International Banking and Cross-border Effects of Regulation: Lessons from the United States[*]

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Abstract

Domestic prudential regulation can have effects across borders and may not be as effective in an environment where banks operate globally. The effects of prudential instruments depend on the countries in which they are levied, the characteristics of the banks directly impacted, and the extent of international banking linkages. The United States is potentially exposed to changes in foreign regulations through the subsidiaries and branches of foreign banks in the United States, and through the domestic activities of U.S. headquartered global banks. Using micro-banking data for 2000 through 2013, this study shows that some regulatory changes implemented abroad have spillovers to lending activity in the United States. Foreign country tightening of capital requirements, limits on loan-to-value ratios, and local currency reserve requirements lead to increased lending growth in the U.S. through both domestically-owned U.S. banks with significant foreign operations and through the U.S. branches and subsidiaries of foreign banks. At the same time, U.S. global banks are found to adjust their foreign lending in those countries in which prudential policies are changed. While the evidence for this transmission channel is weaker, it points to the potential for leakages of foreign policies through the activities of U.S. global banks.

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1.   Introduction

While regulatory policies and macroprudential instruments have received considerable emphasis since the global financial crisis, there are still open questions about the effects of those policies on banks' activities and the economy (Fischer, 2015; Tarullo, 2015). This paper provides evidence on international spillovers of such policies on the activities of U.S. global banks and of foreign banks operating within the United States. Such spillovers inform both the effectiveness of policies and their unintended consequences. We provide evidence that stricter prudential policies abroad lead to increased lending in the United States.

Policymakers may change macroprudential or microprudential regulations ("prudential regulations" hereafter) in their country to enhance the resilience of their domestic banking sector to potential shocks or to limit the rapid growth in domestic credit. However, those regulatory changes may spill over to foreign countries through the operations of the foreign subsidiaries or branches of global banks headquartered in the country modifying its regulations. The magnitude of the effect may depend on the type of prudential regulation changed, as well as the type of legal entity that the bank uses to conduct its operations abroad. For example, a change in the minimum regulatory capital ratio in the home country may have a direct effect on the activities of its branches in a foreign country, as branches typically lend against the capital of its parent bank. In contrast, subsidiaries of foreign banks in the host country operate as standalone entities, following local capital regulations. These entities may only be required to alter their credit activities if the foreign country regulation is tighter than that locally.

Two important features of the U.S. banking system are relevant as potential channels of policy transmission from and to the United States. First, the United States is home to numerous global banks. These global banks have significant exposures to advanced economies, as well as exposures to emerging market countries through their cross-border lending and affiliates located abroad (Cetorelli and Goldberg, 2006). Second, foreign banks significantly expanded their operations in the United States in the 2000s through their U.S. branches, as well as through separately chartered banks (Tarullo, 2012). Some foreign economies have actively used cyclical macroprudential policies to curb financial cycles in recent years (Cerutti, Claessens, and Laeven, 2015; Akinci and Olmstead-Rumsey, 2015). By contrast, U.S. policymakers have favored structural regulations that

are less correlated with the financial cycle and are not changed frequently (Elliott, Feldberg, and Lehnert, 2013).

These features of the U.S. banking system are crucial for hypothesis testing. The paucity of recurrent changes in U.S. regulations means that the identification of the empirical consequences and transmission channels of such policies may mainly be through changes in foreign regulations. Accordingly, we explore two directions of international transmission of prudential policies into lending. In the inward direction, the first channel examines whether foreign regulatory changes affect the lending behavior of the subsidiaries and branches of foreign banks in the United States. The second channel explores whether foreign regulatory changes affect the domestic activities of U.S. headquartered global banks. In the outward direction, we analyze the impact of foreign regulations on the foreign activities of U.S. banks. To test these channels, we use a newly constructed database of prudential instruments for the period 2000Q1 through 2014. The database covers 64 countries and 7 instruments, plus an aggregate prudential policy change metric.

We find evidence that a tightening in prudential policies abroad leads to an increase in lending by both U.S. global banks and U.S. affiliates of foreign banks. While we conduct tests with the seven prudential instruments described in Cerutti et al. (2015), statistically significant effects on bank lending are evident from changes in capital requirements, local currency reserve requirements, and limits on loan-to-value (LTV) ratios. For example, based on our empirical specifications, we calculate that stricter capital requirements abroad added a total of $268 billion in U.S. lending over the period from 2000 to 2013.

 We also study whether prudential policy changes in foreign countries have any significant and material effect on the credit provided by U.S. global banks in those locations. We expect that changes in prudential instruments may have a more important effect on U.S. banks when those policies originate in advanced economies, as a larger fraction of U.S. bank exposures are concentrated in these locations.

We find that foreign changes in prudential instruments have only a weak effect on U.S. banks' claims on foreign residents. Looking across micro-banking data for 59 U.S. global banks with exposures to 64 countries between 2000 and 2013, limits on interbank exposure concentrations are the only policy instrument that reduce U.S. banks' exposures in the country in which the policy is implemented. The effects of tighter interbank exposure limits on U.S. global bank claims mostly

occur through a reduction in the growth rate of cross-border claims to advanced economies, especially to the banking sector. We also observe that contrary to the intent of the policy change, a tightening in foreign LTV ratio limits increases U.S. bank claims to foreign residents. While alternative mechanisms can cause these effects, the statistical importance points to the potential for domestic policies to have some offset through the activities of competing U.S. banks.

The next section describes the data used in the various exercises on inward and outward transmission of foreign prudential policies through foreign banks operating in the United States, and through U.S. global banks. Section 3 presents the empirical methodology and results. Section 4 concludes, emphasizing that despite limited real consequences for the U.S. economy over the past decade, prudential instruments applied abroad have the potential to more significantly influence loan growth in the future.

2.   Data and Stylized Facts for the United States

The U.S. analysis of prudential policy spillovers internationally uses three distinct bank panels. The first panel covers U.S.-headquartered global banks, as these banks may be responsible for the inward transmission of foreign prudential policies, and for the outward transmission via lending adjustment across counterparty countries. For an even richer outward analysis through global banks, a variant of this dataset adds a country dimension to the bank and time dimension, capturing U.S. global bank claims in different locations through cross-border flows or through branches or subsidiaries established in foreign markets. The two other micro-banking datasets cover foreign banking activities in the United States. One contains data on foreign-owned bank subsidiaries operating in the United States, while the other consists of data on U.S. branches of foreign banks. The data for U.S. global banks and for subsidiaries of foreign banks within the United States span the first quarter of 2000 through the third quarter of 2013, while the branch dataset runs from the fourth quarter of 2002 through the third quarter of 2013.[1]

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[1] Our changes in time period relative to the IBRN guidelines (200Q1-2014Q4) are due to data availability issues. The FFIEC 009 reporting form changed in 2013Q4, with no comparable definitions for certain relevant items across this change. The FRY-7Q form used in branch regressions was not introduced until 2002Q4.

2.1 Bank-level Data

Data Sources. For U.S. commercial banks – both the U.S. global banks and the U.S. subsidiaries of foreign banks – we obtain balance sheet, income statement, and select off-balance sheet data from the Federal Financial Institutions Examinations Council (FFIEC) 031 form, better known as the Call Report. Income statement, balance sheet, and selected off-balance sheet data on U.S. bank holding companies are drawn from the FR Y-9C form filed as part of regulatory reporting in the United States. FFIEC 009 forms on the international exposures of U.S. reporting banks are the source of detailed information on the specific distribution of U.S. bank claims on foreign residents. A U.S. global bank is defined as such if it reports the FFIEC 009 and is headquartered in the United States. FFIEC 009 reporters have exposures in foreign countries that exceed $30 million and have at least one branch or subsidiary in a foreign country or U.S. territory, or a legal entity used to conduct international banking activities (e.g., International Banking Facility). Capital and asset data for foreign bank holding companies in our aggregated branch dataset are drawn from the FR Y-7Q form. Balance sheet and off-balance sheet data pertaining to U.S. branches and agencies of foreign banking organizations are drawn from FFIEC 002 filings, aggregated across U.S. branches to the level of the "top bank" within the global banking organization.[2] National Information Center (NIC) data are used to connect commercial banks to their high holders. All of these data filings are quarterly, with the exception of the FR Y-7Q.[3] Although much of the bank-level data we use are publicly available, bank-level data from the FFIEC 009 report are confidential.[4] Further details on data sources and variable construction are provided in Appendix A.

