The Impact of the Deposit Channel on the International Transmission of Monetary Shocks*

Sergey Sarkisyan† Tasaneeya Viratyosin‡

May 3, 2022

Abstract

What role do deposits play in the international transmission of US monetary policy shocks? We find that the US monetary shocks are transmitted internationally through banks' deposits. Specifically, we document that after a 1 p.p. unexpected increase in the policy rate, global banks increase deposit spreads by 0.2 p.p. and experience a 3% decline in deposit growth. Consequently, global banks increase net transfers from foreign branches by 40.4% to finance lending. It allows them to reduce lending growth by half as much as domestic banks per percent of deposit outflow. Finally, global banks contract foreign lending growth by 1.3%.

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

JEL Codes: E52, F23, F34, G21

As global economies become more integrated, academic and policy circles have turned their interest to the outsized role that the Federal Reserve plays on the global stage. The empirical evidence suggests that US monetary policy has international repercussions and that shocks to US monetary policy reverberate to other countries (Cetorelli and Goldberg (2012); Correa et al. (2021)). Banks that operate in multiple countries – *global banks* – play a crucial role in propagating shocks internationally. Despite the importance of global banks in cross-country operations, the underlying mechanisms of the international transmission of monetary

*We thank Andy Abel, Gideon Bornstein, Anna Cieslak, Silvio Contessi (discussant), Itamar Drechsler, Zvi Eckstein, Dan Garrett, Marco Giometti, Itay Goldstein, João Gomes, Sasha Indarte, Oleg Itskhoki, Lorena Keller, Thomas King (discussant), Arvind Krishnamurthy, Karen Lewis, Dmitry Mukhin, James Paron, Nikolai Roussanov, Sergio Salgado, Tom Sargent, Mike Schwert, Luke Taylor, Harald Uhlig, Yao Zeng, conference participants at MFA, OCC Symposium, and FMCG and seminar participants at INSEAD, Wharton School, and Lomonosov MSU for helpful comments. We acknowledge the financial support from the Jacobs Levy Center for Quantitative Financial Research.

†Department of Finance, Wharton School, University of Pennsylvania.
E-mail address: sesar@wharton.upenn.edu

‡Department of Finance, Wharton School, University of Pennsylvania.
E-mail address: tviratyo@wharton.upenn.edu

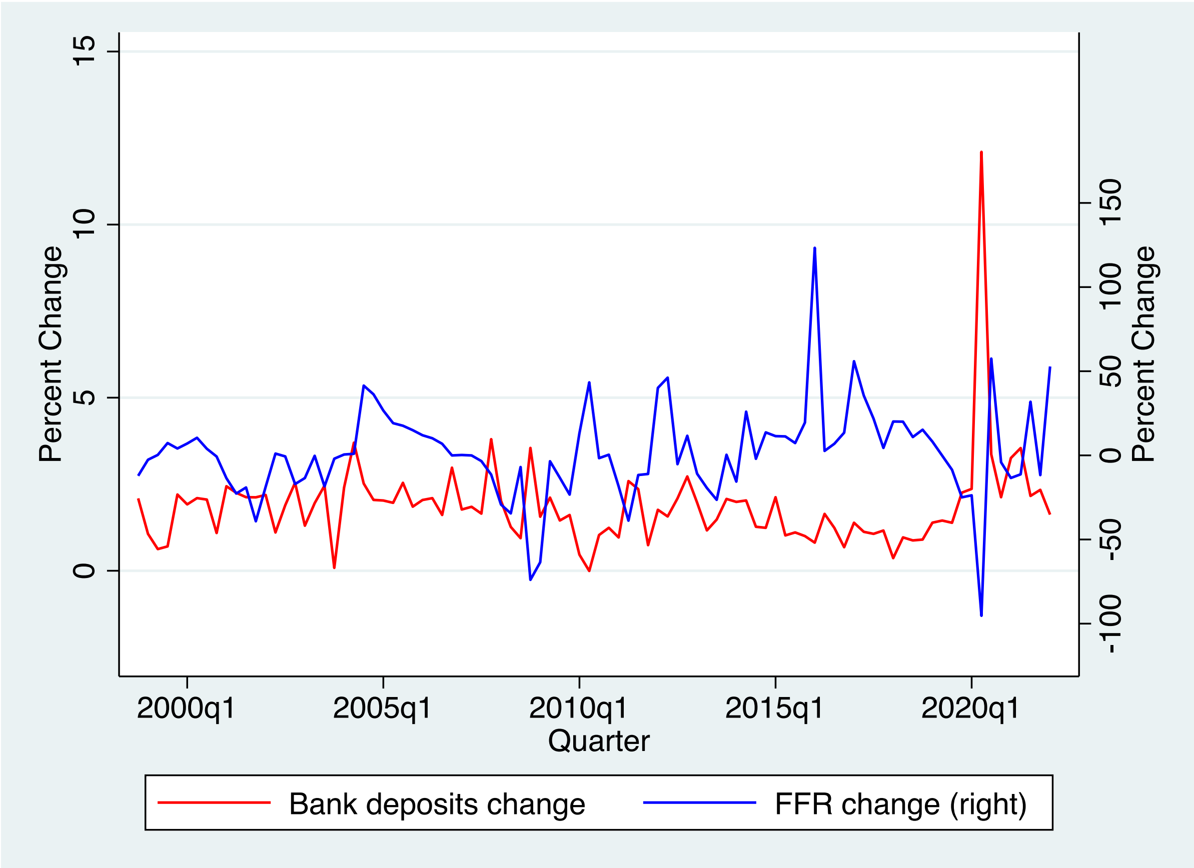
shocks are still under-studied. In this paper, we argue that the US monetary shocks are transmitted internationally through deposits of global banks.

Several channels of the domestic transmission of monetary shocks have been proposed, the most studied one being the transmission through bank reserves (Bernanke and Blinder (1988)) – *the reserve channel*. However, Drechsler et al. (2017) argue that most of the domestic transmission of US monetary policy can be attributed to the bank deposits – *the deposit channel*. Wang et al. (2020) estimate a structural model and find that the deposit channel is at least twice as important as the reserve channel for the domestic transmission. We focus on the deposit channel and show how monetary policy shocks are transmitted abroad through deposits of global banks.

To our knowledge, this is the first paper to evaluate and quantify the role of bank deposits in the international transmission of the US monetary shocks. In our paper, we argue that bank competition for deposits is monopolistic and hence, when the US Federal Funds rate (FFR) increases unexpectedly, banks increase deposit spreads, defined as the spread between the FFR and the deposit rates. Increased spreads result in households withdrawing bank deposits. The negative correlation between FFR and bank deposits can be clearly seen in Figure 1. Domestic banks have to contract lending because they fund it with deposits. However, global banks, unlike domestic banks, have an additional source of financing – foreign assets, which they can transfer funds from foreign branches to the US offices to finance loans. Therefore, they contract lending abroad but do not have to contract lending in the US as much as domestic banks. In other words, monetary policy transmits less on global banks than on domestic banks.

Large banks and corporations that are based in the US also operate in other countries, so we argue that lending in the entire world is influenced by changes in the FFR. Figure 2 shows the pattern. When FFR increases, the lending and debt holdings abroad are likely to decrease. This is true even for total lending for the entire world, not only bank lending. The negative correlation might be even more pronounced for countries that are highly dependent on the US. We claim that deposits of global banks play a crucial role in transmitting monetary shocks abroad. Indeed, Panel (a) of Figure 3 shows that changes in the US bank deposits are correlated with the changes in loans and debt abroad. On the other hand, Panel (b) of Figure 3 shows that bank reserves are not an important determinant of lending abroad. Even domestically, reserves are too tiny to account for the large portion of the monetary transmission (Drechsler et al. (2017); Wang et al. (2020)). Internationally reserves are even less significant.

