Local Power, Global Reach: The Influence of Deposit Market Power on International Banking*

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Abstract

We provide causal evidence that the market power that global banks hold over domestic US deposits drives their operations abroad. After a contractionary monetary shock, global banks with high local deposit market power increase bank deposit spreads and experience outflows of domestic deposits. They, therefore, increase flows from foreign branches to finance domestic lending but reduce lending abroad, thus cutting domestic lending less than local banks: a 1 p.p. US monetary shock leads to $180 billion in flows from foreign branches to US offices. Our results demonstrate that the local deposit market power of global banks has significant repercussions on their international operations.

Keywords: International transmission, monetary policy, deposit channel, banking

JEL Codes: E52, F23, F34, G21

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1 Introduction

As banks in the US become more consolidated and future mergers are expected[1], there has been increased attention to the consequences of bank market power. One market where banks impose market power is in local deposit markets, which have become increasingly concentratedC.1. Banks' market power over deposits allows them to keep their deposit rates rigid despite changes to the policy rate (Berger and Hannan (1989); Hannan and Berger (1991)), impacting aggregate domestic deposits and lending (Drechsler, Savov, and Schnabl (2017)).

Many of these large banks in the United States also operate in multiple countries (*global banks*). Previous literature has shown that global banks adjust both domestic and foreign lending and cross-country flow of funds in response to US monetary events (Schnabl (2012); Cetorelli and Goldberg (2012)). In this paper, we argue that the US banks' *local* deposit market power influences their international operations.

We provide causal evidence that local bank concentration has global implications: specifically, bank market power over local US deposits impacts global banks' foreign lending, cross-border flows, and, finally, domestic credit provision following US monetary policy. After a contractionary monetary shock, we find that global banks with market power over domestic deposits increase domestic deposit spreads and experience outflows of domestic deposits. As a result, global banks increase flows from foreign branches to finance domestic lending, thus cutting domestic lending less than local banks but conversely contracting foreign lending. Indeed, the local concentration of US deposits by global banks has important consequences for the role of global banks in the international transmission of US monetary policy.

Drechsler, Savov, and Schnabl (2017) examine the implications of bank concentration and the transmission of monetary policy, arguing that the domestic transmission of US monetary policy through bank balance sheets is largely driven by bank deposits – *the deposit channel*. Specifically, in response to an increase in the policy rate, they find

[1]See the article from The Economist.

that banks with high deposit market power increase their deposit spreads, experience an outflow of deposits, and, hence, contract lending. Wang, Whited, Wu, and Xiao (2022) estimate a structural model and find that the deposit channel is at least twice as important as other proposed channels (e.g. the reserve channel) for domestic transmission. To our knowledge, this is the first paper to consider and quantify the role of *local* deposit market power of the *international* transmission of US monetary shocks. Critically, we find that not only does the deposit channel act on the transmission of monetary policy domestically as in Drechsler, Savov, and Schnabl (2017), but that the deposit channel drives the transmission of US monetary shocks internationally, and, moreover, the extent to which global banks transmit monetary shocks internationally depends on global banks' market power in the domestic deposit markets of the originating monetary shock.

In this paper, we argue that bank competition for deposits is monopolistic, and hence, when the US Federal Funds rate (FFR) increases unexpectedly,[2] both global and domestic banks increase deposit spreads, defined as the spread between the FFR and deposit rates. As in Drechsler, Savov, and Schnabl (2017), households respond to increased spreads by withdrawing bank deposits, and domestic banks, which rely heavily on deposits for funding, contract lending. However, unlike domestic banks, global banks have an additional source of financing – foreign assets – which they can transfer from foreign branches to their US offices to finance domestic loans. Therefore, global banks contract lending less in the US relative to domestic banks but contract lending abroad. Hence, due to market power in local US deposit markets, global banks mitigate transmission of US monetary policy domestically but propagate it internationally. Indeed, we find that a one p.p. unexpected increase to the FFR corresponds to $180 billion in transfers from foreign branches to the US offices per quarter. We also compare banks with high local deposit market power with banks with low local deposit market power and show that banks with higher market power over domestic deposits transfer significantly more funds from foreign branches.

[2]We use monetary shocks instead of levels to mitigate identification concerns described in detail in Nakamura and Steinsson (2018). In the robustness tests, we repeat the analysis using levels.

We study the impact of banks' deposit market power on their international operations using a novel dataset that combines quarterly branch-level deposit rates from RateWatch and bank-level deposits, cross-border flows, and foreign lending from US Call Reports, for over 5,000 large banks, of which 170 are global banks, from 1994 to 2020. Using this data, we empirically estimate the impact of US monetary policy shocks on changes to US bank deposit rates and US bank deposits.[3] Since the deposit channel works through changes to the FFR policy rate, we define US monetary policy shocks by instrumenting policy rates changes with high-frequency changes to 1 month Fed Funds futures around FOMC announcements (Kuttner (2001); Gurkaynak, Sack, and Swanson (2005); Gertler and Karadi (2015); Nakamura and Steinsson (2018); Indarte (2021)) We find that in response to a 1 percentage point unexpected increase in the Federal Funds rate, deposit spreads of global banks increase by 21 basis points[4] and global banks' deposit growth decreases by approximately 3.0 p.p., suggesting that the deposit channel is important to the behavior of global banks.

Next, we evaluate the impact of deposit market power on lending by global and domestic banks and cross-border flows by global banks. Specifically, we quantify how much banks contract lending, increase cross-border flows, and cut foreign lending in response to an outflow of deposits due to a contractionary monetary shock. We define a global bank as a bank with non-zero cross-border flows between its domestic and foreign branches, and cross-border flows as changes to *NetDue*, the net position of funds the US office owes to foreign offices (an increase to NetDue corresponds to an increase in cross-border flows into the US). Specifically, we begin by regressing changes to bank lending on changes to US deposits as predicted by monetary shocks at the bank level, controlling for bank fixed effects and aggregate macroeconomic variables, including GDP and inflation. We find that global banks reduce lending growth by half as much as domestic banks

[3]We use weekly RateWatch data for branch-level deposit rates, FDIC Summary of Deposits for annual branch-level deposits, and quarterly US Call Report data for bank-level deposits.

[4]This estimate is slightly lower than the one in Drechsler, Savov, and Schnabl (2017) because it instruments FFR changes with monetary shocks. In Appendix, we reproduce Drechsler, Savov, and Schnabl (2017) deposit betas using levels of FFR changes.

per percent of deposit outflow despite increasing deposit spreads by more than domestic banks (higher spread beta).

Finally, for our universe of global banks, we regress changes to cross-border fund flows (*NetDue*) on predicted changes to US deposits and find that cross-border flows into the US increase when these deposits decrease. Specifically, a 1% increase in deposit growth corresponds to a decrease in cross-border flows growth of 13.6%. This implies a 40.4% increase in cross-border flows after a 1 p.p. monetary shock. For post-crisis balance sheet numbers for the US banks, it means that a 1 p.p. unexpected increase to the FFR would lead to $180 billion in transfers from foreign branches to the US offices. Since these are funds that could otherwise be used to finance lending in foreign countries where these branches are based, we test if foreign branches cut their lending. We show that global banks contract foreign lending growth by 1.3%, thereby providing evidence that bank market power over US bank deposits not only transmits US monetary policy shocks domestically through the deposit channel, but also internationally. Our estimates are close to the ones in Cetorelli and Goldberg (2012) where they quantify the *total* international transmission of the US monetary shocks without the focus on domestic market power, suggesting that most of the transmission they identify is driven by the deposit channel.

We address three identification concerns that may bias our results. First, since global and domestic banks target different markets, we should expect borrowers and depositors of global banks (eg. JP Morgan Chase) to be different from borrowers of domestic banks (eg. Artisan's Bank – a domestic bank based in Delaware). Indeed, we observe this when we evaluate the impact of monetary shocks on deposit flows – global banks lose more deposits than local banks in response to an unexpected change to the Federal Funds rate. We mitigate this concern by showing that our results hold when we explicitly measure bank market power using the US county-level deposit market Herfindahl-Hirschman index (HHI). We find that branch-level deposit spreads and deposit outflows are more responsive to monetary policy shocks in counties with high deposit HHI (high bank

market power). We then show that under this measure of bank market power, among global banks, those with higher market power lose more deposits, transfer more funds from foreign branches, and the lending less internationally. Importantly, the branch-level analysis does not compare global banks to domestic banks but rather compares global banks with branches in more and less concentrated areas.

Second, branch locations may not be random – for example, banks choose them to hedge interest rate risk (Drechsler, Savov, and Schnabl (2021)). If these choices correlate with banks' globalness, this will bias our findings. To further address this concern, we conduct an event study and consider non-economic events that limit operations of the US banks abroad, hence impacting banks' globalness changes. Examples include tsunamis in the Indian Ocean, Arab Spring demonstrations and consequent wars, earthquakes, etc. The identifying assumption is that these unexpected events limit the ability of the US banks to operate there but likely do not directly impact either banks' local deposit market power or local lending decisions. We find that the link between domestic deposits and foreign lending weakens for banks that are more exposed to such events, and the link between domestic deposits and domestic lending strengthens. The effect lasts for at least five quarters before reversing.

The final concern relates to separating lending demand and supply. First, since in the long run the choice to open bank branches and decisions intended to increase bank market power are endogenous, one might worry our empirical results are due to ex-ante differences in lending behavior by global banks, for example, those related to differences in pre-existing bank-firm relationships. Second, as measures of loans at the bank level may also reflect changes to loan demand from borrower business opportunities, another concern may be that the observed changes in loan amounts in the bank balance sheets are reflecting an equilibrium response arising from both loan supply and loan demand changes.

To address the concerns that our results are being driven by demand for loans, we quantify our results on the subset of small business lending at the county-bank level from

the Community Reinvestment Act (CRA), which was designed to incentivize banks to lend to borrowers in low and middle-income communities. We argue that for this subset of loans, global and domestic banks face the same set of borrowers in each county. Moreover, since most of the loans are issued to small firms, i.e. firms with annual revenues of less than $1 million, global and domestic banks are less likely to be different, and differences in demand arising from pre-existing relationships are less likely to be a concern. In addition, since we observe loans at the county-bank-year level, this allows us to include county-time and bank-county fixed effects and thus focus only on the loan supply (Khwaja and Mian (2008); Puri, Rocholl, and Steffen (2011); Drechsler, Savov, and Schnabl (2017)). Thus, the identification assumption is that CRA borrowers (small businesses in low and middle-income communities) that interact with global banks participating in CRA do not differ from CRA borrowers that interact with domestic banks participating in CRA. We confirm that our main empirical results hold for CRA loans: all banks originate significantly fewer loans after the contractionary monetary policy shock, but global banks cut lending less. Furthermore, among CRA loans, we find a lending gap between global and domestic banks, which is substantially larger than in the main sample.

We also conduct several robustness tests to refute alternative explanations to our findings. First, since decisions made by the Federal Reserve will impact policy rate decisions in other developed and emerging economies (Bergin and Jorda (2004)), we consider whether our results are driven by correlations between policy rates. We find that including ECB surprises and changes to policy rates in the list of controls for our foreign lending and cross-border flow regressions does not statistically or economically change our results.[5]

In addition, it is well known that exchange rates can impact international flows. Mundell-Fleming's classic result finds that currency appreciation leads to a decrease in net balances (Fleming (1962); Mundell (1963)) and that exchange rates may impact monetary policy decisions (Dornbusch (1976); Shambaugh (2004)). Considering this,

[5]Indeed, Kane, Sarkisyan, and Viratyosin (2022) find that ECB surprises predict FOMC surprises.

we show that our international flow results are robust to controlling for changes to a trade-weighted exchange index.

Our results indicate that the local deposit market power by global banks impacts their foreign lending and, through it, not only drive domestic transmission of US monetary policy but has significant implications for its international transmission. We contribute to several strands of financial and economic literature. First, our results add to the literature on bank market power. Deposit market power by commercial banks results in deposit spreads being less sensitive to monetary policy (Berger and Hannan (1989); Hannan and Berger (1991); Diebold and Sharpe (1990); Neumark and Sharpe (1992); Drechsler, Savov, and Schnabl (2017)). While deposit market power is one channel for monetary transmission, it is not the only proposed channel. Monetary policy transmits to lending and investments through various banking channels, including reserves, capital, and deposits (Bernanke and Blinder (1988, 1992); Kashyap and Stein (2000); Bolton and Freixas (2000); Brunnermeier and Sannikov (2014); Drechsler, Savov, and Schnabl (2017, 2021)). However, Wang, Whited, Wu, and Xiao (2022) estimates from their structural model suggest that the deposit channel accounts for the largest part of the domestic monetary transmission. We contribute to this literature by showing that the US banks' market power not only impacts domestic operations and domestic monetary transmission but also guides banks' international operations and has repercussions for foreign markets.

We also contribute to the growing literature on the international transmission of monetary and liquidity shocks (Cetorelli and Goldberg (2012); Schnabl (2012); Acharya, Drechsler, and Schnabl (2014); Temesvary, Ongena, and Owen (2018); Hale, Kapan, and Minoiu (2020); Correa, Paligorova, Sapriza, and Zlate (2021)), which claims that global banks play a crucial role in the international transmission of monetary policy and liquidity shocks. In particular, several papers, including Cetorelli and Goldberg (2012) and Correa, Paligorova, Sapriza, and Zlate (2021), argue

that global banks actively allocate funds across borders. Our paper documents the role of the deposit market power on the impact of domestic monetary policy on foreign operations of global banks. Moreover, we show that this interaction between the deposit channel arising from the market power of global banks in domestic deposit markets and the portfolio allocation decision of global banks across countries is critical to understanding the extent of both domestic and international transmission of monetary policy. Indeed, we find that the increased market power of global banks in the domestic deposit market serves to diminish monetary transmission domestically relative to domestic banks and amplify monetary transmission internationally.

Finally, we shed new light on the importance of global banks. Multiple theoretical and empirical papers have shown that large global banks are systematically important (Kashyap and Stein (2000); Bolton and Oehmke (2019); Bräuning and Ivashina (2020)), but have generally focused on bank operations across foreign offices rather than documenting the real effects addressed by the literature on domestic banks (Diamond (1984); Holmstrom and Tirole (1997); Baron and Xiong (2017); Baron, Verner, and Xiong (2021)). In contrast, this paper argues that the market power of global banks and the deposit channel are also important to understanding the international transmission of shocks. Moreover, bank market power impacts not just internal bank decision-making but also the magnitude of domestic and foreign lending.

The rest of the paper proceeds as follows. Section 2 provides information on our econometric strategy and data. Section 3 contains our main bank-level and branch-level findings, as well as the discussion of identification concerns. Section 4 provides robustness tests. Section 5 concludes.