Definition of Outliers. The data are trimmed to exclude or correct for potential reporting errors and noise. First, we identify outliers and exclude these observations from all descriptive tables and analysis. Observations are identified as outliers if they satisfy at least one of the following four criteria where applicable: 1) a change in log claims or loans ($\Delta Y_{b,j,t}$ or $\Delta Y_{b,t}$) > 1 or < -1 (precluding most major mergers and acquisitions), 2) tier 1, illiquid asset, core deposit, or international ratio which is > 100% or < 0%, 3) not part of a consecutive string of bank-time

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[2] Bank in this context includes bank holding companies and commercial banks.
[3] The FR-Y7Q is filed quarterly by FBOs whose activities are deemed to be effectively that of a financial holding company, and is filed annually by all other FBOs. Data from the FR Y-7Q is then linearly interpolated in order to construct quarterly data for foreign BHCs.
[4] Most of the data collected on the FR Y-9C, FFIEC 031, FFIEC 002, and FR Y-7Q are available to the public, but there are a small number of series that are confidential. In the case of the FR Y-7Q, a reporting foreign banking organization may request confidential treatment for its bank-level information.

observations at least eight quarters in length, or 4) their home country changes between our contemporaneous and lagged periods (in our Inward B1 and B2 Specifications only).[5]

Definition of Dependent Variables. The dependent variables for the analysis have either purely bank and time dimensions: (1) $\Delta Y_{b,t}$ is defined as the change in log loans by bank b at time t, or add a country dimension (2) for outward transmission through global banks, $\Delta Y_{b,j,t}$ is defined as the change in log claims extended by bank b to counterparties in country j at time t. These claims can be cross-border, which are extended from a particular location to a counterparty external to that location, or local, in which the global bank affiliate in a location extends claims to borrowers in that location.

Bank-level Variables. As the composition of bank balance sheets may influence the effects of prudential instruments, the database also includes: bank size as captured by log of total real assets $\left(LogTotalAssets_{b,t-1} \right)$, percentage of a bank's portfolio of assets that is illiquid $\left(IlliquidAssetRatio_{b,t-1} \right)$, percentage of the banking organization's balance sheet financed with core deposits $\left(CoreDeposits_{b,t-1} \right)$, percentage of banking organization's regulatory Tier 1 risk-based capital to asset ratio $\left(Tier1Ratio_{b,t-1} \right)$, percentage of banking organization's Net Due To –Net Due From of Head Office relative total assets $\left(NetDueTF_{b,t-1} \right)$, and the importance of international activity as proxied by the percentage of banking organization's foreign deposits plus total claims relative to total assets $\left(InternationalRatio_{b,t-1} \right)$.[6]

Summary Statistics. The sample of reporting banks and characteristics of balance sheet data are summarized in Table 1. The number of distinct reporting entities for each dataset is provided in the first data row of the table. The second row of the table reports the number of observations that will be used in our empirical analysis, which combines information on number of entities and numbers of quarters for each entity. For the outwards transmission through global banks, the

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[5] Our prudential instrument variables represent intra-country changes only. We cannot clearly determine whether a move across countries would represent a tightening or loosening of requirements with regards to a particular prudential instrument.
[6] Total assets are converted to 2012Q1 dollars using GDP deflator data from the Bureau of Economic Analysis. The international ratio, as a measure of international activity, is utilized only in our Outwards and Inwards A specifications for U.S. global banks, while our aggregated branch regressions in the Inwards B2 exercise use only the log of total assets, Tier 1 ratio, and the net due ratio as bank level controls amongst those listed above, due to data availability.

counts of observations also reflect the number of countries in which the global banks report claims or local funding activity at each quarter for each global bank.

The loan growth rows of Table 1 show higher growth rates, on average, in lending in the United States by the U.S. branches and subsidiaries of foreign banks compared with lending rates of U.S. global banks. At the same time, the variability in lending is highest for the U.S. branches of foreign banks, and also high for global banks in lending across external locations. For the latter type of lending, a decomposition into cross-border lending versus local claims shows that cross-border lending by bank and by location accounts for more of the variability by global banks.

The global banks are the largest entities as measured by asset size, rely less on core deposits for funding, and have lower illiquid asset ratios. U.S. subsidiaries of foreign banks rely more heavily on U.S. core deposits and lending in the United States, as these entities have more similar business models with smaller U.S. commercial banks than with large U.S. global banks (Cetorelli and Goldberg, 2012). The U.S. branches of foreign banks rely more on wholesale funding and tend to lend more internally within their organization compared to externally lending to bank and non-bank counterparties (Cetorelli and Goldberg, 2015).

2.2   Data on Prudential Instruments

The prudential instruments included in the IBRN database are changes by quarter in: capital requirements, sector specific capital buffers, loan to value ratios, concentration ratios, reserve requirements (local currency and foreign currency), and interbank exposure limits. While the full database covers 64 countries, policies from only those countries with banking entities in the United States or with activities of U.S. global banks enter into our analysis. For inward- analysis through global banks, the prudential instruments are weighted aggregates across countries, with weights constructed on the basis of bank-specific information on country exposures in each period.[7]

Moreover, for analysis of policy spillovers to yield economically meaningful findings, the specific prudential instruments used in each exercise must have sufficient level of variation. We screen for sufficient variation by examining the counts of changes in each prudential instrument as relevant for the particular entities in each data subset, the number of countries associated with those changes, and the number of tightening and loosening observations. The panels of Table 2 show

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[7] Appendix B provides details on the construction and exposure weighting of the prudential instruments.

this information as relevant for different bank subsamples and the inward and outward transmission exercises. While there is not a well-defined rule available for determining a sufficient degree of variation for regressors in an econometric specification, we apply a judgmental approach to capture a sufficient number of episodes and number of countries. Accordingly, we do not examine transmission of concentration ratios in our Outwards and Inwards analysis for U.S. global banks, and exclude foreign reserve requirements, interbank exposure limits, and concentration ratios from our Inwards analysis for U.S. branches of foreign banks.

3.   Empirical Method and Regression Results

This section reports the main empirical specifications and results for the analysis on the impact of prudential regulations on bank claims both in the United States and abroad. Section 3.1 focuses on the spillovers of foreign regulatory changes to U.S. lending. Section 3.2 explores the effect of changes in foreign regulations on the activities of U.S. global banks in foreign locations.

Before presenting these results, we list a few observations on how instruments might spillover into the lending growth of banking entities. While more extensively discussed in Buch and Goldberg (2015), we present the expected effect of changes in capital requirements, reserve requirements, and loan-to-value ratios on bank lending.

A change in capital requirements abroad can affect lending in the U.S. in different ways. Consider U.S. global banks. U.S. banks that operate foreign subsidiaries need to finance these foreign assets with subsidiary-specific capital. When foreign capital requirements are tightened, U.S. parent banks may cut lending in these markets and employ the available funding for lending in a different location. In contrast, the effect of tighter capital requirements in foreign banks' home countries on their U.S. subsidiaries could, in principle, go in both directions. On the one hand, tighter capital requirements in the foreign bank's home country imply that the bank must finance its balance sheet with more capital on a consolidated basis. To achieve this, the parent bank may reduce lending both at home and abroad. However, tighter capital requirements at home also mean that the relative costs of lending at home and abroad change, with lending abroad becoming relatively less expensive.

As opposed to the stand-alone structure of subsidiaries, the assets in branches of foreign banks are directly linked to parent banks' balance sheets. Thus, a reduction of lending in the U.S. branches

and in the domestic offices of a foreign bank should have the same effect on this bank's tier 1 ratio. One would expect that higher capital requirements at home lead to a reduction in lending by U.S. branches of foreign banks, as the parent bank seeks to comply with higher capital standards.

Local currency reserve requirements are put in place by national monetary authorities to control the growth in domestic credit, when used as prudential tools. Higher reserve requirements imply that banks need to hold a larger fraction of funds as reserves with the central bank and can lend out only a smaller fraction to local borrowers. Reserve requirements in local currency, however, do not constrain the bank's activities in other countries. Since local funding becomes more expensive, banks have an incentive to raise funding abroad and could move operations to other locations. In contrast to the case of capital requirements, there is no reason why banks should prefer to change the lending growth at subsidiaries abroad, rather than branches, since local reserve requirements do not have a differential effect across the entities within the banks' organizational structures.

Limits on LTV ratios are aimed at reducing credit in the economy and often are specifically targeted at counteracting a potential real estate bubble. Such limits apply to all banks that engage in mortgage lending in a given country by decreasing the pool of eligible borrowers. A tightening of LTV limits should thus decrease the lending opportunities for all banks and might make them shift operations to other markets.

3.1   Inward Analysis: Spillovers to the United States from Foreign Prudential Policies

The inward transmission exercise investigates the consequences for lending in the United States of foreign prudential policies through two channels. First, U.S. banks with large foreign operations might respond to changes in regulation abroad by reallocating activity across foreign and domestic offices. Second, foreign banks that have to comply with home country regulation might adjust lending by their U.S. subsidiaries or U.S. branches.[8] As noted, the exact mechanisms that cause adjustments vary with the instrument and type of entities considered. Some policy instruments affect all banks that operate in a given market, as is the case for loan-to-value ratios. Other instruments may differentially affect banks in relation to their mode of servicing a location, as

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[8] U.S. credit could also be affected through foreign banks that do not necessarily have U.S. affiliates but lend cross-border to U.S. firms.

could be the case for capital requirements, or the structure of their balance sheets (e.g. reserve requirements). The empirical specifications allow for these distinctions.