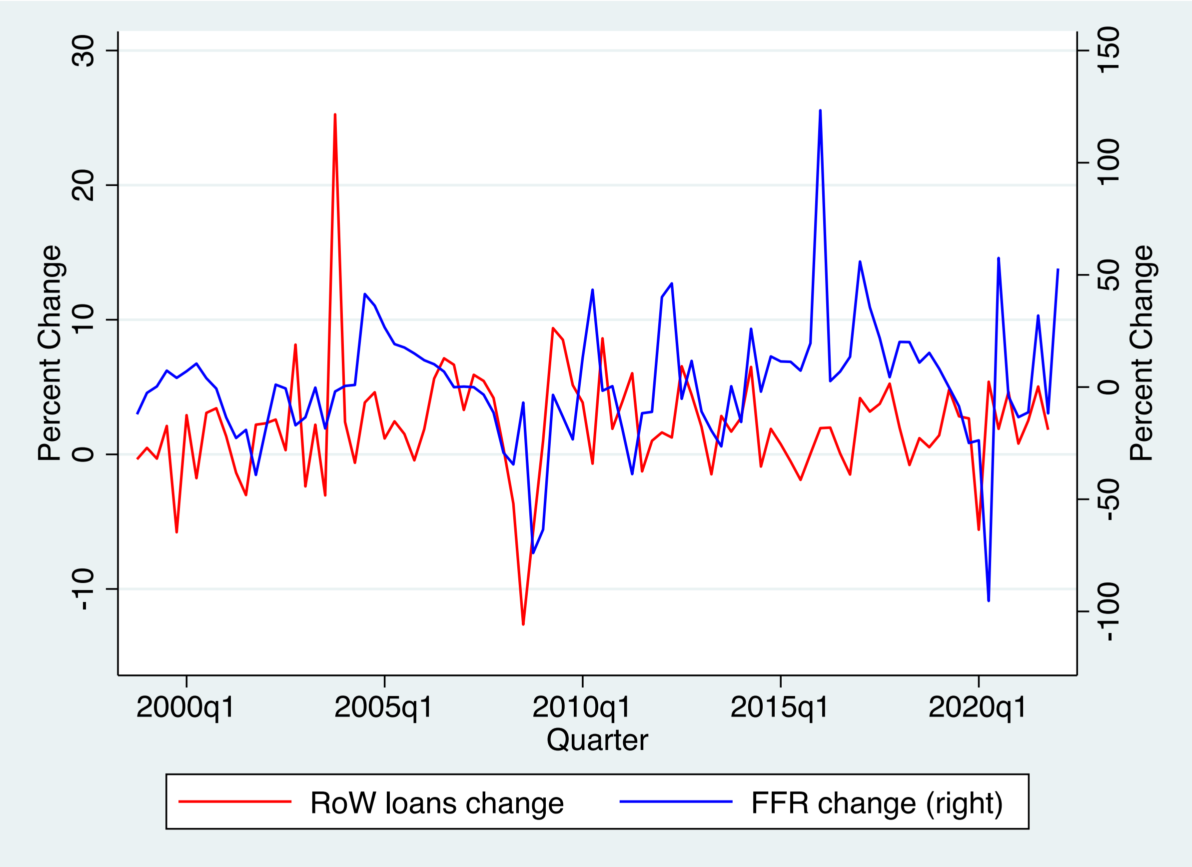
Figure 1: Bank Deposits in the US and Fed Funds Rate



Note: This figure plots changes in bank deposits and changes in FFR. Red line (left axis) corresponds to percent changes in banks deposits and and blue line (right axis) – to percent changes in FFR.

We first build a simple model of a global bank, which generates new predictions regarding how deposits affect the transmission of monetary shocks abroad. In this model, the global bank raises deposits and lends in two countries with independent monetary policies. The global bank can move funds from one country to another subject to costs. As in Drechsler et al. (2017), households view deposits as a composite good, and banks hold market power in the deposit market. When the US raises the Federal Funds rate (FFR), the global bank, like domestic banks, will increase its US deposit spreads. As a result, households will respond by withdrawing their deposits. The key novelty of the model is that, unlike domestic banks, the global banks will also increase cross-border funds into the US, both in response to increased US rates and in response to the decline in US deposits. The transfer of foreign funds has two effects. First, domestically, it will mitigate the reduction in US lending by global banks, relative to lending by domestic US banks. Second, since foreign funds are allocated to the US, the global bank will reduce its foreign lending, thereby transmitting US monetary policy internationally.

Figure 2: Loans and Debt for the Rest of the World and Fed Funds Rate

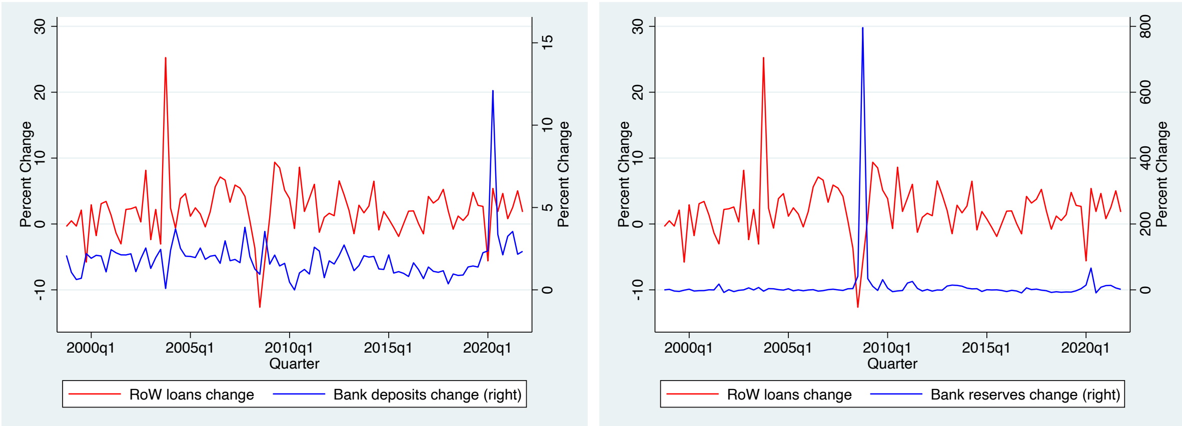


Note: This figure plots changes in loans and debt securities for the rest of the world and changes in FFR. Red line (left axis) corresponds to percent changes in loans and debt securities for the rest of the world and and blue line (right axis) – to percent changes in FFR.

We test the predictions of this framework 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 these data, we empirically estimate the impact of US monetary policy shocks on changes to US bank deposit rates and US bank deposits.[1] We find that in response to a 1 percentage point unexpected increase in the Federal Funds rate, deposit spreads of global banks increase by 20 basis points and global banks' deposit growth decreases by 2.9%, suggesting that the deposit channel is relevant to the behavior of global banks. We also show that banks with higher sensitivity of spreads to monetary policy shocks experience higher deposit outflow.

[1]We define US monetary policy shocks using high-frequency changes to 1 month Fed Funds futures around FOMC announcements. 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.

