House of Finance

Working Paper Series

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International Banking Conglomerates and the Transmission of Lending Shocks across Borders

SAFE Working Paper No. 175

Non-Technical Summary

The links between parents and subsidiaries within international bank conglomerates lead to a reduction of information asymmetries and provide liquidity sources in cases when outside funding is scarce or unavailable. They, however, could also be channels for transmission of adverse shocks across borders. In this paper, we analyze the transmission channels of negative shocks from parent banks to their foreign subsidiaries and try to find an explanation of why a negative shock transmission occurs in certain cases and not in others.

In our analysis, we recognize that not only the negative shocks are important as such, but also is their type, because banks use different approaches to address different types of shocks. We use this observation to identify whether solvency and wholesale shocks to parent banks are systematically related to a reduction subsidiary lending. Our findings suggest that solvency shocks to parents generally have larger effect on subsidiary lending than wholesale shocks. Transmission of wholesale shock does occur and it affects foreign subsidiaries of parent banks that rely heavily on wholesale funding. Further, the transmission of wholesale shocks depends on the relative importance of the subsidiary within the parent business strategy: subsidiaries in markets that are traditionally used as a funding source by the parent tend to be affected by solvency shocks, while subsidiaries that provide investment income appear to be protected by the parent. Cetorelli and Goldberg (2012b) find this effect for U.S. banks hit by liquidity shocks and call it a "locational pecking order". We find evidence for this phenomenon on a global scale. We also find that liquidity regulation tends to exacerbate the effect of wholesale shocks on foreign subsidiaries. We further document that the somewhat subdued effects of both types of shocks for undercapitalized banks and banks that rely on wholesale funding are primarily due to parents using their capital and liquidity buffers. Solvency shocks have higher impact on big subsidiary banks with low growth opportunities in mature markets, which further reinforces the "locational pecking order" hypothesis, as the latter markets may be used as sources of funding for investments in high-growth developing markets.

These results have important theoretical and policy implications and add to our understanding of the transmission of solvency and wholesale shocks across borders. As we find that shocks to parents have strong impact on subsidiaries abroad, and that parents try to address shocks by depleting their own capital and liquidity buffers first, we deduce that the current focus of banking regulation on requiring banks to hold sufficient buffers might be effective in reducing cross-border contagion. However, the liquidity rules currently in place globally aggravate the transmission of shocks across borders and further efforts are needed to find a more effective global regulatory framework.

International Banking Conglomerates and the Transmission of Lending Shocks across Borders*

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August 1, 2017

Abstract

We investigate how solvency and wholesale funding shocks to 84 OECD parent banks affect the lending of 375 foreign subsidiaries. We find that parent *solvency shocks* are more important than *wholesale funding shocks* for subsidiary lending. Furthermore, we find that parent undercapitalization does not affect the transmission of shocks, while wholesale shocks transmit to foreign subsidiaries of parents that rely primarily on wholesale funding. We also find that transmission is affected by the strategic role of the subsidiary for the parent and follows a locational, rather than an organizational pecking order. Surprisingly, liquidity regulation exacerbates the transmission of adverse wholesale shocks. We further document that parent banks tend to use their own capital and liquidity buffers first, before transmitting. Finally, we show that solvency shocks have higher impact on large subsidiary banks with low growth opportunities in mature markets.

JEL classification: G01, G21, G28
Keywords: Commercial banks, global banks, wholesale shocks, solvency shocks, transmission, internal capital markets

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*We thank Cihan Duran for excellent research assistance. We would also like to thank Michela Altieri, Andreas Barth, Claudia Buch, Hans Degryse, Guido Friebel, Artus Galiay, Neeltje van Horen, Magdalena Ignatowski, Cornelia Kerl, Frank Hong Liu, Josef Korte, Theresa Kuchler, Ulrike Malmendier, Friederike Niepmann, Silviu Oprica, Daniel Paravisini and Dorota Skała for valuable discussions and recommendations. We gratefully acknowledge research support from the IWH and the Research Center SAFE, funded by the State of Hessen initiative for research LOEWE.

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1 Introduction

Rapid financial integration has led to a growing interest in the effect of the operations of multinational banks on the supply of credit and economic growth worldwide, especially in times of distress. Therefore, the analysis of the drivers of cross-border lending decisions of multinational banks under distress is of utmost importance for regulators and policy makers. However, there is still insufficient knowledge about the decisive factors in the transmission of shocks both across a country's regions and internationally. In this context, of central importance is the issue of whether negative shocks to parent banks affect the lending behavior of foreign subsidiaries.

From a theoretical perspective, multinational banks rely on internal capital markets to shift risk from headquarters to subsidiaries, to reallocate revenues in either direction or across subsidiaries, and in general to allocate resources in an efficient manner, in order to optimally adjust to financial frictions in different markets (Jeon et al., 2013). Therefore, functioning internal capital markets are instrumental in the conglomerate's operational strategy. However, these markets can also facilitate the transmission of distress from parents to subsidiaries.

In this paper, we analyze the transmission of shocks from 84 OECD parent banks to 375 subsidiaries around the world from 1997 to 2012. We concentrate on the effects of two types of adverse shocks on parent banks and how they are transmitted to foreign subsidiaries: solvency and wholesale funding shocks. These shocks are defined as a large decline in the capital of the parent bank (solvency shock) or in its wholesale funding (wholesale shock). We base this approach on the evidence from our talks to industry representatives that global banks address different type of shocks in a different manner, depending on their nature and the bank's business strategy. [1]

Our results suggest the following: One, it appears that a shock to the parent's bank equity, i.e. a solvency shock, is more strongly transmitted than a wholesale funding

[1]For the validity of our analysis, it does not matter whether the shock to the parent has a supply or demand side origin. The notion "lending supply shock" refers to the potential effect of a solvency or wholesale shock to a parent on the lending of its subsidiaries.

shock. An averse shock to equity of at least 5 percent results in a reduction in lending of the foreign subsidiary of about 6-10 percentage points (depending on the specification), whereas a shock to wholesale funding of equal magnitude only results in a reduction in lending of foreign subsidiaries of 2-5 percentage points, again depending on the specification. Moreover, the transmission of a funding shock is statistically insignificant in some specifications. The level of capitalization of parents does not seem to play a role in the transmission of solvency shocks to our subsidiary sample, while wholesale shocks are transmitted primarily to foreign subsidiaries of parents that rely heavily on wholesale funding. The position of the subsidiary in the business strategy of the parent is also an important determinant of the transmission of shocks across borders: we find that parents extract funds from subsidiaries that are traditionally considered as funding sources within the conglomerate, while protecting subsidiaries that are an important source of investment revenue. The effects are stronger when we incorporate the between-subsidiary variation by including parent fixed effects. This result generally suggests that the findings of Cetorelli and Goldberg (2012b) of a "locational pecking order" do not only apply to US banking conglomerates, but is rather a global phenomenon. Using a unique hand-collected dataset of liquidity reforms in our sample of countries, we find that stricter liquidity rules do not affect subsidiary lending growth in normal times but appear to aggravate the impact of wholesale shocks on foreign subsidiaries: if a host country has imposed stricter liquidity regulation, a parent wholesale shock decreases lending growth by 6.8 to 6.9 percentage points, while the liquidity regulation in the home country of the parent does not affect the transmission of shocks. Therefore, stricter liquidity rules impede lending growth in the host market in times of a parent distress. A possible explanation for this finding could be that parents prefer not to violate the liquidity thresholds imposed by the regulators in the host country and therefore withdraw funds from their subsidiaries by cutting lending, as previously shown by Van den End and Kruidhof (2013) and De Nicolo et al. (2012).

We run several additional checks to understand the drivers of our results. First, delving deeper into the mechanics of the transmission of shocks, we find strong evidence that parent banks initially cushion the negative effects of shocks by reducing their capital and liquidity buffers. Only when these buffers are not sufficient are the shocks transferred to foreign subsidiaries. Furthermore, the shocks affect bigger subsidiary banks with low growth opportunities in mature markets. This is consistent with parents treating high-growth markets (that is, non-OECD countries) as investment targets and therefore avoiding subsidiary lending contraction in these particular host countries. When testing the symmetry of the shocks, we find that positive equity shocks to parents do not transfer in higher subsidiary lending growth, while positive wholesale shocks do, especially to foreign markets with slow past lending growth. Overall, our findings suggest that parents tend to guard investment markets and to channel any excess liquidity to improve lending growth in lagging markets.

We perform a battery of robustness checks to verify the validity of our results. First, we include lags of the dependent variable as control variables to account for possible dynamic dependence and cannot find significant coefficients of these variables. Second, we show that the results are not driven by the global financial crisis of 2008-2009. Third, we test different definitions of the shocks and find no qualitatively changes in our results. Fourth, we check whether the size of the non-traditional business of the parent, proxied by the ratio of non-interest operating income to total operating income, affects the transmission of shocks and find that not to be the case. Fifth, since rolling over bad loans by subsidiary banks can artificially increase loan growth, we check whether evergreening affects the transmission of shocks, by regressing non-performing loans to total loans at the subsidiary level to solvency shocks up to the fourth lag. We cannot find evidence for this phenomenon in our foreign subsidiary sample. Furthermore, to alleviate concerns that our results are driven by larger subsidiaries only, we exclude subsidiaries with assets that are larger than 10% of the assets of the parent banks (about 10% of the subsidiary sample). The main results remain unchanged.

The role of internal capital markets as a transmission channel of shocks has been well documented in the literature (see, e.g., Cetorelli and Goldberg, 2012a,b). Authors usually focus on macroeconomic (see, e.g., Buch et al., 2010) or liquidity shocks (e.g., Ivashina and Scharfstein, 2010) and the recent studies are mostly related to the Global financial crisis. Cetorelli and Goldberg (2012a) find evidence of intra-bank funding flows between parents and their foreign subsidiaries in response to domestic shocks and show that this transmission channel is active not only during crises, but also during tranquil times. Furthermore, having global exposure seems to protect banks from unexpected changes in monetary policy.

Our paper relates to a growing literature that focuses on the bank lending channel and the particular paths of transmission of lending supply shocks, and more specifically: whether internal capital markets within multinational banks play a role in credit supply (Houston and James, 1998; De Haas and van Lelyveld, 2003, 2010; Holod and Peek, 2010; Cetorelli and Goldberg, 2012a,b). De Haas and van Horen (2012) document that as a consequence of the subprime crisis, international banks had to write down assets, refinance in illiquid markets and suffered from a substantial decline in their market-to-book ratio. These negative solvency shocks were subsequently transmitted to foreign banks via a reduction in cross-border lending. Regarding the transmission of wholesale (liquidity) shocks, Schnabl (2012) finds that multinational banks transmit negative liquidity shocks across borders, which leads to a reduction in lending abroad. Correa et al. (2013) document that the U.S. branches of euroarea banks received insufficient financing to fight their reduced funding opportunities after the outbreak of the euro area sovereign debt crisis, which then led to a reduction of the lending to U.S. firms. Comparing the effects between foreign and domestic subsidiaries, De Haan and van den End (2013) find that after a liquidity shock to their Dutch parent, foreign branches and subsidiaries reduce their lending by more than their domestic counterparts. Gambacorta and Mistrulli (2004) and Mora and Logan (2012) find that bank capital has a causal effect on the propagation of shocks to lending due to the existence of regulatory capital constraints. De Haan and van den End (2013) document that after a negative liquidity shock banks decrease their wholesale lending more intensively than their retail lending. The authors attribute this effect to the fact that wholesale loans have shorter maturity than retail loans and argue in favor of the requirement of the Basel Committee for an increase in liquidity buffers, especially for banks that rely heavily on wholesale funding.

In general, our study speaks to the two main views regarding the functioning of the internal capital markets of a global bank. One, cross-border inflows and withdrawals of funds due to shocks at the parent bank level may have a destabilizing effect in the foreign market (Pontines and Siregar, 2012). There is some empirical evidence supporting this view (see, e.g., Reinhart and Rogoff, 2009 and Forbes and Warnock, 2012, who document broad patterns "capital bonanzas" and "sudden stops"). The most widely accepted explanation for this pattern is that global banking flows are not related to the conditions of the particular foreign market and are more driven by parents doing their liquidity management at the global level. This intuition is central in recent models for global banking (see, e.g., Bruno and Shin, 2015 and Devereux and Yetman, 2010). Since this view puts the interests of the headquarter above those of the foreign affiliate, Cetorelli and Goldberg (2012b) refer to the parent and its domestic operations as being on the top of an *organizational pecking order*. Alternatively, global banks may abide to a *locational pecking order*, where there is no clear organizational preference in the global bank's management of the flows in the internal capital market. Rather, a global bank hit by a shock decides whether to withdraw funds from a particular subsidiary depending on whether it views the host market as a source of funding or as an investment target (Cetorelli and Goldberg, 2012b). It may also decide to shield strategically important subsidiaries entirely from shocks. Stein (1997) argues that internal capital markets alleviate cash constraints of units with better investment prospects and therefore allow for a more efficient capital allocation. A number of more recent empirical studies provide evidence that parents discriminate between subsidiaries, depending on the role of the latter in the parent business strategy. Cetorelli and Goldberg (2012b) argue that after a liquidity shock, U.S. parent banks tend to protect subsidiaries that provide stable investment revenue, while subsidiaries that are seen as a funding source (e.g. if the subsidiaries primarily focus on attracting deposits) substantially reduce their lending. Claessens and van Horen (2013) find the opposite effect: during the global financial crisis, foreign subsidiaries used to decrease their lending by less if they are funded locally.

Finally, the paper contributes to the literature on how liquidity regulation affects the transmission of shocks across borders. Banerjee and Mio (2014) do not find a negative effect of tightened liquidity regulation on bank lending to the real economy for a set of U.K. banks. On the other hand, a number of studies (see, for instance, Van den End and Kruidhof, 2013 and De Nicolo et al., 2012) provide evidence that higher liquidity requirements increase lending interest rates, decrease loan volume and lead to inefficiency and reduction of welfare. Our own findings suggest that liquidity regulation has a destabilizing effect for the host market.