Specifications

To test whether foreign policy changes affect lending within the United States, we run regressions separately for (i) U.S. global banks, (ii) U.S. subsidiaries of foreign banks, and (iii) U.S. branches of foreign banks. In each specification, we regress the log change in lending $\Delta Y_{b,t}$ by entity b in quarter t on a relevant measure of foreign prudential policy changes, including several lagged bank characteristics $X_{b,t-1}$ (see Section 2.1 for details) as well as bank- and quarter-fixed effects. Effectively, we investigate with these regressions whether policy changes abroad had an effect on lending growth by entity b, after controlling for a time trend in entity b's lending growth and a quarter-specific shift in lending growth common to all entities in the sample.

We estimate the following equation on the sample of 59 U.S.-headquartered banks with sizeable exposures in foreign countries (global banks):

$$\Delta Y_{b,t} = \alpha_0 + \sum_{k=0}^{2} \alpha_{k+1} ExpP_{b,t-k} + a_4 X_{b,t-1} + f_b + f_t + \epsilon_{b,t}. \tag{1}$$

where $ExpP_{b,t}$ stands for the foreign-exposure-weighted index and captures the extent to which policies are tightened or loosened in countries where entity b has exposures in quarter t.[9] Different prudential policies are explored using this specification and for this bank panel. Prudential policy effects can be immediate (k=0), or appear over the next two quarters (k=1, 2). Standard errors are clustered at the bank level.

The regression equation for the 102 U.S. subsidiaries of foreign banks and 136 U.S. branches of foreign banks is given by:

$$\Delta Y_{b,j,t} = \alpha_0 + \sum_{k=0}^{2} \alpha_{k+1} HomeP_{j,t-k} + \alpha_4 X_{b,t-1} + \alpha_5 Z_{j,t} + f_b + f_t + \epsilon_{b,j,t}. \tag{2}$$

where $HomeP_{j,t}$ indicates whether regulation tightened or loosened in home country j of entity b in quarter t. To control for home country financial and economic developments, the regression also

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[9] Appendix B provides details on the construction of the exposure-weighted index.

includes country-specific variables $Z_{j,t}$, which are measures of the home country's credit cycle and output gap from the BIS. Standard errors are clustered at the country level.

Spillovers into the United States

Table 3 presents the results of the inward transmission through U.S. global banks, U.S. subsidiaries of foreign banks and U.S. branches of foreign banks. We only display results for those prudential instruments for which we find significant effects for at least one of these three types of entities. Three instruments show significant spillovers: capital requirements, local currency reserve requirements and LTV limits. Tighter foreign capital requirements increase the U.S. lending of U.S. global banks and U.S. subsidiaries of foreign banks, but do not significantly affect U.S. lending by the U.S. branches of foreign banks. In contrast, tighter foreign limits on LTV ratios and local currency reserve requirements mainly cause U.S. subsidiaries and branches of foreign banks to adjust their lending. We do not find significant effects on U.S. lending of foreign changes in sector specific capital buffers. The PruC index, which aggregates prudential policy changes over instruments, also has largely insignificant effects, probably because the consequences for lending growth vary substantially by prudential instrument and are more appropriately evaluated in isolation.[10]

Interestingly, both bank and country conditions drive quarterly lending growth rates. U.S. lending by U.S. affiliates of foreign banks follows home country credit conditions. The coefficients on the lagged financial cycle and output gap variables in columns capturing data for U.S. subsidiaries of foreign banks, or for U.S. branches, are often statistically significant. In particular lending by U.S. subsidiaries is relatively strong when the home country has slower growth, while lending by U.S. branches is stronger when financial cycle conditions are looser in the home country.

Bank-level characteristics also help explain lending growth. After controlling for bank fixed effects on lending growth, U.S. global banks with higher tier 1 ratios (in the previous quarter) have stronger lending growth. This also holds for their foreign activities as shown later in the outward exercise and is consistent with previous results in the literature.[11] Tier 1 capital ratios do not

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[10] The effects of changes in concentration ratios were not analyzed because of limited variation in foreign policies in all three samples. For the same reason, the effects of changes in exposure limits and foreign reserve requirements were not explored for U.S. affiliates of foreign banks.

[11] See, e.g., Bernanke and Lown (1991), Berrospide and Edge (2010).

appear as drivers of foreign-owned bank lending growth in the United States. Instead, lending growth is stronger when illiquid asset ratios are lower.

In the following, we discuss the regression results of Table 3 in more detail and estimate the economic impact on loan growth in the U.S. from changes in capital requirements, local currency reserve requirements and limits on LTV ratios abroad.

Capital Requirements

The conjecture that foreign capital requirements could shift global bank activity away from the host country is supported by the regression results. We find a significant positive effect of tighter capital requirements abroad on total lending by U.S. global banks (see column 1 of Table 3).[12] We also used as the dependent variable total lending minus loans to foreign banks, C&I loans to foreign addressees, and loans to foreign governments and official institutions. Results based on this alternative dependent variable do not change qualitatively, which is evidence that we indeed identify spillovers to the United States.

With regards to the U.S. lending of foreign owned subsidiaries, the regression results indicate that our substitution effect from tighter home capital requirements (lending abroad becoming less expensive relative to domestic lending) can dominate that associated with the consolidated entity's increased capital needs and give parent banks a net incentive to expand subsidiary operations in the United States. Overall the support for this is relatively weak, however, as the estimated coefficient shown in column 2 is significant only at the 9.8 percent level.

The point estimate related to branch lending is not significant (see column 3), somewhat in support of the conjecture that changes in home country capital requirements have differential effects for branches and subsidiaries abroad

How large is the positive effect on loan growth in the U.S. from tighter capital requirements abroad? To quantify the effects, one can first compare the magnitudes of the estimated coefficients. If there was a change in capital requirements in all countries in which a U.S. bank holds claims, then that bank's lending growth would be 3.7 percentage points higher according to

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[12] Lagged values of the capital requirement index are dropped in the regressions displayed in columns 1 to 3, since these were never significant.

the estimated coefficient in column 1. The average value of the exposure-weighted index is 0.0274 in the sample, implying an average positive effect on a bank's lending growth rate of 0.1 percentage point. The effect of tighter capital requirements abroad through U.S. subsidiaries of foreign banks is somewhat smaller. The point estimate of 0.0161 in column 2 implies that a tightening in capital requirements at home leads to an increase in lending growth by the subsidiary of around 1.6 percentage points.

To explore the magnitudes of potential spillovers from past capital requirement changes, we conduct the following experiment: (i) we calculate the effect on a bank's lending growth in each quarter multiplying the capital requirement index in each period with the estimated coefficient. (ii) We convert the effect on the bank's lending growth rate to a U.S. dollar value taking into account the lending volume of the bank in the previous period. (iii) We aggregate the calculated U.S. dollar value over all banks. It is important to note that the estimated coefficients often have large confidence intervals, so the resulting dollar amounts are rough estimates of potential spillover effects.

The left chart of figure 1 shows the effect on total lending of U.S. global banks over time. Most of the regulatory changes in the sample occurred in the first quarter of 2012 and 2013 when several industrialized countries introduced Basel II.5 and Basel III, respectively. In some of these countries, U.S. banks have large operations, for example, in Canada, Hong Kong and Switzerland. Accordingly, the effect on aggregate lending is considerable. Based on our calculations, the introduction of Basel II.5 or Basel III in 2012q1 in 28 countries led to an increase in lending by U.S. global banks of almost 2.45 percentage points implying an increase in lending by $122 billion.

The right chart of figure 1 shows the aggregate effects through U.S. subsidiaries of foreign banks. In 2012q1, 19 out of the 37 subsidiaries in the sample in that quarter saw a tightening in home country capital standards. Based on our calculations, this increased lending by 1 percent or $5.6 billion. Note that the aggregate effect on lending through US subsidiaries of foreign banks is not only smaller because the point estimate is smaller but also because aggregate lending by these entities is smaller.[13]

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[13] In 2012q1, total lending by U.S. global banks in our sample was around $5 trillion. Total lending by U.S. subsidiaries of foreign banks was only $550 billion or 11 percent of U.S. global banks' lending.

Local Currency Reserve Requirements

The conjecture that higher local reserve requirements in the home country will make operations by foreign-owned affiliates in the U.S. relatively more attractive is supported by the regression results, as can be seen in columns 5 and 6 of Table 3. Higher local reserve requirements in the home country increase a subsidiary's lending growth rate by a total of 5.2 percentage points over half a year. Lending growth by branches increases by cumulative 3.4 percentage points, although the statistical significance of the sum of coefficients is lower than for subsidiaries. The similar results for branch and subsidiary lending are consistent with the earlier hypothesis that banks should not prefer to move activity to subsidiaries or to branches in particular, as local reserve requirements are not related to the bank's organizational structure.

In contrast, U.S. global banks do not seem to respond to local reserve requirement changes abroad. In principle, changes in local reserve requirements in a market could also affect U.S. global banks that operate there. However, U.S. global banks do not fund themselves to a significant extent in foreign/local currencies and are therefore probably little affected by these types of regulatory changes.

