International banking: An empirical assessment of global financial intermediation in times of crisis

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Inaugural-Dissertation
zur Erlangung des Doktorgrades
der Justus-Liebig-Universität Gießen
Fachbereich Wirtschaftswissenschaften

vorgelegt am 16. August 2013

verteidigt am 14. Januar 2014

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I Introduction

With the outbreak of the financial crisis in mid-2007, a rather long period of growth in global financial markets came to a hold. While foreign claims of banks from countries reporting to the Bank for International Settlements (BIS) increased by almost 40% between 2003 and 2007, they declined by more than 10% in 2008 alone and have stagnated since then. One key factor which promoted this boom was financial innovation such as the securitization of assets and the trading of financial derivatives. These new financial products facilitated the transfer of risk underlying, for instance, a loan contract, to a third party. This fostered liquidity creation within banks and financial firms and opened up further leeway for investments in financial markets and for issuing loans to the real sector. Besides, many emerging countries accelerated the opening of their markets to foreign banks, in order to increase domestic competition and subsequently efficiency of their local financial system.

While financial markets became more and more global, market participants as well as regulators, such as banking supervisors, underestimated the risk associated with the new forms of international financial intermediation. The repackaging and reselling of assets, such as subprime mortgage contracts of house owners in the United States, had become highly complex, which suppressed the risk contained in holding this type of asset-backed commercial paper. Besides, banks carried out many investments via financial firms, whose risk exposure was in general not subject to banking supervision. Banks also conducted international lending and trading on financial markets via affiliates established in financial centers, such as the Cayman Islands or Luxembourg. The favorable legal and tax environment in these locations accelerated the growth of international banks and most likely encouraged risk-taking as well.

Not only in financial centers, the risk management of many financial players turned out to be insufficient as the financial crisis started to unfold. When the loans underlying many securitized assets defaulted, this triggered a wave of loss in value of many related securities, which was unexpected in its size and its potential to propagate quickly across asset types and country borders. This systemic crisis was possible because financial markets across the globe had become highly interconnected. Subsequently, increasing uncertainty about the value of financial assets, as well as growing mistrust among market participants, froze the banks' international funding markets. Thus, interbank lending, for example, was impeded, in particular across country borders. Despite the extensive liquidity support from central banks, banks retreated to a large scale from financial markets and cut back their international lending portfolio.

Against the background of this experience, banks as well as regulators are currently reshaping global finance. Banks that have established dependencies world-wide are reassessing the organization and the management of their banking conglomerates, after they have incurred substantial losses and are preparing for new regulatory rules. In order to foster financial stability, regulators have put more attention on systemic stability. Even small financial institutions can challenge this stability, if they play a key role in the global financial network. On this basis, regulators have, within a very short period of time, developed plans to limit the growth of large global banks

and demand much higher equity capital buffers from individual banks, in particular if they are important counterparties for other financial institutions. However, the regulator faces the challenge that global banks have become highly complex. Besides, regulation has to perform a delicate balancing act. While global financial stability has to be secured, the advantages of internationally integrated financial markets for the global economy, such as better access to finance and lower interest rates on loans, should be preserved. It is therefore of particular importance to understand how global banks are organized, how they make strategic decisions, and how they cope with financial stress.

This dissertation provides four empirical research papers, which contribute to a more thorough understanding of the determinants of international bank lending, on the organization of multinational banks, and on these banks' potential to transmit financial shocks within their organization and across country borders. The task requires a rather deep insight into the structure and development of individual banks' balance sheets over time, which becomes even more important as the group of internationally active banks is rather heterogeneous. This applies to the distribution of lending activity across foreign countries as well as to the modes of operation. While part of a banks' business with foreign counterparties is carried out by the headquarter on a cross-border basis, banks can also lend via affiliates which they establish abroad. Data, which allows analyzing these patterns on the level of the individual bank, is available within central banks, which collect these statistics for oversight purposes. This dissertation relies on the monthly data collected by the Deutsche Bundesbank from all banks registered in Germany. These banks report on a mandatory basis their domestic as well as their foreign business, carried out in part by their foreign affiliates. Next to individual balance sheet positions of all these bank entities, it is possible to identify counterparties by sector and country. This provides a particularly rich basis for the analysis of determinants that drive the banks' decisions, using panel regression techniques.

In the first paper of this thesis, entitled *"Foreign lending, risk aversion and the financial crisis"*, which is coauthored with Rainer Frey and Alexander Lipponer from the Deutsche Bundesbank, we investigate how German banks adjusted their long-term lending to firms located in more than 60 foreign countries in response to the outbreak of the financial crisis. Long-term lending, hence lending with an original maturity of more than one year, reflects the strategic commitment of banks to certain markets particularly well. After the US subprime market collapsed in mid-2007, banks started to reassess their investment strategies and to adjust their portfolios. For German banks, we can observe rather stable long-term lending abroad until the investment bank Lehman Brothers went bankrupt in September 2008, which led to increasing mistrust among participants of funding markets. Thereafter, German banks started to reduce their long-term lending to foreign firms.

Unlike earlier research in this field, we are able to address lending by German parent banks across borders and lending by these banks' affiliates established abroad at the same time. Besides, we are able to identify changes in the stock figures collected which arise from loan decisions of banks and not from valuation effects such as exchange rate movements. This allows a more accurate assessment of banks' portfolio adjustments. Key questions addressed in this paper include whether supply-side (bank-related) factors or demand-side (country-related) factors determined the decline in long-term lending to foreign firms. Besides, we analyze the role of local affiliates for the stabilization of loan supply to the real sector in foreign countries.

We find that supply-side factors, relative to demand-side factors, played a more important role regarding the adjustment of the loan portfolio after the collapse of Lehman Brothers. In particular, banks whose risk aversion increased in response to the crisis events reduced their foreign lending more. This increase in risk aversion is reflected by growing core capital ratios and tightening credit standards reported by German banks, as well as rising loan interest margins between firm and interbank lending rates on the home market. Overall, lending abroad decreased more than domestic lending, which reflects a certain refocus on the home market, possibly because informational asymmetries grew larger outside the domestic market. Foreign affiliates of German banks, which are a means of reducing this lack of local information, do not per se stabilize lending to foreign countries. However, if foreign affiliates are more involved in issuing loans abroad, then the lending is more sensible to local demand. This could be an argument for host countries to encourage the establishment of affiliates by foreign banks, rather than to receive only cross-border loans from these institutions. Supporting this, we find that banks actively managed their loan portfolios during the crisis. They redirected the cross-border part of the lending away from markets that experienced larger declines in GDP growth.

The second paper in this thesis carries the title *"Intra-bank flows as a mirror of multinational banks' priorities and resources in the crisis"*, and is coauthored with Rainer Frey. We focus on lending by foreign affiliates of German banks, and analyze the relevance of different funding sources for the stabilization of loan supply during the period of financial stress after the bankruptcy of Lehman Brothers. One key contribution of this paper to the existing literature consists of measuring to which extent each individual foreign affiliate relies on funds provided by the German parent bank. We then assess how the reliance of an affiliate on intra-bank funding affects its lending behavior during the crisis. Besides, we are able to evaluate whether competition for these internally provided funds has increased between different affiliates of a parent bank, as overall available funds within the banking group became more scarce due to incurred losses on financial markets.

The evaluation of this competition effect is strongly influenced by the specific lending portfolio of different affiliates. We analyze to which extent lending to foreign firms is carried out by German banks' local affiliates or by affiliates lending across borders. By pointing to the existence of these "hub affiliates", and by assessing their role within the banking conglomerate, we provide another contribution to this field of research. We find that competition for internal funds within multinational banks has indeed increased in the course of the financial crisis, but this was not the case if local and hub affiliates joined their efforts in providing loans to firms of a specific country.

Furthermore, affiliates that relied to a large extent on parent bank funding experienced a decline in lending during the financial crisis. This can be interpreted as a sign of parental support for affiliates which had to cover large losses, and had to partly downsize or reorganize their lending activity despite of support received from the parent bank. It fits into that picture, that more profitable affiliates and those relying to a greater extent on deposit funding, hence on funds collected from firms and private individuals, were better able to keep their lending to foreign firms stable. A larger reliance on parent bank funding also renders foreign affiliates more dependent on the stability of the parent banks' funding portfolio as well as on the parent banks' decision on whether to prioritize domestic lending over foreign lending. Hence, in stress

periods, lending by foreign affiliates of German banks is influenced by increasing competition for internal funds within the banking group, as well as by priorities set by the parent bank. Information on how the structure of global banks may impact loan supply of individual foreign affiliates is of particular importance to countries in which firms rely heavily on financing via foreign owned banks. This is for example the case in many of the emerging economies of Central and Eastern Europe.

The third paper in this dissertation, entitled *"Repo funding and internal capital markets in the financial crisis"* draws attention to the different roles of branches and subsidiaries within multinational banks. While branches are affiliates which are consolidated into their parent banks' balance sheet for regulatory purposes, subsidiaries are own legal entities and fulfill regulatory requirements in their host countries. My paper draws on previous research by CETORELLI AND GOLDBERG (2012)[1], who demonstrate that US global banks distinguish in their liquidity management between affiliates functioning as "core investment" locations, and those representing "core funding" locations. In times of distress, core investment locations, meaning affiliates which play an important role for a bank's foreign lending, are more sheltered from the withdrawal of liquidity by their parent banks. Core funding locations refer to those affiliates which are strong in funding their operations locally. In the study on US banks being hit by a funding shock, these are urged to provide additional funds to the rest of the banking organization via internal capital markets.

In my study, I show that the probability of belonging to the one or the other group of affiliates largely depends on whether an affiliate operates as a branch or a subsidiary. Within German banking groups, branches are more likely to be protected from liquidity shocks hitting the parent bank, which reflects their important role within the banking organization in distributing loans to foreign firms. Subsidiaries, on the contrary, are rather used as core funding locations, probably because they dispose of a larger network of depositors and investors, from which they can obtain additional funds in times of distress.

Furthermore, this study shows that the allocation of the core funding and core investment roles to foreign affiliates of German banks changed in the course of the financial crisis, which was, for banks, mainly a crisis in funding markets. I investigate crisis events which limited German banks' use of one of their most important short-term funding sources, namely the sale and repurchase (repo) market. During the crisis, particular concern arose regarding the value of securities used as collateral in these secured short-term funding contracts. While earlier in the financial crisis, banks with a particularly high exposure on repo markets were protecting their foreign branches from this funding shock the more they represented core investment markets, the banks were no longer able to shelter these branches from a withdrawal of liquidity as the crisis progressed. By contrast, the use of subsidiaries as core funding markets lasted longer. This insight into the different roles of branches and subsidiaries within global banks may influence the discussion on whether host countries profit from encouraging foreign banks to establish subsidiaries rather than branches in their jurisdictions.

The longer the crisis lasted, the less German multinational banks withdrew funds from their foreign affiliates. This may have been due to central banks' rescue measures such as the expansion

1 Cetorelli, N. and L. Goldberg (2012). Liquidity management of U.S. global banks: Internal capital markets in the great recession. *Journal of International Economics*, 88, 299–311.

of the Eurosystem's collateral framework. These interventions eased the pressure on banks that were strongly affected by the unexpected drying up of short-term funding via repo markets.

The dissertation is completed by the paper entitled *"German banks in financial centers: How risky is their business?"*. This descriptive study makes an important contribution to the analysis of German banks' foreign activities carried out via affiliates. While the other papers in this thesis concentrate mainly on the relevance of affiliates as lenders to the foreign real sector, this paper puts a spotlight on affiliates located in financial centers, such as the Cayman Islands or Luxembourg, where business is concentrated on the financial sector. The role of financial centers in global banking sharply increased before the financial crisis. Claims of BIS reporting banks on these countries, which are often called "offshore" financial centers due to their large degree of interaction with non-residents, grew by around 60% between 2003 and 2007. The favorable tax and legal system of financial center countries allowed global banks to establish very large and complex organizational structures. These conglomerates made, in part via their affiliates in financial centers, large off-balance sheet investments in US subprime assets. Many empirical studies include lump-sum control variables for characteristics of banks located in financial centers, but do not address these attributes in more detail.

In this study, the balance sheet structure of financial-center affiliates is compared to that of affiliates located outside financial centers, with the aim of determining the role of these affiliates for German multinational banks. Furthermore, first steps are provided towards assessing the risk incorporated in these affiliates' business models. Financial center affiliates are particularly exposed to disruptions on short-term funding markets, as they constantly have to roll over large amounts of short-term debt. As a consequence, they required larger support from their parent banks during the financial crisis compared with affiliates located outside financial centers. Besides, affiliates in financial centers are more likely to spread distress arising from financial markets, as they mainly interact with other financial centers.

Branches as opposed to subsidiaries in financial centers represent the highest balance sheet risk for parent banks among all types of foreign affiliates. In view of the fact that they dispose of the thinnest buffers of equity capital among all types of affiliates, their consolidation into the parent banks' balance sheet for regulatory purposes makes parent banks more susceptible to financial stress stemming from these entities. At the same time, financial center branches are, compared to the other types of affiliates, more likely to suffer from, for example, shortfalls in funding. This is due to the fact that they are highly involved in the trading of financial products, a business that is generally much more volatile than traditional bank lending. New accounting rules implemented at the end of 2010 reveal the large extent to which financial center branches in particular had been involved in off-balance sheet investments, which are not overseen by banking supervision. The risk taken by both financial center branches and subsidiaries should be of even greater interest to both parent banks and supervisors, as German banks' financial center affiliates are, on aggregate, four times as large as their non-financial center affiliates.

The remainder of the thesis is structured as follows: Chapters II to V represent the four research papers, whose contents were outlined in this introductory chapter, and which constitute this dissertation. All four papers are individual contributions to the existing literature on international banking, and are therefore presented as such. Chapter VI concludes.

II Foreign lending, risk aversion and the financial crisis

This paper is based on:

Düwel, C., R. Frey, and A. Lipponer (2011). Cross-border bank lending, risk aversion and the financial crisis. Discussion Paper, *Series 1, Economic Studies*, No 29/2011, Economic Research Centre, Deutsche Bundesbank.

It is submitted to the *Review of International Economics*.

The paper was presented at the following refereed conferences:

- *26th Annual Congress of the European Economic Association*, University of Oslo, Oslo (Norway), August 25-29, 2011.
- *Jahrestagung des Vereins für Socialpolitik 2011*, University of Frankfurt, Frankfurt am Main, September 04-07, 2011.

The paper was furthermore presented at the following non-refereed workshops:

- *FMI Doctoral Seminar*, University of Giessen, Giessen, June 21, 2011.
- *9th Bundesbank MiDi-Workshop*, Deutsche Bundesbank, Frankfurt am Main, November 17, 2011.
- *Bundesbank Conference on "The costs and benefits of international banking"*, Eltville, October 18, 2011.
  (presented by co-author)

Foreign lending, risk aversion and the financial crisis

December 2012

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Abstract

This study investigates the determinants of the provision of foreign loans by internationally active German banks. For the period from 2002 to 2010, we look at quarterly long-term lending based on transactions (excluding valuation effects) by the largest 69 German banking groups to the non-bank private sector of 66 countries. We show that lending by parent banks is based almost exclusively on supply-side determinants, in particular on bank-specific factors. However, foreign countries' demand and risk characteristics become more relevant when loans are granted by banks' affiliates located abroad. Focusing on risk measures such as the parent bank's ratio of Tier I capital to risk-weighted assets, we find that rising risk aversion among banks curbed foreign lending during the financial crisis, especially at a later stage following the collapse of Lehman Brothers. However, we find a threshold at around 11% of the Tier I capital ratio above which an increase in the ratio does not curb lending anymore.

Keywords: foreign lending, banks, financial crisis.

JEL Classification: G21, F23, F34

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The paper represents the personal opinions of the authors and does not necessarily reflect the views of the Deutsche Bundesbank.

This paper has benefited from valuable comments by Carmela D'Avino, Jörg Breitung, Claudia Buch, Ulrich Grosch, Heinz Herrmann, Thomas Kick, Cordula Munzert, Winfried Rudek, Peter Tillmann and the participants of the Bundesbank Workshop on The Costs and Benefits of International Banking in Eltville on 18 October 2011. All remaining errors and inaccuracies are our own. We gratefully acknowledge financial support from the University of Giessen (C. Düwel).

1 Introduction

During the financial crisis, the stability of the banking system and the provision of bank loans to the real economy attracted the particular attention of policymakers and banking supervisors. Increases in risk positions and banks' risk perception, which were triggered by the crisis, led to a change in the behavior of banks. A deleveraging process was initiated and internationally active banks increasingly cut back their foreign activities in particular. Banks' business models abroad may differ from those at home, may have other goals and a narrower scope, and may follow a global lending strategy rather than put the financing needs of the local economy first.

The drivers of the foreign lending behavior of the banks are various and complex against the background of the crisis and it is a challenge to draw a comprehensive picture. This paper aims at filling a gap in the analysis of strategies and adjustments in bank lending beyond the home market. We add to the literature by analyzing different patterns in foreign lending by both the parent banks and their foreign affiliates using confidential micro data on German banking groups. In order to avoid valuation effects, which were especially large during the crisis and have nothing to do with the banks' strategical decisions, we are the first to consider only transaction-based changes in lending. Before and during the financial crisis, we identify the most relevant determinants for lending abroad. We weigh the importance of supply factors predominantly at the bank level against the macroecomic situation in the host countries. Compared to other studies, we put more emphasis on analyzing the impact of risk stemming from both the bank's balance sheet and the general economic conditions, and on disentangling these effects.

The question of the riskiness of a bank points to its solvency, which we measure in line with a large part of the literature by the bank's capitalization. Assessing the banks' risk positions through capital ratios, our study ultimately asks whether relatively low capitalized banks which operate across borders came under pressure due to funding difficulties and responded to this with accelerated deleveraging of loans abroad in the crisis.[1] Capital markets attributed some risk to large banks even before the financial crisis, which was reflected in bank-specific subordinated debt spreads (see SIRONI (2003) who addresses large European banks). However, before the financial crisis, a below average capitalization limited the fundraising possibilities mainly for small banks. KISHAN AND OPIELA (2000) found for the US that the small, rather weakly capitalized banks had to reduce their lending upon restrictive monetary policy shocks. In a broader context, HEMPELL AND SORENSEN (2010) analyze different components of the Eurosystem's bank lending survey and also provide evidence that banks' ability and willingness to supply loans is a crucial determinant for lending in the euro area. ATLUNBAS ET AL. (2009) mention that a bank's ability to supply loans depends on its risk position in the context of financial innovation and market funding becoming more important. Besides, during the financial crisis, a limited number of German banks took recourse to rescue measures of the German government and to liquidity support of the US Federal Reserve Bank. BUCH ET AL. (2011) show that these

1 DE HAAS AND VAN HOREN (2012) provide empirical evidence for this relationship in the case of syndicated lending. AIYAR (2012) finds that funding difficulties abroad feed back on domestic lending.

measures had a dampening effect on banks' deleveraging in foreign assets in a related research project (see also ROSE AND WIELADEK (2011) for the UK).

Earlier research has identified several macro- and microeconomic determinants of foreign bank lending. In our study, we put a special focus on the bank-specific supply factors for parent and affiliate lending. We concentrate on parent banks' characteristics as determinants for lending abroad of both the parent bank and of its foreign affiliates.[2] Although affiliates partly refinance themselves on the local market (MCGUIRE AND TARASHEV (2008)), German banks' foreign offices tend to rely to a great extent on intra-group funding, when compared with foreign affiliates of other nationalities (MCCAULEY ET AL. (2010)). In the literature, characteristics of parent banks mostly appear as control variables for parent bank health, which influences affiliate lending via the internal capital market.[3] DE HAAS AND VAN LELYFELD (2006) and (2010) find that eg lower solvency, liquidity and profitability of parent banks can lead to lower credit growth of multinational banks' subsidiaries located in Central and Eastern European countries.[4] However, these studies focused on either parent bank foreign lending or affiliate in-country lending in order to avoid the bias produced by financial intra-bank relations. Such an approach neglects the crucial role of the lending channel - cross-border or local, which is linked to the question whether the existence of a local affiliate extends the information stance on a local market (DE HAAS AND VAN HOREN (2013)).

We capture all channels of loan provision abroad by considering parent as well as affiliate lending. The influence of local macroeconomic developments may depend on the way banks operate. If banks do not serve foreign economies by any in-country presence, overall local demand factors may not be very relevant and the loan allocation may depend more on deal/borrower-specific factors. This may apply, for instance, to syndicated loans or loans to multinational companies (see PEEK AND ROSENGREN (2000) and BUCH (2000), who also points out that regulatory changes at the EU level have rendered banks' foreign country presence within the EU obsolete in many cases). On an aggregate level, BUCH (2000) empirically investigates the relevance of macroeconomic factors of destination countries for German banks' foreign lending and confirms that the impact of these variables depends on the bank group entity, which may either be the banks' headquarters or the banks' subsidiaries and branches located abroad. PEEK AND ROSENGREN (2000) descriptively demonstrate that in Latin American countries, growth of loans directly provided by foreign parent banks is reduced in times of crisis, while foreign bank subsidiaries have a stabilizing impact. Considering only one part of the banking group, JEANNEAU AND MICU (2002) on the aggregate level and DE HAAS AND VAN LELYFELD (2006) and (2010) on the bank level identify a number of pull factors (local country characteristics) and push factors (banks' home country characteristics) which impact on lending by banks' subsidiaries abroad. Using quarterly bilateral BIS data, which is aggregated on the country level, BLANK AND BUCH (2010) find that banks foreign assets are positively influenced by trade linkages but

2 In a study on lending by affiliates of multinational banks from the EU, NAVARETTI ET AL. (2010) find that the internal capital market at least complements external sources of funding. In financially integrated areas such as the EU, internal capital markets are particularly active.

3 See, for example, HOUSTON AND JAMES (1998) for US banks and their national affiliates, BUCH ET AL. (2009) for identifying a productivity pecking order among German banks' foreign offices, and CAMPELLO (2002) and CETORELLI AND GOLDBERG (2012) for demonstrating monetary policy transmission channels.

4 CETORELLI AND GOLDBERG (2011) find that the larger the pre crisis dollar-vulnerability of a country's aggregate banking system, the lower was its post crisis lending growth to emerging economies by parent banks and (to a lesser extent) by affiliates. However, the authors cannot analyze different reactions of banks from the same country, as they use aggregate data from BIS reporting countries.

are reduced upon increasing interest differentials between the home and the foreign economy. In a panel framework, BUCH ET AL. (2010) conclude that macroeconomic shocks influence the development of bilateral cross-border bank assets. This strand of literature was based on research by CALVO ET AL. (1993) and CHUHAN ET AL. (1998), who investigated the vulnerability of emerging countries arising from international financing. On the macro level, they contrast supply-side factors with demand variables abroad.[5]

Overall, our findings reveal that bank-specific supply-side factors are the key determinants of foreign lending, while local macroeconomic characteristics are less important. Better performing and more diversified banks are more likely to extend credit abroad. Rising levels of risk aversion among parent banks - measured in several ways - play a crucial role for downward adjustments in long-term loans abroad, both by the parent bank itself and by its affiliates. Higher risk aversion has a negative impact on lending to foreign firms, which came to light during the financial crisis following the collapse of Lehman Brothers. In addition, cross-border lending carried out directly by the parent bank was shifted away from countries whose economic growth suffered most during the crisis. Macroeconomic characteristics of potential destination countries become more relevant if, in addition to direct credit allocation by the German parent bank itself, the bank carries out a significant part of its business through the channel of affiliates located abroad. If this is the case, external financing needs and general economic risk in destination countries are both relevant for loan adjustments. The financing of an economy by loans from multinational banks' local affiliates may thus be more favorable for the economy than financing from a foreign parent bank far away. This might be an argument for the countries' governments to foster direct investment by foreign banks.

The paper is organized as follows. Section 2 describes the data, section 3 describes our empirical model. In section 4 we discuss the results, section 5 provides several robustness checks for data selection and regression analysis. Section 6 concludes.

2 Data

2.1 Sample definition

We base our analysis on data that combine several micro and macro datasets in a unique way. To identify the various possible factors influencing German banks' foreign lending, we include four basic sets of variables: first, bank-specific micro data describing supply-side issues; second, general supply-side factors relying on German macroeconomic variables; third, macroeconomic variables capturing primarily the foreign demand side; and, fourth, foreign country risk factors.

We restrict our loan transaction data at the bank level to long-term loans to the non-bank private sector (henceforth "private sector"), ie loans with an original maturity of more than one year. Long-term loans account for more that 85% of German banks' total foreign lending and hence represent a major part of their foreign lending activity. This strong strategic focus parallels German banks' business in their home market. They play the predominant role in the financing

5 Based on empirical analysis, HAOUAT ET AL. (2012) argue that foreign bank penetration of Latin American countries has had the positive effect of reducing real credit volatility, thus stabilizing loan provision to the real sector.

of firms, as capital market funding of enterprises in Germany is less widespread than in Anglo-Saxon countries. [6]

Starting with the largest 100 German banks and then selecting a subsample by excluding promotional banks and foreign-owned banks produces a sample of 69 banks. Owing to a number of bank mergers in the period under review, which we handle by backward integration, we have to include figures for 140 banks overall.[7] Figure 2 in the appendix depicts the dynamics between 2002 and 2010 of total and long-term foreign loans vis-à-vis the foreign private sector, which we cover by our selection of banks.

As a further reduction of complexity - partly driven by the availability of macroeconomic data - we selected 100 countries with the largest amounts of German foreign loans outstanding. This selection of banks and countries still covers roughly 90% with regard to German banks' total foreign lending to the non-bank private sector. Hence, the complexity of the analysis is reduced without any loss of generality of the results.[8] Furthermore, we restrict our analysis to foreign private-sector loans to countries that do not host important financial centers. This type of business is widely driven by financial deals with special purpose entities as well as by banks' proprietary trading in portfolio instruments, which is why we exclude it from our analysis. For the classification of offshore financial centers we make use of the definition of the Financial Stability Forum, the predecessor of today's Financial Stability Board, published in 2000 and in addition we exclude the UK and the US from our sample since they represent large financial hubs for German banks.[9] This reduces the number of countries in our sample to 66. Overall, our sample then covers close to 40% of total German bank lending to the foreign non-bank private sector. Table 1 in the appendix contains the list of selected countries, the number of German banks in our sample which supply foreign loans to these countries (as of December 2009) as well as the total volume of their exposure.

2.2 Micro data

Micro data on German banks' foreign lending transactions stem from monthly statistics on the external positions of German banks.[10] All German parent banks, their affiliates (subsidiaries and branches) abroad as well as subsidiaries of foreign banks operating in Germany are covered in the statistics.[11] The data allow us to analyze German banks' foreign assets and liabilities by asset category, maturity, country, sector and currency. The dataset also enables us to separate

6 An important reason to exclude short-term lending is that it includes trade financing, for which the determinants are different and cannot be accurately explained with our approach. See Figure 1 for the development of overall private sector loans of German banks and Figure 2 for the development of long-term versus total foreign loans to the foreign private sector by the German banks used in this study.

7 For specific banks that transferred a large proportion of their foreign business to another bank within the same group but outside Germany, all subsequent observations following such an event were dropped in order to handle these drastic changes in the reports on foreign operations, which cannot be explained by our general model.

8 As for Serbia and Montenegro, which split in 2006, most explanatory variables only exist for the former union, we take these countries as one for the purpose of this analysis.

9 However, we conduct a robustness check in section 5 of the paper, which includes the two countries in the analysis. For the complete list of countries defined as financial centers, see Table 1.

10 For a detailed description, see FIORENTINO ET AL. (2010).

11 In contrast to branches, subsidiaries have their own legal status. The activities of subsidiaries located abroad are reported by the German parent bank if it is the majority shareholder. There are no exemption limits for the reports.

transaction-based changes from price or exchange rate-related changes of the stock figures collected. Therefore, we can draw on effective transaction changes of long-term loans to the private sector on the parent level, on the affiliate level, and for the level of the consolidated group. The study aims at explaining changes in the consolidated foreign private lending activities of the banking groups (henceforth German banks). These figures therefore do not include inter- or intra-bank loans. Since we can calculate the importance of loans distributed by affiliates abroad relative to loans supplied directly from Germany, we can additionally work out the relevance of the funding channel for firms abroad (directly by the parent bank vs. via affiliates). In this way, we also obtain a measure of the relative intensity of a German bank's presence abroad and its impact on lending to the respective foreign country.[12]

In Figure 2 in the appendix, we plot the development of standard stock data for foreign private-sector loans issued by German banks versus the development of the series solely based on transactions. Most of the pre crisis gap between the actual stock data and the transaction-based data can be explained by the appreciation of the Euro vis-à-vis foreign currencies over this period of time. While the purely transaction-induced dynamics are still roughly similar to those of the actual stock series until 2009, we observe a considerable devaluation of loans since then. This can be attributed to the financial crisis: While the Euro depreciated slightly, especially write-downs on loans increased. As we exclude these effects, our approach allows a more accurate assessment of the impact of the financial crisis on the strategical changes of German banks' lending behavior abroad.

This data set has been supplemented by information on the German parent banks from the monthly balance sheet statistics and the yearly profit and loss account statements. For the risk assessment of individual parent banks, our data set has been augmented using non-official, confidential banking supervision data. All micro data used in this analysis are collected by the Deutsche Bundesbank.

2.3 Macro data

For the macro variables, we have added data from the IMF's International Financial Statistics (IFS) and World Economic Outlook (WEO). Additional data come from the German balance of payments statistics (Deutsche Bundesbank). Market data are from Bloomberg and Datastream. Aggregate data on the general perception of credit standards for long-term private-sector loans by German banks are taken from the German part of the Bank Lending Survey (BLS) to complete the picture. All variables are quarterly data expressed in real terms. For more details on specific variables, especially their original frequency and some summary statistics, see Tables 2 and 3 in the appendix.

12 We only observe the overall volume of loans issued in a country by all German banks' foreign affiliates. The data on the consolidated group do not allow us to distinguish between affiliates located in the destination country itself and affiliates which supply loans to a country but are located in a different (possibly adjacent) foreign country. This view on the data, however, accounts for the fact that banks often create an affiliate "hub" in one country and then serve customers in surrounding countries from there, instead of opening up affiliates in every single market of interest. These "hubs" are then specialized for monitoring markets and issuing loans in a certain region, such as Latin America or Eastern Europe.

3 Empirical model

3.1 Estimation approach

German banks' activities in foreign countries have become quite substantial and now account for nearly one-third of total loans to the non-bank private sector (see Figure 1 in the appendix). Owing to its scale, we hence study a banking system for which foreign private-sector lending is highly relevant, not only to the banks' profits and their risk positions but also to the funding of foreign economies to which these banks - alongside multinational banks from other countries - supply credit. In one out of five observations in which a German bank holds a positive stock of foreign private-sector loans, lending is carried out by both the parent bank and foreign affiliates simultaneously.[13] It is hence important to study both channels through which loans may be supplied. Focusing on only one of the two may lead to an inadequate assessment of the relevance of micro- and macroeconomic determinants of foreign lending.

In focusing on the realized volume of private-sector long-term loans, we observe an equilibrium of supply *and* demand for this type of lending or we observe demand *or* supply if rationing occurs on one side. We therefore evaluate the relevance of both supply and demand-side factors to determine the driving forces behind foreign lending.

As explained above, supply and demand-side factors are best described by four sets of variables which are illustrated in Figure 3 in the appendix. Supply-side determinants rely on bank-specific micro data and on macroeconomic data related to the bank's home country. On the demand side, we have to rely on macro data, as no information on the loan recipient is available. We distinguish between variables which indicate the foreign country's demand for bank loans, and factors representing macroeconomic risk abroad. If a German bank is present abroad via affiliates, the activity level in the respective countries is probably greater and may be based on more detailed information on local conditions. We then expect that the country's demand and risk factors play a larger role. In case of no local presence and thus less country-specific information, risk factors like stock market volatility may also be relevant for the parent banks.

The complexity of the issue requires the estimation of at least three equations to isolate the effects of the different factors. First, we concentrate on the impact of all variables on the loans granted by the bank as a whole and account for presence in foreign countries in the form of affiliates. Thus, we can write the following equation:

$$\begin{aligned}\Delta l_{ikt} &= \alpha_0 + \alpha_1 Bank_{it-1} + \alpha_2 GenHome_{t-1} + \alpha_3 \textit{FrgnDemand}_{kt-1} + \alpha_4 \textit{FrgnRisk}_{kt-1} + \\ &\quad \alpha_5 \textit{Affiliate}_{ikt-1} + \eta_i + \gamma_k + \varepsilon_{ikt} \qquad (1)\end{aligned}$$

with

- $i = 1, ..., N$. N being the number of banks in the sample, $k = 1, ..., K$, K the number of foreign countries, and $t = 1, ..., T$ the time period covered,
- Δl_{ikt} are the real volumes of transaction-induced changes in long-term lending to the private sector from bank i to country k at time t,

13 The correlation between the amount of foreign lending and having an affiliate in the same country amounts to 26%.

- $Bank_{it-1}$ is a vector of bank (i)-specific supply factors,
- $GenHome_{t-1}$ are general macroeconomic supply factors related to the home country,
- *FrgnDemand*$_{kt-1}$ are demand factors in foreign country k,
- *FrgnRisk*$_{kt-1}$are risk factors in foreign country k,
- *Affiliate*$_{ikt-1}$ is the amount of business carried out in country k by affiliates located abroad as a share of total long-term loan allocation of bank i to country k at time $t-1$. This *Affiliate relevance* variable can vary between 0 and 1,[14]
- η_i stands for bank fixed effects,
- γ_k are country fixed effects, and
- ε_{ikt} is the idiosyncratic error.

In our second specification, we focus on the two different channels through which a foreign country's demand and risk may affect foreign lending. For this purpose, we interact the macroeconomic demand and risk variables with our variable representing the relevance of affiliates in granting loans to the private sector of a certain country. This leads to the following equation:

$$\begin{aligned}\Delta l_{ikt} \;=\; & \alpha_0 + \alpha_1 Bank_{it-1} + \alpha_2 GenHome_{t-1} + \alpha_3 \textit{FrgnDemand}_{kt-1} + \alpha_4 \textit{FrgnRisk}_{kt-1} + \\ & \alpha_5 \textit{Affiliate}_{ikt-1} + \alpha_6 \textit{FrgnDemand}_{kt-1}\, x\, \textit{Affiliate}_{ikt-1} + \\ & \alpha_7 \textit{FrgnRisk}_{kt-1}\, x\, \textit{Affiliate}_{ikt-1} + \eta_i + \gamma_k + \varepsilon_{ikt} \qquad (2)\end{aligned}$$

The estimated coefficients α_3 and α_4 measure the impact of foreign demand and risk factors on lending via the direct lending channel from the parent bank to the foreign private sector, while α_6 and α_7 indicate the differing relevance of the foreign country's macroeconomic determinants for the indirect lending channel via affiliates (under consideration of their relative importance).

In our third specification, we try to capture the impact of the financial crisis on the adjustment of long-term loans abroad. In particular, we are interested in the effect of the crisis on bank-specific factors as well as on the relevance of demand and risk factors in the destination countries. We interact all regressors from the second specification with a crisis dummy ($Crisis_{t-1}$) which equals 1 if $t \geq$ 2007Q3, and 0 otherwise. Within the financial crisis, we additionally distinguish time periods before and after the collapse of Lehman Brothers as this event marks a turning point in banks' positions and strategies. Thus for a final specification, we shall split the crisis dummy variable into two, one shall equal 1 if 2007Q3 $\leq t \leq$ 2008Q2 and the other shall equal 1 if $t \geq$ 2008Q3.

All explanatory variables are lagged by one quarter in order to avoid simultaneity problems. We do not include the lagged dependent variable as a regressor. In spite of many other studies which aim at explaining loan provision, we do not operate with stock or growth data which would require including the lagged dependent variable on the right hand side. Instead, we explain the amount of *transaction-based changes* in long-term loans, for which there is no reason

14 It also equals 0 if bank i does not supply any loans at all to country k (either by the parent bank or by affiliates located abroad). The quality of the results remains unchanged in a robustness check which, for the assessment of the affiliate relevance, excludes banks that do not supply any loans at all to country k.

why, a priori, it should depend on the amount of transaction-based changes realized in previous periods. We confirmed this fact by testing the relevance of the lagged dependent variable as a regressor: It turns out to be insignificant. All regressions cover the time period from 2003Q1 to 2010Q4 (32 quarters).[15] For each bank-country combination, we observe, on average, a period of 27 quarters in which a bank held a positive stock of long-term loans vis-à-vis firms in that country.[16]

3.2 Explanatory variables

3.2.1 Bank-specific and general supply-side determinants

Our vector of bank-specific supply factors, *Bank*, consists of five variables: the parent bank's *Change in core capital ratio*, the parent bank's *Interest income over equity*, its *Capital market activity*, *Bank size*, and its long-term lending to the domestic private sector (*Lending at home*). Table 4 provides an overview of the expected signs of the regression variables presented in this section.

With respect to risk aspects, we assume that an increase in the level of risk aversion of a parent bank, measured by a positive *Change in core capital ratio*, goes hand in hand with reduced lending to foreign firms. The core capital ratio which we use here is calculated by setting a bank's Tier I capital in relation to its risk-weighted assets.[17] The minimum regulatory requirement for the core capital ratio is 4%. The mean ratio reported by the banks in our sample amounts to 9%, which is clearly above a critical value (see Table 3 in the appendix for summary statistics). There are only three observational points in our sample where banks have reported a core capital ratio below 5%, and there is no observation below the minimum ratio of 4%. All banks in our sample are thus sufficiently capitalized, which makes it possible to interpret upward changes in the core capital ratio as driven by banks' risk aversion. The core capital ratio can be used to measure the level of capitalization of a bank within the CAMEL profile applied in banking supervision.[18]

A bank with relatively high *Interest income over equity* may have an efficient system of screening firms and assessing other markets and may hence look for additional opportunities like lending abroad.[19] Moreover, these banks have a larger financial scope and can therefore afford to take more risks. We evaluate the role of parent banks' interest generating performance not only for lending which is done by the parent bank itself, but also for lending carried out by its affiliates, as we look at the change in loans granted by both.[20]

15 According to the F-tests, all groups of variables are, in their respective specifications, jointly significant.

16 As mentioned in footnote 14, in a robustness check, we exclude banks that do not supply any loans at all to a country. The quality of the results remains unchanged.

17 We specifically rely on risk-weighted assets as in our opinion they best mirror the risk incorporated in a parent bank's balance sheet total. In a study on the implications of monetary policy on German bank lending, EHRMANN ET AL. (2001) also points this out.

18 CAMEL stands for Capitalization, Asset Quality, Management, Earnings and Liquidity. Other measures not including risk-weighted assets (Tier I capital to total assets, equity to total assets, etc.) are also being used in the literature to assess capitalization (see the discussion by KICK ET AL. (2010)). For example, BUCH ET AL. (2009) find that banks with a higher ratio of Tier I capital to total assets are less likely to open up affiliates in foreign countries. Once abroad however, their activities seem to be more stable.

19 In earlier studies, several measures for the profitability of a parent bank were found to have a positive impact on loan growth of affiliates abroad (BUCH ET AL. (2009), DE HAAS AND VAN LELYFELD (2006) and (2010)).

20 We use the average ratio of interest income to equity over the past four quarters in order to assess the performance of a bank over a longer period of time, and thus avoid issues of reverse causality.

Diversification of strategic activities reduces banks' dependency on specific types of business. We therefore suspect that banks with more diversified portfolios and a strategy that goes beyond traditional lending on the home market are more stable in their provision of loans. Therefore, we include *Capital market activity* as a regressor, which is defined as the amount of security claims to total assets of the parent bank.[21]

We use two variables to measure the information stance and a bank's possibilities of gathering information about foreign markets. First, we include *Bank size* for which an increase proxies for a reduction in relative information costs. In line with OLIVERO ET AL. (2011), we measure the size of a bank as the amount of total assets of the bank which exceeds the average balance sheet total of all banks at the respective observational point in time.[22] In addition, more information about a foreign market can also be acquired by the local presence of affiliates. We therefore consider the *Affiliate relevance* to distributing loans to a certain country. We calculate this variable as the percentage of loans granted by affiliates located abroad in total long-term loans provided by a bank to a certain country. By empirical checks, we can rule out that affiliates are per se more relevant in large foreign countries.[23]

Our bank-specific supply factors include a measure of real change in long-term lending by the parent bank to the bank's home country private sector, *Lending at home*. The relationship between lending to the foreign private sector and *Lending at home* is a priori unclear. From earlier studies on bank lending to the German private sector, we know that real lending growth is positively related to stronger economic activity at home (DEUTSCHE BUNDESBANK (2009)). Banks could then either, at least partly, trade-off lending abroad against lending at home, and seek investment opportunities outside their home country only if economic activity at home is weak.[24] Or, banks could extend their credit allocation simultaneously at home and abroad following increasing demand for loans at home and, possibly, increasing profits on banks' balance sheets which allow the banks to take more risks abroad.

In addition to bank-specific supply-side variables, we consider two general supply factors related to the bank's home country, here Germany, denoted by the vector $GenHome$ in the regression specification. First, we calculate the *Home interest margin* as the average bank-wide interest margin of the lending rate over interbank refinancing costs in Germany (for details, see Table 2); hence it is a measure of the banks' perceived lending risk on the home market. Second, we add a direct measure of broad risk perception present within the German banking sector to complete this picture. Assessments of credit standards which are set for long-term loans by German banks are reported to the Bank Lending Survey (BLS). A rising indicator means that credit standards have been tightened, ie there is a lower willingness to lend, eg because banks require more collateral when issuing loans or are concerned about their refinancing costs. We therefore include the BLS sub-category of *Tightening credit standards* as a result of a worsening of the *bank's liquidity position* as an additional measure of the bank's risk position.

21 We take the average capital market activity over the past four quarters to better assess the bank's strategy.
22 Thus, it can be avoided that the results are distorted by a pure scale effect, since it might be the case that large banks in general carry out large loan transactions.
23 The correlation between foreign country real GDP and affiliate relevance amounts to no more than about 7%.
24 GIANNETTI AND LAEVEN (2012) investigate international syndicated lending during the financial crisis and find an increasing home bias of lenders' loan origination.

