates makes funding costlier, leading to deleveraging and a corresponding decrease in bank lending.

The adjustment dynamics to an exogenous shock are captured by the coefficients of the lagged cointegrating relationship (i.e. the loading coefficient). The system is able to return to the steady state after an exogenous shock when these coefficients are negative and smaller than one in absolute value. The loadings are significant for total foreign liabilities and for cross-border liabilities acquired from unrelated banks, from central banks and from non-banks. Cross-border operations can be adjusted easily and quickly from the bank's headquarters or its offices in international financial centres, while the development of local operations in foreign countries requires a long-term commitment to recover the high start-up costs. Hence, cross-border liabilities play the role of an adjustment channel. In particular, banks adjust cross-border liabilities booked externally in response to a shock, while keeping intragroup transfers fixed. The adjustment to an exogenous shock is completed on average in about five quarters.

6 Conclusions

This paper studies the business models that banks follow to obtain funding abroad. In particular, we analyse the existence of a long-run relationship and test whether such a relationship has been subject to a structural break during the great financial crisis. We document that banks seem to target fixed ratios for cross-border and local liabilities with respect to the total amount of funding that they get abroad. We show that banks changed their equilibrium funding models following the first episodes of turbulence in the interbank market (after 2007:Q2). In their post-break business model, banks use less cross-border liabilities and tap funds abroad using more actively their subsidiaries and branches, as well as interoffice accounts within the same banking group. Finally, we study the adjustment dynamics of the equilibrium and the short-term effects of several weakly exogenous economic determinants. We find that banks adjust to shocks by changing their cross-border liabilities vis-à-vis unrelated banks and non-banks while keeping their local liabilities fixed. Country-specific variables such as short-term rates, the amount of Tier 1 capital held by banks, as well as global liquidity, have a significant short-term effect on the amount of foreign liabilities held by banks and most of their components.

All in all, we provide empirical support for the adjustment in banks' international funding models in reaction to the first signs of severe dislocations in global interbank financial markets in the summer of 2007. Our results add to those in other studies supporting the view that cross-border interbank funding – i.e. funding from unrelated banks – is the main adjustment channel in times of heighted global risk. They also provide a first detailed statistical analysis of the changes in international bank funding patterns in relation to the great financial crisis, including the relative shift from cross-border toward local operations.

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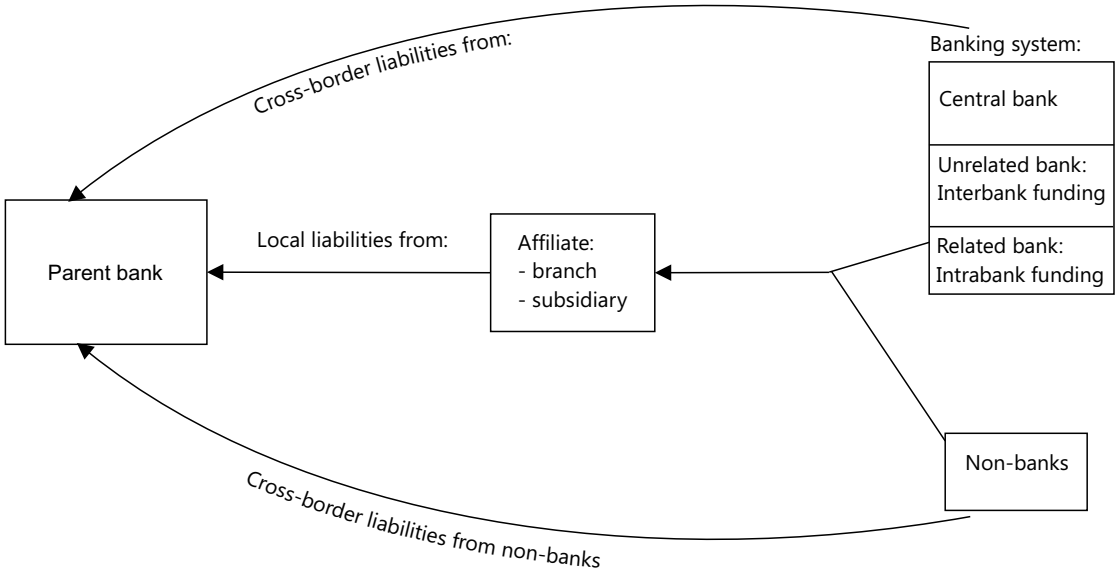
Annex – Additional details on the BIS international banking statistics (IBS)

The locational banking statistics measure claims and liabilities of banking offices resident in reporting countries. The locational banking statistics are compiled following principles that are consistent with balance of payments statistics, meaning that their compilation is based on the residence of entities. Moreover, the total amounts are not adjusted for intragroup positions between offices of the same banking group. The locational banking statistics also include historical data on the positions of banks by their nationality, defined by the country where their headquarters is located. These locational by nationality statistics include breakdowns of interbank positions in inter-office positions (e.g. positions vis-à-vis foreign offices of the same banking group) and positions vis-à-vis other banks (or unrelated banks). Hence, these statistics are particularly suited to the analysis of changes in the global funding of national banking systems, including their use of international interbank markets.