We investigated whether banks respond symmetrically to tightening versus loosening reserve requirements. In terms of magnitudes, the effects appear to be similar but the timing of responses differs. The effect of a tightening unfolds immediately, while responses to a loosening of reserve requirements occur with a lag of half a year.

Figure 2 illustrates the aggregate effects of reserve requirement changes abroad on lending by U.S. affiliates of foreign banks following the methodology described earlier. The chart on the left is for subsidiary lending, the chart on the right for branch lending. The largest effects occurred in 2012. On 18 January 2012, the ECB lowered the reserve requirement ratio from 2% to 1%. India and China, which were parent countries for U.S. subsidiaries in 2012, also lowered their local reserve requirements in this year. Summing the U.S. dollar changes in lending from 2012q1 to 2012q3 over branches and subsidiaries suggests that the reduction in local reserve requirements in this

period led to roughly $15 billion lower lending by these entities. Out of the total contraction, branches contributed 52 percent, while subsidiaries contributed 48 percent.[14]

Limits on Loan-to-value Ratios

The regression results in columns 8 and 9 of Table 3 support the conjecture that banks headquartered abroad redirect activity to the United States in response to tightened LTV limits in their home counties. Lending by both U.S. branches and subsidiaries of foreign banks expands in response to these changes.[15]

If tightening occurs in the parent country, lending growth by U.S. subsidiaries and U.S. branches of foreign banks increases by 2 and 3.5 percentage points, respectively, based on estimates in columns 8 and 9 (sum of contemporaneous and lagged coefficients). Figure 3 shows the aggregate effects of past changes in LTV limits by quarter. The volatility of aggregate effects over time is mainly a reflection of tightening and loosening in foreign countries. In the left chart of figure 3 for subsidiaries, the switching signs on the contemporaneous versus lagged effects of policy changes (see column 8) also play a role. Most changes in LTV limits occurred after the 2007/2008 financial crisis in advanced economies like Sweden, Canada, Norway and the Netherlands but also in developing countries like China and Brazil. Summing the effects of past LTV changes over the sample period and over both types of entities suggests that U.S. branches and subsidiaries lent out an additional $16.4 billion from 2003q3 to 2013q3 due to policy changes in their home countries. Subsidiaries contributed around 36.5 percent, branches around 63.5 percent to the increase. The larger contribution of branches to this expansion stems from a larger impact of an LTV ratio change on branch lending, compared to subsidiary lending, and the fact that more local reserve requirement changes occurred in the home countries of U.S. branches.[16]

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[14] While the impact of a local reserve requirement change on subsidiary lending is larger than on branch lending according to the point estimates (5.2 for subsidiaries versus 3.4 for branches), the fact that more local reserve requirement changes occurred in home countries of U.S. branches, led to the slightly larger contribution of branches to the $15 billion contraction.

[15] We did not find evidence for differential effects of tightening versus loosening LTV limits.

[16] In 2013q3, total lending of branches in our dataset was $ 518 billion versus $595 billion for subsidiaries.

3.2   Outward Analysis: International response of U.S. banks to foreign prudential policies

The outward transmission exercise focuses on assessing the effectiveness of foreign prudential policies in curtailing the growth of U.S. banks claims to foreign countries. It also explores the reallocation of U.S. banks' external claims across foreign markets in response to these policies.

Baseline specification

In the baseline specification we consider the impact of different prudential policies implemented by the destination country for U.S. bank claims. Each of the prudential policy indexes enters the regression specification with its contemporaneous value and two lags. Formally, we estimate the following equation:

$$\Delta Y_{b,j,t} = \alpha_0 + \left(\alpha_1 DestP_{j,t} + \alpha_2 DestP_{j,t-1} + \alpha_3 DestP_{j,t-2} \right) + \alpha_4 X_{b,t-1} + \alpha_5 Z_{j,t} + f_j +$$
$$f_t + f_b + \varepsilon_{b,j,t} \tag{3}$$

where the prudential policy changes are captured by $DestP_{j,t}$, which records the changes in the prudential policy indexes of country j to which U.S. bank b provides credit at time t.   The dependent variable is the change in logs of U.S. bank b's claims on country j at time t evaluated on an ultimate risk basis.

Table 4 summarizes the main results for individual prudential instruments on the foreign claim growth of U.S. banks.   Only three prudential policies show a statistically significant effect: concentration limits, LTV ratio limits, and reserve requirements. The sum of coefficients on the changes in the concentration limits to interbank exposures indicates a negative and significant impact on foreign claim growth. In contrast, the sum of the coefficients on the changes in LTV caps, and the changes in the reserve requirements on foreign currency denominated deposits, is positive and significant.

These results have two interpretations. First, of the prudential policy measures examined, limits on LTV ratios and changes in reserve requirements have been the most actively used across our counterparty countries, especially in emerging markets. However, exposures of U.S. global banks to emerging markets are smaller than exposures to advanced economies, and thus banks may be less concerned about the impact of regulation in the former countries as they can absorb the costs

of the extra regulation. Alternatively, these policies are ineffective in reducing the foreign claim growth of U.S. banks, or global banks are able to bypass these regulatory restrictions.

Among other drivers of total claim growth of U.S. global banks, bank size and the two cycle variables (capturing real and financial cycles) have the expected signs in most cases but are not statistically significant. Regulatory capital ratios are positive and significant indicating that better capitalized banks increase their claims more than less capitalized banks, consistent with previous results. The negative and significant coefficient on the internationalization ratio suggests that the foreign claim growth is smaller for more diversified banks (banks with more international activities). Core deposits are negatively related to total claims growth, reflecting the fact that most U.S. global banks are less dependent on core deposits to fund their foreign claims. The positive and significant coefficient on both the illiquid asset ratio and the net due to ratio suggest that less liquid banks and banks with more net internal borrowing from their parents exhibit a higher growth rate in their foreign claims.

Next we focus on two of the prudential policy measures that entered the previous specification with a significant coefficient to determine whether particular types of claims or counterparty countries explain these results. The prudential policies included in these additional tests are the interbank exposures limits and the caps on LTV ratios.[17] We estimate the specification reported in equation (3) using as dependent variable the log change in cross-border claims for advanced and emerging market countries separately.

Interbank exposure limits

Columns 2 through 5 of Table 5 show the results for changes in interbank exposure limits using a specification similar to the one used in Table 4. The first two columns examine the changes in total claims and the next two columns refer to changes in cross-border claims for all counterparty countries. Columns 4 and 5 indicate that the significantly negative impacts of interbank exposures limits are mainly observed on cross border claims to advanced economies. As shown at the bottom on the table, the sum of coefficients on this macroprudential policy is negative and significant. The result that tighter standards on interbank transactions in advanced economies significantly

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[17] We conducted similar tests for reserve requirements on deposits denominated in foreign currencies. We don't report them in our tables as we only find weak evidence of a negative impact of increases in foreign reserve requirements, mostly from emerging market countries on total claims of U.S. global banks.

reduce claims may reflect the fact that a large share of cross border exposures of U.S. global banks may be funded through interbank markets. Although local regulation may have less control over cross-border transactions, the reduction in cross-border claims may still occur if regulation reduces the demand for interbank loans provided by foreign banks in local markets.[18]

To provide a sense of the economic significance of this effect, we use the results in Table 4 (last column). Total claims by U.S. global banks in the countries that tightened this policy decrease by 2.7 percentage points on average in the first quarter. The effect is persistent and even stronger in the following quarter during which total claims decrease by about 5.3 percentage points. The left chart of figure 4 illustrates this impact in the 12 countries (5 advanced and 7 emerging market) that adjusted this policy between 2000 and 2013. This policy changed in waves in 2003, 2007, and during the sovereign debt crisis in Europe (2009 through 2011). On average, the largest impact occurs in 2011, when 5 European countries changed their restrictions on interbank exposures.

The right panel in figure 4 suggests that the impact of the policy change oscillates more in emerging markets than in advanced economies, particularly after the global financial crisis. However, this pattern is explained by the lag structure in the specifications reported in columns 3 and 4 of Table 5. After we consider the share of U.S. banks' claims in the total bank credit of each country, we find that the aggregate impact from the standpoint of the foreign economy is greater in emerging markets, where the share of U.S. banks' claims is larger (about 80 percent in Mexico and 15 percent in Argentina) than in advanced economies (about 8 percent in Australia, 6 percent in Switzerland, and 4 percent in Germany).

Loan-to-Value ratio limits

Using the regression results in Table 4, we estimate that total claims increase about 2.9 percentage points, on average, in the first three quarters after LTV ratio limits are tightened. In unreported results, we find that this counterintuitive result is explained by a positive relation between changes in LTV ratio limits and the change in cross-border claims to emerging market economies. The positive impact of changes in LTV ratio limits could reflect a possible substitution from real estate

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[18] In unreported regressions we find that most of the negative impact of interbank exposures limits imposed by host countries affects the growth of bank claims. The impact on claims to the public sector is negative but not significant.

loans to other types of loans (e.g., consumer or corporate loans) and holdings of sovereign debt in the host countries. Alternatively, it could reflect the ineffectiveness of this policy in limiting the lending of U.S. banks to foreign residents. In any case, this result points to the potential for leakages of regulatory policies through foreign banks.