To summarize, the contribution of our paper to the literature is along several lines. First, there are virtually no empirical studies investigating both solvency and wholesale shocks to parents simultaneously. Second, as most authors focus on shocks from or to U.S. banks, our work is among the rare instances of global bank-level studies (for examples, see, for instance, Jeon et al., 2013 and Ongena et al., 2013). Third, we confirm on a global scale that multinational banking conglomerates organize the flows in their internal capital markets by following a locational pecking order. Fourth, our study contributes to recent debates on banking regulation by providing important evidence on the impact of liquidity regulation on lending worldwide.

This remainder of this paper is organized as follows. Section 2 presents the institutional framework of the relationship between parents and subsidiaries. Section 3 presents our major hypotheses, empirical baseline model and discusses the data. Section 4 reports the baseline empirical results and further findings and robustness checks. Section 5 concludes.

2 Institutional Details

2.1 Regulation of Foreign Affiliates

In this section, we outline the institutional details that govern foreign subsidiaries, including the legal distinction between subsidiaries and branches and how both types of ownership structures are regulated. Although we focus on foreign *subsidiaries* in this paper, the comparison between branches and subsidiaries is vital in understanding the institutional environment that a parent bank faces when it enters and operates in a foreign market.

There are a number of differences between subsidiaries and branches that banks take into consideration when choosing an optimal organization structure abroad. The most important difference is that subsidiaries are (fairly) independent legal entities, incorporated in the host country, while branches are business units that are part of the parent bank and not legally independent. Subsidiaries are separate banks that are supervised in the host country. Considering financial reporting, most countries do not require branches of foreign parents to issue financial reports.[2] This effectively constrains the scope of our study to foreign subsidiaries.

There are also differences in the freedom of movement of cash flows between the parent and the affiliate. Theoretically, it is unrestricted under the centralized organized form (i.e., for branches), while it may be very limited in the decentralized form (i.e., for subsidiaries). Overall, maintaining a branch network may allow for a liquidity and risk management at the group level, which would help the group in neutralizing idiosyncratic shocks in any part of the network. On the other hand, a subsidiary structure may allow the parent to contain losses in the event of a distress of the particular affiliate.

The legal form also has important implications for the regulation and supervision of a bank's foreign offices. First, supervisory control and oversight responsibility under the subsidiary structure are higher for the host country than for the home country, while the opposite holds for branches.[3] Second, the source of the adverse shocks may lead the host country supervisor to prefer a subsidiary structure when facing adverse external shocks and a branch structure in the case of domestic shocks, since the branch system entails stronger commitment by parents to support their foreign offices. The home country su-

[2]An important exception is the UK where branches are also required to issue financial statements (Saunders and Steffen, 2011).

[3]Within the European Union, while the responsibility for supervision of branches remains with the home country supervisor, the host country authority may decide to actively supervise a branch in its jurisdiction if it is deemed systemically important (Fiechter et al., 2011).

pervisor has exactly the opposite preferences: a branch system would facilitate smoother cash inflows in the economy in the case of a domestic (home country) shock, while a subsidiary structure would protect the home economy from shocks abroad. Third, the fiscal burden in case of a distress may lead to a fiscally-constrained home country to induce its internationally active banks to use a more decentralized organizational structure (i.e. foreign subsidiaries, instead of branches).[4]

In reality, there is no clear cut difference between the centralized form (i.e., branches) and the decentralized form (i.e., subsidiaries) and the actual organizational form lies in between these extremes of the spectrum, because of host and home country requirements and parent considerations (e.g., ring-fencing of branches). Since we focus on subsidiaries which might be part of conglomerates with varying degree of activity of the internal capital markets, and hence in the middle ground between no cash flow transfer and an unconstrained movement of funds between parent and subsidiaries, if we find evidence for any transmission of adverse shocks, our results may be considered a lower bound for the effect of parent shocks on the activity of its foreign affiliates.

2.2 Liquidity Regulation

The liquidity management regulation of banks and its impact on banking practices has been neglected before the Global financial crisis, since the focus has been on capital regulation. Until that point, rules on liquidity levels were considered unnecessary if capital adequacy rules were already in place, as considerable substitution effects were conjectured to take place. After the default of Lehman Brothers, it was revealed that many banks had poor liquidity management practices, despite fulfilling their capital adequacy obligations. In 2009, the works on the new Basel III accord commenced, which strengthened and extended the regulation of capital and proposed a separate leverage ratio. In contrast to the capital rules, which extended a framework that already existed,

[4]The 2008-2011 Icelandic financial crisis is an important example for a case when a country's authorities had the obligation, but not the fiscal capacity to support the insured depositors in the foreign branches of Icelandic banks.

no such standards pre-existed for liquidity regulation. The efforts resulted in the publication of BCBS (2010), which introduced the Liquidity Coverage Ratio (LCR), which aims to ensure that the bank holds enough high-quality liquid assets to withstand a stress period of 30 days.

Since the focus of the current policy discussions is whether the LCR is a viable liquidity management tool and since a number of countries have introduced similar ratios even before Basel III,[5] we decided to focus specifically on that quantitative type of liquidity regulation. Our conjecture is that the liquidity rules in both the home and the host country matter for the transmission of shocks. The home country rules regarding the liquidity buffer affect the capacity of the parent bank to absorb idiosyncratic liquidity shocks before it transmits them to its subsidiaries. On the other hand, the liquidity requirements in the host country limit the size of cash flows that a parent is able to extract without precipitating actions by the host regulators.

3 Theoretical Predictions, Empirical Model and Data

3.1 Theoretical Predictions

A number of theoretical studies suggest that solvency shocks to parent banks affect the lending of their subsidiaries, especially abroad. Bruno and Shin (2015) develop a model of the international banking system where global banks interact with local banks and show leverage to be a transmission channel of shocks through the banking sector capital flows. The authors show that their analysis applies irrespective of whether the local bank is separately owned from the global bank, or whether the local and global banks belong to the same banking organization. Devereux and Yetman (2010) develop a simple two-country model in which highly levered financial institutions hold interconnected portfolios and may be limited in their investment activity by capital constraints. The combination of portfolio interdependence and capital constraints leads a negative

[5] For instance, the Netherlands introduced its first liquidity requirement in 1977, and Luxembourg - in 1993 (Bonner et al., 2014).

shock in the host country to affect the balance sheets of financial institutions in the home country and to precipitate an episode of global balance sheet contractions and disinvestment. Therefore, we formulate our first hypothesis as:

Hypothesis 1. Shocks to the *solvency* of parents lead to a reduction in subsidiary lending.

Khwaja and Mian (2008) introduce a model for the transmission of liquidity shocks to the lending of domestic banks. We argue that through the internal capital markets within international conglomerates, these shocks can also transmit across borders. To test for this effect in our global sample, we introduce our second hypothesis:

Hypothesis 2. Shocks to the *wholesale funding* of parents lead to a reduction in subsidiary lending.

With our next hypothesis, we try to capture the effect of parent capitalization on the transmission of solvency shocks across borders. The level of capital plays a role during crises, because well-capitalized banks might be able to use their capital buffer or raise debt under more favorable terms due to lower agency costs (see, e.g., Kishan and Opiela, 2000; Stein, 1998; Holmstrom and Tirole, 1997; Bernanke and Blinder, 1988). However, Krause and Giasante (2012) use a network model to show that global minimum requirements are not effective in containing contagion and that they should be specifically tailor-made to fit each bank. To test these somewhat contradicting predictions, our third hypothesis reads:

Hypothesis 3. Subsidiaries of parents *below the 5% capital adequacy ratio* are more affected by solvency shocks to parents.

Brunnermeier (2009) and Brunnermeier and Pedersen (2009) show that the lending channel can dry-up if banks that rely heavily on wholesale funding lose access to it and cannot roll-over their debt. Our next hypothesis, therefore, postulates:

Hypothesis 4. Subsidiaries of parents *that rely on wholesale funding* are more affected by wholesale funding shocks to parents.

With our next hypothesis, we provide a direct test of the “organizational vs locational pecking order” streams of literature, described by Cetorelli and Goldberg (2012b). Under the former theory, banks manage their liquidity on a global level and therefore a shock to a parent should be directly felt by its subsidiaries and be negatively correlated with lending (see, e.g., Bruno and Shin, 2015 and Devereux and Yetman, 2010). The latter theory postulates that the transmission may depend on the type of host market: whether it is a funding or an investment source (Cetorelli and Goldberg, 2012b). To analyze these contradicting theories, we formulate our fifth hypothesis as:

Hypothesis 5. The transmission of shocks depends on the *place of the subsidiary in the business strategy* of their parents: whether it is a funding or an investment operation.

Our final hypothesis aims at analyzing the effect of liquidity regulation on the transmission of wholesale shocks. Liquidity buffers decrease the probability of fire sales, deleveraging, liquidity hoarding and restriction of credit, all elements that lead to negative externalities due to their effects on asset prices and the availability of funding (Van den End and Kruidhof, 2013). In addition, since the possibility of liquidity provision by central banks can lead to moral hazard problems (Farhi and Tirole, 2012), the relatively costly liquidity buffers can align the incentives of bank managers and increase the time before liquidity assistance is needed. Our last hypothesis, therefore, reads:

Hypothesis 6. Subsidiaries *in countries with regulatory minimum liquidity requirements* are less affected by wholesale funding shocks to parents.

To summarize, we expect that: negative (i) solvency and (ii) wholesale shocks to parents lead to a reduction in the lending of their subsidiaries. Furthermore, (iii) undercapitalized parent banks tend to transfer solvency shocks to their subsidiaries to a greater extant, compared to well-capitalized parent, while (iv) subsidiaries of parents that rely heavily on wholesale funding are more affected by wholesale shocks. We also predict that the transmission of shocks is affected by (v) the importance of the subsidiary in the business strategy of the parent. Finally, we expect that (vi) tighter liquidity regulation in the subsidiary country mitigates the effect of parent wholesale shocks on foreign subsidiaries. The expected signs are listed in Table 1.

[Place Table 1 about here.]

3.2 Empirical Model and Identification Strategy

3.2.1 General Model

In this paper, we investigate the transmission of idiosyncratic shocks to the solvency and wholesale funding status of a parent bank on the lending of its foreign subsidiaries. To test the hypotheses mentioned above, we estimate variations of the following model:

$$
\begin{aligned}
growth(Loans)_{i,j,k,t} = {} & \alpha_0 + \alpha_1 \cdot SolvencyShock_{j,t-1} \\
& + \alpha_2 \cdot WholesaleShock_{j,t-1} \\
& + \alpha_3 \cdot Interactions_{j,t-1} \\
& + \alpha_4 \cdot BankControls_{i,j,k,t-1} \\
& + \alpha_4 \cdot MacroVariables_{i,j,k,t} \\
& + \beta_t + \gamma_i + \epsilon_{i,j,k,t},
\end{aligned}
\tag{1}
$$

where $growth(Loans)_{i,j,k,t}$ is the loan growth of subsidiary i of parent j in country k at time t; $SolvencyShock_{i,j,t-1}$ and $WholesaleShock_{i,j,t-1}$ are solvency and wholesale funding shocks on parent j at time *t-1*, respectively; $Interactions_{j,t-1}$ is a vector of interaction terms discussed later; $BankControls_{i,j,k,t}$ is a vector of individual bank-related indicators of subsidiary i of parent j in country k at time *t-1*; β_t is a time fixed effect for period t; γ_i is an entity fixed effect for subsidiary i. We define the solvency and liquidity shock as a large decline in the capital of the parent bank (solvency shock), or as a sudden dry-up in its wholesale funding (liquidity shock), respectively. We discuss the definition of shocks in more detail in Section 3.3.3.

The bank variables control for individual bank idiosyncratic characteristics, related to the size, sources of funding, performance and financial health of the subsidiary. The variables that we use are: *size*, defined as the logarithm of the subsidiary's total assets; *profitability*, proxied by the subsidiary's profit to total earning assets; *riskiness*, represented by the bank's loan loss provisions to total loans; *liquidity*, defined as liquid assets to total assets; *capitalization*, being the ratio of the bank's equity to total assets. The last variable, *internally generated funds*, defined by the ratio of net income at time t to total loans at time t-1, is an important indicator for the financial independence of the subsidiary from its parent, and is introduced by Jeon et al. (2013).[6] In our estimations, we lag the bank controls by one period. Throughout the paper, we cluster the standard errors at the parent level.

3.2.2 Identification

Our main specification generally follows Peek and Rosengren (1997), as we regress loan growth on parent shocks and lagged subsidiary bank variables and host country macro characteristics. Since a drop in loan growth can be affected by a subsidiary's poor financial situation, which might coincide with a shock to the parent, by controlling for the situation at the subsidiary bank, we orthogonalize its loan growth with the shock to the parent. Since loan level is a result of the intersection of loan supply and demand, the macro variables help us to disentangle loan supply from loan demand. To further strengthen our empirical approach, we control for unobserved fixed effects in the host country. Loan growth rates can also be affected by a global shock that is unrelated to (or maybe even causes) the shock to the parent. We address this endogeneity concern in two ways. First, we include time fixed effects in our main workhorse model, and second, we provide a robustness check by additionally excluding the period of the Global financial crisis (2008-2009) from our regression sample. Our results remain robust to these specification changes.

Apart from controlling for observables at the subsidiary bank level, we control for unobservable bank characteristics by including bank fixed effects. Thus, in our analysis, we rely on within-subsidiary-bank variation for identification. We relax this in our test of the locational pecking order (Cetorelli and Goldberg, 2012b), by using parent fixed effect as an alternative specification. This allows us to employ for identification the between subsidiary variation within a parent bank, a la Khwaja and Mian (2008).

[6] In contrast to the remaining bank variables, which are stock variables, the internally generated funds is a flow variable.

To further alleviate reverse causality concerns that parent shocks are for instance driven by shocks to big subsidiaries, we use data at unconsolidated level. Furthermore, most of our subsidiaries are small relative to the parent: more than 50% of the subsidiaries have assets that are less than 1% of the assets of the respective parent bank and more than 90% of the subsidiaries are at least 10 times smaller than their parents. In a robustness check, we exclude the biggest subsidiaries (with assets above 10% compared to parent assets) and find no significant difference in our results. As the 5% drop in equity or wholesale funding may be considered arbitrary, we test the robustness of our results by defining the shocks at the 5^{th} or the 10^{th} percentiles (left tail) of the respective distributions. The results remain qualitatively unchanged.