3.2.2 Foreign country demand and risk

The vector *FrgnDemand* combines three variables which measure the demand for bank loans in potential destination countries and the attractiveness for foreign banks to provide loans abroad.

First, we use *Fixed capital formation* relative to a *destination country's GDP* to proxy for changes in the demand for bank loans. As firms expand their business to make additional profits, they require funding for their investments.[25] Second, internationally active banks have the possibility of directing their supply of loans to especially promising markets. We therefore assume that the provision of loans to one country suffers if its economic development lags behind the economic growth experienced in other countries to which the respective bank supplies loans (*Other countries' real GDP growth relative to local,* which is bank-, country- and time-specific). On the basis of a similar approach by DE HAAS AND VAN LELYFELD (2010), we compute this regressor as the weighted average of real GDP growth measures found in all countries (except the country in question) to which the respective bank supplies loans, relative to real GDP growth observed in the respective country. As weights, we use the volume of lending to a country relative to the bank's total foreign loans.

Third, with *Bilateral trade openness* (share of imports from Germany in total imports of a country), we address the effect of international trade on foreign lending, for which we expect a positive effect.[26] Trade relationships can reduce potential informational asymmetries between the lending and borrowing countries and can encourage the provision of loans.[27]

However, the attractiveness of foreign markets for German banks does not only depend on the market potential but also on related risks. We combine country-risk factors in the vector of regressors *FrgnRisk*. Business cycle risk, or the instability of the financial market, is reflected, for instance, in the national *Stock market volatility*. We expect higher volatility to have a negative impact on lending to the local private sector. In addition, the stability of a country and its economy may also be assessed by the sustainability of its government borrowing, an aspect which has received growing attention during the financial crisis. Therefore, we include in our estimations a rough proxy for this aspect in the form of the ratio of general government *Liabilities over GDP*.[28]

Beyond these indicators for macroeconomic risk, *Exchange rate volatility* can hint to additional risk on the macro-level, even though the signal can be blurred by the maintenance of exchange rate regimes (JEANNEAU AND MICU (2002)). However, as foreign lending is partially undertaken in local currency in the absence of a complete currency hedge, there is a direct risk to

25 We believe that fixed capital formation is a better way to capture loan demand, especially from non-bank firms, than GDP growth. A four-quarter average of fixed capital formation over GDP is used in order to better assess market potential. We also do not rely on lending by domestic banks (line 22d of the IFS statistics) as a proxy for loan demand. First, this variable does not capture any lending activities by other foreign banks. Second, likely competition in lending between local and foreign banks could distort the accuracy of the variable as a proxy for demand.

26 Many studies include Foreign Direct Investment (FDI) flows as explanatory variables for foreign lending (eg BUCH (2000)). We find that FDI is highly correlated with bilateral trade. We therefore agree with JEANNEAU AND MICU (2002) and do not include both factors in the regressions. As a large part of bilateral trade is closely related to FDI, because it stems from intra-firm trade of multinational firms, we decided to concentrate on bilateral trade figures as an explanatory variable.

27 This interpretation of the variable *Bilateral trade openness* is supported by the fact that short-term loans and thus trade credit are excluded from the analysis.

28 The variable is averaged over four quarters in order to match the dimension in which we proxy for demand.

a creditor stemming from exchange rate volatility. On the aggregate level, BUCH (2000) has already found a negative impact of exchange rate volatility on cross-border lending by German banks' headquarters. We shall test this result with our disaggregate data. Table 4 summarizes the expected impact on foreign lending of the variables presented.

4 Results

We present the regression results of our analysis in Tables 5 and 6 in the appendix. Columns (1a) and (1b) of Table 5 represent the baseline model. It assesses the overall relevance of micro- and macroeconomic factors to banks' decisions to adjust long-term loans to firms abroad. In column (2) of Table 5, we take into account that the impact of macroeconomic developments of destination countries on lending depends on the channel of loan provision (via the parent bank or via affiliates located abroad). In Table 6, the regression specification in column (3) investigates how the financial crisis influences the effects of supply- and demand-side factors on foreign lending. Finally, column (4) in Table 6 divides the effects of the financial crisis into before and after the collapse of Lehman Brothers.

4.1 Predominant role of supply-side factors

Our estimation results suggest that supply-side factors are the crucial determinants of the realized variation in long-term loans. Our baseline regression, reported in columns (1a) and (1b) of Table 5 reveals that, overall, German banks' adjustment of long-term loans to firms abroad barely responds to credit demand conditions in the destination countries.

Supply-side factors play the predominant role in the allocation of long-term loans to firms abroad and the internal risk position of a parent bank turns out to be highly relevant. All variables which indicate an increase in the level of a parent bank's risk aversion are significant and show the expected signs. We find a negative relationship between rising core capital ratios (*Change in core capital ratio*) and credit provided abroad (see column (1a) in Table 5). This is in line with a large core capital ratio, standing, within the CAMEL profile of the bank, for a high degree of risk aversion. Furthermore, *Tightening credit standards due to the bank's liquidity position*, as measured by the BLS, lead to a reduction in cross-border lending by German banks.

In column (1b), we enlarge upon the role of the core capital ratio, defined as Tier I capital over risk-weighted assets, by adding the level of the ratio as well as the interaction term between change and level to the right-hand side of the regression. The *level of the core capital ratio* by itself does not play a significant role in the adjustment of long-term loans. However, the negative effect of rising core capital ratios on lending becomes smaller, the larger the level of the core capital ratio is (the interaction term between the change and the level of the ratio is positive and significant). This supports the idea that a bank with a high level of core capital ratio might rather conduct a stable loan supply policy and an additional rise in the ratio cannot be interpreted as an increase in its risk aversion. It is rather the case that banks with large core capital ratios might increase their ratio to signal stability to the market (KICK AND KOETTER (2007)). Computations of the average marginal effects at different levels of the core capital ratio (not reported) suggest

that there is a threshold at around 11% above which an increase in the ratio does not curb lending anymore (the mean ratio in our sample amounts to about 9%, see Table 3).

Our baseline regression results show, furthermore, that banks which have been generating larger amounts of *Interest income relative to their equity capital*, and which therefore have a larger financial scope, can afford to take more risks and provide more long-term loans to firms abroad. Moreover, diversified strategic activities of the parent bank have a positive impact on a bank's long-term loans to the private sector abroad. Our variable *Capital market activity* is positive and significant, as expected.

Furthermore, the variable *Home interest margin* is negative and significant. We consider two interpretations for this variable. There could be a certain trade-off between supplying loans to the home market compared with the foreign market. The other line of argument sees in the interest margin an overall market perception of the risk incorporated in long-term lending to the private sector. The larger the interest margin, the higher the premium that banks charge in a more risky environment. Considering the significantly positive relationship between lending abroad and *Lending at home*, the second interpretation turns out to be more accurate, as there does not seem to be any significant trade-off between banks' long-term loan allocation abroad and at home.

Macroeconomic demand and risk in destination countries play only a very small role in the adjustments of long-term private sector loans by German banks. *Fixed capital formation over GDP*, which indicates the increasing need for external financing of the foreign economy, is insignificant, just like *Other countries' real GDP growth relative to local*, other countries being those to which the respective bank supplies loans as well. *Bilateral trade openness* has no effect on the overall lending of a bank. Moreover, an increasing risk in general macroeconomic developments of the destination country does not negatively affect overall credit supply by German banks: *Stock market volatility* is insignificant. The poor performance of the exchange rate volatility as an indicator of risk might be due to our lack of information on the currency in which loans are provided, which, in turn, might depend on the way lending activities are distributed between the parent bank and an affiliate located abroad. Furthermore, we do not detect any negative impact of a country's indebtedness on foreign lending (*Liabilities over GDP*). According to this finding, increasing external debt is not foremost perceived as an indicator of macroeconomic risk.

While the bank's overall lending hardly reacts to macroeconomic conditions in destination countries, we can detect a fostering impact of presence abroad in the form of affiliates. The estimated coefficient of the *Affiliate relevance* variable is positive and significant, while another possible measure for lower informational asymmetries, the *Bank size*, is insignificant. Presence abroad allows local contact with customers and seems to provide the bank with better information than administrative instruments such as extensive screening routines which large banks often have at their disposal.

Overall, these results show that German banks' business model of supplying long-term loans to firms is different abroad from the situation at home. While higher GDP growth in Germany is a key signal that banks issue more long-term loans to domestic firms (DEUTSCHE BUNDESBANK (2009)), German banks do not seem to react to business cycle developments in other countries. It is therefore probable that in general the bank's activities abroad depend more on

factors linked to a specific borrower and/or deal. Overall, they do not satisfy the financing needs of a broad range of firms in the foreign country.[29]

4.2 Demand and country risk impact through foreign affiliates

In the regression reported in column (2) of Table 5, we show that the impact of foreign country-specific demand and risk on lending gains momentum when we distinguish the two channels through which the loans are provided to foreign firms. At the same time, supply-side factors remain important.

The interpretation focuses on the interaction terms between demand as well as risk variables and the *Affiliate relevance*. Most foreign country-specific factors become significant when they are conditioned on the relevance of affiliates in providing loans to the specific country. At the same time, the remaining coefficient of *Affiliate relevance* turns out to be insignificant. This allows us to make the outcome of our baseline estimation more precise. The positive impact of a larger *Affiliate relevance* in destination countries, which we detected in the baseline specification, does not stem from the share of loans per se which is handed out via affiliates, but is linked to a better perception of local macroeconomic demand and risk in the case of local presence.

More specifically, while local affiliates which serve a certain foreign country react to this country's economic development (the overall effect of *Fixed capital formation over GDP* for increasing *Affiliate relevance* is positive), the German parent bank does not adjust loans. The same is true for *Bilateral trade openness*. It positively affects foreign lending with the growing importance of affiliate presence abroad. This result could hint to the fact that affiliates reduce asymmetric information problems which might otherwise curb lending. Besides, affiliates abroad also take into account the country's risk situation to a larger extent than direct lending from the German parent bank does. This is demonstrated by the outcome of significantly negative coefficients when the *Affiliate relevance* variable is interacted with the *Stock market volatility*.

Conversely, the loan adjustment realized by the German parent bank takes business cycle movements in alternative destination countries into account. The estimated coefficient of the non-interacted part of *Other countries' real GDP growth relative to local* is negative and significant. This result signals that foreign lending can, within the direct channel, be shifted to destinations in which market developments are most promising. Within the indirect channel (lending via affiliates), this is not the case (see variable *Other countries' real GDP growth relative to local x Affiliate relevance*). Interestingly, direct lending via the parent bank reacts positively to a country's indebtedness (*Liabilities over GDP*). While this result is, at first glance, surprising, it is possible that governments stimulate economic growth by extensive spending, inducing an expansion in production, thereby increasing firms' demand for loans from both local and foreign banks.

With regard to the parent bank's supply factors, the results from the baseline specification still hold: Banks whose degree of risk aversion increases (measured by the *Change in core capital ratio*) and which have been less successful in generating interest income in the past (ie have

29 In comparison, we tested in unreported regressions whether lending by local banks in the different countries is, on aggregate, related to proxies for local demand and risk. We were able to confirm that local banks' lending to the private sector across the countries reacts to demand and risk factors similar to those to which domestic bank lending reacts in Germany. Hence, German bank lending to these countries does indeed differ from the behavior of local banks.

lower *Interest income over equity*) are less likely to extend credit abroad. Banks which have more diversified strategic activities (ie are more active on capital markets) are more likely to raise their supply of long-term loans to the foreign private sector. Increasing risk in the German home economy (indicated by a large *Home interest margin*) has a negative effect on foreign lending, while *Lending at home* and abroad generally go in the same direction.

We thus conclude that German banks satisfy, to some extent, the external financing needs of those foreign countries' economies to which they supply a relevant share of their overall loan volume via affiliates. The more business is conducted through offices in foreign countries, the more these affiliates behave like local banks in the market in question. Of course, the local presence of a German bank in the form of affiliates is in itself an indication of its deep interest in the given market.

4.3 The impact of the financial crisis on determinants of foreign loans

The third and fourth specifications of our model (see Table 6) investigate the impact of the financial crisis on the relevance of the determinants of foreign lending by interacting with crisis dummies. The results in Table 6 should be read in the following way: In column bloc (3), entitled "Crisis", column (3/1) presents the estimated coefficients for the respective variables listed, without interaction with the crisis dummy, thus capturing the period before the crisis. column (3/2) reports the estimated coefficients of the variables interacted with one single crisis dummy (which equals 1 from 2007Q3 onwards). In column bloc (4) "pre- vs. post-Lehman", column (4/1) reports the pre crisis results. Column (4/2) contains the variables interacted with the pre Lehman crisis dummy (which equals 1 from 2007Q3-2008Q2). Finally, column (4/3) reports the estimated coefficients of the variables interacted with the post Lehman crisis dummy (equaling 1 from 2008Q3 onwards).

By interacting the explanatory variables with only one dummy over the crisis period (column bloc (3)), we are already able to gain some insight into the way the financial crisis changed the relevance of determinants for foreign lending. However, the bank-specific and macroeconomic conditions at an early stage of the crisis differed substantially from the situation after the turning point marked by the collapse of Lehman Brothers. By splitting the crisis period into two stages, one before and one after the collapse of Lehman Brothers, we learn that the far-reaching event of the investment bank's collapse led to cross-border loan supply suffering from rising levels of risk aversion among banks. With the insolvency of Lehman Brothers, risk perception changed, since a major international financial company went into bankruptcy and this had not been prevented by a government bailout. The event triggered a sharp increase in volatility on the capital markets as well as a wave of write downs in balance sheets and a deterioration in the parent banks' risk positions. Therefore, splitting the crisis into two sub-periods enables us to better assign the effects to a certain phase of the crisis.

The volume of German banks' foreign loans shrank significantly during the financial crisis. We observe a reduction in German banks' foreign lending activities starting with the third quarter of 2008 (see Figure 1). Our results suggest that both supply and demand factors were responsible for this development. With respect to the bank-specific supply-side factors, we find that a *rising core capital ratio*, implying a parent bank's stronger risk aversion, impacts negatively on the

supply of foreign loans, and this effect actually stems from the second crisis period (see column (4/3), lower part of the table). Further indicators of the banks' stance vis-à-vis risk do not loose relevance during the financial crisis. *Tightening credit standards due to liquidity position* reported by the banks in the BLS turns out to be negative and significant (columns (3/1) and (4/1)), while the interactions with all crisis dummies are insignificant. Likewise, banks' general risk perception, measured by the *Home interest margin*, continues to affect foreign lending negatively throughout the whole crisis period.

There is a mitigating effect of *Bank size* on the reduction of long-term loans during the crisis. According to this finding, larger banks were more likely to stabilize their business abroad during the first stage of the crisis, ie in the run-up to the collapse of Lehman Brothers (see second figure for *Bank size (relative)* in column bloc (4)). This might be due to large banks disposing of more resources to counterbalance growing losses at the time from the subprime crisis.

With regard to local macroeconomic determinants, the interaction with the broader crisis dummy in column bloc (3) reveals the trade-off which internationally active banks face and which results in adjustment processes, especially in times of distress. The first set of estimated coefficients interacted with the crisis dummy may be interpreted as the impact on the parent banks' cross-border lending (the direct channel). The interaction term between the crisis dummy and the variable *Other countries' real GDP growth relative to local* is negative and significant (column (3/2)). This means that the potential of parent banks to redirect their lending to the most promising markets or, as during the crisis, to markets in which the economic downturn is less pronounced, becomes most obvious during the crisis. During this period of distress, credit allocation to one country suffered increasingly if it grew more slowly than the average of all other countries to which the bank supplied loans as well. For a better illustration of this outcome, the stand-alone effect on long-term lending of a high value of *Other countries' real GDP growth relative to local* is compared to the effect stemming from a low value of *Other countries' real GDP growth relative to local*.[30] The difference between the average impact of a high versus a low value of the variable can be calculated by multiplying the high and low values with the estimated coefficient (see Table 6, column (3/2)). We derive the following result: If a country has a comparably low real GDP growth then the average long-term credit flow to this country is about 11% lower. This result underlines the significant recourse of the parent bank to redirect credit flows in the crisis to the most promising markets within its country portfolio.

As the previous results (see section 4.2) already suggested, there are significant differences in the impact of macroeconomic demand and risk variables on foreign lending via the direct and the indirect channel. For the indirect channel, *Stock market volatility* plays a negative role for lending before and during the crisis (*Stock market volatility x Affiliate relevance* in column bloc 3). At the same time, neither the direct nor the indirect channel of foreign loan provision react negatively to exchange rate fluctuations, another indicator of risk (see column (4/2) *Exchange rate volatility* and *Exchange rate volatility x Affiliate relevance*). This result is consistent with the findings of a companion paper. DÜWEL AND FREY (2012) provide evidence that foreign affiliates of German banks to a substantial portion fund themselves locally, making them, to a large extend, independent from exchange rate fluctuations vis-à-vis the Euro.

30 A high value is defined as the average value of *Other countries' real GDP growth relative to local* beyond the 75th pctl. of the distribution. A low value is defined as the average value of *Other countries' real GDP growth relative to local* below the 25th pctl. of the distribution.

A final interesting result can be found for the estimated coefficient of *Bilateral trade openness* within the indirect channel of foreign lending (ie interacted with the *Affiliate relevance* variable). Lending continues to profit from *Bilateral trade openness* throughout the crisis, the more affiliates are involved in providing loans. Hence, tight international links prior to the crisis positively affect lending also during the financial crisis, when most economies experienced rough distortions. Thus in the crisis, the reduction of loan supply by German banks is less pronounced for economies which have tight trading links with Germany.

5 Robustness checks

Test on the validity of local demand and risk measures

We perform a robustness check on the validity of the set of macroeconomic variables which assess country specific demand and risk in the regressions. For this purpose, we replace all country specific macroeconomic variables with country-time fixed effects and rerun the econometric analysis. The quality of our results regarding the significance of bank-specific determinants of foreign lending does not change. Two conclusions can be drawn from this: First, the estimations we provide do not suffer from omitted variable bias as we select local macroeconomic variables in order to assess the relevance of local demand and local risk which influence foreign lending decisions. Second, all of the bank-specific determinants which we identify as crucial for the adjustment of foreign loans are robust to changes in the set of macroeconomic variables included in the regressions.

Extension of the country sample by the US and the UK

Our sample of destination countries for German foreign bank lending excludes - among other countries - the United States as well as the United Kingdom. These two countries host important financial centers and are therefore classified by the IMF as jurisdictions with offshore financial centers. Without doubt, both countries are also large retail markets for foreign bank lending to non-financial firms. Unfortunately, the data does not allow a distinction to be made between loan recipients who may be part of the respective country's financial center and those borrowers who are part of the real economy. Thus, we opted to exclude both countries from our regressions.

However, due to their relevance, we also investigate the impact on the results when both countries are included (results are reported in Table 7): While bank-specific determinants for foreign lending, such as the banks' risk aversion, maintain their relative and absolute importance, the relevance of macroeconomic developments in destination countries is affected. In the early stage of the crisis, parent bank lending appears to react more strongly to stock market volatility and exchange rate volatility (see in Table 7 column bloc (4), column (4/2)). Parent banks' recourse to redirect their lending to more promising markets remains significant (signaled by a negative coefficient of *Other countries' real GDP growth relative to local* in the crisis period, specifically post Lehman). The result that affiliate lending reacts more strongly to local demand and risk throughout the whole sample period continues to hold. Finally, the inclusion of the US and the UK cancels out the parallel development of *Lending at home* and foreign lending.

All these results stress that lending to countries with financial centers is to a large extend different from lending to predominantly real economies. Credit flows to countries with important financial centers are strongly driven by channeling funds to and from special purpose vehicles, which may be non-bank parts of the banking group itself. As a consequence, the previous outcome regarding local demand and risk determinants for foreign bank lending as well as the relationship between lending at home and foreign lending is blurred when the US and the UK are included in the regressions.

Loan data based on transactions versus loan stock data

In unreported regressions, we tested the outcome of our analysis if stock data (including valuation effects) rather than transaction-based data for lending abroad are used. The use of stock data makes supply-side determinants less relevant. Especially some of the key variables of the bank's risk assessment in lending activity, like the interest margin on the home market, become irrelevant for lending. Moreover, the use of stock data affects the results above more strongly within the crisis period. This supports the presumption that the presence of devaluation effects related to exchange rate changes and write-downs on loans in the stock data variations leads to an overestimation of the crisis' impact on banks' strategic behavior.

6 Conclusions

The paper addresses the motivation for German banks' foreign long-term private sector financing. As our sample also includes a substantial time span of the financial crisis, we are able to address lending strategies and to assess bank-specific and macroeconomic risk in view of the current crisis. The management of risks in a severe financial crisis is not only important for the bank itself, it is also relevant to the macroeconomic stability of countries whose firms rely on loans from foreign banks. To gain a deeper insight into the adjustment processes during the crisis, we split this period into two stages with the break marked by the collapse of Lehman Brothers. This allows our analysis to be more flexible with respect to potential discontinuities in macroeconomic and bank-specific risk conditions over the time horizon of the crisis.

Loans to foreign firms may be granted directly by the German parent bank, whereas large banks, in particular, keep affiliates in major foreign markets and distribute loans via this channel. We are able to address both channels of foreign lending. We are the first to work on the bank level with solely transaction-induced changes in loan provision to the foreign private sector. This data is combined with other bank-specific variables to test the relevance of supply-side factors for foreign lending by German parent banks and their foreign affiliates. We add macroeconomic demand and country risk variables known from the literature. The use of transaction-induced data on long-term lending is found to be key in revealing the importance of bank-specific determinants on the supply side. This is especially true for the period of the financial crisis when write downs in banks' balance sheets as well as exchange rate-related changes drove the stock data of foreign loans to a large extent and thus obscure the strategic adjustments.

Our findings strongly support the relevance of supply factors for the provision of loans by German banks abroad. Bank-specific variables play a crucial role. First and foremost, the parent

banks' stance vis-à-vis risk has major implications for their foreign business. An increase in risk aversion among German banks, which we can observe during the financial crisis - especially after the collapse of Lehman Brothers - is accompanied by a reduction in the supply of foreign loans. We show that risk measures applied in this study - increasing core capital ratios, tightened credit standards reported by German banks, and large loan interest margins between firm and interbank lending rates on the home market - have a negative impact on lending abroad. However, for the core capital ratio, we find a threshold at around 11% above which an increase does not curb lending anymore. We also find that expansion of credit abroad and lending to the home private sector tend to occur in parallel.

Local country variables which include broad demand and risk indicators for the foreign economies show only limited importance for German banks' overall foreign lending. However, if a German bank maintains affiliates abroad which fulfill an important role in channeling funds to firms in foreign markets, macroeconomic characteristics of these foreign economies become relevant. In this case, German banks' lending abroad depends on foreign macroeconomic demand, measured by fixed capital formation relative to GDP. For the cross-border lending carried out by parent banks directly, we find that during the crisis it suffered in markets which grew significantly less than the average economy to which the bank supplied loans. Thus the crisis reveals that this business is redirected to especially promising or, during the financial crisis, less shrinking markets. The funding of the economy by foreign banks' local affiliates may thus be more favorable for a country than the financing by a foreign parent bank from afar. This might be an argument for the country's government to foster direct investment by foreign banks.

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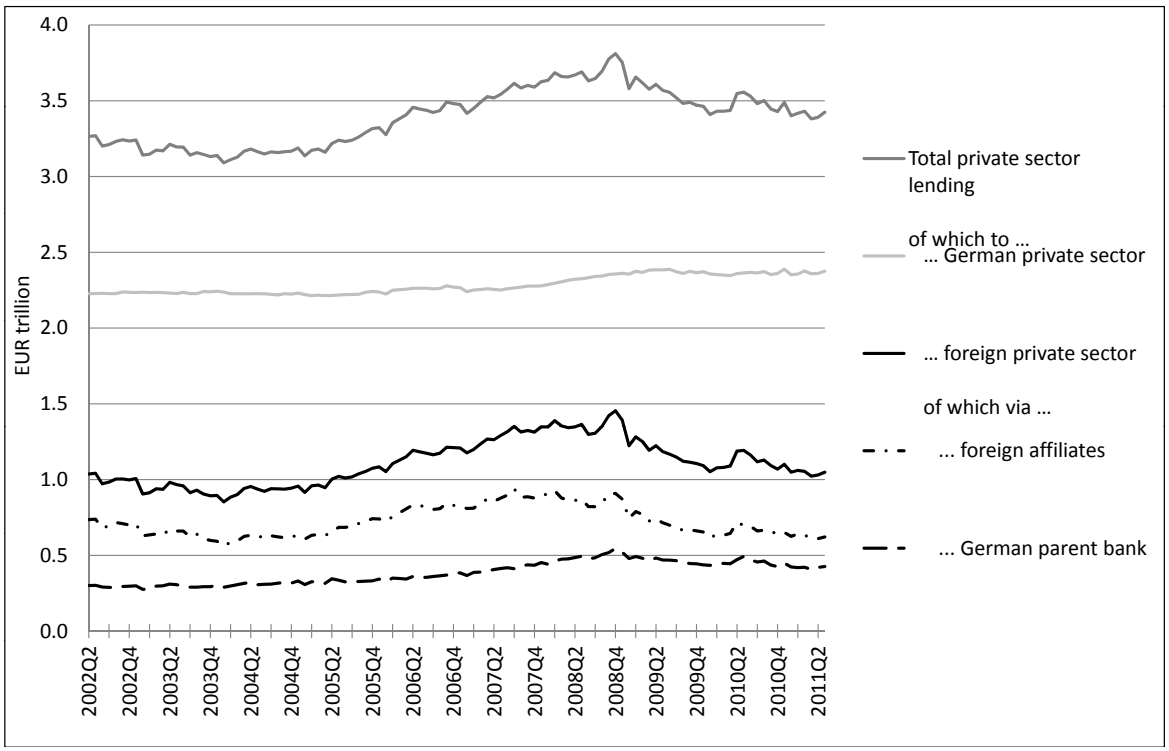
Appendix

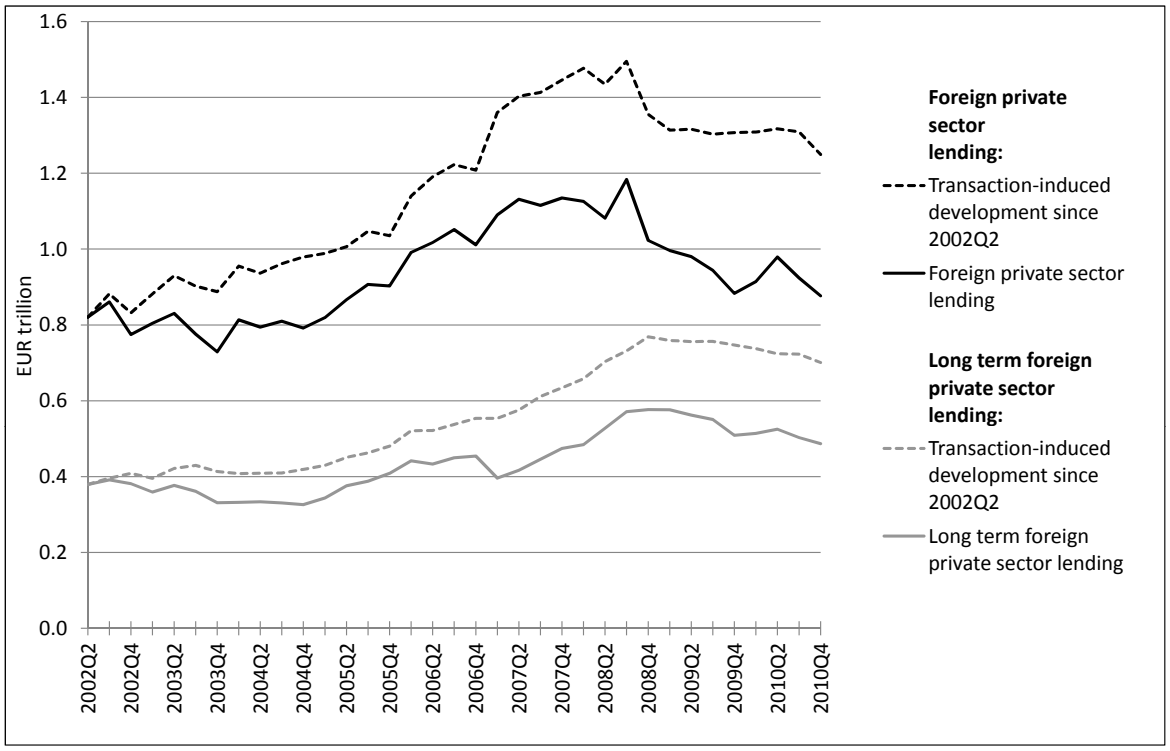
A Figures

Figure 1: Overall non-bank private sector loans of German banks



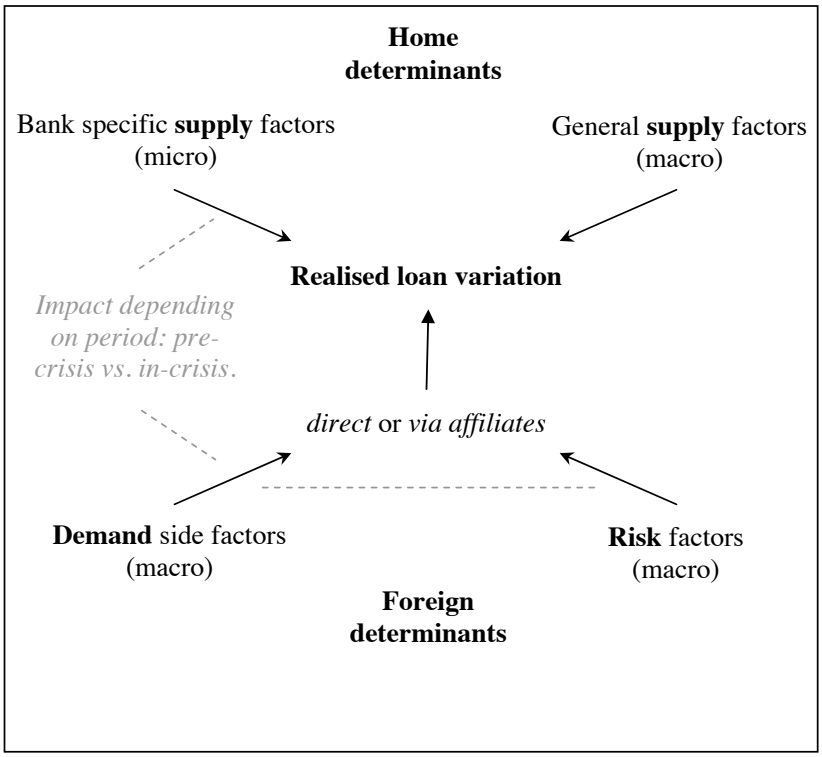
Source: Deutsche Bundesbank.
This graph depicts overall private sector lending to Germany and to all foreign countries by the German banking system. The series are based on monthly observations reported to the Deutsche Bundesbank by the German banks and their affiliates located abroad. (See section 2 for details of the term “affiliates”.)

Figure 2: Transaction-induced versus stock development in foreign non-bank private sector loans issued by selected German banks



Source: Deutsche Bundesbank.
This graph is based on the the sample of 69 banks which are used for the analysis in this paper. The sample covers 84% of total foreign private sector lending by the German banking system. (For details of the selection of banks, see section 2.) The underlying monthly series have been transformed into quarterly series. Dashed series represent our own calculations: Transaction-induced changes in foreign lending are added to the stock of foreign loans of German banks vis-à-vis the foreign private sector observed in 2002Q2.

Figure 3: Variable sets



B Tables

Table 1: List of countries

	Country	Number of German banks active in cross-border lending*	Volume of foreign lending by the largest 69 German banks (in Euro)*	Share of affiliate lending in total foreign lending*
1	United States (US) **	69	243,233,952	0.74
2	United Kingdom (UK) **	69	166,362,224	0.75
3	France (FR)	68	40,632,784	0.44
4	Spain (ES)	67	38,021,832	0.75
5	Italy (IT)	63	37,185,544	0.96
6	Netherlands (NL)	69	35,802,408	0.33
7	Poland (PL)	53	22,814,714	0.70
8	Australia (AU)	58	14,887,369	0.92
9	Japan (JP)	44	14,504,422	0.80
10	Denmark (DK)	60	12,300,106	0.34
11	Sweden (SE)	63	10,788,323	0.38
12	Russian Federation (RU)	47	10,775,946	0.35
13	Hungary (HU)	50	10,367,725	0.72
14	Canada (CA)	60	8,250,127	0.76
15	Belgium (BE)	65	8,137,535	0.41
16	Norway (NO)	61	6,829,931	0.42
17	Portugal (PT)	57	6,790,016	0.78
18	Turkey (TR)	59	6,582,169	0.18
19	Greece (GR)	60	6,259,976	0.33
20	Austria (AT)	67	5,174,791	0.17
21	Czech Republic (CZ)	53	4,948,317	0.45
22	India (IN)	38	4,018,714	0.84
23	United Arab Emirates (AE)	54	3,736,370	0.67
24	Mexico (MX)	41	3,343,853	0.56
25	Finland (FI)	45	3,324,064	0.39
26	Iceland (IS)	24	2,443,195	0.80
27	Saudi Arabia (SA)	25	2,328,016	0.88
28	China (CN)	52	1,883,519	0.83
29	Ukraine (UA)	21	1,875,544	0.80
30	Brazil (BR)	52	1,838,943	0.74
31	Romania (RO)	45	1,758,661	0.29
32	New Zealand (NZ)	38	1,583,593	0.97
33	Chile (CL)	34	1,424,967	0.71
34	Qatar (QA)	25	1,416,024	0.53
35	Indonesia (ID)	30	1,207,416	0.89
36	Slovak Republic (SK)	42	1,126,331	0.30
37	Slovenia (SI)	35	1,073,475	0.05
38	South Africa (ZA)	54	1,068,231	0.80
39	Croatia (HR)	43	959,143	0.40
40	Republic of Korea (KR)	30	858,208	0.82
41	Iran (IR)	27	841,595	0.16
42	Israel (IL)	45	784,920	0.10
43	Kuwait (KW)	16	593,690	0.58
44	Latvia (LV)	26	580,055	0.44
45	Thailand (TH)	47	560,931	0.96
46	Taiwan (TW)	21	452,177	0.99
47	Bulgaria (BG)	30	451,266	0.44
48	Serbia and Montenegro (CS)	30	445,776	0.10
49	Egypt (EG)	28	428,899	0.53
50	Uruguay (UY)	13	422,531	0.01
51	Oman (OM)	15	419,006	0.65
52	Trinidad and Tobago (TT)	10	391,724	0.18
53	Estonia (EE)	17	331,400	0.46
54	Argentina (AR)	33	306,291	0.52
55	Kazakhstan (KZ)	19	276,261	0.46
56	Azerbaijan (AZ)	14	251,393	0.22
57	Colombia (CO)	23	217,869	0.74
58	Peru (PE)	22	150,841	0.69
59	Macedonia (MK)	15	117,583	0.06
60	Lithuania (LT)	17	117,389	0.02
61	Pakistan (PK)	13	117,143	0.94
62	Algeria (DZ)	7	97,178	0.42
63	Nigeria (NG)	18	95,914	0.41
64	Belarus (BY)	11	92,644	0.00
65	Venezuela (VE)	23	92,418	0.72
66	Bosnia and Herzegovina (BA)	18	68,029	0.23
67	Vietnam (VN)	21	66,516	0.97
68	Ghana (GH)	20	48,137	0.22

* Foreign lending is lending to the private sector of the respective country as of 12/2009. It includes lending by the German parent bank itself and by its affiliates located abroad.
** Due to their special character as financial centers, these countries are excluded from the main empirical analysis. However, this exclusion is subject to a robustness check in Section 5.

Offshore financial centers as defined by the IMF (2000) were not considered for the analysis. These are: Luxembourg, Ireland, Switzerland, Singapore, Hong Kong, Malta, Cyprus, Bahrain, Macao, Mauritius, Liechtenstein, Antigua and Barbuda, Anguilla, Netherlands Antilles, Barbados, Bermuda, Guernsey, Gibraltar, Isle of Man, Jersey, Cayman Islands, Liberia, Marshall Islands, Panama, Philippines, Saint Vincent and the Grenadines, Virgin Islands (British), Virgin Islands (U.S.).

Table 2: Data

Variable	Remarks	Source
Dependent Variable		
Real transaction-induced changes in long-term lending	Real transaction-based changes in foreign lending vis-à-vis private sector. Long-term loans only (M ⇒Q).	Deutsche Bundesbank: External Positions
Demand side factors		
Fixed capital formation / GDP	Fixed capital formation over GDP (Q ⇒ average over last 4Q).	IMF: International Financial Statistics
Other countries' real GDP growth relative to local	Weighted average 4Q real GDP growth of all other countries to which bank actually supplies loans (weights are the shares of countries in the long-term loan portfolio of the bank), relative to 4Q real GDP growth of respective country (Q).	IMF: International Financial Statistics, World Economic Outlook, own calculations.
Stock market volatility	12-month volatility of the stock market index. (M⇒ Q)	Bloomberg, Datastream, own calculations.
Liabilities / GDP	Total government liabilities over GDP (Q ⇒ average over last 4Q).	IMF: World Economic Outlook, International Financial Statistics
Exchange rate volatility	6-month volatility of end-of-period exchange rates. (M ⇒ Q)	IMF: International Financial Statistics, own calculations
Bilateral trade openness	Share of imports from Germany in total imports of a country. (M ⇒ Q)	Deutsche Bundesbank: Balance of Payments Statistics
Supply-side factors		
Bank level		
Bank size (relative)	Balance sheet total minus average balance sheet total of all banks. (M ⇒ Q).	Deutsche Bundesbank: Bank Balance Sheet Statistics, own calculations.
Capital market activity	Claims from securities over balance sheet total. (M ⇒ Q ⇒ average over last 4Q)	Deutsche Bundesbank: Bank Balance Sheet Statistics
Interest income / equity	Annual interest income (A ⇒ Q) over equity (M ⇒ Q). (⇒ average over last 4Q)	Deutsche Bundesbank: Profit and loss accounts and Bank Balance Sheet Statistics
Core capital ratio	Tier I capital over risk-weighted assets. (Since 2004 Q, before A ⇒ Q)	Deutsche Bundesbank: Banking Supervision
Lending at home	Real change in long-term loans to German non-financial firms (M ⇒ Q).	Deutsche Bundesbank: Bank Balance Sheet Statistics
Aggregate level		
Tightening of credit standards due to liquidity position	Change of credit standards due to a worsening of the bank's liquidity position as applied to the approval of loans or credit lines to enterprises. Tighter standards go hand in hand with a higher index (Q, since 2003).	Deutsche Bundesbank: Bank Lending Survey
Home interest margin	Spread between the effective rate on new loans to non-financial corporations > EUR 1mio and the 12-months Euribor (Q)	Deutsche Bundesbank, own calculations.
Other		
Affiliate relevance	Fraction of long-term loans to private sector (stocks) handed out via local affiliates (M -> Q)	Deutsche Bundesbank External Positions
Crisis dummy (2007Q3-)	Dummy for financial crisis (=1 since 3rd quarter of 2007) (Q)	Authors' own definition.
Crisis dummy (2007Q3-2008Q2)	Dummy for financial crisis before collapse of Lehman (=1 between 3rd quarter of 2007 and 2nd quarter of 2008) (Q)	Authors' own definition.
Crisis dummy (2008Q2-)	Dummy for financial crisis after collapse of Lehman (=1 since 3rd quarter of 2008) (Q)	Authors' own definition.

M = monthly data, Q = quarterly data, A = annual data,
"⇒" = transformed into. Monthly data quartalized by summing up (flow data) or by taking end-of-period values (stock data). Yearly data quartalized by linear interpolation

Table 3: Descriptive statistics

Variable	Obs.	Mean	StD	Min	Max
Dependent variable					
Real transaction-induced changes in long-term lending (in EUR bn)	144,659	0.001	0.050	-3.078	5.703
Demand-side factors					
Fixed capital formation / GDP	2,079	0.225	0.060	0.073	0.656
Real GDP growth	2,072	0.062	0.089	-0.342	0.607
Other countries' real GDP growth relative to local	141,935	-2.490	170.784	-11,333.74	2,246.322
Bilateral trade openness	2,104	0.110	0.082	0.009	0.489
Stock market volatility	2,106	23.000	12.608	2.057	125.697
Exchange rate volatility	2,100	5.465	4.366	0.000	34.056
Liabilities / GDP	2,022	0.460	0.328	0.040	2.185
Supply-side factors					
Bank level					
Relative bank size	2,192	0.772	101.602	...	...
Capital market activity	2,192	0.230	0.121	...	...
Interest income / equity	2,192	0.378	0.256	...	...
Core capital ratio	2,185	0.095	0.061	...	...
Change in core capital ratio	2,183	0.001	0.011	...	...
Lending at home (in EUR bn)	2,192	-0.023	0.391	...	...
Aggregate level					
Home interest margin	32	0.018	0.008	0.003	0.030
Tightening of credit standards	32	-0.709	10.228	-20.000	23.077
Other					
Affiliate relevance	144,659	0.066	0.226	0	1
Crisis dummy (2007Q3-)	32	0.438	0.504	0	1
Crisis dummy (2007Q3-2008Q2)	32	0.125	0.336	0	1
Crisis dummy (2008Q2-)	32	0.313	0.471	0	1

Maximum number of observations for country-specific variables: 66 countries x 32 quarters = 2,112, for bank-specific variables: 69 banks x 32 quarters = 2,208, for bank- and country-specific variables: 69x66x32 = 145,728.
(...) stands for data not to be published due to confidentiality rules (single observations).