4.   Concluding Remarks

The 2007/2008 financial crisis has led many countries around the world to review their use of microprudential and macroprudential policy tools. In a financially integrated world in which banks are global and run large cross-border operations, two questions naturally arise. First, have prudential policies taken by national regulators affected risk taking and credit growth beyond national borders? Second, can domestic prudential policies be effective in regulating domestic credit growth and addressing risk taking? The U.S. experience is useful since the country is home to a number of globally active banks, many of which are systemically important, and simultaneously hosts many foreign banks engaged in lending domestically through either a subsidiary structure or through U.S. branches.

We find clear evidence that lending in the United States is affected by foreign policy changes. A tightening of foreign policies leads to an increase in lending in the U.S. by both domestically-owned global banks with significant foreign operations and by the U.S. affiliates of foreign banks. Specifically, U.S. lending growth rises with tighter foreign capital requirements, limits on LTV ratios, and local currency reserve requirements enacted in foreign economies. The capacity to lend appears to shift, at least in part, from locations where it is being constrained to external locations

U.S. global banks appear to cut credit abroad in response to tighter limits on interbank exposures, in line with the goals of national regulators. In contrast, there is some evidence that they respond to tighter LTV limits and reserve requirements on foreign currency deposits by expanding credit. While the channel that causes this effect is not entirely clear, it points to the potential for leakages of domestic policies through foreign banks.

While the international spillovers from past prudential policy tightenings were moderate, our results highlight the challenges that policy makers face today. Effective control of domestic credit can be complicated by the prudential policies implemented in foreign jurisdictions. At the same time, calibration of domestic policies will need to take into account the spillovers of prudential

policy changes in foreign countries and their cross-border effects. Despite limited real consequences for the U.S. economy over the past decade, prudential instruments applied abroad have the potential to more significantly influence loan growth in the future through a variety of banking channels.

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Figure 1: The effect of tighter capital requirements abroad

The chart on the left (right) shows the effect of tightenings of foreign capital requirements on lending by U.S. global banks (U.S. subsidiaries of foreign banks). Calculations are based on the estimated coefficients shown in column 1 (column 2) of Table 3. The figure plots by date the additional lending by U.S. global banks (U.S. subsidiaries of foreign banks) in U.S. dollar values due to observed changes in capital requirements abroad.
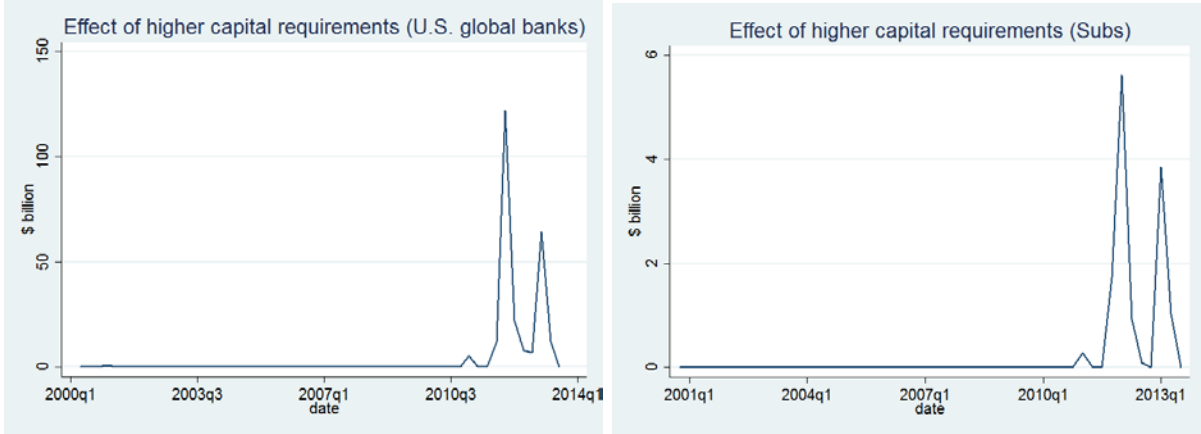
Figure 2: The effects of changes in home country local currency reserve requirements through U.S. subsidiaries and branches of foreign banks

The chart on the left (right) shows the effect of changes in home country local currency reserve requirements on lending by U.S. subsidiaries (branches) of foreign banks. Calculations follow the methodology described in the text on and are based on the estimated coefficients shown in column 5 (6) of Table 3. The figure plots by date the additional lending by subsidiaries (branches) in U.S. dollar values due to observed changes in local currency reserve requirements in these entities' home countries.

Figure 3: The effects of changes in home country limits on LTV ratios through U.S. subsidiaries and branches of foreign banks

The chart on the left (right) shows the effect of changes in home country limits on LTV ratios on lending by U.S. subsidiaries (branches) of foreign banks. Calculations follow the methodology described in the text and are based on the estimated coefficients shown in column 8 (9) of Table 3. The figure plots by date the additional lending by subsidiaries (branches) in U.S. dollar values due to observed changes in limits on LTV ratios in these entities' home countries.

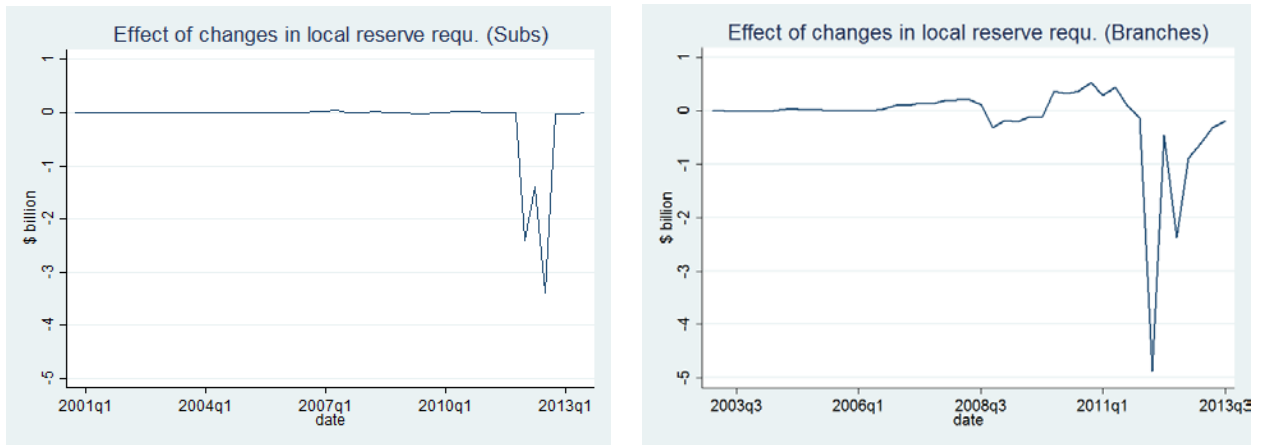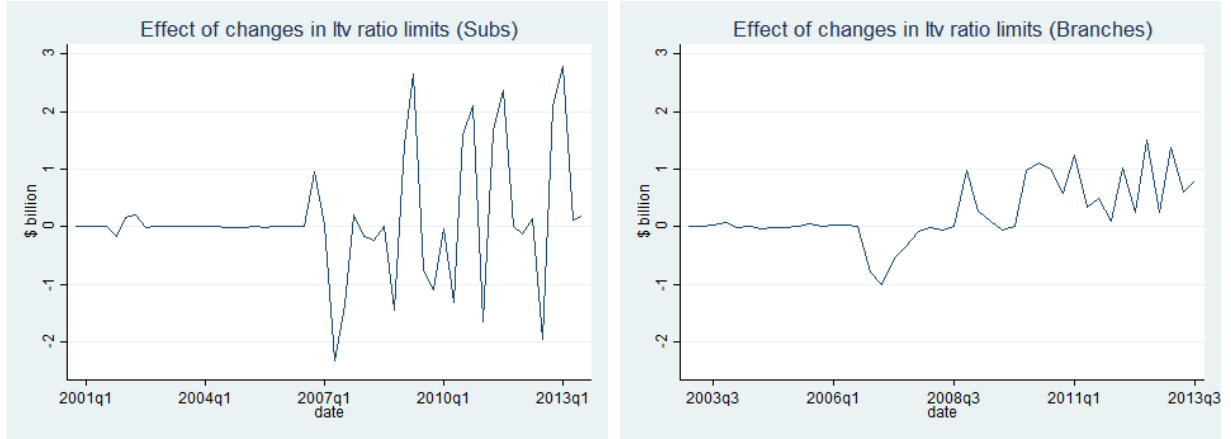## Figure 4: The effects of interbank exposure limits on U.S. banks' foreign claims