2 Empirical strategy and data

2.1 Empirical strategy

Our empirical strategy can be divided into two steps. In the first step, we evaluate the relevance of the deposit channel to global banks and quantify the impact of a contractionary monetary shock on deposit spreads and bank deposits. Specifically, for each bank i, we run the following time-series regression:

$$y_{it} = \beta_i MS_t + \gamma_i X_{it-1} + u_{it} \tag{1}$$

where y_{it} is either a change in deposit spreads, defined as the Federal Funds rate less the deposit rate, or the log change in deposit amounts (henceforth, deposit growth), MS_t is a monetary shock, and X_{it-1} is a vector of controls that includes the growth rate of assets and macro indicators such as inflation and GDP growth. We lag controls to avoid simultaneity bias. We measure monetary shocks by regressing FFR changes on monetary surprises, i.e. fluctuations in FF futures around FOMC meetings.[6]

For each bank i we can interpret β_i as bank i's elasticity of deposit spreads and deposit growth to monetary policy shocks. We refer to β_i from the first set of regressions as *spread betas* (or deposit betas) and β_i from the second set of regressions as *flow betas*. By hypotheses, the average spread beta should be positive. Analogously, flow betas should be, on average, negative.

From the second set of regressions, we obtain fitted values from the regression of monetary shocks on deposit growth and denote predicted deposit growth as $\widehat{DepGrowth}_{it}$. Using fitted values, rather than actual deposits, allows us to evaluate the impact of monetary policy on lending and cross-border flows specifically through the deposit channel, and abstract from changes to deposits that are unrelated to the deposit channel. Note that this assumes that monetary shocks impact lending and cross-border flows only through bank deposits. We acknowledge that the assumption is likely not true since there are alternative channels of the monetary transmission. To mitigate this concern

[6]More details are provided in Section 2.4.

we conduct a branch-level analysis in Secion 3.3 where we interact monetary shocks with the measure of the deposit market concentration.

In the second step, we test if deposit outflow (due to a contractionary monetary shock) leads to a contraction in lending and, for global banks, to an increase in net transfers from foreign branches and decrease in foreign lending. We also have reduced-form regressions but we do not show them in the paper because those results were already documented by Cetorelli and Goldberg (2012). First, to quantify the impact of the deposit channel on domestic lending for both global and domestic banks, we run the following regression:

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it} \qquad (2)$$

where the dependent variable is the log change in lending (henceforth, lending growth), $Global_{it}$ is a dummy that is equal to 1 if the bank i reports to have foreign branches at time t, X_{it-1} is a set of controls, α_i is a bank fixed effect, and θ_t is a quarter fixed effect.

We are interested in two coefficients in (2). The first is γ, the percentage change in lending growth after 1 p.p. change in deposit growth due to the expansionary monetary shock. Our hypothesis predicts that $\gamma > 0$, i.e., a deposit outflow leads to a contraction in lending. The second coefficient is ν, which measures how global banks differ from domestic banks in their response to the deposit growth changes. Our hypothesis predicts $\nu < 0$, that is global banks will contract lending less per percent of deposit outflow. Since the regression effectively does 2SLS, we correct standard error using bootstrap in Appendix. We also directly run 2SLS using deposit spread betas as a measure of market power in Appendix to show that our results are robust.

To recall, given the hypotheses, global banks' lending should react less to the deposit outflow since they can use foreign funds to finance loans. Thus, we should expect to see an increase in net transfers from foreign branches. To test this, we run the following regression:

$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it} \tag{3}$$

where the left hand side variable is the change in log net transfers from foreign branches (henceforth, netdue growth)[7], X_{it-1} is a set of controls, and α_i is bank fixed effects. Following Cetorelli and Goldberg (2012) we control for lagged net due growth, current bank assets and asset growth, and aggregate current and lagged GDP growth and inflation. η measures the sensitivity of netdue growth to deposit growth. Our hypothesis predicts that $\eta < 0$, i.e. banks increase netdue growth after the deposit outflow. We test this empirically.

Finally, to show the international transmission of monetary shocks, we test if deposit outflow leads to a contraction in future foreign lending.[8] Specifically, we estimate the following equation:

$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it} \tag{4}$$

where $\Delta \log ForL_{it}$ is a log change in foreign lending, and X_{it-1} is a vector of controls. We expect $\iota > 0$, meaning that global banks contract foreign lending when they suffer deposit outflow.

Since our analysis proceeds in two steps, the estimate is equal to the 2SLS estimate. We are unable to do 2SLS directly because our first stage consists of a set of time-series regressions. Hence, it is important to estimate standard errors correctly. Standard or Newey-West robust errors are not enough because the independent variable is noisy, and it includes only the variation in bank deposits that are captured by the monetary shocks. That is why we cluster standard errors at the holding company level. Clustering at the bank and/or time level does not change our results. However, even clusterization

[7]Note that net transfers can be negative. That's why, we first take logs of the absolute value, then add sign, and only after that compute changes.

[8]We do not find significant contemporaneous effect. It means that shocks are transmitted with one quarter lag. One quarter is usually taken as a lag to originate loans. For broader discussion see Schwert (2020).

may not be enough because it misses an unobservable variation in covariates. In the Appendix, we show that our results hold if we bootstrap standard errors.

One can argue that the exclusion restriction is not satisfied – monetary policy shocks can impact dependent variables through other channels (e.g. reserve channel). To mitigate this concern, we do branch-level analysis in Section 3.3. There we interact monetary policy shocks with the measure of the deposit market concentration. The interacted measure is unlikely to impact cross-border flows or domestic lending through alternative channels (Drechsler, Savov, and Schnabl (2017); Wang, Whited, Wu, and Xiao (2022)).

2.2 Data

Our data cover the universe of 12,126 banks[9] from 1994 to 2018. 170 banks report to have foreign branches. We define a bank as *global* if during the quarter they have non-zero transactions from foreign branches. We restrict our sample to large banks – banks with assets in the top quantile. Our final sample contains 5,403 subsidiary banks.[10] We next describe the data sources and variables that we use.

1. *Bank-level quarterly data.* We use Consolidated Reports of Condition and Income (US Call Reports), which are maintained by the St. Louis Federal Reserve Bank, to get quarterly bank-level balance sheet data.[11] Sample contains 24,039 banks.[12] Notice that those are not bank-holding companies that we will refer to as BHC. One BHC may have multiple subsidiaries which we call banks. The opposite is also true — one subsidiary can be owned by multiple holding companies. To be clear, we will analyze banks. Call Reports assign a unique identifier to the banks — RSSD ID.

[9]Even uninsured banks file Call Reports. Also, any depository financial institution that files Call Reports is included. Those are mainly but not only commercial banks. We will use the term 'bank' throughout the paper.

[10]In robustness tests, we show that our results hold in the full sample as well.

[11]We thank Philipp Schnabl for posting and regularly updating parts of the US Call Reports.

[12]Throughout the analysis, we show results for banks in the 5th size quantile, i.e. we keep only relatively large banks. All our results hold in the full sample. We also try 90th and 95th percentiles as a threshold and show that our results hold.

2. *Foreign flows.* We obtain net due balances to and net due balances from foreign offices from Call Reports RCON series. RCON 2941 is net due to own foreign offices, Edge and Agreement subsidiaries, and IBFs and RCON 2163 is net due from own foreign offices, Edge and Agreement subsidiaries, and IBFs. The difference is what we call *NetDue*. Its positive value means that the bank *borrowed* funds from the foreign branches. Only banks that have foreign branches file RCON 2941 and RCON 2163. Hence, we define a bank i to be global at time t if its $NetDue_{it}$ is non-zero.[13]

3. *Foreign lending.* For our measure of quarterly bank foreign lending, use RCFN 2327, "Loans Originated by Foreign Offices of Banks" from the US Call Reports RCFN series from 2001 to 2010. This is the main limitation of the data.

4. *Monetary policy surprises.* We use tick-by-tick CME Globex Federal Fund futures data to construct monetary policy surprises. Following the literature, we measure US monetary surprise as the change to the 30-day Fed Fund Futures rate 15 minutes before and 45 minutes after the FOMC meetings.[14] FOMC meetings take place 8 times per year. We convert the data into quarterly observations to make them compatible with the rest of the sources. We will refer to these surprises as monetary *shocks* as opposed to *levels*. Monetary shocks are the unexpected part of monetary policy changes. These shocks have been used in multiple papers including Bernanke and Kuttner (2005), Gertler and Karadi (2015), Gorodnichenko and Weber (2016), and Paul (2020). We also collect other shocks that have been extensively used in the literature, i.e. actual changes in FFR from FRED, Romer and Romer (2017) and Gertler and Karadi (2015) shocks from Valerie Ramey's website. Finally, we collect ECB surprises from CME Globex that are

[13] An alternative would be to define global banks as banks with non-missing figures for RCON series, hence including zero. We do not do it for two reasons. First, zero in the report can mean either that the bank has foreign branches and does not transfer funds, or that the bank does not have foreign branches. Second, even if the bank has foreign branches but does not transfer funds to or from them, that bank does not really operate globally.

[14] We thank Pascal Paul for making his data from Paul (2020) available.

made available by Altavilla, Brugnolini, Gurkaynak, Motto, and Ragusa (2019).

5. *Branch-level deposits.* We collect annual branch-level data on banks' deposits and assets from the FDIC Summary of Deposits (SoD). Each bank has many branches. Households and firms usually open deposit accounts within a branch — that is why it is possible to observe deposits not only for parent banks but also for branches. Since a bank typically has multiple branches spanning across many countries, branch-level analysis allows us to control for country-level unobservables. We merge SoD with Call Reports using a table that links FDIC certificate numbers with RSSD ID. The table is provided by the New York Federal Reserve Bank.

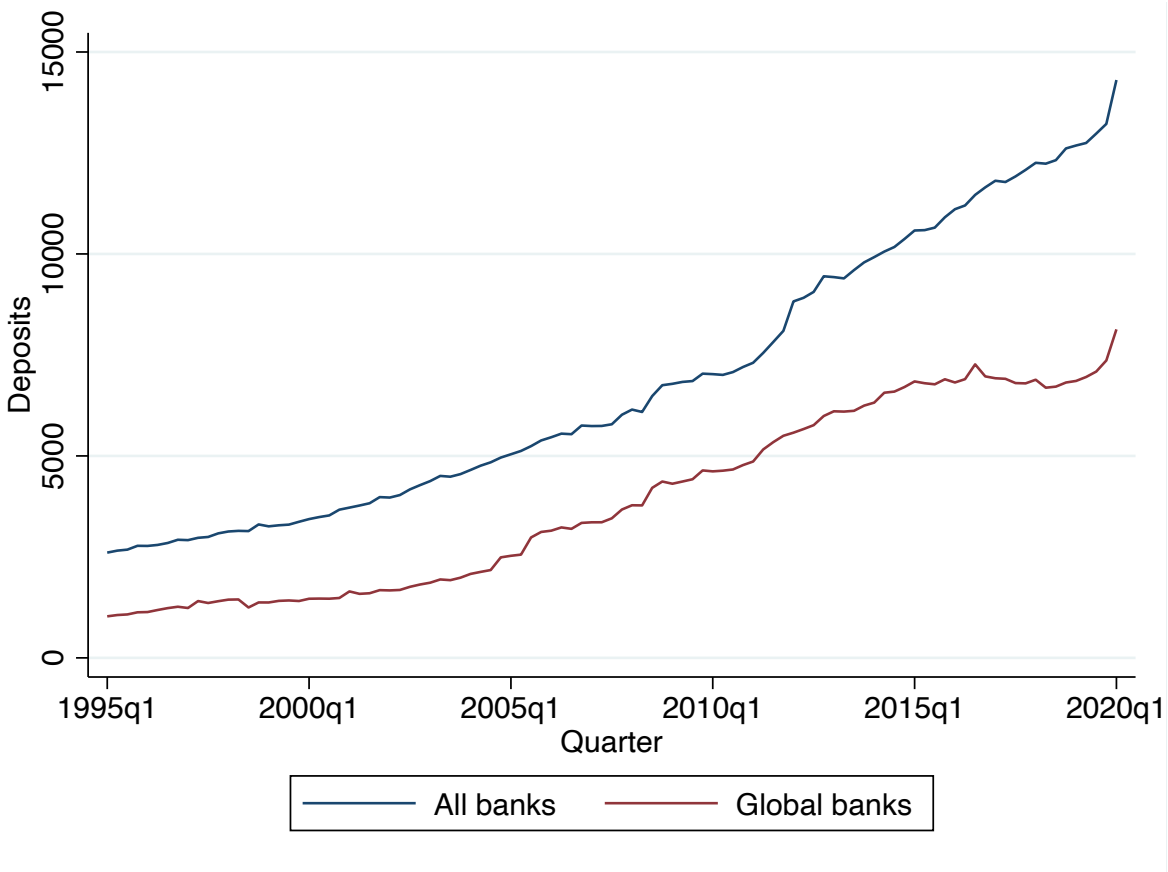
6. *Branch-level deposit rates.* We use weekly branch and product level deposit rate data from S&P Global RateWatch which covers almost all global banks in our sample and more than 50% of the entire sample. The data report deposit rates on new accounts. We follow Drechsler et al. (2017) and restrict our sample to 12-month certificates of deposit with an account size of $10,000 or more, and money market deposit accounts with an account size of $25,000.[15] We aggregate data on the quarterly level to make it compatible with the rest of the data. We merge RateWatch data with SoD using RSSD ID and branch identifier.

7. *Small business lending.* Annual data on loan originations come from the Community Reinvestment Act (CRA). The data are bank level, but they include metropolitan statistical area (MSA) codes. In addition, we observe physical addresses including ZIP codes. We merge the CRA data with our main dataset using transmittal files provided by FFIEC. They match CRA respondent ID and RSSD ID. The data distinguish between loans to firms with annual revenues higher than $1 million and to firms with annual revenues smaller than $1 million. In 2020, 41% of loans were originated to small firms. It corresponds to 27% in dollar value of loans.

8. *County and country variables.* We collect data on counties — employment, wages,

[15]The products represent time and saving deposits, respectively.

