How does the interaction of macroprudential and monetary policies affect cross-border bank lending?[1]

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This draft: August 2020

Abstract: We combine a rarely accessed BIS database on cross-border lending flows with cross-country data on macroprudential regulations. We find significant interactions between the monetary policy of major international currency issuers (USD, EUR and JPY) and macroprudential policies in source (home) lending banking systems. Consistent with the bank lending channel, macroprudential easing in a home country amplifies the effect of currency issuers' monetary policy on lending. For instance, UK macroprudential easing amplifies the negative impact of US monetary policy tightening on USD-denominated cross-border bank lending outflows from UK banks. Vice versa, tighter macroprudential policy mitigates these effects.

Keywords: Monetary policy; macroprudential policy; cross-border claims; diff-in-diff

JEL codes: F34; F42; G21; G38

[1] We are thankful for comments from Stijn Claessens, Bryan Hardy, Machiko Narita, Nikola Tarashev, Rebecca Zarutskie and from seminar participants at the Bank for International Settlements, the Central European University, the University of Basel. We are grateful for comments from conference participants at the 3rd IMF Annual Macro-Financial Research Conference in 2020, the CEBRA 2020 Annual Meeting, the FMA Annual Meeting in 2019, the WEAI Annual Meeting in 2019, the ASSA Annual Meeting in 2020 and the ECB – Bank of Ireland Monetary Policy Task Force on Banking Analysis for Monetary Policy Conference in 2020. We are grateful for expert research assistance from Swapan-Kumar Pradhan. Temesvary is thankful for the support provided by the BIS through the Central Bank Fellowship Program for the completion of this project. The views expressed in this paper are solely those of the authors, and do not necessarily reflect the views of the Bank for International Settlements or the Board of Governors of the Federal Reserve System.

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1. Introduction

Central banks and financial regulators use macroprudential tools increasingly frequently after the global financial crisis to promote financial stability (IMF-FSB-BIS, 2016). At the same time, policy makers continue to use monetary policy tools to address inflation and employment goals. Even though macroprudential and monetary policies have been employed frequently side by side for nearly a decade, there are serious gaps in our understanding of how they work together (Yellen, 2014; Quarles, 2019). This lack of understanding is problematic in that such interactions matter for economic policy: both policies affect the availability and price of credit to the wider economy (Yellen, 2010; Claessens, 2013; Praet, 2018). Yet, identifying the interactions between macroprudential and monetary policies is fraught with difficulties: within a country, these policies respond to similar variables, such as credit growth, and often operate through similar channels, such as the cost of bank credit. This, together with the lack of available data, has hindered efforts in identifying interaction effects in cross-border lending.

For the first time, we are uniquely able to tackle this identification issue and shed light on the interaction between macroprudential and monetary policies. We do so by applying a novel identification strategy to a unique and rarely accessed dataset on a network of cross-border bank claims by currency denomination (from the Stage 1 Enhancements to the Bank for International Settlements' International Banking Statistics (BIS IBS)). We combine this data with two distinct databases on country-specific measures of macroprudential policy actions (from Cerutti et al (2017) (CCFS) and the International Monetary Fund (IMF) Integrated Macroprudential Policy Database (iMaPP)). We find that macroprudential policy easing amplifies the effect of monetary policy on cross-border bank lending, and vice versa, macroprudential tightening mitigates monetary policy effects.

We build our research hypothesis based on the bank lending channel. According to the bank lending channel, the lending effects of monetary policy are particularly potent for those banking systems that are funding-constrained (Takats and Temesvary, 2020), or those that markets perceive as more risky (or as less resilient; Temesvary et al, 2018). Therefore, by altering the resiliency of banking systems (IMF-FSB-BIS, 2016; Takats and Temesvary, 2019; Meuleman and Vennet, 2020), macroprudential policies can change the potency of monetary policy effects on lending. Accordingly, we hypothesize that by making bank funding markets perceive a banking system as less resilient, macroprudential policy *easing* in a source banking system *amplifies* the lending impact of monetary policy on cross-border outflows. In contrast, *tightening* in macroprudential policy in a source banking system *mitigates* monetary policy effects. As a corollary and in the extreme, very large macroprudential tightening could even sterilize the impact of monetary policy on cross-border bank lending.