3.3 Data

3.3.1 Dataset Construction

In constructing our main dataset, we use annual bank-level data from Bureau van Dijk's Bankscope. As in most of the recent literature (see, e.g., Deléchat et al., 2012, Cornett et al., 2011 and Bonner et al., 2014), we concentrate on commercial banks to avoid bias due to the different business models of, for instance, investment banks. We start off by compiling a list of the biggest 500 commercial banks globally. Then, we search manually for the first-level subsidiaries of these banks.[7] We select global subsidiaries of OECD parents, where the ownership share of the parent is at least 50%. At this initial selection stage, we end up with 114 parents and 602 subsidiaries for the period 1997–2012. In the subsequent matching of the datasets of parents and subsidiaries, it turned out that in several cases, when data for the parent for a particular year were available, the data for the subsidiary were missing and vice versa. We also excluded all domestic subsidiaries

[7] Although Bankscope provides a procedure for an automatic selection of the matching subsidiaries, it is not suitable for our analysis, since in the case of conglomerates (e.g. Mitsubishi), the conglomerate is listed as a global owner, and not the commercial bank that is in the top 500 list. In case the conglomerate has several independent commercial banks in the top 500 list, it is impossible to distinguish which subsidiary belongs to which commercial bank.

from the analysis.[8] Eventually, we ended up with 84 parents and 375 subsidiaries for the mentioned period. Table B provides a list of the parent commercial banks, as well as the respective number of their foreign subsidiaries. The full list of subsidiaries is available upon request. Overall, the parent banks represent 27 OECD countries, while the subsidiaries are located in 98 countries (OECD and non-OECD combined). Figure 1 depicts the geographical distribution of the subsidiary sample. We used unconsolidated data for both parents and subsidiaries. The final dataset comprises 2791 subsidiary-year observations matched with 870 parent-year observations. Since Bankscope reports different units of measurement for each bank, the unit of measurement of the balance sheet data was uniformly transformed to millions. To guarantee the valid interpretation of the results, the data were further denominated from the original country-specific currency to U.S. Dollars.

3.3.2 Descriptive Statistics

Table 4 presents the descriptive statistics of some of the main variables in our regression analysis.[9] In terms of loan growth, we notice that the average rate in the subsidiary sample is more than 4 percentage points higher than the average loan growth rate in the parent sample. However, the volatility in loan growth is twice higher in the former sample. Overall, subsidiaries are smaller than parents, but are more profitable, better capitalized and possess more liquid asset relative to total assets. Also, foreign subsidiaries allot more than 50% more funds than parents to provisions against bad loans. We notice a similar pattern when we consider internally generated funds: foreign subsidiaries tend to generate twice higher net income to total loans than their parents. The full set

[8]The focus of the paper is on cross-border transmission. Nevertheless, it would have been interesting to compare the transmission to foreign subsidiaries to the transmission to domestic subsidiaries. However, identification is much weaker when examining transmission to domestic subsidiaries, as it is much more difficult to ensure that they were not simply hit by the same shock as the parent.

[9]*Note:* Not all data for parents are available, therefore the number of observations for some of the variables is lower than 870. These variables are not used in the regression analysis, as it is at the subsidiary level, and the averages are presented for the sake of approximate comparison only.

of regression variables and their descriptions is provided in Table 5.

[Place Table 4 about here.]

3.3.3 Shocks Definition

As mentioned in Section 3.2.1, we define the solvency and liquidity shock as a large decline in the capital of the parent bank (solvency shock), or as a sudden dry-up in its wholesale funding (liquidity shock), respectively. In our main analysis, the solvency and wholesale shocks are dummy variables that take the value of one in the case of a drop by at least five percent in the capital or wholesale funding, respectively, compared to the previous time period. As banks usually expect profits in the next year in they annual forecasts, a year-on-year drop in equity in the unconsolidated parent reports by 5% represents a substantial undershooting of these forecasts. Also, since banks rely on a stable or rising access to funds, a drop in wholesale funding by 5% can seriously undermine their investment strategies. In our robustness Section 4.6.4, we provide a sensitivity analysis with different alternative definitions of these shocks.

[Place Figure 2 about here.]

[Place Figure 3 about here.]

Figures 2 and 3 depict the empirical distributions of equity and wholesale funding growth in the parents dataset that serve as a basis for the construction of the respective shock variables. The distributions are relatively symmetrical, but their mean is above zero in both cases (14.6% for equity growth and 16.6% for wholesale funding growth). The wholesale funding distribution is slightly more spread, with a standard deviation of 36.3%, against 31.3% for the equity growth distribution. The blue curve in both tables represents normal distribution with the same mean and standard deviation as the respective empirical counterpart. The vertical green line shows the threshold that we set for each type of shock (-5% in either case). The shock dummies take the value of one if the respective year-on-year growth variable for a parent bank falls below -5% in a particular year and zero otherwise. The latter definition results in 101 solvency and 174 wholesale shocks that potentially affect foreign subsidiaries.

[Place Figure 4 about here.]

[Place Figure 5 about here.]

Figures 4 and 5 present the number of the respective shocks for each year in our sample. Panel a) of Figure 4 (Figure 5) shows the solvency (wholesale funding) shocks per year in the *parent* sample. In total, there are 101 (174) solvency (wholesale funding) shocks in the parent dataset in the sample period. Panel b) presents the solvency (wholesale funding) shocks per year that are relevant for the sample of 375 subsidiaries after merging both datasets. Since a parent usually has more than one subsidiary, this results in a total of 323 (577) parent solvency (wholesale funding) shocks in our merged dataset. An important conclusion from observing the figures is that the shocks identified using our definitions are well-spread throughout the period and do no cluster exclusively around the global financial crisis of 2008-2009. In our robustness checks section, we show that our main results are not affected if we exclude these years.

[Place Figure 6 about here.]

The correlation between the solvency and wholesale shocks is 0.18 in the parent sample and 0.12 in the subsidiary sample, which means that the shocks are fairly uncorrelated and banks are usually not hit by both shocks simultaneously. This could be seen in Figure 6, where we present the number of simultaneous solvency and wholesale shocks in our parent and subsidiary samples. Panel a) shows the simultaneous shocks per year in the *parent* sample. There are 40 simultaneous shocks in the parent dataset in the sample period. Panel b) presents the simultaneous shocks per year that are relevant for the sample of 375 subsidiaries after merging both datasets. In total, we have 110 simultaneous shocks in our subsidiary sample.

4 Results

In this section, we present the results from our empirical analysis. We start with our baseline model and estimate the effects of solvency and wholesale funding shocks to parents on the full sample of subsidiaries. Subsequently, we study in detail the possible sources of the difference in transmission of shocks along several dimensions. First, we investigate whether the transmission depends on the specific characteristics of the parent bank – the level of its capitalization and its reliance on wholesale funding. Second, we analyze whether the transmission is affected by the position of the subsidiary in the business strategy of the parent: whether the subsidiary is a source of depository funding or of investment income. Third, we investigate the effect of the regulatory environment in the subsidiary country on the transmission of shocks.

4.1 Baseline Regressions

[Place Table 6 about here.]

Table 6 presents the results from our the estimation of our baseline Equation 1 for the overall sample of subsidiaries, without interactions. Model (1) is a simple pooled ordinary least squares model that involves only dummy variables for the solvency and wholesale shocks and no control variables. At this stage, we notice a considerable disparity in the effects of the two types of shocks. A solvency shock to the parents leads to a 10.6 percentage points reduction of the loan growth of their subsidiaries, while a wholesale funding shock reduces the subsidiaries' lending growth by 3.6 percentage points (marginally insignificant at the 10 % level: the p-value is 10.2). Model (2) adds bank variables to control for the subsidiary situation. The magnitude of the effects remains largely unaffected and the bank control variables exhibit the expected signs. Bigger (hence, more mature) and more profitable subsidiaries tend to expand their lending at a slower rate. Also, the better capitalized the subsidiary and the more liquid funds it has at its disposal, the higher the lending growth. Furthermore, an increase in internally generated funds leads to a rise in loan growth. The statistically significant negative effect of bank riskiness could be explained by our definition of the proxy: the higher the ratio of loan-loss reserves to total loans, the less funds the subsidiary has at its disposal to give away as loans. The same direction of the effect of this proxy on loan growth is documented in previous research (see, e.g., Jeon et al. (2013)) . In Model (3), we introduce host country fixed effects to account for unobservable local demand factors in the host country. The results for the main variables of interest remain qualitatively the same. Model (4) includes parent bank fixed effects, leading to a loss of statistical significance of the effect of the wholesale shock, but overall, the results remain consistent to the previous models in terms of magnitude. In Model (5), we introduce subsidiary fixed effects. At this stage, the effect of parent wholesale shocks disappears, while the effect of solvency shocks remains highly significant. The results from Models (4) and (5) suggest that the statistically significant effect of wholesale shocks in the country fixed effects regression is driven by unobserved heterogeneity at the bank level. Including time fixed effects (Model (6)) reduces the magnitude of the effect of solvency shocks, but it remains statistically significant. To further control for *dynamic* loan demand factors at the host country level, we include macroeconomic controls in Model (7).[10] The results remain qualitatively unchanged, compared to Model (6). Since Models (5), (6) and (7) control for unobserved heterogeneity at the narrowest level, we choose these as our workhorse models throughout most of the remaining sections. It is worth noting that the results for the effects of the *continuous* bank control variables for capitalization and liquidity remain relatively robust (at least in terms of magnitude) throughout all model specifications. Therefore, while the starting level of capitalization and liquidity of the subsidiaries at *t-1* may matter for their lending decisions, only solvency shocks affect credit supply at time *t*.

Overall, the results show that solvency shocks to parents reduce subsidiary lending, while we cannot find strong evidence that wholesale shocks have a significant impact. These findings suggest that, overall, solvency shocks to parents are more important than wholesale shocks for the lending expansion of subsidiaries, which provides evidence for cross-border capital transfers after a solvency shock. This is in line with the previous literature (see, e.g., Krause and Giasante (2012) and Popov and Udell (2012)), where subsidiaries are shown to react to solvency shocks to their parents by reducing their lending. However, we cannot confirm the negative impact of wholesale shocks documented in a

[10]The vector of macroeconomic variables contains Gross Domestic Product growth, inflation and unemployment in the country of the respective subsidiary.

number of studies (see, e.g., Ivashina and Scharfstein, 2010 and Cetorelli and Goldberg, 2012b).

4.2 Capitalization and Shock Transmission

In this section, we analyze whether the subsidiaries of parent banks that are close to the minimum capital requirements level recommended by the Basel Committee have a higher impact on the lending of their subsidiaries. For this purpose, we introduce the dummy variable "Below-5%" that takes the value of 1 for parent banks with capital-to-total-assets ratio below 5 percent and 0 otherwise.[11]. In order to avoid simultaneity, we lag the variable with one period.

[Place Table 7 about here.]

The results, presented in Model (1) of Table 7, reveal no statistically significant additional effect of solvency shocks for undercapitalized parents. Our findings are at odds with Giannetti and Laeven (2012), who document a larger decrease in foreign loans for undercapitalized parents after a shock to a bank's net wealth. In Section 4.6.1, we delve deeper in the possible explanations of these findings.

4.3 Reliance on Wholesale Funding and Shocks Transmission

We proceed with an examination of whether subsidiaries of parent banks that rely heavily on wholesale funding are more susceptible to shocks to their parents. We base this analysis on the conjecture that the higher the reliance on unstable non-deposit funding, the higher the likelihood that a parent bank could be hit by a liquidity shock. This could lead to abrupt and severe shortages of liquidity that the parent bank would need to compensate almost immediately and therefore, such banks are theoretically more likely

[11]There is no single capital (or Tier 1) ratio applied by national regulators. The banks in countries that still follow the Basel II accord are required to maintain the ratio at a level no lower than 4%, while Basel III stipulates the minimum capital ratio to be at least 6%. Furthermore, the latter accord introduces different additional capital buffers. We believe that our definition stands on a middle ground with respect to the various legislative requirements across the different regulatory regimes present in our sample.

to transmit the liquidity shock to their subsidiaries (see, e.g., De Haas and van Lelyveld (2014) and Dagher and Kazimov (2015)). To test these hypotheses, we introduce a new variable, "Reliance-on-Wholesale", that is defined in two different ways. It takes the value of 1 if the wholesale funding to total liabilities of the parent bank is below 10% (Model (2)), or above 90% (Model (3)), and 0 otherwise.[12] The lagged variable and its interaction with the wholesale shock is now included.

Models (2) and (3) in Table 7 presents the estimation results. We do not observe any effect on the transmission of wholesale shocks for levels of wholesale funding (Models (2)). This changes for parent banks that rely primarily on this type of funding (Models (3)): the coefficient of the interaction term is highly statistically and economically significant. [13] This supports the findings of Ivashina and Scharfstein (2010), Cornett et al. (2011), Dagher and Kazimov (2015) and De Haas and van Lelyveld (2014) that banks that rely on wholesale funding reduce their lending after an adverse shock by more, compared to banks that rely on retail deposits. And while these studies concentrate on the U.S. market, we find that heavy reliance on wholesale funding is a major channel for transmission of shocks *across borders*.

4.4 Subsidiary Importance and Shock Transmission

In this section, we analyze how the importance of the subsidiary within the multinational conglomerate affects the transmission of shocks. Cetorelli and Goldberg (2012b) find that after a negative liquidity shock, a parent's tendency to extract funds from their subsidiaries depends on their place in the parent's funding and investment strategy. The authors find evidence for what they call a "locational pecking order": subsidiaries in

[12]These values correspond approximately to the 2.5^{th} and the 97.5^{th} percentiles of the wholesale-funding-to-total-liabilities distribution.