Table 4: Summary of main variables considered and expected signs

Variable	Expected sign
Foreign demand and risk	
Foreign demand	
Fixed capital formation over GDP	+
Other countries' real GDP growth relative to local	–
Bilateral trade openness	+
Foreign Risk	
Stock market volatility	–
Exchange rate volatility	–
Liabilities over GDP	+ / –
Supply-side factors	
Bank level	
Relative bank size	+
Capital market activity	+
Interest income over equity	+
Change in core capital ratio	–
Core capital ratio change x level	+
Lending at home	+ / –
Affiliate relevance	+
Aggregate level	
Home interest margin	–
Tightening of credit standards	–

Table 5: Regression results: baseline and affiliate relevance

This table reports robust bank-country fixed-effect regressions of quarterly transaction-induced changes in long-term lending abroad for a panel of the largest 69 German banking conglomerates from 2003Q3 to 2010Q4. Transaction-induced changes in long-term lending abroad correspond to the changes in bank's total long-term loan stock outstanding vis-à-vis the foreign private sector, adjusted for exchange rate fluctuations and cleaned from other valuation effects, like eg write downs. *Affiliate relevance* is the share of this business done by affiliates in the corresponding foreign countries. All explanatory variables are lagged one period and seasonal dummies are included.

	(1a)	(1b)	(2)	
Dependent variable:	Baseline		Affiliate relevance	
Transaction-induced changes in long-term lending				
Foreign country determinants: demand and risk				*Interactions (x Affiliate relevance)*
Fixed capital formation/GDP	-0.000	-0.000	-0.003	0.055*
	(0.002)	(0.002)	(0.002)	(0.031)
Other countries' real GDP growth relative to local	-3.90e-08	-4.02e-08	-8.45e-08*	2.74e-07
	(0.000)	(0.000)	(0.000)	(0.000)
Bilateral trade openess	-0.003	-0.003	-0.012	0.147**
	(0.007)	(0.007)	(0.008)	(0.068)
Stock market volatility	-1.71e-05	-1.75e-05	1.57e-05*	-4.67e-04***
	(0.000)	(0.000)	(0.000)	(0.000)
Exchange rate volatility	6.89e-05**	6.86e-05**	7.70e-05**	-2.49e-04
	(0.000)	(0.000)	(0.000)	(0.001)
Liabilities/GDP	0.001	0.001	0.002**	-0.004
	(0.001)	(0.001)	(0.001)	(0.006)
Affiliate relevance	0.006***	0.006***	-0.009	
	(0.002)	(0.002)	(0.011)	
Home country determinants: general and bank-specific supply				
Home interest margin	-0.176***	-0.176***	-0.176***	
	(0.026)	(0.026)	(0.025)	
Tightening credit standards due to liquidity position	-2.82e-05**	-2.72e-05**	-2.50e-05**	
	(0.000)	(0.000)	(0.000)	
Change in core capital ratio	-0.056**	-0.094***	-0.089**	
	(0.022)	(0.035)	(0.035)	
Core capital ratio		0.001	0.002	
		(0.002)	(0.002)	
Core capital ratio: change x level		0.141***	0.134***	
		(0.052)	(0.052)	
Interest income/equity	0.006***	0.006***	0.006**	
	(0.002)	(0.002)	(0.002)	
Capital market activity	0.005**	0.005**	0.005**	
	(0.002)	(0.002)	(0.002)	
Bank size (relative)	2.74e-05	2.69e-05	3.67e-05	
	(0.000)	(0.000)	(0.000)	
Lending at home	0.001***	0.001***	0.001***	
	(0.000)	(0.000)	(0.000)	
Constant	0.004	0.004	0.003	
	(0.010)	(0.010)	(0.010)	
Observations	136192	136192	136192	
Number of bank-country pairs (clusters)	4484	4484	4484	
adj. R-squared	0.037	0.037	0.038	

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Regression results: financial crisis

This table reports robust bank-country fixed-effect regressions of quarterly transaction-induced changes in long-term lending abroad for a panel of the largest 69 German banking conglomerates from 2003Q3 to 2010Q4. Transaction-induced changes in long-term lending abroad correspond to the changes in bank's total long-term loan stock outstanding vis-à-vis the foreign private sector, adjusted for exchange rate fluctuations and cleaned from other valuation effects, like eg write-downs. *Affiliate relevance* is the share of this business done by affiliates in the corresponding foreign countries. All explanatory variables are lagged one period and seasonal dummies are included. The *crisis dummy* in column (3) equals 1 from 2007Q3 onwards. In column (4) the *pre Lehman crisis dummy* equals 1 from 2007Q3-2008Q2. The *post Lehman crisis dummy* equals 1 from 2008Q3 onwards.

Dependent variable: Transaction-induced changes in long-term lending	(3) Crisis		(4) Crisis: pre- vs. post-Lehman		
	(3/1)	(3/2) *Interacted terms (x Crisis)*	(4/1)	(4/2) *Interacted terms (x Crisis pre Lehman)*	(4/3) *Interacted terms (x Crisis post Lehman)*
Foreign country determinants: demand and risk					
Fixed capital formation/GDP	-0.004	-0.001	-0.004	-0.004	-0.000
	(0.003)	(0.004)	(0.002)	(0.003)	(0.005)
Other countries' real GDP growth relative to local	-5.92e-08	-3.25e-07**	-5.48e-08	-6.29e-05	-2.02e-07
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bilateral trade openess	-0.013	0.004	-0.013	0.009	-0.002
	(0.010)	(0.004)	(0.010)	(0.007)	(0.004)
Stock market volatility	-3.53e-06	3.21e-05*	-4.60e-06	-4.65e-06	3.97e-05**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exchange rate volatility	7.18e-05**	2.66e-05	5.28e-05*	-1.11e-04	-2.21e-05
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liabilities/GDP	0.002*	0.001*	0.002**	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
... via Affiliate Relevance					
Fixed capital formation/GDP x Affiliate relevance	0.022	0.051	0.023	0.022	0.018
	(0.036)	(0.062)	(0.035)	(0.079)	(0.079)
Other countries' real GDP growth x Affiliate relevance	0.000	-2.05e-06	1.27e-06	-2.34e-04	-2.21e-06
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bilateral trade openess x Affiliate relevance	0.183**	-0.117	0.182**	0.123	-0.276
	(0.079)	(0.115)	(0.079)	(0.134)	(0.171)
Stock market volatility x Affiliate relevance	-4.64e-04*	-5.60e-05	-4.66e-04*	-1.08e-04	3.58e-04
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Exchange rate volatility x Affiliate relevance	-4.20e-04	1.71e-04	-4.61e-04	1.46e-04	-3.38e-04
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Liabilities/GDP x Affiliate relevance	-0.005	0.002	-0.005	0.006	0.000
	(0.008)	(0.009)	(0.008)	(0.011)	(0.010)
Affiliate relevance	-0.005	0.000	-0.005	-0.012	0.011
	(0.011)	(0.021)	(0.011)	(0.024)	(0.030)
Home country determinants: general and bank-specific supply					
Home interest margin	-0.149***	-0.066	-0.152***	0.021	-0.084
	(0.030)	(0.050)	(0.031)	(0.178)	(0.065)
Tightening credit standards due to liquidity position	-4.53e-05**	3.02e-06	-3.84e-05*	6.44e-05	-3.66e-05
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Change in core capital ratio	-0.071	-0.051	-0.066	0.069	-0.259**
	(0.046)	(0.072)	(0.045)	(0.065)	(0.115)
Core capital ratio	0.001	0.000	-0.001	0.011	0.007
	(0.002)	(0.009)	(0.002)	(0.011)	(0.011)
Core capital ratio: change x level	0.108	0.213	0.105	-0.257	1.304**
	(0.067)	(0.442)	(0.066)	(0.430)	(0.643)
Interest income/equity	0.006*	0.000	0.005	-0.003*	0.003
	(0.003)	(0.001)	(0.003)	(0.001)	(0.002)
Capital market activity	0.005**	-0.001	0.005*	-0.002	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Bank size (relative)	2.72e-05	7.16e-06*	8.09e-06	2.42e-05***	-2.61e-07
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lending at home	0.001**	0.000	0.001**	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	0.005		0.011		
	(0.010)		(0.010)		
Observations	136192		136192		
Number of bank-country pairs (clusters)	4484		4484		
adj. R-squared	0.039		0.042		

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Regression results: robustness test (extension of the country sample by the US and the UK)

This table reports a robustness test regarding the sample of countries considered for the foreign lending activities of German banks. In contrast to the previously reported results, these regressions include the US and the UK in the analysis (they were considered as hosting predominant financial centers and therefore excluded from the previous regressions). Apart from this, the setup of these regressions is identical to the previously presented ones (see Table 6).

Dependent variable: Transaction-induced changes in long-term lending	(3) Crisis		(4) Crisis: pre- vs. post-Lehman		
	(3/1)	(3/2) *Interacted terms (x Crisis)*	(4/1)	(4/2) *Interacted terms (x Crisis pre Lehman)*	(4/3) *Interacted terms (x Crisis post Lehman)*
Foreign country determinants: demand and risk					
Fixed capital formation/GDP	-0.004	-0.001	-0.004	-0.002	0.002
	(0.003)	(0.004)	(0.003)	(0.006)	(0.006)
Other countries' real GDP growth relative to local	-8.20e-08	-7.76e-07**	-7.18e-08	-6.72e-05	-5.53e-07*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bilateral trade openess	-0.004	0.004	-0.002	0.006	-0.002
	(0.014)	(0.005)	(0.014)	(0.007)	(0.004)
Stock market volatility	-1.65e-05	6.66e-05***	-2.82e-05	-7.65e-05*	7.95e-05***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Exchange rate volatility	2.71e-05	-1.24e-05	2.54e-05	-2.95e-04***	-8.11e-05
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Liabilities/GDP	-0.001	0.001	-0.000	0.001	0.001
	(0.004)	(0.001)	(0.004)	(0.001)	(0.001)
... via Affiliate Relevance					
Fixed capital formation/GDP x Affiliate relevance	0.021	0.214*	0.021	-0.119	0.285
	(0.048)	(0.125)	(0.048)	(0.101)	(0.177)
Other countries' real GDP growth x Affiliate relevance	0.000	-2.36e-06	2.12e-06	1.23e-04	-5.55e-06
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)
Bilateral trade openess x Affiliate relevance	0.161*	-0.057	0.159*	0.007	-0.086
	(0.084)	(0.133)	(0.084)	(0.156)	(0.226)
Stock market volatility x Affiliate relevance	-1.33e-03**	9.10e-04	-1.34e-03**	-7.75e-04	2.02e-03**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Exchange rate volatility x Affiliate relevance	-4.92e-04	-2.63e-03	-5.61e-04	-1.23e-03	-2.27e-03
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Liabilities/GDP x Affiliate relevance	-0.003	-0.018	-0.003	0.005	-0.026
	(0.009)	(0.015)	(0.009)	(0.013)	(0.021)
Affiliate relevance	0.013	-0.043	0.014	0.061	-0.096
	(0.019)	(0.035)	(0.019)	(0.044)	(0.067)
Home country determinants: general and bank-specific supply					
Home interest margin	-0.199**	-0.115	-0.207**	-0.065	-0.169
	(0.083)	(0.116)	(0.084)	(0.328)	(0.109)
Tightening credit standards due to liquidity position	3.29e-05	-8.87e-05	4.45e-05	4.94e-05	-1.83e-04
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Change in core capital ratio	-0.198	-0.044	-0.189	0.145	-0.369*
	(0.165)	(0.168)	(0.162)	(0.173)	(0.199)
Core capital ratio	0.004	-0.007	0.002	0.035	0.002
	(0.002)	(0.012)	(0.002)	(0.028)	(0.015)
Core capital ratio: change x level	0.302	0.502	0.295	-0.158	2.225**
	(0.245)	(0.699)	(0.242)	(0.810)	(0.979)
Interest income/equity	0.007	0.001	0.005	-0.002	0.005
	(0.006)	(0.003)	(0.007)	(0.004)	(0.004)
Capital market activity	0.016*	0.002	0.015*	-0.006	-0.000
	(0.009)	(0.003)	(0.009)	(0.005)	(0.005)
Bank size (relative)	-5.56e-05	5.30e-06	-1.07e-04	5.56e-05***	-2.00e-05
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lending at home	-0.003	0.005	-0.003	0.008	0.004
	(0.004)	(0.005)	(0.004)	(0.006)	(0.004)
Constant	0.026		0.043		
	(0.033)		(0.037)		
Observations	140554		140554		
Number of bank-country pairs (clusters)	4622		4622		
R-squared	0.020		0.022		

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

III Intra-bank flows as a mirror of multinational banks' priorities and resources in the crisis

This paper is based on:

Düwel, C., and R. Frey (2012). Competition for internal funds within multinational banks: Foreign affiliate lending in the crisis. *Bundesbank Discussion Paper*, No 19/2012, Economic Research Centre, Deutsche Bundesbank.

It is at the stage of *"revise & resubmit"* to the *Journal of Banking and Finance*.

The paper was presented/accepted for presentation at the following refereed conferences:

- *27th Annual Congress of the European Economic Association*, University of Málaga, Málaga (Spain), August 27-31, 2012.
- *2013 Annual Meeting of the Midwest Finance Association*, Chicago (United States), March 13-16, 2013.
- *2013 Annual Conference of the Royal Economic Society*, Royal Holloway, University of London, Surrey (United Kingdom), April 03-05, 2013.
- *Jahrestagung des Vereins für Socialpolitik 2013*, University of Düsseldorf, Düsseldorf, September 04-07, 2013.
  (presentation will be given by co-author)

The paper was furthermore presented at the following non-refereed workshops:

- *Joint Doctoral Seminar,* University of Tübingen / Helmut-Schmidt-University Hamburg, Hamburg, April 03-04, 2012.
- *Workshop on financial globalization, financial crises and the (re-)regulation of banking: macroeconomic implications*, University of Zurich, Zurich (Switzerland), May 15-16, 2012. (Poster session)

Intra-bank flows as a mirror of multinational banks' priorities and resources in the crisis

April 2013

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Abstract

We investigate how the lending activities abroad of a multinational bank's local and hub affiliates are being affected by funding difficulties during the financial crisis. We find that affiliates' local deposits and profitability have been stabilizing the loan supply. By contrast, relying on short-term wholesale funding has increasingly proven to be a disadvantage in the crisis, as inter-bank and capital markets froze. By introducing a liable approximate measure for intra-bank flows, we detect competition for intra-bank funding between the affiliates abroad as well as an increasing focus on parent bank's home market activities. In addition, the more an affiliate abroad takes recourse to intra-bank funding in the crisis, the more it becomes dependent on its parent bank having a stable deposit and long-term wholesale funding position. We consider changes in long-term lending to the non-bank private sectors of 40 countries by the affiliates of the 68 largest German banks. To obtain a more precise picture, we clean our lending data from valuation effects.

Keywords: Funding structure, multinational banks, internal capital market, intra-bank lending, wholesale funding, financial crisis.

JEL Classification: G21, F23, F34, E44

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This opinions expressed in the paper are those of the authors and do not necessarily reflect the views of the Deutsche Bundesbank.

This paper has benefited from the rich input we received from Alexander Lipponer in connection with work on an earlier, joint paper. Furthermore, we are very grateful for valuable comments by Jörg Breitung, Claudia Buch, Jens Conrad, Ulrich Grosch, Heinz Herrmann, Thomas Kick, Cordula Munzert, Peter Raupach, Winfried Rudek and Peter Tillmann. Any errors and inaccuracies are our own. We gratefully acknowledge financial support received from the University of Giessen (C. Düwel).

1 Introduction

In the ongoing financial crisis, multinational banks' foreign positions have been declining in the light of losses in the value of assets, growing funding difficulties and increasing risk aversion. Lending by multinational banks' foreign affiliates, which in many economies is a mainstay of credit provision, has been particularly affected by the cutback. Foreign affiliates' lending has been found to develop differently from lending by domestic banks, especially during the recent financial crisis (see, for example, DE HAAS AND VAN LELYVELD (FORTHCOMING)). A key structural difference arises in their options to fund lending activities. Domestic banks rely to a great extent on local funding, whereas the funding by an affiliate is embedded in the financial management of the banking conglomerate. This may be a source of strength but can also limit the scope of action of a foreign affiliate as it is dependent on the bank's decision on how to allocate funds internally.

In this study, we therefore ask about the relevance of a multinational bank's funding structure with regard to foreign affiliate lending during the financial crisis. Within a multinational bank, funds are distributed through the internal capital market, which creates a link between the financial resources of the affiliate itself, of the other affiliates and of the parent bank. Using the example of German banks, we not only assess the impact of various external funding sources like deposits or wholesale on affiliate activity, but also identify and analyze the role of intra-bank funding during the crisis. For German banks, intra-bank flows prove to be an important means of affiliate funding. In the case of substantial intra-bank funding of the affiliate, the funding structure of the parent bank - where the internal funds are primarily generated - and its resistance to crisis are of major interest to the affiliate. However, the affiliates' behavior may not be determined solely by their funding. For example, it is likely that more profitable units can keep lending more stable or even expand their activities, while their funding is guaranteed by the conglomerate. This aspect introduces an element of competition into the relationship among the affiliates. Moreover, a reduction in foreign affiliates' activities as a whole may reflect this business having a lower weighting than the parent bank's exposure at home.

We are the first to investigate the affiliates' lending decisions as an outcome of the funding structure of the affiliate itself, the other affiliates and the parent bank. We introduce an approximate measure for the internal funding of (German) affiliates at the bank level, and are thus able to consider the affiliates' complete funding side. This setting also allows us to address the issue of competition between affiliates for banks' internally available funds during the crisis. Here, we distinguish between affiliates which are active purely locally and affiliates which engage in cross-border lending, thus serving as lending "hub". Although such lending hubs which support or replace local lending have a strong position in the foreign business of German banks, the role played by this type of affiliate in lending abroad has not been discussed before in the literature. Furthermore, we analyze whether, during the financial crisis, banks prioritize parent bank lending to the domestic economy over foreign affiliate lending.

The micro data used in this study are collected by the Deutsche Bundesbank. These comprise information on both lending and other balance sheet characteristics of German parent banks

and of all their foreign affiliates. Furthermore, we are able to accurately address the bank's lending decisions by relying on purely transaction-induced changes in the bank's loan portfolio - excluding valuation effects which are commonly present in earlier studies relying on stock variations.

German banks' lending to the foreign private sector (henceforth: foreign "private sector lending" or "lending") with a prominent share attributable to affiliates declined after the failure of Lehman Brothers.[1] Conversely, lending in Germany remained quite stable (see Figure 1 in the appendix), which is consistent with UK banks' focus on the home market during the financial crisis (ROSE AND WIELADEK (2011)).[2] Funding difficulties turned out to be the main cause of the reduced banking business in some areas. CETORELLI AND GOLDBERG (2011A) provide direct evidence that the collapse of the asset-backed commercial paper market together with the subsequent breakdown of external funding markets probably played a major role with regard to changes in US banks' lending activities both at home and abroad.[3] DE HAAS AND VAN HOREN (2012) have recently shown that the curtailment of cross-border syndicated loan provision was related to shocks to the banks' capital and access to long-term debt. According to MCCAULEY ET AL. (2010), who use data from the Bank for International Settlements, German banks generally fund a substantial part of their lending activity by accessing the internal capital market, which is different from the affiliates of most other European or US banks as these rely more on locally generated funds. CREMERS ET AL. (2011) analyze one banking group and find that the parent bank largely contributes to both its own funding the the funding of affiliates by tapping the external capital market. Furthermore, in contrast to foreign affiliates of US banks (see CETORELLI AND GOLDBERG (2011A)), affiliates of German banks continued, on aggregate, to be net borrowers from their parent banks during the crisis (see Figure 2), though heterogeneity across the affiliates increased. This underlines the strong need for considering affiliates' internal funds for financing, and supports our approach of defining a proxy for bank internal funding and including this major source of funding in the analysis.

In general, lending by affiliates located abroad depends on the stability and resources of the affiliate itself, but it is also influenced by balance sheet characteristics of the parent bank. Evidence of the latter is provided for German banks by BUCH ET AL. (2009), for European banks' activities in eastern Europe by DE HAAS AND VAN LELYVELD (2006) and (2010), as well as by POPOV AND UDELL (2012) for the early period of the financial crisis, and for US banks, for example, by ASHCRAFT (2008). Focusing on liquidity and capital endowment, for US banks HOUSTON ET AL. (1997) find an influence of both subsidiary and parent bank characteristics on subsidiary loan growth without measuring intra-bank flows directly. Furthermore, PEEK AND ROSENGREN (1997), find that Japanese bank branches in the US reduced their credit supply after their parent banks had been hit by a sharp drop in stock prices in 1990 combined with stricter capital requirements. Moreover, the literature on the bank lending channel demonstrates the in-

1 For the relevance of risk aversion and other bank-specific factors in the case of German banks, see DÜWEL ET AL. (2011). Government rescue measures and liquidity support, especially that of the US Federal Reserve, had some stabilizing impact on German banks' foreign activities and dampened the deleveraging of foreign assets (BUCH ET AL. (2011)).

2 In addition, in a study on international syndicated loans, GIANNETTI AND LAEVEN (2012) find that the home bias of lenders' loan origination increased in the early stage of the crisis.

3 Furthermore, CETORELLI AND GOLDBERG (2011B) find that the more a country's aggregate banking system was vulnerable to the dollar prior to the crisis, the lower was its post-crisis growth in lending to emerging economies by parent banks and by affiliates. AIYAR (2012) finds that shocks to international funding dampen domestic lending.

fluence of parent banks' liquidity on the activities of their affiliates (see for the US, for example, HOUSTON AND JAMES (1998) and KASHYAP AND STEIN (2000) as well as CAMPELLO (2002) and CETORELLI AND GOLDBERG (2012)). NAVARETTI ET AL. (2010) conclude that, in financially integrated areas like the EU, banks' internal capital markets are particularly active. It is likely that the parent bank's funding structure becomes especially relevant for an affiliate when the affiliate relies on internal funds to a large extent. By demonstrating this linkage, we also add substantially to the literature.

Our results show that locally active affiliates as well as affiliates serving as lending hubs, which can rely on their own net income and on strong local deposit funding in the period of distress, have been able to stabilize their loan supply. Furthermore, lending activities abroad increasingly depend on parent bank characteristics, the more the affiliates rely on funding via the internal capital market. Parent banks which were able to maintain their deposit funding and long-term wholesale funding proved to be of particular advantage to their affiliates. In the crisis, we find evidence of growing competition for internal funds between affiliates and a concentration of bank resources on parent banks' lending to the home market.

The remainder of the paper is organized as follows. Section 2 introduces the analysis's empirical framework as well as estimation equations and variables. Section 3 provides detailed information on the data sources and the construction of variables. In section 4 we present our estimation results and discuss their implications. Section 5 provides robustness tests, and section 6 concludes.

2 Empirical model

2.1 Funding structures of multinational banks

Our model presents a strong simplification of the complex world in which a bank operates. It tries to capture parts of a bank's business model and the funding structure. We start with a multinational bank and focus on the behavior of its affiliates. We reduce the bank's business model to long-term lending to non-financial firms, since we consider this business to be strategic and thus continuous as market entry and exit is costly. The affiliate has different ways of funding its lending activity and usually relies on a mixture of these (see Figure 3). The affiliate can rely on market funding, its own generated funds and *intra*-bank funding. Market funding comprises local deposits and wholesale funds, which consists in the issuance of bonds and notes (debt securities) and interbank borrowing as its most prominent components (see section 3 for the relevance of funding sources over time). Furthermore, if the affiliate borrows on the bank's internal capital market, it can be expected that parent bank funding characteristics will also become more important for affiliate lending. Below, we limit the bank's internal capital market to the affiliates' intra-connections with the parent bank and leave aside the much less relevant relationships among the affiliates themselves.[4]

While the affiliates can be active on the capital market and collect deposits locally, intra-bank funding constitutes an important addition to their funding portfolio. During a period of crisis,

4 This strong financial linkage between an affiliate and its parent bank is also found by CREMERS ET AL. (2011). Also, data limitations do not allow an exact identification of the inter-affiliate relationships.

in particular, the external finance premium which market funding requires in order to compensate for informational asymmetries can become so high that it cuts banks off from certain funding sources. In this case, intra-bank resources provide a vital funding alternative for affiliates. However, the bank's resources are distributed across the parent bank itself and all affiliates, according to their relevance and needs. Internal capital markets provide the opportunity to allocate resources within business conglomerates wherever they are most efficient (GERTNER ET AL. (1994), STEIN (1997)).[5] From the point of view of a specific affiliate, intra-bank funding is therefore, in most cases, limited (see also the discussion by HOUSTON ET AL. (1997)). This is especially the case in a crisis period, when the bank's overall funds become scarce, as in case of severe funding troubles on the capital and interbank market, for example. Then, the bank's internal management of funds becomes even more important.

Our approach includes loan provision abroad not only to a given country by local affiliates but also by affiliates of the same parent bank which are located in other countries, such as neighboring countries, and are engaged in cross-border lending to the foreign private sector (see Figure 3).[6] Often, this type of affiliate functions as a lending "hub" and therefore fulfills a special role in the structure of the multinational bank. In fact, such hub affiliates provide on average one-third of affiliate lending to the foreign private sector (see also section 3). For this reason, we classify the affiliates in the other countries into two groups: the hub affiliates and the non-hub affiliates. Affiliates located in countries with large financial centers are treated as a separate group, since they have a different business model.[7] Characteristics of the group of hub affiliates become relevant in countries where the hub affiliates conduct a prominent part of the lending, while local affiliates provide only a small fraction of the lending or are not present at all. By contrast, the lending of the remaining non-hub affiliates is confined to their respective local markets and, hence, these affiliates, in particular, are competitors for the bank's internal funds.

2.2 Estimation

The identification strategy of our empirical approach relies on the assumption that the bankruptcy of Lehman Brothers in September 2008 and its direct effects came as a surprise to banks (we thereby follow CORNETT ET AL. (2011)). This decision is motivated by the observation that this event ushered in a new funding situation in which market and inter-bank funding were strongly limited, since investors perceived much higher risks in banks, and a loss of confidence on the interbank market arose. In line with this, we find that strong support for this choice is provided in the data on cross-border loans, where the turning point from expansion to deleveraging is 2008Q3 (see Figure 1). We regress the change in lending realized by an affiliate on its own funding structure as well as on the funding structure of the parent bank and

5 However, efficiency gains might not be fully reached due to misaligned incentives which cause principal-agent problems (RAJAN ET AL. (2000), SCHARFSTEIN AND STEIN (2000)).

6 Furthermore, the parent bank may also provide cross-border loans, an aspect which is not discussed in this paper (but is in DÜWEL ET AL. (2011), for example).

7 In countries with financial centers, a major share of corporate loans is given to special purpose vehicles, hedgefonds and other financial firms. Especially in a financial crisis, banks treat such loans much differently from loans given to non-financial firms. Thus, we see a strong reason to exclude lending in financial centers from our analysis (see also section 3). However, affiliates located in financial centers are taken into account with regard to their role as competitors for internal funds within the banking conglomerate.

other parts of the banking group. As we aim to assess the change in the role of certain funding sources, which was triggered by the Lehman Brothers event, we interact the funding variables and all other explanatory variables with a crisis dummy and interpret the estimated coefficients on these interacted terms only.[8] In doing so, we can assess how the funding difficulties, in turn, affected the banks' and their foreign affiliates lending behavior. In this context, it is important to recognize that, in most cases, the funding structure does not change abruptly. Deposit and long-term wholesale funding, in particular, are characterized by a high degree of inertia (for our sample, see Figure 4 in the appendix). Furthermore, we lag the funding variables.

First, we test how, in terms of the affiliates' lending abroad, the relevance of the bank's and the affiliate's own funding structures changes after the collapse of Lehman Brothers. Second, we evaluate whether competition for internal funds has increased within the banking conglomerate in view of the crisis. Third, we investigate whether an affiliate's strong reliance on intra-bank funding makes it more dependent on the funding structure and activity of the parent bank during the crisis.

Thus, we start with the following fixed-effects regression using a panel of the largest 68 German banks and their foreign affiliates' lending to the private sectors of 40 countries (for detailed information on the data, which is collected by the Deutsche Bundesbank, see section 3). We test how the reliance on a specific funding structure affected lending by affiliates located abroad in the aftermath of the Lehman Brothers collapse:

$$\begin{aligned}\Delta l_{ikt} \;=\; & \mathbf{d\_crisis}^{*}[\alpha_{\mathbf{1}}\mathbf{Local\_AffiliateFund_{ikt-1}}+\alpha_{\mathbf{2}}\mathbf{Hub\_AffiliatesFund_{ikt-1}} \\ & +\alpha_{\mathbf{3}}\mathbf{ParentFund_{it-1}}+\alpha_4 \text{BankControls}_{\text{ikt-1}}] \\ & +\beta_1 \textit{Local\_AffiliateFund}_{ikt-1}+\beta_2 \textit{Hub\_AffiliatesFund}_{ikt-1} \\ & +\beta_3 ParentFund_{it-1}+\beta_4 BankControls_{ikt-1}+\delta+\eta_i+\gamma_{kt}+\varepsilon_{ikt} \qquad (1)\end{aligned}$$

where $i = 1, ..., N$, N is the number of banks in the sample, $k = 1, ..., K$, K the number of foreign countries, and $t = 1, ..., T$ the time period covered (2002Q4-2010Q4). The crisis dummy (**d_crisis**) equals 1 from 2008Q3 onwards. We include a constant (δ) and fixed effects for banks (η_i). To capture changes in local factors, especially the country-specific demand for credit, we also include country-time fixed effects (γ_{kt}). ε_{ikt} represents an idiosyncratic error.

The dependent variable Δl_{ikt} is the real volume of transaction-induced changes in long-term lending TO the private sector of country k by ALL affiliates located abroad of bank i at time t (see also section 3 for information on the structure of the data).

The coefficient vectors $\alpha_1 - \alpha_3$ represent changes in the relevance of funding sources for affiliate lending after the collapse of Lehman Brothers. First and foremost, loans to country k are provided by the local affiliate of bank i, whose funding sources are combined in the vector $\mathbf{Local\_AffiliateFund_{ikt-1}}$. Additionally, lending to country k may be carried out by the group of affiliates serving as hubs and located outside country k, whose aggregate funding structure is incorporated into the vector $\mathbf{Hub\_AffiliatesFund_{ikt-1}}$. Furthermore, the corresponding parent bank's characteristics are included in the vector $\mathbf{ParentFund_{it-1}}$.

8 In a robustness check (see section 5), we use a continuous risk indicator for the phase of distress, instead of the dummy variable. Our key results remain qualitatively unchanged.

In more detail, the main funding sources in the various parts of the bank are *Deposit funding*, *Short-term wholesale funding* and *Long-term wholesale funding*. Long-term wholesale funding is, however, excluded from the main part of the analysis. The reason for this is that the simultaneous inclusion of all funding sources in the regression raises concerns about multicollinearity. Long-term wholesale funding is included in a robustness test only in the estimation entitled "Robustness" in the last column of Table 7. The individual *Net income (relative to equity capital)* is included in the vector of funding variables, since it describes the ability to generate additional funds internally. Below, we refer to net income as being primarily a measure of profitability, which includes the aspect that profitable entities may be of higher strategical relevance for a bank.[9] See Table 1 in the appendix for the definitions of the variables, as well as their expected impact on affiliate lending. Table 2 provides corresponding summary statistics.

The vector $BankControls$ consists of the general characteristics of the banks. We include *Capitalization* and *Size* for all three parts of the banking group. Besides this, we control for the importance of the affiliates' lending business in the context of the banking group as a whole (*Affiliate lending share),* and do so for both the local affiliate and for hub affiliates. The role played by one or the other type of affiliate varies substantially across banks and countries. To take this aspect into account, we attach relative weights to the balance sheet characteristics of both the local affiliate and the group of hub affiliates. These weights correspond to the shares of the local and the hub affiliates in lending to a foreign country (see section 3.2). For the definition of these variables, see also Table 1 in the appendix.

Second, we ask whether competition for internal funds within the banking conglomerate increased during the crisis. Competition might have tightened within the group of affiliates and between the affiliates and the parent bank due to the external funding contraction in the aftermath of the Lehman bankruptcy. For this, we additionally include the share of intra-bank financing of the local affiliate and the other groups of affiliates in our set of regressors in equation (1); additionally, we add the parent bank's home activities as a possible competitor for affiliate lending:

$$\begin{aligned}\Delta l_{ikt} \;= (...) \quad & + \mathbf{d\_crisis}^{*}[\alpha_{5}\mathbf{Local\_AffiliateIntra_{ikt-1}} + \alpha_{6}\mathbf{Hub\_AffiliatesIntra_{ikt-1}} \\ & + \alpha_{7}\mathbf{NonHub\_AffiliatesIntra_{ikt-1}} + \alpha_{8}\mathbf{Fin\_AffiliatesIntra_{ikt-1}} \\ & + \alpha_{9}\mathbf{\Delta ParentHomeLend_{it-1}}] \\ & + \beta_{5}\textit{Local\_AffiliateIntra}_{ikt-1} + \beta_{6}\textit{Hub\_AffiliatesIntra}_{ikt-1} \\ & + \beta_{7}\textit{NonHub\_AffiliatesIntra}_{ikt-1} + \beta_{8}\textit{Fin\_AffiliatesIntra}_{ikt-1} \\ & + \beta_{9}\Delta ParentHomeLend_{it-1} \end{aligned} \tag{2}$$

where (...) stands for the inclusion of all explanatory variables of equation (1).

Intra-bank funding is, in principle, accessible to all affiliates belonging to a banking conglomerate. In the second regression specification, we therefore not only include *Intra-bank funding* as a special type of funding source for the local affiliate and for hub affiliates (vectors

9 Similarly, in their pre-crisis analysis, CREMERS ET AL. (2011) use a productivity measure defined as income over costs and find that affiliates which are more productive receive more intra-bank funding and experience higher loan growth.

$\mathbf{Local\_AffiliateIntra_{ikt-1}}$ and $\mathbf{Hub\_AffiliatesIntra_{ikt-1}}$), but also account for possible competition for these funds stemming from the other non-hub affiliates and from affiliates located in financial centers (vectors $\mathbf{NonHub\_AffiliatesIntra_{ikt-1}}$ and $\mathbf{Fin\_AffiliatesIntra_{ikt-1}}$). Furthermore, we investigate whether a potential stabilization of lending activities in the home market on the part of the parent bank was conducted at the expense of foreign affiliate lending during the crisis. In doing so, we add the parent bank's change in lending on the home market ($\mathbf{\Delta ParentHomeLend_{it-1}}$). Besides this, we account for the relative importance of the non-hub affiliates for the banking group by including their *Affiliate lending share*, and we measure the role of financial center affiliates in the banking group by their size relative to that of the banking group.

Third, as we expect that the recourse of the affiliate to *intra*-bank funds causes the affiliate's lending activity to be additionally dependent on the funding of the parent bank, we interact parent bank funding characteristics with the local affiliate's share of intra-bank funding in total assets. Additionally, we interact the change in the parent bank's home lending with the share of the local affiliate's intra-bank funding, as affiliate lending is likely to come more into competition with parent bank home lending, the more the affiliate relies on intra-bank funding:

$$
\begin{aligned}
\Delta l_{ikt} \;=\; & \mathbf{d\_crisis}*[\alpha_{\mathbf{1}}\text{Local\_AffiliateFund}_{\text{ikt-1}}+\alpha_{\mathbf{2}}\text{Local\_AffiliateIntra}_{\text{ikt-1}} \\
& +\alpha_{\mathbf{3}}\text{Hub\_AffiliatesFund}_{\text{ikt-1}}+\alpha_4\text{Hub\_AffiliatesIntra}_{\text{ikt-1}}+\alpha_5\text{BankControls}_{\text{ikt-1}} \\
& +\alpha_{\mathbf{6}}\text{ParentFund}_{\text{it-1}}+\alpha_{\mathbf{7}}\mathbf{ParentFund_{it-1}}*\mathbf{Local\_AffiliateIntra_{ikt-1}} \\
& +\alpha_{\mathbf{8}}\Delta\text{ParentHomeLend}_{\text{it-1}}+\alpha_{\mathbf{9}}\mathbf{\Delta ParentHomeLend_{it-1}}*\mathbf{Local\_AffiliateIntra_{ikt-1}}] \\
& +\beta_1 \textit{Local\_AffiliateFund}_{ikt-1}+\beta_2 \textit{Local\_AffiliateIntra}_{ikt-1} \\
& +\beta_3 \textit{Hub\_AffiliatesFund}_{ikt-1}+\beta_4 \textit{Hub\_AffiliatesIntra}_{ikt-1}+\beta_5 BankControls_{ikt-1} \\
& +\beta_6 ParentFund_{it-1}+\beta_7 ParentFund_{it-1}*\textit{Local\_AffiliateIntra}_{ikt-1} \\
& +\beta_8 \Delta ParentHomeLend_{it-1}+\beta_9 \Delta ParentHomeLend_{it-1}*\textit{Local\_AffiliateIntra}_{ikt-1} \\
& +\delta+\eta_i+\gamma_{kt}+\varepsilon_{ikt} \qquad (3)
\end{aligned}
$$

3 Data

3.1 Sample

Concerning the business activity of German banks' affiliates abroad, we concentrate on long-term lending to the non-bank private sector (in this paper, the non-bank private sector is also referred to as "private sector").[10] Long-term loans, ie loans with an original maturity of more than one year, already account for more than 85% of German banks' total cross-border lending activities. An additional reason for dropping short-term loans is that they also include trade financing, a more erratic business which pursues motives and determinants other than those discussed in this study. As lending to the private sector in a country which hosts a major financial center is strongly influenced by financial deals with special purpose entities as well as by banks'

10 These figures comprise both lending by subsidiaries as well as by branches. Subsidiaries are reported whenever a parent bank acts as majority shareholder, and they have an own legal status whereas branches do not. For both types of affiliates, there are no reporting thresholds.

proprietary trading in portfolio instruments, we focus on lending to countries which do not host major financial centers.

Affiliate lending abroad accounts for a large share of German banks' overall international activities of German banks.[11] Figure 1 in the appendix illustrates that activities by affiliates located abroad account, on aggregate, for 60% to 70% of total foreign private sector lending by German banks over time. Foreign private sector lending by affiliates underwent a steady expansion between 2004 and 2007, before stagnating and starting to decline after the collapse of Lehman Brothers. For our regression, which covers the period from 2002Q4 to 2010Q4, we use real transaction-induced changes in lending. These exclude changes in the loan stock due to exchange rate fluctuations or other valuation effects and thus give a more precise reflection of the bank's strategic decisions. In the aggregate figures, a shift in lending behavior after the failure of Lehman Brothers is reflected in the transaction-induced variations, although the decline does not prove to be as drastic as that for changes in the stock data (see Figure 2).

As international activities are, first and foremost, a strategic field of large banks, we selected the 100 German parent banks with the largest balance sheet size, which also account for most of the cross-border lending. Foreign-owned banks as well as promotional banks, with their (partly) federal or state government ownership and their role as supporters of specified investment activities, are excluded. This drives the number of banks down to 68. Nevertheless, owing to bank mergers in the period under review, which we handle by backward integration, we consider 140 parent banks overall. For these banks, we collect information on all of their foreign affiliates.

We further focus on the 51 countries with the largest amounts of German cross-border loans outstanding so that the amount of data on foreign affiliates remains feasible. Having done that, our sample still covers roughly 80% of German banks' total lending to the non-bank private sector abroad. For the reasons mentioned above, we concentrate on the lending activities of German banks' foreign affiliates with respect to countries without financial centers. For the classification of offshore financial centers we make use of the definition applied by the Financial Stability Forum – the predecessor of the present Financial Stability Board – which was published in 2000, and additionally exclude the UK and the US from our sample[12] since they represent large financial hubs for German banks. We thus shrink our sample of destination countries from 51 to 40 (see Table 3 in the appendix). Nevertheless, we account for the relevance of affiliates in countries with major financial centers by including aggregate information on these affiliates for every bank (see section 2.1).

3.2 Bank data, bank aggregates and grouping of banks

The micro data is collected by the Deutsche Bundesbank. Parent banks report balance sheet statistics of affiliates abroad separately for branches and subsidiaries. While each subsidiary files its own report, the activities of branches are aggregated by foreign country. In order to gain a clear picture of the relevance of various foreign economies to the banks, we aggregate balance sheet data from branches and subsidiaries by parent bank and country to produce one affiliate-per-bank-country pair.

11 There are many more branches than subsidiaries of German banks - a fact that is reflected in the aggregate volumes, where branches are found to be more significant.

12 This is in line with the practice of the IMF, which also regards the UK and the US as hosting financial centers.

The statistics on German banks' external positions allow a breakdown of lending activities by destination country.[13] We use quarterly series, which were calculated from the original monthly series. For all foreign countries to which German banks supply loans, we observe lending to the private sector at the parent level, at the affiliate level (subsidiaries and branches combined), and at the level of the consolidated group, which is cleaned from intra-bank lending positions. The consolidated lending data consist of the volume of loans distributed to a country aggregated over all affiliates of one bank, irrespective of whether they are located in the given country or in other (probably, neighboring) foreign countries. This view on the data has the advantage that it accounts for the lending of affiliates acting as "hubs" which are located in other foreign countries. The relevance of the affiliates which lend across borders is captured by the inclusion of their aggregate funding structure in the regressions. To take into account the relative importance of local lending vis-à-vis lending from outside, the share of each type of affiliate in lending to a country is used as a weight on the respective funding structure. On average, local affiliates account for about two-thirds of affiliate lending to a foreign country, while hub affiliates provide one-third of the lending (see descriptive statistics in Table 2).

In our study, we address, in particular, the role of affiliates' intra-bank funding, which requires that the net borrowing position vis-à-vis their parent banks be identified. While subsidiaries report this exposure, we have to proxy for the assets and liabilities of branches vis-à-vis their parent bank. For this, we rely on their positions vis-à-vis the German banking sector (excluding positions vis-à-vis the central bank). This, in turn, relies on the assumption that the main business partner for branches on the home market is their parent bank. As a robustness check for this assumption, in Figure 5 in the appendix we compare this approximation with the actual data series which are available as of June 2010 and find very similar dynamics as well as comparable volumes.