Our identification strategy focuses on the interaction of a monetary policy that is exogenous to the macroprudential policy, yet affects the same lending flows. We build on the currency dimension of the international bank lending (CDIBL) channel, an internationalization of the bank lending channel logic developed by Kashyap and Stein (2000): monetary policy tightening by the issuer of a reserve currency of lending lowers cross-border lending flows in that currency, even when neither the lending banking system nor the borrower country uses that currency as its own (Takats and Temesvary, 2020).[4]

Invoking this CDIBL channel, we focus on foreign currency-denominated lending of banks across borders, and examine how changes in monetary policy by the *issuers of the top three reserve currencies* (the US dollar (USD), euro (EUR) and Japanese Yen (JPY)) interact with macroprudential policies enacted in the *domestic* jurisdictions of global banks, in driving cross-border bank lending. By focusing on a network of cross-border bank lending flows in reserve currencies, we are able to separate monetary policy (enacted by the currency issuer

[4] For instance, according to the CDIBL channel, tightening by the Federal Reserve raises the cost of USD funding, and thus reduces USD cross-border bank lending globally, even if the US is neither the lender nor the borrower.

rather than domestic policy makers) from macroprudential policy (enacted by domestic policy makers). An example of what we do in this paper is to investigate how UK macroprudential tools interact with US monetary policy in affecting USD-denominated cross-border bank lending outflows from the UK banking system to borrowers' countries (e.g. to Malaysia).

The examination of the interaction between currency-specific monetary policy and country-specific macroprudential policy (in our example, US monetary policy and UK macroprudential policy) provides an exogenous identification which would be impossible in a single-country setup. In addition, we have bilateral lending data in *several major* currencies (in our example, also EUR and JPY denominated cross-border bank lending by UK banks to Malaysia). This feature has multiple identification advantages. First, studying *several* currencies not only allows us to draw conclusions generalizable across denominations, but also lets us apply country-time fixed effects to control for confounding changes in credit demand (in our example, by Malaysian borrowers).[5] Second, the monetary policies of central banks that issue *major* global currencies, due to their economic centrality and size, are generally unaffected by the macroprudential policies of other countries (in our example, US monetary policy is arguably independent of UK macroprudential policy). This separation ensures the exogeneity of policies, that we need for identification.

This identification strategy is afforded by the novel dataset that we construct from three sources. First, the "Stage 1 Enhancements" to the BIS IBS lists cross-border lending flows by currency (USD, EUR and JPY) from 27 lending banking systems to 50 borrowers' countries starting in 2012 Q2. This database provides a unique breakdown of lending flows by (1) lending banking system, (2) borrowers' country, and (3) currency. We combine this data with two

[5] Specifically, we apply a generalization of the Khwaja and Mian (2008) identification method as we include extensive sets of fixed effects, including country-time fixed effects. Importantly, global shocks which affect all countries simultaneously, and thus introduce possible co-movement of macroprudential and monetary policies, are taken out by our consistent use of time fixed effects in the analysis.

distinct macroprudential databases on country-specific measures of macroprudential policy actions (from the CCFS and the IMF iMaPP). Our work is unique in combining multiple databases on macroprudential policies, a feature we think is critical to ensure robustness.

We conduct our analysis as follows. We start by focusing on the period of the effective (zero) lower bound on monetary policy rates, starting with 2012 Q2 and ending in 2014 Q4, the eve of the year of US monetary policy liftoff (Lhuissier et al, 2019). Given the binding effective lower bound, we use shadow interest rates from Krippner (2016) to capture the stance of post-crisis unconventional monetary policy, and examine the macroprudential-monetary policy interaction using regulatory measures from both the CCFS and IMF iMaPP databases. Second, we extend our analysis to 2016 Q4 to study the policy interaction during and after US monetary policy liftoff. For this extended analysis, we have the IMF iMaPP database available.