Figure 3: Loans and Debt for the Rest of the World, Bank Deposits in the US and Reserves in the US



(a) Deposits

(b) Reserves

Note: This figure plots changes in loans and debt securities for the rest of the world and changes in US deposits and reserves. Left figure plots deposits. Red line (left axis) corresponds to percent changes in loans and debt securities for the rest of the world and and blue line (right axis) – to percent changes in the US bank deposits. Right figure plots reserves. Red line (left axis) corresponds to percent changes in loans and debt securities for the rest of the world and and blue line (right axis) – to percent changes in the US bank reserves.

Next, using estimates of US deposits, as predicted by monetary shocks through the deposit channel, we evaluate the impact of the deposit channel on lending by global and domestic banks and cross-border flows by global banks. We define a global bank as a bank with non-zero cross-border flows between its domestic and foreign branches. We define cross-border flows as the net transfers from foreign offices to the domestic office which we denote as *NetDue*. As the bank increases cross-border flows into the US, *NetDue* increases. Specifically, we begin by regressing changes to bank lending on predicted changes to US deposits[2] at the bank level, controlling for bank and time fixed effects and aggregate macroeconomic variables, including GDP and inflation. As predicted by our framework, we find that global banks reduce lending growth by half as much as domestic banks per percent of deposit outflow.

We address two identification concerns that may bias our results on lending growth. First, since global and domestic banks target different markets, we should expect borrowers and depositors of JP Morgan Chase to be different from borrowers of Artisan's Bank – a domestic bank based in Delaware. Indeed, we observe this when evaluating the impact of monetary shocks on deposit flows – global banks lose much more deposits than local banks in response to an unexpected change to the Federal Funds rate. Global banks are also larger, so our results may be driven by the bank size. This concern may persist even after controlling for the size and

[2]Predicted by monetary shocks.

keeping only relatively large banks because the decision to open a branch abroad is not random. The second concern is that loan amounts in the bank balance sheets are an equilibrium response of both loan supply and loan demand. Since our measure of loans is at the bank-level, we are not able to account for the changes to loan demand from borrower business opportunities. In addition, loans in the balance sheet are *retained* loans as opposed to *originated* loans. While mostly retained loans matter for banks' portfolio risks, it is important to consider all originated loans, including those that are later sold or securitized.

To address these concerns, we quantify our results on the subset of small business lending at the county-bank-level from the Community Reinvestment Act (CRA). We argue that, with respect to CRA loans, global and domestic banks target the same sets of borrowers, because CRA incentivizes all banks (both global and local) to lend to the borrowers in the low and middle-income communities. Moreover, most of the loans are issued to small firms, i.e. firms with annual revenues of less than \$1 million. The data also allow us to control for county fixed effects and thus focus only on the loan supply (Khwaja and Mian (2008)). Thus, the only identification assumption here 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: banks originate significantly fewer loans after the contractionary monetary policy shock but global banks cut lending less.

Next, for our universe of global banks, we regress changes to cross-border fund flows (*Net-Due*) on predicted changes to US deposits and find that cross-border flows into the US increase when deposits decrease. Specifically, a 1% increase in deposit growth corresponds to a decrease in cross-border flows growth of 13.6%, equivalent to a 39.4% increase in netdue growth rate 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. These are funds that would otherwise be used to finance lending in foreign countries where branches are based. Therefore, we test if foreign branches cut their lending. We show that global banks contract foreign lending growth by 1.3%, thereby transmitting the US monetary policy shock through the deposit channel.

We perform a number of further tests to confirm that our results are indeed driven by bank market power in the US deposit market, as the deposit channel would suggest, we show that our results hold when we explicitly measure bank market power using 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). Our results are also robust to using changes to the level of Federal Funds in place of monetary shocks and to size effects.

We also consider whether our results are driven by cross-country flows caused by the correlation between policy rates in different countries, since decisions made by the Federal Reserve will impact policy rate decisions in other developed and emerging economies (Bergin and Jorda (2004)). We find that the correlation between Federal Fund surprises (including lags) and similarly defined European Central Bank (ECB) surprises is small, suggesting that this interdependence is not strongly evident in monetary *shocks*. The correlation between policy rate levels is another reason to use surprises rather than levels. Moreover, including ECB surprises in the list of controls for our foreign lending and cross-border flow regressions does not statistically or economically change our results.

Finally, it is well known that exchange rates can impact international flows. Mundell-Fleming's classic results indicate that currency appreciation leads to a decrease in net balances (Fleming (1962); Mundell (1963)) and exchange rates may impact monetary policy decisions (Dornbusch (1976); Shambaugh (2004)). Considering this, we show that our international flow results are robust to controlling for changes to a trade-weighted exchange index.

Our results indicate that the deposit channel and the market power of global banks are important to the transmission of US monetary policy internationally. Specifically, we show that a large portion of the international propagation of US monetary policy shocks can be attributed to the deposit channel. In response to an unexpected increase in US Federal Funds rates, when global banks experience more outflow of deposits, they increase cross-border flows into the US, thus transmitting the US monetary policy shock internationally.

We contribute to several strands of financial and economic literature. First, our results shed new light on the transmission of monetary policy. There are three main channels that economists considered before. The first is a reserve channel, where interest rate decisions affect required reserves and hence, lending (Bernanke and Blinder (1988, 1992); Kashyap and Stein (2000)). The second one is a capital channel — interest rate movements tighten banks' capital and therefore, affect their decisions (Bolton and Freixas (2000); Brunnermeier and Sannikov (2014); Elenev et al. (2021)). Finally, recent papers argue that shocks are transmitted through banks' deposits because banks have market power in the deposit market (Drechsler et al. (2017, 2021); Wang et al. (2020)). Indeed, under the structural model estimated in Wang et al. (2020) the deposit channel accounts for most of the transmission. Rather than considering domestic transmission, this paper quantifies the effect of the deposit channel on international transmission. Moreover, unlike previous papers, we show that shocks are also transmitted through the deposit channel.

We also contribute to the growing literature on the international transmission of monetary and liquidity shocks (Cetorelli and Goldberg (2012); Schnabl (2012); Acharya et al. (2014); Temesvary et al. (2018); Hale et al. (2020); Correa et al. (2021)) which claims that global banks play a crucial role in the transmission. In particular, several papers, including Cetorelli and Goldberg (2012) and Correa et al. (2021), argue that global banks actively allocate funds across borders. For example, Cetorelli and Goldberg (2012) shows that in response to a contractionary US monetary policy shock global banks increase cross-border flows into the United States and reduce foreign lending thereby propagating the US monetary shock internationally. While most do not take a stance on the channel of the transmission, our paper documents the role of the deposit market on the international transmission of shocks.

Finally, we contribute to the literature on global banking. 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 et al. (2021)). In contrast, this paper argues that the market power of global banks and the deposit channel are 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.

Our results may have useful policy implications. Banks are known to accelerate and even cause panics and crises (Diamond and Dybvig (1983); Goldstein and Pauzner (2005); Gennaioli et al. (2012); He and Xiong (2012); He and Krishnamurthy (2013); Gertler and Kiyotaki (2015); Bernanke (2018); Piskorski and Seru (2021)). Global banks are usually large and their decisions and financial health have an impact on the entire economy. In addition, understanding the impact of the deposit channel may be of increased importance to countries that are more dependent on foreign bank lending. It is, therefore, crucial to understand global banks' actions and impact on their assets when conducting monetary policy.

The rest of the paper proceeds as follows. Section 1 describes the stylized theoretical models where global banks choose deposits and lending in two countries. Section 2 provides information on our econometric strategy and data. Section 3 contains our main bank-level and branch-level findings. Section 4 provides robustness tests. Section 5 concludes.