To conclude the data section, we take a look at the funding structure of our sample's affiliates located in countries without major financial centers at the aggregate level (in Figure 4 in the appendix). Wholesale funding accounts, on average, for 40% to 50% of total assets and represents the major source of funding for these affiliates. In this context, short-term wholesale funding dominates but has been declining since mid-2007, falling by approximately 10% to roughly 33% of total assets at the end of 2010. Long-term wholesale funding demonstrates, on average, greater stability, especially during the crisis, but accounts for no more than around 7% of total assets. For the average affiliate in our sample, deposits as a share of total assets declined between 2005 and 2009 from roughly 27% to 17%, before this share started to increase again to slightly above 20% at the end of 2010. By contrast, intra-bank funding has become relatively more important since 2005. It rose, on average, to over 30% in 2009Q1 and has since been fluctuating at around 28% of affiliates' total assets. The fact that intra-bank funding has such a relatively high degree of relevance mainly mirrors branches' dependence on parent banks.[14] In turn, subsidiaries rely more strongly on deposit financing. The dynamics with respect to all funding types, especially during the crisis period, are, however, almost the same for both subsidiaries and branches (outside financial centers), which supports the approach of aggregating over branches and subsidiaries per bank and country below.

13 For a detailed description, see FIORENTINO ET AL. (2010).

14 Branches of German banks already account for roughly two-thirds of total affiliate lending to the foreign private sector.

4 Results

Table 4 shows two columns of results per regression, with the first column reporting estimated coefficients of the explanatory variables interacted with the crisis dummy. We aim at interpreting only these coefficients, as they show the crisis-driven changes in affiliate lending abroad in dependence on the underlying funding sources. The second column of each regression outcome reports controls for these variables (the estimated coefficients for the variables that are not interacted with the crisis dummy).

4.1 Stable funding of local and hub affiliates important for loan supply in the crisis

The outcome of the regression reported in Table 4 demonstrates that local affiliates were more likely to extend credit to a certain country during the crisis if they relied on stable *Deposit funding* and on large *Net income*. We find the very same effects for the funding variables of the bank's affiliates serving as lending hubs, when they complement the lending activities of the local affiliate or when they are the sole lender to a certain country. This corroborates IVASHINA AND SCHARFSTEIN (2010), who suggest that, during the financial crisis, banks with better access to deposit financing - as the traditional source of loan funding - cut back less of their syndicated lending with mainly large corporations. In addition, CORNETT ET AL. (2011) stress the importance of core deposits as a stable source of funding during the crisis. Beyond this main point of emphasis in the earlier literature, we demonstrate that affiliates which remain successful in generating income reduce their lending activities to a smaller extent, as they are more profitable and thus try to keep their activities at least stable in the crisis.

By contrast, local affiliates and hub affiliates which relied more on *Short-term wholesale funding* found it increasingly difficult to provide a stable loan supply (the interaction term with the crisis dummy is negatively significant for both types of affiliates). The degree to which hub affiliates dampen affiliate lending during the crisis depends on how large their risk aversion, measured by their *Capitalization*, is. Leaving the funding side of the affiliates, we even find that the parent bank's degree of short-term funding has a negative impact on affiliate lending in the crisis. This dependency on the parent bank may already point to intra-bank funding linkages, an aspect we will concentrate on in the next section.

4.2 Intra-bank funding and competition on the internal capital market

The second regression reported in Table 5 includes *intra*-bank funding at the affiliate level as an additional source of affiliate funding. Owing to data limitations, this has not been done before in the literature. We introduce a proxy for internal funding based on reporting of affiliates in order to consider this highly relevant financial source. The inclusion of such funding allows us to introduce two further aspects into the analysis. First, the implications of this kind of funding for the stability of lending in the crisis can be investigated. Second, we are able to consider competition for internal funds across the bank's affiliates and with regard to the parent bank.

The local affiliate's intra-bank net borrowing is found to be a rather limiting factor for the loan supply abroad in the crisis (the interaction of the local affiliate's *Intra-bank funding* with the

crisis dummy is significantly negative). This could indicate that, as the overall available bank resources become scarce, internal funds are increasingly used to support strategically important affiliates as well as the parent banks' home market activities (see also the results in section 4.3). Thus, affiliates that were already relying strongly on intra-bank funding before the crisis experienced growing competition for these internal funds and had to cut back on their lending in the context of the bank's overall strategy. In addition, despite parent banks supporting affiliates which, in some cases, realized large losses during the crisis, a bank-strategic cut back in lending was inevitable.

With the results of this second regression, we can provide another key insight into the multinational bank's internal fund management. Alongside intra-bank funding, which is provided to local affiliates and hub affiliates, we also include the reliance on this type of funding by affiliates with no hub function located in other countries and by financial center affiliates. Such entities of the bank may be competitor for internal funds. As expected, in the light of increasingly scarce funding resources during the financial crisis, the estimated coefficient of intra-bank funding provided to other non-hub affiliates turns out to be negative and significant. From the point of view of the affiliates involved in lending to a given country, the group of other non-hub affiliates is a direct competitor for intra-bank funds. In line with this, we find no significant impact on affiliate loan supply stemming from the intra-bank funding of the hub affiliates. Similarly, there seems to be no competition with the group of financial center affiliates: The coefficient is, in fact, significantly positive but quite small.

In a crisis, intra-bank competition may be a phenomenon not only between a bank's affiliates but also between the group of affiliates and the parent bank itself. Probably, home market lending by the parent bank is a core business and the question arises as to how affiliate lending behaves vis-à-vis home market lending in the crisis. For this, in the regression outcome reported in Table 5, we introduce the *Change in long-term lending at home* by the parent bank, which - by analogy with our dependent variable, affiliate lending - refers to the variation in long-term loans provided to corporations. It is lagged one period to reduce simultaneity issues (see also Table 1 for the definition of variables). We find a highly significant relationship between the *Change in long-term lending at home* of the parent bank and transaction-induced changes in long-term affiliate lending abroad before the financial crisis.[15] This finding is consistent with an earlier study (DÜWEL ET AL. (2011)), in which we demonstrate more generally that this kind of relationship exists between the lending of the whole banking conglomerates to foreign markets and the activities of the German parent banks on their home market. The results presented here show that, during the crisis, the banks' scarcity of funding sources stops the formerly parallel expansion of parent banks' home lending and affiliates' lending abroad. This can be seen as a signal of increasing competition between home lending and foreign lending via affiliates.

To conclude this section, we assess the relative magnitude of the pressure on foreign affiliate lending in the crisis, exerted by the competition for internal funds among the affiliates and with the parent bank shown above. A marginally larger reliance on intra-bank funding by the local affiliate has a negative effect on affiliate lending that is five times larger than the pressure stemming from a marginal increase in competition for intra-bank funds from the group of other non-hub affiliates (see the estimated coefficients on *Intra-bank funding* of the local affiliate and

15 As domestic parent bank lending is like the dependent variable, affiliate lending abroad, a flow variable, an economic interpretation of the coefficient for the pre-crisis period is possible.

of non-hub affiliates). However, the competition from non-hub affiliates puts much greater pressure on affiliate lending than on the parent bank's operations at home: One percentage point increase in the share of intra-bank funding that is granted to the group of non-hub affiliates has the same dampening effect on affiliate lending as if the parent bank had doubled the average amount of new long-term loans to firms on the home market.[16]

4.3 Parent banks as funders and competitors of affiliates

It seems likely that the funding possibilities and the activities of the parent bank are especially relevant for affiliates which rely strongly on intra-bank funding. According to the results of regression (3), reported in Table 6, we find that a larger percentage of intra-bank funding increases the dependence of affiliate lending on the balance sheet characteristics of the parent bank (as the most important supplier of internal funding). While the parent bank's *Deposit funding* has no impact *per se* on affiliate lending abroad in the crisis (as we can conclude from the insignificant coefficient estimated for the interaction of the parent bank's *Deposit funding* with the crisis dummy), its relevance emerges with affiliates taking recourse to intra-bank funding (see interaction term of parent bank's *Deposit funding* with the local affiliate's intra-bank funding). In a robustness test, we additionally investigate the impact of the degree to which parent banks rely on *Long-term wholesale funding* (see last column in Table 7). The same conclusion can be drawn from this test. The more local affiliates rely on internal funds, the more we find that relatively stable *Long-term wholesale funding* by the parent bank contributes positively to lending by affiliates abroad in the crisis.

In the competition analysis using equation (2) (see section 4.2), we show that, during the crisis, the formerly parallel expansion of parent banks' home lending and affiliates' lending abroad ceased to exist. With regression (3), reported in Table 6, we can be more specific about this. The delinkage of home and foreign activities is driven by the local affiliates abroad, which rely on intra-bank funding: Before the crisis, the more affiliates abroad borrow from their parent, the more their lending is expanded in parallel to the activities of the parent bank on the home market (see the interaction term between *Change in long-term lending at home* of the parent bank and *Intra-bank funding* of local affiliates). However, this parallel movement is lost during the financial crisis (the interaction of the term with the crisis dummy is significantly negative and the total effect in the crisis is insignificant). This reflects the competition for internal funds between the parent bank and its affiliates in foreign countries.

5 Further robustness tests

5.1 Robustness of the distress indicator

Our key results hold when we employ a continuous indicator of the generally perceived risk on funding markets for German banks instead of a crisis dummy variable. For this, we replace the crisis dummy marking the period from 2008Q3 onwards with the spread between the three-month European interbank offered rate (EURIBOR) and the three-month German government

16 The calculation is based on the coefficient estimated for the parent bank's *Change in long-term lending at home* and the descriptive statistics reported in Table 2.

bond rate.[17] This spread peaked in 2008Q4 at about 240 basis points. Until the end of our sample in 2010Q4, the spread was fluctuating at around 50 basis points, which is still well above the pre-crisis level of less than 10 basis points. With this alternative measure, we can confirm our above outcome that the net income of the local and the cross-border affiliates becomes increasingly relevant for a stable loan supply in the crisis. Deposit funding of the cross-border affiliates[18] and of the parent banks support affiliate lending abroad. As before, growing competition among the affiliates for internal funds can be detected during the crisis, and home lending by the parent bank is given priority over affiliate lending abroad during the time of distress.

5.2 Treatment of "zero" observations

Banks report their foreign activities to the Deutsche Bundesbank on a mandatory basis. Therefore, the panel of banks with which we operate contains no missing values. Zeros in the dataset have been reported as such by the banks. We investigate that part in foreign lending which is conducted by the German banks' affiliates located abroad. This lending may be undertaken either by local affiliates or hub affiliates which lend across borders or by both. Furthermore, a bank may or may not have other non-hub affiliates or affiliates operating in financial centers. If no business is conducted or no affiliate is present, these positions appear as zeros in our dataset. They nevertheless have an informational content, namely the decision of the bank not to conduct this type of business, which is why we include them in the analysis. It is, however, possible to carry out a robustness test on a smaller sample which includes only those observations where either a local or a hub affiliate reports a positive stock of loans outstanding in a country or where the stock is being built up or dissolved. When using this smaller sample, all our main results remain qualitatively unchanged.

6 Conclusions

The ongoing financial crisis with its abruptly arising funding difficulties, banks' increasing risk aversion and stricter capital requirements has given rise to a growing discussion about deleveraging by banks. In this context, there seems to be a particularly large degree of uncertainty about the behavior of banks' foreign affiliates, as their decisions depend not only on the country-specific loan demand and their own resources, but also on the strategy of the banking group as a whole. The ensuing restrictions on some funding instruments in the crisis have also become highly relevant for banking supervision. By addressing the impact of a global funding structure on affiliate lending abroad, we are making an explicit connection to the discussion on the international transmission of financial shocks. The management of this type of shock transmission is currently a focal point of interest for international organizations and is taking center stage in the design of the future European banking union.

With the unexpected bankruptcy of Lehman Brothers in September 2008, the funding of banks became more difficult due to the loss of confidence on both the capital and interbank markets.

17 We thereby follow CORNETT ET AL. (2011) who use the difference between the three-month London interbank offered rate (LIBOR) and the three-month Treasury rate for the US.

18 The estimated coefficient on deposit funding of the local affiliate remains positive but turns out to be insignificant.

Against this background, we have investigated the impact of the multinational banks' funding structures on the lending of their affiliates located abroad and provided some evidence of increasing competition for internal funds within the banking conglomerates. Our unique data set allows us to rely on lending and funding balance sheet data of both the affiliates and the parent banks at the micro level and thus to distinguish between market funding, internal funding (net income) and intra-bank funding. With regard to intra-bank funding, we are the first to identify the financial intra-bank relationship between German parent banks and their branches abroad. Thus, we can provide new insight into the competition for internal funds among the various different parts of the banking group, including locally active affiliates as well as affiliates acting as "hubs" which lend across borders or which are hosted in countries with large financial centers. Furthermore, we assure an accurate assessment of lending strategies by using transaction-induced changes in the banks' loan portfolios in real terms, which excludes changes in loan stocks caused by exchange rate fluctuations and other valuation effects.

First and foremost, we expect the foreign affiliates' own funding structure to be relevant for its lending decisions. In fact, we find that their local deposit funding as well as their potential to generate own funds internally prove to be key in stabilizing the loan supply after the bankruptcy of Lehman Brothers. As the net income can be also interpreted as a measure of profitability, we find that the success of the affiliates' lending business protects them from sizable deleveraging within the banking group in the crisis. With respect to the loan provision to a specific country, these results hold independently of the channel of loan distribution, which is either lending through a local affiliate or lending on a cross-border basis through affiliates functioning as lending "hubs" and are located in other, possibly neighboring countries. In contrast, we see short-term wholesale funding of local affiliates as a destabilizing element in the crisis. This is all the more troubling as this funding instrument, which is dominated by interbank loans, was by far the most relevant funding source for the affiliates up to the outbreak of the financial crisis (above 40 % of total assets), whereas, during the crisis, it has undergone a sharp decline.

The emerging funding gap, which was additionally increased by a temporary reduction in deposits, was partly offset by the financial support of the parent banks to their affiliates. Intra-bank funding as a share of total assets rose to slightly above 30 % in the crisis. Our results show that, with reliance on intra-bank funding, the funding characteristics of parent banks become relevant for the affiliates' lending behavior during the crisis. Affiliate lending abroad receives additional support from parent banks, which are more successful in collecting deposits and which have a stronger position in the long-term wholesale funding market. This market represents an important funding tool at the parent bank level and has a strong focus on the bonds and notes issued by the bank.

As banks' overall funds become scarce in the course of the crisis, we detect growing competition for funds within the banking organization. Affiliates with local lending activity increasingly compete with each other for internal funds. Conversely, unified in their aim to provide loans to a foreign economy, local affiliates and hub affiliates do not compete with each other for intra-bank funding. In addition, the fact that parent banks give priority to lending on their home market, as home lending is a core business for German banks, is found to be a further limiting factor for the affiliates' business abroad in the crisis. While lending by affiliates to the private sector in foreign countries used to expand more or less in parallel with lending to the home

market, this relationship no longer applies from late 2008 onwards. Especially affiliates relying on intra-bank funding suffer from the shift in funding priorities towards business on the home market.

We conclude that, in times of crisis, a bank adjusts its strategy, focusing on its most relevant business fields. Deleveraging as a response to the financial crisis is found to differ strongly across the various activities of the banks. It is therefore not easy to give a general prediction regarding the development of the loan supply by foreign affiliates during the crisis in certain regions of the world, as it is primarily bank-country specific. Western European banks' foreign affiliate lending, for example, plays a crucial role in the supply of loans to several Central and Eastern European countries; withdrawal on a considerable scale would probably have a noticeable effect on real activity. However, the BIS (2011) assesses a deleveraging of west European banks in this region as rather unlikely, since most of them operate through their in-country presence, and their claims are, to a large extent, long-term and are tradable only at relatively high cost. This is consistent with our outcome, which suggests that the strategic importance of the market combined with established banking infrastructure in the form of local affiliates which have independent funding implies significant exit costs. This may result in a rather stable loan provision in such regions, even during periods of distress.

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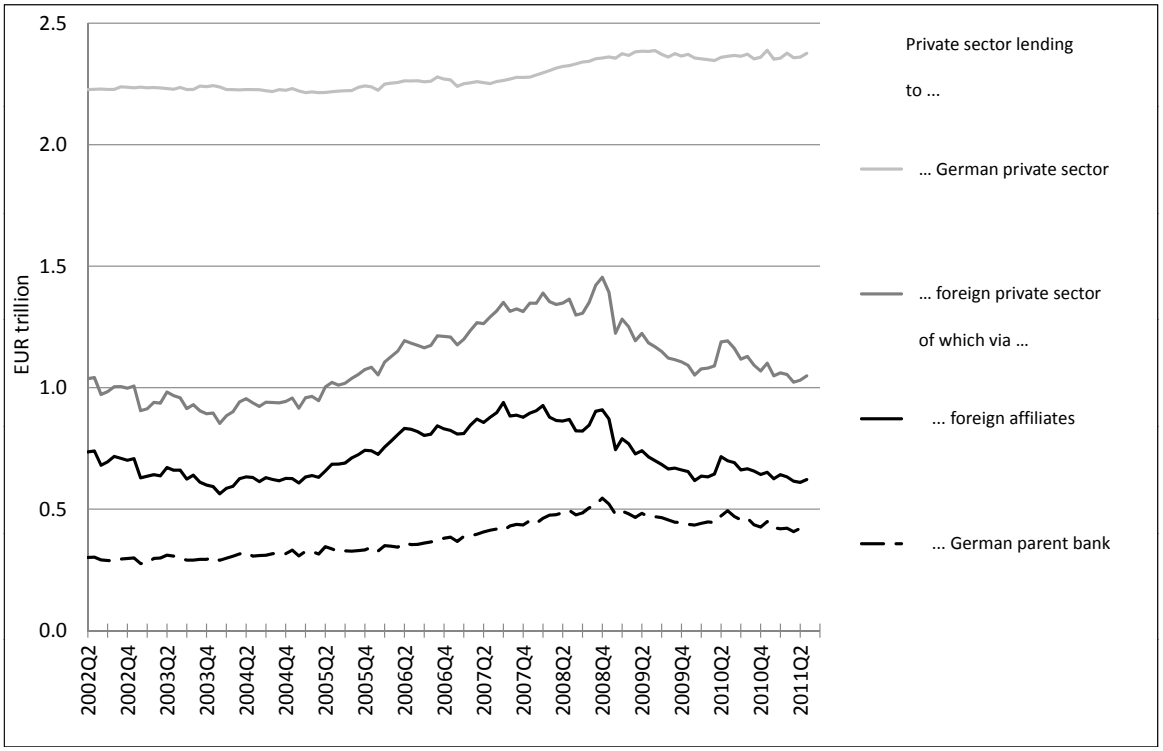
Appendix

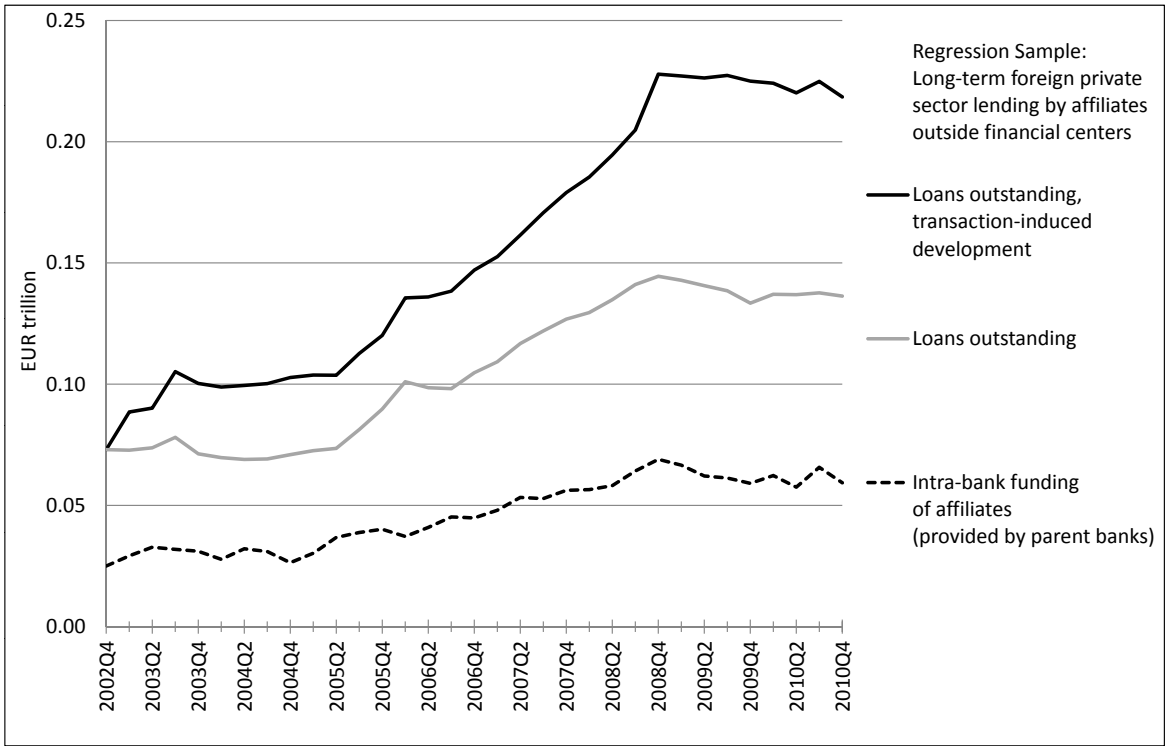
A Figures

Figure 1: Overall private sector lending by German banks



Source: Deutsche Bundesbank.
This graph depicts overall private sector lending to the German economy and to all foreign economies by the German banking system. The series are based on monthly observations reported to the Deutsche Bundesbank by the German banks and their affiliates (subsidiaries and branches) located abroad.

Figure 2: Lending and intra-bank funding by affiliates of German banks



Source: Deutsche Bundesbank / own calculations.
This graph depicts the aggregate development of transaction-induced long-term foreign private sector lending and intra-bank funding of affiliates located abroad comprising the largest 68 German banking organizations. These banking organizations account for approximately 84% of total foreign private sector lending by the German banking system (for details of the selection of banks and destination countries, see section 3). The underlying monthly series have been transformed into quarterly series. Transaction-induced changes are variations in loan stock which are not caused by exchange rate fluctuations or other valuation effects. The transaction-induced developments in loans outstanding is calculated by adding transaction-induced changes in loans to the stock of loans outstanding in 2002Q4. Intra-bank funding corresponds to net liabilities of foreign affiliates vis-à-vis the German parent banks.

Figure 3: Model of the lending and funding behavior of a multinational bank

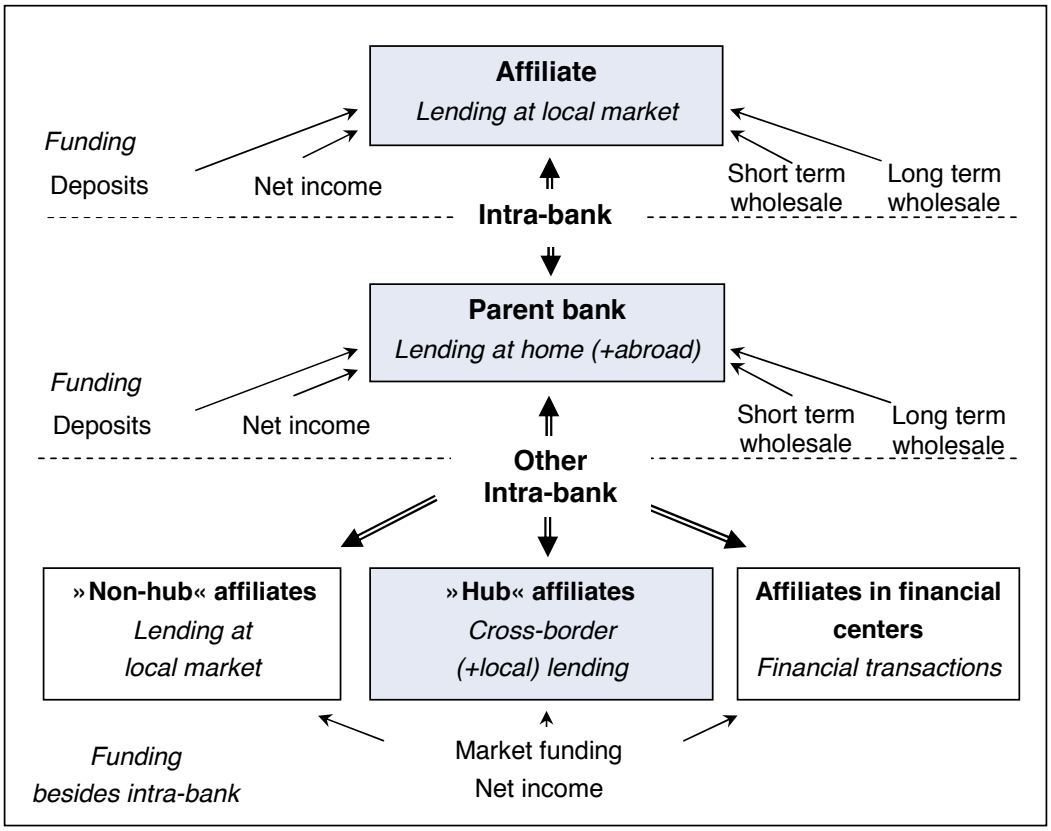
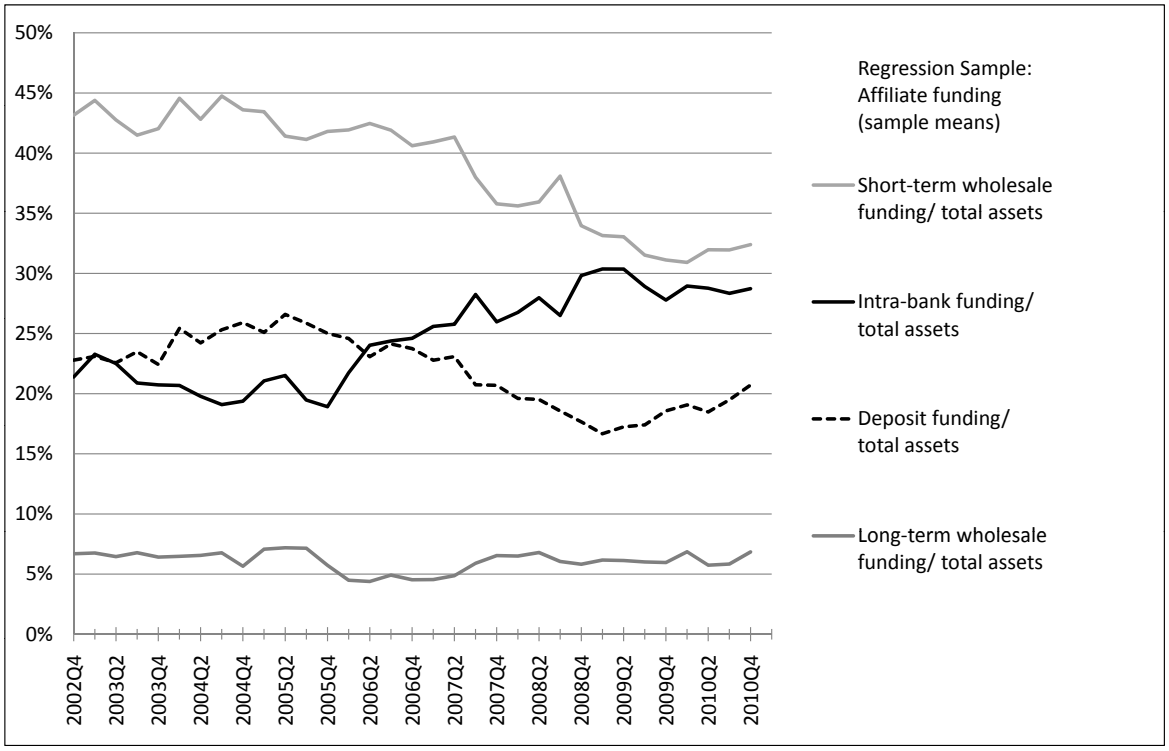
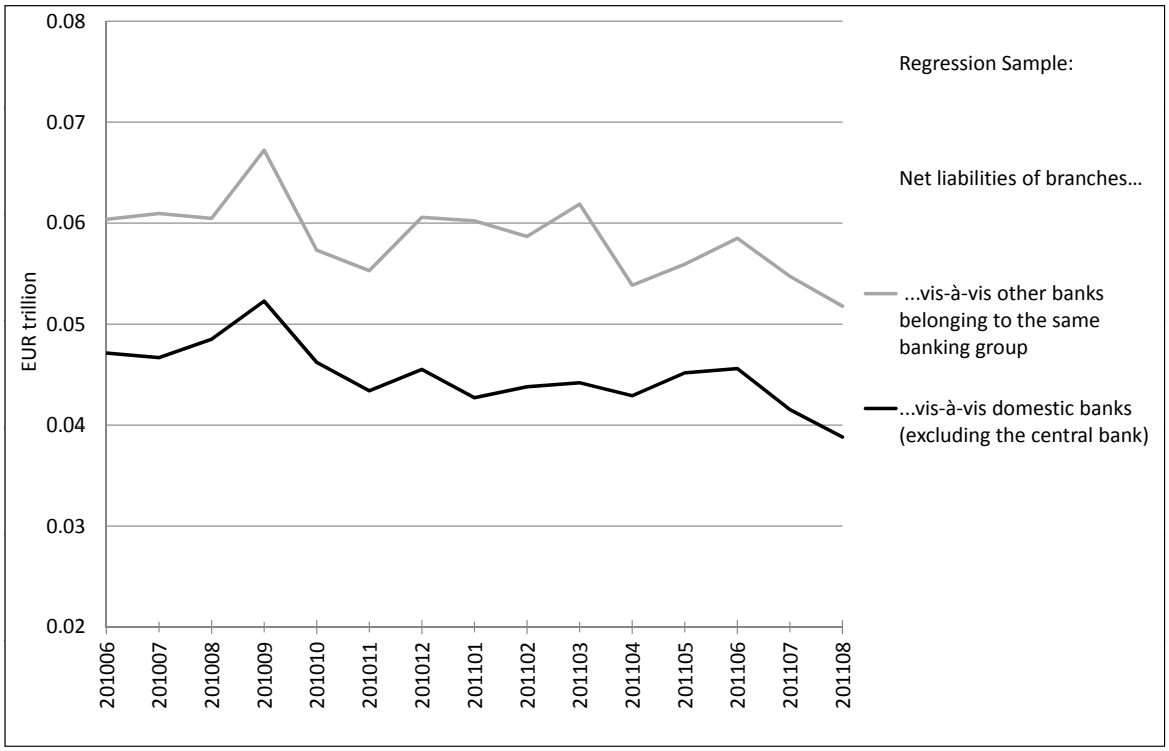


Figure 4: Funding structure of affiliates located abroad



Source: Deutsche Bundesbank / own calculations.
Based on balance sheet statistics, collected by the Deutsche Bundesbank, on subsidiaries and branches (together: affiliates) of German banks located abroad, we calculated quarterly mean shares of funding sources relative to total assets of affiliates over time. The graph is based on affiliates which appear in the regression sample.
Intra-bank funding corresponds to net borrowing of affiliates abroad vis-à-vis the German parent bank. Wholesale funding comprises both liabilities of affiliates vis-à-vis foreign banks and the issuance of bonds and notes.

Figure 5: Approximation of intra-bank flows for branches



Source: Deutsche Bundesbank / own calculations.
This graph supports our decision to use net liabilities vis-à-vis banks in Germany as an approximation of branches' net intra-bank borrowings. This becomes necessary for our analysis since it requires data from before and after the bankruptcy of Lehman Brothers, but the more accurate information on branches' net liabilities vis-à-vis banks belonging to the same banking group has been available only since June 2010. The dynamics between the two series follow a very similar pattern. The difference in volume might arise from the fact that the new series on net liabilities of branches vis-à-vis other banks of the same banking group comprise not only borrowing from the parent bank but also from other affiliates located abroad. Regarding the position vis-à-vis domestic banks, small inaccuracies may occur if branches abroad borrow from domestic banks other than their parent bank. However, we consider this to be rather unlikely and suggest that a branch's main business partner in the home banking sector is the parent bank.

B Tables

Table 1: Definition of variables and their expected impact on foreign affiliate lending in the crisis

Variable	*Definition*	*Notes on definition*	*Expected impact on foreign affiliate lending in the crisis*	*Short intuition*
Transaction-induced changes in long-term lending by affiliates abroad	Change in loan stock outstanding, adjusted for exchange rate fluctuations and cleaned from other valuation effects such as right-downs.	Measured in real terms using the German consumer price index to deflate initial series.	- *Dependent variable* -	
Deposit funding	Liabilites vis-à-vis non-banks / total assets		+	Banks that successfully raise deposits locally can rely on a stable source of funding as it is independent from the functioning of interbank and liquidity markets, even in times of crisis.
Short-term wholesale funding	(Short-term liabilities vis-à-vis banks + short-term debt securities issued) / total assets	For affiliates located abroad, only liabilities vis-à-vis foreign banks (international interbank market) are used. For parent banks, the position vis-à-vis other German banks (without the central bank) is used.	-	Short-term funding makes banks more dependent on market conditions and confidence within the wholesale funding market, which both worsened during the crisis.
Long-term wholesale funding	(Long-term liabilities vis-à-vis banks + long-term debt securities issued) / total assets		+	Banks with long-term refinancing on the wholesale market rely on a stable funding source during the crisis.
Intra-bank funding	Net liabilities of affiliate vis-à-vis parent bank / total assets	net liabilites of affiliate = net liabilities of subsidiary vis-à-vis parent bank + net liabilites of branch vis-à-vis German banking sector (the latter proxies for series not registered)	+/-	The affiliate's recourse to intra-bank funding provided by the parent bank could stabilize lending by compensating for other lost funding sources (+). Due to bank-wide competition on the bank's internal capital market a cut-back may arise especially in the crisis (-).
Net income	Net income / equity capital	Both series are averaged over the past two quarters in order to eliminate high fluctuations from the series.	+	Banks which are successful in generating net income are more independent from external finance or intra-bank funding and can stabilize their lending. It is also a signal of profitability and thus it reflects strategical importance of the affiliates.
Affiliate lending shares	Long-term loans outstanding vis-à-vis the foreign private sector / total amount held by the whole banking organization	Calculated for local affiliate, cross-border affiliates and non-cross-border affiliates.	+	The larger the share of local and cross-border affiliates in lending activities of the whole banking group, the more they are likely to extend credit.
Relevance of financial center affiliates	Overall balance sheet size of affiliates located in countries with important financial centers / total assets of banking organization		+/-	The larger the affiliates located in countries with important financial centers, the higher is their relevance within the bank (+), or the more they compete with affiliates engaged in lending to corporations for internal funds (-).

Table 1: *continued*

Change in long-term home lending of the parent bank	First difference of parent bank's loans outstanding vis-à-vis corporations located in the home market	Measured in real terms using the German consumer price index to deflate initial series.	-	In times of declining intra-bank funds, affiliate lending abroad compends with home lending by the parent bank for internal funds.
Capitalization	Equity capital / loans outstanding		-	High capitalization hints to higher risk aversion of the bank, which may limit the expansion of credit.
Size	Total assets		+	Size controls for lower informational asymmetries due to eg better screening instruments.
Weight on balance sheet characteristics of the *local* affiliate	Local affiliate's long-term loans to firms outstanding / total loan supply to firms in the specific country provided by all affiliates of the common parent bank	The share is averaged over the past six months in order to avoid misjudgement due to single events. For the extreme values: Set to 0 if denominator=0 (there is no loan supply by affiliates). Set to 1 if the calculated share exceeds 1.		This weight measures to which extent the local affiliate is able to satisfy local loan demand. Balance sheet characteristics of the local affiliate should be the more important compared to those of cross-border affiliates, the more it is responsible for the whole banking group's loan supply to the local market.
Weight on balance sheet characteristics of the group of *hub* affiliates which supply loans across borders	1- (Local affiliate's long-term loans to firms outstanding / total loan supply to firms in the specific country provided by all affiliates of the common parent bank)	The share is averaged over the past six months in order to avoid misjudgement due to single events. For the extreme values: Set to 0 if denominator=0 (there is no loan supply by affiliates). Also set to 0 if the weight on the local affiliate=1 (see definition right above).		This weight measures to which extent other affiliates outside the destination country support a potential local affiliate in satisfying local loan demand. Balance sheet characteristics of these hub affiliates which lend across borders should be the more important compared to local affiliates, the less these local dependencies cover the local demand for loans.

Table 2: Descriptive statistics

This table reports summary statistics for the panel of the largest 68 German banking conglomerates between 2002Q4 and 2010Q4. The data stem from statistics collected on a monthly basis by the Deutsche Bundesbank. Transaction-induced changes in long-term lending by affiliates abroad correspond to the variation in these affiliates' long-term loan stock outstanding vis-à-vis the foreign non-bank private sector, adjusted for exchange rate fluctuations and other valuation effects.

Affiliates comprise both subsidiaries and branches; the data are constructed such that, at most, one *Local affiliate* exists per parent bank and destination country (in other words 2,720 local affiliates would exist in a given quarter if all 68 banks had a local affiliate in each of the 40 destination countries). Balance sheet data of other affiliates of the same parent bank are, for the purpose of the analysis, aggregated according to their function in relation to the specific destination country. *Hub affiliates*=affiliates of the same parent bank outside the destination country, which are active in cross-border lending, and hence may also supply loans to this country. *Non-hub affiliates*=affiliates of the same parent bank outside the destination country whose lending is focused on their local market. *Financial center affiliates*=affiliates which are located in countries with major financial centers (see section 3).

For a better comparison of the different types of affiliates, summary statistics are reported at the level of the individual affiliate. For example, a hub affiliate in this table is an affiliate which potentially lends across borders and may therefore be, in the regressions, part of a group of hub affiliates of a specific bank with regard to its lending via affiliates to a given country. Minima and maxima of bank-specific variables are not shown here on grounds of confidentiality.

	Pre crisis avg (2002Q4-2008Q2)		Crisis avg (2008Q3-2010Q4)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.
Dependent variable				
Transaction-induced changes in long-term lending by affiliates abroad (in EUR bn)	0.002	0.056	0.002	0.066
Local affiliate				
Deposits / total assets	0.237	0.255	0.189	0.234
Short-term wholesale funding / total assets	0.422	0.325	0.338	0.315
Long-term wholesale funding / total assets	0.059	0.121	0.062	0.155
Net income / equity capital	4.552	45.060	8.841	83.342
Intra-bank funding / total assets	0.221	0.449	0.284	0.451
Capitalization (equity capital / loans outstanding)	0.792	14.372	0.131	0.497
Affiliate lending share (within banking group)	0.045	0.120	0.040	0.098
Total assets (in EUR bn)	2.653	4.347	2.998	5.329
Lending share within group of affiliates, used as weight on local lending	0.657	0.393	0.612	0.423
# of local affiliates per quarter	90	2	101	3
Hub affiliate				
Deposits / total assets	0.166	0.203	0.146	0.201
Short-term wholesale funding / total assets	0.410	0.322	0.304	0.309
Long-term wholesale funding / total assets	0.069	0.113	0.088	0.190
Net income / equity capital	1.179	5.026	1.680	7.941
Intra-bank funding / total assets	0.343	0.415	0.473	0.395
Capitalization (equity capital / loans outstanding)	0.047	0.053	0.049	0.062
Affiliate lending share (within banking group)	0.063	0.079	0.064	0.073
Total assets (in EUR bn)	3.770	4.251	2.873	3.451
Lending share within group of affiliates, used as weight on cross-border lending	0.477	0.475	0.464	0.479
# of hub affiliates per quarter	25	3	28	2
Other affiliate of the same banking group				
Non-hub affiliate: Lending share (within banking group)	0.037	0.132	0.031	0.105
Non-hub affiliate: Intra-bank funding / total assets	0.174	0.453	0.210	0.450
# of non-hub affiliates per quarter	65	2	72	3
Financial center affiliate: Relevance (size rel. to banking group)	0.053	0.064	0.047	0.054
Financial center affiliate: Intra-bank funding / total assets	0.075	0.294	0.193	0.368
# of financial center affiliates per quarter	77	1	77	1
Parent bank				
Deposits / total assets	0.466	0.220	0.512	0.222
Short-term wholesale funding / total assets	0.057	0.065	0.054	0.054
Long-term wholesale funding / total assets	0.308	0.183	0.260	0.162
Net income / equity capital	0.192	0.168	0.145	0.181
Capitalization (equity capital / loans outstanding)	0.060	0.042	0.060	0.028
Change in long-term lending at home (in EUR bn)	-0.041	0.429	0.012	0.318
Total assets (in EUR bn)	57.030	98.530	63.103	102.454
# of parent banks per quarter	68	0	68	0

Table 3: List of countries

Numbers refer to the regression sample and provide a snapshot of aggregate lending to the foreign non-bank private sector by affiliates located abroad of the largest 68 German banking organizations as of 12/2009. Affiliates may be located in or outside the destination country. Lending volumes and number of active affiliates may include both local affiliates and affiliates situated in other foreign countries. The data stem from monthly reports to the Deutsche Bundesbank.