[13]In an unreported robustness check, we set the thresholds at the 5^{th} and the 95^{th} percentiles of the wholesale-funding-to-total-liabilities distribution. The results remain qualitatively unaffected. Moving the thresholds closer to the median lead to a loss of significance, which further strengthens the argument that the wholesale shocks in our sample transmit only for parents that rely extensively on wholesale funding.

locations that are an important source of investment revenue are protected during adverse liquidity shocks, while subsidiaries in markets that are used as a funding source appear to provide buffers to counter the shock at the parent level. As a measure of the importance of the subsidiary as a funding source, we consider the ratio of total liabilities minus total customer deposits to total liabilities of the subsidiary. The measure of the importance of the subsidiary as an investment revenue source is the ratio of net loans to total assets of the subsidiary. We include the one-period lag of the variables and their interactions with both solvency and wholesale shocks.

Model (4) in Table 7 presents the results from the regression with subsidiary fixed effects. We find evidence for a locational pecking order in the transmission of solvency shocks across borders: subsidiary banks used as a funding operation see an economically significant reduction in their lending after a solvency shock (with p-value at 10.5%, the coefficient is marginally statistically insignificant at the 10% level), while subsidiaries that provide higher investment revenue maintain a positive loan growth. In Model (5), we employ both within and between subsidiary variation by including fixed effects at the parent level. This set-up is in the spirit of Khwaja and Mian (2008) and allows us to compare the effect of parent shocks on the lending of subsidiaries within the same conglomerate. Including between variation strengthens our results, both statistically and economically. If wholesale funding to total funding increases by one standard deviation (30 percentage points), a subsidiary in a funding market decreases its lending by more than 5.4 percentage points (up from a 3.27 percentage points reduction using within variation only), while if the ratio of net loans to total assets increases by one standard deviation (20 percentage points), a subsidiary in an investment market sees an increase of their lending growth by almost 0.6 percentage points[14].

These results complement the findings of Cetorelli and Goldberg (2012b), who conclude that strategic importance plays a major role in the intensity of the transmission

[14]Normally, we would expect the ratio of net loans to total assets to be below 1. However, the ratio ranges from -.13 to 99.43 in our sample, hence the value of the original ratio is multiplied by 100 in Bankscope, which also affects the interpretation of the economic effects.

of *liquidity* shocks across borders, based on data for U.S. banks and their foreign subsidiaries. We find that on a global level the effect is stronger if the source of liquidity needs is a shock to the equity of the parent.

4.5 Liquidity Regulation and Shock Transmission

As mentioned in our introduction and hypotheses sections, the existing literature does not provide definitive evidence whether stricter liquidity rules are beneficial in preventing liquidity crises and in fostering lending growth. One major drawback of these studies is that they are focusing on the experience of a particular country (e.g., the U.K. in Banerjee and Mio (2014)) or the results are based on theoretical simulations (Van den End and Kruidhof (2013); De Nicolo et al. (2012) and Gai et al. (2011)). Overall, most studies fail to take into account the cross-sectional dimension of liquidity regulation. To our knowledge, Bonner et al. (2014) is the only study that investigates the effects of liquidity regulation in a large sample of 7000 banks in 24 OECD countries. However, the authors focus on the effect of liquidity regulation on parent bank liquidity holdings and not on the transmission of liquidity shocks from parents to subsidiaries.

To address this omission in the literature, we collect a unique dataset of liquidity reforms in the 27 parent-bank countries, as well as in the 98 countries where our parent banks have subsidiaries. We start our search with the World Bank's Bank Regulation and Supervision surveys in 1998-2000, 2002, 2006, and 2011. We further complement our data with information from the competent national authorities, legal acts at national level, as well as with a survey among several of the authorities in countries in our sample, for which no information was available. We concentrate on requirements for liquidity buffers beyond the traditional required reserves (such as regulatory minimum ratio on liquid assets) that exist in almost all countries in our sample.[15] 47 host countries had such rules in the beginning of our sample in 1997, and this number rose to 73 in 2012. Considering the parent home-country sample, 8 countries had such legislation in 1997, and 15 – in 2012.

[15] 90 countries had required reserves rules throughout the full sample period between 1997 and 2012.

After collecting the legal information, we introduce liquidity regulation dummy variables "Liquidity_sub$_j$" and "Liquidity_par$_l$" that take the value of 1 if a liquidity requirement apart from the general required reserves is officially instituted in a subsidiary's country j or in a parent's country l at time *t-1*, respectively and 0 otherwise. In our regressions, we include the dummies and an interaction with the wholesale shocks. Since several countries strengthened and subsequently relaxed their liquidity requirements, our design allows for different countries (and, hence, subsidiaries) to be either in the control or the treatment group at different points in time.

Table 8 presents the results from our analysis. Model (1) includes only the dummy for host country liquidity regulation with its interaction with the wholesale funding shock. Model (2) presents the results for home country liquidity regulation with its interaction with the wholesale funding shock, while Model (3) includes both dummies and both interaction terms. In Model (1), we observe a positive but statistically insignificant coefficient of the standalone liquidity dummy. The main coefficient of interest, the coefficient of the interaction term, is negative and statistically significant at the 10% level for both groups. These results suggest that liquidity regulation has limited beneficial effect on loan growth abroad in times when no wholesale shock occurs, while it decreases lending in times of liquidity shocks. A plausible explanation for our results is suggested by Bonner et al. (2014), who find that liquidity regulation serves as a substitute for a bank's incentives for actual liquidity buffer holding based on fundamental bank characteristics. The results from regression models (2) and (3) show that home country regulation has no additional effect on the transmission of shocks. This is also in line with the descriptive findings in Bonner et al. (2014), where the presence of liquidity regulation is shown to have no effect on the aggregate liquidity in the banking sector of 24 OECD countries. As in our study, the authors find that domestic lending rates increase during tranquil time, but decrease during a crisis. In our case, we find that host country liquidity regulation has an impact on the transmission shocks across borders.

Our results suggest that the liquidity buffers of foreign subsidiaries do not prevent the transmission of a parent wholesale shock to the host country's economy. A possible explanation for the transmission taking place despite the liquidity rules in the host country is that while parents prefer not to violate the liquidity thresholds in the foreign market, they withdraw funds from their subsidiaries by halting subsidiary lending and using the proceeds from past subsidiary lending to cushion the shocks. Our findings are also somewhat at odds with the results of Van den End and Kruidhof (2013) and De Nicolo et al. (2012) who find that liquidity regulation leads to an overall decrease in lending growth, efficiency and welfare. We find this not to be the case in normal times. However, we find evidence for a negative effect of liquidity regulation on subsidiary lending if a parent wholesale shock hits, which can have a disruptive effect for the economy of the host country.

4.6 Further Findings

4.6.1 Capital Buffers

One important question regarding the transmission of solvency shocks is whether the affected parents rely on their own capital buffers to address the onset of a solvency crisis and whether shocks are transmitted to their subsidiaries only if the buffers are not sufficiently large. Gambacorta and Mistrulli (2004) and Meh and Moran (2010) find that bank capitalization is an important determinant of the propagation of solvency shocks in an economy and that well-capitalized banks are better able to absorb negative shocks.

To examine the above hypotheses, we regress the change in *parent* capital ratio on contemporaneous and lagged solvency shocks, up to the third lag. Tables 9 and 10 present the results for parents that are below the 5% capital ratio and for well-capitalized parents, respectively. We observe a contemporaneous reduction of the capital buffer for both types of banks, but the reduction is about 20% smaller for the "below-5%" sample: 0.56 against 0.67 percentage points for the well-capitalized parents. At average capitalization for both groups at 3.8 percent and 7.2 percent, respectively, these values represent a substantial drop. However, the latter banks on average do not reduce their capital buffer in the subsequent periods, while the former continue to deplete their capital buffers, aggravating their capital position. In fact, the coefficients for the lagged capital shocks for the well-capitalized parents, albeit insignificant, appear to add up to the size of the initial negative change in the capital ratio. This hints that these banks replenish their capital buffers in the periods after a solvency shock. These findings are somehow at odds with the results of Jokipii and Milne (2011), who document that between 1986 and 2008, undercapitalized U.S. commercial banks rebuild their capital buffers faster than well-capitalized banks. We find that on the global level, this effect exists only for well-capitalized banks and there is no evidence for a positive adjustment of capital buffers by undercapitalized banks. This reduction of capital buffers of the already undercapitalized parent banks can lead to an additional vulnerability in the bank group in the subsequent periods after a shock.

[Place Table 9 about here.]

[Place Table 10 about here.]

Overall, we observe a reduction in the parent capital buffers, which however may not be sufficient to completely immunize their subsidiaries. The initially well-capitalized parents return to their pre-shock level of capital buffers several periods after a solvency shock, while the banks below the 5% capital ratio reduce their ratios even further, making them more vulnerable to subsequent shocks.

4.6.2 Liquidity Buffers

Considering wholesale shocks, the reason for their limited transmission to subsidiaries may be the sufficient level of liquidity buffers at the parent level to cushion the effect of a liquidity crisis.[16]

To analyze the behavior of liquidity buffers after a wholesale shock, we regress the growth rate of parent liquid assets on the contemporaneous and lagged wholesale shocks.[17] Tables 11 and 12 present the results for the parents relying on wholesale funding and

[16]Gai et al. (2011) examine the effects of liquidity buffers in a network model and find that they improve the resilience of the financial system by reducing the susceptibility of banks to haircut shocks.

[17]We performed the same analysis using the ratios of liquid assets to total assets, of liquid assets to deposits and short-term funding and of liquid assets to total deposits and borrowing, arriving at qualitatively the same results.

for parents relying on retail funding.[18] We notice an instant drop of the liquidity buffers of parents reliant on wholesale funding by almost 10 percentage points, while the reduction of non-reliant banks is about 7 percentage points. The initial drop in parent liquid assets is sufficient and we do not notice neither a further drop in liquidity, nor a lasting effect on foreign subsidiary lending. We also notice replenishing of the liquidity buffers of parents that do not rely on wholesale funding one period after the shock, which is not present for the other group. However, for both set of parents, there is no subsequent reduction in the liquidity buffer and ultimately no liquidity shocks are allowed to transmit to their foreign subsidiaries.

[Place Table 11 about here.]

[Place Table 12 about here.]

4.6.3 Subsidiary Size, Past Growth and Country Development

In Sections 4.4 and 4.5, we investigated what subsidiary characteristics affect the transmission of parent shocks. In this subsection, we extend this analysis by slicing the subsidiary sample across several further dimensions.

If parent banks do not discriminate between subsidiaries in distributing the shock, bigger subsidiaries should be able to weather shocks better than smaller subsidiaries (see, e.g., Cetorelli and Goldberg (2012b)). Therefore, in Models (1) and (2) in Table 13, we split the subsidiary sample into below and above median bank size and find that lending is reduced primarily by large foreign subsidiaries. In Models (3) and (4), we test how the shock is transmitted depending on the past lending growth of foreign subsidiaries and find that the highest drop is for the subsidiaries with already sluggish lending growth. This is in line with the results from Models (5) and (6), where we split the sample into non-OECD and OECD subsidiaries, respectively: solvency shocks are transmitted to the mature OECD markets.[19] These results also support the findings in Section 4.4, if we as-

[18]Note that due to the low number of parent shocks in the group with a ratio of wholesale funding to total funding above 90%, in this section we set the median value of this ratio as a threshold to define banks that rely heavily on wholesale funding.

[19]In unreported regressions, we find that shock to subsidiaries is the highest for low loan-growth OECD

sume that developing countries are the most likely investment targets for multinational conglomerates.

Overall, the shocks affect bigger subsidiary banks with low growth opportunities in mature markets. This is consistent with parents treating high-growth markets as investment targets and therefore avoiding subsidiary lending contraction in these particular host countries.

4.6.4 Robustness

Setting our solvency and liquidity shocks at a 5% drop in equity and wholesale funding may cast doubts that our results might be driven by the definition of the shocks or that they are affected by the subprime crisis. Therefore, as a robustness check, we re-estimate our baseline regressions using alternative definitions of solvency and liquidity shocks (Models (2), (3) and (4) in Table 14) and excluding the subprime crisis period of 2008-09 (Models (5) in Table 14). Since an increase in deposits may substitute a drop in wholesale funding, the reason why we do not observe an effect due to the latter might be simply a change in the funding source. The average bank in our sample splits its funding equally between deposits and wholesale funding and therefore, in Model (1), we redefine the wholesale shock dummy by setting it to zero when a drop in wholesale funding of at least 5% occurs at the same time as an increase of deposits by at least 5%. This does not change the the coefficients and their statistical significance substantially. In Model (3) ((4)), we fix the dummies for the shocks at the 5^{th} (10^{th}) percentile of the parent equity and wholesale funding growth distributions (left tail), respectively. The conclusions from our analysis remain unchanged - foreign subsidiary lending is affected only by solvency shocks to parents - and, as can be expected, bigger solvency shocks lead to a higher reduction in subsidiary lending. Furthermore, excluding the subprime period (Model (5)) has practically no effect on our baseline results. A reduction in parent equity may be accompanied by a reduction in parent assets (e.g. through selling or outsourcing of parts of the headquarter's operations), an hence a drop of equity may not reflect a decline in the

banks.

parent's solvency position. Therefore, in Model (6) we reduce the sample to cases where we have observed only a positive change in total parent assets in the previous period. The baseline results are qualitatively unchanged.

We may also be interested in whether the transmission of shocks is symmetric: whether positive solvency or wholesale shocks *increase* the lending of foreign subsidiaries. Models (2) and (3) in Table 15 present the results from these estimations, by setting both shocks at their 90^{th} (Model (2)) and 95^{th} (Model (3)) distribution percentiles, respectively. Interestingly, we find that positive solvency shocks do not have a significant effect on subsidiary lending, while positive wholesale shocks actually increase lending. In unreported regressions, we find that the increase of lending is mainly for subsidiaries with slow past lending growth. These findings suggest that parent banks channel any excess liquidity to increase their presence in markets where their lending has been lagging.

