Multinational Banks

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Abstract

This paper starts by establishing a set of stylized facts about global banks with operations in the United States. First, we show evidence of selection into foreign markets: the parent banks of global conglomerates tend to be larger than national banks. Second, selection by size is related to the mode of foreign operations: foreign subsidiaries of global banks and their parents are systematically larger than foreign branches and their parents, in terms of deposits, loans, and overall assets. Third, the mode of foreign operations affects the response of global banks to shocks and how those shocks are transmitted across countries. We develop a structural model of entry into global banking whose assumptions mimic the institutional details of the regulatory framework in the US. Heterogeneous, profit-maximizing banks decide whether and how to enter a foreign market. While shedding light on the relationship between market access, capital flows, regulation, and entry, the model rationalizes the observed stylized facts and can be used as a laboratory to perform counterfactual analysis.

Keywords: banks, entry, multinational firms.

JEL Classification: F12, F23, F36, G21

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1 Introduction

“Spanish-based Santander (...) acquired Sovereign Bank in 2009 as the springboard for its US ambitions, [establishing] 700 branches and ATMs across nine northeastern states.”

“Santander is the fourth-largest bank by deposits in Massachusetts and has 1.7 million US customers. Emilio Botin, chairman of the parent company, said last week during a visit to the United States that he hopes to see profits for the American business double in three years to $2 billion.” (The Boston Globe, October 26th 2013)

15% of the outstanding loans in the US are held by various types of foreign banking institutions, headquartered in more than 50 countries. Like Banco Santander SA in the quote above, these multinational banks have the ability of reallocating profits and losses in different markets, and they are often very large players in the countries in which they operate. As noted by Goldberg (2009), the sheer size of foreign banking institutions and their involvement with the real economy makes them important vehicles for the global transmission of shocks. Several empirical studies have explored the role of multinational banks in the transmission of shocks across countries. To our knowledge however, previous work has overlooked the importance of banks’ mode of entry and of the endogeneity of this decision for shock transmission. Moreover, most of the existing work has been conducted using exclusively reduced form analysis.

This paper contributes to the literature in two ways. First, methodologically, we develop a micro-founded structural model of foreign entry in the banking sector. The model is designed to describe the institutional details of the banking industry and to be consistent with a number of stylized facts from US bank-level data. The model explicitly distinguishes foreign banking institutions by their mode of entry, which is endogenous and responds to differences in cost structure and management efficiency. This feature allows us to assess whether the mode of entry matters for the extent of the transmission of various shocks across countries. Second, operationally, we calibrate the model and use it to perform a series of counterfactual exercises that shed light on the implications of the current regulation for the extent of shock transmission.

Despite the presence of a wide variety of organizational forms in the data, we focus our analysis on the two most prominent forms of foreign banking institutions in the US: branches and sub-

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1 See most notably Cetorelli and Goldberg (2011, 2012a,b).
2 Notable exceptions are Bremus et al. (2013), de Blas and Russ (2013), and Niepmann (2013).
sidiaries. The existing banking regulation treats branches and subsidiaries differently, so that the kind of activities that these firms are allowed to undertake differ: for example, while subsidiaries are separately capitalized, branches do not raise independent equity and are subject to capital requirements only at the level of the global conglomerate. While subsidiaries can issue all types of deposits, branches can only issue uninsured wholesale deposits. Finally, unlike subsidiaries, branches can freely and costlessly transfer funds to and from their parent.

Our analysis starts by establishing a series of stylized facts about the cross-section of global banks in the US and their responses to shocks. First, we show evidence of selection into foreign markets: the parent banks of global conglomerates tend to be larger than national banks. Second, selection by size is related to the mode of foreign operations: the parent banks of foreign subsidiaries are systematically larger than the parent banks of foreign branches. Also at the affiliate levels, subsidiaries are larger than branches. These size rankings hold in terms of deposits, loans, and overall assets. Third, the mode of foreign operations affects the response of global banks to shocks and how those shocks are transmitted across countries. To study the extent of shock transmission, we analyze the response of US-based affiliates of European banks to the European sovereign debt crisis of 2011. We find that, in the wake of the crisis, US branches of exposed European banks experience a flight in their uninsured deposits, while subsidiaries’ deposits (both insured and uninsured) grow. The shortage of funding that branches experience is at least partially filled by intrafirm transfers of funds from their parents: the probability that a US branch receives an intrafirm transfer from the exposed parent increases, and the amount of the transfer increases. At the same time, US branches of exposed European banks decrease their assets in the US, while assets increase in exposed US subsidiaries.

In order to confidently use our framework for policy analysis, we model carefully the institutional differences between branches and subsidiaries, to accurately describe the global banking sector in the US. To keep the analysis as simple as possible, the problem of a bank is modeled as a monopolistically competitive extension of the Monti-Klein model (see Klein, 1971, and Monti, 1972), augmented to include risky loans and capital requirements, and aggregated to an industry equilibrium with heterogeneous banks. The models features the channels of adjustment that we document in the data, and its simple structure allows us to calibrate it and use it for quantitative analysis. While able to replicate the features of the cross-section of foreign banks in the US and the

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Section 2 illustrates the institutional features of the US banking sector. Appendix A summarizes the US banking regulation and the changes it underwent in the past decades.
differential response to shocks of branches and subsidiaries, the model can be used as a laboratory to perform policy-relevant counterfactual exercises.

Our most important numerical exercise is an analysis of the EU sovereign debt crisis through the lens of the model. In the model, the crisis is isomorphic to a sudden drop in the probability of loan repayment in Europe. This reduces European banks’ profits and equity accumulation, decreases their equity to risk-weighted assets ratio, and tightens the banks’ buffer on capital requirements. What is the effect of this change on the balance sheet of European banks for the operations of their US-based affiliates? We model deposit supply following the empirical evidence reported in Egan et al. (2015): on the one hand, a tightening in global conglomerates’ capital reduces the supply of wholesale deposits, a funding shock for US branches. Faced with solvency issues in their foreign branches, EU parents use the internal capital market of the conglomerate to keep foreign branches afloat, but foreign branches decrease their US assets nonetheless. On the other hand, foreign subsidiaries’ balance sheets are isolated from the shock hitting their parents. As a result, their assets and liabilities are unaffected. The only way for the parent to reduce the effect of the shocks via its foreign subsidiaries’ operations is through restructuring, i.e. shutting down the affiliate to repatriate part of the capital invested overseas.

So which form of multinational banking better mitigates the effect of financial shocks? The answer depends on whether the objective is to minimize disruptions to aggregate banking flows or to reduce contagion across countries. Subsidiarization isolates banks’ balance sheets by location, hence minimizes contagion. However, by not providing an internal capital market to the conglomerate, it does not provide any instrument to dampen the global effect of shocks, resulting in possible reorganizations and exits. Conversely, parent-branch conglomerates can take advantage of their internal capital market and smooth the effect of the shock across countries, so reducing its global impact.

This paper is related to a large empirical literature that studies the role of global banks as vehicles of shock transmission across countries. Goldberg (2009) nicely sets the ground for the discussion of this topic. In a seminal contribution, Peek and Rosengren (2000) have shown the role of US-based branches of Japanese banks in transmitting the effect of the Japanese banking crisis to the US. In a similar spirit, Cetorelli and Goldberg (2011) document a decline in cross-border lending and in lending from foreign affiliates of global banks into emerging economies in the wake of the 2007-2009 financial crisis. Cetorelli and Goldberg (2012a,b) point to the presence of the internal capital markets of global banking conglomerates as a channel that strongly contributed
to spread financial shocks during the 2007-2009 crisis. The possibility of parents and branches to transfer funds across borders but within the boundaries of the bank holding company is a feature of primary importance in the framework that we present in this paper.

By presenting stylized facts about the features distinguishing multinational banks from domestic ones, our analysis is also closely related to Claessens et al. (2001) and Niepmann (2013). Goldberg (2016) illustrates the deep complexity underlying the organization of multinational banks’ operations through their foreign affiliates. Our structural model simplifies away most of this complexity by focusing on two possible, alternative forms of foreign banking: branching and subsidiarization. In this dimension, our work is related to Cerutti et al. (2007), Dell’Ariccia and Marquez (2010), Fiechter et al. (2011), and Danisewicz et al. (2015). Some of the facts that we report, related to changes in foreign branches’ balance sheets in the wake of the European sovereign debt crisis, are present also in Correa et al. (2013). We explicitly compare changes in branches’ balance sheets to (the lack of) changes in the balance sheets of subsidiaries.

This paper is related to a small but growing literature using tools from international trade theory to study the operations of multinational banks. The seminal paper by Eaton (1994) sets directions for structural research on this topic, but the first contributions to this agenda are contained in the pioneering work by Niepmann (2013, 2015). While Niepmann (2015) is mostly concerned with identifying the factors that drive bilateral cross-border banking flows at the country-level, our framework shares with Niepmann (2013) the emphasis on banks’ heterogeneity within country and on the role of selection to understand aggregate outcomes in the global banking sector. While Niepmann (2013) focuses on features distinguishing banks that engage in cross-border lending/borrowing versus multinational banks, we focus on multinational banks and model their organization through branching versus subsidiarization. The role of banks’ heterogeneity is also prominent in de Blas and Russ (2013) and Bremus et al. (2013), who show evidence of granularity in the banking sector and carefully model the determination of banks’ mark-ups. Finally, this paper shares with Corbae and D’Erasmo (2013) the emphasis on using quantitative analysis to understand features of the banking data.