This figure shows the impact of changes in interbank exposure limits (IBEX) on aggregate foreign claims of U.S. banks between 2001:Q1 and 2013:Q3 in percentage points.
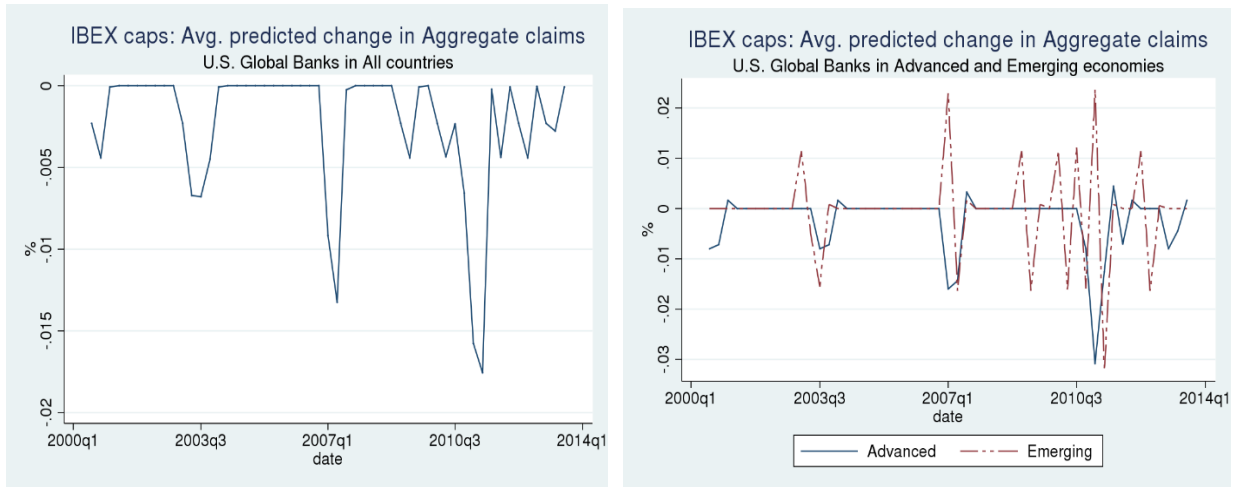
Table 1: Summary Statistics on Bank Lending and Characteristics

This table provides summary statistics for bank balance sheet and lending data, summarizing those observations included in our baseline regressions. Data are observed quarterly from 2000Q1-2013Q3 for U.S. global banks and U.S. subsidiaries of foreign banks, and from 2002Q4-2013Q3 for U.S. branches of foreign banks. Banking data sources by subset can be found in Appendix Table A and are reported at the level of the top bank within the global banking organization for U.S. global banks and for the U.S. branches of foreign banks (aggregated across U.S. branches in this case), and at the subsidiary level for the U.S. subsidiaries of foreign banks. The tier 1 asset ratio reported for branches is that of this associated parent. The Net Due To (or Due From) variable measures from the perspective of a bank's head office total net internal lending (or borrowing) vis-à-vis all its related domestic and international offices.

	Outward- US Global Banks			Inward- US Global Banks			Inward- US Subsidiaries of Foreign Banks			Inward- US Branches of Foreign Banks		
Entity Count	60			59			102			136		
Observation Count	37781			1873			2707			4230		
Variable	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD	Mean	Median	SD
Balance sheet data (for each bank *i* and quarter *t* [and destination country *j* in Outwards])												
Dependent Variables												
Δ Y	0.009	0.00	0.31	0.008	0.008	0.095	0.022	0.015	0.095	0.019	0.005	0.21
Δ Log Cross-Border Claims	0.006	0.00	0.37									
Δ Log Local Claims	0.011	0.00	0.50									
Δ Loans to US Residents				0.010	0.007	0.097						
Balance Sheet Composition												
Total Assets (Billions)	618.5	205.4	737.7	269.8	66.1	519.8	14.8	1.4	31.2	15.8	3.6	26.5
Tier1 Ratio(%)	11.0	10.1	3.4	11.8	10.9	4.1	16.8	12.6	12.5	10.4	9.5	4.8
Illiquid Assets Ratio (%)	57.3	60.7	21.8	64.0	72.9	21.9	70.5	75.0	17.7			
International Activity	11.7	5.2	13.8	18.6	8.6	21.5						
Net Due To (Head Office)/Assets (%)	0.1	0.0	0.7	-0.5	0.0	6.4	2.8	0.0	8.2	8.2	11.3	46.9
Core Deposits Ratio (%)	39.8	41.7	22.7	50.5	55.4	21.2	60.7	66.0	24.7			
Loan to Asset Ratio (%)	0.5	0.5	0.2	56.9	64.0	20.1	62.5	64.8	18.8	39.9	36.2	28.3

Table 2: Summary Statistics on Changes in the Prudential Instruments

These tables show summary statistics on changes in the prudential instruments in home and/or destination countries of banks located in the U.S. over the period 2000Q1-2013Q3. Data on the seven instruments come from the prudential instruments database compiled by Cerutti et al. (2015) and are on the quarter level. The table is based on the estimation sample. The table shows the total number of changes, i.e. tightening or loosening, for each instrument as well as the proportion of non-zero entries. "na" indicates that no data has been available for this instrument. All home and/or destination countries of banks located in the U.S. are included. Source: IBRN.

Instrument	Base Data (Before Aggregating to Exposure-Weighted Measures)					Exposure-Weighted Observations
	# of Country-Time Changes	# of Country-Time Changes (Tightening)	# of Country-Time Changes (Loosening)	# of Bank-Time Changes	Proportion Base-MPP Nonzero	Proportion ExpP_t Nonzero
Outward- US Global Banks						
Prudential Index	498	326	172	1399	0.156	0.89
General capital requirements	64	64	0	258	0.037	0.251
Sector specific capital buffer	69	51	18	545	0.022	0.483
Loan-to-value ratio limits	88	64	24	689	0.042	0.625
Reserve requirements: Foreign	133	83	50	809	0.029	0.684
Reserve requirements: Local	269	124	145	1112	0.064	0.786
Interbank exposure limit	21	20	1	204	0.008	0.211
Concentration ratio	32	29	3	348	0.011	0.321
Inward- US Global Banks						
Prudential Index	502	330	172	1468	0.154	0.685
General capital requirements	64	64	0	307	0.027	0.145
Sector specific capital buffer	68	51	17	622	0.022	0.283
Loan-to-value ratio limits	88	64	24	833	0.033	0.37
Reserve requirements: Foreign	136	86	50	932	0.037	0.427
Reserve requirements: Local	270	125	145	1224	0.073	0.549
Interbank exposure limit	21	20	1	260	0.008	0.114
Concentration ratio	32	29	3	394	0.01	0.177
Inward- US Subsidiaries of Foreign Banks						
Prudential Index	92	71	21	204	0.075	
General capital requirements	22	22	0	55	0.02	
Sector specific capital buffer	17	14	3	27	0.01	
Loan-to-value ratio limits	31	23	8	91	0.034	
Reserve requirements: Foreign	1	1	0	1	0	
Reserve requirements: Local	30	13	17	38	0.014	
Interbank exposure limit	8	8	0	13	0.005	
Concentration ratio	6	6	0	10	0.004	
Inward- US Branches of Foreign Banks						
Prudential Index	226	175	51	642	0.152	
General capital requirements	37	37	0	129	0.03	
Sector specific capital buffer	36	28	8	87	0.021	
Loan-to-value ratio limits	60	48	12	220	0.052	
Reserve requirements: Foreign	48	35	13	79	0.019	
Reserve requirements: Local	99	56	43	236	0.056	
Interbank exposure limit	14	14	0	41	0.01	
Concentration ratio	18	18	0	41	0.01	

Table 3: Inward Specification

This table reports the effects of changes in capital requirements, local currency reserve requirements and LTV limits. Columns (1), (4) and (7) show the results based on the sample of U.S. global banks. Columns (2), (5) and (8) are for U.S. subsidiaries of foreign banks and columns (3), (6) and (9) for U.S. branches of foreign banks. In specifications (1) to (3), the variable P_t stands for $ExpP_{b,t}$, the exposure-weighted index. In specifications (4) to (9), P_t stands for $HomeP_{j,t}$, the prudential index that captures prudential policy changes in entity b's home country j. For more details on the variables, see Appendix A. All specifications include time and bank fixed effects as specified in the lower part of the table. Standard errors are robust. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Capital requirements			Reserve Requirements Local		
	(1)	(2)	(3)	(4)	(5)	(6)
	Global banks	Subs	Branches	Global banks	Subs	Branches
P_t	0.037**	0.0161*	-0.0125	-0.0043	0.0177**	0.0235*
	(0.019)	(0.0093)	(0.0229)	(0.0082)	(0.0075)	(0.0135)
P_t-1				0.0082	0.0101	-0.0004
				(0.0084)	(0.0068)	(0.0177)
P_t-2				-0.0054	0.0238***	0.0103
				(0.0070)	(0.0043)	(0.0084)
Log Total Assets_t-1	-0.0575***	-0.0339***	-0.0179	-0.0645***	-0.0344***	-0.0174
	(0.0140)	(0.0117)	(0.0125)	(0.0149)	(0.0118)	(0.0125)
Tier1 Ratio_t-1	0.0025**	-0.0000	-0.0001	0.0024**	0.0001	-0.0000
	(0.0011)	(0.0005)	(0.0010)	(0.0011)	(0.0005)	(0.0010)
Illiquid Assets Ratio_t-1	-0.0001	-0.0014***	-0.0021***	-0.0001	-0.0014***	-0.0021***
	(0.0002)	(0.0004)	(0.0004)	(0.0003)	(0.0004)	(0.0004)
Net Due To_t-1	-0.0032	0.0005	-0.0000	-0.0028	0.0005	-0.0000
	(0.0025)	(0.0005)	(0.0002)	(0.0027)	(0.0005)	(0.0002)
Core Deposits Ratio_t-1	0.0007	-0.0001	0.0003	0.0006	-0.0002	0.0003
	(0.0005)	(0.0003)	(0.0011)	(0.0005)	(0.0003)	(0.0011)
BIS financial cycle_t		0.0007	0.0011***		0.0006	0.0011**
		(0.0004)	(0.0004)		(0.0004)	(0.0004)
BIS business cycle_t		0.0040*	0.0006		0.0040*	0.0003
		(0.0021)	(0.0037)		(0.0021)	(0.0036)
International Activity_t-1	0.0007			0.0009*		
	(0.0005)			(0.0005)		
Observations	1,935	2,707	4,224	1,873	2,707	4,224
R-squared	0.188	0.172	0.097	0.194	0.173	0.098
Adjusted R-squared	0.135	0.120	0.056	0.139	0.121	0.056
Number of banks	59	102	136	59	102	136
Proportion of P_t Nonzero	0.141	0.020	0.030	0.549	0.014	0.056
P_t Coefficient Sum				-0.002	0.052***	0.034
p-value				[0.865]	[0.000]	[0.126]