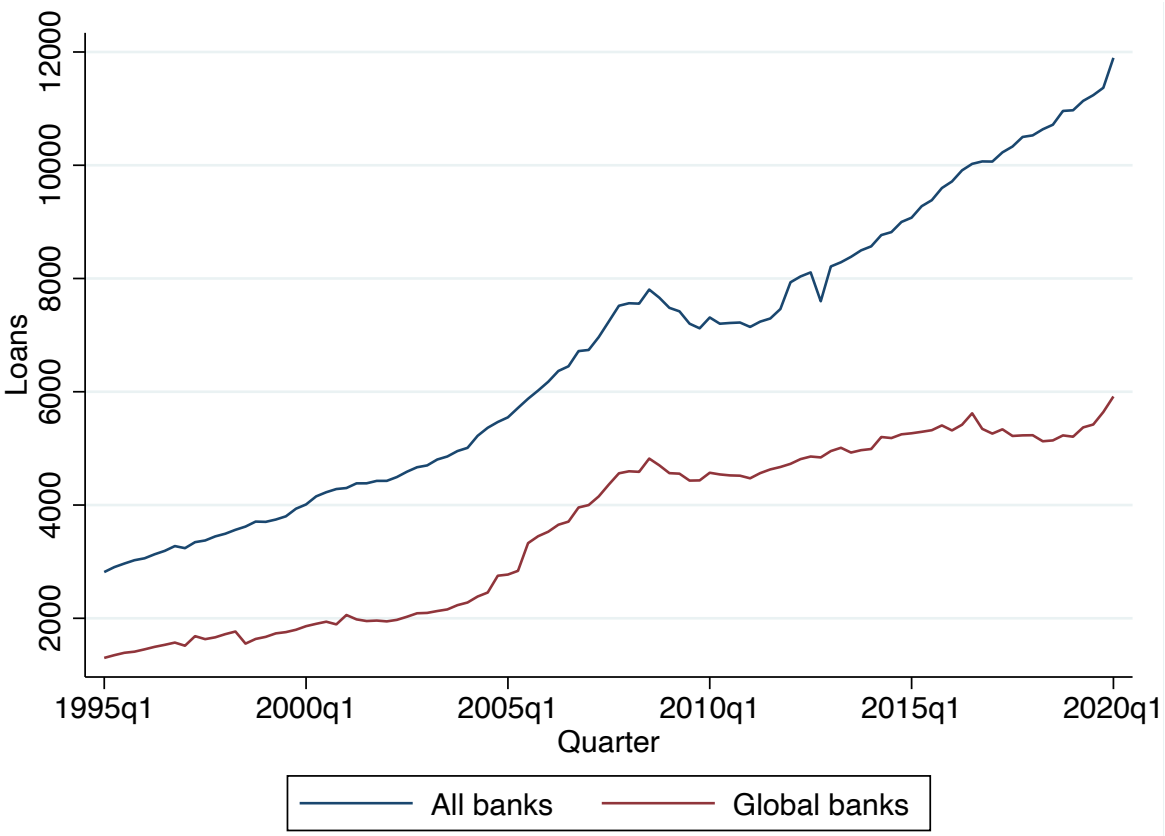
Figure 1: Deposits of the Banks



Note: Source: data is ffrom the US Call Reports maintained by Chicago Fed. This figure plots total deposits for US banks. Blue line corresponds to aggregate total deposits of all banks and red line — to global banks. Deposits are measured in billion of dollars.

and population from US Census. We need these to compute the Herfindahl-Hirschman index for each county. We identify counties using FIPS. We can then merge county data with branch-level data using zip-FIPS crosswalk. In the case a zip code spans multiple counties, we assign the zip code to the county with the largest population for that zip code. Country data come from BIS, OECD, FRED, and the World Bank. We collect annual real and potential GDP, quarterly CPI inflation, FFR, GDP growth, FX dollar trade index, and employment rates.

Figure 2: Total Loans by the US Banks



Note: Source: data is from the US Call Reports maintained by Chicago Fed. This figure plots total loans net of unearned income for US banks. Blue line corresponds to aggregate total loans net of unearned income of all banks and red line — to global banks. Loans are measured in billions of dollars.

2.3 Summary statistics

Table 1 contains summary statistics of our data. Panel A presents bank characteristics. We define commercial banks as *subsidiary* banks that file Call Reports identified by RSSD ID. We also observe their holding companies (their identifier is RSSD HCR), but we will focus on subsidiary banks in this paper unless mentioned otherwise. Our sample of banks has 204,005 bank×quarter observations spanning the first quarter of 1994 to the last quarter of 2017. Only 5,781 of these observations are global banks. For our regressions with international data, we restrict the sample and keep only observations from 2001 to 2011 to have reliable data on netdue and foreign loans.

Note that global banks have on average more assets, deposits, and loans.[16] If the bank can afford to have foreign branches, that bank is likely to be large. This fact poses potential identification concerns to our empirical strategy. That is why we control for asset growth in all our regressions. Moreover, in the robustness tests, we show that our results are robust to the inclusion of the level of assets. Hence, we are able to control for the size and make sure that our results are not driven by the simple fact that global banks are large. Another way of coping with the problem is to analyze changes rather than levels. We see from Table 1 that log changes are not significantly different across groups.

As a main measure of lending, we use loans net of unearned income for two reasons. First, we want to separate effects on lending from potential effects on unearned income that are possible if interest rates are rising. The second reason is data-driven — banks stopped reporting total loans after 2010. From 2011 banks only have to report loans net of unearned income and breakdown of loans by categories — commercial and industrial loans (C&I), personal loans, and real estate loans. Global banks dominate all three markets. From Figure 2, we see that global banks represent a substantial portion of total US lending.

The table also shows net transfers from foreign branches. As mentioned above, net transfers can be negative in rare circumstances.[17] That is why, we first take logs from the absolute value of netdue, then add sign, and only after that take the differences. The measure is comparable to other log changes. Hence, we call it *Netdue Growth* in the paper. Of course, only global banks report netdue. Banks report non-zero netdue only if they have foreign branches. We then define the bank to be global at time t if it reports non-zero netdue at time t. Panel A also shows foreign loans. Those are loans that are originated by banks' foreign offices. By definition, only global banks report foreign loans.

Finally, Panel A shows deposit spreads. We define deposit rate in basis points as

[16] See Figures 1 and 2.

[17] The United States remains the most important player in the financial markets. Most funds still flow *into* the US rather than *out*.

follows:

$$DepRate_{it} = 400 \cdot \frac{IntExp_{it}}{IntBearDep_{it}} \tag{5}$$

where $IntExp_{it}$ is interest expenses and $IntBearDep_{it}$ is the amount of interest-bearing deposits. Most deposits are interest-bearing. They only exclude checking accounts. All interest paid by banks is included in interest expenses. We can also use total deposits as a denominator and/or interest expenses on domestic deposits as a numerator. In the robustness tests, we show that results are not sensitive to the denominator and numerator in (5). We multiply the ratio by 100 to interpret rates in percentage points. To convert rates into spreads, we simply subtract $DepRate_{it}$ from the respective Federal Funds rate.

Panels B and C represent branch-level data. We focus on two deposit products — CDs and MMs. In the main branch-level analysis we leave only CDs as they are more sensitive to interest rate movements. When analyzing deposit amounts, we use FDIC data rather than RateWatch since the latter only represents 50% of the sample.

Branch-level data have two main advantages. First, we can observe deposit rates directly at the branch level rather than using the weighted average deposit rate at the bank level as described earlier. Second, we know branch addresses. That allows us to compute county HHIs as a measure of market power in the deposit market. We are unable to do it in our main bank-level analysis. HHI is computed as a squared share of deposits in the county. We then divide the number by 1000. The average HHI in our sample is 0.19 meaning that the deposit market is **not** perfectly competitive.[18] This is the crucial feature of the deposit channel and our analysis — it would not work in a perfectly competitive market. The imperfect competition allows branches to increase spreads without losing an entire clientele.

[18]The US Department of Justice considers a market with an HHI of less than 0.15 to be a competitive market, an HHI of 0.15 to 0.25 to be a moderately concentrated market, and an HHI of 0.25 or greater to be a highly concentrated market.

Table 1: Summary Statistics

	All		Global		Domestic	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Panel A: Bank characteristics (Call Reports)						
Total assets (mill. $)	2,724	33,236	58,956	185,148	1,084	6,511
Total deposits (mill. $)	1,635	15,895	30,145	88,249	804	2,919
Interest expenses (mill. $)	11.69	148.67	259.06	822.96	4.47	34.07
Loans net of unearned income (mill. $)	1,573	15,942	32,094	87,924	683	2,858
C&I loans (mill. $)	341	3,608	7,801	19,378	123	880
Foreign loans (mill. $)	2,364	19,338	2,364	19,338	—	—
Net transfers from abroad (mill. $)	1,916	11,828	1,916	11,828	—	—
Log deposit growth ($\times 10^3$)	17.84	52.23	18.27	76.91	17.83	51.33
Log loan growth ($\times 10^3$)	18.92	43.00	21.08	56.57	18.86	42.54
Log foreign loan growth ($\times 10^3$)	12.75	470.33	12.75	470.33	—	—
Change in log netdue ($\times 10^3$)	(21.18)	5,026.43	(21.18)	5,026.43	—	—
Observations (bank×quarter)	204,005		5,781		198,224	
Panel B: Branch characteristics (Ratewatch)						
Deposits (mill. $)	379	6,010	2,206	18,1246	177	1,695
CD deposit rate (b.p.)	1.58	1.40	1.24	1.42	1.65	1.40
MM deposit rate (b.p.)	0.78	0.87	0.58	0.83	0.82	0.87
CD deposit spread (b.p.)	(0.28)	0.92	0.06	0.81	(0.32)	0.92
MM deposit spread (b.p.)	0.66	1.43	0.91	1.46	0.64	1.43
Branches	304	911	2,339	1,606	59	251
Observations (branch×quarter)	669,659		68,931		600,728	
Panel C: Branch characteristics (FDIC)						
Deposits (mill. $)	81	1,438	121	2,126	56	713
Branch-HHI	0.19	0.12	0.17	0.10	0.20	0.12
Observations (branch×year)	2,431,461		872,908		1,558,553	

Note: This table provides descriptive statistics for banks and branches in our restricted sample. Global banks are banks that report to have foreign branches. Panel A contains statistics of bank-quarter level variables. Bank-level deposit rates are computed as interest expenses divided by interest-bearing deposits. Panel B represents statistics on deposits, deposit rates, and deposit spreads for branches. It contains both CD (time) deposit rates and spreads and MM (saving) deposit rates and spreads. Panel C provides statistics on deposits of branches as reported to FDIC. Panel C also depicts Herfindahl-Hirschman indices for respective counties.

2.4 Measure of monetary shock

We use monetary surprises as our main measure of monetary shock. In Section 3 we also check if our results hold with actual changes in FFR. We choose surprises as our main measure for exogeneity reasons. FFR changes are driven by observable and unobservable factors that might be related to banking. That is an important macroeconomic identification concerns (Nakamura and Steinsson (2018)). Following the literature (Bernanke and Kuttner (2005); Gorodnichenko and Weber (2016)), we overcome the problem by using unexpected changes to FFR — deviations in 1-month FF futures around FOMC meetings (one hour window). They include only the part of the change that was not priced by the market.

To interpret our main results as a reaction to unexpected FFR changes, we instrument changes in FFR with monetary surprises (Indarte (2021)). Specifically, we run the following regression:

$$\Delta FF_t = \delta Surprise_t + \xi X_t + \varepsilon_t \tag{6}$$

where $Surprise_t$ is a monetary surprise and X_t is a vector of controls that includes GDP growth, inflation, and lagged values of FFR changes. We thus separate the unexpected component of changes to FFR. Predicted values from (6) are used as our measure of monetary shock. We can interpret one unit of the measure as an unexpected 1 percentage point increase to FFR.

3 Main results

We first show our main bank-level results. Specifically, for each bank we regress deposit spreads and deposit growth on monetary shocks – equation (1). Recall that if the deposit channel is relevant to global banks, they will react to the contractionary monetary shocks by increasing spreads and thereby losing deposits. We then run (2) and (3) to show that global banks do not contract lending as much as domestic banks and that they transfer

funds from abroad. One of the hypotheses is that global banks cut domestic lending less due to subsidization of foreign funds. Finally, we regress foreign loans on predicted deposit growth to show that global banks contract foreign lending. We also turn to the branch-level analysis to refute the endogeneity concern — the fact that banks can shift their spreads for other reasons, not necessarily because they have market power. Another concern is that the outcome variables are affected by the monetary shocks through alternative channels. The branch-level analysis allows us to compare banks with similar market power, as narrowly defined by HHI. We address other concerns in Section 4.

3.1 Bank-level results

3.1.1 Deposit growth and deposit spreads

We estimate equation (1) for each bank in our sample using OLS. We do not need to use VAR to mitigate reverse causality concerns here for two reasons. First, our measure of monetary policy shock is completely exogenous, hence, our LHS variables cannot impact shocks. Second, we lag controls. Omitted variable bias is unlikely to be a problem here too because, by our assumption, nothing impacts MS_t, including any unobservables that at the same time affect deposits.

Table 2 provides means and medians of estimates separately for domestic, global, and all banks. We follow Drechsler et al. (2017) and denote bank sensitivities of deposit growth to monetary shock as *flow betas* and sensitivity of deposit spreads as *spread betas*. Column 3 suggests that deposit growth declines for all banks, including global. A one p.p. contractionary shock leads to a 3% decline in deposit growth for an average global bank and a 2.4% decline for a median global bank. Indeed, we observe in Column 4 that deposit spreads increase by 21.3 b.p. for the average global bank and by 17.1 b.p. for the median global bank following a one p.p. contractionary shock.

Spread betas of local banks are generally lower, implying less deposit market power. There are several reasons why global banks have more market power. For example,

Table 2: Sensitivity of Deposit Spreads and Deposit Amounts to Monetary Shocks

$$y_{it} = \beta_i MS_t + \gamma_i X_{it-1} + u_{it}$$

Subset	Statistics	Flow beta	Spread beta
Domestic	Mean	-0.005^{***}	0.141^{***}
	Median	-0.002	0.118
Global	Mean	-0.030^{***}	0.213^{***}
	Median	-0.024	0.171
All	Mean	-0.006^{***}	0.142^{***}
	Median	-0.003	0.118

Note: This table provides mean and median flow and spread beta for domestic banks, global banks, and all banks in our sample as measured by equation (1). Column 3 depicts flow betas, i.e. estimates of (1) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (1) with changes in spreads as a LHS variable. Outliers are dropped at 1% level. We also conduct t-tests for means. *** above the estimate mean that we reject the hypothesis that the mean is zero at 1% level of confidence.

global banks tend to be larger and systematically more important. We also find that flow betas of global banks are larger in absolute value, consistent with a higher market power. Using the branch-level analysis that we do in Section 3.3 we compare global and domestic banks with the same market power.

Overall, our results for deposit spreads and deposit growth suggest that contractionary monetary shock induces both domestic and global monopolistic banks to increase deposit spreads, and hence, experience an outflow of deposits. We interpret deposit flows predicted by equation (1) as a *deposit growth predicted by the deposit channel*:

$$\widehat{DepGrowth}_{it} = \hat{\beta}_i MS_t + \hat{\gamma}_i X_{it} \tag{7}$$

We use these fitted values in further analysis to separate the effect of monetary policy on deposits from other supply and demand-side movements.

3.1.2 Domestic lending, net transfers, and foreign lending

By our hypothesis, global banks respond to the deposit outflow by transferring funds from their foreign branches and thus reduce domestic lending less than domestic banks. To test this hypothesis we estimate (2) and (3) using OLS with fixed effects. As before, we

lag controls to avoid reverse causality concerns. Additionally, our independent variable is only a predicted part of deposit growth, and hence, should not be affected by the LHS variable.