The remainder of the paper is organized as follows. Section 2 illustrates the data and documents a series of stylized facts about foreign banking institutions in the U.S. market. Section 3 develops a simple model that illustrates the decisions that multinational banks face. The model is then calibrated and used to perform counterfactual exercises in Section 4. Section 5 concludes.

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4Banks’ mark-ups are constant in our framework to preserve tractability of the bank problem.
2 Foreign Banks in the US: Stylized Facts

In this section we present a series of facts that motivate the theoretical analysis that follows. We start with a description of the cross-section of foreign banks operating in the US, and then present evidence on how foreign banks respond to shocks depending on their mode of organization in the host country.

2.1 Data

This analysis relies on bank-level data from different sources. Our main source is data from the Quarterly Reports of Condition and Income that every US bank is required to file. These reports are better known as “Call Reports”. In addition to domestic banks, US-based subsidiaries of foreign banks must fill out these reports as well. We also use the quarterly “Report of Assets and Liabilities of US Branches and Agencies of Foreign Banks” that every branch and agency of a foreign bank is required to file. Call Reports data include detailed information about banks’ US operations, and the identity of ultimate owner which allows us to distinguish US-based entities belonging to global banks from US national banks.

In order to have a more detailed picture of global banks’ operations at home and abroad, we merge Call Reports data with two additional data sources: SNL Financial, which includes regulatory reporting data and accounting data filed by the foreign parents of US-located subsidiaries and branches, and reported sovereign debt holdings of European banks provided as part of the European Banking Authority’s (EBA) Stress Test information. As a result of this merge, we are left with a sample of 56 parent banks of US-based affiliates. These merged data allow us to present evidence about the response to shocks of different entities belonging to the same global banking conglomerate but located in different countries.

Since the heart of our empirical analysis focuses on global banks’ response to the European

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5 The Federal Financial Institutions Examination Council (FFIEC) collects these data in two different reporting forms: FFIEC 031 and FFIEC 041. Banks with foreign offices must report the FFIEC 031 form and banks with only domestic offices must file the FFIEC 041. The information about domestic operations is identical across reports for all practical purposes.

6 Form FFIEC 002. This report is similar to the Call Reports but it also contains the balances due from and due to the head office (parent) and related depository institutions, wherever located. Branches do not have their own balance sheet, as they are consolidated into the parent institution. Nonetheless, the US regulatory framework requires foreign owned branches and agencies to report their assets and liabilities in the FFIEC 002 form. Foreign owned branches are not required to report income statement variables.
Sovereign Debt crisis of 2011, we restrict our sample period to 2007-2013.

2.2 The Cross-Section of Foreign Banks

The presence of foreign institutions in the US banking market is substantial. Figure 1 shows aggregate data on the population of foreign banking organizations operating in the US. About 20% of the aggregate assets held by banks operating in the US belongs to banking offices that are ultimately owned by a foreign parent. Deposits and loans display a similar pattern over the last two decades, ranging from 15% of total deposits to 30% of the total commercial and industrial loans in hands of foreign owned banking offices.

Figure 1: Percentage of assets, commercial and industrial loans, total loans, and deposits held in foreign owned banking institutions in the U.S. Data source: Structure Data for US Offices of Foreign Banking Organizations - Selected Assets and Liabilities of Domestic and Foreign Owned US Commercial Banks plus US Branches and Agencies of Foreign Banks.

The Riegle-Neal Interstate Banking and Branching Efficiency act of 1994 repealed interstate restrictions in the original Bank Holding Company act of 1956. Based on this, studies of the global banking sector in the US should restrict the sample period to post-1995 to avoid capturing market dynamics stirred by the deregulation of interstate banking. For this reason, when presenting long-term trends in the global banking sector in the US, we use a longer sample period, spanning the years 1995-2015. Appendix A summarizes the regulatory reforms that have been shaping the US banking industry in recent years, with special focus on those regulations that had an impact on foreign banks operating in the US.

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What are the activities of foreign banking organization (henceforth, FBOs) in the US? The answer is complex, as a foreign bank may enter in the US market under different organizational forms, associated with very different activities and – most importantly – different regulation. A foreign bank may open a subsidiary bank, which is subject to US regulation, raises independent equity, and is subject to capital requirements. A subsidiary bank may accept both wholesale deposits and retail insured deposits (insured by the Federal Deposit Insurance Corporation) and performs the same type of operations than a domestically owned US bank does. Possible capital flows between the subsidiary and the parent must happen at arm’s length. This means that if a parent wants to transfer funds to or from a subsidiary in the US, there is not a fully internal channel to do so. In our data set, we count 51 US-based subsidiaries of foreign banks, with total assets of approximately $1.14tn or 7.1% of all bank assets in the US.

The other most common form of entry is via branching: a branch is also subject to US regulation, but does not raise independent equity. It is only subject to capital requirements at the conglomerate level in its home country (i.e., its assets are consolidated with the ones of the parent when evaluating its capital ratios). Branches may give loans, but accepts only non-insured wholesale deposits. Opposite to subsidiaries, branches have the possibility of an intrafirm channel to transfer capital flows to/from the parent, and indeed do display large intrafirm capital flows with their foreign parents (more on this below). In our data set there are 181 US-based branches of foreign banks, with total assets of approximately $2.4tn, or 15% of all bank assets in the US.

Subsidiaries and branches are the two most relevant forms in which foreign banks enter the US banking system. Jointly, they represent more than 99% of the assets held by foreign-owned banking offices. In terms of business lines, these two forms of entry also entail activities that are close to those of a traditional bank. In addition to branches and subsidiaries, the data display two more types of organizations. Edge and agreement corporations cannot engage in business in the US with US-based entities, including making any domestic loan or accept domestic deposits. Lastly, representative offices and non-depository trusts do not accept deposits or give loans, and their asset holdings are negligible, compared with the other types of foreign entities. Given their small weight in aggregate banking activities, we drop edge and agreement corporations, representative offices and non-depository trusts from our sample and focus the analysis on foreign branches and subsidiaries.

Which kind of foreign banks enter the US market? We start our description of the foreign banking sector in the US by showing that there is selection by size akin to what we observe for multinational firms in other, non-banking sectors.
Figure 2: Foreign Parents vs Foreign National Banks. Comparison of various size measures of foreign parents of US-based FBOs (subsidiaries and branches) versus foreign banks without overseas operations in the US. Source: SNL data for top tier parents of U.S. branches and subsidiaries from Europe. Sample period: 2007-2013.

Figure 2 illustrates the comparison between European parents of US-based Foreign Banking Organizations and European banks without overseas operations in the US, in terms of various measures of size (loans, deposits, and overall assets) and income. It is evident that the foreign banks that enter the US market through affiliates are larger and more profitable than the ones that do not. Niepmann (2013) presents evidence of a similar pecking order based on bank efficiency (computed as the ratio of overhead costs to total assets). Multinational banks appear to be systematically more efficient than domestic banks. The model that we present in the next section features a positive relationship linking bank efficiency and bank size, to be consistent with both Niepmann (2013)’s observations and with the fact displayed in Figure 2. The figure further distinguishes parents of foreign subsidiaries from parents of foreign branches, and shows that parents of foreign subsidiaries are on average larger banks compared to parents of foreign branches.

To properly argue about selection by size, we should be comparing foreign parents of US-based FBOs with foreign national banks without operations abroad. Unfortunately, the available data do not allow us to distinguish foreign national banks from foreign parents of FBOs located in countries other than the US. However, we argue that the US is one of the most popular markets for the activities of multinational banks, so it is likely that foreign banks that don’t have operations in the US also don’t have operations in other foreign markets.
Figure 3: **Size of Domestic versus Foreign Assets.** Share of US assets in a parent’s total assets versus the parent’s size. Source: SNL data for top tier parents of U.S. branches and subsidiaries from Europe, 2013.

Figure 3 shows that the amount of assets foreign banks hold in the US is positively related to their domestic size. This relationship also supports selection by size if we believe that banks are able to at least partially “transfer” their managerial efficiency when going abroad.

There are large size differences between subsidiaries and branches of FBOs, illustrating that selection by size does not only interests the foreign banking phenomenon as a whole, but is also important depending on the organizational form that the foreign banks take in the US market. Table 1 reports the average size of deposits, loans, and overall assets held by a US branch or subsidiary of a foreign bank. The average subsidiary of a foreign bank is substantially bigger than the average branch in terms of deposits, loans, and overall assets.

Table 1 reports size differences between branches and subsidiaries for a quarter at the end of our sample period, but these size differences are persistent throughout the entire sample period, as Figure 4 illustrates. Moreover, the size differences that appear from the averages in the summary statistics are not driven by a few firms holding extraordinarily large balance sheets. As it is evident in Figure 5, the deposits, loans, and assets size distributions of foreign subsidiaries first-order

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9The asset side of a bank’s balance sheet includes many types of loans, wholesale (commercial and industrial loans, real estate loans, and loans to other financial institutions) and retail (mortgages, home equity, auto loans, and credit cards). In addition, other assets held by banks are securities (treasuries, residential and commercial mortgage-backed securities, other asset-backed securities, and a small amount of equity) and trading assets. The liabilities side includes deposits, short-term and long-term debt, and owners’ equity.