Table 3: Inward Specification (continued)

	Loan to Value Ratio		
	(7)	(8)	(9)
	Global banks	Subs	Branches
P_t	0.0371	-0.0146	0.0204**
	(0.0305)	(0.0092)	(0.0092)
P_t-1	-0.0054	0.0145	0.0051
	(0.0107)	(0.0133)	(0.0090)
P_t-2	-0.0137	0.0194*	0.0094
	(0.0097)	(0.0103)	(0.0137)
Log Total Assets_t-1	-0.0645***	-0.0343***	-0.0179
	(0.0149)	(0.0119)	(0.0123)
Tier1 Ratio_t-1	0.0025**	0.0000	-0.0001
	(0.0011)	(0.0005)	(0.0010)
Illiquid Assets Ratio_t-1	-0.0001	-0.0014***	-0.0021***
	(0.0003)	(0.0004)	(0.0004)
Net Due To_t-1	-0.0028	0.0005	-0.0000
	(0.0027)	(0.0005)	(0.0002)
Core Deposits Ratio_t-1	0.0006	-0.0002	0.0002
	(0.0005)	(0.0003)	(0.0011)
BIS financial cycle_t		0.0007	0.0010**
		(0.0004)	(0.0004)
BIS business cycle_t		0.0040*	0.0001
		(0.0022)	(0.0039)
International Activity_t-1	0.0009*		
	(0.0005)		
Observations	1,873	2,707	4,224
R-squared	0.195	0.174	0.098
Adjusted R-squared	0.140	0.121	0.056
Number of banks	59	102	136
Proportion of P_t Nonzero	0.370	0.034	0.052
P_t Coefficient Sum	0.018	0.019	0.034**
p-value	[0.504]	[0.381]	[0.023]

Table 4: Outward transmission of Destination Country Prudential Policy

This table reports the effects of changes in destination country regulation and firm characteristics on log changes in total loans by destination country. The data are quarterly from 2000Q1 to 2014Q4 for a panel of bank holding companies. DestP refers to the changes in regulation in the destination country of the loan. For more details on the variables see Appendix A. Each column gives the result for the regulatory measure specified in the column headline. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by country. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

VARIABLES	(1) Prudential IndexC	(2) Capital Requirements	(3) Sector-Specific Capital Buffer	(4) Loan To Value Ratio	(5) Reserve Requirement Foreign	(6) Reserve Requirement Local	(7) Interbank Exposure Limits
P_t	0.0072	-0.0010	0.0002	0.0159	-0.0019	0.0083	-0.0274**
	(0.0077)	(0.0157)	(0.0110)	(0.0100)	(0.0066)	(0.0151)	(0.0135)
$P\_t\text{-}1$	0.0073	0.0004	-0.0083	-0.0060	0.02863**	0.02375**	-0.0531**
	(0.0064)	(0.0150)	(0.0081)	(0.0079)	(0.0139)	(0.0097)	(0.0208)
$P\_t\text{-}2$	0.0076	-0.0122	0.0216	0.01913*	-0.0013	-0.0036	-0.0007
	(0.0053)	(0.0129)	(0.0146)	(0.0109)	(0.0112)	(0.0082)	(0.0121)
Log Total Assets_t-1	-0.0097	-0.0097	-0.0096	-0.0097	-0.0097	-0.0097	-0.0096
	(0.0084)	(0.0085)	(0.0085)	(0.0085)	(0.0084)	(0.0084)	(0.0084)
Tier1 Ratio_t-1	0.0025**	0.0025**	0.0025**	0.0025**	0.0025**	0.0025**	0.0025**
	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)	(0.0009)
Illiquid Assets Ratio_t-1	0.0008*	0.0008*	0.0008*	0.0008*	0.0008*	0.0008*	0.0008*
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
International Activity_t-1	-0.0023***	-0.0023***	-0.0023***	-0.0023***	-0.0023***	-0.0024***	-0.0023***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)	(0.0007)
Net Due To_t-1	0.0022**	0.0022**	0.0022**	0.0022**	0.0022**	0.0022**	0.0022**
	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0010)
Core Deposits Ratio_t-1	-0.0008**	-0.0008**	-0.0008**	-0.0008**	-0.0008**	-0.0008**	-0.0008**
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)
BIS financial cycle_t	0.0128	0.0113	0.0096	0.0103	0.0155	0.0158	0.0138
	(0.0249)	(0.0248)	(0.0247)	(0.0246)	(0.0250)	(0.0245)	(0.0235)
BIS business cycle_t	-0.0002	0.0003	0.0002	0.0000	0.0002	0.0000	0.0004
	(0.0017)	(0.0017)	(0.0017)	(0.0016)	(0.0017)	(0.0017)	(0.0017)
Observations	20643	20643	20643	20643	20643	20643	20643
Adjusted R-squared	0.0139	0.0136	0.0138	0.0139	0.0139	0.0141	0.0139
DestP$_{(t)}$ coefficient sum	0.0222*	-0.0128	0.0135	0.0291***	0.0254**	0.0285	-0.0812***
p-value	[0.0974]	[0.6890]	[0.5549]	[0.0086]	[0.0101]	[0.1541]	[0.0072]

Table 5: Outward transmission of changes in Interbank Exposure limits by Destination Country

This table reports the effects of changes in interbank exposure limits (IBEX) by destination country and firm characteristics on log changes in total claims, cross-border claims, foreign office claims of U.S. global banks to all, emerging market (EME) and advanced foreign economy (AFE) countries. Total claims are further disaggregated by bank claims and public sector claims. The data are quarterly from 2000Q1 to 2014Q4 for a panel of U.S. bank holding companies. For details on countries in EME and AFE country lists, see Appendix C. For more details on the variables see Appendix A. Each column gives the result for the type of claim in the group of countries specified in the column headline. All specifications include fixed effects as specified in the lower part of the table. Standard errors are clustered by country. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Variables	(1) Cross Border Claims ALL Countries	(2) Local Affiliate Claims ALL Countries	(3) Total Claims EMEs	(4) Total Claims AFEs	(5) Cross Border Claims EMEs	(6) Cross Border Claims AFEs	(7) Bank Claims AFEs	(*) Public Sector Claims AFEs
P_t	-0.0240*	-0.0450	0.0800**	-0.0400***	0.0620*	-0.0300***	-0.0960***	-0.0260
	(0.0130)	(0.0520)	(0.0360)	(.0080)	(0.0320)	(0.0080)	(0.0290)	(0.0250)
P_t-1	-0.0780***	-0.0340	-0.1140***	-0.0360	-0.1220***	-0.0640*	0.0160	0.0030
	(0.0270)	(0.0750)	(0.0160)	(0.0240)	(0.0130)	(0.0350)	(0.0380)	(0.0290)
P_t-2	-0.0050	-0.0060	0.0060	0.0090	-0.0710	0.0200	-0.0090	0.0450
	(0.0250)	(0.0310)	(0.0690)	(0.0180)	(0.1330)	(0.0260)	(0.0520)	(0.0330)
Log Total Assets_t-1	-0.0130	0.0340*	-0.0030	-0.0120	-0.0080	-0.0160*	-0.0600	-0.0530
	(0.0090)	(0.0190)	(0.0200)	(0.0080)	(0.0190)	(0.0080)	(0.0400)	(0.0470)
Tier1 Ratio_t-1	0.0040***	0.0050	0.0010	0.0040***	0.0010	0.0050***	0.0080*	0.0050
	(0.0010)	(0.0030)	(0.0010)	(0.0010)	(0.0020)	(0.0010)	(0.0040)	(0.0070)
Illiquid Assets Ratio_t-1	0.0010	0.0010	0.0000	0.0010**	-0.0010	0.0010**	0.0030*	0.0010
	(0.0010)	(0.0010)	(0.0000)	(0.0010)	(0.0010)	(0.0010)	(0.0010)	(0.0030)
International Activity_t-1	-0.0020***	-0.0030**	0.0000	-0.0030***	0.0000	-0.0030***	-0.0020	-0.0040**
	(0.0010)	(0.0010)	(0.0020)	(0.0010)	(0.0020)	(0.0010)	(0.0020)	(0.0020)
Net Due To_t-1	0.0030	0.0020	-0.0180	0.0030***	0.0100	0.0040*	0.0010	0.0120***
	(0.0020)	(0.0020)	(0.0160)	(0.0010)	(0.0220)	(0.0020)	(0.0020)	(0.0030)
Core Deposits Ratio_t-1	-0.0010***	-0.0010	-0.0010	-0.0010	-0.0010	-0.0010**	0.0010	0.0000
	(0.0000)	(0.0010)	(0.0010)	(0.0000)	(0.0010)	(0.0010)	(0.0020)	(0.0020)
BIS financial cycle_t	0.0010	0.0080***	-0.0010	0.0000	0.0000	-0.0010	0.0050	0.0090
	(0.0020)	(0.0030)	(0.0010)	(0.0030)	(0.0020)	(0.0030)	(0.0050)	(0.0060)
BIS business cycle_t	0.0160	0.0060	0.0000	0.0360	0.0070	0.0340	-0.0360	-0.5500***
	(0.0240)	(0.0520)	(0.0520)	(0.0240)	(0.0480)	(0.0220)	(0.0720)	(0.1900)
Observations	20096	8992	8001	12642	7785	12311	4588	2553
Adjusted R-squared	0.01	0.016	0.018	0.016	0.015	0.01	0.003	0.027
Sum of Coefficients of Ibex	-0.107	-0.085	-0.028	-0.067	-0.131	-0.074	-0.089	0.022
p-value	0.0003	0.16	0.804	0.042	0.441	0.02	0.3	0.597