We perform a number of additional robustness checks to verify the validity of our results. First, we include lags of the dependent variable to account for possible dynamic dependence and cannot find significant coefficients of these variables. Second, we check whether the size of the non-traditional business of the parent, proxied by the ratio of non-interest operating income to total operating income, affects the transmission of shocks and find that not to be the case. Third, since rolling over bad loans by subsidiary banks can artificially increase loan growth, we check whether evergreening affects the transmission of shocks, by regressing non-performing loans to total loans at the subsidiary level to solvency shocks up to the fourth lag. We cannot find evidence for this phenomenon in our foreign subsidiary sample. Furthermore, to alleviate concerns that our results are driven by larger subsidiaries only (which may even lead to concerns about reverse causality), we exclude subsidiaries with assets that are 10% of the assets of the parent banks (about 10% of the subsidiary sample). The main results remain unchanged.

5 Conclusion

The links between parents and subsidiaries within international bank conglomerates lead to a reduction of information asymmetries and provide liquidity sources in cases when outside funding is scarce or unavailable. They, however, could also be channels for transmission of adverse shocks across borders. In this paper, we analyze the transmission channels of negative shocks from parent banks to their foreign subsidiaries and try to find an explanation of why a negative shock transmission occurs in certain cases and not in others.

In our analysis, we recognize that not only the negative shocks are important as such, but also is their type, because banks use different approaches to address different types of shocks. We use this observation to identify whether solvency and wholesale shocks to parent banks are systematically related to a reduction subsidiary lending. Our findings suggest that solvency shocks to parents generally have larger effect on subsidiary lending than wholesale shocks. Transmission of wholesale shock does occur and it affects foreign subsidiaries of parent banks that rely heavily on wholesale funding. Further, the transmission of wholesale shocks depends on the relative importance of the subsidiary within the parent business strategy: subsidiaries that are traditionally used as a funding source by the parent tend to be affected by solvency shocks, while subsidiaries that provide investment income appear to be protected by the parent. Cetorelli and Goldberg (2012b) find this effect for U.S. banks hit by liquidity shocks and call it a "locational pecking order". We find evidence for this phenomenon on a global scale. We also find that liquidity regulation tends to exacerbate the effect of wholesale shocks on foreign subsidiaries. We further document that the somewhat subdued effects of both types of shocks for undercapitalized banks and banks that rely on wholesale funding are primarily due to parents using their capital and liquidity buffers. Solvency shocks have higher impact on big subsidiary banks with low growth opportunities in mature markets, which further reinforces the "locational pecking order" hypothesis, as the latter markets may be used as sources of funding for investments in high-growth developing markets.

These results have important theoretical and policy implications and add to our understanding of the transmission of solvency and wholesale shocks across borders. As we find that shocks to parents have strong impact on subsidiaries abroad, and that parents try to address shocks by depleting their own capital and liquidity buffers first, we deduce that the current focus of banking regulation on requiring banks to hold sufficient buffers might be effective in reducing cross-border contagion. However, the liquidity rules currently in place globally aggravate the transmission of shocks across borders and further efforts are needed to find a more effective global regulatory framework.

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A Figures

Figure 1: Geographical Distribution of Subsidiaries. This figure presents the geographical distribution of the 375 subsidiaries of the 84 OECD parent banks in our sample.

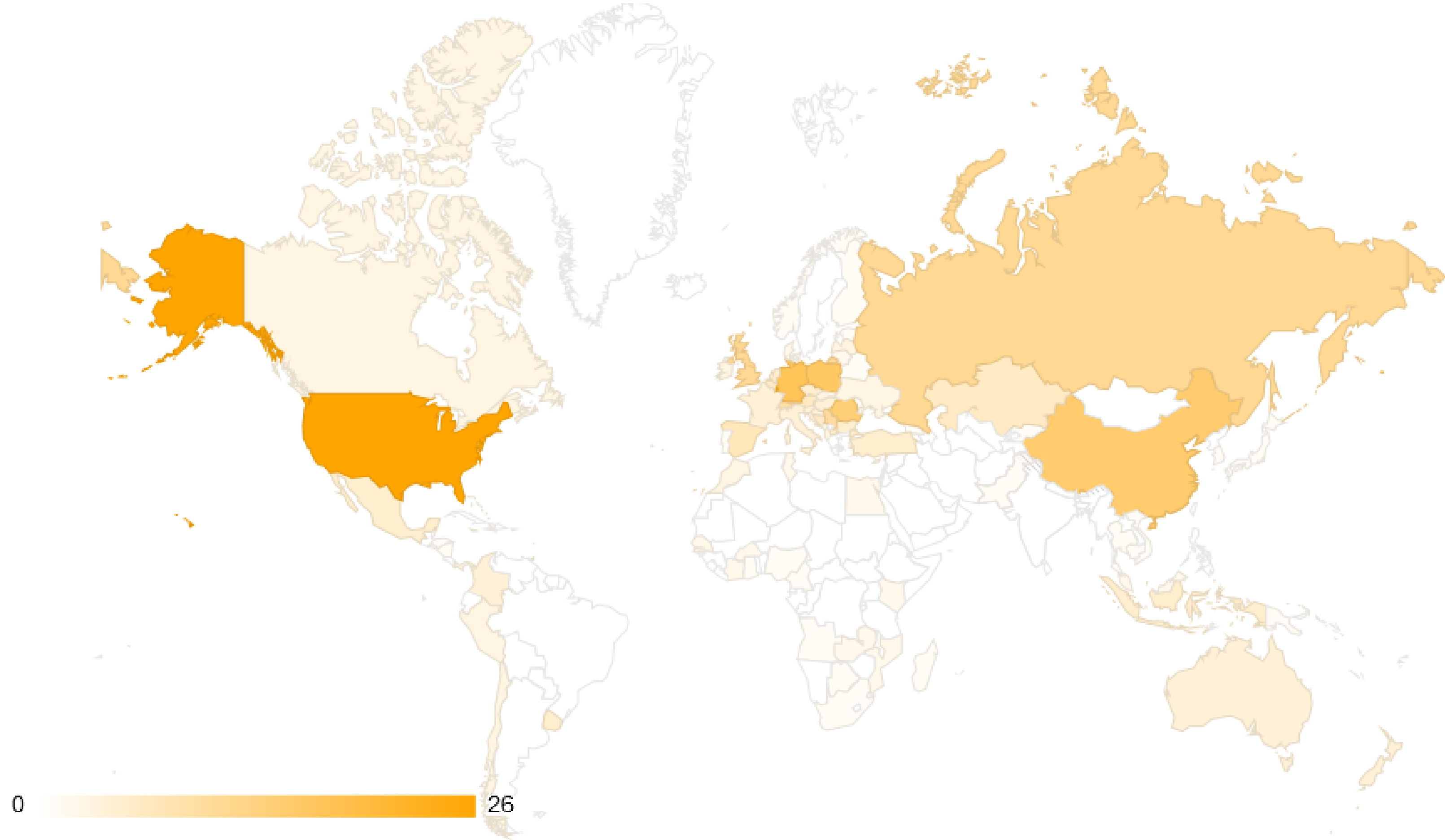


Figure 2: Equity Growth Distribution. This figure presents the empirical distribution of equity growth of the 84 OECD parent commercial banks in our sample between 1997 and 2012, winsorized at the 1% level. Panel a) presents the original distribution in the parent sample. Overall, there are 870 observations in the parent dataset to be merged with the subsidiary sample. The green vertical lines represent the -5%-threshold that we set for our solvency shocks. The solvency shock dummy takes the value of one if the equity growth is below -5% and zero otherwise. This results in a total of 101 solvency shocks in our parent dataset. The empirical distribution is juxtaposed to a normal distribution with the same mean and standard deviation (blue curve). Panel b) presents the distribution of parent equity growth observations that are relevant for the sample of 375 subsidiaries after merging both datasets. The green vertical lines represent the -5%-threshold that we set for our solvency shocks. Since a parent usually has more than one subsidiary, this results in a total of 323 parent solvency shocks in our merged dataset. The empirical distribution is juxtaposed to a normal distribution with the same mean and standard deviation (blue curve).

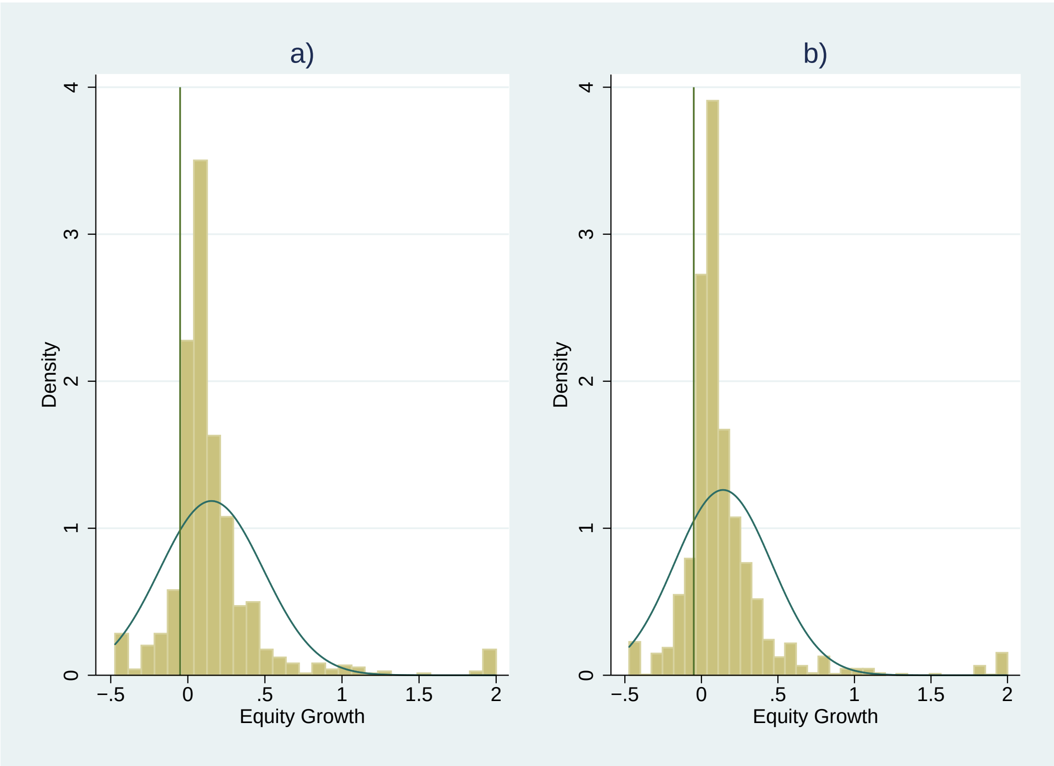


Figure 3: Wholesale Funding Growth Distribution. This figure presents the empirical distribution of wholesale funding growth of the 84 OECD parent commercial banks in our sample between 1997 and 2012, winsorized at the 1% level. Panel a) presents the original distribution in the parent sample. Overall, there are 870 observations in the parent dataset to be merged with the subsidiary sample. The green vertical lines represent the -5%-threshold that we set for our wholesale shocks. The wholesale shock dummy takes the value of one if the wholesale funding growth is below -5% and zero otherwise. This results in a total of 174 wholesale shocks in our parent dataset. The empirical distribution is juxtaposed to a normal distribution with the same mean and standard deviation (blue curve). Panel b) presents the distribution of parent wholesale funding growth observations that are relevant for the sample of 375 subsidiaries after merging both datasets. The green vertical lines represent the -5%-threshold that we set for our wholesale shocks. Since a parent usually has more than one subsidiary, this results in a total of 577 parent wholesale shocks in our merged dataset. The empirical distribution is juxtaposed to a normal distribution with the same mean and standard deviation (blue curve).

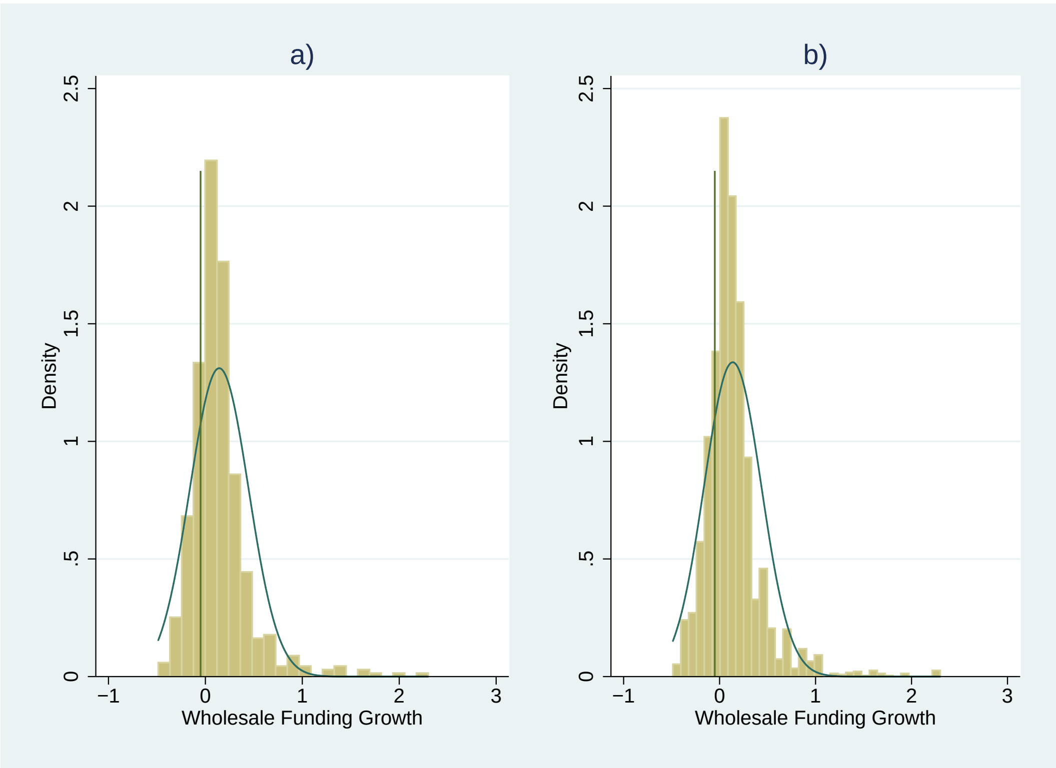


Figure 4: Number of Solvency Shocks Per Year. This figure presents the number of solvency shocks that transfer from the 84 OECD parent banks to the 375 subsidiary banks in our sample between 1997 and 2012. Panel a) presents the solvency shocks per year in the parent sample. In total, there are 101 solvency shocks in the parent dataset in the sample period. Panel b) presents the solvency shocks per year that are relevant for the sample of 375 subsidiaries after merging both datasets. Since a parent usually has more than one subsidiary, this results in a total of 323 parent solvency shocks in our merged dataset.