<table>
<thead>
<tr>
<th></th>
<th>2013 Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Assets</td>
</tr>
<tr>
<td>Subsidiaries</td>
<td>$38,368.61</td>
</tr>
<tr>
<td>Branches</td>
<td>$18,921.99</td>
</tr>
</tbody>
</table>

stochastically dominate the analogous distributions of foreign branches.

We mentioned above that US-based branches of FBOs display large intrafirm capital flows with their foreign parents. Figure 6 shows the evolution of the aggregate net flows to and from related institutions, confirming that throughout the majority of the sample period (until 2011) the amounts that parent banks have been borrowing from their foreign branches are much larger than the amounts that foreign branches have been borrowing from their parent banks. This pattern is consistent with the evidence shown by Cetorelli and Goldberg (2012a,b) and Correa et al. (2013) about foreign branches being a source of funding to their US parents. This pattern sharply reverts at the onset of the European sovereign debt crisis in 2011, a fact that we analyze more in detail in the next section.

To summarize, we documented here a few facts that characterize the cross-section of foreign banks in the US. First, foreign presence in the US banking system is a large phenomenon. Second, global banks are larger, on average, than national banks. Third, foreign banks can enter the US market by opening subsidiaries or branches. Larger parents tend to open subsidiaries, while smaller parents tend to open branches, and – at the affiliate level – subsidiaries are, on average, larger than branches.

2.3 Foreign Banks’ Response to Shocks

In this subsection, we use the EU sovereign debt crisis of 2011 as a natural experiment to analyze global banks’ response to shocks and the extent to which global banks are vehicles of shock transmission across countries. The analysis in this section is similar in spirit to the one in Cetorelli and Goldberg (2012b) and Correa et al. (2013), but with an emphasis on the distinction between foreign subsidiaries and foreign branches. In a nutshell, we find that, after the European
Figure 5: **Size Distributions.** Cumulative distribution functions for deposits, loans, and assets, respectively, held in foreign owned subsidiaries and branches in the fourth quarter of 2013. Data source: US Structure Data for US Offices of Foreign Banking Organizations - Selected Assets and Liabilities of Domestic and Foreign Owned US Commercial Banks plus US Branches and Agencies of Foreign Banks.
sovereign debt crisis: 1) US-based branches of exposed European banks decrease their assets in the US while US-based subsidiaries of exposed European banks do not experience a drop in assets; 2) the probability that a US branch receives an intrafirm transfer from the exposed parent increases, and the amount of the transfer increases; and 3) there is a flight in the uninsured deposits of US branches of exposed European parents, while the deposits of US subsidiaries of exposed European parents are not affected.

We establish these facts by using our merged data set. We classify a bank as exposed if it has positive Greek, Italian, Irish, Portuguese, or Spanish (GIIPS) sovereign debt holdings. For this exercise, we use quarterly data from 2007:Q2 to 2013:Q4. Our results are robust to alternative definitions of exposed banks.\footnote{For robustness, we performed the empirical analysis reported in this section also using the following alternative definitions of “exposed parent”: i) classify a bank as exposed if it has (GIIPS) sovereign debt holdings above the median, ii) classify a bank as exposed if from a country in the Euro zone; and iii) classify a bank as exposed if European. We define exposure using these coarse dummies rather than using directly exposure levels as explanatory}
Table 2: Intensive Margin of Assets of Branches versus Subsidiaries

<table>
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<th>ln(Total Assets)</th>
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<tbody>
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<td>Crisis</td>
<td>0.458***</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
</tr>
<tr>
<td>Sub</td>
<td>-0.356***</td>
</tr>
<tr>
<td></td>
<td>(0.044)</td>
</tr>
<tr>
<td>Exp</td>
<td>2.719***</td>
</tr>
<tr>
<td></td>
<td>(0.308)</td>
</tr>
<tr>
<td>Crisis × Sub</td>
<td>-0.597***</td>
</tr>
<tr>
<td></td>
<td>(0.062)</td>
</tr>
<tr>
<td>Crisis × Exp</td>
<td>-1.024***</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
</tr>
<tr>
<td>Crisis × Exp × Sub</td>
<td>1.329***</td>
</tr>
<tr>
<td></td>
<td>(0.093)</td>
</tr>
<tr>
<td>Constant</td>
<td>20.64***</td>
</tr>
<tr>
<td></td>
<td>(0.159)</td>
</tr>
<tr>
<td>bank FE</td>
<td>YES</td>
</tr>
<tr>
<td>No. of Obs.</td>
<td>4489</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.113</td>
</tr>
</tbody>
</table>

We start by assessing the differential response of branches versus subsidiaries by looking at assets. For this purpose, we run the following regression:

\[
a_{e,b,t} = \alpha + \beta_1 \text{Crisis}_t + \beta_2 \text{Sub}_e + \beta_3 \text{Exp}_{e,b} + \ldots + \gamma_1 \text{Crisis}_t \times \text{Sub}_e + \gamma_2 \text{Crisis}_t \times \text{Exp}_{e,b} + \gamma_3 \text{Crisis}_t \times \text{Exp}_{e,b} \times \text{Sub}_e + \delta_b + \varepsilon_{e,b,t} \tag{1}
\]

where $a_{e,b,t}$ is the log of total assets of entity $e$ belonging to bank $b$ at time $t$, and an entity is either a US-based branch or a US-based subsidiary part of a banking conglomerate $b$. The variable Crisis$_t$ is a dummy taking value 1 for all years after 2011 (included), while the variable Exp$_{e,b}$ is a dummy taking value 1 when parent bank $b$ of entity $e$ is exposed to GIIPS debt. Sub$_e$ is a dummy variable taking value 1 if entity $e$ is a subsidiary.

The results are reported in Table 2 and show that, after the European sovereign debt crisis, US branches of exposed European banks decrease their assets in the US, while US subsidiaries of variables because exposure to GIIPS sovereign debt holdings is very small as a share of these banks’ balance sheets: among exposed parent, the mean exposure is only 3.07% of assets, while the median is 1.7%. For this reason, we don’t think that variation in the intensive margin of exposure drives the different responses of banks to the crisis. The chain of events in 2010 resulted in a contagion of fears of sovereign default in the GIIPS countries which at the same time fuelled the concerns about the stability of the Euro and the Euro zone more broadly.
exposed European banks increase their assets.

Given that the sovereign debt crisis hit the balance sheets of the European parents of these banks, one could think that the drop in assets of their US-based branches was associated with an internal transfer of resources from the US to Europe. To establish whether this is the case, it is instructive to look more closely into the change of sign of branches’ intrafirm flows that the data display around the year of the sovereign debt crisis, 2011. Simply looking at the raw data, it is evident from Figure 7 that the sign reversal in intrafirm capital flows between parents and branches is mostly due to FBOs whose parents were exposed to the crisis.

![Figure 7: Net intrafirm flows for foreign branches, by exposure of the parent to GIIPS debt. Net due from and net due to related parties. Data source: “Report of Assets and Liabilities of US Branches and Agencies of Foreign Banks”, or FFIEC 002. All values are expressed in billions.](image)

To establish more accurately this sharp distinction between the activities of exposed versus non-exposed banks with foreign branches, we run the following regressions:

$$T_{e,i,t} = \alpha + \beta_1 \text{Crisis}_t + \beta_2 \text{Exp}_{e,b} + \beta_3 \text{Crisis}_t \times \text{Exp}_{e,b} + \varepsilon_{e,i,t}$$

(2)

where $T_{e,i,t}$ is either a dummy variable taking value one if parent bank $b$ has a claim on branch $e$’s assets in period $t$, or the size of the intrafirm transfer of parent bank $b$ to branch $e$ at time $t$. The
Table 3: Intensive and Extensive Margin of Intrafirm Transfers between European Parents and their US Branches.

<table>
<thead>
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<th></th>
<th>prob(T &gt; 0)</th>
<th>T</th>
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</thead>
<tbody>
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<tr>
<td></td>
<td>(0.045)</td>
<td>(0.377)</td>
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<tr>
<td>Exp</td>
<td>-1.06***</td>
<td>-8.014***</td>
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<tr>
<td></td>
<td>(0.062)</td>
<td>(0.536)</td>
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<tr>
<td>Crisis × Exp</td>
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<td>15.15***</td>
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<tr>
<td></td>
<td>(0.096)</td>
<td>(0.791)</td>
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<tr>
<td>Constant</td>
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<td>-0.955***</td>
</tr>
<tr>
<td></td>
<td>(0.03 )</td>
<td>(0.255)</td>
</tr>
</tbody>
</table>

No. of Obs. 4732 4372
R² 0.068 0.094

other variables have been defined above.

The results are reported in Table 3 and show that at the onset of the European sovereign debt crisis, both the intensive and the extensive margin of the intrafirm transfer between parent and branch are affected for those conglomerates whose parent is exposed to GIIPS debt. The probability that a US branch receives an intrafirm transfer from the exposed parent increases, and also the amount of the transfer increases.