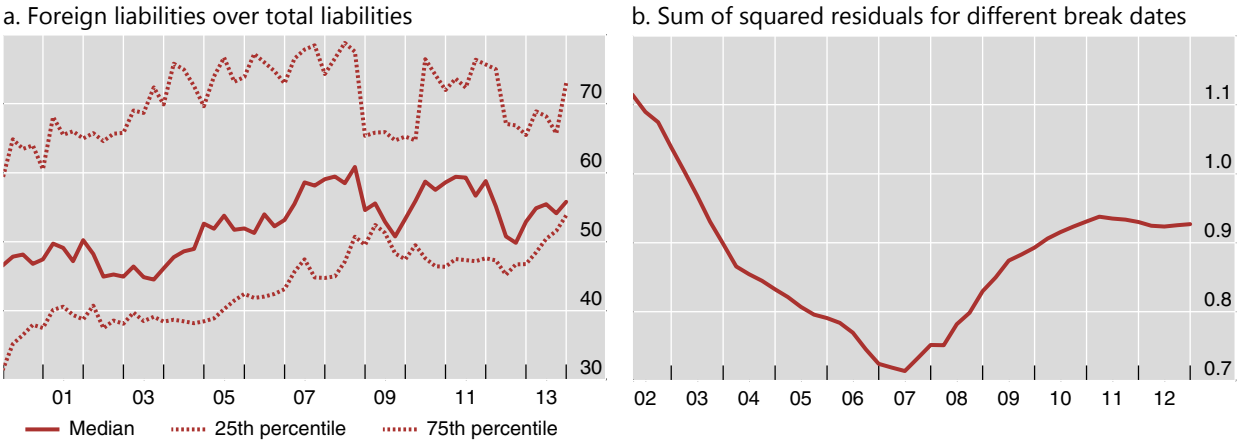
The consolidated banking statistics capture the worldwide consolidated positions of internationally active banking groups headquartered in reporting countries. These statistics are designed to analyse the exposure of internationally active banks of different nationalities to individual countries and sectors (Avdjiev et al., 2016). Thus, banks are classified only by nationality. The consolidated data include the claims of reporting banks' foreign affiliates but exclude intragroup positions, similarly to the consolidation approach followed by banking supervisors and in line with international accounting practices. Hence, the consolidated banking statistics are particularly useful to compare the global banking business models adopted by different national banking systems. These statistics are compiled in two different ways: by immediate counterparty and by ultimate risk. The immediate counterparty is the entity with whom the bank contracts to lend or borrow. Ultimate risk takes account of instruments that mitigate credit risk, i.e. that transfer the bank's credit exposure from one counterparty to another.

Foreign liabilities and their components **Figure 1**



Note: Parent banks can acquire foreign liabilities through branches and subsidiaries abroad (local liabilities) or directly from their headquarters (cross-border liabilities). We break down cross-border liabilities by lending sector. Foreign lenders can be central banks, unrelated banks (interbank funding), related banks (intrabank funding) or non-banks (mostly deposits).

Bank funding composition and structural breaks **Figure 2**



Note: The left-hand graph represents the ratio between foreign liabilities (domestic and cross-border) and total liabilities. The three lines indicate the median value, the first and the last quartile of the distribution. The right-hand graph shows the sequence of the sum of squared residuals obtained by introducing a break dummy into equation (8), while also adding leads and lags of first differences of the right-hand side variables. The most likely candidate for a structural break is the date where the series of sum of squared residuals attains its minimum (Bai, 1997, Kurozumi, 2002 and Carrion-i Silvestre and Sansó, 2006). The model is given by: $FL_{i,t} = LL_{i,t} + XBL_{i,t}^{b,rel} + XBL_{i,t}^{b,unrel} + XBL_{i,t}^{b,CB} + XBL_{i,t}^{nb}$.

Source: Authors' calculations.