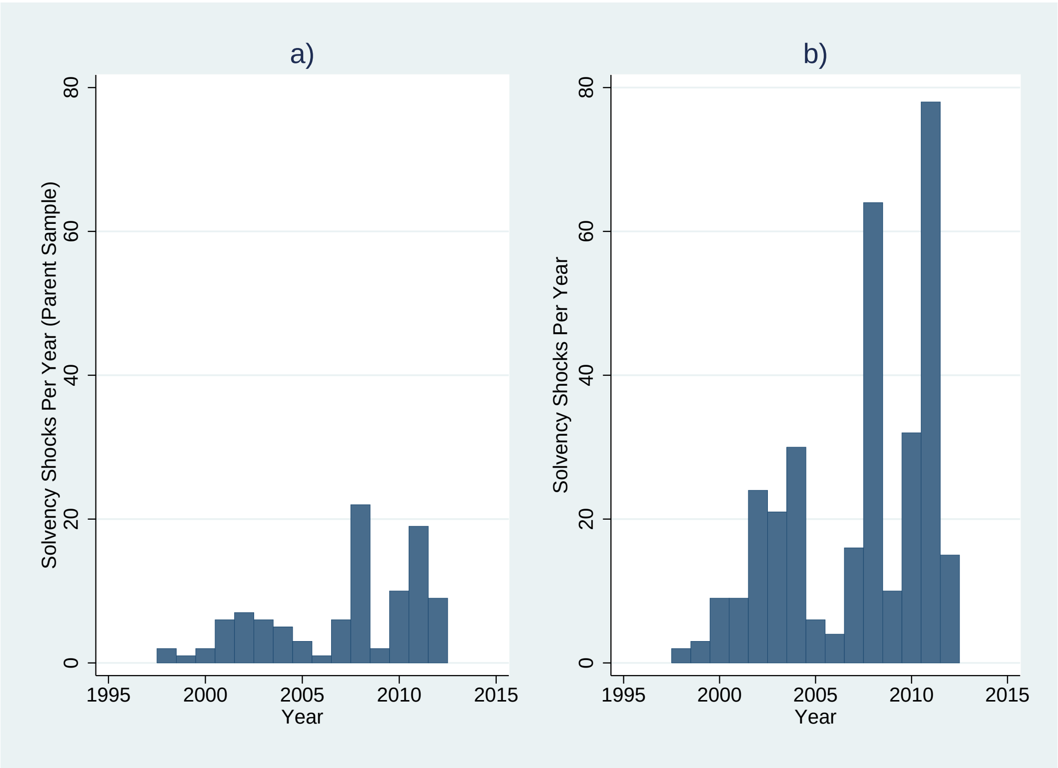


Figure 5: Number of Wholesale Shocks Per Year. This figure presents the number of wholesale shocks that transfer from the 84 OECD parent banks to the 375 subsidiary banks in our sample between 1997 and 2012. Panel a) presents the wholesale shocks per year in the parent sample. In total, there are 174 wholesale shocks in the parent dataset in the sample period. Panel b) presents the wholesale shocks per year that are relevant for the sample of 375 subsidiaries after merging both datasets. Since a parent usually has more than one subsidiary, this results in a total of 577 parent wholesale shocks in our merged dataset.

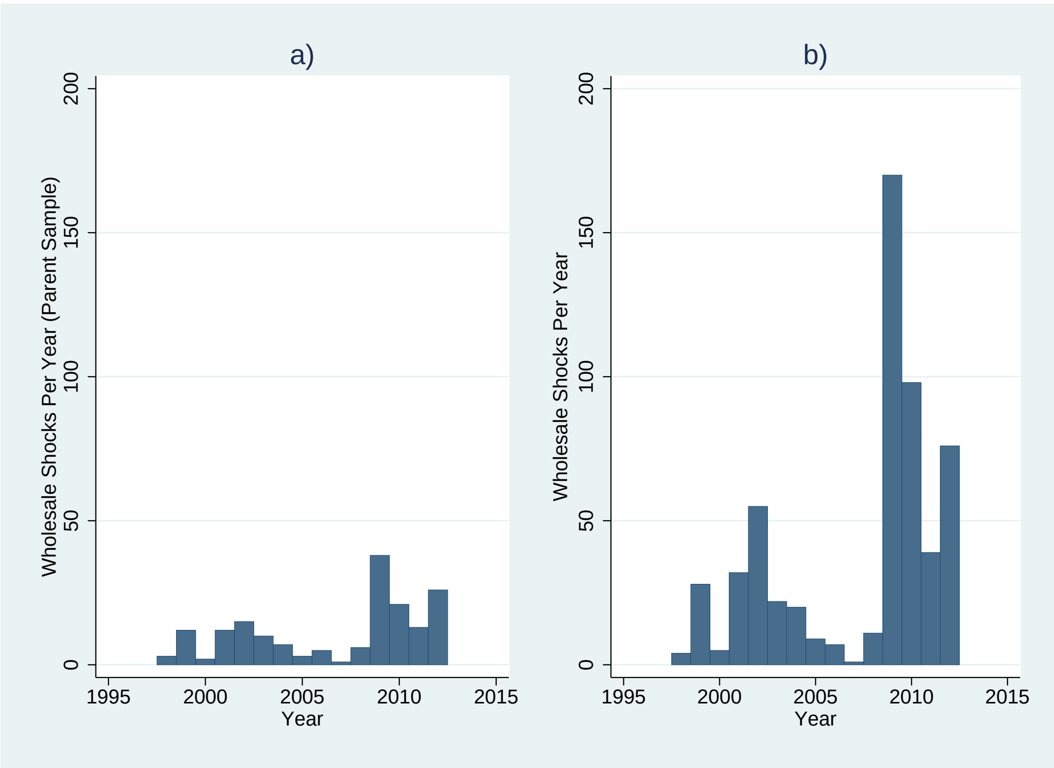
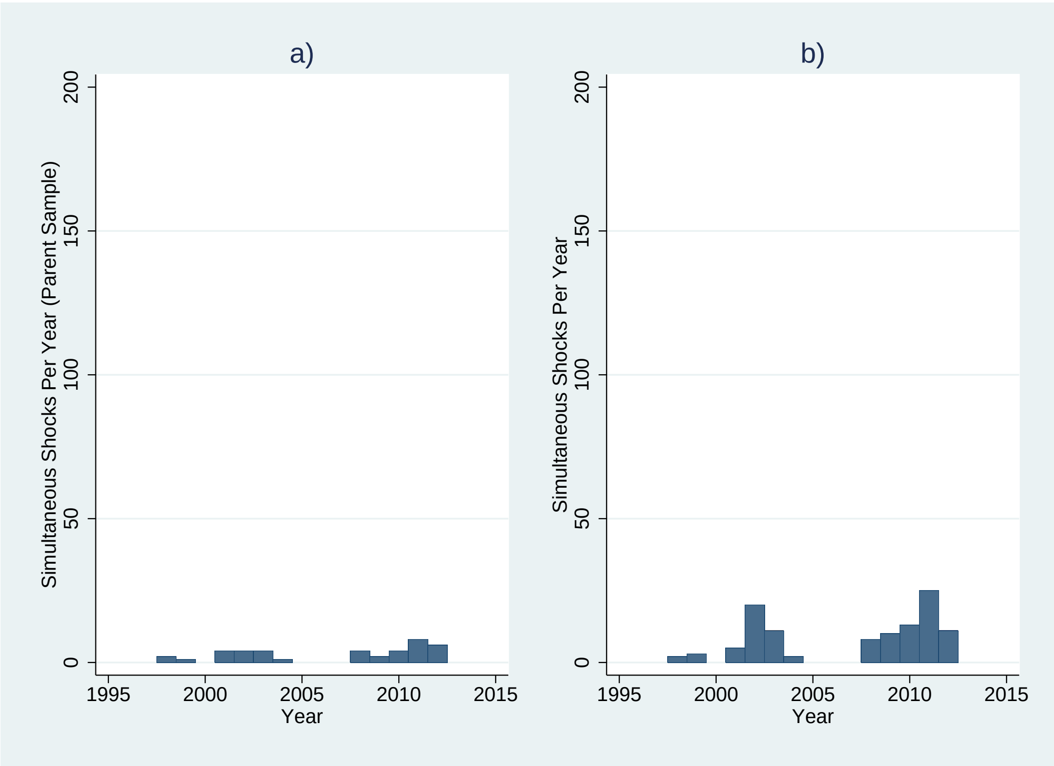


Figure 6: Number of Simultaneous Solvency and Wholesale Shocks Per Year. This figure presents the number of simultaneous solvency and wholesale shocks that transfer from the 84 OECD parent banks to the 375 subsidiary banks in our sample between 1997 and 2012. Panel a) presents the simultaneous shocks per year in the parent sample. In total, there are 40 simultaneous shocks in the parent dataset in the sample period. Panel b) presents the simultaneous shocks per year that are relevant for the sample of 375 subsidiaries after merging both datasets. Since a parent usually has more than one subsidiary, this results in a total of 110 simultaneous parent shocks in our merged dataset.



B Tables

Table 1: Theoretical Predictions and Expected Signs. This table presents the expected signs of the effects analyzed in our empirical section, based on our theoretical predictions in Section 3.1.

Hypothesis	Expected Sign
H1: Solvency Shocks	-
H2: Wholesale Shocks	-
H3: Parent Capitalization and Solvency Shocks	-
H4: Parent Reliance on Wholesale Funding and Wholesale Shocks	-
H5: Subsidiary Importance in Parent Business Strategy (Investment vs. Funding Source)	-/+
H6: Liquidity Requirement and Liquidity Shocks	-

Table 2: Parents and Subsidiaries. This table presents the 84 parent commercial banks in our sample and the overall number of subsidiaries per bank.

#	Parent Name	Parent Country	Number of Subsidiaries
	Parent Name	Parent Country	Number of Subsidiaries
1	ABN AMRO Bank NV	NETHERLANDS	2
2	Akbank T.A.S.	TURKEY	1
3	Allied Irish Banks plc	IRELAND	1
4	Alpha Bank AE	GREECE	5
5	Australia and New Zealand Banking Group	AUSTRALIA	6
6	Banca Mediolanum SpA	ITALY	1
7	Banca Monte dei Paschi di Siena SpA	ITALY	2
8	Banco Bilbao Vizcaya Argentaria SA	SPAIN	7
9	Banco Comercial Português, SA-Millennium bcp	PORTUGAL	3
10	Banco de Sabadell SA	SPAIN	2
11	Banco Desio - Banco di Desio e della Brianza SpA	ITALY	1
12	Banco Espirito Santo SA	SPAIN	2
13	Banco Santander SA	SPAIN	18
14	BANIF - Banco Internacional do Funchal, SA	PORTUGAL	1
15	Bank für Arbeit und Wirtschaft und Österreichische Postsparkasse Aktiengesellschaft-BAWAG PSK Group	GERMANY	1
16	Bank Hapoalim BM	ISRAEL	2
17	Bank Leumi Le Israel BM	ISRAEL	5
18	Bank of Montreal-Banque de Montreal	CANADA	2
19	Bank of Nova Scotia (The) - SCOTIABANK	CANADA	13
20	Bank of Tokyo - Mitsubishi UFJ Ltd (The)-Kabushiki Kaisha Mitsubishi Tokyo UFJ Ginko	JAPAN	1
21	Bankia, SA	SPAIN	1
22	Banque Fédérative du Crédit Mutuel	FRANCE	1

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Table 2 – *Continues from previous page*

#	Parent Name	Parent Country	Number of Subsidiaries
23	Banque Internationale à Luxembourg SA	LUXEMBOURG	1
24	Barclays Bank Plc	UNITED KINGDOM	7
25	BNP Paribas	FRANCE	25
26	Caixa Geral de Depositos	PORTUGAL	5
27	Canadian Imperial Bank of Commerce CIBC	CANADA	4
28	Citibank NA	UNITED STATES OF AMERICA	10
29	Commerzbank AG	GERMANY	6
30	Commonwealth Bank of Australia	AUSTRALIA	1
31	CorpBanca	CHILE	3
32	Credit Agricole Corporate and Investment Bank-Credit Agricole CIB	FRANCE	1
33	Credit Europe Bank N.V.	NETHERLANDS	2
34	Credito Emiliano SpA-CREDEM	ITALY	1
35	Danske Bank A/S	NORWAY	3
36	Denizbank A.S.	TURKEY	1
37	Deutsche Bank AG	GERMANY	18
38	Dexia Crédit Local SA	FRANCE	2
39	DNB Bank ASA	NORWAY	5
40	East West Bank	UNITED STATES OF AMERICA	1
41	Eurobank Ergasias SA	GREECE	3
42	First International Bank of Israel	ISRAEL	2
43	Hana Bank	REPUBLIC OF KOREA	1
44	HSBC Bank plc	UNITED KINGDOM	5
45	Industrial Bank of Korea	REPUBLIC OF KOREA	1
46	ING Bank NV	NETHERLANDS	6
47	Intesa Sanpaolo	ITALY	10
48	Investec Bank Plc	UNITED KINGDOM	1

Continues on next page

Table 2 – *Continues from previous page*

#	Parent Name	Parent Country	Number of Subsidiaries
49	Israel Discount Bank Ltd.	ISRAEL	2
50	Jyske Bank A/S	DENMARK	1
51	KB Kookmin Bank	REPUBLIC OF KOREA	2
52	KBC Bank NV	BELGIUM	5
53	Korea Exchange Bank	REPUBLIC OF KOREA	4
54	Mizuho Bank Ltd	JAPAN	6
55	MKB Bank Zrt	HUNGARY	1
56	National Australia Bank Limited	AUSTRALIA	2
57	National Bank of Greece SA	GREECE	6
58	Natixis	FRANCE	2
59	NLB dd-Nova Ljubljanska Banka d.d.	SLOVENIA	5
60	Nordea Bank Danmark Group-Nordea Bank Danmark A/S	DENMARK	1
61	OTP Bank Plc	HUNGARY	5
62	Piraeus Bank SA	GREECE	6
63	Raiffeisen Bank International AG	AUSTRIA	7
64	RCI Banque	FRANCE	1
65	Royal Bank of Canada RBC	CANADA	10
66	Royal Bank of Scotland NV (The)-RBS NV	NETHERLANDS	6
67	Shinhan Bank	REPUBLIC OF KOREA	7
68	Skandinaviska Enskilda Banken AB	SWEDEN	6
69	Société Générale	FRANCE	26
70	Standard Chartered Bank	UNITED KINGDOM	8
71	Sumitomo Mitsui Banking Corporation	JAPAN	2
72	Svenska Handelsbanken	SWEDEN	2
73	T.C. Ziraat Bankasi A.S.	TURKEY	2
74	Toronto Dominion Bank	CANADA	3

Continues on next page

Table 2 – *Continues from previous page*

#	Parent Name	Parent Country	Number of Subsidiaries
75	Turk Ekonomi Bankasi A.S.	TURKEY	1
76	Turkiye Garanti Bankasi A.S.	TURKEY	2
77	Turkiye Halk Bankasi A.S.	TURKEY	1
78	Turkiye is Bankasi A.S. - ISBANK	TURKEY	2
79	Turkiye Vakiflar Bankasi TAO	TURKEY	1
80	UBS AG	SWITZERLAND	5
81	UniCredit SpA	ITALY	24
82	Westpac Banking Corporation	AUSTRALIA	3
83	Woori Bank	REPUBLIC OF KOREA	3
84	Yapi Ve Kredi Bankasi A.S.	TURKEY	2
		Total	**375**

Table 3: Parents and Subsidiaries. This table presents the distribution of the 375 subsidiaries across countries. For a graphical representation, see Figure 1.