So we have a drop in assets in US branches accompanied by a transfer of resources from the already exposed European parents to their branches. In order to shed light on this apparent puzzle, we examine the funding side of US FBOs’ balance sheets. To do so, we run regressions of deposits on a set of dummies analogous to the ones used previously:

\[ d_{e,b,t} = \alpha + \beta_1 \text{Crisis}_t + \beta_2 \text{Sub}_e + \beta_3 \text{Exp}_{e,b} + ... \]

\[ \gamma_1 \text{Crisis}_t \times \text{Sub}_e + \gamma_2 \text{Crisis}_t \times \text{Exp}_{e,b} + \gamma_3 \text{Crisis}_t \times \text{Exp}_{e,b} \times \text{Sub}_e + \delta_b + \varepsilon_{e,i,t} \quad (3) \]

where \( d_{e,i,t} \) is the log of total deposits of entity \( e \) at time \( t \). We run two separate regressions for wholesale uninsured deposits, which are held by both branches and subsidiaries, and retail insured deposits, which are only accepted by subsidiaries. The results are shown in Table 4. Wholesale deposits in subsidiaries are classified as retail if they are under the FDIC threshold: $100,000 until 2005 and $250,000 thereafter. Wholesale deposits are those above the FDIC threshold, and deposits in branches are all considered wholesale. The reason for running separate regressions is that the nature of the deposits is substantially different across types. Current regulations, as described above, prevent foreign branches to accept insured retail deposits while subsidiaries may accept insured retail deposits and wholesale deposits.
deposits in branches owned by exposed parents suffered a large and significant decline with respect to those in subsidiaries owned by exposed parents. At the same time, retail deposits in exposed subsidiaries do not fall. Other papers documented the flight in wholesale deposits during the European sovereign debt crisis. However, previous contributions highlighted the responsiveness of wholesale deposits without taking into account the organizational form of the banks accepting those deposits. The results shown in Table 4 suggests that the deposits flight interested only those deposits that were into branches, indicating that the less regulated organizational form was perceived as less stable from large wholesale depositors.

The results of this analysis depict a scenario where distress among some European parents was associated with a flight of uninsured deposits in their foreign branches in the US. The reaction of the funding side of branches has the effect of changing the direction of intrafirm banking flows: foreign branches appeared to be a source of funding to their parents until 2011, while after the crisis parents started acting as a source of funding to their branches. This evidence indicates that foreign branches appear to transmit shocks across countries more than subsidiaries, whose institutional arrangements have the effect of isolating them from potential distress affecting their parents.

---


---

### Table 4: Intensive Margin of retail deposits vs. wholesale deposits.

<table>
<thead>
<tr>
<th></th>
<th>Retail</th>
<th>Wholesale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crisis</td>
<td>0.378***</td>
<td>0.968***</td>
</tr>
<tr>
<td></td>
<td>(0.063)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>Sub</td>
<td>3.569***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.083)</td>
<td></td>
</tr>
<tr>
<td>Exp</td>
<td>1.755***</td>
<td>1.429***</td>
</tr>
<tr>
<td></td>
<td>(0.657)</td>
<td>(0.464)</td>
</tr>
<tr>
<td>Crisis × Sub</td>
<td>-1.235***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.107)</td>
<td></td>
</tr>
<tr>
<td>Crisis × Exp</td>
<td>0.551***</td>
<td>-0.321***</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.112)</td>
</tr>
<tr>
<td>Crisis × Sub × Exp</td>
<td>1.026***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.181)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>19.48***</td>
<td>15.55***</td>
</tr>
<tr>
<td></td>
<td>(0.376)</td>
<td>(0.22)</td>
</tr>
<tr>
<td>bank FE</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>No. of Obs.</td>
<td>1136</td>
<td>4065</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.116</td>
<td>0.376</td>
</tr>
</tbody>
</table>
In the next section we introduce a structural model of foreign banking that is consistent with the institutional features of the foreign banking sector in the US and with the empirical evidence presented up to here.

3 A Model of Foreign Banking

We introduce here a simple model that sets the ground for the quantitative analysis developed in the next sections. The model is useful to introduce the main trade-offs that a bank faces when deciding whether and how to sell in a foreign country. Banks in the model operate in several interconnected markets, each with its own features. Our model is a monopolistically competitive extension of the Monti-Klein model (see Klein, 1971, and Monti, 1972), augmented to include risky loans and capital requirements, and aggregated to an industry equilibrium with heterogeneous banks. The model enables us to understand banks’ state-contingent decisions as responses to various shocks and their consequences for the banking sector on aggregate.

3.1 Setup

The model economy is composed by two countries, Home and Foreign. Variables referring to the Foreign country are denoted by an asterisk (*). The Home and Foreign countries are each populated by a large mass of banks. In addition, each bank may open an affiliate in the other country, either as a branch or as a subsidiary, so becoming the parent of a multinational bank.

We first model the maximization problem of a bank conditional on its international status: national bank (N), parent (PS) + subsidiary (S), parent (PB) + branch (B). Once the tradeoffs driving optimal banks’ decisions conditional on status are well understood, we model selection into international status. A bank enters the foreign market if by doing so it makes higher profits than from operating only domestically.

When the economy starts, each bank is endowed with a common amount of equity $E_0$. In the domestic market, each bank offers one-period loans ($L$), which with a certain probability of default ($1 - p$) may be delinquent and not repay the principal. Each bank also accepts deposits ($D$), and borrows/lends in the interbank market ($M$). We assume that each bank has market

---

13 Initial equity could also differ across banks, but this would not affect the qualitative results of the model. Over time, equity accumulation is related to bank efficiency: more efficient banks accumulate equity faster. A common initial equity does not affect the accumulation pattern and reduces the set of parameters to be calibrated.
power in the loans market, originating from some kind of differentiation (spatial or product). This differentiation, together with customers’ love for variety of banking products, is the rationale for the coexistence of many banks in the economy. Banks are heterogeneous in the efficiency with which they manage their activities, and operate under monopolistic competition in both the loans and the deposits market. For simplicity, the interbank market is assumed to be perfectly competitive. We do not model domestic entry: all banks operate and (due to monopoly power) make non-negative profits in their Home market.

During each period, banks need to pay a cost to manage deposits and loans described by the convex cost function \( a \cdot C(D,L) \). The bank-specific efficiency parameter \( a \) is the source of heterogeneity across banks, and it affects the management cost function multiplicatively, so that “low \( a \)” banks are more efficient than “high \( a \)” banks. In addition, banks that accept retail deposits have to pay a deposit insurance premium every period. The FDIC determines the deposit insurance premium (or “assessment”) on a risk basis. A bank’s assessment is calculated by multiplying its assessment rate \( f_p \) by its assessment base, where a bank’s assessment base is equal to its average consolidated total assets minus its average tangible equity (definition from the Dodd-Frank Act). Hence the total premium \( IP \) is given by:

\[
IP = f_p \cdot (L + 1_{M>0}M - E) \approx f_p \cdot D
\]

where the last term comes from the bank’s resource constraint (see below). The assessment rates \( f_p \) used range from 0.025% to 0.45% of total assets, and are reported in Table 5.

Table 5: FDIC assessment rates by risk categories, in basis points. Source: https://www.fdic.gov/deposit/insurance/assessments/proposed.html.

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate</td>
<td>2.5 to 9</td>
<td>9 to 24</td>
<td>18 to 23</td>
<td>30 to 455</td>
<td>2.5 to 45</td>
</tr>
</tbody>
</table>

Finally, banks are subject to capital requirements every period, i.e. there is a lower bound on the capital ratio that they are allowed to sustain:

\[
\frac{E}{\omega_L L + \omega_M 1_{\{M>0\}} M} \geq k
\]

where the value of \( k \) is set in the US under the Basel II/ Basel III regulations. The parameters \( \omega_L \) and \( \omega_M \) are appropriate weights that reflect the riskiness of loans and investment. These weights
are determined by the regulatory agencies (in the US case, by the Federal Reserve, FDIC, and Office of the Comptroller of the Currency).\footnote{Uncertainty is essential to model the banks’ optimal decisions. In a model without uncertainty, where loans are always repaid and there are no runs on deposits, there would be no need of capital requirements or of deposit insurance. For this reason, parent banks, branches and subsidiaries would all be solving the same problem. Zero arbitrage would make equilibrium interest rates equal across markets.}

When a bank enters the Foreign market, it transfers his efficiency $1/a$ to the new affiliate. Entering the Foreign market involves a fixed cost, that is higher if the bank enters with a subsidiary compared to when it enters with a branch: $F_s > F_b > 0$. The fixed costs of opening a subsidiary may include the cost of setting up a network of affiliates, acquiring customers, and learn about the regulatory framework of the host country. As branches’ activities are somehow more limited compared to subsidiaries’, we assume that the fixed cost of branching is lower than the one of subsidiarization. If a bank enters as a subsidiary, the Foreign subsidiary performs exactly the same operations as the parent: it accepts deposits, issues loans, makes investments, borrows/lends on the interbank market, holds independent equity, and it is subject to capital requirements on its own. The operating costs are also modeled in the same way.