Descriptive statistics **Table 1**

	Obs	Mean	Std. Dev.	Min	Max
Endogenous variables					
Foreign liabilities	672	2,208,200	1,584,825	177,631	6,364,350
Local liabilities	672	690,857	524,374	62,134	2,633,494
Cross-border liabilities	672	1,517,344	1,158,028	112,985	4,832,023
vis à vis banks	672	978,775	734,406	78,838	3,293,631
related offices	672	542,518	459,837	13,905	2,040,974
unrelated offices	672	380,322	299,837	32,896	1,768,014
central banks	672	55,935	50,925	1,374	268,649
vis à vis non-banks	672	495,566	429,319	30,055	1,985,434
Country-specific determinants (pull factors, borrowing country)					
Real GDP	672	705.36	903.35	64.78	3963.28
Three-month interest rate	672	2.31	1.71	-0.28	6.70
Tier 1 capital	672	187,681	174,656	17,279	925,170
Global determinants (push factors)					
VIX	672	21.91	9.46	10.79	59.98
Fed funds rate (1)	672	1.79	2.55	-1.99	6.63

Notes: The descriptive statistics are computed for the pooled sample of 12 countries over the period 2000:Q1–2013:Q4. The balance sheet variables are expressed in USD millions. Real GDP, real effective exchange rate and VIX are displayed as indices. Tier 1 capital is expressed in USD millions. (1) Effective federal funds rate for the period 2001:Q1–2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1–2013:Q4.

Unit root tests **Table 2**

	Maddala-Wu		Pesaran	
	Test stat	P-value	Test stat	P-value
Foreign liabilities	28.652	0.233	-0.794	0.213
Local liabilities	23.629	0.483	-0.526	0.299
Cross-border liabilities	26.837	0.312	-0.923	0.178
vis à vis banks	19.498	0.725	0.565	0.714
related offices	23.771	0.475	0.857	0.804
unrelated offices	13.813	0.951	1.665	0.952
central banks	17.706	0.817	-0.386	0.350
vis à vis non-banks	30.593	0.166	-0.198	0.422

Notes: The Maddala-Wu (1999) and the Pesaran (2007) tests are valid under the null that the series is non-stationary. A high p-value is evidence in favour of the presence of a unit root in the series. The Maddala-Wu test ignores cross-section dependence in the data. The Pesaran test allows for cross-section dependence in the form of a single unobserved common factor. All the test statistics are computed using ADF regressions with four lags and without a deterministic trend. All the variables are in logs.

Long-run relationships in bank funding models **Table 3**

	Dependent variable: Foreign liabilities		
	(I)	(II)	(III)
Local liabilities	0.291***	0.268***	0.303***
	(0.00691)	(0.00927)	(0.0256)
Cross-border liabilities	0.689***		
	(0.00768)		
Vis à vis banks			
Related offices		0.247***	0.229***
		(0.0115)	(0.0279)
Unrelated offices		0.137***	0.216***
		(0.0152)	(0.0401)
Central banks		0.0381***	0.0300***
		(0.00848)	(0.00509)
Vis à vis non-banks		0.236***	0.221***
		(0.0143)	(0.0198)
Break * Local liabilities	0.0305***	0.0573***	0.0762**
	(0.00758)	(0.0106)	(0.0373)
Break * Cross-border liabilities	-0.0371***		
	(0.00778)		
Break * Vis à vis banks			
Break * Related offices		0.0274***	0.0162***
		(0.00835)	(0.00214)
Break * Unrelated offices		-0.0365***	-0.0705**
		(0.0100)	(0.0270)
Break * Central banks		0.0297***	-0.000780
		(0.00863)	(0.0117)
Break * Vis à vis non-banks		-0.0571***	-0.0446**
		(0.0134)	(0.0221)
Break dummy	0.140***	-0.194*	0.644**
	(0.0403)	(0.102)	(0.294)
Observations	576	576	684
Break date	2007:Q2	2007:Q2	2007:Q2
Wald test statistics	24.95	27.87	17.26
P-value (Wald, k)	0.000	0.000	0.008

Notes: The sample includes quarterly data from 12 advanced economies over the period 2000:Q1 – 2013:Q4. The break interaction term with variable *x* is shown as Break ∗ *x*. The Wald test statistics and p-values are based on the null hypothesis that the break dummy and the interaction terms are jointly equal to 0. All the variables are in logs. HAC robust standard errors are reported in parentheses. All the regressions include country fixed effects and leads and lags of first differences of the explanatory variables. The coefficients in columns I and II are obtained using a dynamic OLS estimator. Therefore, they include leads and lags of the right-hand side variables. The coefficients in column III are derived using a mean group estimator, hence they allow both the constant and the slopes to be heterogeneous across countries. The larger number of observations of regression III is due to the lack of leads and leads of the right-hand-side variables. *** p<0.01, ** p<0.05, * p<0.1. Breakdown I: $FL_{i,t} = LL_{i,t} + XBL_{i,t}$; Breakdown II and III: $FL_{i,t} = LL_{i,t} + XBL_{i,t}^{b,rel} + XBL_{i,t}^{b,unrel} + XBL_{i,t}^{b,CB} + XBL_{i,t}^{nb}$.