1 Model

We consider a framework of deposits in each country which follows Drechsler et al. (2017). In each country, households have preferences over final wealth W and liquidity services l, given initial wealth W_0

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

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

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

Importantly, in Drechsler et al. (2017) (henceforth, DSS) deposits themselves are composite goods, with deposits by each bank being imperfect substitutes, where

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

To understand the behavior of a global bank we consider the static decision of a bank which demands deposits and makes lending decisions in two countries, US and UK, subject to The bank faces policy rates $\{f_{UK}, f_{US}\}$ in each country. Following DSS and Kashyap and Stein (2000), demand for loans in each country is downward sloping, $\ell_{UK_1}, \ell_{US_1} > 0$. The 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

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

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 lending.

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

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

Thus, given policy rates $\{f_{UK}, f_{US}\}$ and spreads $\{s_{UK}, s_{US}\}$, the bank's problem, can be expressed as a choice of deposits in each country D_{US} and D_{UK}, and transfers between each country, T.

$$\begin{aligned}\Pi = \max_{D_{US}, D_{UK}, T} & \left[f_{UK} - \left(\ell_{UK_0} + \frac{\ell_{UK_1}}{2} L_{UK}\right)\right] L_{UK} - (f_{UK} - s_{UK}) D_{UK} \\ & + \left[f_{US} - \left(\ell_{US_0} + \frac{\ell_{US_1}}{2} L_{US}\right)\right] L_{US} - (f_{US} - s_{US}) D_{US} - \frac{\alpha}{2} T^2\end{aligned} \tag{7}$$

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

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

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

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

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

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

Recall that in each country, i, as the policy rate f_i increases, deposit spreads increase, $\frac{\partial f_i}{\partial s_i} > 0$, and households withdraw deposits, $\frac{\partial D_i}{\partial s_i} < 0$. The rate with wich 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

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

If we assume monetary policy is independent $\frac{\partial f_{UK}}{\partial f_{US}} = 0$,[3] then

$$\frac{\partial D_{UK}}{\partial f_{US}} = \frac{\partial D_{UK}}{\partial f_{UK}} \frac{\partial f_{UK}}{\partial f_{US}} = 0 \tag{12}$$

so

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

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

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

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

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

Thus as the US policy rate f_{US} increases, recall that 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.

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

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

[3]Note that if one focuses on exogenous shocks, rather than levels, policies are independent by definition of the shock.

2 Empirical strategy and data

The static model has four main predictions in response to a contractionary monetary policy shock:

1. Global banks increase deposit spreads and lose deposits after the contractionary monetary policy shock.

2. Global banks are able to use their foreign funds to finance US lending. We expect to see an increase in net transfers from foreign branches.

3. As a result, global banks do not contract their lending per unit of deposit outflow as much as domestic banks. We expect to see that the deposit channel is weaker for global banks.

4. Global banks cut future foreign lending because they transferred funds that were supposed to finance loans abroad.

We next propose an empirical strategy and data that we use to test predictions.

2.1 Empirical strategy

Our empirical strategy can be divided into two steps. First, we evaluate the relevance of the deposit channel to global banks (i.e. if they increase spreads and lose deposits after the contractionary monetary policy shock). Specifically, for each bank i we run the following time-series regression:

$$y_{it} = \beta_i MS_t + \gamma_i X_{it-1} + u_{it} \tag{17}$$

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.

(17) gives us β_i for each bank i, or each bank'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*. Our model predicts that spread betas should be on average positive for both domestic and global banks, while flow betas should be negative.

We also obtain fitted values from the regression of monetary shocks on deposit growth and denote deposit growth as predicted by the deposit channel as $\widehat{DepGrowth}_{it}$. Importantly, we use fitted values of deposits rather than actual deposits because we want to evaluate the impact of monetary policy and the deposit channel, in particular, on lending and net flows. In this way, we abstract from changes to deposits that are unrelated to the deposit channel but that impact lending and net flows. To account for potential error terms, we cluster standard errors in second-stage regressions at the bank level. We also cluster at the time level as a robustness test.

In the second step of our analysis, we test if deposit outflow is 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 consequent cut in foreign lending. To answer the first question we run the following regression:

$$\Delta \log L_{it} = \theta \widehat{DepGrowth}_{it} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it} \tag{18}$$

where the left hand side 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 2 coefficients in (18) for which our model has direct predictions. The first is θ, the percentage change in lending growth after 1 p.p. change in deposit growth due to the expansionary monetary shock. Our model predicts that $\theta > 0$, 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 model predicts $\nu < 0$, that is global banks' will contract lending less per percent of deposit outflow. To recall, given the model, 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:

$$NetDueGr_{it} = \eta \widehat{DepGrowth}_{it} + \mu Y_{it-1} + \alpha_i + \theta_t + v_{it} \tag{19}$$

where the left hand side variable is the change in log net transfers from foreign branches (henceforth, netdue growth)[4], Y_{it-1} is a set of controls, and α_i is bank fixed effects. Following

[4]Note that net transfers can be negative. That's why, we first take logs of the absolute value, then add sign,

following Cetorelli and Goldberg (2012) we control for lagged netdue growth, contemporary and lagged GDP growth, inflation, and asset growth. We also control for assets to account for the size.

Next, η measures the sensitivity of netdue growth to deposit growth. Our model predicts that $\eta < 0$, i.e. banks increase netdue growth after the deposit outflow. We test this empirically. Moreover, we want to show that netdue growth changes due to the deposit channel lead to lending growth changes. We will address this in detail in Section 3.

Finally, to show the international transmission of monetary shocks, we test if deposit outflow leads to a contraction in future foreign lending.[5] Specifically, we estimate the following equation:

$$\Delta \log ForL_{it} = \iota \widehat{DepGrowth}_{it-1} + \mu Z_{it-1} + \alpha_i + \theta_t + m_{it} \tag{20}$$

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

2.2 Data

Our data cover the universe of 12,126 banks[6] from 1994 to 2018. 170 banks report to have foreign branches — we define them as *global*. We keep only banks with assets in the 5th quantile to drop small banks and finance companies. Our final sample contains 5,403 subsidiary banks. In robustness tests, we show that our results hold in the full sample as well. 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.[7] Sample contains 24,039 banks.[8] Notice that those are not bank-holding companies that we will refer to as BHC. One BHC may have

and only after that compute changes.

[5] We do not find significant contemporaneous effect. It means that shocks are transmitted with one quarter lag.

[6] 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.

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

[8] 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.

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.

2. *Foreign flows.* We get net due to and 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.[9] We merge RCON series with bank-level data using RSSD ID.

3. *Foreign lending.* Foreign lending data comes from Call Reports RCFN series. Specifically, RCFN 2327 corresponds to loans originated by foreign offices of banks that report in the United States. We observe foreign lending only 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. They are defined as changed in futures 15 minutes before and 45 minutes after the FOMC meeting.[10] 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 made available by Altavilla et al. (2019).

5. *Branch-level deposits.* We collect annual branch-level data on banks' deposits and assets

[9] 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. That's why we exclude such banks from our sample.

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

from the FDIC Summary of Deposits. 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. This will let us control for county unobservables and exploit branch-level analysis. 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.