Conversely, if a bank enters as a branch, the activities of the affiliate differ from the ones of the parent. Branches do not raise independent equity and they are not subject to capital requirements. In the data, parent banks and subsidiaries can accept all kinds of deposits (both wholesale and retail), while branches only accept wholesale deposits and they are not subject to deposit insurance. For simplicity, in the model we assume that parent banks and subsidiaries only hold insured deposits, while branches only hold uninsured deposits. Following Egan et al. (2015), we assume that the supply of uninsured deposits is less elastic than the supply of insured deposits, and that uninsured deposits are sensitive to some measure of “distress” of the banking corporation, while insured deposits are not.

Finally, there exists an intrafirm channel linking the assets and liabilities of the parent and the ones of the branch: parents of offshore branches can borrow from or lend to their branches at no cost. This intrafirm transfer characterizes the activities of parent-branch pairs, but is not allowed between parents and subsidiaries, who can trade only at arm’s length via the interbank market.
3.2 National Banks

A national bank chooses the optimal amounts of loans $L$, interbank activity $M$, and deposits $D$ to maximize its profits:

$$\max_{L, D, M} \quad pr_L(L) \cdot L - (1 - p)L + r_M M - r_D(D) \cdot D - aC(D, L) - f_p \cdot D$$

s.t.  

$$E + D \geq L + M \quad \text{(resource constraint)}$$

$$\frac{E}{\omega_L L + \omega_M M \mathbb{1}_{M \geq 0}} \geq k \quad \text{(capital requirement)}$$

where $r_L(L)$ denotes a downward sloping demand for loans, and $p$ is the probability of loan repayment. $r_D(D)$ is an upward sloping supply of insured deposits, while $r_M$ is the interbank rate, which the bank takes as exogenous, but is endogenously determined in industry equilibrium. Each bank maximizes the profits generated by its activities subject to two constraints. First, assets must not exceed liabilities (the resource constraint). Second, equity over risk-weighted assets must be above a given threshold that the regulators establish (the capital requirement $k$). The weights $\omega_L$ and $\omega_M$ are also set by the regulators and are meant to quantify the different degrees of riskiness of the different assets in the banks’ balance sheets.

In “normal times”, we observe in the data that banks choose to operate with a buffer on their capital requirements, i.e., capital requirements are normally not binding. For this reason, we solve the model in “normal times” assuming that the resource constraint binds, while the capital requirement does not. We refer to this solution of the model as the “unconstrained equilibrium”. The unconstrained equilibrium is characterized by an interior solution for $(L, D)$, described by the following first-order conditions:

$$\begin{align*}
[L] & \quad p \left[ \frac{\partial r_L(L)}{\partial L} L + r_L(L) \right] = \frac{a \partial C}{\partial L} + (1 - p) + r_M \\
[D] & \quad \left[ \frac{\partial r_D(D)}{\partial D} D + r_D(D) \right] + \frac{a \partial C}{\partial D} + f_p = r_M
\end{align*}$$

while the resource constraint pins down interbank activity: $M = E + D - L$.

The first order conditions are intuitive. A bank chooses the optimal amount of loans such that the marginal revenue from loans is equal to the marginal cost of loans management plus the
expected marginal loss from delinquent loans plus the opportunity cost of alternatives forgone, namely loans to other financial institutions in the interbank market. Similarly, deposits are set such that their “total” marginal cost, inclusive of management cost and insurance premium, is equal to the marginal cost of borrowing in the interbank market.

To get closed-form solutions for the variables of interest, we make a few additional parametric assumptions. We assume a constant elasticity loan demand function: \( L(r_L) = r_L^{\varepsilon} A \), where \( \varepsilon > 1 \) is the elasticity of loan demand, and \( A \) is a parameter describing the aggregate size of the loans market. Similarly, we assume a constant elasticity deposit supply function: \( D(r_D) = r_D^{\vartheta} B \), where \( \vartheta > 0 \) is the elasticity of deposit supply, and \( B \) is a parameter describing the aggregate size of the deposits market. For tractability, we also assume a linear separable management cost function: \( C(D, L) = c_L L + c_D D \) where \( c_L, c_D > 0 \). Under these assumptions, loans and deposits in the unconstrained equilibrium are given by:

\[
L_N^u = \left\{ \frac{\varepsilon}{p(\varepsilon - 1)}[(1 - p) + r_M + ac_L] \right\}^{-\varepsilon} A \tag{6}
\]

\[
D_N^u = \left\{ \frac{\vartheta}{(\vartheta + 1)[(r_M - ac_D - f_p)]} \right\}^\vartheta B, \tag{7}
\]

while a bank’s maximal profits are:

\[
\pi_N = r_M E + H_1(\varepsilon, p)((1 - p) + r_M + ac_L)^{1-\varepsilon} A + H_2(\vartheta)(r_M - ac_D - f_p)^{1+\vartheta} B \tag{8}
\]

where \( H_1(\cdot) \) and \( H_2(\cdot) \) are functions of model parameters only. Hence optimal banks’ profits are increasing in bank efficiency \( 1/a \) and in the bank’s equity \( E \).

Shocks to the economy may induce situations where the capital constraint of a national bank is binding. We will refer to this scenario as “stressful times”. During stressful times, banks’ choose the profit-maximizing levels of assets and liabilities subject to a binding capital requirement.

The constrained equilibrium has two possible configurations, depending on whether the bank borrows or lends in the interbank market. We present these below.

1. **Constrained equilibrium with interbank lending.**

   If the bank is a lender in the unconstrained equilibrium (\( M_N^u > 0 \)), it could be also a lender in the constrained one. In this scenario, both customer loans and interbank loans enter the expression for risk-weighted assets, so that

   \[
   M_N^c = \frac{E}{\omega_M k} - \frac{\omega_M}{\omega_M} L_N^c. \]

   Deposits adjust to clear the
resource constraint: \( D^c_N = \left(1 - \frac{\omega_L}{\omega_M}\right) L^c_N - \left(1 - \frac{1}{\omega_M k}\right) E \) while constrained loans solve:

\[
L^c_N = \left\{ \frac{\varepsilon}{p(\varepsilon - 1)} \left[ (1 - p) + \frac{\omega_L}{\omega_M} r_M + ac_L + (ac_D + f_p) \left(1 - \frac{\omega_L}{\omega_M}\right) + \ldots \right] \right. \\
\left. \frac{\vartheta}{\vartheta + 1} \left[ (1 - \frac{\omega_L}{\omega_M}) L^c_N - \left(1 - \frac{1}{\omega_M k}\right) E \right]^{1/\vartheta} \right]^{-\varepsilon} A. \quad (9)
\]

If the resulting \( M^c > 0 \), these conditions characterize the constrained equilibrium. Otherwise, the constrained equilibrium will be one with interbank borrowing (see below).

2. Constrained equilibrium with interbank borrowing.

If the constrained equilibrium found above is inconsistent, or if the bank is a borrower in the unconstrained equilibrium, it will be a borrower also in the constrained equilibrium.

Under this scenario, the amount of loans is the maximum that the capital requirement allows:

\[
L^c_N = E/(\omega_L k), \quad (10)
\]

deposits remain at their unconstrained value, \( D^c_N = D^u_N \), while interbank borrowing clears the resource requirement:

\[
M^c_N = D^c_N + \left(1 - \frac{1}{\omega_L k}\right) E. \quad (11)
\]
3.3 The Parent-Subsidiary Pair

Given that foreign-owned subsidiaries are de facto US banks, a parent-subsidiary pair solves virtually the same profit maximization problem as a national bank in each market in which it operates:

\[
\begin{aligned}
\max_{L,D,M} & \quad pr_L(L) \cdot L - (1 - p) L + r_M M - r_D(D) \cdot D - aC(D, L) - f_p \cdot D + \ldots \\
& \quad p^* r_L^*(L^*) \cdot L^* - (1 - p^*) L^* + r_M^* M^* - r_D^*(D^*) D^* - \ldots \\
& \quad aC(D^*, L^*) - f_p \cdot D^* - F_S
\end{aligned}
\]

\[
\begin{align*}
\text{s.t.} & \quad E + D \geq L + M \\
& \quad E^* + D^* \geq L^* + M^* \\
& \quad \frac{E}{\omega_L L + \omega_M \mathbb{1}_{(M \geq 0)} M} \geq k \\
& \quad \frac{E^*}{\omega_L L^* + \omega_M \mathbb{1}_{(M^* \geq 0)} M^*} \geq k
\end{align*}
\]

where asterisks denote foreign market variables. The problem of a parent of a subsidiary is identical to the problem of a national bank except for the fact that – upon establishing the subsidiary – a transfer of equity \( s_E E \) is made in order for the subsidiary to have some initial capital. As a result, the parent’s equity reduces to \( (1 - s_E) E \) upon establishing the subsidiary, while the subsidiary’s initial equity is \( E^* = s_E E \). Subsequently, the two entities accumulate equity independently. Notice that operating a foreign subsidiary also entails a fixed cost \( F_S > 0 \).

Given that the country-level profit functions associated with the two entities forming the pair are identical, the equilibrium for each entity of a parent-subsidiary pair takes the same exact form as the equilibrium for a national bank, with the appropriate equity levels, both in the unconstrained and in the constrained case.