Consistent with our hypothesis, we find strong and robust evidence that over the 2012 Q2 – 2016 Q4 period monetary policies of the issuers of reserve currencies interact with macroprudential policies enacted in source banking systems in affecting cross-border lending flows. As we hypothesized, macroprudential policy easing amplifies the lending impact of monetary policy (irrespective of whether monetary policy tightens or eases). Referring back to our example, our results imply that macroprudential policy easing in the UK amplifies the negative impact of US monetary policy tightening on USD cross-border lending outflows from the UK banking system (say, to Malaysia). In contrast, we find that tighter macroprudential policy generally mitigates the lending effect of monetary policy.[6] Furthermore, as expected, very strong macroprudential tightening increases banking system resilience to the point that the bank lending channel of monetary policy disappears.

[6] Importantly, these results pertain to policy interactions – and not the level effects of macroprudential policies. For instance, macroprudential tightening, by making domestic bank lending relatively more expensive, may drive UK banks' lending outward and thereby increase cross-border bank lending to Malaysia. While not in our focus, we account for such level effects in all our estimations.

These results are economically significant: following a 25 basis point monetary tightening over four quarters, cross-border lending outflows decline by around 2.5 percentage points (p.p.) more in a source banking system that eases macroprudential tools (i.e. India in 2014 Q1) than from a source that tightens such tools (i.e. the Netherlands in 2014 Q1). This impact is substantial, given that the average quarterly growth in bilateral cross-border bank claims is 1.2 percent. Our findings are robust to numerous alternative specifications and robustness checks.

The results are policy relevant. First, the macroprudential-monetary policy interactions matter for central banks in the countries of borrowers to assess credit supply. In our earlier example, Malaysian policy makers would benefit from understanding early how the interaction of US monetary policy and UK macroprudential policy affects cross-border USD loan supply to their economies. An early recognition could help calibrate a timely domestic policy response. Second, these interactions matter for regulators of major international banks, when they calibrate macroprudential policies. In our example, assessing the policy interaction enables UK regulators to account for cross-border lending effects when fine-tuning their macroprudential policies. Furthermore, understanding the policy interactions also matters for the central banks associated with the reserve currencies. In our example, understanding policy interactions may provide information to the Federal Reserve to more precisely assess spillbacks to the US.

The rest of the paper proceeds as follows. In Section 2, we describe the related literature and develop our hypothesis. In Section 3, we describe the data. We present the methodology in Section 4 and detail the results in Section 5. We discuss robustness in Section 6 and conclude in Section 7.

2. Related literature and hypothesis development

Separately, extensive research has examined macroprudential and monetary policy effects, in both domestic and international settings. Research on *macroprudential policies* (as reviewed by Elliott (2013), Claessens (2015) and Galati and Moessner (2018)) has addressed externalities that arise as individual lenders and borrowers do not internalize how their actions affect the financial system as a whole (Bianchi and Mendoza, 2010, 2018; Bianchi, 2011; Bianchi et al, 2012; Benigno et al, 2013; Farhi and Werning, 2016; Jeanne and Korinek, 2019). Dating back to Crockett (2000) and Borio (2003), previous work also suggests that macroprudential policies have an international dimension (see, for instance, IMF-FSB-BIS (2016)), as international capital flows and foreign currency lending can aggravate the very externalities that invoked macroprudential policies in the first place (Schmitt-Grohe and Uribe, 2012). Earlier papers have established a wide range of strong evidence of regulatory impact on global banks' cross-border lending flows and location choices (Houston et al, 2012; Temesvary, 2018; Frame et al, 2019; Takats and Temesvary, 2019; Buch and Goldberg, 2017).