	Country	Volume of affiliate long-term lending to private sector (in Euro Million)	Number of German banks with active affiliates	Affiliate share in total long-term lending by German banks
1	Italy (IT)	26,091.250	12	0.95
2	Spain (ES)	22,820.940	18	0.73
3	Poland (PL)	13,164.440	12	0.68
4	France (FR)	12,359.650	19	0.41
5	Netherlands (NL)	8,220.244	20	0.30
6	Hungary (HU)	5,991.111	9	0.74
7	Australia (AU)	4,943.627	12	0.84
8	Portugal (PT)	4,410.414	11	0.76
9	Japan (JP)	3,314.444	8	0.56
10	Russian Federation (RU)	3,235.044	8	0.40
11	Sweden (SE)	2,900.897	11	0.31
12	Denmark (DK)	2,627.659	13	0.39
13	Norway (NO)	2,198.446	8	0.39
14	Belgium (BE)	2,109.908	14	0.39
15	United Arab Emirates (AE)	1,910.929	10	0.66
16	India (IN)	1,901.942	9	0.80
17	Canada (CA)	1,766.109	12	0.51
18	Czech Republic (CZ)	1,647.326	10	0.41
19	Mexico (MX)	1,295.724	10	0.51
20	Finland (FI)	1,080.531	9	0.36
21	Chile (CL)	920.475	7	0.69
22	Saudi Arabia (SA)	900.928	5	0.79
23	Brazil (BR)	880.329	8	0.68
24	Turkey (TR)	847.644	9	0.16
25	Ukraine (UA)	834.890	4	0.78
26	South Africa (ZA)	783.251	5	0.85
27	Greece (GR)	623.486	10	0.14
28	Qatar (QA)	570.247	5	0.51
29	Iceland (IS)	523.858	10	0.72
30	China (CN)	505.746	9	0.62
31	Austria (AT)	418.298	11	0.11
32	Romania (RO)	413.421	5	0.28
33	Republic of Korea (KR)	278.359	7	0.69
34	Indonesia (ID)	268.412	7	0.77
35	Slovak Republic (SK)	252.944	6	0.31
36	New Zealand (NZ)	150.493	6	0.79
37	Iran (IR)	103.856	5	0.15
38	Israel (IL)	61.155	6	0.09
39	Slovenia (SI)	39.833	3	0.04
40	Croatia (HR)	36.838	4	0.11
	Total	133,405.098		
	Financial centers*	135,474.400		

* Countries hosting major financial centers that were not considered for the analysis. Alongside the US and the UK, all offshore financial centers as defined by the IMF (2000) were excluded as destination countries for lending. These are Luxembourg, Ireland, Switzerland, Singapore, Hong Kong, Malta, Cyprus, Bahrain, Macao, Mauritius, Liechtenstein, Antigua and Barbuda, Anguilla, Netherlands Antilles, Barbados, Bermuda, Guernsey, Gibraltar, Isle of Man, Jersey, Cayman Islands, Liberia, Marshall Islands, Panama, Philippines, Saint Vincent and the Grenadines, Virgin Islands (British), Virgin Islands (US).

Table 4: Role of affiliates' funding structures

This table reports fixed-effects regressions of quarterly transaction-induced changes in long-term lending by affiliates abroad for a panel of the largest 68 German banking conglomerates, 2002Q4 to 2010Q4. Transaction-induced changes correspond to the affiliates' variations in the long-term loan stock outstanding vis-à-vis the foreign non-bank private sector, adjusted for exchange rate fluctuations and other valuation effects. Intra-bank funding corresponds to net liabilities of an affiliate abroad vis-à-vis its German parent bank (the affiliate variables are the authors' calculations based on data collected by the Deutsche Bundesbank such that one affiliate exists per parent bank and country). *Local affiliate*=local affiliate in destination country. *Hub affiliates*=affiliates of the same parent bank outside the destination country, which are active in cross-border lending, and hence may also supply loans to this country (see section 3). All explanatory variables are lagged one period. *Crisis* dummy=1 if t≥2008Q3. Standard errors, clustered by bank-country pairs, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	Dependent variable	*Change*	*control for*
	Transaction-induced change in long-term lending by affiliates	*in crisis*	*pre-crisis*
I.	*Local affiliate:*		
	Deposit funding	0.147**	0.031
		(0.070)	(0.049)
	Short-term wholesale funding	-0.072*	-0.013
		(0.039)	(0.025)
	Net income	0.005***	-0.000***
		(0.001)	(0.000)
	Capitalization	-0.039	0.029
		(0.040)	(0.032)
	Affiliate lending share	-0.114	0.045
		(0.077)	(0.038)
	Size (total assets)	-0.005	0.007*
		(0.003)	(0.004)
II.	*Hub affiliates:*		
	Deposit funding	0.082***	-0.042***
		(0.021)	(0.015)
	Short-term wholesale funding	-0.021*	0.022***
		(0.011)	(0.009)
	Net income	4.74e-04***	-6.07e-04***
		(0.000)	(0.000)
	Capitalization	-0.193***	0.057
		(0.062)	(0.054)
	Affiliate lending share	-0.004	-0.014
		(0.009)	(0.009)
III.	*Parent bank:*		
	Deposit funding	-0.000	0.005
		(0.004)	(0.004)
	Short-term wholesale funding	-0.035**	-0.020***
		(0.018)	(0.006)
	Net income	-0.002	0.001
		(0.003)	(0.003)
	Capitalization	-0.012	0.003
		(0.021)	(0.007)
	Size (total assets)	-1.26e-05	1.06e-04**
		(0.000)	(0.000)
	Parent bank fixed effects	Yes	
	Country-time fixed effects (demand controls)	Yes	
	Quarterly time dummies	Yes	
	Constant	-0.026	
		(0.020)	
	Observations	89684	
	Number of bank-country pairs (clusters)	2720	
	adj. R-squared	0.0228	

Table 5: Intra-bank competition with affiliates and parent

This table reports fixed-effects regressions of quarterly transaction-induced changes in long-term lending by affiliates abroad for a panel of the largest 68 German banking conglomerates, 2002Q4 to 2010Q4. Transaction-induced changes correspond to the affiliates' variations in the long-term loan stock outstanding vis-à-vis the foreign non-bank private sector, adjusted for exchange rate fluctuations and other valuation effects. Intra-bank funding corresponds to net liabilities of an affiliate abroad vis-à-vis its German parent bank (the affiliate variables are the authors' calculations based on data collected by the Deutsche Bundesbank such that one affiliate exists per parent bank and country). *Local affiliate*=local affiliate in destination country. *Hub affiliates*=affiliates of the same parent bank outside the destination country, which are active in cross-border lending, hence may also supply loans to this country. *Non-hub affiliates*=affiliates of the same parent bank outside the destination country whose lending is focused on their local market. *Financial center affiliates*=affiliates which are, in contrast to all other affiliates, located in countries with important financial centers (see section 3). All explanatory variables are lagged one period. *Crisis* dummy=1 if t≥2008Q3. Standard errors, clustered by bank-country pairs, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	Dependent variable	*Change*	*control for*
	Transaction-induced change in long-term lending by affiliates	*in crisis*	*pre-crisis*
I.	*Local affiliate:*		
	Deposit funding	0.116*	0.049
		(0.070)	(0.048)
	Short-term wholesale funding	-0.076**	-0.003
		(0.038)	(0.024)
	Net income	0.005***	-0.001**
		(0.001)	(0.000)
	Capitalization	-0.018	0.008
		(0.038)	(0.028)
	Affiliate lending share	-0.026	-0.071
		(0.062)	(0.051)
	Size (total assets)	-0.004	0.006
		(0.003)	(0.004)
	Intra-bank funding	**-0.057***	0.058**
		(0.034)	(0.025)
II.	*Hub affiliates:*		
	Deposit funding	0.061***	-0.044**
		(0.023)	(0.018)
	Short-term wholesale funding	-0.018	0.030***
		(0.013)	(0.010)
	Net income	5.40e-04**	-5.76e-04**
		(0.000)	(0.000)
	Capitalization	-0.137**	0.027
		(0.068)	(0.067)
	Affiliate lending share	-0.006	-0.031*
		(0.011)	(0.016)
	Intra-bank funding	**-0.014**	0.010
		(0.009)	(0.008)
III.	*Further affiliates of the same parent bank:*		
	Non-hub affiliates: Lending share	0.020	-0.039
		(0.012)	(0.027)
	Non-hub affiliates: Intra-bank funding	**-0.010****	0.003
		(0.005)	(0.004)
	Financial center affiliates: Relevance	-0.004	0.010
		(0.016)	(0.016)
	Financial center affiliates: Intra-bank funding	**0.003***	0.003
		(0.002)	(0.003)
IV.	*Parent bank:*		
	Balance sheet controls (as in specification 1)	Yes	
	Change in long-term lending at home	**-0.007****	0.010***
		(0.004)	(0.003)
	Parent bank FE / Country-time FE / Quarter dummies	Yes / Yes / Yes	
	Constant	-0.016	
		(0.026)	
	Observations	89684	
	Number of bank-country pairs (clusters)	2720	
	adj. R-squared	0.0307	

Table 6: Intra-bank relation with the parent

This table reports fixed-effects regressions of quarterly transaction-induced changes in long-term lending by affiliates abroad for a panel of the largest 68 German banking conglomerates, 2002Q4 to 2010Q4. Transaction-induced changes correspond to the affiliates' variations in the long-term loan stock outstanding vis-à-vis the foreign non-bank private sector, adjusted for exchange rate fluctuations and other valuation effects. Intra-bank funding corresponds to net liabilities of an affiliate abroad vis-à-vis its German parent bank (the affiliate variables are the authors' calculations based on data collected by the Deutsche Bundesbank such that one affiliate exists per parent bank and country). *Local affiliate*=local affiliate in destination country. *Hub affiliates*=affiliates of the same parent bank outside the destination country, which are active in cross-border lending, and hence may also supply loans to this country (see section 3). All explanatory variables are lagged one period. *Crisis* dummy=1 if t≥2008Q3. Standard errors, clustered by bank-country pairs, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	Dependent variable	*Change*	*control for*
	Transaction-induced change in long-term lending by affiliates	*in crisis*	*pre-crisis*
I.	*Local affiliate:*		
	Deposit funding	0.138**	0.042
		(0.069)	(0.048)
	Short-term wholesale funding	-0.076**	-0.010
		(0.038)	(0.024)
	Net income	0.004***	-0.000
		(0.001)	(0.000)
	Capitalization	-0.047	0.021
		(0.045)	(0.031)
	Affiliate lending share	-0.123	-0.007
		(0.083)	(0.043)
	Size (total assets)	-0.004	0.006*
		(0.003)	(0.004)
	Intra-bank funding	-0.025	0.046
		(0.055)	(0.033)
II.	*Hub affiliates:*		
	Deposit funding	0.063***	-0.039**
		(0.022)	(0.017)
	Short-term wholesale funding	-0.021*	0.022***
		(0.011)	(0.008)
	Net income	4.54e-04**	-4.75e-04**
		(0.000)	(0.000)
	Capitalization	-0.138*	0.038
		(0.071)	(0.067)
	Affiliate lending share	-0.003	0.005
		(0.010)	(0.008)
	Intra-bank funding	-0.010	0.008
		(0.009)	(0.008)
III.	*Parent bank:*		
	Deposit funding	-0.003	0.004
		(0.004)	(0.004)
	Deposit funding * Intra-bank funding of local affiliate	**0.135***	-0.110**
		(0.070)	(0.053)
	Short-term wholesale funding	-0.037**	-0.007
		(0.017)	(0.005)
	Short-term wholesale funding * Intra-bank funding of local affiliate	**-0.620**	0.203
		(0.393)	(0.256)
	Net income	0.000	-0.002
		(0.003)	(0.002)
	Net income * Intra-bank funding of local affiliate	**0.027**	0.251***
		(0.235)	(0.089)
	Capitalization	-0.019	-0.002
		(0.021)	(0.005)
	Size (total assets)	1.23e-06	6.00e-05
		(0.000)	(0.000)
	Change in long-term lending at home	-0.002	0.004***
		(0.002)	(0.001)
	Change in long-term lending at home * Intra-bank funding of local affiliate	**-0.101****	0.125***
		(0.046)	(0.033)
	Parent bank FE / Country-time FE / Quarter dummies	Yes / Yes / Yes	
	Constant	-0.012	
		(0.017)	
	Observations	89684	
	Number of bank-country pairs (clusters)	2720	
	adj. R-squared	0.0720	

Table 7: All specifications and robustness

This table provides the full specifications of all the regressions reported earlier. The table additionally contains a robustness test including long-term wholesale funding, which is the funding source that was previously omitted in order to limit concerns about multicollinearity. The different groups of affiliates are defined as in section 3 and in the regressions reported in Tables 4 to 6. All explanatory variables are lagged one period. *Crisis* dummy=1 if t≥2008Q3. Standard errors, clustered by bank-country pairs, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	(1)		(2)		(3)		(Robustness)	
Dependent variable	Role of affiliates'		Intra-bank competition		Intra-bank relation		Including	
Transaction-induced change in long-term lending by affiliates	funding structures		with affiliates and parent		with the parent		long-term wholesale funding	
	Change in crisis	*control for pre-crisis*	*Change in crisis*	*control for pre-crisis*	*Change in crisis*	*control for pre-crisis*	*Change in crisis*	*control for pre-crisis*
. *Local affiliate:*								
Deposit funding	0.147**	0.031	0.116*	0.049	0.138**	0.042	0.138*	0.043
	(0.070)	(0.049)	(0.070)	(0.048)	(0.069)	(0.048)	(0.071)	(0.049)
Short-term wholesale funding	-0.072*	-0.013	-0.076**	-0.003	-0.076**	-0.010	-0.083**	-0.007
	(0.039)	(0.025)	(0.038)	(0.024)	(0.038)	(0.024)	(0.038)	(0.023)
Long-term wholesale funding							0.066	-0.034
							(0.051)	(0.045)
Net income	0.005***	-0.000***	0.005***	-0.001**	0.004***	-0.000	0.004***	-0.000
	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)
Capitalization	-0.039	0.029	-0.018	0.008	-0.047	0.021	-0.045	0.022
	(0.040)	(0.032)	(0.038)	(0.028)	(0.045)	(0.031)	(0.045)	(0.033)
Affiliate lending share	-0.114	0.045	-0.026	-0.071	-0.123	-0.007	-0.087	-0.014
	(0.077)	(0.038)	(0.062)	(0.051)	(0.083)	(0.043)	(0.086)	(0.048)
Size (total assets)	-0.005	0.007*	-0.004	0.006	-0.004	0.006*	-0.004	0.006*
	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Intra-bank funding			-0.057*	0.058**	-0.025	0.046	-0.081	0.057
			(0.034)	(0.025)	(0.055)	(0.033)	(0.050)	(0.037)
I. *Hub affiliates:*								
Deposit funding	0.082***	-0.042***	0.061***	-0.044**	0.063***	-0.039**	0.067***	-0.039**
	(0.021)	(0.015)	(0.023)	(0.018)	(0.022)	(0.017)	(0.023)	(0.018)
Short-term wholesale funding	-0.021*	0.022***	-0.018	0.030***	-0.021*	0.022***	-0.020	0.020**
	(0.011)	(0.009)	(0.013)	(0.010)	(0.011)	(0.008)	(0.013)	(0.009)
Long-term wholesale funding							0.006	0.007
							(0.011)	(0.010)
Net income	4.74e-04***	-6.07e-04***	5.40e-04**	-5.76e-04**	4.54e-04**	-4.75e-04**	4.43e-04**	-4.47e-04**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capitalization	-0.193***	0.057	-0.137**	0.027	-0.138*	0.038	-0.165**	0.042
	(0.062)	(0.054)	(0.068)	(0.067)	(0.071)	(0.067)	(0.072)	(0.068)
Affiliate lending share	-0.004	-0.014	-0.006	-0.031*	-0.003	0.005	-0.004	0.007
	(0.009)	(0.009)	(0.011)	(0.016)	(0.010)	(0.008)	(0.011)	(0.008)
Intra-bank funding			-0.014	0.010	-0.010	0.008	-0.009	0.008
			(0.009)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)
II. *Further affiliates of the same parent bank:*								
Non-hub affiliates: Lending share			0.020	-0.039				
			(0.012)	(0.027)				
Non-hub affiliates: Intra-bank funding			-0.010**	0.003				
			(0.005)	(0.004)				
Financial center affiliates: Relevance			-0.004	0.010				
			(0.016)	(0.016)				
Financial center affiliates: Intra-bank funding			0.003*	0.003				
			(0.002)	(0.003)				
V. *Parent bank:*								
Deposit funding	-0.000	0.005	-0.007**	0.008	-0.003	0.004	0.012	0.007
	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)	(0.004)	(0.021)	(0.011)
Deposit funding * Intra-bank funding of local affiliate					0.135*	-0.110**	0.147*	-0.123**
					(0.070)	(0.053)	(0.076)	(0.057)
Short-term wholesale funding	-0.035**	-0.020***	-0.054***	-0.002	-0.037**	-0.007	-0.021	-0.005
	(0.018)	(0.006)	(0.019)	(0.008)	(0.017)	(0.005)	(0.029)	(0.015)
Short-term wholesale funding * Intra-bank funding of local affiliate					-0.620	0.203	-0.882**	0.287
					(0.393)	(0.256)	(0.377)	(0.275)
Long-term wholesale funding							0.015	0.005
							(0.020)	(0.010)
Long-term wholesale funding * Intra-bank funding of local affiliate							0.231*	-0.052
							(0.118)	(0.078)
Net income	-0.002	0.001	0.001	0.001	0.000	-0.002	0.000	-0.001
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Net income * Intra-bank funding of local affiliate					0.027	0.251***	-0.092	0.303**
					(0.235)	(0.089)	(0.245)	(0.137)
Capitalization	-0.012	0.003	-0.003	-0.004	-0.019	-0.002	-0.015	0.004
	(0.021)	(0.007)	(0.016)	(0.006)	(0.021)	(0.005)	(0.015)	(0.006)
Size (total assets)	-1.26e-05	1.06e-04**	-3.50e-06	7.47e-05	1.23e-06	6.00e-05	7.77e-06	8.25e-05**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Change in long-term lending at home			-0.007**	0.010***	-0.002	0.004***	-0.002	0.004***
			(0.004)	(0.003)	(0.002)	(0.001)	(0.002)	(0.001)
Change in long-term lending at home * Intra-bank funding of local affiliate					-0.101**	0.125***	-0.088*	0.125***
					(0.046)	(0.033)	(0.050)	(0.033)
Parent bank fixed effects	Yes		Yes		Yes		Yes	
Country-time fixed effects (demand controls)	Yes		Yes		Yes		Yes	
Quarterly time dummies	Yes		Yes		Yes		Yes	
Constant	-0.026		-0.016		-0.012		-0.020	
	(0.020)		(0.026)		(0.017)		(0.017)	
Observations	89684		89684		89684		89684	
Number of bank-country pairs (clusters)	2720		2720		2720		2720	
adj. R-squared	0.0228		0.0307		0.0720		0.0729	

IV Repo funding and internal capital markets in the financial crisis

This paper is available as:

Düwel, C. (2013). Repo funding and internal capital markets in the financial crisis. *Bundesbank Discussion Paper*, No 16/2013, Economic Research Centre, Deutsche Bundesbank.

It is at the stage of *"revise & resubmit"* to the *International Journal of Central Banking*.

The paper was presented at the following refereed conference:

- *18th Spring Meeting of Young Economists*, University of Aarhus, Aarhus (Denmark), May 30 - June 01, 2013.

The paper was furthermore presented at the following non-refereed workshops:

- *MAGKS Doctoral Seminar*, Rauischholzhausen, September 20–21, 2012.
- *FMI Doctoral Seminar*, University of Giessen, Giessen, December 19, 2012.
- *Joint Doctoral Seminar,* University of Tübingen / Frankfurt School of Finance and Management, Frankfurt am Main, April 10-11, 2013.

Repo funding and internal capital markets in the financial crisis

April 2013

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Abstract

This paper examines key events during the financial crisis which called into question the low risk associated with providing and obtaining secured funding. Domestic parents of German multinational banks which were more exposed to the runs on the collateralized repo (sale and repurchase) markets are found to have withdrawn bank-internal funds from their foreign affiliates to a greater extent. After the collapse of the subprime market, they briefly protected their branches, which were core investment locations abroad, while subsidiaries were used as core funding locations up to the Lehman Brothers bankruptcy. The rescue of Bear Stearns triggered the largest contraction on internal capital markets from the part of the parent bank. All in all, this study finds that the funding shocks primarily related to the US financial system were transmitted abroad both through repo financing on capital markets and through bank-internal capital markets.

Keywords: Repo, funding structure, multinational banks, internal capital market, intra-bank lending, financial crisis.

JEL Classification: G21, G15, F34, E44

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This paper was written during research visits to the Deutsche Bundesbank. I would like to thank the Bundesbank and its staff for their continuous hospitality and support. The paper has benefited from valuable comments by Claudia Buch, Jens Conrad, Ben Craig, Falko Fecht, Rainer Frey, Linda Goldberg, Heinz Herrmann, Alexander Lipponer, Cordula Munzert, Winfried Rudek and Peter Tillmann. All remaining errors and inaccuracies are my own. Financial support from the University of Giessen is gratefully acknowledged.

1 Introduction

In the run-up to the financial crisis, the interconnectedness of financial institutions and excessive risk-taking worldwide were underestimated (MISHKIN (2011)). Recent literature has highlighted the role of globally active banks in transmitting the crisis, which began with the collapse of the US subprime housing market and spread to the global financial system. CETORELLI AND GOLDBERG (2012) document that US global banks activated their internal capital market in order to reallocate liquidity within their banking organizations, putting the needs of the parent bank first and, in some cases, using their foreign affiliates as sources of funding. In Europe, it was first believed that the subprime crisis was a market-specific crisis that would be confined to within the borders of the United States or disappear with the write-down of loans and the adjustments in the value of the collateral directly linked to the US subprime market, if not sooner. In stark contrast to such expectations, the disruptions in the US financial system triggered a worldwide financial crisis that continued to escalate for more than two years following the collapse of the subprime market in mid-2007. Such severe consequences would not have been possible without further transmission channels besides the direct exposure of banks around the world to the US subprime market. Referring to the interconnectedness of banks, GORTON AND METRICK (2012) argue that securitized banking was the key financial market instrument that aggravated the crisis and transmitted it to the rest of the world. This type of short-term refinancing on capital markets uses securitized assets as collateral in sale and repurchase (repo) transactions, and was believed to be more stable than unsecured funding. However, during the crisis, uncertainty about the value of the offered collateral and mistrust among market participants increased sharply, which severely limited the liquidity of these markets.

Using confidential data on German multinational banks, this paper analyzes to which extent the exposure of these banks to the disruptions in securitized banking affected their global fund management. Three key events are analyzed with regard to their role in accelerating the loss of confidence and the deterioration of collateral value in the repo market: the collapse of the subprime market, the rescue of Bear Stearns, and the bankruptcy of Lehman Brothers. The study tests to what extent the vulnerability of parent banks to the drying-up of repo markets following these events reduced their support of affiliated banks abroad. Furthermore, this study tests whether German banks adopted, in this period of distress, a type of pecking order similar to that of US banks. This puts the needs of the parent bank first and redirects funds internally in order to protect the most important parts of the banking organization in terms of its lending business (CETORELLI AND GOLDBERG (2012)). However, the literature has, so far, not compared the two types of affiliates, branches and subsidiaries, with regard to their role in internal capital markets. By inspecting the changes on the banks' internal capital markets, this paper asks whether the decisions taken by a parent bank regarding its global fund management are related to the organizational form of the affiliate (branch or subsidiary). The study aims to contributing to an understanding of global banks' fund management as well as to assess the role of securitized banking in the international transmission of a funding crisis.

Two strands of literature are linked in this study. These assess at different levels how the crisis was transmitted from subprime housing assets to bank refinancing and, ultimately, affected banks' lending activities. One strand of literature investigates how the financial crisis spread on refinancing markets from subprime-related assets to non-subprime related asset classes. KRISHNAMURTHY (2010) argues that the financial crisis has been a crisis especially in debt markets, as participants on these markets were no longer able to raise funds easily and quickly owing to the separation of fundamental values and market prices for certain assets. As a major source of funding shuts down, banks that do not have ready alternatives may downsize their lending activity either domestically or abroad, eventually reducing the financing of the real economy.[1] GORTON AND METRICK (2012) find strong correlation of counterparty risk measures with the spreads for many non-subprime-related asset classes that were used as collateral in refinancing transactions. They draw the conclusion that concerns about counterparty solvency and uncertainty about the value of the offered collateral led to a run on repo markets by investors, which is analogous to a run on banks by bank depositors. Since repo markets represented a major source of funding for financial institutions, the authors argue that this run on repo was the key accelerator of the crisis.[2] ACHARYA AND ÖNCÜ (2013) conclude from the recent events that financial distress of individual participants can quickly cause systemic illiquidity on repo markets. They propose to introduce tighter regulation on repos as systemically important liabilities rather than on the market participants themselves in order to avoid runs on the markets. These aspects call for a closer investigation of repo funding as a major short-term funding source of multinational banks.

HÖRDAHL AND KING (2008) compare developments on the US repo market with refinancing conditions on the European repo market after the outbreak of the subprime crisis. They find that the size of the European repo market declined due to growing risk aversion, greater preference for cash, and the increasing volatility of prices. The findings by MARTIN ET AL. (2012) derived from a dynamic equilibrium model are consistent with this picture. They illustrate how short-term collateralized borrowing may become highly unstable in times of crisis. This environment was responsible for the fact that even large and well-established market participants were hit by the disruptions and were prompted to downsize their activities related to repo markets. European banks' access to this important source of funding consequently became limited. The present paper links this aspect to the ability of parent banks to provide funds to their foreign affiliates.

A second strand of literature suggests that the global nature of many large banks is key to the international transmission of funding shocks (see CETORELLI AND GOLDBERG (2011) for the transmission of dollar-funding shocks to emerging markets, PEEK AND ROSENGREN (1997) and (2000) on the decline in the lending of Japanese bank branches in the US upon funding shocks to their parent banks, as well as AIYAR (2011) and ROSE AND WIELADEK (2011) for the recent comparably large decline in lending by foreign-owned banks' affiliates in the UK). CETORELLI AND GOLDBERG (2012) show that US global banks reduced their net lending via the internal

1 MISHKIN (2011) alludes to the possibility that increasing uncertainty in a financial crisis also increases asymmetric information and thus reduces the bank's ability to distribute credit effectively to firms and households. DE HAAS AND VAN HOREN (2012A) lend empirical support to this suggestion by showing that foreign lending remained more stable when banks had close relationships with borrowers.

2 KRISHNAMURTHY ET AL. (2012) observe that US money market funds and security lenders, which were largely financing the shadow banking system via repos, ran from their investments and thus significantly contributed to deteriorating lending conditions on repo markets.

capital market to affiliates located abroad, the more they were exposed to the collapse of the asset-backed commercial paper market. DE HAAS AND VAN LELYVELD (2006) and (2010) as well as POPOV AND UDELL (2012) document that financially strong European parent banks can stabilize their central and eastern European entities' loan supply in a local crisis, but that they are not a source of strength for their subsidiaries in a global, systemic crisis like the recent one which has negatively affected their own balance sheets.[3] The crisis hit the lending business of banks harder if ex ante they had relied more on short-term funding via interbank markets and less on deposit funding (see CORNETT ET AL. (2010) and IVASHINA AND SCHARFSTEIN (2010) for US banks, and DÜWEL AND FREY (2012) for German banks). The present study provides evidence for the transmission of a repo funding shock via internal capital markets of multinational banks.

This paper shows that German parent banks which were more exposed to the run on repo markets during the financial crisis were more aggressive in reducing their liquidity provision to foreign affiliates, especially after the subprime market collapse and the Bear Stearns rescue. Hence, funding via repo markets is found to be one channel that transmitted shocks primarily related to the US financial system abroad. The strongest negative impact on intra-bank lending induced by the repo funding shock can be observed after the Bear Stearns rescue, the event which raised even greater concerns about the solvency of potential counterparties in the interbank lending market. The further decline of the repo market after the Lehman Brothers bankruptcy triggered lower adjustments on internal capital markets, possibly because rescue measures conducted by central banks provided alternative funding sources. All in all, the distortions related to funding via repo markets contributed to the continuity and the development of the funding crisis.

The results reveal significant differences between branches and subsidiaries regarding fund management with these two types of affiliates. German banks restricted their support to foreign subsidiaries which were strong in raising funds locally, and redirected these funds to the parent bank. Conversely, branches located abroad were given greater protection, the more important was their individual lending business compared to the rest of the bank holding company. This finding reflects the larger role of branches in financing foreign real economies compared with that of subsidiaries.

However, this clear pattern in fund management can be observed only at the beginning of the crisis. With increasing disruptions on short-term funding markets and repo markets in particular, the scope of German parent banks to protect branches with an important lending business narrowed. However, better capitalized parent banks were able to shelter their foreign affiliates from the withdrawal of funds after the Bear Stearns rescue. This result supports the view that a stronger equity capital base can effectively signal stability to the market in times of distress.

The remainder of the paper is organized as follows: Section 2 discusses the disruptions that occurred on European repo markets during the financial crisis and the reliance of German banks on repo financing. Section 3 describes German banks' movements on internal capital markets in the crisis. Section 4 outlines the analysis and presents the methodology. Section 5 presents and discusses regression results, section 6 provides robustness tests. Section 7 concludes.

3 Further studies reveal that cross-border lending, either in the form of syndicated lending (IVASHINA AND SCHARFSTEIN (2010), GIANNETTI AND LAEVEN (2012) or DE HAAS AND VAN HOREN (2012B)) or direct cross-border lending (SCHNABL (2012)), suffered from crisis-related funding shocks.

2 Repo funding of German multinational banks

2.1 Key developments on the European repo market in the financial crisis

The declining participation of banks in repo market financing was a central characteristic of the evolving financial crisis in Europe. In their June and December 2008 surveys among European financial institutions, the International Capital Market Association states that, for the first time since the beginning of the biannual survey in 2001, there were more banks with contracting than with expanding repo books. The market also saw a drastic shortening of maturities and a total contraction of the volume of repo transactions by 26%, which was the largest fall recorded since the survey began.

Repurchase agreements are mostly short-term interbank loans (overnight or with a maturity of less than one month) that are secured or collateralized in most cases with some type of securities. A bank can lend cash on a short-term basis from another financial player, such as a bank or a money market fund, in exchange for securities, which the bank agrees to buy back at some time in the future. The lender provides, for example, €80 by imposing a haircut (eg 20%) on the security (having a market value of €100) and demands a repo rate (eg 10%) from the borrower, who than has to pay back €88. This way of obtaining (from the perspective of the borrower) short-term cash or a specific type of security (from the perspective of the lender) was believed to be fairly safe before the financial crisis.

However, with the crisis unfolding, uncertainty arose about the value of the collateral provided in these transactions. Besides, there was growing uncertainty about the liquidity of markets on which collateral such as asset-backed securities could be sold in the event that the counterparty defaulted on the repo loan. In general, counterparty risk rose. The spread of the Euribor to OIS, being an indicator of counterparty risk on European interbank markets, rose considerably in mid-2007 when the subprime market collapsed.[4] It increased again after the Bear Stearns rescue in March 2008 and peaked with the collapse of Lehman Brothers in September 2008 (see AIYAR (2011)). These developments led to increasing haircuts and repo rates. For some asset classes used as collateral, the repo market shut down completely (GORTON AND METRICK (2012)).

Recent literature has highlighted the role of the events that occured in July/August 2007, March 2008 and September 2008 in the development of the financial crisis. KACPERCZYK AND SCHNABL (2010) see the failure of two Bear Stearns hedge funds in July 2007 as the first signal of the subprime market collapsing and as the starting point of the crisis in debt markets. In the same month, the German bank IKB became the first European victim of the crisis. Both institutions had heavily invested in the US subprime mortgage market. On August 7 2007, BNP Paribas was unable to assess the value of subprime-related assets held in some of its money market funds and suspended the redemption of shares. MISHKIN (2011) interprets this event as the key signal for deteriorating conditions on credit markets. What followed after July/August 2007 was a "fire sale" dynamic (SHLEIFER AND VISHNY (2011)), which led financial institutions to deleverage because of increasing uncertainty about the value of collateral offered in interbank

4 The conditions attached to an overnight index swap (OIS) result in minimum credit risk associated with this type of interest rate swaps. The spread against the Libor or Euribor therefore measures credit risk in the interbank market.

refinancing transactions. The investment bank Bear Stearns collapsed in March 2008 due to its inability to secure funding on repo markets (BRUNNERMEIER (2009)) and was rescued with the support of the US regulators. This event focused attention on the run on debt markets and provoked another increase in counterparty and credit risk; MISHKIN (2011) points to the rise in the spread between interest rates on Baa corporate bonds and US Treasury bonds observed after the Bear Stearns event. Finally, the bankruptcy of Lehman Brothers on September 15, 2008 highlighted the deterioration in interbank lending conditions and the vulnerability of the global financial system.

Compared to the US market, the European repo market experienced lower distortions regarding the value of collateral used in repo transactions (HÖRDAHL AND KING (2008)). This was due to subprime-related asset classes being used to a lesser extent in Europe than in the US. Instead, there was a greater percentage of government securities used in repo transactions. Nevertheless, uncertainty about counterparty solvency and the liquidity of markets rose in Europe as well. Not only did lenders increasingly fear the default of repo loans, but borrowers were less willing to lend out their high-quality collateral, fearing that the securities would not return upon the default of the cash lender. It was common practice in both Europe and in the US for collateral to be "rehypothecated", meaning that the collateral obtained in a repo agreement could be used by the lender in another repo transaction. This practice contributed to a multiplier effect when uncertainty about the value of collateral increased (see GORTON AND METRICK (2012)).

The dominance of bilateral repo agreements is another feature of the European repo market which might have played a part in growing mistrust among market participants. More than 50% of repo transactions in Europe are carried out on a bilateral basis (HÖRDAHL AND KING (2008)). This means that no central clearing party, which in a tri-party repo would keep the deposited collateral safe, stands between the borrower and the lender. Besides this, there was an increase in the number of "anonymous" settlements, in which the names of the borrower and the lender are known only to the central clearing counterparty, which testifies to the fact that many market participants feared that revealing their identity would worsen the lending conditions offered to them on repo markets (ICMA (JUNE 2008) and (DECEMBER 2008)).

2.2 Reliance on repo funding by German banks

Monthly balance sheet data collected by the Deutsche Bundesbank from all banks registered in Germany provides the opportunity to study the individual exposure of each bank to the disruptions observed on repo markets during the financial crisis.[5] Next to a detailed reporting of the asset side of the balance sheet, banks provide, on a mandatory basis, information on the composition of their liabilities by counterparty sector and term structure. Besides this, the amount of funding achieved through repo transactions is reported. From this information, it is possible to assess the individual bank's reliance on funding via repo markets, which determines their vulnerability to shocks on these markets.

As shown in Figure 1, before the outbreak of the subprime crisis, German parent banks funded, on aggregate, about one-third of their total claims (the total of accounts receivable) on the

5 The bank-level data is confidential but can be accessed for research purposes on the premises of the Deutsche Bundesbank.

short-term wholesale market (short-term referring to an original maturity of less than one year), meaning via interbank loans including repo agreements with other monetary and financial institutions, own bonds and notes issued and repo agreements with non-banks, being, for example, central clearing counterparties.[6] This ratio of short-term funding to total claims remained stable until the bankruptcy of Lehman Brothers, when it decreased to less than 1:4. Repo funding as a share of German parent banks' short-term wholesale funding on aggregate started to decline as soon as the outbreak of the subprime crisis occurred. It dropped from a pre-crisis level of almost 60% of short-term wholesale funding to 48% just before the Bear Stearns rescue in March 2008 and accounted for no more than 35% of short-term funding after the Lehman Brothers bankruptcy (this is a total decline of almost 25 percentage points during this time span).

These figures point to the fact that repo funding as a short-term funding source became less accessible as soon as the outbreak of the crisis occurred, and had to be replaced with other short-term funding sources in order to limit the need to deleverage on the asset side of the balance sheet. The fact that the share of total claims financed by short-term funding in general (including repo funding) remained rather stable until the Lehman Brothers bankruptcy suggests that this replacement of repo funding was, on aggregate, possible at first. The immediate decline in repo funding compared with overall short-term wholesale funding might have been due to the fact that the subprime market collapse disproved the relative safety of repo transactions. The Lehman event severely worsened interbank lending conditions again. Alternative short-term funding sources (apart from repo funding) then started to dry up on an even broader scale, which led to a decline in the percentage of overall short-term funding in banks' total funding.

3 Internal capital markets of German banks

3.1 Movements observed during the financial crisis

Along with increasing difficulties in accessing short-term funding via repo transactions, the effectiveness of the banks' internal fund management gained relevance. In order to fill funding gaps, the parent bank of a multinational banking organization can limit or redirect the funds that flow to affiliated banks abroad via the bank-internal capital market. In June 2007, 60 banks in Germany had affiliates located in foreign markets (domestically-owned or foreign-owned). In total, the German banking sector had 310 foreign affiliates at that time; 32 of which belonged to banks in Germany whose headquarters are located abroad. While these banks file regulatory reports in the same way as domestically based German parent banks do, they are not the headquarters of the respective multinational banks and might not have the same scope of action as a German parent bank. The analysis carried out below therefore concentrates on German parent banks.[7]

During the core stages of the financial crisis (ie from mid-2007 until the end of 2009), the German parent banks' net amount of accounts receivable from their own foreign branches fluctuated between roughly €200 billion and €330 billion (see Figure 2, this is, from the point

6 Up to June 2010, no information was collected regarding the maturity structure of repo funding. When the data became available, 96% of all repo agreements were short-term. In this study with a sample period that ends before 2010, it is therefore assumed that all repo funding is short-term funding.

7 A robustness check including foreign-owned banks located in Germany is provided in section 6.

of view of the branches, equivalent to their net borrowing from the parent bank). This corresponds to a fluctuation in net funds provided to the branches of between 10% and 18% of their aggregate total assets. Subsidiaries were, on aggregate, providing net funds to the parent banks before the financial crisis. By the time of the Lehman collapse, their aggregate net borrowing amounted to roughly €50 billion (or about 10% of subsidiaries' aggregate total assets). There is, however, substantial heterogeneity in these figures. While some branches or subsidiaries became net providers of funds to the parent organization during the crisis, others increased their dependence on the parent bank.

Both branches and subsidiaries of parent banks registered in Germany file monthly balance sheet reports with the Deutsche Bundesbank.[8] Within this report, subsidiaries provide information on the amount of assets and liabilities that they hold vis-à-vis the German parent bank. From this, the fluctuations in the net borrowing position of subsidiaries can be calculated. Branches do not report the position vis-à-vis the parent bank explicitly. Since June 2010, new series on the internal capital market have been reported, including the position of branches vis-à-vis the rest of their banking group. From a comparison of these series' dynamics with the dynamics of the net borrowing position of branches vis-à-vis the German banking sector (excluding the central bank), DÜWEL AND FREY (2012) concluded that this position was a fair approximation of the borrowing of branches from their parent bank. This approximation is used here in order to follow the fluctuations in the individual branch's net borrowing from its parent bank during the financial crisis.

3.2 Branches' and subsidiaries' role in internal capital markets

There are major differences between a bank's branches and its subsidiaries and these differences are relevant to their role in the bank's internal fund management. Branches are part of the parent banks' balance sheet, while subsidiaries are separate legal entities and fulfill regulatory capital requirements in the country in which they are located. Conditionally, branches operate mostly as an extension of the parent bank, and subsidiaries resemble more stand-alone banks. This is also reflected in the funding structure of branches and subsidiaries. Relative to their size, subsidiaries fund themselves, on average, to a larger extent locally than branches (see Table 1, *core funding role* of branches and subsidiaries). They are also less dependent than branches on funding received from the parent bank.[9] Before the crisis, subsidiaries funded, on average, 17% of their total assets on the internal capital market, while branches' net borrowing from the parent bank amounted, on average, to roughly 40% of their total assets.

Branches and subsidiaries of German banks are, on aggregate, quite important in supplying loans to the real sector of foreign countries: About two-thirds of German banks' real sector loans to foreign firms are channeled abroad via branches or subsidiaries (see DÜWEL ET AL. (2011)). Of these, branches account for the vast majority of the loans, but, on average, are also larger than subsidiaries in terms of asset size (see again Table 1). As of June 2007, a German domestically-owned multinational bank (below "German parent bank") served an average of 5.6 foreign

8 Several branches of one parent bank, which are located in the same foreign country, submit a single joint report. Subsidiaries of German parents file reports whenever the German bank is the majority shareholder.

9 Compared to other European or US multinational banks, German banks tend to borrow more at home and lend abroad, hence they fund fewer of their foreign assets in the respective local market (MCCAULEY ET AL. (2010)).

countries via affiliated banks abroad. The list of countries and the number of parent banks that had set up affiliates in these countries can be seen in Table 2. The roles of specific branches and subsidiaries in the lending business of the bank holding company, as well as their ability to fund themselves locally suggests that, in times of distress, the fund management of the bank via the internal capital market takes these characteristics into account.

4 Empirical model

4.1 Outline of the analysis

Investigation 1: The first objective is to test whether the exposure of German parent banks to the distortions on repo markets during the financial crisis activated the banks' internal fund management, leading parent banks to withdraw and/or redirect liquidity within the bank holding company. One key aspect is to investigate whether the fund management was different depending on whether a foreign affiliate was a branch or a subsidiary.

The run on repo funding markets (as described, for example, by GORTON AND METRICK (2012)) was triggered by increasing concern about the value of collateral used in repo transactions and growing mistrust among market participants. In this analysis, three key events which raised these types of risk are considered with regard to their effect on the internal fund management of German global banks: the outbreak of the subprime crisis in July 2007, the rescue of Bear Stearns in March 2008, and the bankruptcy of Lehman Brothers in September 2008. Figure 1 shows the aggregate decline of repo funding as a short-term funding source of German banks around these events. For all three events, the amount of the foreign affiliates' net borrowing from their respective parent banks before the specific event is compared with the amount of their net borrowing after the event. If the exposure of parent banks to the disruptions on repo markets did indeed lead to a shortage of short-term funding sources on the part of the parent bank, we should then observe a limitation of the amount of funds provided to foreign affiliates, and hence a reduction in the affiliates' net borrowing from the parent bank.

Investigation 2: Second, it is investigated whether in times of distress the fund management within German global banks follows a similar type of locational pecking order as is the case within US banks (CETORELLI AND GOLDBERG (2012)). This would mean that the parent bank, while limiting the amount of funds provided to its foreign affiliates, adopts a strategy that distinguishes between "core investment locations" and "core funding locations". The larger the share of an affiliate is in the total volume of foreign lending to firms by the whole bank holding company, the more this affiliate fulfills the role of a "core investment" location. These affiliates would then be more sheltered from the withdrawal of funds due to their important role in banks' lending business to the real sector. Conversely, if parent banks, following a funding shock, withdraw even more funds from affiliates which are strong in local refinancing (relative to their total refinancing), then these affiliates fulfill the role of "core funding locations".