3.4 The Parent-Branch Pair

When a parent bank enters the Foreign market with a branch, the possibility of intrafirm transfers between parent and branch and the aggregate capital requirement link the decisions of the two entities. A parent-branch pair solves:
\[
\max_{L,D,M,T} \quad p r_L(L) \cdot L - (1-p)L + r_M M - r_D(D) \cdot D - a C(D, L) - f_p \cdot D + \\
\ldots p^* r^* L^* \cdot L^* - (1-p^*)L^* + r^*_M M^* - r^*_D(D) \left( D^*_w; \left( \frac{E}{k \cdot RWA} \right) \right) \cdot D^*_w + \\
\ldots - a C(D^*_w, L^*) - F_B \\
\text{s.t.} \quad E + D \geq L + M + T \\
D^*_w + T \geq L^* + M^* \\
\frac{E}{\omega_L(L + L^*) + \omega_M 1_{(M + M^*) \geq 0}(M + M^*)} \geq k 
\]
than the one paid by banks and subsidiaries on retail deposits. We describe in Section 4 the restrictions that we impose on the parameterization to make sure that this is the case.

The parent-branch pair equilibrium is complicated by the fact that the problems of the two entities must be solved jointly, and that the conglomerate must keep into account how each variable affects the aggregate capital requirement. The presence of the intrafirm transfer $T$ implies that the conglomerate is subject to a unique resource constraint: $M + M^* = D + D^*_w - L - L^*$. Activities in the interbank market in each country are perfect substitutes, so based on the values of $r_M$ and $r^*_M$ the conglomerate decides in which country to borrow or lend and possibly transfers resources across countries through the intrafirm transfer. In the unconstrained equilibrium, deposits and loans for parent and branch are jointly determined by solving the system of first-order conditions.

As in the case of national banks, the constrained equilibrium has two possible configurations, depending on whether the conglomerate borrows or lends in the interbank market. We present those below.

1. Constrained equilibrium with interbank lending.

   If the conglomerate is a lender in the unconstrained equilibrium, it could be also a lender in the constrained one. In this scenario, both customer loans and interbank loans enter the expression for risk-weighted assets, so that total interbank market activity is given by:

   $$ M + M^* = \frac{E}{\omega_M k} - \frac{\omega_L}{\omega_M} (L + L^*). $$

   The binding capital requirement drives the flight of branches’ wholesale deposits: $D^*_w = 0$, while retail deposits adjust to clear the resource constraint:

   $$ D = \left(1 - \frac{\omega_L}{\omega_M}\right)(L + L^*) - \left(1 - \frac{1}{\omega_M k}\right) E. $$

   Constrained loans solve the remaining first-order conditions, the conglomerate does all interbank lending in the country where $r_M$ is higher and transfers intrafirm the funds it needs to clear the resource constraint in each market.

   If the resulting $(M^c + M^{*c}) > 0$, the description above characterizes the constrained equilibrium. Otherwise, the constrained equilibrium will be one with interbank borrowing (see below).

2. Constrained equilibrium with interbank borrowing.
If the constrained equilibrium found above is inconsistent, or if the conglomerate is a borrower in the unconstrained equilibrium, the conglomerate is a borrower in the constrained equilibrium. Under this scenario, the total amount of loans is the maximum that the capital requirement allows:

\[ L + L^* = \frac{E}{(\omega_L k)}, \]  

(17)

the parent’s retail deposits remain at their unconstrained value, while the binding capital requirement drives the flight of branches’ wholesale deposits: \( D^*_w = 0 \). Interbank borrowing clears the aggregate resource constraint:

\[ M + M^* = \left(1 - \frac{1}{\omega_L k}\right) E + D + D^*_w. \]  

(18)

The conglomerate does all interbank borrowing in the country where \( r_M \) is lower and transfers intrafirm the funds it needs to clear the resource constraint in each market.

### 3.5 Industry Equilibrium and Equity Accumulation

Each country is populated by continuum of banks, who draw their bank-specific efficiency \( 1/a \) from the exogenous distributions \( F(a), F^*(a) \). Selection into the foreign market implies that there are endogenous, equilibrium distributions of banks operating in each country, which we denote with \( G(a), G^*(a) \).

The interest rates on the interbank market are given by market clearing, so \( r^M \) and \( r^{M^*} \) are such that:

\[
\int M(a)G(a)da = 0 \\
\int M^*(a)G^*(a)da = 0.
\] 

(19), (20)

All banks start with the same level of equity \( E_0 \), and accumulate equity over time through reinvested profits:

\[ E_{t+1} = E_t + \pi_t. \]  

(21)

Finally, banks exit the market if they reach negative equity: if \( E_t < 0 \) for a national bank or for the parent of a conglomerate, the entire bank shuts down, while if \( E_t < 0 \) for a subsidiary, only
the subsidiary shuts down.

### 3.6 Selection: Matching Cross-Sectional Facts

The simple model developed in this section is a useful tool to understand the tradeoffs that banks face when entering foreign markets. The combination of bank-level efficiency with fixed and variable costs of operation delivers selection of individual banks into the three possible international/organizational statuses: national banks, parent + subsidiary pairs, and parent + branch pairs.

The fixed costs associated with foreign operations imply that the most efficient and large banks become multinational banks, consistently with what we observe in the data (see Figure 2) and with the features of multinational corporations in other sectors (see Bernard et al. 2009). For the model to generate selection by size across the different organizational modes of multinational banking, we need to impose some relationship between the fixed versus variable costs of branching versus subsidiarization. Particularly, one obtains selection of the most (least) efficient and biggest (smallest) global banks into subsidiarization (branching) if subsidiarization is associated to lower variable costs but higher fixed costs than branching, as illustrated in Figure 8.

To achieve this result, we do two things. First, we assume that the fixed cost associated with operating a foreign subsidiary is higher than the fixed cost associated with operating a foreign branch: $F_S > F_B$. Second, we parameterize the deposit supply in such a way that, for the same amount of deposits, wholesale deposits command interest rates that are higher than the interest rates on retail deposits plus the deposit insurance premium: $r_{D}^{w} > r_{D}^{*} + f_p$.

Under these restrictions, it is immediate to show that the profit functions of the parent/subsidiary pair and of the parent/branch pair are increasing in bank efficiency $1/a$, with the parent/subsidiary pair having a lower intercept (due to higher fixed cost) but a higher slope (due to the lower marginal cost of deposits). As a result the model delivers selection of the most efficient banks into global banks, and among global banks the most (least) efficient ones operate in the foreign market through subsidiaries (branches).

In the model, differences in efficiency directly translate into differences in the size of deposits, loans, and overall assets. The first-order conditions imply that more efficient banks issues more loans, accept more deposits, and have overall more assets than less efficient banks. Coupled with
selection by efficiency into different modes of entry, the model is consistent with the stylized facts we observe in the data: foreign subsidiaries are larger than foreign branches in terms of loans, deposits, and overall assets.

4 Numerical Analysis (in progress)

In this section, we give quantitative content to the model in order to make it amenable for counterfactual analysis. We start by calibrating the model so that it is consistent with the cross-sectional stylized facts that we reported in Section 2. The calibrated model is a good description of the foreign banking sector in the US, and it is able to reproduce the differential response of global banks with different organizational structure to the shock we studied empirically, the European sovereign debt crisis. To answer a set of policy-relevant questions, we perform a series of counterfactual exercises that shed light on the strength and weaknesses of the current regulation.
4.1 Calibration

Our calibration exercise proceeds in three steps. First, a subset of the parameters of the model can be directly matched to empirical observations or to previous studies. Second, we use the empirical distributions of loans and deposits to calibrate the banks’ efficiency distribution and the loans elasticity of demand. Third, we use the model to jointly calibrate the remaining parameters by matching some moments of interest.

We calibrate directly the parameters $p$, $f_p$, $k$, $\omega_L$, $\omega_M$, and $s_E$.

In our model, one minus the probability of loan repayment is equivalent to the bank expected loss per dollar, which in turn is given by the probability of default times loss given default (one minus the recovery rate). The recovery rate is calibrated to a standard value of 40%, which in case of default implies $(1 - p) = 0.4$. In times of no default, we calibrate the probability of default to a baseline value of 2.5%. This is an approximate middle-range measure based on estimated probabilities of default on sovereign debt for institutions with credit ratings varying from AAA to BB. Based on these observations, we set the probability of loan repayment (in normal times) to 0.99, and we consider scenarios of distress where it can drop down to 0.6.

We quantify the insurance premium $f_p$ following the FDIC assessment rates described in Table 5. Assessment rate vary from 0.025% to 0.45%, so we choose a value in the middle of this range: $f_p = 0.2\%$.

We set the capital requirement to $k = 0.08$. This can be interpreted as the average capital requirement of 5%, as set by the Basel II/Basel III regulation, augmented by a surcharge for large institutions. The Basel II/Basel III regulation also gives guidelines on the weights used to compute risk-weighted assets: we choose $\omega_L = 1$ based on corporate, retail, and residential mortgage exposures, and $\omega_M = 0.2$ based on exposures to U.S. depository institutions and credit unions.

Finally, in the model we assume that subsidiaries’ initial equity is provided by a transfer from the parent. We quantify the magnitude of this transfer by comparing subsidiaries’ equity with the parent’s equity, and set $s_E = 0.06$. Table 6 summarizes the parameters that we calibrate directly.