In addition to extensive research on the domestic lending effects of monetary policy (Kashyap and Stein, 2000), papers on the international effects of domestic monetary policy have identified cross-border bank lending as a spillover channel (Miranda-Agrippino and Rey, 2012; Forbes and Warnock, 2012; Bruno and Shin, 2015; Temesvary et al, 2018). Monetary policy of a currency issuer can transmit into lending in that currency in foreign countries as well (Alper et al, 2016; Ongena et al, 2015; Avdjiev and Takats, 2018; Avdjiev et al, 2016; Brauning and Ivashina, 2020).

The strands of research on macroprudential and monetary policies have converged little. Although macroprudential and monetary policies may suffice separately to reach their respective goals of financial stability and stable inflation (or business cycle), assessing their interaction is key for fine-tuning the combined policy effects. As a result, the interaction of these policies has become critical for policymakers (Yellen, 2010; Claessens, 2013; Claessens and Valencia, 2013; Praet, 2018; Cecchetti et al, 2018).

Various models have proposed how macroprudential policies could interact with monetary policy (Beau et al, 2011, 2012; De Paoli and Paustian, 2013; Brunnermeier and Sannikov, 2014; Smets, 2014; Darracq Paries et al, 2019, Coman and Lloyd, 2019). In the related scarce empirical literature, recent papers have described macroprudential and monetary policies as reinforcing each other (Gambacorta and Murcia (2017) in Latin America, and Bruno et al (2017) in the Asian context). Hills et al (2019) investigate the policy interactions through the external lending of UK banks.

Based on evidence in this line of work, we hypothesize that *monetary and macroprudential policies significantly interact in affecting cross-border lending flows.* To the best of our knowledge, ours is the first research paper to investigate such policy interactions in the global and cross-border bank lending context.

To refine our hypothesis on the directionality of the policy interaction effects, we draw on the bank lending channel literature, as well as papers on the efficacy of macroprudential tools in promoting banking system resilience. Regarding the bank lending channel, earlier papers have established that following a tightening in monetary policy, financial markets judge "weaker" (less resilient), banks to be riskier (Bernanke et al, 1996; Halvorsen and Jacobsen, 2016). As a result, although all banks borrow at higher costs after a monetary policy tightening, riskier banks face a relatively larger increase in funding costs in funding markets (the external finance premium) than more resilient banks, resulting in correspondingly larger lending reductions. Takats and Temesvary (2020) show that this mechanism operates in the CDIBL channel as well, across a broad range of banking systems, currencies of lending, and measures of resilience.

Macroprudential policies affect financial stability; as such, tighter macroprudential policies enhance banking system resilience (IMF-FSB-BIS, 2016; Takats and Temesvary, 2019; Meuleman and Vennet, 2020), while easing in such policies reduces resilience. Therefore, we hypothesize further that *macroprudential policy easing in the source banking system amplifies the lending impact of monetary policy on cross-border outflows, and tightening in macroprudential policy mitigates monetary policy effects.* Furthermore, the CDIBL channel, and more broadly the bank lending channel literature, suggests that the bank lending channel of monetary policy operates weakly (if at all) on resilient banks – as the external finance premium that funding markets expect from such banks following a monetary policy tightening-induced rise in funding costs is minimal. Therefore, *large macroprudential tightening could neutralize the cross-border lending effects of monetary policy*.

3. Data description

3.1 Data on macroprudential measures

Our data on country-level regulatory measures come from two sources: the macroprudential (CCFS) database developed and described in Cerutti et al (2017), also incorporating the 2013 Global Macro Prudential Instruments (GMPI) survey (Avdjiev et al, 2017; Berrospide et al, 2017); and the IMF's Integrated Macroprudential Policy Database (iMaPP). The CCFS database extends on a quarterly frequency up until 2014 Q4, and the IMF iMaPP database is available up to 2016 Q4. The panels in Table A1 summarize and describe these indices.