#	Subsidiary Country	Number of Subsidiaries	#	Subsidiary Country	Number of Subsidiaries
1	ALBANIA	3	50	LATVIA	3
2	ANDORRA	1	51	LITHUANIA	2
3	ANGOLA	1	52	LUXEMBOURG	24
4	ARUBA	1	53	MACAO	2
5	AUSTRALIA	4	54	MACEDONIA (FYROM)	5
6	AUSTRIA	6	55	MADAGASCAR	1
7	BAHAMAS	3	56	MALAYSIA	2
8	BARBADOS	2	57	MALTA	3
9	BELARUS	1	58	MEXICO	5
10	BELGIUM	6	59	MONTENEGRO	3
11	BELIZE	1	60	MOROCCO	3
12	BOSNIA AND HERZEGOVINA	6	61	MOZAMBIQUE	2
13	BOTSWANA	1	62	NETHERLANDS	5
14	BULGARIA	5	63	NEW ZEALAND	4
15	BURKINA FASO	2	64	NICARAGUA	1
16	CAMBODIA	1	65	NIGERIA	1
17	CAMEROON	1	66	NORWAY	1
18	CANADA	3	67	PAKISTAN	1
19	CAPE VERDE	3	68	PANAMA	3
20	CHILE	3	69	PAPUA NEW GUINEA	1
21	CHINA	15	70	PERU	3
22	COLOMBIA	4	71	POLAND	16
23	COTE D'IVOIRE	2	72	PORTUGAL	1
24	CROATIA	4	73	REPUBLIC OF KOREA	1
25	CURACAO	1	74	REPUBLIC OF MOLDOVA	1
26	CYPRUS	3	75	ROMANIA	14
27	CZECH REPUBLIC	5	76	RUSSIAN FEDERATION	11
28	DENMARK	2	77	SAMOA	2
29	EGYPT	2	78	SENEGAL	2
30	EL SALVADOR	1	79	SERBIA	10
31	ESTONIA	1	80	SEYCHELLES	1
32	FINLAND	1	81	SINGAPORE	1
33	FRANCE	4	82	SLOVAKIA	3
34	GEORGIA	1	83	SLOVENIA	4
35	GERMANY	17	84	SOUTH AFRICA	1
36	GHANA	1	85	SPAIN	7
37	GRENADA	1	86	SWITZERLAND	9
38	HAITI	1	87	THAILAND	1
39	HONDURAS	1	88	TONGA	1
40	HONG KONG	4	89	TRINIDAD AND TOBAGO	4
41	HUNGARY	4	90	TUNISIA	2
42	INDONESIA	5	91	TURKEY	5
43	IRELAND	3	92	UKRAINE	3
44	ITALY	4	93	UNITED KINGDOM	11
45	JAMAICA	3	94	UNITED STATES OF AMERICA	26
46	JAPAN	1	95	URUGUAY	5
47	KAZAKHSTAN	6	96	VANUATU	1
48	KENYA	2	97	VIET NAM	1
49	KYRGYZSTAN	1	98	ZAMBIA	2
				Total:	**375**

1

Table 4: Descriptive Statistics. This table presents the descriptive statistics of the dependent variable and the bank control variables in our regression analysis. The sample comprises 375 foreign subsidiaries of 84 OECD parent banks in the period 1997-2012.
Note: Not all data for parents are available, therefore the number of observations for some of the variables below is lower than 870. These variables are not used in the regression analysis, as it is at the subsidiary level, and the averages are presented for the sake of approximate comparison only.

Variable		**Parents**	**Subsidiaries**
Loan Growth Rate	Mean	14.33%	18.72%
	Standard Deviation	24.25%	44.99%
	Observations	870	2791
Size	Mean	11.77	7.70
	Standard Deviation	1.49	1.89
	Observations	870	2791
Profitability (Profit/Total Earning Assets)	Mean	0.91%	1.56%
	Standard Deviation	1.27%	2.51%
	Observations	860	2791
Riskiness (LLP/Loans)	Mean	0.89%	1.31%
	Standard Deviation	1.11%	2.45%
	Observations	843	2791
Capitalization (Equity/Total Assets)	Mean	6.36%	12.62%
	Standard Deviation	3.03%	9.74%
	Observations	870	2791
Liquidity (Liquid Assets/Total Assets)	Mean	22.10%	27.86%
	Standard Deviation	12.96%	20.68%
	Observations	870	2791
Internally Generated Funds (Net Income$_t$)/Loans$_{t-1}$)	Mean	1.80%	3.50%
	Standard Deviation	3.37%	7.51%
	Observations	860	2791

Table 5: Regression Variables. This table presents a description of the regression variables and data sources. All relevant balance sheet variables are converted to U.S. dollars for an easier interpretation of the results.

Variable name	Description	Data source
Loan Growth Rate$_i$	Growth of total subsidiary loans	Bankscope
Size$_i$	Natural logarithm of total subsidiary assets	Bankscope
Profitability$_i$	Ratio of subsidiary profits to total earning assets	Bankscope
Riskiness$_i$	Ratio of subsidiary loan-loss provisions to total loans	Bankscope
Capitalization$_i$	Ratio of subsidiary equity to total assets	Bankscope
Liquidity$_i$	Ratio of subsidiary liquid assets (cash, trading securities and interbank lending of maturities less than three months) to total assets	Bankscope
Internally Generated Funds$_i$	Ratio of subsidiary net income at time t to total loans at time t-1	Bankscope
Parent Capitalization$_j$	Ratio of parent equity to total assets	Bankscope
Parent Wholesale Funding$_j$	Total parent liabilities minus equity and deposits	Bankscope
Parent Reliance on Wholesale Funding$_j$	Dummy variable that takes the value of 1 if the wholesale funding to total liabilities of the parent bank is: 1) below 10% or 2) above 90% , and 0 otherwise	Bankscope
Subsidiary Importance as a Funding Source	Ratio of total liabilities minus total customer deposits to total liabilities	Bankscope
Subsidiary Importance as an Investment Income Source	Ratio of net loans to total assets	Bankscope
Liquidity_sub$_k$	Dummy variable that takes the value of 1 if a liquidity requirement apart from the general required reserves is officially instituted in a *subsidiary* country k and 0 otherwise	World Bank's Bank Regulation and Supervision surveys, National authorities documentation, Survey among national authorities
Liquidity_par$_l$	Dummy variable that takes the value of 1 if a liquidity requirement apart from the general required reserves is officially instituted in a *parent* country l and 0 otherwise	World Bank's Bank Regulation and Supervision surveys, National authorities documentation, Survey among national authorities
Gross Domestic Product Growth$_k$	Annual GDP growth in subsidiary country	Datastream, World Bank's World Development Indicators
Inflation$_k$	Annual inflation in subsidiary country	Datastream, World Bank's World Development Indicators
Unemployment$_k$	End-of-year unemployment in subsidiary country	Datastream, World Bank's World Development Indicators

Table 6: Baseline Regressions. This table reports the results from the estimation of Equation 1 without interactions at the subsidiary bank level. The sample comprises 375 foreign subsidiaries of 84 OECD parent banks in the period 1997-2012. The dependent variable is the growth rate of subsidiary loans. "Solvency Shock$_j$" and "Wholesale Shock$_j$" are dummy variables that take the value of 1 if a parent bank j is hit by a solvency and wholesale shock, respectively, and 0 otherwise. The bank controls ("Size", "Profitability", "Riskiness", "Capitalization", "Liquidity" and "Internal") are at the subsidiary i level. They are lagged with one period. The variable "Internal" stands for "Internally Generated Funds". The "Macro Controls" vector of variables contain Gross Domestic Product growth, inflation and unemployment in the host country k of the respective subsidiary. All variables are defined in Table 5 and in the main text. The country fixed effects are at the host country level. The bank fixed effects are at the subsidiary level. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Solvency Shock$_{j,t-1}$	-0.1057***	-0.1037***	-0.1208***	-0.1060***	-0.0892***	-0.0694***	-0.0571**
	(0.025)	(0.026)	(0.027)	(0.029)	(0.028)	(0.025)	(0.026)
Wholesale Shock$_{j,t-1}$	-0.0363	-0.0456**	-0.0513**	-0.0361	-0.0178	0.0323	0.0226
	(0.022)	(0.021)	(0.022)	(0.022)	(0.022)	(0.029)	(0.028)
Size$_{i,j,t-1}$		-0.0340***	-0.0451***	-0.0466***	-0.1466***	-0.2131***	-0.2078***
		(0.006)	(0.007)	(0.005)	(0.015)	(0.033)	(0.033)
Profitability$_{i,j,t-1}$		-1.6205**	-1.3119	-2.0931**	-1.9739**	-1.7250**	-1.9333**
		(0.770)	(0.930)	(0.935)	(0.898)	(0.840)	(0.850)
Riskiness$_{i,j,t-1}$		-1.0891***	-1.5893***	-1.6124***	-2.6558***	-1.8145***	-1.7250**
		(0.396)	(0.441)	(0.448)	(0.625)	(0.675)	(0.673)
Capitalization$_{i,j,t-1}$		0.3719*	0.2503	0.5755**	0.4875	0.2639	0.3770
		(0.188)	(0.179)	(0.288)	(0.316)	(0.310)	(0.308)
Liquidity$_{i,j,t-1}$		0.2924***	0.4260***	0.3911***	0.7946***	0.7399***	0.7178***
		(0.056)	(0.069)	(0.067)	(0.124)	(0.135)	(0.131)
Internally Generated Funds$_{i,j,t-1}$		0.6244***	0.5707**	0.6955***	0.8367***	0.7771***	0.8454***
		(0.227)	(0.234)	(0.263)	(0.285)	(0.286)	(0.286)
Host Country Fixed Effects	No	No	Yes	No	No	No	No
Parent Fixed Effects	No	No	No	Yes	No	No	No
Subsidiary Fixed Effects	No	No	No	No	Yes	Yes	Yes
Time Fixed Effects	No	No	No	No	No	Yes	Yes
Macro Controls	No	No	No	No	No	No	Yes
Observations	2791	2791	2791	2791	2791	2791	2791
R-squared	0.007	0.076	0.127	0.129	0.145	0.216	0.235
Adjusted R-squared	0.006	0.073	0.093	0.099	0.143	0.210	0.228

Table 7: Shock Transmission Channels. This table reports the results from the estimation of Equation 1 with interactions at the subsidiary bank level. The sample for models (1)-(3) comprises 375 foreign subsidiaries of 84 OECD parent banks in the period 1997-2012. The sample for models (4) comprises 324 foreign subsidiaries of 75 OECD parent banks in the period 1997-2012. The dependent variable is the growth rate of subsidiary loans. "Solvency Shock$_j$" and "Wholesale Shock$_j$" are dummy variables that take the value of 1 if a parent bank j is hit by a solvency and wholesale shock, respectively, and 0 otherwise. "Below 5%$_j$", "Reliance-on-Wholesale$_j$" are at the parent j level. "Funding$_i$", "Investment$_i$" are at the subsidiary i level. Regressions (2) and (3) use the two definitions of the "Reliance-on-Wholesale$_j$" variable explained in Table 5, respectively. The bank controls are at the subsidiary i level and lagged with one period. The "Macro Controls" vector contains GDP growth, inflation and unemployment in the host country k of the respective subsidiary. All variables are defined in Table 5 and in the main text. The bank fixed effects are at the subsidiary level. The numbers in parentheses are are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)	(4)	(5)
Solvency Shock$_{j,t-1}$	-0.0718***	-0.0559**	-0.0570**	-0.1773***	-0.1519***
	(0.024)	(0.026)	(0.026)	(0.059)	(0.046)
Wholesale Shock$_{j,t-1}$	0.0229	0.0191	0.0286	0.1052	0.1238*
	(0.028)	(0.029)	(0.028)	(0.066)	(0.065)
Below 5%$_{j,t-1}$	0.0038				
	(0.024)				
Below 5%$_{j,t-1}$*Solvency Shock$_{j,t-1}$	0.0254				
	(0.050)				
Reliance-on-Wholesale$_{j,t-1}$		0.0772	0.0238		
		(0.154)	(0.042)		
Reliance-on-Wholesale$_{j,t-1}$*Wholesale Shock$_{j,t-1}$		0.0949	-0.3837***		
		(0.161)	(0.142)		
Funding Market$_{i,j,k,t-1}$				0.1528	0.1095**
				(0.097)	(0.054)
Investment Market$_{i,j,k,t-1}$				-0.0098***	-0.0014
				(0.002)	(0.001)
Funding Market$_{i,j,k,t-1}$*Solvency Shock$_{i,j,k,t-1}$				-0.1091	-0.1824***
				(0.067)	(0.061)
Funding Market$_{i,j,k,t-1}$*Wholesale Shock$_{i,j,k,t-1}$				-0.0314	-0.0523
				(0.078)	(0.074)
Investment Market$_{i,j,k,t-1}$*Solvency Shock$_{i,j,k,t-1}$				0.0033***	0.0031***
				(0.001)	(0.001)
Investment Market$_{i,j,k,t-1}$*Wholesale Shock$_{i,j,k,t-1}$				-0.0016	-0.0017
				(0.001)	(0.001)
Subsidiary FE	Yes	Yes	Yes	Yes	No
Parent FE	No	No	No	No	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes
Observations	2791	2791	2791	2775	2775
R-squared	0.235	0.235	0.236	0.265	0.227
Adjusted R-squared	0.227	0.228	0.228	0.256	0.194