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16Source: http://www.newyorkfed.org/research/staff_reports/sr190.pdf.
17Data source: https://www.fdic.gov/deposit/insurance/assessments/proposed.html.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
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<td>$p$</td>
<td>prob. of loan repayment</td>
<td>0.99, 0.6</td>
<td>World Bank</td>
</tr>
<tr>
<td>$f_p$</td>
<td>insurance premium</td>
<td>0.002</td>
<td>FDIC</td>
</tr>
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<td>$k$</td>
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<tr>
<td>$\omega_L$, $\omega_M$</td>
<td>weights for RWA</td>
<td>1, 0.2</td>
<td>Basel II/III</td>
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<tr>
<td>$s_E$</td>
<td>subsidiary’s equity share</td>
<td>0.06</td>
<td>Call Reports</td>
</tr>
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</table>

Table 6: Direct Calibration

Figure 9: **Estimating the Size Distributions.** Plots of log-rank on log-size for interest expenses on deposits and interest revenues from loans held by European banks in the fourth quarter of 2013. Data source: SNL Financial.

The skewness of the banks’ size distribution suggests that it can be well approximated by a Pareto distribution. We start by assuming that bank efficiency $1/a$ is distributed Pareto with shape parameter $\phi$. The implied size distributions of interest revenues from loans and interest expenses on deposits are then also well approximated by Pareto distributions with shape parameters $\phi/(\varepsilon - 1)$ and $\phi/(1 + \vartheta)$, where $\varepsilon$ is the elasticity of loan demand and $\vartheta$ is the elasticity of retail deposit supply. Under the Pareto assumption, the size distribution can be estimated empirically as a log-linear relationship between the rank of a bank in the size distribution (with smaller numbers associated to bigger banks) and its size.

Figure 9 plots the log-rank versus log-size relationship for interest revenues from loans and interest expenses on deposits held by European parents of foreign owned U.S.-based subsidiaries and

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19 Appendix C discusses this approximation.
Table 7: Calibration from Size Distributions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Definition</th>
<th>Value</th>
<th>Source</th>
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<td>$\vartheta$</td>
<td>elasticity of loan demand</td>
<td>2.46</td>
<td>Estimation of loans size distrib.</td>
</tr>
<tr>
<td>$\vartheta_w$</td>
<td>elasticity of retail dep. supply</td>
<td>0.56</td>
<td>Egan et al. (2015)</td>
</tr>
<tr>
<td>$\varepsilon$</td>
<td>elasticity of wholesale dep. supply</td>
<td>0.16</td>
<td>Egan et al. (2015)</td>
</tr>
<tr>
<td>$\phi$</td>
<td>shape param. of efficiency distrib.</td>
<td>0.67</td>
<td>Estimation of deposits size distrib.</td>
</tr>
</tbody>
</table>

branches in the fourth quarter of 2013. The plots appear approximately linear for a sizeable portion of the size range, supporting the use of Pareto distributions. Given that we cannot separately identify the efficiency dispersion parameter $\phi$ from the elasticity parameters $\varepsilon$, $\vartheta$, and $\vartheta_w$, we take values for the elasticities of deposit supply from Egan et al. (2015) and set $\vartheta = 0.56$ and $\vartheta_w = 0.16$.

Then we use the slope of the log-rank versus log-size relationship for deposits to identify $\phi$: since we find $\phi/(1 + \vartheta) = 0.43$, then $\phi = 0.67$. Finally, we use the slope of the log-rank versus log-size relationship for loans together with the estimated value of $\phi$ to identify $\varepsilon$: since we find $\phi/(\varepsilon - 1) = 0.46$, then $\varepsilon = 2.46$\[33].

It remains to calibrate the parameters of the management cost function $c_L$, $c_D$, the aggregate parameters of loan demand and deposit supply, $A$ and $B$, the fixed entry costs $F_S$, $F_B$, and the common initial equity $E_0$. These are parameters that we cannot directly match to magnitudes in the data, so we use the model to choose values for these parameters such to match some relevant moments from the data. We choose the following set of target moments:

1. average buffer on capital requirement;
2. relative size of average branch/ average subsidiary, in terms of loans;
3. relative size of average branch/ average subsidiary, in terms of deposits;
4. relative presence of foreign branches versus foreign subsidiaries;
5. average interest rate on retail deposits;
6. average interest rate on wholesale deposits;
7. average interest rate on loans.

\[33]\text{Notice that the estimated value of } \phi \text{ implies an efficiency distribution with infinite mean.}
Given that we observe non-binding capital requirements in the data, it is important that the model replicates the existence of a buffer between equilibrium equity over risk-weighted assets and the capital requirement set by the Basel regulation. We compute this buffer as the difference between Tier 1 capital ratios and the regulatory required capital (8%), and set our target to a value of 16%, observed in the data in 2013. This moment is closely tied to the initial equity parameter $E_0$. The average foreign subsidiary in our data has loans equal to 5.48 times the loans of the average branch, and deposit equal to 3.51 times the deposits of the average branch. Moreover, in our data set there are 51 subsidiaries and 181 branches, so subsidiaries account for 22% of FBOs in the US. These moments related to relative size and relative frequency help to pin down the cost parameters $c_L$, $c_D$, $F_S$, and $F_B$. Finally, interest rates are endogenous in the model, but we use some targets from the data to get sensible numbers for them. As a target for the average interest rate on retail deposits, we use the interest rate on one-year CDs, equal to approximately 0.0025. As a target for the average interest rate on wholesale deposits we use LIBOR, equal to approximately 0.006. Finally, loans in the model encompass a variety of products including car loans, mortgages, and credit cards. Targeted rates on loans should then be in the interval 5-20%.

4.2 Global Banks’ Organization and the European Sovereign Debt Crisis

In this section, we perform a comparative statics exercise that has the goal of illustrating the consequences of the European sovereign debt crisis for the global banking sector through the lens of the model. In this exercise, we model the EU sovereign debt crisis as a sudden drop in the probability of loan repayment in Europe ($p$ decreases). We show that model-generated changes in the activities of national banks, parent-branch pairs, and parent-subsidiary pairs are qualitatively similar to what we observe in the data.

Figure illustrates the selection into international status that the unconstrained equilibrium of the calibrated model generates. The least efficient banks remain national, while the most efficient become global. Among global banks, the most efficient banks enter as subsidiaries and the least efficient enter as branches (which also implies that subsidiaries are larger than branches).

To simulate the European Sovereign Debt crisis, we shock the probability of loan repayment, which drops from $p = 0.99$ to $p' = 0.4$ after banks have decided their optimal amounts of loans and deposits based on $p$. This large change in banks’ revenues reduces equity accumulation at the end

\footnote{As the quantitative match of the moments from the data is still in progress, the analysis is only qualitative at this point.}
of the period and implies that European banks and European parents of global banks reduce their buffer on capital requirements ($E/RWA$ decreases). As a consequence, wholesale deposit supply in US-based branches decreases due to depositors’ fears about the health of the conglomerate. Branches experience a funding shock, reduce their loans, and their demand for borrowing increases. In equilibrium, this increases the interest rate in the interbank market in the US ($r^*_M$ increases), and branches borrow intrafirm from their parents ($T > 0$) to stay afloat. At the same time, the balance sheet of US-based subsidiaries is unaffected by the shock that happens in Europe.

Figure 10 shows how the equilibrium profits of the three groups of banks are affected by the shock. Profits drop across the banks’ distribution, but banks with different global statuses show different responses. In particular, the fact that subsidiaries are completely isolated from the shocks does not allow parent-subsidiary conglomerates to reallocate resource internally, and the global profits of these banks are the most affected. On the other hand, the internal capital market that allows parents and branches to reallocate resources within the conglomerate across countries implies that their global profits fall less than the ones of the parent-subsidiary pair.

This simple exercise is qualitatively consistent with the changes in branches and subsidiaries’ balance sheets that we documented in Section 2 and provides some guidance about the implications of different organizational forms for the transmission of shocks across countries. On the one hand, as already shown by Cetorelli and Goldberg (2012a, b), branches act as vehicles of shock transmission across countries through their internal capital market, but they are the organizational form that minimizes the aggregate, global consequences of a negative shock. On the other hand, subsidiaries

\[^{22}\text{Recall that the wholesale deposit supply function is sensitive to the magnitude of the buffer between the equity over risk-weighted assets ratio and the capital requirement.}\]
are isolated from shocks to their parents, but the lack of adjustment mechanisms among different units of the corporation makes banks that own subsidiaries less resilient to the shock. So what should the regulators do? The answer depends on whether policy priorities are more concerned with limiting the transmission of shocks across countries or with the stability of large, systemically important banks.

4.3 Counterfactual Analysis

TBA

5 Conclusions

In this paper we studied how different organizational forms of global banking shape the transmission of shocks across countries. Our analysis focused on the endogenous choice of banks to serve foreign markets via branching or subsidiarization.

We started by establishing a series of stylized facts about features of the cross-section of global banks and their response to the European sovereign debt crisis. Informed by the data, we developed a micro-founded structural model of foreign entry in the banking sector. The model is designed to mimic the institutional details of the banking industry and to be consistent with the aforementioned stylized facts. The model explicitly distinguishes foreign banking institutions by their mode of entry, which is endogenous and responds to differences in cost structure and management efficiency. This feature allows us to explain the economic channels through which banks’ mode of entry matters for the extent of the transmission of various shocks across countries.