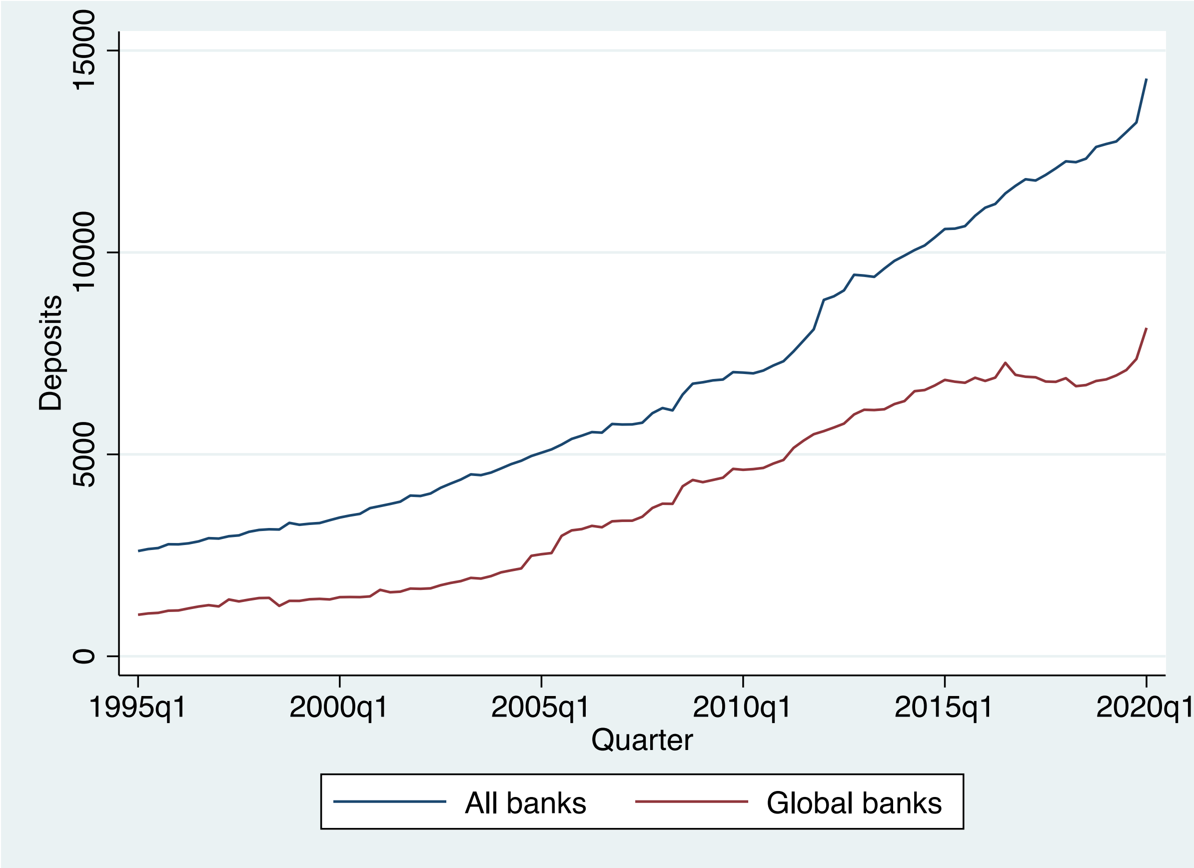
6. *Branch-level deposit rates.* Weekly deposit rates by branches are available in S&P Global RateWatch. They cover almost all global banks in our sample and more than 50% of the entire sample. The data report deposit rates on new accounts. We follow Drechsler et al. (2017) and restrict our sample to 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.[11] 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 trasmittal 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, 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. 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.

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

Figure 4: Deposits of the Banks



Note: 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.

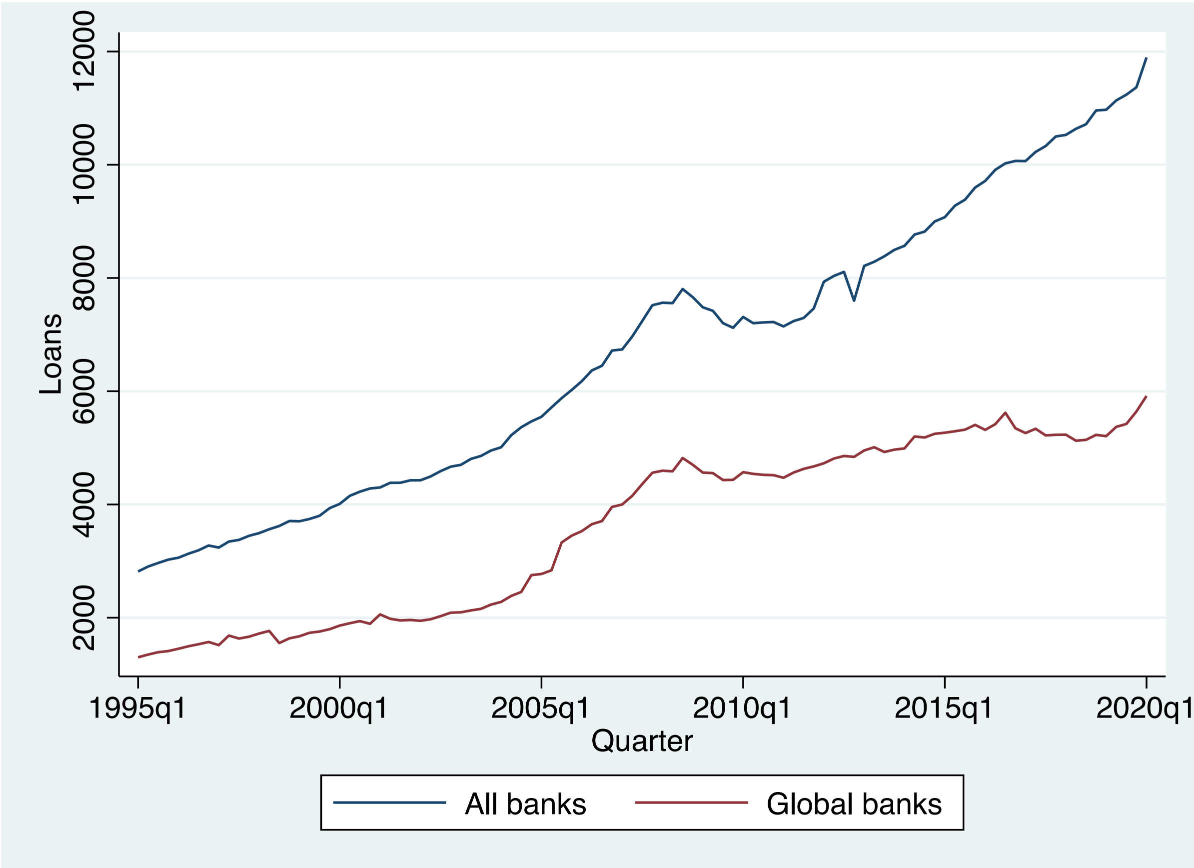
2.3 Summary statistics

Table 1 contains summary statistics of our data. Panel A represents bank characteristics. We define commercial banks as *subsidiary* banks that file Call Reports. Their main identifier is 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. The time period is from 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.

We can see that global banks have on average more assets, deposits, and loans.[12] If the bank can afford to have foreign branches, that bank is likely to be large. This fact poses potential

[12]See Figures 4 and 5.

Figure 5: Total Loans of the US Banks



Note: 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 billion of dollars.

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. Figure 5 plots US lending by all banks and global banks. It is clear that global banks dominate the market.

The table also shows net transfers from foreign branches. As mentioned above, net transfers can be negative in rare circumstances.[13] 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. Banks do not report their deposit rates because each branch can have its own deposit rate. However, banks report interest expenses. We thus define deposit rate in basis points as follows:

$$DepRate_{it} = 100 \cdot \frac{IntExp_{it}}{IntBearDep_{it}} \tag{21}$$

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 (21). 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 because of the much broader sample size.

Branch-level data have two main advantages. First, we can observe deposit rates, so we do not have to use a potentially noisy measure given by (21). Second, we know branch addresses. That allows us to compute county HHIs and identify an exact effect of market power. 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.