Table 8: Liquidity Regulation and Shock Transmission. This table reports the results from the estimation of Equation 1 with interactions of parent shocks with liquidity regulation dumies at the subsidiary and parent bank levels. The sample comprises 368 foreign subsidiaries of 84 OECD parent banks in the period 1997-2012. The dependent variable is the growth rate of subsidiary loans. "Solvency Shock$_j$" and "Wholesale Shock$_j$" are dummy variables that take the value of 1 if a parent bank j is hit by a solvency and wholesale shock, respectively, and 0 otherwise. "Liquidity_sub$_k$" is at the host subsidiary country k level. "Liquidity_par$_l$" is at the home parent country l level. The bank controls are at the subsidiary i level. They are lagged with one period. The "Macro Controls" vector contains GDP growth, inflation and unemployment in the host country k of the respective subsidiary. All variables are defined in Table 5 and in the main text. The bank fixed effects are at the subsidiary level. The numbers in parentheses are are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	(1)	(2)	(3)
Solvency Shock$_{j,t-1}$	-0.0585**	-0.0569**	-0.0569**
	(0.025)	(0.026)	(0.026)
Wholesale Shock$_{j,t-1}$	0.0571	0.0275	0.0609*
	(0.035)	(0.029)	(0.036)
Liquidity_sub$_{k,t-1}$	0.0614		0.0618
	(0.039)		(0.039)
Liquidity_sub$_{k,t-1}$*Wholesale Shock$_{j,t-1}$	-0.0689*		-0.0681*
	(0.038)		(0.038)
Liquidity_par$_{l,t-1}$		-0.0204	-0.0249
		(0.046)	(0.046)
Liquidity_par$_{l,t-1}$*Wholesale Shock$_{j,t-1}$		-0.0221	-0.0128
		(0.048)	(0.048)
Subsidiary FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes
Observations	2745	2745	2745
R-squared	0.234	0.233	0.234
Adjusted R-squared	0.226	0.225	0.226

Table 9: Parent Capitalization, Overall Sample. This table reports the results from a regression of the capitalization of 84 OECD parent banks on lags of solvency shocks in the period 1997-2012. "Solvency Shock$_j$" is a dummy variable that take the value of 1 if a parent bank j is hit by a solvency shock and 0 otherwise. The bank fixed effects are at the parent level. All regressions include time fixed effects. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	Overall Parent Sample, Overall Period			
	(1)	**(2)**	**(3)**	**(4)**
Solvency Shock$_{j,t}$	-0.0144***			
	(0.003)			
Solvency Shock$_{j,t-1}$		-0.0099***		
		(0.003)		
Solvency Shock$_{j,t-2}$			-0.0052*	
			(0.003)	
Solvency Shock$_{j,t-3}$				-0.0020
				(0.003)
Parent Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	870	775	693	616
Adjusted R-squared	0.086	0.053	0.031	0.026

Table 10: Parent Capitalization, Below and Above 5% Samples. This table reports the results from a regression of the capitalization of 84 OECD parent banks on lags of solvency shocks in the period 1997-2012. Regressions (1)-(4) involve parent banks with a capital ratio below 5%, while regressions (5)-(8) involve parent banks with a capital ratio above 5%. The sample comprises 84 OECD parent banks in the period 1997-2012. "Solvency Shock$_j$" is a dummy variable that take the value of 1 if a parent bank j is hit by a solvency shock and 0 otherwise. The bank fixed effects are at the parent level. All regressions include time fixed effects. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	Below 5% Parent Sample, Overall Period				**Above 5% Parent Sample, Overall Period**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Solvency Shock$_{j,t}$	-0.0056***				-0.0067**			
	(0.001)				(0.003)			
Solvency Shock$_{j,t-1}$		-0.0058***				-0.0010		
		(0.002)				(0.003)		
Solvency Shock$_{j,t-2}$			-0.0029*				0.0017	
			(0.002)				(0.003)	
Solvency Shock$_{j,t-3}$				0.0004				0.0055
				(0.001)				(0.003)
Parent Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	317	279	247	218	553	496	446	398
Adjusted R-squared	0.223	0.231	0.202	0.198	0.038	0.033	0.033	0.057

Table 11: Parent Liquidity Buffer, Overall Sample. This table reports the results from a regression of the growth of the liquidity buffer of 84 OECD parent banks on lags of wholesale shocks in the period 1997-2012. "Wholesale Shock$_j$" is a dummy variable that take the value of 1 if a parent bank j is hit by a wholesale shock and 0 otherwise. The bank fixed effects are at the parent level. All regressions include time fixed effects. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	Overall Parent Sample, Overall Period			
	(1)	**(2)**	**(3)**	**(4)**
Wholesale Shock$_{j,t}$	-0.0804***			
	(0.014)			
Wholesale Shock$_{j,t-1}$		0.0378**		
		(0.019)		
Wholesale Shock$_{j,t-2}$			-0.0033	
			(0.019)	
Wholesale Shock$_{j,t-3}$				-0.0139
				(0.021)
Parent Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Observations	775	775	689	610
Adjusted R-squared	0.111	0.084	0.080	0.090

Table 12: Parent Liquidity Buffer, Reliant and Non-Reliant on Wholesale Funding Samples. This table reports the results from a regression of the growth of the liquidity buffer of 84 OECD parent banks on lags of wholesale shocks in the period 1997-2012. Regressions (1)-(4) involve parent banks with reliance on wholesale funding below the median level in the sample, while regressions (5)-(8) involve parent banks with reliance on wholesale funding above the median level in the sample. "Wholesale Shock$_j$" is a dummy variable that take the value of 1 if a parent bank j is hit by a wholesale shock and 0 otherwise. The bank fixed effects are at the parent level. All regressions include time fixed effects. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	Non-Reliant on Wholesale Funding				**Reliant on Wholesale Funding**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Wholesale Shock$_{j,t}$	-0.0708***				-0.0964***			
	(0.022)				(0.020)			
Wholesale Shock$_{j,t-1}$		0.0474**				0.0090		
		(0.023)				(0.032)		
Wholesale Shock$_{j,t-2}$			-0.0167				0.0102	
			(0.018)				(0.032)	
Wholesale Shock$_{j,t-3}$				-0.0120				0.0075
				(0.027)				(0.031)
Parent Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	365	365	323	282	410	410	366	328
Adjusted R-squared	0.106	0.088	0.072	0.098	0.167	0.129	0.129	0.127

Table 13: Subsidiary Size, Growth and Country Development. This table reports the results at the subsidiary bank level, with the subsidiaries split according to their size (Models (1) and (2)), past growth (Models (3) and (4)) and host country development (Models (5) and (6)). The full sample comprises 375 foreign subsidiaries of 84 OECD parent banks in the period 1997-2012. The dependent variable is the growth rate of subsidiary loans. "Solvency Shock$_j$" and "Wholesale Shock$_j$" are dummy variables that take the value of 1 if a parent bank j is hit by a solvency and wholesale shock, respectively, and 0 otherwise. The bank controls include: Size, Profitability, Riskiness, Capitalization,, Liquidity and Internally Generated Funds and are at the subsidiary i level. They are lagged with one period. The "Macro Controls" vector of variables contain Gross Domestic Product growth, inflation and unemployment in the host country k of the respective subsidiary. All variables are defined in Table 5 and in the main text. The bank fixed effects are at the subsidiary level. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	Subsidiary Size		**Past Subsidiary Growth**		**Subsidiary Country Development**	
	Below Median	**Above Median**	**Below Median**	**Above Median**	**Non-OECD**	**OECD**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Solvency Shock$_{j,t-1}$	-0.0434	-0.0774***	-0.0870**	0.0048	-0.0151	-0.0882**
	(0.037)	(0.022)	(0.037)	(0.045)	(0.033)	(0.037)
Wholesale Shock$_{j,t-1}$	0.0335	0.0071	0.0755**	-0.0114	0.0249	0.0162
	(0.037)	(0.030)	(0.038)	(0.043)	(0.025)	(0.048)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Subsidiary Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1378	1413	1381	1381	1360	1431
R-squared	0.256	0.287	0.201	0.283	0.391	0.130
Adjusted R-squared	0.242	0.274	0.187	0.270	0.379	0.115

Table 14: Robustness: Different Definitions of Shocks. This table reports the results at the subsidiary bank level for different definitions of the solvency and wholesale shocks. Model (1) defines the solvency and wholesale shocks as a 5-% drop in equity and wholesale funding, respectively. Model (2) uses the same definition, but sets the wholesale shock dummy to zero if there is a simultaneous rise in deposits by 5%. Model (3) sets the solvency and wholesale shocks at the 5-% tail (left tail) of equity and wholesale funding, respectively. Model (4) sets the solvency and wholesale shocks at the 10-% tail (left tail) of equity and wholesale funding, respectively. Model (5) defines the solvency and wholesale shocks as a 5-% drop in equity and wholesale funding, respectively, and exclude the subprime crisis period of 2008 and 2009. Model (6) constrains the sample to cases with positive change in parent assets. The full sample comprises 375 foreign subsidiaries of 84 OECD parent banks in the period 1997-2012. The dependent variable is the growth rate of subsidiary loans. The bank controls include: Size, Profitability, Riskiness, Capitalization,, Liquidity and Internally Generated Funds and are at the subsidiary i level. They are lagged with one period. The "Macro Controls" vector of variables contain Gross Domestic Product growth, inflation and unemployment in the host country k of the respective subsidiary. All variables are defined in Table 5 and in the main text. The bank fixed effects are at the subsidiary level. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	Overall Parent Sample					
	Overall Period				Excluding 2008-09	Positive Change in Assets
	(1)	(2)	(3)	(4)	(5)	(6)
Solvency Shock$_{j,t-1}$	-0.0571**	-0.0542**			-0.0565*	-0.0737*
	(0.028)	(0.024)			(0.032)	(0.041)
Wholesale Shock$_{j,t-1}$	0.0226				0.0246	0.0242
	(0.421)				(0.029)	(0.038)
Wholesale Shock $_{j,t-1}$		0.0264				
		(0.026)				
Solvency Shock$_{j,t-1}$(5\%-Tail)			-0.0707**			
			(0.030)			
Wholesale Shock$_{j,t-1}$(5\%-Tail)			-0.0499			
			(0.044)			
Solvency Shock$_{j,t-1}$(10\%-Tail)				-0.0519**		
				(0.024)		
Wholesale Shock$_{j,t-1}$(10\%-Tail)				-0.0125		
				(0.030)		
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Subsidiary Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2791	2791	2791	2791	2263	2116
R-squared	0.235	0.235	0.235	0.234	0.212	0.214
Adjusted R-squared	0.228	0.228	0.228	0.227	0.204	0.205

Table 15: Robustness: Positive vs. Negative Shocks. This table reports the results at the subsidiary bank level of positive and negative solvency and wholesale shocks. Model (1) defines the solvency and wholesale shocks as a 5-% drop in equity and wholesale funding, respectively. Model (2) sets the solvency and wholesale shocks at the 90-% tail (right tail) of equity and wholesale funding, respectively. Model (3) sets the solvency and wholesale shocks at the 95-% tail (right tail) of equity and wholesale funding, respectively. The full sample comprises 375 foreign subsidiaries of 84 OECD parent banks in the period 1997-2012. The dependent variable is the growth rate of subsidiary loans. The bank controls include: Size, Profitability, Riskiness, Capitalization,, Liquidity and Internally Generated Funds and are at the subsidiary i level. They are lagged with one period. The "Macro Controls" vector of variables contain Gross Domestic Product growth, inflation and unemployment in the host country k of the respective subsidiary. All variables are defined in Table 5 and in the main text. The bank fixed effects are at the subsidiary level. The numbers in parentheses are standard errors. All standard errors are clustered at the parent level. Statistical significance at the 1%, 5% and 10% levels is denoted by ***, **, and *, respectively.

	Overall Period, Overall Sample		
	(1)	**(2)**	**(3)**
Solvency Shock$_{j,t-1}$	-0.0571**		
	(0.028)		
Wholesale Shock$_{j,t-1}$	0.0226		
	(0.421)		
Positive Solvency Shock$_{j,t-1}$(90%-Tail)		-0.0382	
		(0.027)	
Positive Wholesale Shock$_{j,t-1}$(90%-Tail)		0.0523**	
		(0.026)	
Positive Solvency Shock$_{j,t-1}$(95%-Tail)			-0.0281
			(0.052)
Positive Wholesale Shock$_{j,t-1}$(95%-Tail)			0.0790
			(0.056)
Bank Controls	Yes	Yes	Yes
Subsidiary Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes
Macro Controls	Yes	Yes	Yes
Observations	2791	2791	2791
R-squared	0.235	0.235	0.234
Adjusted R-squared	0.228	0.228	0.227

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