We first estimate (2) for a total lending net of unearned income and separately for the three largest loan categories — C&I, personal, and real estate. Columns 1-2 of Table 3 presents results of the regression estimation. The first column represents total lending. Significant positive coefficient at $\widehat{DepGrowth}$ implies that an increase in deposit growth as predicted by the deposit channel leads to an increase in lending growth. Recall that contractionary monetary policy cause deposits to *flow out*. Lending growth, thus, declines. The coefficients at the $Global \cdot \widehat{DepGrowth}$ are negative and significant. It means that global banks contract lending growth **less** after the contractionary monetary shock. Results are in line with our predictions – *per percent of deposit outflow* global banks contract lending less.

We hypothesize that global banks are able to reduce lending less in response to the same deposit outflow due to increased inflow of cross-border funds. We estimate this directly by regressing Net Due on predicted deposits. Columns 3-4 of Table 3 present results. The coefficient is negative and significant, suggesting that outflow of deposits leads to an increase in net transfers from foreign branches. 1% decline in deposit growth leads to 13.6% increase in netdue growth. This is both statistically and economically significant. This suggests that after 1 p.p. monetary shock, global banks will increase a growth rate of netdue by 39.4%. Given that netdue rises at 1% each quarter, banks practically increase their existing netdue by 40.4%. It implies nearly $180 billion flowing into the US for each p.p. of monetary shock.[19]

Finally, we estimate the impact of predicted deposits on foreign lending by global banks – equation (4). Columns 5-6 of Table 3 show results. We find that a 1% decline in deposits corresponds to a 0.46% decline in foreign lending, or analogously, a 1 p.p. monetary shock corresponds to a 1.3% decline in foreign lending. This is strong evidence

[19]Total netdue is $270bn averaged across quarters.

Table 3: Bank-level Results on Lending, Net Transfers, and Foreign Lending

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowth}$	0.225***	0.239***	−13.640***	−12.128**	0.462**	0.381**
	(0.010)	(0.010)	(5.202)	(5.033)	(0.177)	(0.186)
$Global \cdot \widehat{DepGrowth}$	−0.117***	−0.105***				
	(0.031)	(0.032)				
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	203,926	203,926	1,319	1,319	1,107	1,107
R^2	0.218	0.161	0.222	0.210	0.196	0.196

Note: This table provides results of estimation of equations (2), (3), and (4). The first two columns correspond to lending net of unearned income. Columns 3 and 4 show results of netdue regression. Columns 5 and 6 correspond to a foreign lending regression. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There is only one independent variable in the netdue and foreign lending regressions because all banks in those regressions are global. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

that US monetary shocks are transmitted internationally through the deposit channel. Our results are robust to the inclusion of time fixed effects and to macro controls.

We can now compare our findings with the literature to advocate for the deposit channel. We estimate the effect of monetary shocks on cross-border flows and foreign lending directly for the same time period. In other words, we check how monetary shocks impact international transmission without the channel. Specifically, we run the following regressions:

$$NetDueGr_{it} = \eta MS_t + \mu X_{it-1} + \alpha_i + v_{it} \tag{8}$$

Table 4: Results on Net Transfers and Foreign Lending without the Channel

$$NetDueGr_{it} = \eta MS_t + \mu X_{it-1} + \alpha_i + v_{it} \; \Delta \log ForL_{it} = \iota MS_{t-1} + \mu X_{it-1} + \alpha_i + m_{it}$$

	Dependent variable:			
	Netdue		Foreign loans	
	(1)	(2)	(3)	(4)
MS	−0.908	−0.991	0.059*	0.073**
	(0.918)	(0.862)	(0.035)	(0.031)
Bank FE	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes
Observations	1,319	1,343	1,107	1,145
R^2	0.207	0.166	0.195	0.056

Note: This table provides results of estimation of equations (8), and (9). Columns 1 and 2 show results of netdue regression. Columns 3 and 4 correspond to a foreign lending regression. Independent variable is our measure of monetary shock. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

and

$$\Delta \log ForL_{it} = \iota MS_{t-1} + \mu X_{it-1} + \alpha_i + m_{it} \tag{9}$$

Results are presented in Table 4. Monetary shocks do not impact cross-border flows directly and have limited and small impact on foreign lending. Comparison with the results in Table 3 reveals that the deposit channel drives the international transmission of US monetary shocks.

3.2 Alternative explanations

In the previous subsection, we presented evidence that the deposit channel drives the international transmission of monetary shocks and in fact. Specifically, we have shown that 1 p.p. contractionary shock can lead to a 39.4% increase in the growth rate of net transfers from foreign offices. For the average bank, this translates to an additional $1 billion in net transfers. Provided that we have 170 global banks in the sample, total transfers can add up to $180 billion transfer.

Nevertheless, there are several concerns. First, global and domestic banks are system-

atically different along the dimensions that can ultimately impact the effect of domestic market power on lending and cross-border flows. For example, Citibank has many international connections around the world, so using foreign funds to finance domestic lending can be easier for them than for a local bank to use deposits. We might also be concerned that deposit flows are demand-driven rather than supply-driven. If banks lend less, they do not need as many deposits. This is a lending channel of monetary policy as opposed to the deposit channel (Bernanke and Blinder (1992)). We exploit our branch-level data to address this concern in Section 3.3.

Specifically, instead of comparing domestic banks to global banks, we compare global banks with high market power to global banks with low market power (and same for domestic banks). Observing weekly rates for each product and deposits of all branches allows us to compute the Herfindahl-Hirschman indexs – measure of the deposit market concentration for each county. We then interact monetary policy shocks with the HHI. Our exclusion restriction is then that the interacted variable impacts lending and cross-border flows only through deposits. It is a reasonable assumption since we utilize the concentration on the deposit market and include county, time, bank-time, and state-time fixed effects to account for the unobservable lending opportunities in the county. Details are provided in Section 3.3.

Even though the branch-level analysis compares global banks with different levels of market power, there is still a concern that banks' domestic branch locations are endogenously chosen to hedge against interest risk (Drechsler, Savov, and Schnabl (2019)). If such decisions are correlated with banks' 'globalness', there will be a bias in our estimates. To address the challenge, we use a series of non-economic events that impact the ability of foreign branches to operate. We conjecture that such events create an exogenous variation in banks' globalness, and hence, our estimates can be treated as causal. We analyze if the events that deteriorate foreign branches' ability to operate lead to a weaker relationship between predicted domestic deposits and foreign lending and a stronger connection between predicted domestic deposits and domestic lending.

In other words, we argue that the events make global banks more local.

Finally, global and domestic banks have different sets of borrowers. For example, a big firm like Apple would likely borrow from a systematically important bank that is also global. Even if we match banks based on the size, the decision to open a foreign branch is not random. Another concern is that a decline in domestic lending is demand-driven – borrowers cut lending demand when interest rates are high. To address both concerns, we use the Community Reinvestment Act (CRA) as a setting to analyze lending. CRA provides data on loans originated to small borrowers in low- and medium-income communities. We argue in Section 3.5 that within CRA, global and domestic banks lend to borrowers with the same characteristics.

We also address several minor concerns. First, our results are based on the belief that deposits flow out because banks have market power. We argue that deposit spreads vary with the Fed Funds rate, consistent with models of imperfect competition in the deposit market, and moreover, using a measure of deposit market concentration, we show that deposit spreads are more responsive for branches and banks operating in more concentrated markets.

Next, since previous papers on the deposit channel specifically evaluate the changes to levels in the transmission of monetary policy, our use of unexpected monetary shocks instead might raise concerns.[20] We address this in Section 4 by repeating our analysis with monetary policy levels rather than shocks and show that our main results hold.

Another concern is that monetary policy decisions in countries can be correlated. Countries usually respond to global shocks by increasing or decreasing their policy rates at the same time. In addition, small economies often take rates of big economies (such as the US) as given (Fleming (1962)). Big economies move their rates when other big economies do it. For example, European Central Bank (ECB) often follows Fed in their decisions. However, by construction, monetary surprises should not be correlated. We formally test it in Section 4 and find that our results are robust to including ECB

[20]For details see Drechsler, Savov, and Schnabl (2017, 2019).

surprises.[21]

Apart from foreign surprises, exchange rates may impact foreign flows. When monetary policy rate increases, exchange rates appreciate. This in turn makes net exports decrease, i.e. funds flow in the US (Mundell (1963)). Note that the effect of exchange rates has the same direction as our results. In order for exchange rate changes to bias our results, they must impact on net transfers, foreign loans, and predicted deposits. While exchange rates may have impact net transfers since the currency has to be converted, the effect on predicted deposits is unlikely. Predicted deposits are driven by monetary surprises, so exchange rates have to impact surprises. This is wrong by the construction of surprises. However, we formally test if this is true. We also include FX dollar trade index to our regressions and check if our main results change. We present results in Section 4.

3.3 Branch-level results

The biggest threat to our identification is the fact that global and domestic banks are different in many dimensions. For example, lending can be affected by monetary shocks through other channels and then lead to an outflow of deposits differently for global and domestic banks. We address this concern by using branch-level analysis to measure deposit market power at the branch level using HHI measure of market concentration. We then evaluate how deposits and spreads respond given this measure of bank market power and finally compare how global and domestic banks differentially respond. Such an approach allows us to, instead of comparing global banks with domestic banks, compare global banks with different market power (same with domestic banks).

As before, we regress changes to deposit spreads or log deposit growth of each branch, on the monetary shock, but this time interacted with branch HHI, our measure of market

[21] We take ECB rate because it impacts European countries. For the complete analysis, we would need to check our results for other rates as well. However, ECB rate is well representative of other rates in Eurasia, and data on ECB shocks are available.

power:

$$y_{it} = \beta MS_t \cdot BranchHHI_c + \gamma Global_{it} \cdot MS_t \cdot BranchHHI_c + \alpha_i + \theta_c + \zeta_{st} + u_{icst} \quad (10)$$

where y_{it} is either a change in deposit spread or log deposit growth of branch i at time t[22], $BranchHHI_c$ is a HHI index of county c where branch i is located, $Global_{it}$ is an indicator which is equal to 1 if branch i is a branch of the global bank at time t, α_i is branch FE, θ_c is county FE, and ζ_{st} is state-time FE.[23] By our hypothesis, γ should be statistically indifferent from zero.

We present our results in Table 5 We observe that the coefficient of deposit growth on the interactions between the MS and Branch HHI is negative, meaning that banks with more market power lose more deposits. This finding is in line with Drechsler, Savov, and Schnabl (2017) — deposits flow out because of the supply, not demand. Secondly, the negative coefficient on the indicator for a global bank suggests that this effect is even stronger for global banks than for domestic banks. Global banks lose twice as many deposits as domestic banks.

Column 2 shows that banks with more market power increase CD spreads more following a contractionary monetary policy shock. Global banks are not significantly different. Finally, column 3 implies that MM spreads do not change with monetary surprises. This can be related to the fact that MM spreads are very low. Their movements are usually explained by fundamental changes in the FF rate, not by surprises. The most important fact is that global banks are not different from domestic banks.

We next aggregate predicted deposit flows from regression (10) up to the bank level to analyze lending and cross-border flows weighting market concentration (HHI) by deposit amounts. Here we are able to control for lending demand (which may influence deposit growth) by including county and time fixed effects.

[22] Regressions with deposit flows are annual because we use FDIC data.

[23] We follow Drechsler, Savov, and Schnabl (2017) in choosing fixed effects. Our results are robust to inclusion of bank-time FEs as well.

Table 5: Branch-level Results on Deposits

$$y_{it} = \beta MS_t \cdot BranchHHI_c + \gamma Global_{it} \cdot MS_t \cdot BranchHHI_c + \alpha_i + \theta_c + \eta_{bt} + \zeta_{st} + u_{it}$$

	Dependent variable:		
	Deposits	CD Spreads	MM spreads
	(1)	(2)	(3)
$MS \cdot BranchHHI$	-0.018^{***}	0.199^{**}	0.177
	(0.005)	(0.092)	(0.139)
$Global \cdot MS \cdot BranchHHI$	-0.019^{***}	0.204	-0.390
	(0.008)	(0.220)	(0.279)
Fixed effects	Yes	Yes	Yes
Observations	1,307,583	89,711	72,682
R^2	0.315	0.834	0.880

Note: This table provides branch-level regression results for equation (10). First column runs regression with log deposit growth as a LHS variable. Second column runs regression with time deposit spreads, and third column — with saving deposit spreads. Fixed effects are branch, county, and state-time. Standard errors in parentheses are clustered at the county level. *,**, and *** correspond to 10-, 5-, and 1% significance level, respectively.

We repeat the analysis of Section 3.1 here with predicted deposits from branch-level regressions. We denote them by $\widehat{DepGrowthBr}$. We ask if global banks contract lending less than domestic banks. We estimate the following regression:

$$\Delta \log L_{it} = \gamma \widehat{DepGrowthBr}_{it} + \nu Global_{it} \cdot \widehat{DepGrowthBr}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it} \quad (11)$$

where α_i are bank FE.[24]

Then, we estimate netdue and foreign lending regressions. Specifically, we run the following regression for netdue:

$$NetDueGr_{it} = \eta \widehat{DepGrowthBr}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it} \quad (12)$$

[24]We use bank FE rather than HC FE here because aggregation was specifically at the bank level.

and for foreign lending:

$$\Delta \log ForL_{it} = \iota \widehat{DepGrowthBr}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it} \tag{13}$$

Controls in the regressions above are the same as in bank-level regressions. We include bank balance sheet variables (e.g. asset growth) and macro variables. The only difference between these regressions and bank-level ones is an explanatory variable. In the current section, the explanatory variable is entirely driven by monetary shock **and** market power. All estimates thus should be interpreted as a sensitivity to the deposit channel.

Table 6 presents results. Coefficients at the $\widehat{DepGrowthBr}$ in the regressions are positive and significant. It means that deposit outflow caused by the contractionary monetary shock leads to a contraction in lending growth. Moreover, coefficients at the interaction term are negative and significant.

Column 3 of Table 6 shows that banks with higher market power increase the growth rate of net transfers more. The results are in favor of the deposit channel. We don't find a significant coefficient in the regressions without time fixed effects. The potential reason is that the sample is too small, and time effects become crucial. That is another reason for using bank-level analysis as a benchmark. We also don't find any significant effect on foreign lending, although signs are as expected. One possible reason is that we observe only annual data. Bank-level analysis suggested that in a year all effect on foreign loans is gone. Thus, it is impossible to pin down foreign lending results in a branch-level setting.