In order to study the effects of the European sovereign debt crisis through the lens of the theory, we calibrate the model and use it to perform a series of exercises that shed light on the implications of the current regulation for the extent of shock transmission.

Our most important finding clarifies the relationship between global banks’ organization and shock transmission. We show that subsidiarization isolates banks’ balance sheets by location, hence minimizes contagion. However, by not providing an internal capital market to the conglomerate, it does not provide it with any instrument to dampen the global effect of shocks, resulting in possible reorganizations and exits. Conversely, branching can take advantage of an internal capital market
within the corporation and smooth the effect of the shock across countries, so reducing its global impact.

References


Fiechter, J., İnci Ötker Robe, A. Ilyina, M. Hsu, A. Santos, and J. Surti (2011). Subsidiaries or branches: Does one size fit all? IMF Staff Discussion Note.


Appendix

A The Regulatory Framework: History and Current Status

Edge Act 1919

The Edge Act amended section 25 of the Federal Reserve Act, allowing national banks to engage in international banking. Each bank was required to be properly capitalized and enter into an agreement with the Federal Reserve System as to the type of activities it would undertake. Upon Federal Reserve approval, banks set up subsidiaries that were allowed to undertake foreign banking activities that the parent banks were not legally permitted to undertake. At this point in time, only U.S. Banks could establish Edge Act corporations.

McFadden Act of 1927

Prior to 1927, national banks had to operate within a single building while, in many states, state banks were allowed to operate multiple branches. In order to end this advantage, the McFadden Act allowed national banks to operate branches within the city or town they were headquartered, if state law allowed this right to state banks. Not allowing national banks the right to open branches in multiple states led to a significant impact of this law becoming prohibiting interstate branching. Since foreign banks and Edge Act corporations did not fall under the jurisdiction of this law, they were the only banking organizations that could legally own branches in multiple states.

Banking Act of 1933 (Glass-Steagall)

The Glass-Steagall Act substantially reformed the American banking system, with three provisions having a large effect on the competitive landscape facing foreign banks. The most commonly cited provision of the Glass-Steagall Act is the separation of commercial banking from investment banking, a requirement foreign banks avoided until 1978. The act also created the Federal Deposit Insurance Corporation (FDIC), which insured bank deposits up to $2,500, then quickly increased to $5,000. This provision required all Federal Reserve member banks to become stockholders in the FDIC but did not allow foreign banks to become stockholders. Another provision extended the branching rights of national banks to fully mirror the rights of state banks in the state they are
headquartered, an extension of the rights granted in the McFadden Act which applied to foreign banks after 1978.

**International Banking Act of 1978 (IBA)**

The IBA instituted the principle of national treatment, where foreign banks were subject to the same regulatory restrictions and benefits as domestic banks whenever possible. Prior to the act, the branches of foreign banks were not subject to restrictions of federal law, such as those on interstate banking (McFadden) and separation of commercial and investment operations (Glass-Steagall), and were not required to meet the reserve requirements of the Federal Reserve. However, they were ineligible for FDIC insurance, making it hard to compete for retail deposits. Foreign Subsidiaries were already under federal regulatory authority. The act required foreign banks to choose a home state, then they were subject to the laws of that state and could not set up branches or subsidiaries in any other states. They also became subject to federal laws including Glass-Steagall, ending competitive advantages they previously had over domestic banks. All foreign banks that accepted retail deposits were now required to become part of the FDIC insurance system, but they did have the option to opt out by not accepting retail deposits. These banks were now subject to the reserve requirements set by the Federal Reserve and subject to their examinations or that of a similar banking authority. The act also allowed foreign banks to open Edge Act corporations, adding another organizational form for foreign banking activity in the U.S.

**Depository Institutions Deregulation and Monetary Control Act (DIDMCA) of 1980**

DIDMCA expanded the influence of the Federal Reserve to all depository institutions, as opposed to only the approximately 40 percent of banks that were currently members of the Federal Reserve System. This meant non-member banks had to meet the reserve requirements and assets and liabilities reporting requirements set by the Federal Reserve, similar to how the IBA applied these requirements to US operations of foreign banks. These new requirements also allowed all depository institutions the benefits of membership in the Federal Reserve System, including use of the discount window, a first for both foreign banks and non-member banks.
Foreign Bank Supervision Enhancement Act (FBSEA) of 1991

The FBSEA, part of the Federal Deposit Insurance Corporation Improvement Act, prohibited new foreign bank branches in the U.S. from access to FDIC system and deposit insurance. This created a major operating difference from a foreign bank opening a new subsidiary, which were still able to offer deposit insurance. The act also expanded the Federal Reserve's authority to supervise and regulate foreign banks. The Federal Reserve could now examine any foreign-owned banking entity in the U.S., which were now required to be examined annually by state or federal regulators, and was allowed greater privilege to information about the parent companies. The act also allowed the Federal Reserve to terminate any unsafe foreign banking entity, whether it had a state or federal license. To form a new banking entity in the U.S., a foreign bank now needed the approval of the Federal Reserve independent of licence.

Riegle-Neal Interstate Banking and Branching Efficiency Act (IBBEA) of 1994

The IBBEA overturned the McFadden Act by allowing interstate banking. Prior to this act, many states passed laws allowing banks from other states to operate within their state under specified conditions. The IBBEA set up a national framework to allow interstate banking under a standardized set of rules. States were given the choice of whether to opt-in or out of the Act. All states but Montana and Texas opted in for interstate entrance via acquisition, later to opt in in 2002 and 1999 respectively, while few states, only 13 initially, opted in for branching via de novo establishment, up to 22 by 2005. The act required a bank to get Federal Reserve approval before beginning interstate operations. For foreign-owned banks, this legislation meant a parent bank could set up branches in multiple states, or a subsidiary would be allowed to open branches in multiple states.

B Data Description

U.S. Office-Level Data

Our office-level data comes from two different forms, FFIEC 031 and FFIEC 002. FFIEC 031 is formally known as Consolidated Reports of Condition and Income for a Bank with Domestic and Foreign Offices, often referred to as Call Reports. This is our source of data on the financial positions
of foreign owned subsidiaries. FFIEC 002 is formally known as Report of Assets and Liabilities of U.S. Branches and Agencies of Foreign Banks, and is our source of data on the financial positions of foreign owned branches.

We complemented this data with the Federal Reserve Board Structure and Share Data for U.S. Offices of Foreign Banks. The Structure Data is U.S. office-level data of foreign banking organizations covering selected variables from the FFIEC 031 and FFIEC 002, including “top-tier” foreign parent bank and country, as well as U.S. office type and assets. This allowed us to identify the two types of organizational forms that are the object of this study, branches and subsidiaries. We defined as “branches” both uninsured federal branches and uninsured state branches. “Subsidiaries” encompass state member banks, state non-member banks, national banks, state savings banks, and federal savings banks in the data. The Share Data contains summary statistics on the fraction and level of total assets, commercial and industrial loans, total loans or deposits in domestic owned banks, foreign owned banks (subsidiaries) and foreign owned branches and agencies.

Balance sheet data for subsidiaries in our sample are contained in the form FFIEC 031. Specifically, we construct retail deposits as the sum of $conf049, the amount of deposits (excluding retirement accounts) of $250,000 or less, and $conf045, the amount of retirement deposits of $250,000 or less. Wholesale deposits are given by the sum of $conf051, the amount of deposits (excluding retirement) above $250,000, and $conf047, the amount of retirement deposits above $250,000. The sum of wholesale and retail deposits gives our measure of total deposits. $conf2122 (loans and leases net of unearned income) measures total net loans. Finally, $conf4340 (net income or loss attributable to the bank) is our measure of net income.

The form FFIEC 002 provides additional information on branches. Specifically, wholesale deposits are given by $conf1653 (total deposits and credit balances in transaction accounts of the branch). $conf2122 (loans and leases net of unearned income) is our measure of total net loans. The intrabank transfer is computed using data on flows of funds between parent and branches: $conf2944 reports the balance due to their parent institution and $conf2154 the balance due from their parent institution.

**European Bank Level Data**

SNL.com is our data source on European banks. Using bank names, we were able to match this data with the parents of U.S. offices in the structure data: there are 56 European “top-tier” parent
banks in our structure data sample. The variables we use from SNL.com are total assets (SNL Keyfield 132264), total deposits (132288), total net loans (132214), net income (132740), interest earned on loans (132532) and interest expense on deposits (133820.)

**Exposure Data**

Exposures for “top-tier” are contained in the European Banking Authority (EBA) stress test data, which reports each bank’s total value of holdings of sovereign debt in each country. Only 50 of our 56 European parents participated in these stress tests. For this reason, we construct two different definitions of exposure of a parent bank. According to our baseline definition, any parent bank with positive holdings of government debt from Portugal, Ireland, Italy, Greece or Spain is considered exposed and all other parent banks are not. An alternative definition considers any parent bank in a country using the Euro to be exposed, while all other parent banks are not. This second definition does not require EBA stress test data.

**C  Details on the Calibration Procedure**

TBA