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

It means that the deposit market is **not** perfectly competitive.[14] This is the crucial feature of our analysis — the deposit channel would not work in a perfectly competitive market. The imperfect competition allows branches to increase spreads without losing an entire clientele. Also, HHI for global banks is close to HHI for domestic banks, meaning that their markets are not significantly different.

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 one of the most important macroeconomic identification concerns (Nakamura and Steinsson (2018)). We successfully overcome the problem by using truly unexpected changes — deviations in 1-month FF futures around FOMC meetings. 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. Specifically, we run the following regression:

$$\Delta FF_t = \delta Surprise_t + \xi X_t + \varepsilon_t \tag{22}$$

where MS_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 (22) are used as our measure of monetary shock. One unit of the measure can be interpreted as an unexpected 1 percentage point increase to FFR.

3 Results

We first show our main bank-level results. Specifically, we estimate equation (17) for spreads and deposits. 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 (18) and (19) to show that global banks do not contract lending as much as domestic banks

[14] 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	—	—
Deposit spread (b.p.)	1.54	1.89	2.04	2.07	1.52	1.89
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 sample. All panels provide a breakdown into global and domestic banks. Global banks are banks that report to have foreign branches. Panel A contains statistics of bank-quarter level variables. It includes balance sheet variables and log growth (change) for deposits, loans, and netdue. Bank-level deposit spreads are computed as interest expenses divided by interest-bearing deposits. Panel B representes 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.

and that they transfer funds from abroad. One of the model predictions is that global banks can afford not to cut lending because they can use foreign funds. We use 2SLS to quantify the prediction. Finally, we estimate (20) 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. This is important for our lending results because global banks and domestic banks might target different markets. The branch-level analysis allows us to compare banks with similar market powers. We address other concerns in Section 4.

3.1 Bank-level results

3.1.1 Deposit growth and deposit spreads

We estimate equation (17) 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. 1 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. Column 4 suggests that deposit spreads increase by 19.8 b.p. for the average global bank and by 20.2 b.p. for the median global bank following a 1 p.p. contractionary shock.

Average domestic bank increases its deposit spread by 20.9 b.p. Spread betas are nearly the same for two groups of banks. Hence on average global banks and domestic banks are not significantly different from each other in their decision to increase spreads. It suggests that global banks have identical sources of market power as domestic banks. We explore that statement more in Subsection 3.4.

Flow betas differ across samples. Although global banks' deposits are more sensitive to monetary shocks, we do not think that it is related to market power. First, results on deposit spreads suggest that banks' responses are nearly the same. Banks increase spreads because they have market power, and global banks increase spreads by the same amount as domestic banks. Second, global banks initially have a higher mean deposit growth rate. Finally, this can be related to the size — global banks are generally larger and grow faster. Using the branch-level analysis that we do in Section 3.4 we compare global and domestic banks with the same market power.

We also find that banks with higher spread betas (i.e. with more market power) lose more deposits. We run the following regression:

$$\Delta \log D_{it} = \alpha SpreadBeta_i \cdot MS_t + \gamma X_{it-1} + u_{it} \tag{23}$$

where $SpreadBeta_i$ is a spread beta for bank i. Our estimate for α is equal to -0.032 and it is significant at a 1% level of confidence for both domestic and global banks.[15] That is, banks with more market power lose more deposits, suggesting our deposit results are not driven by the deposit demand. We elaborate on this more in Section 3.4 where we account for branch-level market power using county-level HHI.

Overall, our results on deposit spreads and deposit growth suggest that contractionary monetary shock induces monopolistic banks to increase deposit spreads, and hence, they suffer an outflow of deposits. That holds for both domestic and global banks. In contrast, in perfectly competitive markets, banks would not change their spreads in response to monetary policy, and deposits would not change. We interpret deposit flows predicted by equation (17) as a *deposit growth predicted by the deposit channel*:

$$\widehat{DepGrowth}_{it} = \hat{\beta}_i MS_t + \hat{\gamma}_i X_{it} \tag{24}$$

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 allowing them to reduce lending less. To test these hypotheses we estimate

[15]We do not display a table with results here to save space.

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^{***}	0.209^{***}
	Median	-0.002	0.209
Global	Mean	-0.030^{***}	0.198^{***}
	Median	-0.024	0.202
All	Mean	-0.006^{***}	0.208^{***}
	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 (17). Column 3 depicts flow betas, i.e. estimates of (17) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (17) 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.

(18) and (19) 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 (18) 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.

Recall that 1 p.p. shock leads to a 2.9% decrease in deposit growth of an average global bank. It implies that global banks contract lending growth by 0.3%. Domestic banks contract lending by 0.1%. It may seem that global banks actually contract lending growth less but two things should be noticed. First, global banks initially have a higher loan growth rate (it exceeds the loan growth rate of domestic banks by 0.1 p.p.). Second, global banks lose much more deposits. Hence, *per percent of deposit outflow* global banks contract lending less.

It is worth noting that global banks and domestic banks target different markets, so our samples are self-selected. We can't use domestic banks as a counterfactual for global banks. We mitigate these concerns partly by limiting our sample and leaving only relatively large banks.

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

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

	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 (18), (19), and (20). 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.

We also control for size and bank fixed effects. Nonetheless, we still may be missing important features of international banks. That's why domestic lending results alone cannot be sufficient enough proof that global banks reduce lending exposure to monetary shocks using their foreign funds. For a complete picture, we need to show that banks indeed increase transfers from foreign branches.

We thus estimate regression (19). 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. It 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.[16]

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

Finally, we estimate (20). Columns 5-6 of Table 3 show results. Banks contract foreign lending if they lost deposits in the previous quarter due to monetary shock. Specifically, 1 p.p. shock leads to a 1.3% decline in foreign lending growth. Hence, US monetary shocks are transmitted internationally through the deposit channel. Our results are robust to the inclusion of time fixed effects as well as to macro controls.

3.2 Alternative explanations

In the previous subsection, we presented evidence that the deposit channel impacts the international transmission of monetary shocks. 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, it is equivalent 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, our results are based on the fact that deposits flow out because banks have market power. We provide evidence that deposit spreads move, and they can only move in an imperfectly competitive market. However, deposits can flow out because of changes in lending. In other words, deposit flows might be 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 refute this concern in the next subsection.

Second, we focus on shocks rather than levels of monetary policy rate for exogeneity reasons. However, some deposit channel papers specifically use levels and discuss the transmission of the *policy*.[17] We address this concern in Section 4 by repeating our analysis with monetary policy levels rather than shocks. We expect to find little statistical difference.

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. We also test if our main results are driven by ECB surprises.[18]

[17]For details see Drechsler et al. (2017, 2019).

[18]We take ECB rate because it impacts European countries. For the complete analysis, we would need to check

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 rates to bias our results, they should have impact on net trasfers, 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 the monetary surprises, so exchange rates have to impact surprises. This is wrong by construction of surprises. However, we formally test if this is true. We also include FX dollar trade index to out regressions and check if our main results change. We present results in Section 4.

3.3 Results with loan originations

Our lending results suggest that global banks shrink lending growth less than other banks. The average global bank contracts lending growth 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 the 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 branches.

Second, global banks have different sets of deposits and borrowers than domestic banks. For deposits, Table 2 shows that global banks lose much more deposits than domestic banks. We partly overcome that problem by interpreting our results in units of deposit outflow. However, sets of borrowers are also different. Large transnational corporation 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. It means that the decision to cut loans is made by banks. However, in the environment of rising interest rates it is likely that

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.

borrowers seek for alternative sources of financing. So our results might be demand-driven. This problem is idetified in many papers (Mian and Sufi (2009)). We partly overcome the problem in Section 3.4 by utilizing the variation in market power. In this section, we propose an alternative way to mitigate the concern.