The results above mitigate potential identification concerns and show that the deposit channel is weaker for global banks. We show that our results are more pronounced for global banks that operate in more concentrated areas. The results also indicate that the exclusion restriction is likely to be satisfied. Magnitudes in Table 6 are smaller than in bank-level regressions because here, we focus on just one source of market power — HHI, i.e., deposit shares in the county. Moreover, here we focus specifically on global banks

Table 6: Results on Lending, Net Transfers, and Foreign Lending: Aggregated from Branches

$$\Delta \log L_{it} = \gamma \widehat{DepGrowthBr}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \varepsilon_{iht}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowthBr}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowthBr}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowthBr}$	0.010***	0.010***	−0.736**	−0.288	0.084	0.006
	(0.001)	(0.001)	(0.321)	(0.256)	(0.100)	(0.021)
$Global \cdot \widehat{DepGrowthBr}$	−0.020***	−0.021***				
	(0.004)	(0.004)				
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	141,112	141,112	332	157	206	96
R^2	0.349	0.349	0.394	0.674	0.372	0.859

Note: This table provides results of estimation of equations (11)-(13). Columns 1-2 show domestic lending results. Columns 3-4 correspond to netdue regressions. Finally, columns 5-6 show foreign lending results. Independent variables are log deposit growth predicted by the branch-level deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There are no interaction terms in netdue and foreign lending regressions, because all banks in those regressions are global. Bank and time fixed effects are included. Standard errors in parentheses are clustered at bank level. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

and show with this narrow source of market power, even within the set of global banks, banks with higher market power transfer more funds than banks with lower market power. That is why we decide to focus on bank-level results. Branch-level analysis in this section proves that our lending results hold even in a very constrained case with just one source of the market power, but at the same time, these results are purely driven by the deposit channel.

3.4 Event study evidence

The branch-level evidence above suggests that banks with higher market power bring more funds from foreign branches to the domestic ones to finance lending. Although the evidence implies that local deposit market concentration impacts cross-border flows, one may argue that the decision to open the branch in a given location is not random (Drechsler, Savov, and Schnabl (2021)). For example, global banks can also be better at hedging interest rate risk; thus, they can choose branch locations to increase their deposit franchise value.

To address the concern, we ideally need the banks to be local or global randomly. Since it is not feasible, we propose an event study where banks' globalness changes unexpectedly due to non-economic reasons. Specifically, we construct a list of non-economic events that could force global banks to close their branches in the locations of the events. The assumption is that the decision to close the branch at the location is not correlated with banks' local market power, banks' deposits, or monetary shocks. Since the events are plausibly unexpected and non-economic, the assumption is likely to be satisfied.

We choose non-economic and plausibly unexpected events that would make the operations of the branches difficult. Our list includes a parliament attack in India (2001), bombings in Indonesia (2002), a Tsunami in the Indian Ocean (2004), a military coup in Thailand (2005), the Nargis cyclone in Myanmar (2007), Mumbai attacks in India (2008), earthquake in Haiti (2010), Arab Spring protests (2011). We then treat the location as difficult to operate in for a year after the event. We measure the exposure of the bank to the location using the exposure variable from the FactSet – the banks' assets in the location as a percentage of all foreign assets. We run the following regression for global banks:

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} \cdot EventExp_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it} \tag{14}$$

where $EventExp_{it} = \sum Event_{\ell t} \cdot Exp_{\ell it}$ where $Event_{\ell t}$ is a dummy variable for the event

in location ℓ at time t and $Exp_{\ell it}$ is the exposure of bank i to the location ℓ. We run a similar regression for foreign lending as well.

Figures 3 and 4 plot the coefficient γ along with the standard errors. After the event, the link between foreign lending and domestic deposits predicted by the monetary shocks weakens. In other words, fewer deposits are used to finance foreign lending following the domestic monetary shock. The link strengthens again after three quarters because the events in small economies usually do not disrupt banks' operations for a long time.

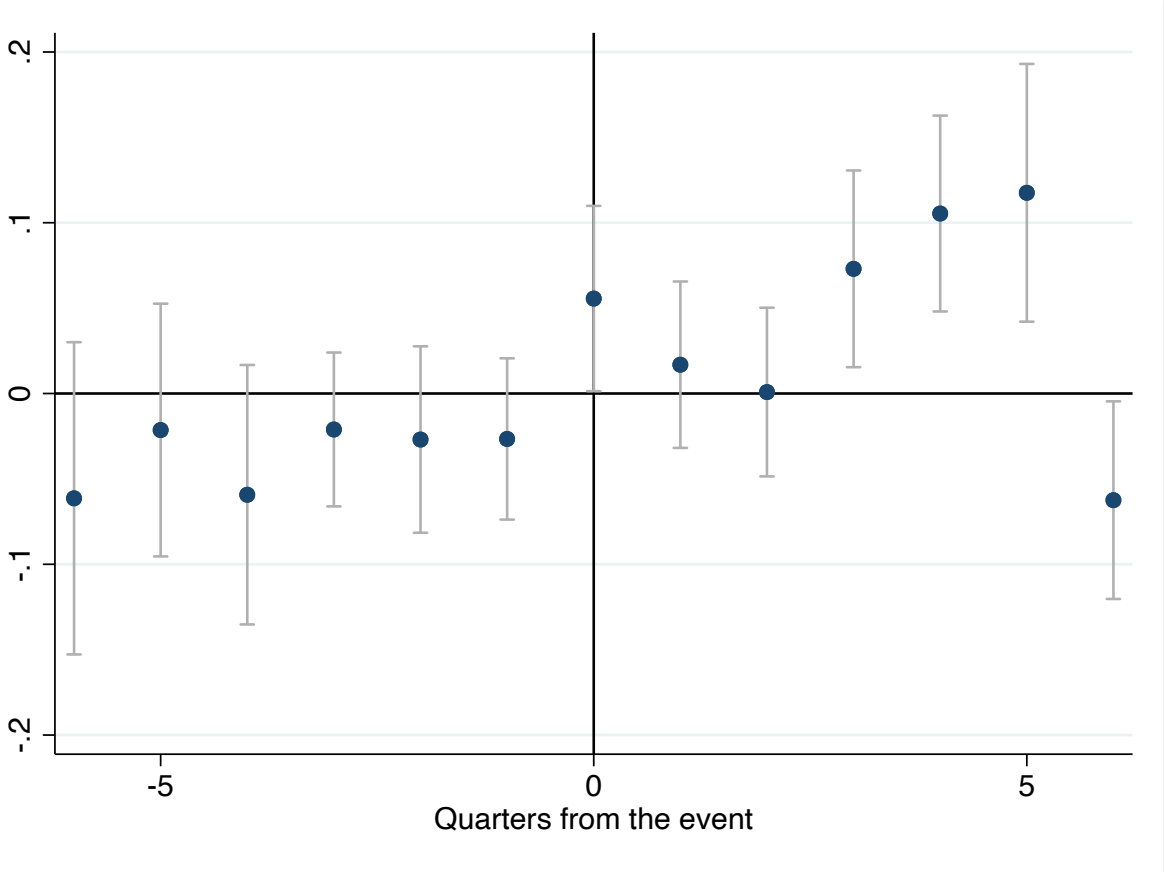
Since banks use fewer deposits to finance foreign loans after the events, the market power channel suggests that the banks should use more deposits to finance domestic loans. Figure 3 documents the finding – the link between domestic deposits and lending becomes stronger, especially after three quarters, and then weakens again, consistent with the reversal in foreign lending.

Put differently, the events make global banks less global, and hence, their financing decisions more similar to local banks. Note that the events by assumption do not affect domestic deposits and loans directly, nor do they affect local market power and monetary policy decisions. We also run the regressions on the sample of just global banks, so there is no comparison across two groups of the banks.

3.5 Community Reinvestment Act results

Our lending results suggest that global banks shrink lending growth less than other banks. The average global bank contracts lending growth is half as much as a domestic bank per percent of deposit outflow. They effectively offset half of the lending cut by transferring funds from foreign offices. These results might be biased due to the following identification concerns. First, we compare global banks to domestic banks. It is clear from Table 2.3 that global banks are larger. Hence, we are comparing large banks to small banks. Even though we focus on relatively large banks and control for assets, we are still left with this selection bias. For example, if we keep only top 1% of our banks, most of those will be global banks. In fact, all top largest banks in the US have foreign

Figure 3: Domestic Lending: Event Study Evidence



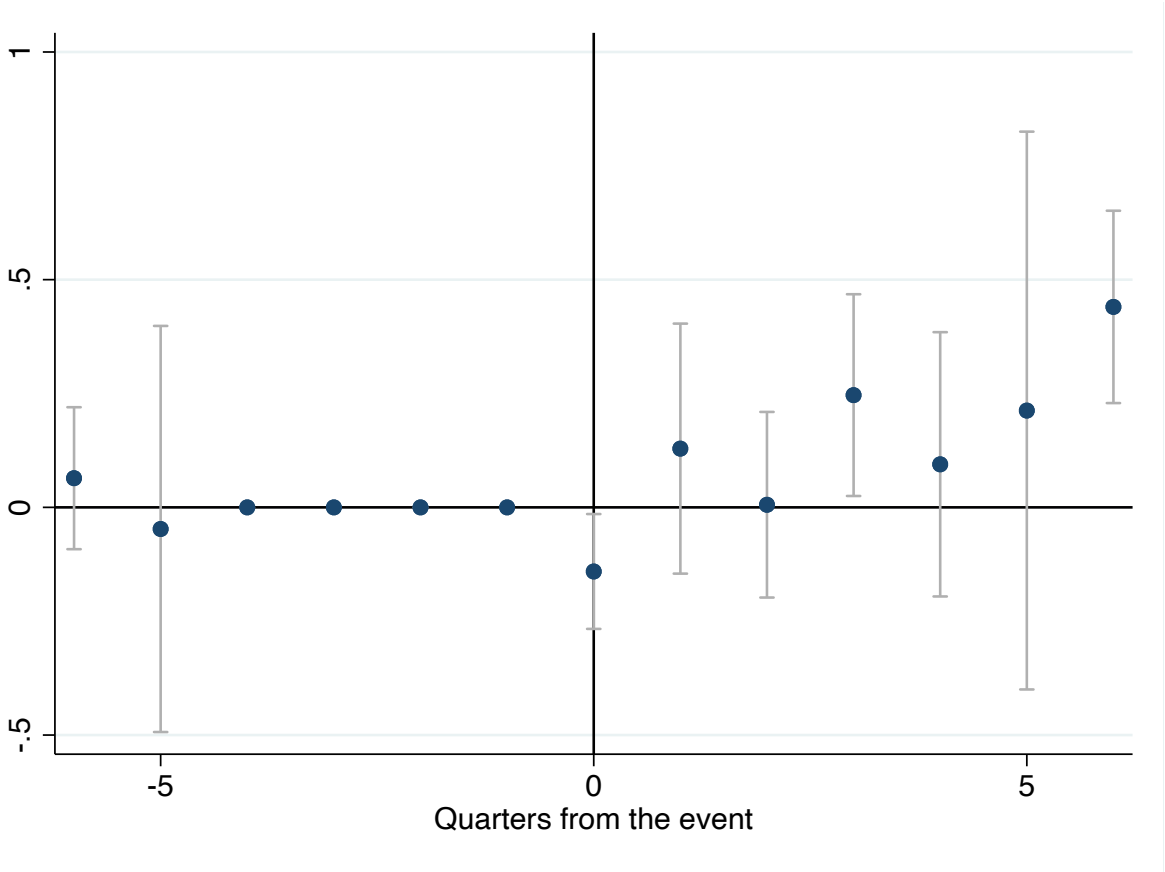
Note: This figure provides results of estimation of equations (14). The dependent variable is domestic lending growth. The deposit growth is predicted by the US monetary shocks. The blue dots correspond to the point estimates of the parameter η along with 95% confidence intervals. The graph also shows pre-trends and post-trends. Bank and time fixed effects are included. Standard errors in parentheses are clustered at bank level.

branches.

Second, global banks have different sets of deposits and borrowers than domestic banks. Large transnational corporations likely borrow from large banks like Bank of America and not local banks. Large banks are also more likely to lend in syndicates or securitize loans. All these facts imply that the contraction in lending supply for global banks cannot be compared to the one for domestic banks.

Finally, we are assuming that our results are supply-driven, that is, the decision to cut loans is made by banks. However, in the environment of rising interest rates, it is likely that borrowers seek alternative sources of financing. So, our results might

Figure 4: Foreign Lending: Event Study Evidence



Note: This figure provides results of estimation of equations (14). The dependent variable is foreign lending growth. The deposit growth is predicted by the US monetary shocks. The blue dots correspond to the point estimates of the parameter η along with 95% confidence intervals. The graph also shows pre-trends and post-trends. Bank and time fixed effects are included. Standard errors in parentheses are clustered at bank level.

be demand-driven. This problem is discussed in many papers (Mian and Sufi (2009); Khwaja and Mian (2008); Puri, Rocholl, and Steffen (2011)). We partly overcome the problem in Section 3.3 by utilizing the variation in market power. In this section, we propose an alternative way to mitigate the concern – including county-time fixed effects to account for the loan demand.

To tackle the identification concerns above, we focus on *newly originated* loans from the Community Reinvestment Act (CRA), which provides data on small business lending on the county-bank level. Community Reinvestment Act is designed to encourage lenders to issue loans in low- and middle-income communities. Moreover, banks are incentivized

to lend to small businesses, i.e. firms with annual revenues less than \$1 million.[25] In 2020, 41% of all loans were originated to small businesses. It corresponds to 27% in dollar value of loans. Finally, lenders in CRA are approved by OCC, FDIC, or Fed. The data also allow us to control for the unobservable changes to borrower demand at the county level. Similar identification has been used by Khwaja and Mian (2008); Mian and Sufi (2009); Chodorow-Reich (2014). Our identification assumption is that global banks that participate in CRA do not differ from domestic banks that participate in CRA in lending to small businesses in low- and middle-income communities. Specifically, we run the following regression:

$$\log OrigLoans_{it} = \gamma \widehat{DepGrowth}_{it-1} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it-1} \tag{15}$$
$$+ \xi X_{it-1} + \alpha_i + \theta_{tc} + \omega_{ic} + \varepsilon_{ict}$$

where $OrigLoans$ are newly originated loans, θ_{tc} are county-time fixed effects, and ω_{ic} are bank-county fixed effects. Since the dependent variable here, loan originations is annual, we use lagged deposit growth and other variables to avoid cases where the loan is originated before the monetary shock.[26] The key set of controls is county-time and bank-county fixed effects. They allow us to compare banks located in the same county across time. In such a way, we account for an unobservable lending demand (Drechsler, Savov, and Schnabl (2017)) and interpret our results as differences in lending supply.

Table 7 shows our results. Banks originate significantly fewer loans after the monetary policy shock. At the same time, global banks contract lending less. This is in line with our main results. Coefficients are both statistically and economically larger than with the balance-sheet loans. Indeed, the larger magnitudes relative to using all loans suggest that the demand component and market differentiation biased our results towards zero.

[25] For more details, see https://www.occ.treas.gov/topics/consumers-and-communities/cra/index-cra.html

[26] Our results hold without the lag as well – see Appendix.