Cointegration tests **Table 4**

	Breakdown I		Breakdown II	
	Test stat	P-value	Test stat	P-value
Pre-crisis: 2000:Q1-2007:Q1				
ADF panel	-5.28	0.000	-2.84	0.005
ADF group	-5.76	0.000	-3.63	0.000
t panel	-5.59	0.000	-3.27	0.001
t group	-5.95	0.000	-4.12	0.000
Crisis: 2007:Q2 – 2013:Q4				
ADF panel	-3.84	0.000	-4.21	0.000
ADF group	-5.12	0.000	-4.89	0.000
t panel	-3.30	0.001	-2.84	0.005
t group	-2.96	0.003	-3.41	0.001

Notes: test statistics are taken from Pedroni (1999). Panel statistics pool data along the within dimension, while group statistics pool data along the between dimension. All the statistics have an asymptotically standard normal distribution under the null hypothesis of no cointegration. A small p-value is evidence of cointegration. The pre-break tests are performed over the sample 2000:Q1-2007:Q1. The post-break tests are performed over the sample 2007:Q2 – 2013:Q4.

Tests for weak exogeneity from the cointegrating vector **Table 5**

	Δ. Real GDP	Δ. Three-month rate	Δ. Tier 1 capital	Δ. VIX	Δ. Fed funds rate (1)
L. Cointegration residual	-0.210***	0.736	-0.0397	1.076**	-0.599
	(0.0774)	(0.636)	(0.0984)	(0.455)	(0.526)
Observations	264	306	312	312	312
R^2	0.044	0.012	0.012	0.018	0.004

Notes: Each column of the table tests for the weak exogeneity of a different economic determinant with respect to the cointegrating relationship derived by estimating equation (7) (i.e. the long-run equation of Breakdown II) with leads and lags of the explanatory variables in first differences. If L.Cointegration residual is insignificant in one of the regressions, then there is evidence in favour of the weak exogeneity of that particular economic determinant. The sample includes quarterly data from 12 advanced economies for the period 2007:Q2-2013:Q4. All the variables are in logs, except the three-month interest rates and the Fed funds rate. HAC robust standard errors are reported in parentheses. All the regressions include country fixed effects. (1) Effective federal funds rate for the period 2007:Q2 – 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 – 2013:Q4. *** p<0.01, ** p<0.05, * p<0.1.

VECM estimates of λ and Ψ **Table 6**

	Δ. Foreign liabilities	Δ. Local liabilities	Δ. Cross-border liabilities			
			Vis à vis banks			Vis à vis non-banks
			Related offices	Unrelated offices	Central banks	
L. Cointegration residual	-0.202***	0.0528	0.0235	-0.222*	-0.331*	-0.739***
	(0.0688)	(0.0953)	(0.117)	(0.129)	(0.188)	(0.227)
Δ. Three-month rate	0.0475***	0.0441**	0.0449***	0.0441	0.0697**	0.0511***
	(0.0143)	(0.0195)	(0.0104)	(0.0309)	(0.0228)	(0.0139)
Δ. Tier 1 capital	0.365***	0.379***	0.306***	0.433**	0.0404	0.533***
	(0.0656)	(0.110)	(0.0712)	(0.159)	(0.0979)	(0.121)
Δ. Fed funds rate (1)	-0.0196**	-0.000865	-0.0322**	-0.0334	0.0613	-0.0617***
	(0.00830)	(0.0177)	(0.0134)	(0.0251)	(0.0350)	(0.0132)
# of quarters to go back to equilibrium	5	-	-	5	3	1
Observations	306	306	306	306	306	306
R^2	0.352	0.281	0.167	0.086	0.095	0.225

Notes: The model is a conditional panel VECM with 1 lag and with a set of weakly exogenous variable. The first row contains the estimate of the speed of adjustment λ while the remaining rows contain the estimates of the short-term parameters Ψ. The sample size includes quarterly data from 12 advanced economies for period 2007:Q2-2013:Q4. Tier 1 capital is in logs. HAC robust standard errors are reported in parentheses. All the equations of the VECM include country FE. (1) Effective federal funds rate for the period 2007:Q2 – 2008:Q4, Wu-Xia Shadow rate for the period 2009:Q1 – 2013:Q4. *** p<0.01, ** p<0.05, * p<0.1, $^{\lozenge}$ p<0.15

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