To tackle identification concerns above we focus on *newly originated* loans within counties. Community reinvestment act (CRA) provides the 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.[19] 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 MSA fixed effects, thus accounting for borrower's demand unobservables. This 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:

$$\log OrigLoans_{it} = \theta \widehat{DepGrowth}_{it-1} + \nu Global_{it} \cdot \widehat{DepGrowth}_{it-1} + \xi X_{it-1} + \alpha_i + \theta_t + \omega_c + \varepsilon_{ict} \tag{25}$$

where $OrigLoans$ are newly originated loans and ω_c are county fixed effects. Any results from this regression should be interpreted as a loan supply results. We lag an independent variable because we annualize data. We want to avoid the situation in which the loan is originated before the monetary shock.[20]

Table 4 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 more significant than with the balance-sheet loans. It means that the demand component and market differentiation biased our results towards zero.

The gap between global and domestic banks is narrower when we consider only small firms. It means that when global banks bring funds to finance otherwise lost loans in the

[19]For more details, see https://www.occ.treas.gov/topics/consumers-and-communities/cra/index-cra.html
[20]Our results hold without the lag as well.

Table 4: County-level Results on Originated Loans

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

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

Note: This table provides results of estimation of equation (25). The first two columns correspond to lending to all firms. Columns 3 and 4 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.

US, they choose to keep larger firms. Many banking theories support this finding. For example, global banks may want to keep their relationship borrowers which are usually large (see Chodorow-Reich and Falato (2022)). Alternatively, banks can choose larger firms for bigger profits. At the end of the day, bank strategically increase deposit spreads – they know that they will have to cut lending. So they may optimally choose to lose mostly small loans.

3.4 Branch-level results

One of the concerns outlined above is that our lending results might be driven by lending channel rather than deposit channel. We address this concern by conducting branch-level analysis. We first quantify the effects of monetary shocks on deposits and spreads interacted with market power. In other words, we compare banks with high and low market power. We then predict deposits and test if global banks are different than domestic banks in lending behavior.

We run the following panel regression to find out if branches change spreads and lose deposits:

$$y_{it} = \beta MS_t \cdot BranchHHI_c + \gamma Global_{it} \cdot MS_t \cdot BranchHHI_c + \alpha_i + \theta_c + \zeta_{st} + u_{icst} \quad (26)$$

where y_{it} is either a change in deposit spread or log deposit growth of branch i at time t[21], $BranchHHI_c$ 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.[22] By our hypothesis, γ should be statistically indifferent from zero.

Table 5 provides estimates. The first column suggests that the coefficient at an interaction between shock and market power is negative. It implies that banks with more market power lose more deposits. This finding is in line with Drechsler et al. (2017) — deposits flow out because of the supply, not demand. If it was demand, banks with market power would never want to deliberately lose deposits. The second coefficient is negative and significant. It implies that branches of global banks lose more deposits. We got the same result in bank-level analysis. Branch-level regression allows us to pin down an exact difference between two groups. 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 (26) up to the bank level to analyze lending and netdue. We use deposit shares of branches as weights. Notice that, unlike the previous section, predicted deposit growth in this section cannot be explained by lending. All lending opportunities are included in county and state fixed effects. Market segmentations are captured by the HHI index, and deposits move because banks have market power. The branch-level analysis makes it possible to directly account for the market power. That is why all following results can be interpreted as pure deposit channel findings, not lending channel

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

[22] We follow Drechsler et al. (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 (26). 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 statetime. Standard errors in parentheses are clustered at the county level. *,** , and *** correspond to 10-, 5-, and 1% significance level, respectively.

ones.

We repeat the analysis of Section 3.1 here with predicted deposits from branch-level regressions. We denote them by $Dep\widehat{Growth}Br$. Notice that R^2 of deposit regressions are high enough, so we fit the data well. We ask if global banks contract lending less than domestic banks. We estimate the following regression:

$$\Delta \log L_{it} = \theta Dep\widehat{Growth}Br_{it} + \nu Global_{it} \cdot Dep\widehat{Growth}Br_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it} \tag{27}$$

where α_i are bank FE.[23]

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

$$NetDueGr_{it} = \eta Dep\widehat{Growth}Br_{it} + \mu Y_{it-1} + \alpha_i + \theta_t + v_{it} \tag{28}$$

and for foreign lending:

$$\Delta \log ForL_{it} = \iota Dep\widehat{Growth}Br_{it-1} + \mu Z_{it-1} + \alpha_i + \theta_t + m_{it} \tag{29}$$

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

Controls in 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 $Dep\widehat{Growth}Br$ 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. Hence, global banks offset lending risk.[24]

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.

Results above mitigate potential identification concerns and show that the deposit channel is weaker for global banks. Magnitudes in Table 6 are smaller than in bank-level regressions. That is because here we focus on just one source of market power — HHI, i.e. deposit shares in the county. Another reason has to do with interpretation. We don't ask if global banks are different from domestic banks. We rather ask if global banks with high market power are different from global banks with low market power. Of course, banks and especially global banks can have other sources of market power including marketing, state law, or government. That is why our main results are bank-level. Branch-level analysis in this section proves that our lending results hold even in the 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.

Overall, 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 1 p.p. contractionary monetary shock. By doing that, global banks effectively offset lending risk — they do not have

[24]In these regressions it even appears that global banks offset all of the risks.

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

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

	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 (27)-(29). Columns 1-2 show domestic lending restuls. 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.

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 check if our results are robust to the measure of monetary policy shock, inclusion of foreign monetary shock, exchange rates, and the full sample. We have evidence that our results are robust to standard errors, various sets of controls and fixed effects, exclusion of random sets of banks or quarters, denominator and numerator in (21), size threshold, and measure of lending, but we leave it all beyond the text of the paper.[25]

[25] Most of our robustness tests are in the Appendix of the paper.

4.1 Changes in FF level

Most deposit channel papers focus on FF levels rather than shocks (Drechsler et al. (2017); Wang et al. (2020)). 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.[26] We first compute spread and flow betas — we estimate the following regression for each bank i:

$$y_{it} = \beta_i \Delta FF_t + \gamma_i X_{it-1} + u_{it} \tag{30}$$

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 7 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%. Medians are fairly close to means.

The results above suggest two important implications. First, our first step results are robust to whether we use FF changes or monetary surprises. Second, deposit channel works for global banks not only in transmitting shocks but also in transmitting policy itself. 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 $Dep\widehat{Growth}FFR$. We first estimate the following regression to test if our lending results are robust to the measure of monetary shock:

$$\Delta \log L_{it} = \theta Dep\widehat{Growth}FFR_{it} + \nu Global_{it} \cdot Dep\widehat{Growth}FFR_{it} + \xi X_{it-1} + \alpha_i + \theta_t + \varepsilon_{it} \tag{31}$$

where α_i is a bank FE.

Next, we show that netdue results are also robust to the measure of monetary shock. We

[26]We have data on FFR up to 2020 in contrast to surprises that we have only up to 2018.