This part of the analysis furthermore addresses the ultimately empirical question of whether the organizational form (branch or subsidiary) influences the assignment of these roles to the affiliates. On the one hand, as subsidiaries are less dependent on the parent bank and resemble more stand-alone banks (see section 3.2), they should be predestined to be assigned the core funding

role. Often, subsidiaries are former stand-alone banks which were acquired by the global bank and possess a large network of depositors and investors. On the other hand, subsidiaries have to fulfill local regulatory requirements, which limits the possibility of withdrawing funds. Branches distribute, overall, more loans to foreign firms than subsidiaries, which suggests that they might rather be sheltered from the withdrawal of funds and be more protected due to their fulfilling a core investment role. However, branches are consolidated into the parent bank's balance sheet, which facilitates the withdrawal of funds from these entities, as no strict local regulatory requirements apply.

The three different events considered also allow to investigate whether the assignment of core investment and core funding roles was consistent throughout the different episodes of the financial crisis. With banks facing increasing stress on interbank markets, the ability to protect core investment locations, for example, might have faded in the course of the crisis.

Investigation 3: Third, it is argued above that increasing uncertainty about the value of collateral and counterparty solvency on repo markets were key in disrupting the short-term funding possibilities of parent banks during the financial crisis. It should then be the case that parent banks that were able to signal a high level of solvency (were better capitalized) and/or possessed greater liquidity were less forced to withdraw funds from their foreign affiliates despite their exposure to the run on repo markets. Informational advantages and implicit government guarantees of banks with a large balance sheet size could have facilitated access to short-term refinancing on capital markets. These aspects are tested here.

Investigation 4: Finally, the regression results can reveal whether, in terms of volume, one of the three events put particular pressure on parent banks to limit the allocation of funds to their foreign affiliates. For each event, the degree to which funds were withdrawn from branches and subsidiaries due to the run-on-repo exposure of the parent bank are quantified. The responses of banks with high and low exposures to the disruptions are compared with regard to the volumes of funds which the model predicts they will withdraw due to their shock exposure. This determines in which of the events a relatively large exposure of the parent bank to the run on repo markets put the most pressure on the net borrowing of branches and subsidiaries from the parent bank, leaving aside the special treatment of core investment or core funding locations. Although borrowing conditions on repo markets steadily worsened throughout the crisis (see description in section 2.1), banks might have sought other funding sources after the first shock in order to limit their vulnerability to a further deterioration in borrowing conditions. Moreover, banks might have benefited from rescue measures conducted by central banks. Possibly, this response reduced the need to withdraw funds from foreign affiliates as the crisis progressed.

4.2 Methodology and variables

The empirical approach is based on the methodology established by CETORELLI AND GOLDBERG (2012). For each of the three events, a "pre" and a "post" period is defined. The difference between average net borrowing of foreign branches or subsidiaries after and before the event reveals whether the net amount of funds received by a particular branch or subsidiary from the parent bank subsequently increased or decreased. The time span of the pre and post periods of each event are marked in the time line of Figure 3.

For the three events, the dependent variable of the analysis is hence a first-difference variable defined in the following way, with $NetBorrow_j$ corresponding to net liabilities of branch or subsidiary j vis-à-vis their parent bank:

Subprime market collapse (occurring in 2007m7):

$$\Delta NetBorrow_j = NetBorrow_j|_{avg(2007m7-2008m2)} - NetBorrow_j|_{avg(2007m1-2007m6)} \quad (1)$$

Bear Stearns rescue (occurring in 2008m3):

$$\Delta NetBorrow_j = NetBorrow_j|_{avg(2008m3-2008m8)} - NetBorrow_j|_{avg(2007m8-2008m2)} \quad (2)$$

Lehman Brothers bankruptcy (occurring in 2008m9):

$$\Delta NetBorrow_j = NetBorrow_j|_{avg(2008m9-2009m3)} - NetBorrow_j|_{avg(2008m4-2008m8)} \quad (3)$$

The period from 2007m1 to 2007m6 should accurately reflect the average level of net borrowing of a foreign affiliate before the first repo funding shock, which is the subprime market collapse. The results are nevertheless robust to extending (up to one year) or shortening (eg to four months) this time period. Moreover, the results remain unchanged if the collapse of the subprime market is fixed to August instead of July 2007. It is assumed that the level of the affiliate's net borrowing from the parent bank after the funding shock manifests itself over the time period from 2007m7 to 2008m2. The pre and post periods of the second repo funding shock, the Bear Stearns rescue, are defined by the timing of the other two events, as it is assumed that no other comparable shock to repo markets occurs during this time period. The post period of the third event, the Lehman Brothers bankruptcy, ends in 2009m3. This should exclude direct effects stemming from central bank measures, such as the covered bond purchase programme (starting in May 2009), which released the pressure from banks that depended strongly on securitized banking. The quality of the results remains unchanged if the month in which the respective event occurred is excluded from the post period.

Note that a reduction in the amount of a branch's or a subsidiary's net borrowing from the parent bank can occur on either the asset side or the liability side of the affiliate's balance sheet. Either the parent bank increases the amount of funds previously demanded from the foreign affiliate or it cuts the provision of funds to the foreign affiliate. It also has to be understood that a negative outcome of the dependent variable does not necessarily mean that a branch or a subsidiary becomes a net lender to the parent bank. It can also mean that the support previously given to the respective entity by the parent bank has been reduced, but that the branch or subsidiary still remains a net borrower from the parent bank.

The main explanatory variable for the changes in the volumes of funds granted to affiliates is the exposure of parent banks to the distortions on repo markets just before the respective event (as defined below). Explanatory variables include further parent-bank specific variables (index i) from before the respective shock event, variables specific to the foreign affiliate (index j) before each event, and variables characterizing the host country of the foreign affiliate (index k). The view on the data yields *three cross-sectional datasets*, one for each event. Equation (4) is used to test all *three events separately* with regard to their effect on the internal fund management of the bank.

$$\begin{aligned} \Delta NetBorrow_j \quad = \quad & \alpha_0 * repo\_exposure_i + \alpha_1 * d\_sub * repo\_exposure_i \\ & + \beta_0 * X_j + \beta_1 * d\_sub * X_j + \gamma * X_i \\ & + \eta_0 * X_k + \eta_1 * d\_sub * X_k + \kappa * Z_k + \varepsilon_j \end{aligned} \quad (4)$$

where

$$\alpha_0 = A_0 + B_0{}^*X_j + \Gamma^*X_i + H_0{}^*X_k + K^*Z_k \qquad (5)$$

$$\alpha_1 = A_1 + B_1{}^*X_j + \Gamma^*X_i + H_1{}^*X_k + K^*Z_k \qquad (6)$$

In order to determine whether the exposure of parent banks to the run on repo had effects on the net borrowing of subsidiaries that were different than those on net borrowing by branches from the parent bank, $repo\_exposure_i$ in equation (4) is interacted with a dummy variable, which equals one if the affiliate j is a subsidiary (d_sub). Affiliate-specific characteristics and some characteristics of the host country, which are expected to play different roles for branches and subsidiaries, are also interacted with this dummy variable.

With equation (5) and (6) plugged into equation (4), the regression equation suggests that the severance with which the exposure of the parent bank i to the distortions on repo markets ($repo\_exposure_i$) affects changes in the net borrowing position of branches and subsidiaries ($\Delta NetBorrow_j$) depends on further characteristics of the parent bank (Γ^*X_i) as well as characteristics of the foreign branch j ($B_0{}^*X_j$) or subsidiary j ($B_1{}^*X_j$) and the country k ($H_0{}^*X_k$ or $H_1{}^*X_k$, K^*Z_k) in which the affiliate is located.

- The $repo\_exposure$ of the parent bank is defined as the reliance on repo funding relative to short-term wholesale funding of the parent bank, in amounts outstanding *at the end of the month prior to the event*.[10]

- X_j are affiliate- (branch- or subsidiary-) specific characteristics, namely the total *size* of the affiliate's balance sheet, the degree to which the affiliate fulfills a *core investment role* (share of the affiliate in the bank holding company's total lending to the foreign non-bank private sector, measured in loan stocks outstanding) and the intensity with which the affiliate takes the *core funding role* (the affiliate's local liabilities relative to its total liabilities). All of these characteristics are calculated as *averages over the pre period of the respective event*.[11]

- X_i is a vector of further parent bank characteristics. It includes the total *size* of the parent bank's balance sheet, parent bank *capitalization* (equity capital / total assets) and parent bank *liquidity* (liquid assets / total assets), all in *averages over the pre period of the respective event*.[12]

- X_k are dummy variables characterizing the host country of the affiliate: *d_fin_platform* marks countries which represent financial platforms to German banks. Affiliates which are located in these countries might have been hit more by the original events, since they were heavily involved in the trading of securities on international financial markets. Financial

10 Repo funding and short-term wholesale funding of the parent bank exclude positions held vis-à-vis affiliated banks abroad. Short-term wholesale funding includes interbank liabilities (including repo agreements with other monetary and financial institutions), own bonds and notes issued and repo agreements with non-banks, such as central clearing counterparties. Short-term refers to an original maturity of less than one year.

11 The data for calculating these positions are taken from the monthly External Positions Report, which the banks submitting balance sheet positions fill out as well. It provides a breakdown of banks' lending and funding abroad by the different foreign countries (FIORENTINO ET AL. (2010)).

12 Parent banks' liquid assets are defined as the sum of cash holdings, claims on the central bank, short-term claims on other (unaffiliated) banks and holdings of short-term securities. Possibly, liquidity is slightly smaller than in this calculation, because some liquid securities are held on the balance sheet but are in fact lent out, for example, in a repo and are therefore not immediately available. This should, however, not be the majority of the positions. The correlation between liquidity and repo exposure is negative and small (-11%), which supports this view.

platforms are financial centers, mainly offshore (the list is taken from the Financial Stability Forum (2000)), as well as the UK and the US. These countries are marked with an asterisk in the list of host countries of German banks' foreign affiliates (Table 2). Another dummy is introduced for the euro area, inside which affiliates are geographically close to the parent bank and operate mainly in the same currency (*d_euro_area_no_fin_platform*). Only countries that do not represent major financial platforms are included here in order to avoid overlapping with the other dummy variable in this category.[13]

- Z_k contains a continuous financial openness indicator (CHINN AND ITO (2008)) for each country (*fin_openness*).[14] The index increases with the degree of financial openness. As this indicator is not specific to the mode of operation in these countries (via branches or subsidiaries), its impact is not estimated separately for the two types of affiliates.

See Tables 1 and 3 for descriptive statistics on the different variables.

4.3 Interpreting the estimated coefficients

If it is true that the exposure of parent banks to the run on repo exerted significant pressure on the net borrowing of branches from the parent bank, then $A_0 < 0$ (see equation (5)). If the same applies to subsidiaries, then $A_0 + A_1 < 0$ (see equations (5) and (6)). A_1 gives the difference between branches and subsidiaries regarding the change in net borrowing from the parent due to the parent bank's run-on-repo exposure. **(Investigation 1)**

If other affiliate-specific characteristics, such as a core investment or core funding role of a branch or subsidiary, influenced the degree to which the parent bank's exposure to the disruptions on repo markets affected net borrowing of this branch or subsidiary, then the corresponding coefficients estimated within the vector of coefficients B_0 (for branches) or $B_0 + B_1$ (for subsidiaries) should be significant. A positive sign then means that this particular characteristic (eg the *core investment role* of an affiliate) buffers the negative impact on net borrowing stemming from the parent bank's exposure to the run on repo. A negative sign means that this characteristic (eg the *core funding role*) amplifies the withdrawal of funds from this affiliate in response to the parent bank's shock exposure (see equations (5) and (6) as plugged into equation (4)). **(Investigation 2)**

In a similar fashion, it is analyzed whether the parent bank having a higher level of capitalization buffers the impact of the exposure to the run on repo on the internal borrowing of the affiliate. If the specific coefficient of the vector Γ was estimated to be positive, this would be the case. **(Investigation 3)**

13 The quality of the results remains unchanged if, in addition, a dummy variable for emerging markets in Asia or a dummy variable for eastern European countries is included. Both regions may have been sheltered more from the withdrawal of funds since they were fairly untouched by the initial shocks and, therefore, represented important investment markets. However, the dummies turn out insignificant in the regressions.

14 The index is calculated from information given in the Annual Reports on Exchange Arrangements and Export Restrictions (AREAER) prepared by the International Monetary Fund. It is a de jure financial openness indicator.

5 Results

Table 4 depicts regression results for the event of the subprime market collapse, Table 5 addresses the Bear Stearns rescue, and Table 6 reports results for the analysis of the Lehman Brothers bankruptcy. Whenever a variable has been interacted with the subsidiary dummy, the total effect of this variable on a subsidiary (not just the deviation from the effect estimated for a branch) is reported in the second numerical column of each table. In each regression, the explanatory variables are jointly significant. Standard errors are clustered by parent bank. The regression results reported concentrate on the sample of German parent banks and hence exclude foreign-owned banks, which are likely to fulfill other tasks and have a smaller scope of action than a parent bank headquartered in Germany. Nevertheless, a robustness check in section 6 includes foreign-owned banks in the regressions.

5.1 Investigation 1: Transmission of the funding crisis occurs via repo funding and via bank-internal capital markets

In all three events, it can be shown that the exposure of the parent bank to the distortions on repo markets (*repo_exposure*) negatively affected the provision of funds to foreign affiliates (hence the net borrowing of affiliates from the parent bank, $\Delta NetBorrow$).

After the subprime market collapse (Table 4), the negative impact of the shock hitting short-term funding possibilities of the parent bank was the same for both branches and subsidiaries. This can be concluded from the observation that the exposure of the parent to the run on repo (*repo_exposure*) is significantly negative for both types of affiliates, and that the two effects are not statistically different from each other. After the Bear Stearns rescue (Table 5), the parent bank's exposure to disruptions on repo markets had a significantly larger impact on the withdrawal of funds from branches than from subsidiaries. The impact of *repo_exposure* on the net borrowing of both types of affiliates is significantly negative (A_0 and $A_0 + A_1$ are both significantly negative, see Table 5), and the effect on subsidiaries deviates positively (and significantly) from that on branches (A_1 reported in the last column). Finally, after the Lehman Brothers bankruptcy (Table 6), the repo market exposure of parent banks exerted a negative pressure on the net borrowing of branches from the parent bank, but not on that of subsidiaries.

Hence, while the parent bank's exposure to the run on repo had an equally strong impact on branches' and subsidiaries' net borrowing after the subprime market collapse, it had a significantly stronger impact on branches after the two subsequent events. In the course of the crisis, the degree to which funds could be withdrawn from subsidiaries might have declined faster than from branches because subsidiaries had to continue fulfilling regulatory capital requirements, while branches are consolidated into the balance sheet of the parent bank for regulatory purposes. Especially in the short run, this aspect might have influenced the parent banks' fund management decisions. Furthermore, branches had received more support from the parent bank to begin with, and hence the scope to withdraw funds might have been larger.

In general, after all three events, the internal fund management of the multinational banks reflects the increasing difficulty experienced by parent banks in rolling over their short-term debt on repo markets. Their funding difficulties affect, via internal capital markets, the financing of

their foreign affiliates. This finding supports the idea of the parent bank as the central decision-making entity of the global bank and reinforces the notion of an organizational pecking order, which puts the needs of the parent bank first (as described by CETORELLI AND GOLDBERG (2012) for US banks). Furthermore, the significant impact of the run on repo on bank-internal fund management provides evidence for the transmission of the funding crisis both through repo financing on capital markets and through bank-internal capital markets.

5.2 Investigation 2: Fund management pattern dependent on type of affiliate and crisis episode

According to the results, the fund management of German global banks in the financial crisis initially followed a pattern of assigning to certain affiliates a *core investment role* or a *core funding role* (as defined in section 4.2). With the parent bank's increasing exposure to the disruptions on repo markets, branches with important lending business compared with the rest of the bank holding company were, at the time of the subprime market collapse, sheltered more from the withdrawal of funds by the parent bank (see regression results: *repo_exposure*core investment role* in Table 4, column *"total effect branches"*). Subsidiaries which had a greater ability to raise funds locally fulfilled a *core funding role* after the subprime market collapse as well as after the Bear Stearns rescue, the more the parent bank was exposed to the run on repo (see coefficients for *repo_exposure*core funding role* in Table 4 and Table 5, column *"total effect subsidiaries"*). No effect of either the core investment role or the core funding role can be detected in fund management following the Lehman Brothers bankruptcy (Table 6).

The results suggest that it was only at the beginning of the financial crisis that parent banks assigned the *core investment role* to certain branches, and only branches. The buffering effect of this role vanishes, however, with the rescue of Bear Stearns. Possibly, this next unexpected shock to repo funding amplified the parent banks' needs to limit the provision of funds to foreign affiliates, resulting in a smaller scope for the stabilization of branches that were important for lending business abroad. After both the collapse of the subprime market and the rescue of Bear Stearns, subsidiaries, and only subsidiaries, fulfilled the *core funding role* the more they refinanced themselves locally. This may be due to the fact that subsidiaries are more likely to have a strong standing in the local funding market. When subsidiaries are former stand-alone banks, which at one point became part of the global bank holding company, they possess a larger network of depositors and investors than branches, which are often established from scratch. Branches, on the other hand, have a greater responsibility within the bank holding company for the provision of loans to the real sector abroad. Moreover, they are more dependent overall on funding provided by the parent bank (see section 3). These aspects might explain the differences detected in fund management with regard to branches and subsidiaries.

The pattern followed by the parent banks' fund management became less clear the longer the crisis lasted. After the Bear Stearns rescue had taken place, parent banks became less engaged in protecting core investment locations than they had been after the subprime market collapse. After the Lehman Brothers bankruptcy, fund management no longer makes any distinction between core investment and core funding locations, either for branches or for subsidiaries. Possibly, the Bear Stearns rescue fomented mistrust in the stability of large global banks, which

worsened their funding conditions. There was subsequently a decline in the parent banks' scope for sheltering affiliates with a more important lending business.

5.3 Investigation 3: Higher parent bank capitalization signals stability after Bear Stearns rescue

Even if a parent bank's exposure to the run on repo is large, the bank can avoid losing its counterparty's trust if it shows credibly that it is solvent and can withstand shocks to its funding sources. A bank with a larger share of equity capital in total assets can signal stability to the market in times of distress (KICK AND KOETTER (2007)). Higher liquidity may help overcome temporary disruptions to funding sources. Larger banks are more likely to be implicitly guaranteed by the government (since they are "too big to fail"), which may reduce their probability to default and thus facilitates the raising of funds from investors. The results show that, after the Bear Stearns rescue, banks with a higher level of capitalization were better able to buffer the negative impact on intra-bank borrowing of foreign affiliates, which resulted from their exposure to the run on repo (see estimated coefficient for *repo_exposure*capitalization* in Table 5). This is consistent with the picture that the troubles of Bear Stearns demonstrated for the first time in the financial crisis that even large banks were seriously vulnerable to the disruptions observed on financial markets. Therefore, it became more important for these banks to be soundly capitalized, which signaled high solvency to repo market investors.

5.4 Investigation 4: The repo funding shock's magnitude compared across events

The negative impact of a high exposure to the disruptions on repo markets on foreign affiliates' net borrowing from their parent banks was not only significant, but also quite large in scale. A closer investigation of the repo funding shock across the three different events furthermore suggests that banks did not react or were unable to react sufficiently to the first event so as to avoid being notably affected by future repo funding shocks.

The model, as estimated in sections 5.1 to 5.3, predicts that the Bear Stearns rescue was the event which forced parent banks with a relatively high run-on-repo exposure to conduct the largest reduction of funds provided to foreign affiliates compared with the other two events. In order to demonstrate this, for each event the stand-alone effect on net borrowing of affiliates stemming from a parent bank's high run-on-repo exposure is compared with the effect stemming from a low exposure of the parent bank. The results of this exercise are reported in Table 7. The average exposure of the parent bank to the disruptions on repo markets (hence the average share of repo funding in overall short-term wholesale funding) is calculated for the group of parent banks with a high exposure (above the 75th percentile of the distribution) and those with a low exposure (below the 25th percentile of the distribution) in each of the three events. Then, the average impact of a high and a low exposure on the net borrowing of branches and subsidiaries is calculated using the coefficients estimated for the three different events as reported in Tables 4 to 6. As the average parent bank below the 25th percentile of the distribution uses no repo funding, the impact calculated for an average bank with a high repo exposure signals, at the same time, the difference between a low and high exposure.

For both branches and subsidiaries, the average stand-alone effect of a high run-on-repo exposure on the volume of net internal borrowing from the parent bank is predicted to be the largest after the Bear Stearns rescue (-€2.3 billion or -127% of absolute pre event average net borrowing for branches, -€1.4 billion or -600% for subsidiaries). The second largest average withdrawal is predicted for the subprime market collapse (-€1.36 billion or -100% for branches, -€1.13 billion or -281% for subsidiaries). These figures might appear quite large, but it has to be kept in mind that they represent the stand-alone effect predicted for a bank with a very high exposure to disruptions on repo markets, stand-alone meaning that a potential buffering (or amplifying) effect of other parent or affiliate characteristics is left aside. The short-term wholesale funding of this type of bank depended to over 60% on repo financing. While a bank with a very high exposure to the disruptions is predicted to withdraw larger volumes of funds from branches than from subsidiaries, the relative impact appears stronger for subsidiaries, since they were borrowing fewer funds from the parent bank to begin with. After the Lehman Brothers bankruptcy, a bank with a high exposure is predicted to having withdrawn €0.72 billion (or 39%) from branches. No significant stand-alone impact can be detected on the net borrowing of subsidiaries.

These figures suggest that the subprime market collapse had a strong impact on banks' internal fund management. However, after this first shock, parent banks did not or were unable to limit their exposure to future repo funding shocks. The even larger volume of funds that the model predicts to have been withdrawn after the Bear Stearns rescue suggests that this second shock severely increased the pressure on parent banks' short-term refinancing again. After this watershed event, parent banks restricted their need to transmit their short-term refinancing problems via internal capital markets to their foreign affiliates. The Lehman Brothers bankruptcy, even though it represented an intensifying shock to confidence on capital markets, was then less reflected in the movements of funds on internal capital markets.

It is likely that the actions taken by central banks to provide alternative funding possibilities had an impact as well. The European Central Bank started expanding the Eurosystem's collateral framework in October 2008 and lowered the minimum credit rating from A- to BBB- in order to counter the tensions on interbank markets. Furthermore, the launch of the covered bond purchase programme was announced for May 2009. Covered bonds were widely used as collateral for obtaining liquidity in the euro area (see FEGATELLI (2010)). These support measures might have eased the pressure on banks that were strongly dependent on securitized banking.[15]

6 Robustness of results

6.1 Possible endogeneity of run-on-repo exposure in later events

The main econometric analysis assumes that the ex ante run-on-repo exposure of parent banks is exogenous to the ex post withdrawal of funds related, respectively, to the subprime market collapse, the Bear Stearns rescue and Lehman Brothers bankruptcy. Since the three events occurred

15 BUCH ET AL. (2011) show that parts of German bank holding companies also profited via intra-bank spillovers from the US Federal Reserve's Term Auction Facility, which was introduced in June 2008 in response to the Bear Stearns event.

successively, this assumption may be very strong. It is conceivable that the amount of funding provided to a parent bank's foreign affiliates after the subprime market collapse (on average during 2007m7-2008m2) is related to the amount of funding which a parent bank obtained via repo transactions directly before the Bear Stearns rescue (in 2008m2). This could be the case since a parent bank's repo funding might be persistent between 2007m7 and 2008m2. Since the degree to which foreign affiliates were supported via the internal capital market before the Bear Stearns rescue enters the calculation of the change in net internal borrowing of affiliates in response to this event, the run-on-repo exposure of the parent bank might be endogenous to the analysis. Likewise, it is possible that the exposure of parent banks to the repo market distortions triggered by the Lehman Brothers bankruptcy is endogenous to the subsequent change in the provision of funds to foreign affiliates via internal capital markets.

Although the run-on-repo exposure of parent banks is calculated on a different observational level (the parent bank) than the change in net borrowing of affiliates (the affiliate level), an instrumental variables approach is conducted as a robustness test. The run-on-repo exposure of the parent bank at the time of the Bear Stearns rescue and the Lehman Brothers bankruptcy is instrumented with its value observed before the subprime market collapse, and hence before the first event which potentially affected the bank's repo funding behavior. Due to the time lag, this instrument can affect the dependent variable in later events only through its own future value, which is the main explanatory variable in the analysis.

It turns out that the run-on-repo exposure of parent banks from 2007m6 is a valid instrument for their run-on-repo exposure observed in 2008m2, and thus before the Bear Stearns rescue. This can be concluded from the first-stage regressions (not reported) of the two-stage-least-squares estimation as well as from the identification test (see Table 8). Conversely, neither the run-on-repo exposure of parent banks from before the subprime market collapse nor that from before the Bear Stearns rescue provide sufficient identification for the exposure of parent banks to the repo market distortions triggered by the Lehman Brothers bankruptcy (results not reported). This finding corroborates the previously stated finding that the exposure of parent banks to shocks on repo markets was quite persistent throughout the first two episodes of the crisis, but that it changed after the Bear Stearns rescue as banks adjusted their funding behavior. They responded to the deterioration of confidence in well-established market participants. As concluded from the main analysis, the Lehman Brothers bankruptcy thereafter had a significantly lower impact on the banks' internal fund management.

Where the instrumentation of the run-on-repo exposure with an earlier value is valid (in the event of the Bear Stearns rescue), the regression results are reported in Table 8. The quality of the results, as obtained from ordinary least squares regression (Table 5), are unchanged in the instrumental-variables approach. The robustness test thus reinforces the conclusions previously drawn.

6.2 The branches' and subsidiaries' own exposure to short-term funding problems

Branches and subsidiaries also refinance themselves to some degree on short-term wholesale funding markets. Following a worldwide shock to these markets, this might have an effect on

their ability to do without internal support from their parent bank. If, in the course of the financial crisis, branches and subsidiaries with a greater exposure to shocks to short-term funding markets were supported to a larger extent by their parent banks, this affiliate characteristic should then dampen the negative impact of a large run-on-repo exposure of the parent bank. It is indeed found to be the case that upon the repo funding shock experienced by the parent after the Bear Stearns rescue, subsidiaries with a larger share of short-term wholesale funding in total assets were more protected. Possibly, the obligation of subsidiaries to fulfill local regulatory capital requirements prompted the need to take the subsidiary's own short-term refinancing problems into account with regard to the amount of net borrowing that it was granted.

The main analysis assumes that the deteriorations on repo markets hit, first and foremost, the parent bank, which then controlled the fund management of the bank. The reliance of affiliates on repo funding as a specific short-term funding source was presumably very limited in comparison to the parent bank. Branches of German banks have conducted, on average, only 2%-3% of their short-term wholesale funding via repo markets during the crisis. Parent banks, in contrast, have relied, on average, to roughly 20% on this short-term funding source. It is therefore unlikely that the drying-up of repo markets had large effects on branches. For subsidiaries, no information on the share of repo funding in short-term wholesale funding is available. Possibly, it is larger than that of branches, since, in terms of their funding structure, subsidiaries resemble more stand-alone banks. This might be another reason for the observation that subsidiaries with a greater reliance on short-term wholesale funding, of which repo funding is a part, were sheltered more from the withdrawal of funds.

6.3 Inclusion of foreign-owned banks in the analysis

Foreign-owned banks were previously excluded from the analysis, as identification relies on the assumption that the parent bank is the decision-making entity with regard to the fund management of the bank. Since foreign-owned banks in Germany (which themselves have branches and/or subsidiaries) are not the headquarters of bank holding companies, they are very likely to differ in their operations from German parent banks. When they are included in the regressions, the quality of the main results (the significant impact of the run-on-repo exposure on the internal fund management) remains unchanged, except for the event of the subprime market collapse. Here, the repo exposure of the parent bank is irrelevant. In the other two events, the magnitude of the effects is slightly smaller. This can result from the fact that foreign-owned banks rely, on average, less on repo markets than German parent banks (9%-12% for foreign-owned banks versus 19%-24% for German parent banks, see Table 1).

Regarding the relevance of parent bank characteristics, the regressions which include foreign-owned banks assign more importance to parent bank liquidity. For foreign-owned banks, which are not the headquarters of the multinational bank, it might be more important to have liquid assets available to support own affiliates than to demonstrate solvency to other market participants. The regressions feature a dummy variable for foreign-owned banks. Upon the shock experienced due to the Lehman Brothers bankruptcy, foreign-owned banks withdraw significantly more funds from their foreign affiliates than domestically-owned banks.

7 Conclusions

This study uses confidential bank-level data on German parent banks and their foreign branches and subsidiaries to investigate fund management within the multinational bank upon a shock to the parent bank's refinancing possibilities in the course of the financial crisis. It is demonstrated that the exposure of German parent banks to the disruptions observed on the sale and repurchase markets (the repo markets) after the subprime market collapse, the Bear Stearns rescue and the Lehman Brothers bankruptcy significantly reduced bank-internal borrowing of funds by foreign branches and subsidiaries from the parent bank. Hence, the crisis-related shocks to short-term funding are transmitted via both repo markets and bank-internal capital markets.

In terms of magnitude, the stand-alone effect of the parent banks' repo market exposure on the withdrawal of funds from foreign affiliates was strongest, for both branches and subsidiaries, after the Bear Stearns rescue. Although the collapse of the subprime market in July 2007 represented a dramatic shock to banks' short-term refinancing sources, this study finds that banks did not or were unable to reduce their exposure to these types of disruptions until after the Bear Stearns failure in March 2008. The bankruptcy of Lehman Brothers in September 2008 then triggered less reallocation of funds via bank holding companies' internal capital markets. Measures introduced by central banks after the Bear Stearns rescue might also have played a part in this.

Nevertheless, major differences between the two types of affiliates can be detected regarding the internal fund management of parent banks. Overall, the empirical analysis predicts fewer funds to be withdrawn from subsidiaries than from branches due to the parent bank's run-on-repo exposure. But these volumes imply a stronger relative effect on subsidiaries, since they borrowed on a net basis, on average, fewer funds from parent banks to begin with. Subsidiaries were more likely to be used as "core funding locations" in the early stages of the crisis, while branches were used more as "core investment locations"; in other words locations within the bank holding company which were relatively important in delivering credit to the foreign real sector. Both effects vanish in the course of the crisis, with the use of core funding locations continuing longer than the protection of core investment locations. This finding suggests that parent banks' increasing troubles in rolling-over short-term debt allowed a consistent protection of major lending markets to an ever decreasing extent, the longer the crisis on debt markets persisted. Better capitalized parent banks felt less impelled to withdraw funds from their foreign affiliates after the Bear Stearns rescue despite their exposure to the disruptions on repo markets. All in all, for globally active banks, short-term refinancing aspects at the level of the parent bank have implications for the whole bank holding company. The difference in the volumes of funds withdrawn from branches and from subsidiaries might be due not only to different funding structures, but also to their organizational forms (subsidiaries have to fulfill local regulatory requirements at all times). This might set incentives to augment the volume of liquidity withdrawal from branches in times of crisis, and might explain why some global banks have lately transformed subsidiaries into branches.

It is true that the financial crisis disrupted unsecured funding markets in general, but this study shows that it also had severe effects on secured funding markets, such as repo markets. The results presented here furthermore suggest that disruptions to repo markets were already being

reflected in the internal fund management of multinational banks at the time of the subprime market collapse. This type of funding was believed to be quite safe before the financial crisis, but many financial institutions ran from their investments in repo markets when uncertainty about the value of the collateral and the solvency of the counterparty unexpectedly increased.

Demand for high quality collateral, such as government bonds, rose dramatically in the course of the crisis. On the European repo market, it is common to use a bundle of government bonds from euro area countries as collateral in repo transactions. Now that the financial crisis has triggered a sovereign debt crisis, it has to be asked whether this type of collateral is still of the high quality that it is believed to be. On aggregate, banks are again increasing the share of short-term funding carried out via repo transactions, and it has been demonstrated in this paper that large globally active banks may withdraw funds from their affiliated banks abroad upon disruptions to these markets. This may affect the efficient allocation of credit to the real economy. It has to be kept in mind that the next distortion to collateral value might be linked to the declining creditworthiness of governments.

Another development should be observed closely as well. Growing mistrust among market participants led to an increase in the percentage of repo transactions settled with central clearing counterparties (tri-party repo). Although this might help overcome the loss of confidence in repo markets to some extent, it is leading to large volumes of transactions being concentrated on only very few institutions. Operational practices within these institutions lead to them providing a large amount of credit to their borrowers during the day, and settling this position again with the cash provided by the repo lender at the end of the day (a procedure called "unwinding"). From their theoretical model, MARTIN ET AL. (2012) draw the conclusion that this creates a destabilizing effect on the market, and that, on that date, it played a part in the bankruptcy of Lehman Brothers. The management of liquidity and the administration of collateral deposited with these institutions should therefore be monitored closely.

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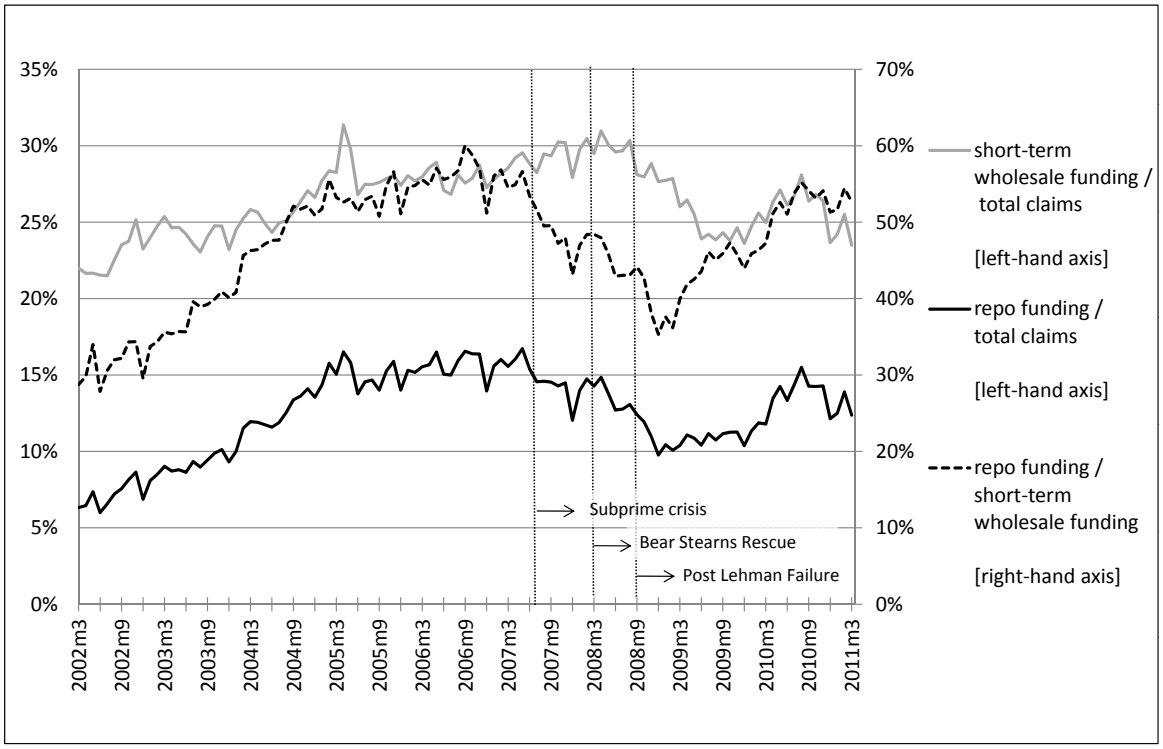
Appendix

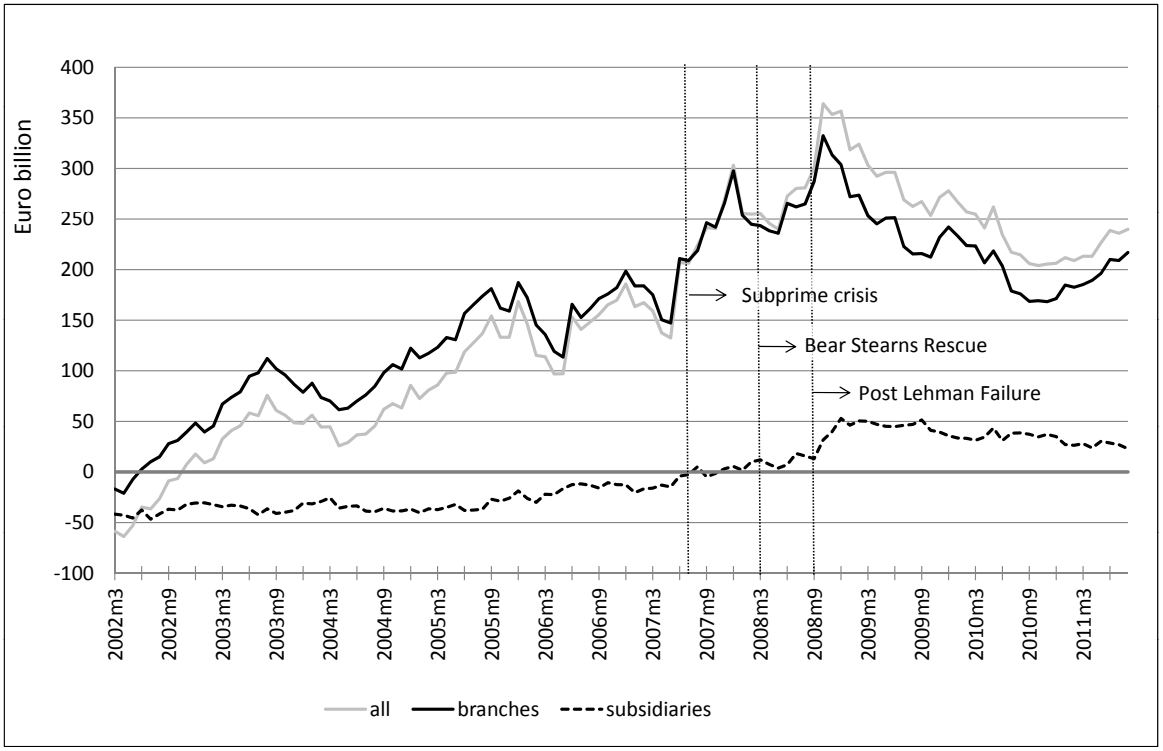
A Figures

Figure 1: Aggregate short-term wholesale and repo funding of German parent banks



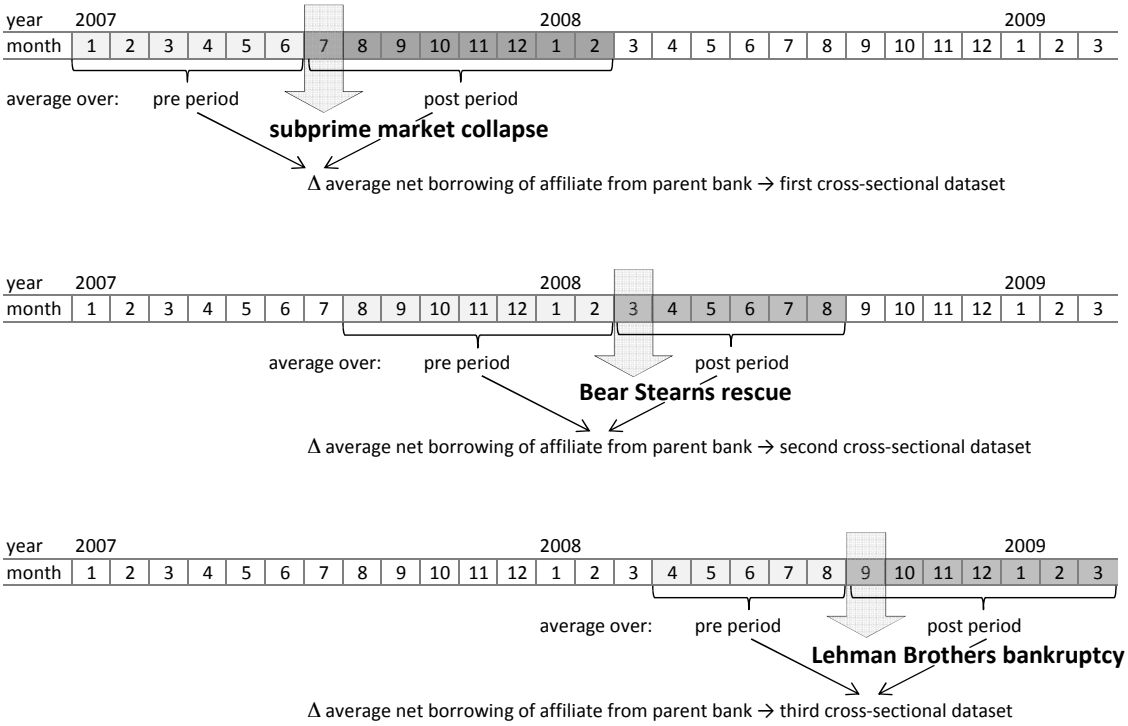
Source: Deutsche Bundesbank / own calculations.
This graph illustrates the dynamics of short-term wholesale funding and repo funding of German parent banks. It is based on monthly reports of parent banks to the Deutsche Bundesbank. Repo funding and short-term wholesale funding of the parent bank exclude positions held vis-à-vis affiliated banks abroad. Short-term wholesale funding comprises funding via interbank loans (including repo agreements with other monetary and financial institutions), own bonds and notes issued and repo agreements with non-banks, being, for example, central clearing counterparties. Short-term refers to an original maturity of less than one year. Foreign-owned parent banks registered in Germany are not included; however, their influence on the aggregate is so small that their inclusion would not change the dynamics or the order of magnitude of the ratios.

Figure 2: Aggregate net borrowing of branches and subsidiaries from German parent banks



Source: Own calculations.
The graph depicts aggregate numbers for net borrowing of branches and subsidiaries from German parent banks. The series are based on individual reports which each foreign affiliate of a bank headquartered in Germany reports on a monthly basis to the Deutsche Bundesbank. While subsidiaries report this position directly, it is approximated for branches to correspond with these entities' net borrowing from the German banking sector. For details, see section 4.2 and DÜWEL AND FREY (2012) who establish this measurement. Affiliates of foreign-owned banks registered in Germany are not included in the aggregate series. However, their volume of net borrowing is so small that it does not change the aggregate noticeably.