Importantly, we focus on the overall impact of macroprudential rules, rather than formulating hypotheses around specific tools and their impact on cross-border bank lending in our main analysis. Therefore, we construct macroprudential policy indices from both databases. In the construction, we follow similar steps as those taken in Cerutti et al (2017). The CCFS and IMF iMaPP regulatory databases describe quarterly changes in the stance of individual macroprudential tools, coded as 1 for tightening and -1 for easing. Our macroprudential index in each database is a country index by time *t* and country *i*, which equals 1 if the sum of changes in the individual policy tools listed in Table A1 is greater than or equal to 1, equals -1 if the sum of the changes is less than or equal to -1, and is 0 otherwise (Cerutti et al, 2017).

In our investigation, we focus on strictly macroprudential tools. This distinction matters because both the CCFS and IMF iMaPP databases contain a mix of macroprudential and (micro)prudential measures. Most importantly, both databases contain information on minimum capital requirements. These capital requirements reflect more (micro)prudential considerations – in fact, they often reflect the adoption of Basel III regulatory reforms. In other words, the changes in capital requirements, though they might affect cross-border bank lending (Forbes et al, 2017), are not macroprudential tools and are outside the scope of our analysis. Therefore, we exclude changes in minimum capital requirements, when we create our index of macroprudential tools.[7]

The two macroprudential databases show a similar, but not identical, picture. The correlation across the macroprudential indexes constructed from the two databases is near 0.7. This underlines the importance of investigating interactions using both measures.

3.2 Data on bilateral cross-border bank claims

Cross-border bank claims total around 30 trillion USD globally. These claims include cross-border bank lending and other claims (such as securities holdings). The Bank for International Settlement's International Banking Statistics (BIS IBS) provides detailed data about these cross-border claims along several dimensions.

[7] We include capital requirements in our robustness checks to show that this exclusion does not drive our results.

In order to identify the interaction between home macroprudential tools and the monetary policy of the currency issuer, we need three dimensions of the cross-border bank claims data: (A) the currency composition of cross-border claims; (B) the residence of the borrower, and (C) the nationality of the lending banking system.[8] The currency composition (A) is necessary to study the currency-specific effects of the monetary policies of the issuers of reserve currencies. The borrowers' residence (B) is necessary to control for changes in credit demand in the borrowers' countries. The nationality of the lending banking system (C) is necessary to identify the home macroprudential agency whose policy we aim to follow. Using our leading example, these three dimensions enable us to investigate how USD-denominated cross-border bank flows from UK-headquartered banks to Malaysia are affected by the interaction of (A) US monetary policy and (C) UK macroprudential policy while controlling for credit demand in Malaysia (B).

In our analysis, we use the Stage 1 enhancements of the BIS IBS, because this dataset uniquely allows us to have all three necessary dimensions of the underlying cross-border bank claims data (Table A2).[9] The Stage 1 Enhancement to the BIS IBS is available by quarterly

[8] We focus on "lending banking systems" as opposed to "lending countries", so that we can follow the decision-making unit as precisely as possible: Fender and McGuire (2010) and Cecchetti et al (2010) argue that the lending bank's nationality tends to be more relevant than its residence in identifying the decision-making unit. Building on these findings, Avdjiev et al (2015) describe the (absence of) triple coincidence in international finance: national borders, the conventional units of international economic analysis, often do not coincide with the economically relevant decision-making unit.

[9] In comparison, two main BIS IBS datasets cover cross-border claims: the consolidated and the locational data. The first, consolidated dataset groups claims according to the nationality of banks. It covers residence of borrower (B) and the nationality of the lending banking system (C), but not the currency composition (A). In our case, the consolidated dataset would not allow us to focus on currency-specific monetary policy effects, i.e. to identify the CDIBL channel. The second dataset, the locational banking statistics defines creditors and debtors according to their residence, consistently with national accounts and balance of payments principles. It has three main subsets: the residence-based, the nationality-based and the Enhanced Stage 1 data. The residence based data has information on the currency composition (A) and the residence of borrower (B), but not on the nationality of the lending banking system (C). This can be an issue with financial centers. For instance, a UK bank's lending through its Hong Kong subsidiary to Malaysia, would be identified as two separate lending relationships in residence-based approach: one loan from the UK to Hong Kong and another one from Hong Kong to Malaysia. In our case, that would mask the impact of the home (i.e. the UK) macroprudential regulator's macroprudential policies on lending to Malaysia. In contrast, the nationality-based data observes nationality of the lending bank (C) along with the currency denomination (A) – but not the residence of the borrower (B). In our case, not having access to the residence of borrower would preclude controlling for changes in credit demand.