Table 7: County-level Results on Originated Loans

$$\log OrigLoans_{it} = \gamma \widehat{DepGrowth}_{it-1} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it-1} + \xi X_{it-1} + \alpha_i + \theta_{tc} + \omega_{ic} + \varepsilon_{itc}$$

	Dependent variable:					
	Loans to all firms			Loans to small firms		
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowth}$	0.605***	0.515***	0.522***	1.323***	1.339***	1.342***
	(0.054)	(0.052)	(0.055)	(0.078)	(0.075)	(0.079)
$Global \cdot \widehat{DepGrowth}$	−1.363***	−1.343***	−1.432***	−1.655***	−1.673***	−1.659***
	(0.152)	(0.150)	(0.152)	(0.181)	(0.179)	(0.182)
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	No	Yes	No	No
County FE	Yes	Yes	No	Yes	Yes	No
County×Time FE	No	No	Yes	No	No	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,330,453	1,330,453	1,330,453	961,110	961,110	961,110
R^2	0.216	0.214	0.221	0.190	0.188	0.197

Note: This table provides results of estimation of equation (15). The first three columns correspond to lending to all firms. Columns 4-6 correspond to lending to small firms, defined as firms with annual revenues smaller than $1 million. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. Standard errors are robust and displayed in the parentheses. Bank, county-time, and county-bank fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

The gap between global and domestic banks is narrower when we consider only small firms, suggesting that cross-border funds predominantly finance larger domestic loans. This is consistent with theories of bank lending (see Chodorow-Reich and Falato (2022)) which suggest that loans by large borrowers are more influenced by relationship dynamics.

Overall, the findings in this section shed new light on the transmission of US monetary shocks abroad. We show that global banks transfer up to $180 billion following a one p.p. contractionary monetary shock. By doing that, global banks effectively mitigate lending losses — they do not have to contract lending growth rates so much as domestic

banks per percent of deposit outflow. This is strong evidence that the deposit channel impacts the international transmission of monetary shocks.

4 Robustness

We have already shown that our results are robust to the level of aggregation, exclusion of certain fixed effects, and macro variables. In this section, we evaluate whether our results are robust to the measure of monetary policy shock, inclusion of foreign monetary shock, and to changes in exchange rates. We also confirm that our results are robust to bootstrapping standard errors, running direct 2SLS regression, various sets of controls and fixed effects, exclusion of random sets of banks or quarters, denominator and numerator in (5), size threshold, full sample, and measure of lending, but we leave it all beyond the text of the paper.[27]

4.1 Changes in FF level

Most deposit channel papers focus on Fed Funds levels rather than shocks (Drechsler, Savov, and Schnabl (2017); Wang, Whited, Wu, and Xiao (2022)). We are interested in the transmission of shocks, but in this section, we show that our results hold for Federal Fund rate changes too. We only show bank-level results here, however, the branch-level analysis produces analogous findings. We repeat the analysis of Section 3.1. Specifically, we define ΔFF_t as a change in Federal Funds rate (henceforth, FFR) from period $t-1$ to t.[28] We first compute spread and flow betas — we estimate the following regression for each bank i:

$$y_{it} = \beta_i \Delta FF_t + \gamma_i X_{it-1} + u_{it} \tag{16}$$

[27] Most of our robustness tests are in the Internet Appendix of the paper.
[28] We have data on FFR up to 2020 in contrast to surprises that we have only up to 2018.

Table 8: Sensitivity of Deposit Spreads and Deposit Amounts to FFR Changes

$$y_{it} = \beta_i \Delta FF_t + \gamma_i X_{it-1} + u_{it}$$

Subset	Statistics	Flow beta	Spread beta
Domestic	Mean	-0.004^{***}	0.287^{***}
	Median	-0.003	0.281
Global	Mean	-0.012^{***}	0.260^{***}
	Median	-0.008	0.258
All	Mean	-0.004^{***}	0.286^{***}
	Median	-0.003	0.281

Note: This table provides statistics of estimates of equation (16). The first statistic is a mean, and the second one is a median. First row provides estimates for domestic banks, second — for global banks, and third — for all banks in our sample. Column 3 depicts flow betas, i.e. estimates of (16) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (16) with changes in spreads as a LHS variable. Outliers are dropped at 1% level. We also conduct t-tests for means. *** above the estimate mean that we reject the hypothesis that the mean is zero at 1% level of confidence.

where y_{it} is either a change in deposit spreads or log deposit growth. We include the same controls here as in regressions with monetary surprises.

Table 8 presents results. After a 1 p.p. change in FFR, banks increase spreads and lose deposits. The average bank increases spreads by 0.29 b.p., the average global bank — by 0.26 b.p., and the average domestic bank — by 0.29 b.p. The average bank's growth of deposits decreases by 0.4%, for the average global bank — by 1.2%, and for the average domestic bank — for 0.4%.

The results above suggest two important implications. First, our first step results are robust to whether we use FFR changes or monetary surprises. Second, the deposit channel acts on global banks not only in transmitting shocks but also in transmitting changes to the level of the monetary policy rate. Magnitudes in regressions with FFR are generally close but still smaller than ones in main regressions. This can be explained by the fact that FFR changes themselves are predictable.

We use deposit regressions to fit predicted deposit growth as we did before. We denote the variable by $\widehat{DepGrowthFFR}$. We first estimate the following regression to

test if our lending results are robust to the measure of monetary shock:

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth} FFR_{it} + \nu Global_{it} \cdot \widehat{DepGrowth} FFR_{it} + \xi Z_{it-1} + \alpha_i + \theta_t + \varepsilon_{it} \quad (17)$$

where α_i is a bank FE.

Next, we show that our results with respect to cross-border flows are also robust to the measure of monetary shock. We estimate the following regression:

$$NetDueGr_{it} = \eta \widehat{DepGrowth} FFR_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it} \quad (18)$$

Finally, we test if foreign lending results are robust to the expectedness of the shock:

$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth} FFR_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it} \quad (19)$$

Table 9 presents main findings. Both global and domestic banks contract lending growth after an increase in FFR. This is in line with our main findings. However, we don't find significant evidence that global banks contract lending less.[29] This is because changes in FFR are predictable and banks adjust domestic lending accordingly. However, the same logic doesn't apply to foreign flows. Columns 3-4 present results on netdue. Global banks increase net transfers after an increase in the FF rate. Magnitudes are very close to ones in Table 3. Finally, we show that global banks contract foreign lending. Magnitudes again are similar to the main results.

Hence, global banks react to changes in FFR by increasing net transfers and contracting foreign lending. We don't find evidence that they contract domestic lending less than local banks. The reason is that changes to FFR are induced by market decisions and anticipated. We can't observe counterfactuals and see how global banks would behave if they didn't have foreign offices. That is one reason why we concentrate on monetary shocks and not levels.[30]

[29] Coefficients are significant in the full sample.
[30] See Nakamura and Steinsson (2018) for more on identification issues with FFR.

Table 9: Bank-level Results on Lending, Net Transfers, and Foreign Lending with FFR

$$\Delta \log L_{it} = \gamma \widehat{DepGrowthFFR}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowthFFR}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowthFFR}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowthFFR}$	0.212***	0.225***	−13.671**	−11.364*	0.524***	0.518***
	(0.009)	(0.010)	(5.965)	(5.803)	(0.148)	(0.171)
$Global \cdot \widehat{DepGrowthFFR}$	−0.045	−0.057				
	(0.037)	(0.037)				
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	239,745	239,745	1,275	1,275	1,106	1,106
R^2	0.200	0.147	0.227	0.215	0.238	0.211

Note: This table provides results of estimation of equations (17), (18), and (19). The first two columns correspond to lending net of unearned income. Columns 3 and 4 show results of netdue regression. Columns 5 and 6 correspond to a foreign lending regression. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There is only one independent variable in the netdue and foreign lending regressions because all banks in those regressions are global. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

4.2 Monetary policy abroad

Monetary policy decisions in different countries are correlated (Bergin and Jorda (2004)). Hence, when Federal Funds rate increases, it is possible that the ECB rate also soars. European banks will then contract lending. Therefore, foreign lending results may be driven by the cross-country correlation between monetary policy rates. However, monetary surprises should be endogenous by construction. Surprises in the US should not impact surprises in Europe. We test it formally by running the following regression:

$$ECBshock_t = \sum_{i=0}^{1} \gamma_i MS_{t-i} + \varepsilon_t \tag{20}$$

Table 10: Correlation between Monetary Policy Shocks

$$ECBshock_t = \sum_{i=0}^{1} \gamma_i MS_{t-i} + \varepsilon_t$$
$$MS_t = \sum_{i=0}^{1} \beta_i ECBshock_{t-i} + u_t$$

	Dependent variable:					
		ECB shock		FFR surprise	FFR change	MS
	(1)	(2)	(3)	(4)	(5)	(6)
Surprise	−42.966*					
	(24.266)					
ΔFF		0.786				
		(2.932)				
MS			1.332			
			(4.414)			
ECBshock				0.002	0.019	0.018**
				(0.001)	(0.008)	(0.009)
Observations	75	76	75	74	75	74
R^2	0.069	0.002	0.008	0.202	0.026	0.097

Note: This table provides results of estimation of equations (20), (3), and (21) in the full sample. The first three columns correspond to ECB shock regressions. Regressors are monetary surprises, FFR changes, and our measure of monetary shock (MS). Columns (4)-(6) correspond to regressions with ECB shocks as a regressor. Numbers are sums of coefficients (i.e. variable and its lag). Standard errors are from the t-test. Standard errors are robust and displayed in the parentheses. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

where $ECBshock_t$ is ECB surprise. It is constructed in the same fashion as Federal Funds surprises. We run (20) for our measure of monetary shock, monetary surprises, and changes in FF rate. We also check if ECB shocks impact measures of monetary policy shock in the US by running the following regression:

$$MS_t = \sum_{i=0}^{1} \beta_i ECBshock_{t-i} + u_t \tag{21}$$

Since the European Union is a large economy, a policy surprise may impact US policy rates and deposits, potentially creating endogeneity concerns.

Results are presented in Table 10. Numbers are sums of coefficients. We can see

that in most cases ECB shocks are not correlated with measures of monetary policy shock or with lags. It supports the fact that shocks are exogenous. However, Column 6 suggests that positive ECB shock has a slightly positive impact on our measure of monetary shock which may be due to omitted variables that impact both ECB shock and FF shock. Hence, we include ECB surprises in regressions (3) and (4) as a control variable. Table 11 shows that our results are robust to controlling for ECB shocks.

The results above indicate a few things. First, predicted deposits significantly impact netdue and foreign loans and subsume all possible effects from foreign monetary policy. Second, *surprises* unlike policy rates seem to be uncorrelated. This is another reason for using monetary surprises instead of changes in levels. Finally, ECB shocks do not drive foreign funds after controlling for predicted deposit growth. It means that our main findings are not biased because of the missing correlation effect between monetary policy decisions.

4.3 Exchange rates

When cross-country flows are being discussed, it is essential to make sure that exchange rates do not contaminate results. This is because unless a foreign country uses the US dollar, they will need to convert assets first and then transfer. It would not make difference in the world with fixed and stable exchange rates, however, that is not the case for most countries. Hence, shocks to exchange rates and potential movements can result in policy rate changes in the US or foreign flows.

When policy rate increases, currency generally appreciates (Fleming (1962)). It results in a decrease in net exports, hence, funds flow into the country. We find exactly it – foreign funds are being transferred to the US. Therefore, it is important to make sure that exchange rates do not drive our results. The second concern is that the exchange rate fluctuations can impact monetary policy decisions (Shambaugh (2004)). However, it is unlikely to be the case since we use monetary surprises. They exclude all observable information available before FOMC meetings, including exchange rates. Nonetheless, we

Table 11: Bank-level Results on Net Transfers and Foreign Lending with ECB Shocks

$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \gamma ECBshock_t + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \gamma ECBshock_t + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:			
	Netdue		Foreign loans	
	(1)	(2)	(3)	(4)
$\widehat{DepGrowth}$	-13.640^{***}	-12.167^{**}	0.462^{**}	0.384^{**}
	(5.202)	(5.028)	(0.177)	(0.187)
$ECBshock$		0.030		0.001
		(0.033)		(0.001)
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes
Observations	1,319	1,319	1,107	1,107
R^2	0.222	0.210	0.226	0.196

Note: This table provides results of estimation of equations (3) and (4) controlling for ECB shocks. Columns 1 and 2 show results of netdue regression. Columns 3 and 4 correspond to a foreign lending regression. Independent variable is log deposit growth predicted by the deposit channel. Standard errors are clustered at the holding company level and displayed in parentheses. Bank and time fixed effects are included. *,**, and *** correspond to 10-, 5-, and 1% significance level, respectively.

formally check the statement and confirm that exchange rate movements as measured by the FX dollar trade index do not explain monetary surprises.

We follow the strategy from Section 4.2. Specifically, we include log changes in the FX dollar trade index in the list of controls in regressions (3) and (4). Results are presented in Table 12. Our main results change neither statistically nor economically. Moreover, any effect of exchange rates is subsumed by controls. Therefore, we conclude that our findings are not driven by exchange rate movements.

5 Conclusion

In this paper, we contribute to the understanding of how banks' local deposit market power impacts banks' foreign operations. Given the large academic and political interest

Table 12: Bank-level Results on Net Transfers and Foreign Lending with Exchnage Rate

$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \gamma FX_t + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \gamma FX_t + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:			
	Netdue		Foreign loans	
	(1)	(2)	(3)	(4)
$\widehat{DepGrowth}$	-13.640^{***}	-12.720^{**}	0.462^{**}	0.377^{**}
	(5.202)	(5.163)	(0.177)	(0.187)
FX		-8.968		-0.221
		(5.702)		(0.212)
Bank FE	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes
Observations	1,319	1,319	1,107	1,107
R^2	0.222	0.212	0.226	0.196

Note: This table provides results of estimation of equations (3) and (4) controlling for exchange rates. Columns 1 and 2 show results of netdue regression. Columns 3 and 4 correspond to a foreign lending regression. Independent variable is log deposit growth predicted by the deposit channel. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

in understanding how banking consolidation and increased concentration impact banks' lending, we consider the question of whether market power also impacts foreign lending. In the paper, we show that when global banks with high market power increase deposit spreads and lose deposits after the contractionary monetary policy, they are able to cut lending less than domestic banks because they have access to foreign funds. Instead, they bring cross-border flows from foreign branches and contract their lending abroad.

The results of this paper suggest that understanding bank market power in the US deposit market is critical in quantifying the transmission of US monetary policy, both domestically and abroad. Relative to a closed economy, an increase in bank market power further dampens the impact of US monetary policy domestically and amplifies the transmission internationally. This paper raises a few further questions. First, we show that

global banks with high market power fund domestic operations through foreign flows, and this impacts US lending. A quantitative understanding of the impact on foreign lending and foreign business activity, including investment and trade, is important in understanding the full impact of the deposit channel on foreign lending and the portion of the international transmission of US monetary policy that can be attributed to the deposit channel. Next, a clear evaluation of the relative impact of the deposit channel and the reserve channel in the international transmission of monetary and liquidity shocks would provide policymakers with a better understanding of how monetary policy is transmitted and which parties are most impacted. Finally, this framework abstracts from concerns of capital controls that may be relevant to bank decision-making. We leave these questions for future research.

References

Acharya, V., I. Drechsler, and P. Schnabl (2014). A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk. *Journal of Finance 69*(6), 2689–2739.

Altavilla, C., L. Brugnolini, R. Gurkaynak, R. Motto, and G. Ragusa (2019). Measuring Euro Area Monetary Policy. *Journal of Monetary Economics 108*, 162–179.