Figure 3: Pre and post event periods of intra-bank lending during the financial crisis, yielding three cross-sectional datasets



This figure divides the time period of the financial crisis into pre and post periods for the three events considered in this study as amplifiers of uncertainty on repo markets (the subprime market collapse, the Bear Stearns rescue and the Lehman Brothers bankruptcy). Comparing the post event and pre event difference of a foreign affiliate's average net borrowing reveals whether the level of net amount of funds received from the parent bank increased or decreased in response to the specific shock. This view of the data yields three cross-sectional datasets, one for each event. The quality of the regression results for all three events is robust to excluding from the post period the months in which the shocks occur. The results are also robust to shortening or extending the pre period of the subprime market collapse.

B Tables

Table 1: Descriptive statistics on German parent banks and their foreign affiliates

Unless otherwise stated, all figures reported refer to domestically-owned banks, hence they exclude foreign-owned banks (banks with a foreign majority shareholder). The statistics are based on the regression samples.
Maximums and minimums of bank-specific data are not shown here due to confidentiality.

	Before Subprime market collapse		*Before Bear Stearns rescue*		*Before Lehman Brothers bankruptcy*	
Variable	Mean	StD	Mean	StD	Mean	StD
Parent bank level						
	Avg: 2007m1-2007m6		*Avg: 2007m8-2008m2*		*Avg: 2008m4-2008m8*	
capitalization (equity capital / total assets)	0.042	0.018	0.041	0.019	0.047	0.028
liquidity (liquid assets[a] / total assets)	0.036	0.071	0.042	0.040	0.039	0.080
size (total assets) in € billion	85.412	103.884	89.128	108.405	81.989	111.291
	2007m6		*2008m2*		*2008m8*	
repo_exposure[b]	0.238	0.294	0.229	0.272	0.190	0.265
repo funding / total claims	0.083	0.137	0.086	0.136	0.086	0.187
short-term wholesale funding / total claims	0.223	0.199	0.240	0.215	0.266	0.252
(avg) # of countries served by branches and/or subsidiaries	5.6	8.0	5.7	8.3	5.6	8.1
# of parent banks, domestically-owned	42		42		48	
# of parent banks, foreign-owned	18		18		17	
Affiliate level						
Branches	*Avg: 2007m1-2007m6*		*Avg: 2007m8-2008m2*		*Avg: 2008m4-2008m8*	
net borrowing from parent bank / total assets	0.392	1.738	-0.006	1.768	0.168	1.387
core investment role[c]	0.069	0.134	0.066	0.126	0.067	0.119
core funding role[d]	0.242	0.258	0.222	0.249	0.231	0.261
size (total assets) in € billion	10.678	50.478	11.188	50.004	9.497	42.432
short-term wholesale funding / total assets	0.306	0.290	0.292	0.294	0.280	0.294
	2007m6		*2008m2*		*2008m8*	
# of branches, domestically-owned	178		181		203	
# of branches, foreign-owned	26		27		28	
Subsidiaries	*Avg: 2007m1-2007m6*		*Avg: 2007m8-2008m2*		*Avg: 2008m4-2008m8*	
net borrowing from parent bank / total assets	0.170	1.169	0.067	0.476	0.257	1.201
core investment role[c]	0.044	0.091	0.042	0.088	0.040	0.086
core funding role[d]	0.351	0.290	0.339	0.284	0.345	0.271
size (total assets) in € billion	5.611	9.658	5.420	9.621	5.449	10.021
short-term wholesale funding / total assets	0.315	0.279	0.283	0.260	0.247	0.237
	2007m6		*2008m2*		*2008m8*	
# of subsidiaries, domestically-owned	100		101		108	
# of subsidiaries, foreign-owned	6		3		4	

[a] Sum of cash holdings, claims on the central bank, short-term claims on other (unaffiliated) banks and holdings of short-term securities.
[b] The repo_exposure of the parent bank is defined as the financing via repurchase agreements relative to overall short-term wholesale funding (interbank liabilities, including repo agreements with other monetary and financial institutions, own bonds and notes issued and repo liabilities to non-banks). Short-term refers to an original maturity of less than one year.
[c] Core investment role: share of the affiliate in the bank holding company's total lending business to the foreign non-bank private sector (measured in loan stock outstanding).
[d] Core funding role: affiliate's local liabilities / total liabilities.

Table 2: List of countries with local presence of German banks

The list contains all countries in which German parent banks have established branches and/or subsidiaries. All figures are listed as of 2007m6.
(*) marks countries which represent financial platforms for German banks (see section 4.2).
(...) stands for data not shown here on grounds of confidentiality.

	Country	Aggregate size of branches and subsidiaries of German banks (in € billion)	# of parent banks operating in this country via branches and/or subsidiaries	Aggregate net borrowing of branches and subsidiaries from German parent banks (in € billion)
1	Argentina	…	1	…
2	Australia	…	2	…
3	Austria	1.847	7	-0.797
4	Belgium	9.409	6	-5.476
5	Brazil	…	2	…
6	Canada	…	2	…
7	Cayman Islands *	184.925	10	20.125
8	Chile	…	1	…
9	China	5.327	7	-0.044
10	Czech Republic	3.444	3	-0.509
11	Denmark	…	1	…
12	Finland	…	2	…
13	France	31.625	12	12.004
14	Greece	2.163	3	0.925
15	Guernsey *	…	1	…
16	Hong Kong *	33.837	7	1.193
17	Hungary	10.140	6	0.552
18	India	…	1	…
19	Indonesia	…	1	…
20	Ireland *	64.323	10	8.563
21	Italy	107.590	12	31.687
22	Japan	50.324	6	0.637
23	Jersey *	13.316	3	-0.414
24	Luxembourg *	371.387	23	-19.825
25	Malaysia	…	2	…
26	Mauritius	…	1	…
27	Netherlands	16.187	9	-1.941
28	Netherlands Antilles *	…	1	…
29	New Zealand	…	1	…
30	Pakistan	…	1	…
31	Philippines *	…	1	…
32	Poland	16.711	6	0.136
33	Portugal	6.983	4	-0.776
34	Republic of Korea	…	1	…
35	Russian Federation	3.372	4	1.362
36	Saudi Arabia	…	1	…
37	Singapore *	75.584	10	10.271
38	Slovak Republic	…	1	…
39	South Africa	…	2	…
40	Spain	30.492	9	16.983
41	Sri Lanka (Ceylon) *	…	1	…
42	Sweden	3.072	4	3.023
43	Switzerland *	26.516	11	2.221
44	Taiwan	…	1	…
45	Thailand	…	1	…
46	Turkey	…	2	…
47	United Arab Emirates	…	1	…
48	United Kingdom *	1,097.080	20	100.310
49	United States *	307.444	12	16.704
50	Vietnam	…	1	…

Table 3: Descriptive statistics on host countries of German banks' affiliates

Country level	Obs	Mean	StD	Min	Max
	Before Subprime market collapse: 2007m6				
euro area (excluding financial platforms)	278	0.259	0.439	0	1
financial platform	278	0.518	0.501	0	1
financial openness	278	2.039	1.035	-1.159	2.456
	Before Bear Stearns rescue: 2008m2				
euro area (excluding financial platforms)	282	0.262	0.441	0	1
financial platform	282	0.511	0.501	0	1
financial openness	282	2.075	0.963	-1.159	2.456
	Before Lehman Brothers bankruptcy: 2008m8				
euro area (excluding financial platforms)	311	0.283	0.451	0	1
financial platform	311	0.460	0.499	0	1
financial openness	311	2.068	0.963	-1.159	2.456

euro area (excluding financial platforms): *d_euro_area_no_fin_platform*	Dummy variable: =1 if country is a euro area country but no financial platform
financial platform: *d_fin_platform*	Dummy variable: =1 if country is a financial platform for German banks (see Table 3 "List of countries")
financial openness: *fin_openness*	De jure financial openness indicator (Chinn and Ito (2008))

Table 4: Regression results: Subprime market collapse

The dependent variable is the change in net borrowing of the affiliate (branch or subsidiary) j from parent bank i (avg. 2007m8-2008m2 vs. avg. 2007m1-2007m6). The parent bank's *repo_exposure* is its share of funding via repurchase agreements in overall short-term wholesale funding (defined in section 4.2) as of 2007m6. The *core investment role* is calculated as the share of the affiliate in the bank holding company's total foreign non-bank private sector lending. The *core funding role* is the affiliate's local liabilities relative to total liabilities (all affiliate variables are avg. 2007m1-2007m6). Financial platforms (dummy variable *d_fin_platform*) are host countries defined as important financial centers in section 4.2. The regression sample contains only German domestically-owned banks. The differentiation of effects between branches and subsidiaries is obtained by interacting with a dummy variable (*d_sub*) and by calculating total effects from that.
Standard errors, clustered by parent bank, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	Subprime			
Dependent variable	**market collapse**			
Change in net borrowing from the parent bank	(shock to funding occurs in 2007m7)			
	total *effect branches*		***total*** *effect subsidiaries*	
Explanatory variables:	*(d_sub=0)*		*(d_sub=1)*	
				difference:
(Parent bank) repo_exposure	**-2.091****		**-1.743***	0.349
	(0.860)		**(0.912)**	(0.320)
Interaction terms:				
Affiliate level:				
repo_exposure * core investment role	14.321***		-10.463	
	(4.393)		(11.568)	
repo_exposure * core funding role	-0.460		-0.718**	
	(0.443)		(0.318)	
repo_exposure * size	-0.074*		0.057	
	(0.044)		(0.042)	
Parent bank level:				
repo_exposure * size		0.004		
		(0.003)		
repo_exposure * capitalization		6.182		
		(7.255)		
repo_exposure * liquidity		-0.704		
		(7.723)		
Country level:				
repo_exposure * d_eurozone_no_fin_platform	0.157		-0.569**	
	(0.425)		(0.043)	
repo_exposure * d_fin_platform	0.501		-0.420	
	(0.355)		(0.121)	
repo_exposure * fin_openness		-0.034		
		(0.046)		
Non-interacted terms:				
Affiliate level:				
core investment role	-0.965*		-1.065	
	(0.520)		(0.869)	
core funding role	0.292		0.106	
	(0.335)		(0.299)	
size	0.077		0.048	
	(0.050)		(0.050)	
Parent bank level:				
size		0.001		
		(0.002)		
capitalization		-1.130		
		(1.534)		
liquidity		-0.585		
		(0.731)		
Country level:				
d_euro_area_no_fin_platform	0.042		-0.118	
	(0.448)		(0.697)	
d_fin_platform	-0.522*		-0.156	
	(0.295)		(0.481)	
fin_openness		0.017		
		(0.051)		
constant		0.321		
		(0.365)		
Observations		278		
Number of parent banks (clusters)		42		
R-squared		0.336		

Table 5: Regression results: Bear Stearns rescue

The dependent variable is the change in net borrowing of the affiliate (branch or subsidiary) j from parent bank i (avg. 2008m3-2008m8 vs. avg. 2007m8-2008m2). The parent bank's *repo_exposure* is its share of funding via repurchase agreements in overall short-term wholesale funding (defined in section 4.2) as of 2008m2. The *core investment role* is calculated as the share of the affiliate in the bank holding company's total foreign non-bank private sector lending. The *core funding role* is the affiliate's local liabilities relative to total liabilities (all affiliate variables are avg. 2007m8-2008m2). Financial platforms (dummy variable *d_fin_platform*) are host countries defined as important financial centers in section 4.2. The regression sample contains only German domestically-owned banks. The differentiation of effects between branches and subsidiaries is obtained by interacting with a dummy variable (*d_sub*) and by calculating total effects from that.
Standard errors, clustered by parent bank, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	Bear Stearns			
Dependent variable	**rescue**			
Change in net borrowing from the parent bank	(shock to funding occurs in 2008m3)			
	total *effect branches*		***total*** *effect subsidiaries*	
Explanatory variables	*(d_sub=0)*		*(d_sub=1)*	
				difference:
(Parent bank) repo_exposure	**-3.714****		**-2.254***	**1.460****
	(1.543)		**(1.219)**	**(0.038)**
Interaction terms				
Affiliate level				
repo_exposure * core investment role	19.711		0.669	
	(13.022)		(13.523)	
repo_exposure * core funding role	0.501		-1.802**	
	(0.659)		(0.771)	
repo_exposure * size	0.077**		-0.074	
	(0.030)		(0.062)	
Parent bank level				
repo_exposure * size		0.006**		
		(0.002)		
repo_exposure * capitalization		20.128**		
		(8.653)		
repo_exposure * liquidity		0.597		
		(3.184)		
Country level				
repo_exposure * d_eurozone_no_fin_platform	0.055		-0.803**	
	(0.285)		(0.037)	
repo_exposure * d_fin_platform	-0.294		-0.226	
	(1.716)		(0.463)	
repo_exposure * fin_openness		0.225*		
		(0.114)		
Non-interacted terms				
Affiliate level				
core investment role	-0.437		-1.162	
	(0.445)		(0.855)	
core funding role	0.068		0.117	
	(0.331)		(0.377)	
size	-0.084**		0.052	
	(0.032)		(0.052)	
Parent bank level				
size		0.000		
		(0.001)		
capitalization		-1.176		
		(1.316)		
liquidity		-0.288		
		(0.567)		
Country level				
d_euro_area_no_fin_platform	-0.016		0.168	
	(0.230)		(0.36)	
d_fin_platform	0.284		-0.138	
	(0.498)		(0.474)	
fin_openness		-0.114*		
		(0.061)		
constant		0.532		
		(0.335)		
Observations		282		
Number of parent banks (clusters)		42		
R-squared		0.155		

Table 6: Regression results: Lehman Brothers bankruptcy

The dependent variable is the change in net borrowing of the affiliate (branch or subsidiary) j from parent bank i (avg. 2008m9-2009m3 vs. avg. 2008m4-2008m8). The parent bank's *repo_exposure* is its share of funding via repurchase agreements in overall short-term wholesale funding (defined in section 4.2) as of 2008m8. The *core investment role* is calculated as the share of the affiliate in the bank holding company's total foreign non-bank private sector lending. The *core funding role* is the affiliate's local liabilities relative to total liabilities (all affiliate variables are avg. 2008m4-2008m8). Financial platforms (dummy variable *d_fin_platform*) are host countries defined as important financial centers in section 4.2. The regression sample contains only German domestically-owned banks. The differentiation of effects between branches and subsidiaries is obtained by interacting with a dummy variable (*d_sub*) and by calculating total effects from that.
Standard errors, clustered by parent bank, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	Lehman Brothers			
Dependent variable	**bankruptcy**			
Change in net borrowing from the parent bank	(shock to funding occurs in 2008m9)			
	total *effect branches*		***total*** *effect subsidiaries*	
Explanatory variables	*(d_sub=0)*		*(d_sub=1)*	
				difference:
(Parent bank) repo_exposure	**-1.224***		**-0.697**	0.526
	(0.620)		**(0.620)**	(0.206)
Interaction terms				
Affiliate level				
repo_exposure * core investment role	4.114		-20.744	
	(2.859)		(15.055)	
repo_exposure * core funding role	0.055		-0.472	
	(0.840)		(0.921)	
repo_exposure * size	0.051		0.025	
	(0.053)		(0.132)	
Parent bank level				
repo_exposure * size		0.003		
		(0.003)		
repo_exposure * capitalization		-5.465		
		(6.469)		
repo_exposure * liquidity		2.922		
		(6.237)		
Country level				
repo_exposure * d_eurozone_no_fin_platform	-0.772***		-0.978	
	(0.283)		(0.115)	
repo_exposure * d_fin_platform	0.134		-1.049**	
	(0.627)		(0.044)	
repo_exposure * fin_openness		0.316**		
		(0.142)		
Non-interacted terms				
Affiliate level				
core investment role	0.447*		0.830	
	(0.246)		(0.609)	
core funding role	-0.338*		-0.494	
	(0.175)		(0.402)	
size	-0.044*		0.089	
	(0.023)		(0.061)	
Parent bank level				
size		0.001		
		(0.001)		
capitalization		-1.679		
		(1.216)		
liquidity		-0.930***		
		(0.301)		
Country level				
d_euro_area_no_fin_platform	0.177**		-0.204	
	(0.086)		(0.432)	
d_fin_platform	0.558**		-0.061	
	(0.208)		(0.687)	
fin_openness		-0.062		
		(0.044)		
constant		0.204		
		(0.164)		
Observations		311		
Number of parent banks (clusters)		48		
R-squared		0.409		

Table 7: Stand-alone effect of parent banks' run-on-repo exposure

This table provides a comparison of the responses of banks with high and low exposures to the disruptions on repo markets in the three different events. The calculations are based on summary statistics of the branches' and subsidiaries net borrowing from the parent bank (line a), as well as the parent banks' $repo\_exposure$ (repo funding/short-term wholesale funding) (line b), and the estimations presented in Tables 4, 5 and 6 (line c). The figures calculated in lines d and e demonstrate in which of the events the model predicts highly exposed parent banks to withdraw the largest volumes of internal funds from their foreign affiliates, leaving aside the potential buffering of amplifying effect of other parent or affiliate characteristics.
High repo exposure = above the 75th percentile of the distribution, low repo exposure = below the 25th percentile of the distribution.

			Subprime market collapse		Bear Stearns rescue		Lehman Brothers bankruptcy	
			high repo exposure of parent (>75th percentile, average)	low repo exposure of parent (<=25th percentile, average)	high repo exposure of parent (>75th percentile, average)	low repo exposure of parent (<=25th percentile, average)	high repo exposure of parent (>75th percentile, average)	low repo exposure of parent (<=25th percentile, average)
a	average pre-period net borrowing (in € billion)	branches	1.34	0.26	1.82	0.66	1.86	0.38
		subsidiaries	-0.40	0.15	-0.23	0.23	0.02	0.14
b	average repo exposure of parent		0.65	0.00	0.62	0.00	0.58	0.00
c	estimated impact of repo exposure of parent on net borrowing	branches	-2.09		-3.71		-1.22	
		subsidiaries	-1.74		-2.25		0.00	
d (= b x c)	predicted change in net borrowing due to repo exposure (in € billion)	branches	-1.36	0.00	-2.32	0.00	-0.72	0.00
		subsidiaries	-1.13	0.00	-1.41	0.00	0.00	0.00
e (= d / a)	predicted change in net borrowing due to repo exposure (relative to abolute pre-period average net borrowing)	branches	-101.19%	0.00%	-127.41%	0.00%	-38.54%	0.00%
		subsidiaries	-280.80%	0.00%	-600.20%	0.00%	0.00%	0.00%

Table 8: Robustness: Instrumental-variables approach for Bear Stearns rescue

The dependent variable is the change in net borrowing of the affiliate (branch or subsidiary) j from parent bank i (avg. 2008m3-2008m8 vs. avg. 2007m8-2008m2). The parent bank's *repo_exposure* is its share of funding via repurchase agreements in overall short-term wholesale funding (defined in section 4.2) as of 2008m2.

The regression is estimated using two-stage least squares. The parent bank's *repo_exposure* is instrumented with its *repo_exposure* as of 2007m6 (before the subprime market collapse). Likewise, other parent bank variables (size, capitalization, liquidity) are instrumented with earlier values. The model is exactly identified. Statistics on the first stage regressions (not reported) and the reported Kleinbergen-Paap rank LM-statistic for identification (which is robust to clustered standard errors) suggest that the instruments are sufficiently strong in explaining the endogenous regressors. Standard errors, clustered by parent bank, in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

The *core investment role* is calculated as the share of the affiliate in the bank holding company's total foreign non-bank private sector lending; the *core funding role* is the affiliate's local liabilities relative to total liabilities (all affiliate variables are avg. 2007m8-2008m2). Financial platforms (dummy variable *d_fin_platform*) are host countries defined as important financial centers in section 4.2. The regression sample contains only German domestically-owned banks. The differentiation of effects between branches and subsidiaries is obtained by interacting with a dummy variable (*d_sub*) and by calculating total effects from that.

	Bear Stearns rescue		
Dependent variable	***- two-stage least squares -***		
Change in net borrowing from the parent bank	(shock to funding occurs in 2008m3)		
	total *effect branches*	***total*** *effect subsidiaries*	
Explanatory variables	*(d_sub=0)*	*(d_sub=1)*	**difference:**
(Parent bank) repo_exposure	**-4.749****	**-3.452****	**1.297****
	(1.995)	**(0.037)**	**(0.586)**
Interaction terms			
Affiliate level			
repo_exposure * core investment role	19.112	-12.277	
	(12.181)	(0.455)	
repo_exposure * core funding role	0.600	-1.721**	
	(0.480)	(0.013)	
repo_exposure * size	0.081*	-0.119**	
	(0.044)	(0.027)	
Parent bank level			
repo_exposure * size	0.007***		
	(0.003)		
repo_exposure * capitalization	17.342***		
	(6.550)		
repo_exposure * liquidity	3.982		
	(4.100)		
Country level			
repo_exposure * d_eurozone_no_fin_platform	0.378	-0.492	
	(0.350)	(0.186)	
repo_exposure * d_fin_platform	0.618	0.057	
	(1.685)	(0.872)	
repo_exposure * fin_openness	0.258**		
	(0.114)		
Non-interacted terms			
Affiliate level	Yes	Yes	
Parent bank level	Yes		
Country level	Yes	Yes	
constant	0.987**		
	(0.473)		
Observations	282		
Number of parent banks (clusters)	42		
R-squared	0.147		
Underidentification (H0: Not identified)			
Kleinbergen-Paap rank LM-statistic	9.661		
p-value (Chi-sq (1))	0.002		
Exogeneity of explanatory variables (H0: Exogenous)			
Robustified Durbin-Wu-Hausman test statistic	F(19,41) = 170.372		
p-value	0.000		

V German banks in financial centers: How risky is their business?

This paper is available from the author as:

Düwel, C. (2013). German banks in financial centers: How risky is their business? *Mimeo*.

It is currently being revised for publication as *Bundesbank Discussion Paper*.

German banks in financial centers: How risky is their business?

August 2013

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Abstract

German banks' financial center affiliates are on aggregate four times as large as the affiliates located elsewhere, and their balance sheet total is half the size of the German parent banks' aggregate total assets. Besides, they are strongly connected with financial players in other financial centers, which makes them susceptible to distress in financial markets. German banks' affiliates in financial centers operate predominately as branches as opposed to subsidiaries. This promotes the transmission of shocks to the parent bank due to the balance sheet consolidation for regulatory purposes. Financial center affiliates constantly have to roll over large amounts of short-term debt. As a consequence, they required larger injections of liquidity from their parent banks during the recent financial crisis. Balance sheet risk for parent banks is most likely to arise from financial center branches, as they are in general weakly capitalized, and as a change in accounting rules reveals since December 2010 their strong, formerly off-balance sheet involvement in derivatives trading.

Keywords: Financial center, offshore banking, internal capital market, rollover risk.

JEL Classification: G21, G15, F36, G28

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This paper was written during research visits to the Deutsche Bundesbank. I would like to thank the Bundesbank and its staff for their continuous hospitality and support. The paper has benefited from valuable comments by Claudia Buch, Rainer Frey, Heinz Herrmann, Sebastian Hügelschäffer, Leif Lengelsen, Alexander Lipponer, Cordula Munzert and Peter Tillmann. All remaining errors and inaccuracies are my own. Financial support from the University of Giessen is gratefully acknowledged.

1 Introduction

While expanding their business internationally during the past decade, many banks established important affiliates in major financial centers such as Luxembourg or the Cayman Islands. The financial crisis has revealed the potential of financial shocks being transmitted via international financial platforms where assets are traded globally and interdependence of financial institutions is very high. It is therefore of particular importance to understand how banks make use of international financial centers.

This paper seeks to clarify the role of foreign affiliates of German banks located in financial centers, and to provide first steps in analyzing whether they represented or still represent a source of risk to the stability of German multinational banks. For this purpose, a closer look is taken at the development of the financial center affiliates' assets and liabilities during the financial crisis, relative to other affiliates of German banks located outside these centers. Detailed data on German banks' foreign branches and subsidiaries reported to the Deutsche Bundesbank allow a deeper analysis of the affiliates' individual balance sheets, which is not possible using reports made to the Bank for International Settlements (BIS) or data provided by individual host countries.

Many empirical studies on international banking include a lump-sum control for characteristics of banks located in financial centers, but do not discuss these differences in more detail. Partly due to the lack of bank-level data, the literature on the role of foreign banks' affiliates in financial centers is rather limited. With a macroeconomic perspective, ERRICO AND MUSALEM (1999) investigate legal and tax regimes of financial centers and state that greater leeway for balance sheet management in these centers leads to higher solvency risk for banks. They highlight the role of financial center affiliates of Asian and Latin American banks in several regional crises during the 1980s and 1990s. These affiliates had built up unhedged exposures which were concentrated on very few asset types. Besides, they had provided extensive funding to their parent banks, which ran into trouble as their financial center affiliates experienced large losses.

WILLIAMS ET AL. (2005) analyze the costs and benefits for countries of becoming an offshore financial center using data on realized government revenues in existing financial centers. They point to potential risk stemming from bank affiliates in financial centers as they become even larger than their parent banks. DIXON (2001) compares consolidated and locational claims of BIS reporting banks on financial centers in order to determine the intermediation function of these platforms for several BIS reporting countries. She stresses the potential risk stemming from unobserved off-balance sheet activity of banks in financial centers, on which no data exist. ROSE AND SPIEGEL (2007) regard this very aspect as one of the major risks arising from financial centers. They assess the influence of offshore financial centers on neighboring countries and come to the conclusion, that loose regulation in financial centers encourages "bad behavior" on the part of source country banks, eg the building up of large off-balance sheet activity. Focusing on Chinese direct investment into financial centers, SHARMAN (2012) emphasizes the advantage of these locations as points of access to international capital markets. Furthermore, he states that

they are platforms where investors can establish links to profitable investments in, for example, developing countries.

According to LEWIS (1999), financial centers have either evolved from places which used to have the largest amount of capital to export (eg New York and London), or which have aimed at diversifying away from agriculture and tourism (eg the Cayman Islands). With new technology becoming available, some financial centers have become more and more specialized in providing international managerial and support services such as clearing (eg Luxembourg). In order to encourage this development, many financial centers have established favorable fiscal and legal systems, which render bank business more profitable than elsewhere. In terms of the number of financial centers that have evolved over time and the volume of transactions carried out there, ERRICO AND MUSALEM (1999) called this a "pervasive practice" early on. The locational claims of BIS banks on the Cayman Islands, for example, amounted to 600 times its nominal GDP at the end of 2012. For comparison, BIS banks' locational claims on Germany were 0.5 times nominal German GDP.

The International Monetary Fund (IMF) describes financial centers as "jurisdictions whose financial sector accounts for a significant - and disproportionate - share of its domestic economy" (DARBAR (2003)). These jurisdictions are also often called "offshore" financial centers, highlighting the fact that the lion's share of financial interactions of these locations is carried out with non-residents. Besides, these locations are often said to be "jurisdictions where offshore banks are exempt from a wide range of regulations which are normally imposed on onshore institutions" (ERRICO AND MUSALEM (1999)). There exists, however, no clear-cut definition of financial centers. In 2000, the Financial Stability Forum launched an assessment program in order to address regulatory deficits in several financial centers, and drew up a list of countries hosting major financial centers for this purpose, which this study relies on in the main.

The aggregate size of German banks' financial center affiliates exceeds the size of affiliates outside financial centers by a factor of three. Besides, they are about half the aggregate size of their German headquarters. Both figures highlight the relevance of financial center affiliates for German banks. Activities in financial centers are mainly carried out via branches, which do not fulfill local regulatory requirements and therefore allow greater flexibility regarding the management of balance sheets. This is reflected by low levels of capitalization. In their loan portfolio, financial center affiliates, and financial center branches in particular (a share of almost 90%), focus on lending to banks and firms in financial centers. In doing so, they lend, however, more across borders than affiliates located outside financial centers. Besides, they are highly involved in trading securities, which put particular pressure on their stability during the financial crisis and required increased support from parent banks.

Furthermore, it is striking that financial center affiliates have to constantly roll over large amounts of short-term debt. During the financial crisis, funding obtained from the parent bank is found to compensate for difficulties of financial center affiliates in particular to tap short-term wholesale funding markets. Since December 2010, new accounting rules require banks to report trading portfolio derivatives as part of the balance sheet position "other assets". This dramatically increases the share of these assets in the total balance sheets of financial center branches and likely reveals part of the off-balance sheet risk which these entities have built up.

The remainder of the paper is structured as follows. Section 2 defines the group of financial

center countries and investigates the location and size of German banks' financial center affiliates. Section 3 analyzes in detail the asset structure and the funding sources of branches and subsidiaries in financial centers and compares them with affiliates outside financial centers. In section 4, paths for further research and data limitations with regard to the analysis of risk in financial centers are discussed. Section 5 concludes.

2 How large is the German banks' investment in financial centers?

2.1 Defining financial centers

This paper relies, in principle, on the FINANCIAL STABILITY FORUM's list of financial centers (2000). First, all "financial centers with significant offshore activities" are included[1], as well as "major financial centers", which also received the questionnaires for offshore supervisors[2]. Furthermore, in this study, the United Kingdom and the Unites States are classified as financial centers. This decision is based on several considerations. First, ZOROMÉ (2007), following the initiative of the IMF, developed an identification scheme for offshore financial centers based on macroeconomic characteristics. His results strengthen the IMF's definition, but also call for the UK to be regarded as a financial center. In view of the presence of foreign banks and the dominance of international banking, CASSIS (2006) sees both the UK and the US as offshore financial centers. For both countries, BIS consolidated foreign claims are smaller than locational foreign claims, which hints at a strong presence of foreign banks in both locations transacting with other countries (MILESI-FERRETTI ET AL. (2010)). Almost all of the existing German banks' affiliates in the UK are located in London, one of the world's largest financial centers. Similarly, with negligible exceptions, the existing German affiliates in the US are located in New York or Delaware. The US has established the "International Banking Facilities", a booking concept which allows banks to conduct international banking under more favorable tax rules. According to the FEDERAL RESERVE BANK OF NEW YORK (2007A), the majority of International Banking Facilities are registered in New York, as New York has established laws to facilitate the establishment of International Banking Facilities and has exempted net income derived from such facilities from state and local taxes. Delaware has become the most popular state in which to host holding companies, under which many foreign banks operate, since it has a very favorable tax and legal environment.

2.2 Location and size of German banks' financial center affiliates

The data used in this study stem from the reporting of banks to the Deutsche Bundesbank. All banks registered in Germany report, on a monthly basis, balance sheet characteristics of the German part of the bank, as well as of all its foreign affiliates (branches and subsidiaries).[3] Branches

1 These are Andorra, Anguilla, Antigua, Aruba, Bahamas, Bahrain, Barbados, Belize, Bermuda, British Virgin Islands, Cayman Islands, Cook Islands, Costa Rica, Cyprus, Gibraltar, UK Channel Islands (Guernsey, Isle of Man, Jersey), Lebanon, Liechtenstein, Macau, Malta, Marshall Islands, Mauritius, Monaco, Nauru, Netherlands Antilles, Nevis, Niue, Panama, St Kitts, Saint Lucia, St Vincent, Samoa, Seychelles, Turks & Caicos Islands, Vanuatu.

2 These include Hong Kong, Ireland, Luxembourg, Malaysia, Singapore, Switzerland.

3 Reports of subsidiaries are submitted if the German bank is the majority shareholder.

do not fulfill regulatory capital requirements in their host countries but are consolidated into the balance sheet of the parent bank, whereas subsidiaries represent own legal entities. While subsidiaries are covered indiviually in the reports, activities of a bank's foreign branches are aggregated by foreign country. In addition to the standard balance sheet positions, all of the mentioned entities of the bank file an additional "Foreign Positions Report" (see FIORENTINO ET AL. (2010)). This allows for an identification of foreign activities vis-à-vis individual foreign countries and sectors within those countries.

Table 1 provides a list of countries with major financial centers in which German banks had established foreign affiliates by the end of 2006. Table 2 serves to compare the presence of banks in financial centers with their engagement in other foreign countries. Both the large number of banks with foreign affiliates in financial centers and the size of these affiliates underline the importance of the centers for German banks.

By the end of 2006, 39 German banks had established affiliates in 13 financial center countries, almost as many as across all other 47 countries (42 German banks). The majority of banks had representations in the financial centers of Luxembourg (26) and the United Kingdom (25), while Italy and Austria were the most popular among the non-financial center countries (in both countries, 16 banks had established affiliates by December 2006). The aggregate balance sheet size of financial center affiliates is roughly four times the aggregate size of non-financial center affiliates (roughly €2 trillion versus €1/2 trillion). Even if the US and the UK are excluded from the list of the 13 financial center countries, the remaining financial center affiliates in 11 countries are, on aggregate, larger than the non-financial center affiliates in the 47 other countries. The distribution of total assets between financial center affiliates and non-financial center affiliates does not change much between 2006m12 and 2012m12. The same applies to the number of banks active in the two categories of countries.

Individual financial centers host rather large affiliates. The overall size of affiliates in the Cayman Islands, for example, is on its own already larger than the size of all affiliates in Austria and France taken together. In view of the large balance sheet size of German banks' financial center affiliates, it is of particular importance that parent banks control the risk associated with these affiliates effectively. For this purpose, it is important that supervisors of home and host country cooperate in order to achieve consolidated supervision of the respective bank holding companies (FINANCIAL STABILITY FORUM (2000)).

In financial centers, aggregate balance sheet size of affiliates splits into 76% to 24% between branches and subsidiaries, whereas the difference in aggregate size is much smaller in non-financial center countries. There, branches account for roughly 42% of the aggregate size of all affiliates. German banks thus operate in financial centers mainly through branches, while subsidiaries are more important outside financial centers. The dominance of branches in financial centers means that potential risk is more easily transmitted to the parent bank, as the common balance sheet facilitates transfers between the two entities of the bank holding company.

Furthermore, the aggregate size of all parent banks at that time was around €4 trillion. This means that all German parent banks together were only twice as large as their financial center affiliates (€2 trillion, see Table 1). This ratio highlights the relevance of financial center affiliates for German multinational banks, and the need to control the risk taken by these affiliates.

3 The role of financial center affiliates for German banks

3.1 Strong focus on financial markets

During the recent financial crisis, the risk associated with some operations in financial markets was largely underestimated. Banks which were highly active on these markets therefore had to cope with substantial losses after the collapse of the US subprime market triggered a world-wide financial crisis and harmed the functioning of financial markets. However, in general, investments made on financial markets, in particular the trading of securities, are more volatile than, for example, bank lending to the real sector. This section analyzes to what extent German banks' affiliates in financial centers focus on intermediation on financial markets versus traditional bank lending.

Securities holdings and portfolio trading characterize financial center affiliates

The four panels in Figure 1 show a breakdown of German banks foreign affiliates' assets at three points in time: 2006m12 characterizes the situation before the outbreak of the financial crisis, 2009m12 captures the structure of balance sheets after the first phase of the crisis and before the beginning of the sovereign debt crisis. 2012m12 stands for the situation as it is found today. All statistics distinguish between branches and subsidiaries and show aggregates of the two types of affiliates for those located in financial centers and those located elsewhere.

When comparing branches and subsidiaries in financial centers (top row of Figure 1) with their equivalents outside financial centers (bottom row of Figure 1), it is striking that both types of affiliates in financial centers hold a larger percentage of their total assets as securities. At the end of 2006, the share of securities holdings in total assets of branches in financial centers amounted to 24%, and those of subsidiaries in financial centers to 35%. Their equivalents outside financial centers held 15% and 16% respectively. This reflects the fact that financial center affiliates are more heavily invested in securities and probably participate to a greater extent in trading securities on financial markets. For all categories of affiliates, the share of securities holdings in total assets shrank during the financial crisis, in particular for financial center subsidiaries. This is probably the outcome of sales and a loss in value of many securities related to the collapse of the US subprime market.

The degree to which securities holdings decreased for financial center branches is overshadowed by a change in the accounting rules which was introduced at the end of 2010. Since then, banks report trading portfolio derivatives as part of the balance sheet position "other assets", while these derivatives were held off-balance sheet before. The dramatic change in balance sheet compositions, in particular for financial center branches, again reflects, that an important part of these entities' business is to trade on financial markets. Since this business is mostly short-term and generally more volatile than traditional bank lending, the business model of financial center branches, as it is today, might add to the parent banks' risk of having to provide rapid support during market downturns.

Financial centers mainly lend to each other

The focus of financial center branches' and subsidiaries' assets clearly lies on financial markets. First, in 2006m12, financial center branches and subsidiaries (top row of Figure 1), used only 37% and 16%, respectively, of their balance sheets for lending to foreign firms[4]. For comparison, the lion's share of the balance sheet of branches and subsidiaries outside financial centers (bottom row of Figure 1) consisted in lending to foreign firms (almost 50% of the balance sheet in 2006m12).

Second, according to Figure 2, financial center affiliates hold a very large share of claims vis-à-vis counterparties to financial centers. Financial center branches direct 85% of their lending to banks and firms in financial centers. Financial subsidiaries' loan portfolio is, at 30% to 50% of lending to financial centers, more balanced between the two categories of destinations. However, the share of loans that they grant to counterparties in financial centers is still significantly higher than the proportion of loans given to financial centers by branches and subsidiaries located outside those centers (both direct only between 5% and 20% of their total lending to financial centers).

On the one hand, in the event of a shock hitting first and foremost financial markets, a high concentration of assets on these markets, as can be found, in particular, in the case of financial center branches, most certainly limits the affiliates' ability to compensate possible losses. This, in turn, increases the risk for parent banks of having to step in and provide emergency assistance. On the other hand, this focus on financial markets brings about deeper and more liquid markets with a highly specialized labor force. Parent banks may profit from this, as information on the development of global credit and funding markets is transmitted faster to the headquarter. It has to be admitted that affiliates outside financial centers are in a similar situation. Although they might be more sheltered from shocks hitting financial markets, they are highly exposed to economic slowdowns hitting the non-bank private sector. At the same time, their specialization on lending to the real sector of their country of residence might induce the bank's local success.

A large exposure to financial centers might, however, lead to higher balance sheet risk than a comparably large exposure to other economies. This arises from the fact that financial markets are highly connected with each other. As mentioned above, the lion's share of lending by financial center affiliates is directed to financial centers (Figure 2). Furthermore, as shown in Figure 3, the share of lending to local rather than foreign banks and firms is much smaller for financial center affiliates than it is for non-financial center affiliates. While financial center subsidiaries have recently lent 60% locally, subsidiaries outside financial centers grant 80%-90% of their total bank and firm loans to local counterparties. Branches in financial centers lend only around 40% locally, while their equivalents outside financial centers focus on local lending to the tune of 80%. A shock hitting one financial center might therefore quickly affect other financial centers. This risk of contagion is brought forward for example by GARRATT ET AL. (2011). By contrast, if one affiliate located outside a financial center suffers from a local economic downturn, then this will be less likely to drag down other affiliates, as those located outside financial centers are mostly exposed to their country of residence. This very concentrated exposure certainly is disadvantageous from a diversification point of view if local problems arise. Still, parent

4 The term "firms" is used to describe lending to the foreign non-bank private sector. The term "foreign" applies to all countries but Germany, hence it also applies to the affiliate's country of residence.

banks then have the chance to isolate and solve the temporary difficulties. By contrast, in the case of a financial center crisis, necessary support measures for affiliates may soon exceed the parent banks' capacity due to the high interconnectedness of financial centers with each other.

3.2 Maturity structure of assets and liabilities

Short-term assets dominate financial center affiliates' lending portfolio

Figure 4 shows the share of short-term claims in total claims on banks and firms of all four groups of affiliates. Both branches and subsidiaries in financial centers (top panels) hold relatively more short-term claims on foreign firms than their equivalents outside financial centers (bottom panels). For branches, this difference is particularly striking. While branches outside financial centers grant only around 35% of their loans to foreign firms on a short-term basis, financial center branches lend roughly 60%-70% on a short-term basis. This higher degree of short-term lending reflects once more the large interaction of financial centers with each other. Branches and subsidiaries in financial centers probably lend more to financial firms such as hedge funds or investment vehicles, which engage more in short-term assets and securities trading activities and less in longer-term investments in, for example, plant and equipment. These activities in general increase the default risk of loans, particulary in a financial crisis.

However, due to the shorter-term structure, balance sheets of branches and subsidiaries in financial centers seem to be more liquid. This is likely to increase their potential to buffer shocks to their portfolio and can thus reduce the risk of transmitting disruptions to the parent banks. After the outbreak of the financial crisis, branches in financial centers, whose balance sheets were the most liquid before the crisis, seem to have used this buffer the most. They were at the forefront of letting short-term loans to foreign firms expire, which led to a drop in the share of short-term lending to foreign firms by 12 percentage points.

When comparing the situations before and after the financial crisis, 2006m12 and 2012m12, the maturity structure of loans granted to foreign firms lengthened slightly across all four groups of affiliates. Vis-à-vis foreign banks, financial center affiliates (top panels of Figure 4) reduced or kept stable their short-term claims relative to longer-term claims. In contrast, affiliates outside financial centers (bottom panels of Figure 4) increased slightly the share of loans to banks which are granted on a short-term basis. A possible explanation for this development could be that, in the light of increasing opacity of risk incorporated in many banks' balance sheets, branches and subsidiaries outside financial centers had been downsizing their longer-term investments in other banks, and instead concentrated on their core business, which is longer-term lending to firms. Besides, they could have aimed at increasing the liquidity of their asset portfolios after the financial crisis had rendered the economic environment less predictable. If one assumes that investments in other banks have become more risky since the financial crisis due to remaining toxic assets in many banks' balance sheets, then affiliates outside financial centers have lately downsized the risk of their lending portfolio by shortening the maturity of loans to foreign banks.