frequency starting from 2012 Q2 onward both in stocks (levels) and in currency-adjusted flows.[10] The stocks and flows are also available by currency denomination, across the major international currencies.[11] We focus on the three main currencies (USD, EUR and JPY) that are the most prevalent in cross-border lending. When analyzing the Stage 1 enhanced dataset, we use a large cross section that covers 27 lending banking systems and 50 borrowers' countries.[12] The Stage 1 enhanced IBS data is fairly representative, though not yet fully complete. On aggregate, information on the nationality of lending banks is available for more than 90 percent of global cross-border claims (Avdjiev and Takats, 2018). However, this ratio varies and tends to be higher for larger counterparty countries.

Looking at the breakdown by major lenders and borrowers, Japanese, US and UK banks dominate USD lending and French and German banks are the top EUR lenders. On a much smaller scale, Japanese banks dominate JPY lending. On the borrower side, the highest USD and JPY borrowers are the United States and Japan, respectively. Being a financial center, the UK is home to the largest cross-border borrowers in EUR and the second largest in USD and JPY.

By currency, the USD, the EUR and the JPY dominate cross-border bank lending globally with shares of around 47 percent, 32 percent and 5 percent of the total volumes at end-2014, respectively. The shares at the start of our sample in Q2 2012 were 38, 41 and 5 percent for

[10] The start of our sample is determined by data availability. However, 2012 Q2 is also the period that marks the start of the effective zero lower bound (ZLB) in the euro-area – thus allowing us to focus on a more uniform time frame during which each of our reserve currencies experienced a binding ZLB.
[11] The flows are also adjusted for breaks in the series.
[12] The 27 lending banking systems are Austria; Australia; Belgium; Brazil; Canada; Chinese Taipei; Denmark; Finland; France; Germany; Greece; India; Ireland; Italy; Japan; Korea; Luxembourg; Mexico; the Netherlands; Norway; Portugal; Spain; Sweden; Switzerland; Turkey; United Kingdom; United States. The 50 borrowing countries are Angola; Austria; Australia; Belgium; Brazil; Bulgaria; Canada; Chile; China; Chinese Taipei; Croatia; Cyprus; Czech Republic; Denmark; Finland; France; Germany; Greece; Hungary; Ireland; Israel; Italy; Japan; Korea; Liberia; Lithuania; Luxembourg; Malta; Marshall; Island; Mexico; Morocco; the Netherlands; New Zealand; Nigeria; Norway; Poland; Portugal; Romania; Russia; Slovakia; Slovenia; South Africa; Spain; Sweden; Switzerland; Turkey; Ukraine; United Kingdom; United States; Vietnam.

USD, EUR and JPY, respectively. The fourth largest currency network, the British Pound (GBP), constitutes less than 5 percent of total cross-border bank claims.

In line with the overall retraction in cross-border lending following the global financial crisis, bilateral cross-border flows declined over our sample period. On average, total bilateral lending flows tapered by a quarterly 2.4 percent (declines of 2.3, 1.0 and 5.9 percent in USD, EUR and JPY, respectively).