Baron, M., E. Verner, and W. Xiong (2021). Banking Crises without Panics. *Quarterly Journal of Economics 136*(1), 51–113.

Baron, M. and W. Xiong (2017). Credit Expansion and Neglected Crash Risk. *Quarterly Journal of Economics 132*(2), 713–764.

Berger, A. N. and T. H. Hannan (1989). The Price-Concentration Relationship in Banking. *The Review of Economics and Statistics 71*(2), 291.

Bergin, P. and O. Jorda (2004). Measuring Monetary Policy Interdependence. *Journal of International Money and Finance 23*(5), 761–783.

Bernanke, B. and A. Blinder (1988). Credit, Money, and Aggregate Demand. *American Economic Review 78*(2), 435–439.

Bernanke, B. and A. Blinder (1992). The Federal Funds Rate and the Channels of Monetary Transmission. *American Economic Review 82*(4), 901–921.

Bernanke, B. and K. N. Kuttner (2005). What Explains the Stock Market's Reaction to Federal Reserve Policy? *The Journal of Finance 60*(3), 1221–1257.

Bolton, P. and X. Freixas (2000). Equity, Bonds, and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information. *Journal of Political Economy 108*(2), 324–351.

Bolton, P. and M. Oehmke (2019). Bank Resolution and the Structure of Global Banks. *Review of Financial Studies 32*(6), 2383–2421.

Bräuning, F. and V. Ivashina (2020). Monetary Policy and Global Banking. *Journal of Finance LXXV*(6).

Brunnermeier, M. K. and Y. Sannikov (2014). A Macroeconomic Model with a Financial Sector. *American Economic Review 104*(2), 379–421.

Cetorelli, N. and L. S. Goldberg (2012). Banking Globalization and Monetary Transmission. *The Journal of Finance 67*(5), 1811–1843.

Chodorow-Reich, G. (2014). The Employment Effects of Credit Market Disruptions: Firm-Level Evidence from the 2008-9 Financial Crisis. *The Quarterly Journal of Economics 129*(1), 1–59.

Chodorow-Reich, G. and A. Falato (2022). The Loan Covenant Channel: How Bank Health Transmits to the Real Economy. *Journal of Finance 77*(1), 85–128.

Correa, R., T. Paligorova, H. Sapriza, and A. Zlate (2021). Cross-Border Bank Flows and Monetary Policy. *The Review of Financial Studies 35*(1), 438–481.

Diamond, D. W. (1984). Financial Intermediation and Delegated Monitoring. *The Review of Economic Studies 51*(3), 393.

Diebold, F. X. and S. A. Sharpe (1990). Post-Deregulation Bank-Deposit-Rate Pricing: The Multivariate Dynamics. *Journal of Business & Economic Statistics 8*(3), 281–291.

Dornbusch, R. (1976). Exchange Rate Expectations and Monetary Policy. *Journal of International Economics 6*(3), 231–244.

Drechsler, I., A. Savov, and P. Schnabl (2017). The Deposits Channel of Monetary Policy. *The Quarterly Journal of Economics 132*(4), 1819–1876.

Drechsler, I., A. Savov, and P. Schnabl (2019). How Monetary Policy Shaped the Housing Boom. *SSRN Electronic Journal* (February).

Drechsler, I., A. Savov, and P. Schnabl (2021). Banking on Deposits: Maturity Transformation without Interest Rate Risk. *Journal of Finance LXXVI*(3).

Fleming, M. (1962). Domestic Financial Policies under Fixed and under Floating Exchange Rates. *Staff Papers (International Monetary Fund) 9*(3), 369–380.

Gertler, M. and P. Karadi (2015). Monetary Policy Surprises, Credit Costs, and Economic Activity. *American Economic Journal: Macroeconomics 7*(1), 44–76.

Gorodnichenko, Y. and M. Weber (2016). Are Sticky Prices Costly?: Evidence from the Stock Market. *American Economic Review 106*(1), 165–199.

Gurkaynak, R., B. Sack, and E. T. Swanson (2005). The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models. *American Economic Review 95*(1), 425–436.

Hale, G., T. Kapan, and C. Minoiu (2020). Shock Transmission Through Cross-Border Bank Lending: Credit and Real Effects. *The Review of Financial Studies 33*(10), 4839–4882.

Hannan, T. H. and A. N. Berger (1991). The Rigidity of Prices: Evidence from the Banking Industry. *The American Economic Review 81*(4), 938–945.

Holmstrom, B. and J. Tirole (1997). Financial Intermediation, Loanable Funds, and the Real Sector. *Quarterly Journal of Economics 112*(3), 663–691.

Indarte, S. (2021). Financial Crises and the Transmission of Monetary Policy to Consumer Credit Markets. *SSRN Electronic Journal*.

Kane, A., S. Sarkisyan, and T. Viratyosin (2022). Are US Monetary Surprises Surprising? Evidence from Global Markets. *SSRN Electronic Journal*.

Kashyap, A. K. and J. C. Stein (2000). What Do a Million Observations on Banks Say about the Transmission of Monetary Policy? *American Economic Review 90*(3), 407–428.

Khwaja, A. I. and A. Mian (2008). Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market. *American Economic Review 98*(4), 1413–1442.

Kuttner, K. N. (2001). Monetary Policy Surprises and Interest Rates: Evidence from the Fed Funds Futures Market. *Journal of Monetary Economics 47*(3), 523–544.

Mian, A. and A. Sufi (2009). The Consequences of Mortgage Credit Expansion: Evidence from the US Mortgage Default Crisis. *Quarterly Journal of Economics 124*(4), 1449–1496.

Mundell, R. (1963). Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates. *The Canadian Journal of Economics and Political Science 29*(4), 475–485.

Nakamura, E. and J. Steinsson (2018). Identification in Macroeconomics. *Journal of Economic Perspectives 32*(3), 59–86.

Neumark, D. and S. A. Sharpe (1992). Market Structure and the Nature of Price Rigidity: Evidence from the Market for Consumer Deposits. *The Quarterly Journal of Economics 107*(2), 657–680.

Paul, P. (2020). The Time-Varying Effect of Monetary Policy on Asset Prices. *Review of Economics & Statistics 102*(4), 690–704.

Puri, M., J. Rocholl, and S. Steffen (2011). Global Retail Lending in the Aftermath of the U.S. Financial Crisis: Distinguishing between Supply and Demand Effects. *Journal of Financial Economics 100*(3), 566–578.

Romer, C. D. and D. H. Romer (2017). New Evidence on the Aftermath of Financial Crises in Advanced Countries. *American Economic Review 107*(10), 3072–3118.

Schnabl, P. (2012). The International Transmission of Bank Liquidity Shocks: Evidence from an Emerging Market. *The Journal of Finance 67*(3), 897–932.

Schwert, M. (2020). Does Borrowing from Banks Cost More than Borrowing from the Market? *Journal of Finance 75*(2), 905–947.

Shambaugh, J. (2004). The Effect of Fixed Exchange Rates on Monetary Policy. *The Quarterly Journal of Economics 119*(1), 301–352.

Temesvary, J., S. Ongena, and A. Owen (2018). A Global Lending Channel Unplugged? Does U.S. Monetary Policy Affect Cross-Border and Affiliate Lending by Global U.S. Banks? *Journal of International Economics 112*(C), 50–69.

Wang, Y., T. M. Whited, Y. Wu, and K. Xiao (2022). Bank Market Power and Monetary Policy Transmission: Evidence from a Structural Estimation. *The Journal of Finance 77*(4), 2093–2141.

Appendix

A Additional empirical results

A.1 Denominator in the definition of deposit rates

In (5) we define deposit rates as the share of interest expense in interest-bearing deposits. We next show that our results are robust to the denominator in the definition. Specifically, Tables A.1 and A.2 show that our results don't change when we use total deposits in the denominator instead of interest-bearing deposits.

Table A.1: Sensitivity of Deposit Spreads and Deposit Amounts to Monetary Shocks

$$y_{it} = \beta_i MS_t + \gamma_i X_{it-1} + u_{it}$$

Subset	Statistics	Flow beta	Spread beta
Domestic	Mean	-0.005^{***}	0.207^{***}
	Median	-0.002	0.209
Global	Mean	-0.029^{***}	0.190^{***}
	Median	-0.021	0.177
All	Mean	-0.006^{***}	0.207^{***}
	Median	-0.003	0.209

Note: This table provides mean and median flow and spread beta for domestic banks, global banks, and all banks in our sample as measured by equation (1) when the denominator in (5) is total deposits. Column 3 depicts flow betas, i.e. estimates of (1) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (1) with changes in spreads as a LHS variable. Outliers are dropped at 1% level. We also conduct t-tests for means. *** above the estimate mean that we reject the hypothesis that the mean is zero at 1% level of confidence.

A.2 Numerator in the definition of deposit rates

In (5) we used total interest expenses in the numerator. We next show that our results are robust when we use interest expenses on domestic deposits. Tables A.3 and A.4 show our findings.

We can conclude from A.1 and A.2 that our results are robust to the definition of deposit rates for banks. Results are not driven by changes in foreign deposit rates or by the fact that domestic deposits pay interest.

Table A.2: Bank-level Results on Lending, Net Transfers, and Foreign Lending

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowth}$	0.223^{***}	0.237^{***}	-13.538^{**}	-11.984^{**}	0.449^{**}	0.348^{*}
	(0.010)	(0.010)	(5.227)	(5.053)	(0.192)	(0.194)
$Global \cdot \widehat{DepGrowth}$	-0.086^{***}	-0.097^{***}				
	(0.031)	(0.032)				
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	204,406	204,406	1,279	1,279	1,002	1,002
R^2	0.216	0.160	0.227	0.214	0.264	0.227

Note: This table provides results of estimation of equations (2), (3), and (4) when the denominator in (5) is total deposits. The first two columns correspond to lending net of unearned income. Columns 3 and 4 show results of netdue regression. Columns 5 and 6 correspond to a foreign lending regression. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There is only one independent variable in the netdue and foreign lending regressions because all banks in those regressions are global. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank and time fixed effects are included. *,**, and *** correspond to 10-, 5-, and 1% significance level, respectively.

A.3 CRA results without lags

In Table 7 we show that our results are not driven by the differences in sets of borrowers between domestic and global banks. We also show that this is true not just for small loans but also for all loans within the CRA program. One concern is that we lag the explanatory variable. Table A.5 shows that our results are robust.

A.4 Analysis on top-10% of the sample

One concern for our domestic lending results is that global and domestic banks are different in size. Apart from doing CRA analysis, we focus on top 20% of our sample.

Table A.3: Sensitivity of Deposit Spreads and Deposit Amounts to Monetary Shocks

$$y_{it} = \beta_i MS_t + \gamma_i X_{it-1} + u_{it}$$

Subset	Statistics	Flow beta	Spread beta
Domestic	Mean	-0.005^{***}	0.220^{***}
	Median	-0.002	0.221
Global	Mean	-0.030^{***}	0.211^{***}
	Median	-0.024	0.222
All	Mean	-0.006^{***}	0.220^{***}
	Median	-0.003	0.221

Note: This table provides mean and median flow and spread beta for domestic banks, global banks, and all banks in our sample as measured by equation (1) when the numerator in (5) is interest expenses on domestic deposits only. Column 3 depicts flow betas, i.e. estimates of (1) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (1) with changes in spreads as a LHS variable. Outliers are dropped at 1% level. We also conduct t-tests for means. *** above the estimate mean that we reject the hypothesis that the mean is zero at 1% level of confidence.

In this section, we focus on top 10% of the sample and show that results are robust. Results are displayed in Tables A.6 and A.7.

A.5 Full sample

There is evidence in the literature that large and small banks differently transmit monetary policy (Kashyap and Stein (2000)). Large banks are believed to use their balance sheet to smooth the transmission. In our case, it would mean that large banks will be more resistant to lending cuts. It is a concern because most global banks are indeed large. In this section, we show that our results are not driven by size.

In all previous regressions, we focused on relatively large banks, i.e. we dropped banks beyond the fifth size quantile. In this section, we repeat the analysis but we keep all banks. First, we report deposits and spread betas. Table A.8 report results. The main patterns of our analysis remain the same. Specifically, global banks increase spreads and lose deposits. As in the benchmark sample, global banks lose more deposits than domestic banks.

We then repeat analysis for lending, net transfers, and foreign lending. Table A.9 presents results. The main coefficients are robust to the sample. We don't find any

Table A.4: Bank-level Results on Lending, Net Transfers, and Foreign Lending

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowth}$	0.220***	0.234***	−10.660**	−9.449*	0.438**	0.338*
	(0.010)	(0.010)	(5.292)	(4.826)	(0.193)	(0.194)
$Global \cdot \widehat{DepGrowth}$	−0.081***	−0.093***				
	(0.027)	(0.027)				
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	204,294	204,294	1,313	1,313	1,028	1,028
R^2	0.216	0.160	0.225	0.213	0.261	0.223

Note: This table provides results of estimation of equations (2), (3), and (4) when the numerator in (5) is interest expenses on domestic deposits only. The first two columns correspond to lending net of unearned income. Columns 3 and 4 show results of netdue regression. Columns 5 and 6 correspond to a foreign lending regression. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There is only one independent variable in the netdue and foreign lending regressions because all banks in those regressions are global. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

statistical or economic difference in findings. We also repeat analysis with FFR in the full sample and find that results are robust. In addition, we try 70- and 90% cutoff for size and find no statistical difference.[31] Overall, we conclude that our main findings are robust to the samples and are not driven by the fact that global banks are large.

A.6 Boostrapping standard errors

In the analysis above, we use multi-stage regressions. To capture a bank specific noise in the covariates, we cluster standard errors. However, such clusterization fails to account

[31] We do not show these results to save space.

Table A.5: County-level Results on Originated Small Business Loans

$$\log OrigLoans_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \omega_c + \varepsilon_{itc}$$

	Dependent variable:	
	Loans to small firms	
	(1)	(2)
$\widehat{DepGrowth}$	1.140***	1.376***
	(0.092)	(0.089)
$Global \cdot \widehat{DepGrowth}$	−1.816***	−1.650***
	(0.190)	(0.188)
Bank FE	Yes	Yes
Time FE	Yes	No
County FE	Yes	Yes
Controls	Yes	Yes
Observations	985,147	985,147
R^2	0.193	0.191

Note: This table provides results of estimation of equation (15) when the explanatory variable is not lagged. Results correspond to lending to small firms defined as firms with annual revenues smaller than $1 million. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. Standard errors are robust and displayed in the parentheses. Bank, county, and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

for an unobservable variation. We repeat the analysis with boostrapped standard errors. We use either 300 or 500 replications to make sure the estimates are precise. The results presented in Table A.10 show that our findings are robust.

A.7 2SLS analysis

To further confirm that our lending results are not driven by wrong standard errors, we run 2SLS regressions directly. Specifically, we instrument deposits with deposit spread betas following Drechsler et al. (2017) and Drechsler et al. (2021). Table A.11 confirms that our results are robust.