Large rollover risk in financial centers

Financial center affiliates not only issue relatively more short-term loans - they also finance their business to a larger extent on short-term wholesale markets. The liability structure of all four groups of affiliates is depicted in Figure 5 as of 2006m12, 2009m12 and 2012m12. Branches in financial centers are the group which uses short-term wholesale funding the most, meaning interbank funding with an original maturity of less than one year as well as own bonds and notes issued. Before the financial crisis, this group raised 43% of its total funding via short-term wholesale markets, compared to 25% obtained by branches outside financial centers. When located in financial centers, subsidiaries used short-term wholesale funding to a similar extent as branches, but they reduced or had to reduce their funding via this market earlier in the financial crisis. By the end of 2012, both types of financial center affiliates had raised 25% of their total funding on short-term wholesale markets.

However, the development of the branches' liability portfolios is again overshadowed by the change in the accounting rules implemented in 2010m12. In the liability composition as of 2012m12, liabilities arising from trading portfolio derivatives are reported as other liabilities. This increases the share of this funding source in total liabilities, and reduces the share of short-term wholesale funding. Yet, as most of these newly reported liabilities are probably of a short-term nature as well, the dominance of short-term liabilities of financial center branches is still striking. In total, over 50% of the liabilities of financial center branches were thus short-term at 2012m12.

Subsidiaries outside financial centers can rely much more, and branches outside financial centers slightly more, than their financial center equivalents on deposit funding, ie on funding obtained from non-banks. This funding source adds stability to the liability portfolio of non-financial center affiliates, as it is less volatile and generally longer-term than wholesale funding. During the financial crisis, the share of deposits in total liabilities remained rather stable for all types of affiliates except branches in financial centers. The higher degree of interaction with financial firms might explain the relatively large decline in deposits as a share of total liabilities. It has to be kept in mind that, at the time, counterparties like special purpose vehicles were realizing dramatic losses due to the collapse of the subprime market. Therefore, they might have withdrawn their deposits from banks. Again, the change in accounting rules might also impact on the variation in deposits relative to total liabilities.

The comparably larger reliance on short-term funding by affiliates located in financial centers versus outside financial centers creates greater exposure to rollover risk. Especially when providers of short-term funds such as other banks lose confidence in market participants, as occurred during the financial crisis, this will hit financial center affiliates sooner and stronger than other affiliates due to the maturity structure of their liabilities. In a systemic crisis, it has proved to be advantageous if a bank has access to longer-term deposit funding. Many banks have therefore aimed at increasing the share of funding from non-banks in total liabilities. Parent banks holding affiliates which rely largely on short-term funding have to be prepared to compensate possible shortfalls during a funding crisis.

3.3 Capitalization

Branches in general very weakly capitalized

As can be concluded from Figure 5, equity capital represents only a small fraction of total liabilities of all groups of affiliates. Subsidiaries are generally better capitalized than branches, both in and outside financial centers. Figure 6 traces in more detail the development over time of the affiliates' equity capital to total liabilities. The large difference in the level of capitalization between branches and subsidiaries is striking. While branches have only 1%-2.5% of equity capital relative to total liabilities, subsidiaries hold roughly between 4% and 7% of equity capital. This reflects the obligation of subsidiaries to fulfill local regulatory rules, including minimum capital requirements. However, their stock of equity capital is likely to include buffers. For comparison, German parent banks hold on aggregate roughly 4% of equity capital relative to total liabilities. Being own legal bank entities themselves, subsidiaries are therefore rather well capitalized. Branches, by contrast, would be undercapitalized if they did not have unconditional access to the parent banks' resources.

When capitalization is low, affiliates are by themselves unable to compensate large losses. Branches are therefore most likely to need support from the parent bank, in particular when they are located in financial centers. In the recent financial crisis, due to their exposure to the disruptions on financial markets, banks located in financial centers registered rather large defaults on loans and massive depreciations of securities. Branches in financial centers probably experienced the largest losses of all groups of affiliates, and were at the same time the least sufficiently capitalized group. To avoid an erosion of their capital base, many foreign affiliates of multinational bank holding companies most likely tapped the internal capital market organized by their parent banks.

Financial center subsidiaries increasingly well capitalized

According to Figure 6, financial center branches and subsidiaries dispose of less equity capital relative to total liabilities than their equivalents outside financial centers. While the difference between the two types of branches amounts to only half a percentage point on average over time, financial center subsidiaries had an equity capital ratio of roughly one to one and a half percentage points below the ratio of subsidiaries outside financial centers. Since mid-2009, however, financial center subsidiaries have increased their aggregate capital ratio to almost the level of non-financial center subsidiaries. Both now hold between 6% and 7% of equity capital relative to total liabilities. This adjustment might be driven by the increasing need for capital buffers in connection with impending losses in the sovereign debt crisis. Branches, by contrast, have slightly reduced their capital buffers since 2009, although the changes occurred on a much smaller scale.

The relevance of the capital ratio, as defined here, will most likely increase in the near future. US regulators have proposed implementing a stricter leverage rule for bank holding companies above a certain size. This would entail insured depository institutions such as subsidiaries of these bank holding companies being considered "well capitalized" only if they had a capital ratio (also called "leverage ratio") of around 8% (BOARD OF GOVERNORS OF THE FEDERAL RESERVE

SYSTEM (2013), the ratio might be slightly lower if IFRS is used as the reporting standard rather than US GAAP, on which this figure is based).[5]

3.4 Reliance on funding provided by the parent bank

The lower level of capitalization of branches compared to subsidiaries, as well as their use of deposit funding to a lesser degree, suggest that they rely more on parent bank funding. The liability portfolio compositions in Figure 5 demonstrate this. Irrespective of their country of residence, German banks' foreign branches generally use more parent bank funding on a regular basis (accounts payable to the parent bank) than subsidiaries.[6] Before the crisis (in 2006m12), branches in financial centers relied to an extent of 21% on parent bank funding, while subsidiaries in financial centers only received about 14% of total funding from the headquarter (see top row of Figure 5). The difference between branches and subsidiaries is even more drastic for entities located outside financial centers (bottom row of Figure 5). Branches outside financial centers used parent bank funding for 37% of their business in 2006m12, while subsidiaries outside financial centers only received 9% of their funding from parent banks (bottom row of Figure 5). A larger reliance on parent bank funding generally increases the responsibility for parent banks to provide liquidity assistance on a regular basis.

Parent bank funding replaced short-term wholesale funding in the crisis

In the financial crisis, all four groups of affiliates increased the share of parent bank funding in total liabilities. The increase mirrors the decline in short-term wholesale funding during the first stage of the financial crisis. This enforces the impression that during the crisis parent bank funding was used to compensate for the decline in interbank and market funding, not only by financial center affiliates. The largest increase in parent bank funding in total liabilities occurred for subsidiaries outside financial centers (+14 percentage points), which had relied the least on parent bank funding before the crisis. However, they reverted in part the increase in funding via parent banks between 2009m12 and 2012m12, and instead returned to a higher degree of short-term wholesale funding.

In contrast to these subsidiaries outside financial centers, subsidiaries in financial centers continued to expand their borrowing from the parent bank between 2009m12 and 2012m12, too, and could not return to higher levels of market funding. Those subsidiaries might have been more deeply involved in the sovereign debt market, which was hit by the subsequent stage of the crisis when banks had to incur extensive write-downs on sovereign bonds from European peripheral states.

This development suggests that a high level of borrowing from the parent bank on a regular basis does not per se increase the risk for parent banks stemming from the affiliates' balance

5 Most branches of foreign banks in the US are not insured depository institutions (FEDERAL RESERVE BANK OF NEW YORK (2007B)). Therefore, this rule will most likely be applied to only the banks' subsidiaries, for which deposit insurance is available.

6 While subsidiaries report their assets and liabilities vis-à-vis the parent bank explicitly, it has to be approximated for branches. DÜWEL AND FREY (2012) find that branches' claims and liabilities vis-à-vis the German banking sector (excluding the central bank) provide a fairly well approximation for the position vis-à-vis the parent bank, as branches rarely interact with domestic banks other than their own headquarter. This approach is implemented here.

sheets. During the crisis, affiliates which had the largest difficulties to keep up their short-term wholesale funding increased the most their reliance on parent bank funding as a share of total liabilities. This development was not solely linked to affiliates residing in financial centers. These difficulties arose during the financial crisis from increasing uncertainty about the riskiness of the affiliates' asset portfolio as well as from a worsened economic outlook.

Net support by parent banks in the crisis greatest for financial center affiliates

As mentioned above, funds regularly flow between parent banks and affiliates, not only in times of crisis. Liquidity may be shifted to affiliates for funding purposes, but may also be withdrawn from affiliates by the parent bank in order to prioritize other activities such as domestic lending. The net liabilities of affiliates to the parent bank therefore provide another insight into the role of the different groups of affiliates within the banking organization. Figure 7 shows this net position, ie the aggregate net borrowing of affiliates from the parent bank, scaled by aggregate total foreign assets of the affiliates (hence by the volume of the business which these affiliates carry out abroad).

Before 2007, foreign subsidiaries of German banks, both in and outside financial centers, were net providers of funds to their parent banks. This means that they were used as net funding sources by parent banks, possibly due to their greater ability to raise funds locally compared to branches. Subsidiaries, being own legal entities and often former stand-alone banks, usually have a greater network in place to attract deposits. This is reflected in their negative net borrowing position vis-à-vis parent banks. The situation changed, however, in the first stage of the financial crisis. Since mid-2007, subsidiaries have been net borrowers from their parent banks, as have branches. Compared with net borrowing of non-financial center affiliates, net reliance of financial center affiliates on their parent banks increased more strongly after the collapse of the subprime market in mid-2007 and again with the bankruptcy of Lehman Brothers in September 2008. This development was probably due to losses which financial center affiliates had to realize, as defaults and impairments had to be recognized in relation to receivables and securities in the aftermath of the crisis events.

Net borrowing from the parent bank relative to total foreign assets seems to have experienced a downward trend after 2008. At that time, German banks might have started to repatriate funds in order to stabilize domestic lending after their own access to market funding became more limited (see DÜWEL (2013)). Branches in financial centers needed increasing net support again starting in mid-2010, however. This might again signal deeper involvement of financial center branches in the trading of sovereign debt. Some of these investments had possibly turned risky, in particular with some European peripheral states struggling against insolvency, as they were unable to shoulder the support of their over indebted banking systems.

Hence, whereas before the financial crisis, branches and subsidiaries outside financial centers had relied more on parent bank funding than their respective equivalents in financial centers, in the course of the crisis, the increase in net borrowing from the headquarter was larger for financial center affiliates. This possibly reflects the higher risk that was incorporated in their balance sheets, and which materialized with the disruptions on financial markets.

4 Paths for further research and data limitations

This paper provides a first insight into the relevance of financial centers to German multinational banks and potential risk which is associated with affiliates located in these centers. Banks shift business, such as the intermediation of international bank lending, to financial centers if this appears to be more profitable than conducting the same business elsewhere within the bank holding company.

New regulatory approaches, which are being implemented within the framework of the Basel III accords, aim at strengthening the equity capital base of banks and put new limits to the growth of multinational bank holding companies. It is however widely unclear how banks will react to these new rules. Regulators are struggling with the implementation of uniform regulation across country borders to create a "level playing field". This opens up leeway for jurisdictions that refrain from implementing tighter restrictions on financial transactions. Some offshore financial centers will continue to provide or will enlarge their platforms where regulation is less strict, so that they will attract bank business from more tightly regulated countries.

It is therefore possible that home countries of multinational banks will experience a further loss of control over parts of their banks' balance sheets despite of tighter regulation. As described in this paper, financial center affiliates of multinational banks can increase to very large sizes compared to their home institutions. This development will probably continue as restrictions on home institutions tighten. Further research should therefore analyze to which extent the size of financial center affiliates actually contributes to the spillover of financial stress to parent banks.

For this purpose, it can be of advantage to model in more detail the relationship between parent banks and their financial center affiliates, as well as between financial center affiliates and non-financial center affiliates. For German banks, new data reports since June 2010 provide further insight into claims and liabilities of German banks' foreign affiliates vis-à-vis each other. As longer time series become available, an analysis of this data can refine an assessment on how stress can be transmitted within banking groups and to other banks. Models which assess the risk of contagion within and between networks can provide useful tools. GARRATT ET AL. (2011), for example, conduct such an analysis on the country level.

As is the case with other studies on the role of financial centers, balance sheet data reported to bank supervisors, though they are very detailed, do not reveal the extent to which banks make off-balance sheet investments (LANE AND MILESI-FERRETTI (2010)). A change in accounting rules implemented in Germany in December 2010 offers first insights into this off-balance sheet activity by requiring the reporting of trading portfolio derivatives. For branches in financial centers, this has changed the composition of assets dramatically, as this position now accounts for roughly 40% of the balance sheet (see section 3.1).

Still, the lack of data on activities in financial centers probably leads to an underestimation of the risk which parent banks ultimately have to bear (DARBAR (2003)). In particular, complex unreported ownership structures of financial firms such as hedge funds and special purpose vehicles make it even harder to assess the size and the riskiness of banks' investments in financial centers. Therefore, more data on relationships between banks and non-banks should be collected and analyzed by supervisors. ARTETA ET AL. (2013), for instance, assemble data on ownership and size of special purpose vehicles that had invested in the US subprime market prior to its

collapse. They find that the building up of too much risk by these vehicles was possible because of manager agency problems but also because of the lack of government control of ownership structures. This path of research should be extended in order to assess more accurately the risk incorporated in financial center investments.

5 Conclusion

Financial centers are often accused of encouraging tax fraud and money laundering (ROSE AND SPIEGEL (2007)), but many of them have adopted stricter legislative frameworks for their financial systems in order to address these concerns (WILLIAMS ET AL. (2005)). Nevertheless, these countries still offer an advantageous tax and legal environment for financial transactions (LANE AND MILESI-FERRETTI (2010)). Their importance for global banking has continued to increase in terms of the number of existing financial centers and the volume of financial transactions intermediated. This study therefore analyzes the role played by financial center affiliates for German multinational banks and provides first steps towards assessing the risk for parent banks incorporated in these affiliates' balance sheets.

Financial center affiliates of German banks are four times as large as their affiliates located elsewhere. Besides, the German parents of these bank affiliates are on aggregate only twice as large as the financial center affiliates themselves. Due to their large size and a particularly strong focus on interacting with each other, financial center affiliates are likely to transmit distress to their parent banks whenever disruptions to financial markets occur. Furthermore, German banks operate in financial centers mainly through branches, which are consolidated into the parent banks' balance sheets. This promotes the transmission of shocks. When several financial center affiliates need support from the parent bank at the same time, the latter may quickly become overtaxed by the support needed, particularly when taking into account the large size of financial center affiliates.

Branches both in and outside financial centers would be largely undercapitalized if they were not consolidated into the parent banks' balance sheets. On the contrary, financial center subsidiaries have increased capitalization almost to the level of non-financial center subsidiaries, and are better capitalized than the aggregate of their parent banks. This development reduces the risk incorporated in their balance sheets.

When the recent crisis unfolded, parent bank funding was used by all types of affiliates to compensate for a loss in short-term wholesale funding. Only subsidiaries outside financial centers have managed to return to their pre crisis level of market funding. In general, affiliates in financial centers, and branches there in particular, constantly need to roll over large amounts of short-term debt. This increases the risk that parent banks may have to provide financial assistance during downturns on funding markets. Therefore, it had to be expected that net borrowing of financial center affiliates from their parent banks would increase more sharply after the collapse of the subprime market in mid-2007.

With the experiences of the financial crisis, regulators in advanced economies are tightening regulation for large banks and are setting limits to their size. The envisaged introduction of leverage ratios, for example, compares equity capital to total assets rather than only to risk-weighted assets. In case of a bank defaulting, this is expected to reduce the problem of institutions being

"too big to fail". The new rules may however encourage to shift business off the balance sheet. Besides, the largely unregulated hedge fund industry can pick up investments which are no longer profitable for banks. Financial centers have hosted mostly banking activity, but the fund industry has made some ground (MILESI-FERRETTI ET AL. (2010)). Due to lower tax burdens and their platform character within the global banking network, financial centers represent an attractive place not only for banks but also for hedge funds and other financial firms. In the early 2000s, the hedge fund industry grew, for example, in the Cayman Islands by 30% per year (MCGUIRE (2005)).

The relevance of financial centers as international financial platforms is therefore likely to increase in the near future. In order to avoid excessive risk-taking in these countries, supervisors should aim at increasing the transparency of local activities and work closely together with the regulators of international banks' home countries. Tax regimes and supervisory standards should be further harmonized (FINANCIAL STABILITY FORUM (2000)). Effective supervision of bank holding companies on a consolidated level may help to avoid the build-up of risk exposures which may threaten the solvency of international banks and ultimately endanger global financial stability.

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Appendix

A Tables

Table 1: German banks' affiliates in countries with major financial centers

This table provides a list of countries defined as financial centers (see section 2.1), in which German banks had established affiliates (branches or subsidiaries) as of 2006m12. (...) stands for data not shown here on grounds of confidentiality. The UK Channel Islands comprise Guernsey, the Isle of Man and Jersey. Source: Deutsche Bundesbank / own calculations.

	Country	Aggregate size of branches and subsidiaries of German banks (in € billion)	# of parent banks operating in this country via branches or subsidiaries
1	Cayman Islands	178.109	10
2	Hong Kong	31.395	7
3	Ireland	85.537	11
4	Luxembourg	387.167	26
5	Malaysia	…	...
6	Mauritius	…	...
7	Netherlands Antilles	…	...
8	Philippines	…	...
9	Singapore	68.725	10
10	Switzerland	24.467	13
11	UK Channel Islands	19.380	3
12	United Kingdom	940.446	25
13	United States	300.966	12
Total in financial centers		2041.144	39
Total in fin. centers without US and UK		799.732	34
Total via branches in fin. centers		1544.126	31
Total via subsidiaries in fin. centers		497.018	30

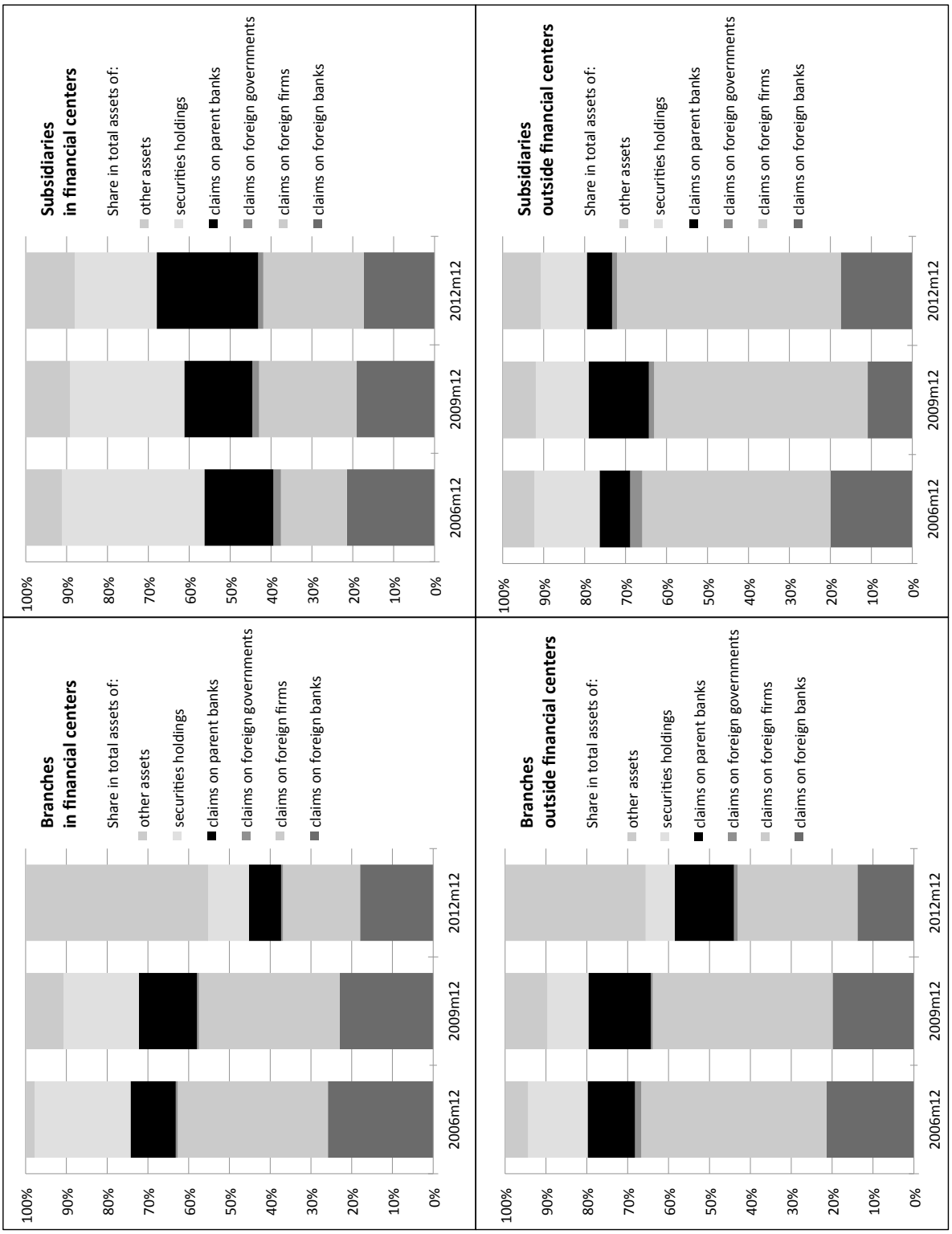
Table 2: German banks' affiliates in non-financial center countries

This table lists all countries not considered to be financial centers (see section 2.1), in which German banks had established foreign affiliates as of 2006m12. (...) stands for data not shown here on grounds of confidentiality. Source: Deutsche Bundesbank / own calculations.

	Country	Aggregate size of branches and subsidiaries of German banks (in € billion)	# of parent banks operating in this country via branches or subsidiaries		Country	Aggregate size of branches and subsidiaries of German banks (in € billion)	# of parent banks operating in this country via branches or subsidiaries
1	Argentina	…	...	26	Netherlands	14.507	10
2	Australia	…	...	27	New Zealand	…	...
3	Austria	140.233	16	28	Norway	…	...
4	Belgium	8.615	6	29	Pakistan	…	...
5	Bosnia and Herzegovina	…	...	30	Poland	14.479	7
6	Brazil	…	...	31	Portugal	6.326	4
7	Bulgaria	…	...	32	Republic of Korea	…	...
8	Canada	6.046	3	33	Romania	…	...
9	Chile	…	...	34	Russian Federation	10.119	5
10	China	5.201	7	35	Saudi Arabia	…	...
11	Czech Republic	10.804	4	36	Slovak Republic	…	...
12	Denmark	…	...	37	Slovenia	…	...
13	Estonia	…	...	38	South Africa	…	...
14	Finland	…	...	39	Spain	28.515	11
15	Serbia and Montenegro	…	...	40	Sri Lanka (Ceylon)	…	...
16	France	31.140	14	41	Sweden	2.443	5
17	Greece	2.323	5	42	Taiwan	…	...
18	Hungary	15.092	7	43	Thailand	…	...
19	India	…	...	44	Turkey	…	...
20	Indonesia	…	...	45	Ukraine	…	...
21	Iran	…	...	46	United Arab Emirates	…	...
22	Italy	50.290	16	47	Vietnam	…	...
23	Japan	44.621	6	Total outside financial centers		459.480	42
24	Latvia	…	...	Total via branches outside fin. centers		195.271	34
25	Lithuania	…	...	Total via subsidiaries outside fin. centers		264.209	20

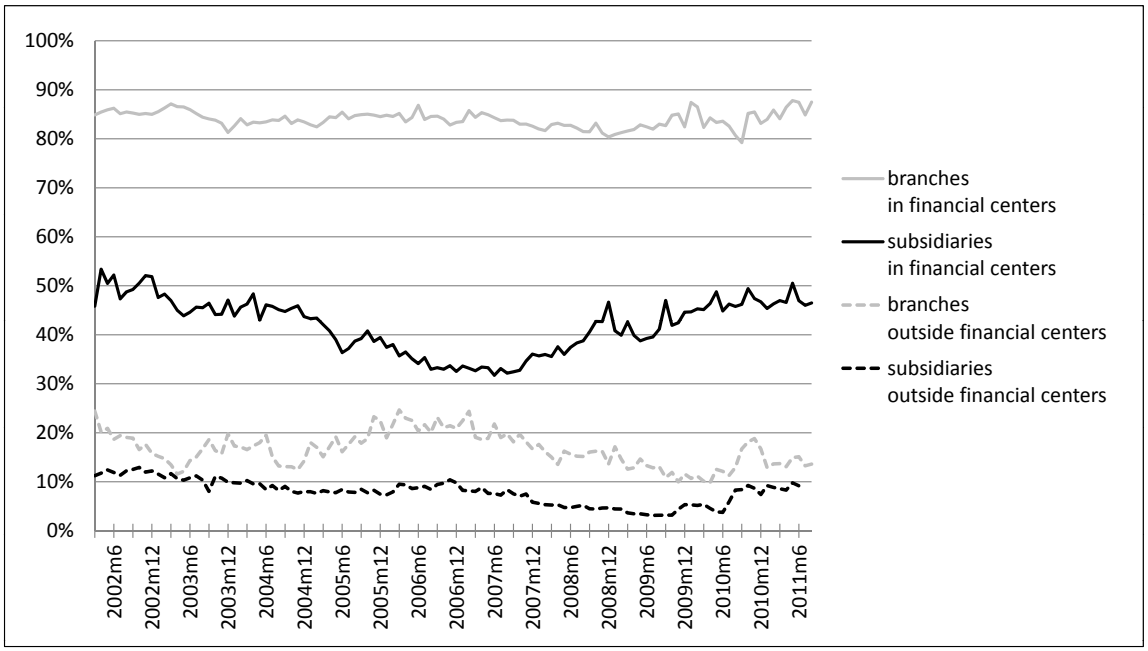
B Figures

Figure 1: Asset portfolio of German banks' foreign affiliates



The four panels depicted in this figure show the composition of aggregate total assets of German banks' foreign branches and subsidiaries located in financial centers as well as outside those centers. "Claims" refer to accounts receivable. "Firms" stand for the non-bank private sector. "Foreign" are all countries except Germany. Source: Deutsche Bundesbank / own calculations.

Figure 2: Affiliates' lending to financial centers



This figure depicts lending to banks and firms in financial centers relative to total lending to foreign banks and foreign firms carried out by the different groups of affiliates. "Firms" stands for the non-bank private sector. "Foreign" are all counterparties located outside Germany. Source: Deutsche Bundesbank / own calculations.

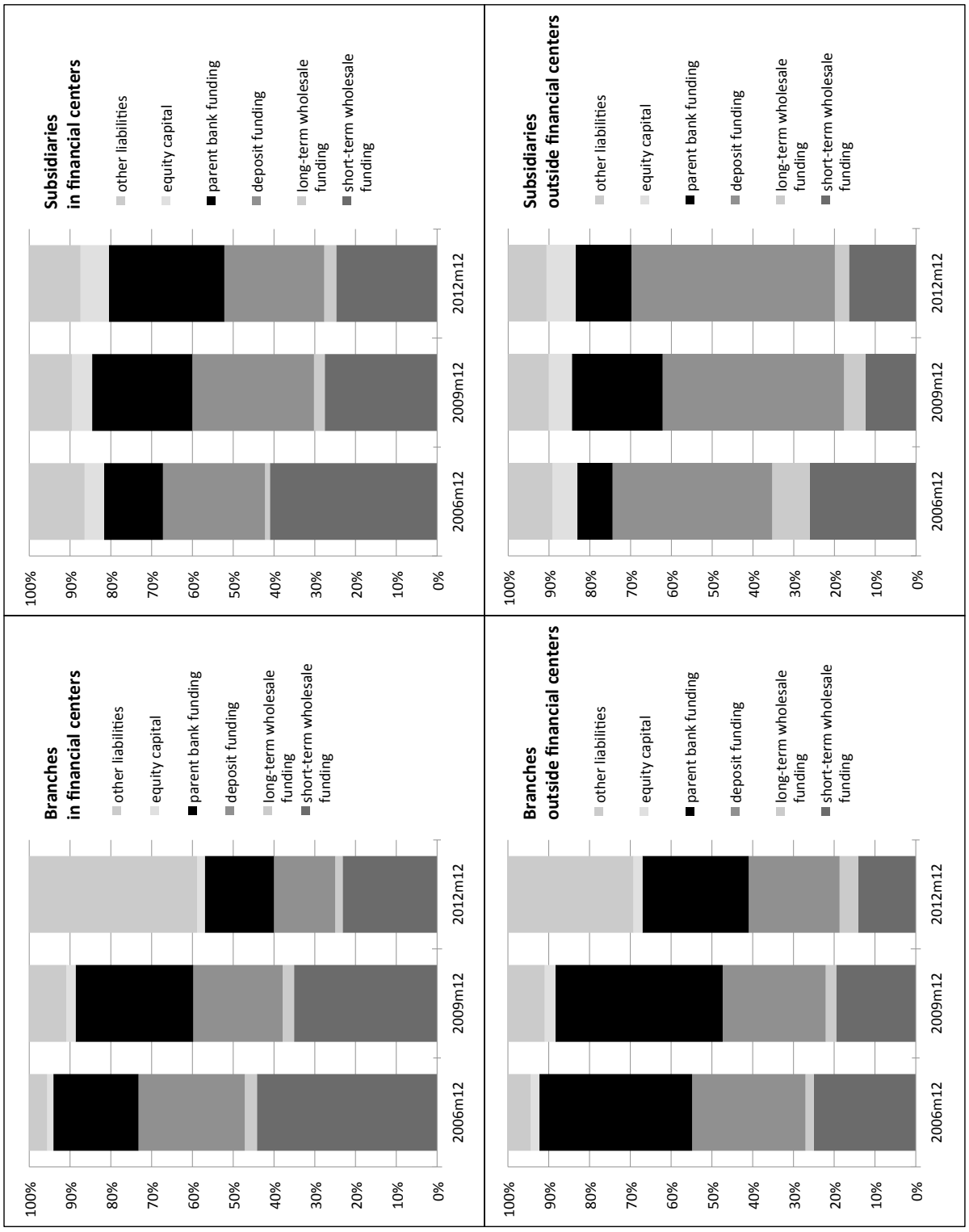
Figure 3: Local lending

This figure demonstrates the extent to which extent the different groups of affiliates lend locally as a share of their total lending to foreign banks and foreign firms. "Firms" stands for the non-bank private sector. "Foreign" are all countries except Germany.
Source: Deutsche Bundesbank / own calculations.

Figure 4: Maturity structure of claims on foreign firms and foreign banks

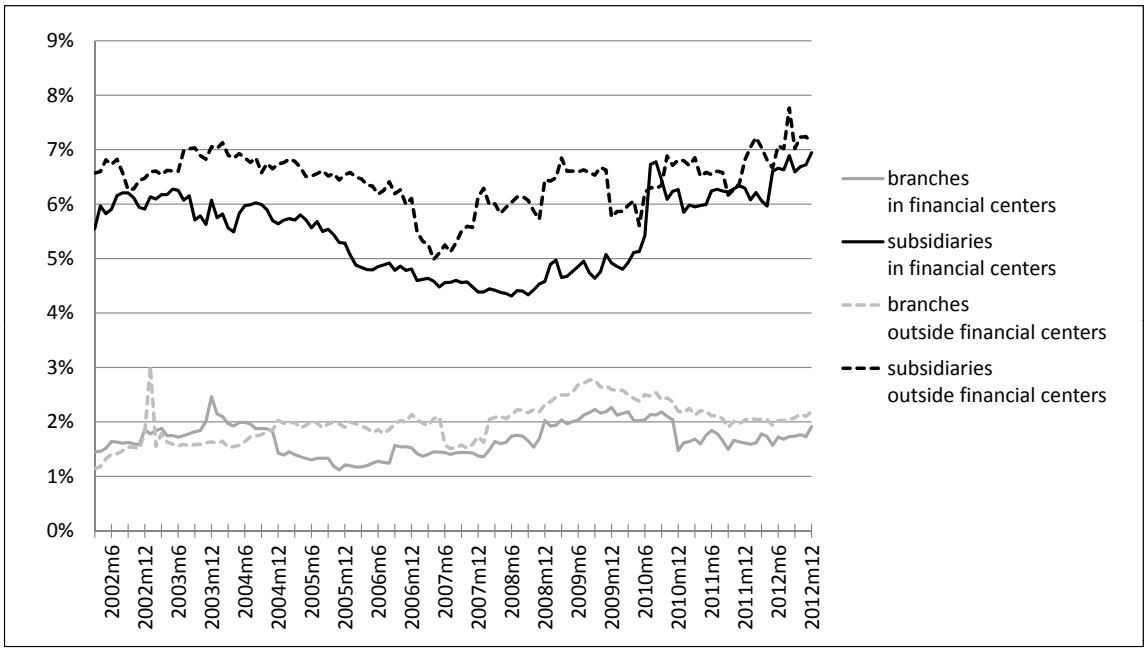
Short-term claims (accounts receivable) are displayed as a share of total claims on foreign banks and firms by affiliates in and outside financial centers. "Firms" stands for the non-bank private sector, "foreign" refers to counterparties located outside Germany.
Source: Deutsche Bundesbank / own calculations.

Figure 5: Liability portfolio of German banks' foreign affiliates



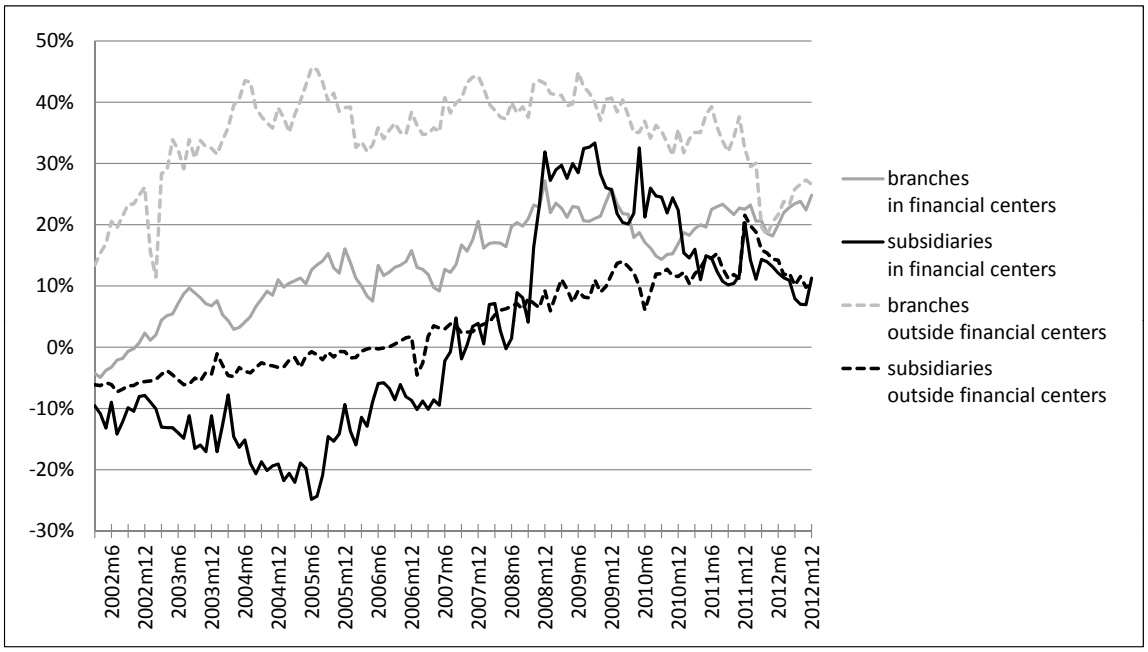
The four panels show the composition of aggregate funding sources of German banks' foreign branches and subsidiaries located in and outside financial centers. "Parent bank funding" refers to liabilities to the German headquarter. "Deposit funding" comprises all liabilities to non-banks. "Wholesale funding" consists of funding via foreign banks (ie banks outside Germany) and own bonds and notes issued. "Short-term" refers to original maturities of less than one year.
Source: Deutsche Bundesbank / own calculations.

Figure 6: Capitalization



The figure shows ratios of aggregate equity capital to total liabilities of German banks' foreign affiliates in and outside financial centers. Source: Deutsche Bundesbank / own calculations.

Figure 7: Net borrowing from the parent bank



Net borrowing from the parent bank is shown relative to total foreign assets of affiliates. Net borrowing is calculated as aggregate liabilities (accounts payable) of affiliates to their German parent banks minus aggregate claims (accounts receivable) on parent banks. For branches, this position is approximated by liabilities and claims vis-à-vis the German banking sector, as branches interact mostly with their parent banks there (see DÜWEL AND FREY (2012)).
Source: Deutsche Bundesbank / own calculations.

VI Conclusion

The recent financial crisis can be seen as a turning point in the evolution of international banking. Internationally active banks as well as regulators are currently reshaping the functioning of global financial markets, after the riskiness of many financial investments had been underestimated in the run-up to the crisis. This dissertation studies how the financial crisis has affected the foreign activities of German banks conducting loan supply worldwide, by using detailed information provided by the Deutsche Bundesbank.

The German banking sector had largely expanded its lending to both domestic and foreign counterparties between 2004 and 2007, but reduced its lending abroad relatively stronger during the financial crisis, in particular after the bankruptcy of the investment bank Lehman Brothers in September 2008. Foreign lending was curtailed in particular by German banks' affiliates located abroad. The collapse of Lehman Brothers has demonstrated how unstable even some very large financial institutions were due to the risk that they had built up in their balance sheets. This risk manifested itself as the market for asset-backed commercial paper in the United States froze in mid-2007, in the face of large default rates on subprime mortgages that had been issued to homeowners in the United States. These investments had partly been made by the banks themselves or by their bank affiliates. Besides, banks had established financial firms for this special purpose, either in the US or in offshore financial centers.

The complexity of operations that global banks had established prior to the crisis had rendered supervision of these risks nearly impossible. The high level of complexity of global banks was, next to the high degree of interconnectedness of financial institutions, a key factor for the rapid spreading of the financial turmoil to markets outside the United States. Depending on the bank-specific resilience to this crisis and the banks' business models pursued before the turmoil, many banks are currently refocusing their business on traditional deposit taking and lending to the real sector. This development is enforced by governments in and outside of Europe, in particular with regard to banks that have received state support during the crisis.

In the first paper contributing to this thesis, it is found that German banks' adjustments in their risk assessment and their risk aversion largely determined the reduction in long-term loan supply to foreign firms while domestic lending was sustained after the collapse of Lehman Brothers. This article also adds to the existing literature by recognizing that foreign lending by global banks is not per se more stable in times of crisis if the bank has established local affiliates in destination countries. These affiliates are rather more sensible to changes in local risk and demand. This can be of advantage to host countries in the case of stable or increasing demand, but can also limit lending by foreign banks when the local environment becomes more risky, for example, due to an increase in stock market volatility.

For internationally active banks, the financial crisis represented first and foremost a crisis in funding markets. The second paper in this thesis puts a special focus on the implications which German banks' funding had on their portfolio adjustments in response to the financial turmoil. Extending previous research, this contribution evaluates the relevance of the funding structure

of an entire multinational bank, on the level of both the parent bank and the different types of foreign affiliates. For this, a measure of intra-bank funding is developed, which assesses liquidity support given by German parent banks to their foreign affiliates. As the crisis on funding markets unfolded, increasing competition can be detected between different affiliates of a multinational bank. This does, however, not apply to affiliates which carry out cross-border lending and, thus, replace or support other, local affiliates in lending to their country of residence.

The third paper included in this dissertation finds significant differences in the role of branches versus subsidiaries with respect to the liquidity management of multinational banks in times of distress. The roles are determined by the particular strength of branches to conduct foreign lending operations while subsidiaries usually have better access to local funding sources. Different from what might have been expected, subsidiaries were, despite of their greater legal independence from the parent bank, used to a larger extent to fill funding gaps of parent banks, when compared with branches. This finding contributes to the discussion on whether countries hosting affiliates of foreign banks should encourage subsidiarization in order to make affiliates of foreign banks more resilient to shocks transmitted within multinational banks.

German banks have, prior to the financial crisis, established large foreign affiliates in financial centers such as the United Kingdom or the Cayman Islands. In the last part of this dissertation, it is demonstrated that this business has grown to very large sizes and that it is concentrated on trading securities and passing on funds to other financial platforms on a short-term basis. The article highlights that especially German banks' branches in financial centers are very weakly capitalized and funded to a large extent by their parent banks. Therefore, the latter have to be prepared to inject rapid support into financial center branches, whenever short-term funding via financial markets is impaired. This was for instance the case during the recent financial crisis. The article also puts forward an analysis of former off-balance sheet risk taken in particular by financial center affiliates. Still, risks taken in locations hosting large financial centers are probably underestimated, as information on off-balance sheet activity of banks is limited.

Understanding how multinational banks organize their funding structures, and how they adjust their internal as well as their external lending in response to funding shocks, is crucial for the design of new regulation. The findings presented in this dissertation hint at how important it is that regulators cooperate across country borders in order to enhance financial stability, as financial intermediation is conducted internationally by banks operating offices around the globe.

Eidesstattliche Erklärung

„Ich erkläre hiermit, dass ich die vorgelegten und nachfolgend aufgelisteten Aufsätze selbstständig und nur mit den Hilfen angefertigt habe, die im jeweiligen Aufsatz angegeben oder zusätzlich in der nachfolgenden Liste aufgeführt sind. In der Zusammenarbeit mit den angeführten Koautoren war ich mindestens anteilig beteiligt. Bei den von mir durchgeführten und in den Aufsätzen erwähnten Untersuchungen habe ich die Grundsätze guter wissenschaftlicher Praxis, wie sie in der Satzung der Justus-Liebig-Universität Gießen zur Sicherung guter wissenschaftlicher Praxis niedergelegt sind, eingehalten."

Cornelia Kerl geb. Düwel

Gießen, den 18. Januar 2014

Eingereichte Aufsätze

Düwel, C., R. Frey, and A. Lipponer (2012). Foreign lending, risk aversion and the financial crisis. *Mimeo*. Based on: Düwel, C., R. Frey, and A. Lipponer (2011). Cross-border bank lending, risk aversion and the financial crisis. Discussion Paper, *Series 1, Economic Studies*, No 29/2011, Economic Research Centre, Deutsche Bundesbank.

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