Appendix A: Construction of Balance Sheet Variables for the United States[*]

Variable Name	Report Form Description	Outward/Inwards - US Global Banks: Source	US Subsidiaries of Foreign Banks: Source	US Branches of Foreign Banks: Source	Notes
P_t	Outward: [log(Total Claims$_t$) - log(Total Claims$_{t-1}$)] * 100 Inward: [log(Total Loans$_t$) - log(Total Loans$_{t-1}$)] * 100	**FFIEC 009** FCEX C918, C919, C920, C922, 8593, 8577, 8578, 8579, C915, C916, C917	**FR Y-9C, FFIEC 031** BHCK and RCFD 2122	**FR Y-9C, FFIEC 031, FFIEC 002** BHCK and RCFD 2122	
Illiquid Assets Ratio_t-1	{[Loans held for sale + Loans net of unearned income and allowances for loan & lease losses (A.L.L.) + Held-to-maturity MBS, ABS, and structured financial products (amortized cost) + Available-for-sale MBS, ABS, and structured financial products (fair value)]/Assets}*100	**FR Y9-C, FFIEC 031** BHCK and RCFD 5369, B529, B838, B841, B842, B845, B846, B849, B850, B853, B854, B857, B858, B861, G300, G303, G304, G307, G308, G311, G312, G315, G316, G319, G320, G323, G324, G327, G328, G331, K142, K145, K146, K149, K150, K153, K154, K157, 1698, 1703, 1709, 1714, 1718, 1733, 1702, 1707, 1713, 1717, 1732, 1736	**FR Y9-C, FFIEC 031** BHCK and RCFD 5369, B529, B838, B841, B842, B845, B846, B849, B850, B853, B854, B857, B858, B861, G300, G303, G304, G307, G308, G311, G312, G315, G316, G319, G320, G323, G324, G327, G328, G331, K142, K145, K146, K149, K150, K153, K154, K157, 1698, 1703, 1709, 1714, 1718, 1733, 1702, 1707, 1713, 1717, 1732, 1736		Structured financial products available on the FR Y9-C report form starting 2009 Q2.
Log Total Assets_t-1	Log [Total assets*(GDP Deflator$_{2012}$/GDP Deflator)]	**FR Y9-C, FFIEC 031, BEA** BHCK 2170, RCFD 2170	**FR Y9-C, FFIEC 031, BEA** BHCK 2170, RCFD 2170	**FFIEC 031, FFIEC 002** RCFD2170	Nominal assets are converted to real values (2012 dollars). The GDP implicit price deflator series is from the Bureau of Economic Analysis.
Core Deposits Ratio_t-1	{[Total transaction accounts + Savings deposits (MMDAs, etc.) + Total time deposit accounts with balances less than $100,000]/Liabilities}*100	**FR Y9-C, FFIEC 031** BHCB 2210, 2389, 3187, 6648, BHOD 3187, 3189, 2389, 6648, RCON 2215, 2385, 2604. BHCK and RCFD 2948	**FFIEC 031** RCON 2215, 2385, 2604		
Tier1 Ratio_t-1	[Tier 1 risk-based capital/Risk-weighted assets (net of allowances and other deductions)]*100	**FR Y9-C, FFIEC 031** BHCA and RCFD 8274, A223	**FR Y9-C, FFIEC 031** BHCA and RCFD 8274, A223	**FR Y-7Q** FBOQ 8274, A223	Linear interpolation is used for FR Y-7Q data
Net Due To_t-1	[(Net due to own foreign offices, edge and agreement subsidiaries, and IBFs - Net due from own foreign offices, edge and agreement subsidiaries, and IBFs)/Assets]*100	**FFIEC 009, FR Y-9C, FFIEC 031** FCEX 8595, BHCK and RCFD 2170	**FFIEC 031** RCON 2941, 2163, RCFD 2170	**FFIEC 031, FFIEC 002** RCON 2941, 2163, RCFD 2170, 2944, 2154	From the perspective of the commercial bank head office vis-a-vis own foreign offices, edge and agreement subsidiaries, and IBFs.
International Activity_t-1	[(Foreign Assets +Deposits in foreign offices, edge and agreement subsidiaries, and IBFs)/Assets]*100	**FFIEC 009, FR Y-9C, FFIEC 031** FCEX C918, C919, C920, C922, 8577, 8578, 8579, BHDM 6631, 6636, RCFN 2200, BHCK and RCFD 2170	**FR Y-9C, FFIEC 031** BHDM and RCFN 6631, 6636		

Appendix B: Construction of exposure-weighted prudential index

The exposure-weighted prudential index $ExpP_{b,t}$ is used to measure the effect of prudential policy changes on US banks' lending growth. It enters regression equation (1) as follows:

$$\Delta Y_{b,t} = \alpha_0 + \alpha_1 ExpP_{b,t} + \alpha_2 ExpP_{b,t-1} + \alpha_3 ExpP_{b,t-2} + a_4 X_{b,t-1} + f_b + f_t + \epsilon_{b,t}.$$

PP_{it} in the formulas below stands for any of the indices that measures the change in one of the prudential instruments from the prudential database (e.g. limits on LTV ratios, capital requirements etc.) by regulators in country i.

The exposure weighted prudential index for bank b at time t is calculated as follows:

$$ExpP_{bt} = \sum_{i \neq USA} PP_{it} \cdot \phi_{ibt-1} , \text{ where } \quad \cdot \phi_{ibt-1} = \frac{\sum_{t=t-4}^{t-1} claims_{bit}}{\sum_{i \neq USA} \sum_{t=t-4}^{t-1} claims_{bit}} .$$

Claims$_{bit}$ represent bank b's claims on country i at time t from the FFIEC 009 reports.

In the following we provide an example: To construct the exposure-weighted index at time t for bank b with exposures as given in the table below, we proceed as follows:

$ExpP_{bt} = (3+5+4+6)/ (6+9+7+12) \times 1 + (3+4+3+6)/ (6+9+7+12) \times 0 = 0.53 \times 1 + 0.47 \times 0 = 0.53.$

date	country A	country B	USA	total exp.	exp. on A and B
t	1	6	4	11	7
t-1	3	3	6	12	6
t-2	5	4	2	11	9
t-3	4	3	3	10	7
t-4	6	6	4	16	12
MPP change at t	1	0	-1		

Appendix C: List of countries by level of development

Advanced Economies: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Malta, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.

Emerging Market Economies: Argentina, Brazil, Bulgaria, Chile, China, Colombia, Croatia, Czech Republic, Estonia, Hong Kong, Hungary, India, Indonesia, Israel, Korea, Kuwait, Latvia, Lebanon, Lithuania, Malaysia, Mexico, Mongolia, Nigeria, Peru, Philippines, Poland, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovak Republic, Slovenia, South Africa, Taiwan, Thailand, Turkey, Ukraine, Uruguay, and Vietnam.