Table A.6: A.4 Sensitivity of Deposit Spreads and Deposit Amounts to Monetary Shocks

$$y_{it} = \beta_i MS_t + \gamma_i X_{it-1} + u_{it}$$

Subset	Statistics	Flow beta	Spread beta
Domestic	Mean	-0.005^{***}	0.206^{***}
	Median	-0.002	0.209
Global	Mean	-0.031^{***}	0.200^{***}
	Median	-0.025	0.196
All	Mean	-0.006^{***}	0.205^{***}
	Median	-0.003	0.209

Note: This table provides mean and median flow and spread beta for domestic banks, global banks, and all banks in our sample as measured by equation (1) for top 10% of the sample. Column 3 depicts flow betas, i.e. estimates of (1) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (1) with changes in spreads as a LHS variable. Outliers are dropped at 1% level. We also conduct t-tests for means. *** above the estimate mean that we reject the hypothesis that the mean is zero at 1% level of confidence.

B Model

We consider a framework of deposits in each country which follows Drechsler, Savov, and Schnabl (2017) to rationalize our main findings. In each country, households have preferences over final wealth W and liquidity services l, given initial wealth W_0

$$u(W_0) = \max_{W,l} \left(W^{\frac{\rho-1}{\rho}} + \lambda l^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \tag{B.1}$$

where money, M, and deposits, D, are imperfect substitutes for liquidity services

$$l(M, D) = \left(M^{\frac{\epsilon-1}{\epsilon}} + \delta D^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \tag{B.2}$$

Importantly, in Drechsler, Savov, and Schnabl (2017) (henceforth, DSS) deposits themselves are composite goods, with deposits by each bank being imperfect substitutes, where

$$D = \left(\frac{1}{N} \sum_{i=1}^{N} D_i^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}} \tag{B.3}$$

To understand the behavior of a global bank we consider the static decision of a bank which demands deposits and makes lending decisions, L_{US} and L_{UK}, in two countries,

Table A.7: Bank-level Results on Lending, Net Transfers, and Foreign Lending

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowth}$	0.192***	0.205***	−13.247***	−12.128**	0.419**	0.328*
	(0.013)	(0.013)	(5.032)	(5.033)	(0.191)	(0.190)
$Global \cdot \widehat{DepGrowth}$	−0.083***	−0.093***				
	(0.031)	(0.032)				
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	97,844	97,844	1,343	1,319	1,048	1,048
R^2	0.217	0.158	0.221	0.210	0.245	0.245

Note: This table provides results of estimation of equations (2), (3), and (4) for top 10% of the sample. The first two columns correspond to lending net of unearned income. Columns 3 and 4 show results of netdue regression. Columns 5 and 6 correspond to a foreign lending regression. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There is only one independent variable in the netdue and foreign lending regressions because all banks in those regressions are global. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

US and UK, respectively. The bank faces policy rates $\{f_{UK}, f_{US}\}$ in each country. We define the return on loans in each country as follows. The rate of return on loans in each country is increasing in the policy rate, f, and decreasing in the amount lended L as below, where $\ell_{UK0}, \ell_{UK1} > 0$ and $\ell_{US0}, \ell_{US1} > 0$ are parameters that reflect the bank's lending opportunities in the US and the UK, respectively

$$f_{UK} - \left(\ell_{UK_0} + \frac{\ell_{UK_1}}{2} L_{UK} \right)$$

$$f_{US} - \left(\ell_{US_0} + \frac{\ell_{US_1}}{2} L_{US} \right)$$

Table A.8: Sensitivity of Deposit Spreads and Deposit Amounts to Monetary Shocks: Full Sample

$$y_{it} = \beta_i MS_t + \gamma_i X_{it-1} + u_{it}$$

Subset	Statistics	Flow beta	Spread beta
Domestic	Mean	-0.009^{***}	0.199^{***}
	Median	-0.007	0.205
Global	Mean	-0.030^{***}	0.195^{***}
	Median	-0.024	0.196
All	Mean	-0.009^{***}	0.199^{***}
	Median	-0.007	0.205

Note: This table provides mean and median flow and spread beta for domestic banks, global banks, and all banks in the full sample as measured by equation (1). Column 3 depicts flow betas, i.e. estimates of (1) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (1) with changes in spreads as a LHS variable. Outliers are dropped at 1% level. We also conduct t-tests for means. *** above the estimate mean that we reject the hypothesis that the mean is zero at 1% level of confidence.

This reflects the notion that as the bank increases lending in each country, returns on loans in each country are decreasing, either due to competition for loans or because the bank reduces the quality of loans. The bank pays deposit rates $f_{UK} - s_{UK}$ and $f_{US} - s_{US}$. Recall the spreads, s_{UK} and s_{US}, are the spreads between the policy rate and the rate on deposits. Finally, the bank faces convex adjustment costs to funds which it moves across borders, $\frac{\alpha}{2}T^2$ where

$$T = L_{US} - D_{US} = D_{UK} - L_{UK} \tag{B.4}$$

is the amount the bank transfers from the UK to the US and $\alpha > 0$. This may reflect currency risk and regulatory costs and suggests that it is increasingly expensive to fund lending in one country through foreign deposits. Note that lending in each country can be expressed as a function of deposits and transfers.

$$L_{US} = D_{US} + T \tag{B.5}$$

$$L_{UK} = D_{UK} - T \tag{B.6}$$

Table A.9: Bank-level Results on Lending, Net Transfers, and Foreign Lending: Full Sample

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowth}$	0.298***	0.305***	−13.247***	−11.782**	0.477***	0.398**
	(0.005)	(0.006)	(5.032)	(4.870)	(0.169)	(0.178)
$Global \cdot \widehat{DepGrowth}$	−0.149***	−0.160***				
	(0.031)	(0.031)				
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	631,882	631,882	1,343	1,343	1,142	1,142
R^2	0.209	0.163	0.221	0.209	0.224	0.195

Note: This table provides results of estimation of equations (2), (3), and (4) in the full sample. The first two columns correspond to lending net of unearned income. Columns 3 and 4 show results of netdue regression. Columns 5 and 6 correspond to a foreign lending regression. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There is only one independent variable in the netdue and foreign lending regressions because all banks in those regressions are global. Standard errors are clustered at the holding company level and displayed in the parentheses. Bank and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

Thus, given policy rates $\{f_{UK}, f_{US}\}$ and spreads $\{s_{UK}, s_{US}\}$, the bank's static problem can be expressed as a choice of deposits in each country D_{US} and D_{UK}, and transfers between each country, T. Note that the bank faces decreasing returns to lending and quadratic costs of transfers.

$$\Pi = \max_{D_{US}, D_{UK}, T} \underbrace{\left[f_{UK} - \left(\ell_{UK_0} + \frac{\ell_{UK_1}}{2} L_{UK}\right)\right] L_{UK}}_{\text{gross return on UK lending}} - \underbrace{(f_{UK} - s_{UK}) D_{UK}}_{\text{cost of UK deposits}} \tag{B.7}$$
$$+ \underbrace{\left[f_{US} - \left(\ell_{US_0} + \frac{\ell_{US_1}}{2} L_{US}\right)\right] L_{US}}_{\text{gross return on US lending}} - \underbrace{(f_{US} - s_{US}) D_{US}}_{\text{cost of US deposits}} - \underbrace{\frac{\alpha}{2} T^2}_{\text{transfer costs}}$$

Table A.10: Bank-level Results on Lending, Net Transfers, and Foreign Lending: Bootstrapping

$$\Delta \log L_{it} = \gamma \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it}$$
$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu X_{it-1} + \alpha_i + \theta_t + v_{it}$$
$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu X_{it-1} + \alpha_i + \theta_t + m_{it}$$

	Dependent variable:					
	Loans		Netdue		Foreign loans	
	(1)	(2)	(3)	(4)	(5)	(6)
$\widehat{DepGrowth}$	0.238***	0.238***	−12.128*	−12.128*	0.386*	0.386*
	(0.009)	(0.009)	(7.092)	(6.961)	(0.231)	(0.226)
$Global \cdot \widehat{DepGrowth}$	−0.108***	−0.108***				
	(0.033)	(0.033)				
Replications	300	500	300	500	300	500
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	631,882	631,882	1,343	1,343	1,142	1,142
R^2	0.209	0.163	0.221	0.209	0.224	0.195

Note: This table provides results of estimation of equations (2), (3), and (4). The first two columns correspond to lending net of unearned income. Columns 3 and 4 show results of netdue regression. Columns 5 and 6 correspond to a foreign lending regression. Independent variables are log deposit growth predicted by the deposit channel and an interaction of that variable with the indicator which is equal to 1 for global banks. There is only one independent variable in the netdue and foreign lending regressions because all banks in those regressions are global. Standard errors are bootstrapped and displayed in the parentheses. Bank and time fixed effects are included. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

subject to constraints

$$D_{US} + T \geq L_{US}$$

$$D_{UK} - T \geq L_{UK}$$

$$D_{US}, D_{UK} \geq 0$$

Solving the bank's problem, the bank chooses optimal transfers

$$T = \frac{f_{US} - f_{UK} - (\ell_{US_0} - \ell_{UK_0})}{\ell_{US_1} + \ell_{UK_1} + \alpha} + \frac{\ell_{UK_1}}{\ell_{UK_1} + \ell_{US_1}} D_{UK} - \frac{\ell_{US_1}}{\ell_{UK_1} + \ell_{US_1}} D_{US} \tag{B.8}$$

Table A.11: 2-Stage Least Square Analysis

	Dependent variable:			
	Deposits		Loans	
	(1)	(2)	(3)	(4)
Spread betas·MS	-0.039^{***}	-0.032^{***}		
	(0.002)	(0.002)		
Deposits			0.588^{***}	1.778^{***}
			(0.035)	(0.203)
Global·Deposits			-0.167^{**}	-0.214^{*}
			(0.082)	(0.113)
Bank FE	No	Yes	No	Yes
Controls	Yes	Yes	Yes	Yes
Observations	631,882	631,882	631,882	631,882
R^2	0.012	0.072	0.082	0.209

Note: This table provides results of 2SLS regression. The first two columns show the results of the firs stage where deposit growth is regressed on deposit spread betas times monetary shock. Columns 3 and 4 show the results of the second stage where loan growth is regressed on deposit growth and on interaction of deposit growth and global bank indicator. Standard errors are clustered at the bank level and displayed in the parentheses. Bank fixed effects are included in columns 2 and 4. *,**, and *** correspond to 10-, 5-, and 1% significance level, respectively.

We can evaluate how transfers, T, which reflect cashflows from the UK to the US, vary with policy rate f_{US}.

$$\frac{dT}{df_{US}} = \frac{1}{\ell_{US_1} + \ell_{UK_1} + \alpha} + \frac{\ell_{UK_1}}{\ell_{UK_1} + \ell_{US_1}} \frac{\partial D_{UK}}{\partial f_{US}} - \frac{\ell_{US_1}}{\ell_{UK_1} + \ell_{US_1}} \frac{\partial D_{US}}{\partial f_{US}} \tag{B.9}$$

As f_{US} increases, the first term, reflects the increase in return from lending in the US. Since $\ell_{US_1}, \ell_{UK_1}, \alpha > 0$, this term is positive

$$\frac{1}{\ell_{US_1} + \ell_{UK_1} + \alpha} > 0 \tag{B.10}$$

Recall that in each country, i, as the policy rate f_i increases, deposit spreads increase, $\frac{\partial s_i}{\partial f_i} > 0$, and households withdraw deposits, $\frac{\partial D_i}{\partial s_i} < 0$. The rate with which households withdraw deposits depends on the bank's market power. Thus deposits in country i are

decreasing in the policy rate in the same country, $\frac{\partial D_i}{\partial f_i} < 0$. Therefore

$$\frac{\ell_{US_1}}{\ell_{UK_1} + \ell_{US_1}} \frac{\partial D_{US}}{\partial f_{US}} < 0 \tag{B.11}$$

If we assume monetary policy is independent $\frac{\partial f_{UK}}{\partial f_{US}} = 0$, then

$$\frac{dD_{UK}}{df_{US}} = \frac{\partial D_{UK}}{\partial f_{UK}} \frac{\partial f_{UK}}{\partial f_{US}} = 0 \tag{B.12}$$

so

$$\frac{dT}{df_{US}} = \frac{1}{\ell_{US_1} + \ell_{UK_1} + \alpha} + \frac{\ell_{UK_1}}{\ell_{UK_1} + \ell_{US_1}} \frac{\partial D_{UK}}{\partial f_{US}} > 0 \tag{B.13}$$

and transfers are always increasing in f_{US}.

If monetary policy is positively correlated, then $\frac{\partial D_{UK}}{\partial f_{US}} < 0$ and transfers T is increasing in the policy rate f_{US} so long as

$$\frac{1}{\ell_{US_1} + \ell_{UK_1} + \alpha} - \frac{\ell_{US_1}}{\ell_{UK_1} + \ell_{US_1}} \frac{\partial D_{US}}{\partial f_{US}} > - \frac{\ell_{UK_1}}{\ell_{UK_1} + \ell_{US_1}} \frac{\partial D_{UK}}{\partial f_{US}} \tag{B.14}$$

If monetary policy is negatively correlated, then $\frac{\partial D_{UK}}{\partial f_{US}} > 0$ and thus transfers T are always increasing in policy rate f_{US}.

Now we evaluate the impact of the increase in US policy rate f_{US} on US lending and UK lending under this framework. Recall that US lending is the sum of US deposits plus transfers.

$$L_{US} = D_{US} + T \tag{B.15}$$

Thus as the US policy rate f_{US} increases, US deposits decrease $\frac{\partial D_{US}}{\partial f_{US}} < 0$. If US and UK monetary policies are independent then, transfers are increasing, $\frac{\partial T}{\partial f_{US}} > 0$, and transfers act to mitigate the decrease in lending.

Similarly, note that UK lending is equal to UK deposits less transfers.

$$L_{UK} = D_{UK} - T \tag{B.16}$$

If US and UK monetary policies are independent, then UK deposits are constant, but transfers increase, decreasing UK lending.

C Additional figures

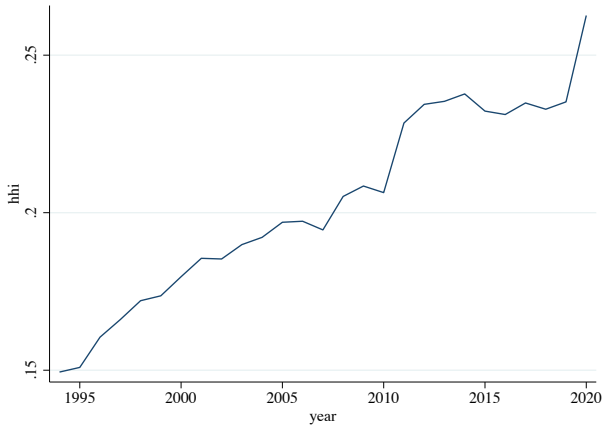



Figure C.1: County-Level Deposit Concentration