Since smaller-scale lending flows can be very volatile, we winsorize the observations at the 5th and 95th percentile. This is common in related work (Avdjiev and Takats, 2014; Avdjiev and Takats, 2018; Takats and Temesvary, 2019, 2020), because one can observe several hundred percentage point changes in some very small bilateral claims.[13]

3.3 Data on monetary policy stance

Our benchmark sample focuses on the period of the binding effective zero lower bound (2012 Q2 – 2014 Q4), preceding the liftoff of US monetary policy. During this period, the major central banks, the Federal Reserve, the European Central Bank and the Bank of Japan relied on "unconventional" expansionary monetary policies. As a result, the short-term policy target interest rates set by these three central banks hit the effective zero lower bound in early 2009 – and therefore became uninformative of the stance of expansionary monetary policy thereon (Figure 1, left panel). Hence, we use the currency-specific short-term shadow interest rates (as described in Krippner (2013, 2015 and 2016)) to measure the change in monetary policy stance of the three major reserve currencies (Figure 1, right panel). By construction, the short-term

[13] For instance, this might happen due to small idiosyncratic shocks, such as a new FDI project.

shadow interest rates are not subject to the zero lower bound, and are thus able to capture expansionary monetary policy actions by dipping into the negative range.[14]

Our larger sample extends through end-2016, including the post-liftoff period of conventional monetary policy actions. However, for consistency and comparability, we continue to use the Krippner shadow rates also in this extended sample. This is appropriate, as by construction the Krippner shadow short-term rates are identical with policy interest rates during conventional monetary policy periods. We define the change in the monetary policy stance as the quarterly change (from t–1 to t, in p.p.) in the short-term shadow interest rate that corresponds to the monetary conditions determined by the central bank that issues currency *c*.

3.4 Additional macro controls

Whenever we do not rely on (borrowers') country*time fixed effects, we control for macroeconomic and financial effects on credit demand in borrowers' countries and credit supply in source bank lending systems. To do so, we add (real) GDP growth and changes in domestic interest rates as controls in specifications where country*time fixed effects are not

[14] Regarding the short-term shadow interest rate, Krippner (2016) writes: "The SSR is the shortest maturity rate from the estimated shadow yield curve. It is essentially equal to the policy interest rate in non-LB/conventional monetary policy environments (eg August 2008), but the SSR can freely evolve to negative values in LB/unconventional environments (eg July 2011) to indicate an overall stance of policy that is more accommodative than a near-zero policy rate alone. In particular, the SSR reflects the effects that unconventional policy actions (such as quantitative easing and forward guidance) have on longer-maturity interest rate securities, because it is estimated from yield curve data. SSRs have therefore become a popular and intuitive indicator of the stance of monetary policy across conventional and unconventional environments (emphasis added)." (page 4). In addition, Krippner describes: "…an in-principle issue with SSRs is that negative values do not represent interest rates at which economic agents can transact. Therefore, the levels and changes in SSRs when they are negative should not necessarily be expected to influence the economy in the same way as policy rate levels and changes in conventional policy periods… However, the results for the United States in Krippner (2015) indicate that SSR estimates from K-ANSM(2) models do provide useful quantitative indicators of unconventional monetary policy, and hence I think it is useful to retain them in the suite of unconventional monetary policy indicators. (emphasis added)" (page 4). That is to say, because the short-term shadow interest rate is designed so that lower values correspond to quantitative easing and large-scale asset purchases (LSAPs), they indicate a flatter yield curve characterizing banks' portfolio. The extra liquidity on bank balance sheets, spurred by a relative rise in short-term interest rates (corresponding to lower long-term rates, resulting from unconventional monetary policies including LSAPs (Reis, 2009; 2019)) is a powerful channel via which lower shadow interest rates may be related to more bank lending (investment), even without any changes in funding costs.

included. We also add quarterly changes in the exchange rate between the currencies of the source (home) and the borrowers' country, to capture any additional valuation effects which may influence banks' cross-border lending flows. We describe our model variables in Table 1.