Table 7: Sensitivity of Deposit Spreads and Deposit Amounts to FF 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 (30). The first irst 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 (30) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (30) 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.

estimate the following regression:

$$NetDueGr_{it} = \eta Dep\widehat{Growth}FFR_{it} + \mu Y_{it-1} + \alpha_i + \theta_t + v_{it} \tag{32}$$

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

$$\Delta \log ForL_{it} = \iota Dep\widehat{Growth}FFR_{it-1} + \mu Z_{it-1} + \alpha_i + \theta_t + m_{it} \tag{33}$$

Table 8 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.[27] 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

[27]Coefficients are significant in the full sample.

Table 8: Bank-level Results on Lending, Net Transfers, and Foreign Lending with FFR

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

	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 (31), (32), and (33). 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.

foreign offices. That is one reason why we concentrate on monetary shocks and not levels.[28]

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:

$$ECBshock_t = \sum_{i=0}^{1} \gamma_i MS_{t-i} + \varepsilon_t \tag{34}$$

[28] See Nakamura and Steinsson (2018) for more on identification issues with FFR.

where $ECBshock_t$ is ECB surprise. It is constructed in the same fashion as Federal Funds surprises. We run (34) 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:

$$MS_t = \sum_{i=0}^{1} \beta_i ECBshock_{t-i} + u_t \tag{35}$$

We do it because EU is a big economy and its policy surprise may have an effect on the US rates and deposits creating potential endogeneity concern.

Results are presented in Table 9. 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. It might be due to omitted variables that impact both ECB shock and FF shock. To be safe, we next include ECB surprises in regressions (19) and (20) as a control variable. We aim to show that our findings are not driven by ECB shocks.

Results are presented in Table 10. Columns 1 and 3 show results with time fixed effects. They are analogous to main results because time fixed effects subsume ECB shocks. However, coefficients with bank fixed effects only are as significant as in the main results. We can see that effects are slightly smaller but ECB shocks do not significantly impact neither netdue nor foreign loans.

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

Table 9: 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		FF surprise	FF 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 (34), (19), and (35) in the full sample. The first three columns correspond to ECB shock regressions. Regressors are monetary surprises, FF 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.

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 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

Table 10: Bank-level Results on Net Transfers and Foreign Lending with ECB Shocks

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

	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 (19) and (20) 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 the parentheses. Bank and time fixed effects are included. *,**, and *** correspond to 10-, 5-, and 1% significance level, respectively.

dollar trade index in the list of controls in regressions (19) and (20). Results are presented in Table 11. 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.

4.4 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 12 report results. The main patterns of our analysis remain the same. Specifically, global banks increase spreads and lose deposits. As in

Table 11: Bank-level Results on Net Transfers and Foreign Lending with Exchnage Rate

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

	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 (19) and (20) 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.

the benchmark sample, global banks lose more deposits than domestic banks.

We then repeat analysis for lending, net transfers, and foreign lending. Table 13 presents results. The main coefficients are robust to the sample. We don't find any 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.[29] Overall, we conclude that our main findings are robust to the samples and are not driven by the fact that global banks are large.

5 Conclusion

In this paper, we contribute to the understanding of how bank deposits and market power impact the international transmission of monetary policy. Given the large academic and political interest in understanding how US monetary policy is transmitted internationally, we consider the question of whether the deposit channel, which recent literature has argued is a major channel for the transmission of monetary policy domestically, has implications to the internal

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

Table 12: 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 (17). Column 3 depicts flow betas, i.e. estimates of (17) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (17) 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.

decision by the global banks to allocate resources across borders, and to the transmission of monetary policy. To understand the bank decision, we suggest a static model of a global bank which operates in two countries and has market power in the deposit market. We show that under this framework, when the policy rate in one country increases, like domestic banks, global banks increase their deposit spreads. The increase in spreads is commensurate to their market power in the deposit market, with high market power banks optimally choosing a spread which results in a larger outflow of deposits. However, unlike domestic banks, global banks optimally choose to transfer funds from foreign branches, thereby reducing domestic lending less than domestic banks but also reducing foreign lending.

We then evaluate the predictions of this framework empirically. We confirm that the deposit channel holds for both domestic and global banks and both expected and unexpected movements in the Federal Funds rate. Moreover, the decreases in deposits as predicted by unexpected changes to the Federal Funds Rate, reduce lending for both domestic and global banks, but as predicted, global banks reduce lending less per percent of deposit outflow. This predicted decline in deposits also increases net flows by global banks into the US. Finally, we show that global banks contract foreign lending.

The results of this paper suggest that understanding bank market power 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 clarifying questions. First, we show that global banks fund domestic operations through

Table 13: Bank-level Results on Lending, Net Transfers, and Foreign Lending: Full Sample

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

	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 (18), (19), and (20) 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.

foreign flows, and this impact 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.

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.

Bernanke, B. S. (2018). The Real Effects of the Financial Crisis. *Brookings Papers on Economic Activity* (September).

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.

Diamond, D. W. and P. H. Dybvig (1983). Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy 24*(1), 14–23.

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).

Elenev, V., T. Landvoigt, and S. Van Nieuwerburgh (2021). A Macroeconomic Model With Financially Constrained Producers and Intermediaries. *Econometrica 89*(3), 1361–1418.

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

Gennaioli, N., A. Shleifer, and R. W. Vishny (2012). Neglected Risks, Financial Innovation, and Financial Fragility. *Journal of Financial Economics 104*(3), 452–468.

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

Gertler, M. and N. Kiyotaki (2015). Banking, Liquidity, and Bank Runs in an Infinite Horizon Economy. *American Economic Review 105*(7), 2011–2043.

Goldstein, I. and A. Pauzner (2005). Demand-Deposit Contracts and the Probability of Bank Runs. *Journal of Finance 60*(3), 1293–1327.

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

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.

He, Z. and A. Krishnamurthy (2013). Intermediary Asset Pricing. *American Economic Review 103*(2), 732–770.

He, Z. and W. Xiong (2012). Dynamic Debt Runs. *The Review of Financial Studies 25*(6), 1799–1843.

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

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.

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.

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

Piskorski, T. and A. Seru (2021). Debt Relief and Slow Recovery: A Decade after Lehman. *Journal of Financial Economics 141*(3), 1036–1059.

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.

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 (2020). Bank Market Power and Monetary Policy Transmission: Evidence from a Structural Estimation. *NBER Working Paper No. w27258*.

Internet Appendix

A.1 Denominator in the definition of deposit rates

In (21) 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 14 and 15 show that our results don't change when we use total deposits in the denominator instead of interest-bearing deposits.

Table 14: 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 (17) when the denominator in (21) is total deposits. Column 3 depicts flow betas, i.e. estimates of (17) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (17) 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 (21) 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 16 and 17 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.

A.3 CRA results without lags

In Table 4 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 18 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. In this section, we focus on top 10% of the sample and show that results are robust. Results are displayed in Tables 19 and 20.

Table 15: A.1 Bank-level Results on Lending, Net Transfers, and Foreign Lending

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

	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 (18), (19), and (20) when the denominator in (21) 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.

Table 16: A.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***	0.220***
	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 (17) when the numerator in (21) is interest expenses on domestic deposits only. Column 3 depicts flow betas, i.e. estimates of (17) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (17) 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.

Table 17: A.2 Bank-level Results on Lending, Net Transfers, and Foreign Lending

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

	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 (18), (19), and (20) when the numerator in (21) 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.

Table 18: A.3 County-level Results on Originated Small Business Loans

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

	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 (25) 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.

Table 19: 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 (17) for top 10% of the sample. Column 3 depicts flow betas, i.e. estimates of (17) with log deposit growth as a LHS variable. Column 4 represents spread betas, i.e. estimates of (17) 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.

Table 20: A.4 Bank-level Results on Lending, Net Transfers, and Foreign Lending

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

	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 (18), (19), and (20) 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.