4. Estimation methodology

4.1 Identification

The main issue for identification is the potential endogeneity of macroprudential tools to monetary policy. In a domestic context, policy makers might observe overheating credit markets and react with either macroprudential or monetary policy tightening – or a combination of the two. In short, the use of the two policies are typically endogenous in a domestic context. Consequently, when we investigate interactions with source macroprudential tools, we need to focus on the effects of a monetary policy that is not linked to the source bank lending system.[15]

4.2 Panel regression setup

Our dependent variable, *Δclaims* is the quarterly change in the natural logarithm of bilateral claims between the source lending banking system i and borrowers' country j, denominated in currency c. Our two main explanatory variables are (1) our CCFS and IMF iMaPP indices of applied macroprudential measures (*macroprudential*) in source bank lending system i as defined in Section 3.1 above, and (2) the change in the monetary policy stance (*monetary*) associated with the major international currencies (USD, EUR, JPY) as measured by the Krippner (2016) shadow rates. Following the standards of the bank lending literature (Kashyap

[15] Similarly, when we extend the analysis to policy interactions with borrowers' country macroprudential tools, then we need to examine a monetary policy that is unrelated to borrowers' country regulatory policies.

and Stein, 2000; Cetorelli and Goldberg, 2012) in accounting for potential persistence in lending flows, we consistently add the lagged dependent variable to the right-hand side.

To strengthen identification, we restrict all our estimations to exclude both same country lending and own currency lending (in the terminology of Takats and Temesvary (2020)). These two sets of lender-borrower pairs could potentially confound identification. First, same country lending (e.g. US-owned bank subsidiaries lending back to US-based borrowers) suffer from a more severe endogeneity of monetary and macroprudential policies. Second, own currency lending (e.g. German bank lending in EUR or US banks' lending in USD) might confound the country and currency-specific impact of monetary policy.

We use four equations throughout the paper. The first regression explains lending flows as a function of macroprudential policies in source bank lending system i ($\Delta macroprudential_{it}$) and monetary policy by currency issuer c ($\Delta monetary_{ct}$). We also include four lags of borrowers' country macroprudential stringency ($\Delta macroprudential_{jt}$). In addition, we control for macroeconomic variables both in source bank lending system i ($\Delta macro_{it}$) and borrowers' country j ($\Delta macro_{jt}$). Furthermore we apply fixed effects for each source bank lending system (FE_i), borrowers' country (FE_j) and currency (FE_c) to capture any time-invariant level differences. Finally, we apply time fixed effects for each quarter (FE_t) to control for unobserved global factors. Equation (1) is formally written as:

1. $$\Delta claims_{ijct} = \sum_{k=1}^{4}(\beta_{1k}\Delta macroprudential_{it-k} + \beta_{2k}\Delta monetary_{ct-k} + \\ + \beta_{3k}\Delta macroprudential_{jt-k} + \beta_{4k}\Delta macro_{it-k} + \\ + \beta_{5k}\Delta macro_{jt-k}) + FE_i + FE_j + FE_c + FE_t + \varepsilon_{ijct}$$

In the second regression, we add our main interest: the interaction between macroprudential and monetary policy ($\Delta macroprudential_{it} * \Delta monetary_{ct}$):

2. $$\Delta claims_{ijct} = \sum_{k=1}^{4}(\boldsymbol{\gamma_{1k} \Delta macroprudential_{it-k}} * \boldsymbol{\Delta monetary_{ct-k}} + \\ + \gamma_{2k} \Delta macroprudential_{it-k} + \gamma_{3k} \Delta monetary_{ct-k} + \\ + \gamma_{4k} \Delta macroprudential_{jt-k} + \gamma_{5k} \Delta macro_{it-k} + \\ + \gamma_{6k} \Delta macro_{jt-k}) + FE_j + FE_i + FE_c + FE_t + \varepsilon_{ijct}$$

While Equation (2) addresses the policy interaction, a potential identification question remains. Namely, the question is the extent to which the macro controls capture non-policy related changes in credit demand from the borrowers' countries and credit supply from the source bank lending systems. Less than fully controlling for such confounding factors might result in omitted variable bias, which may, in turn, affect our interaction estimates.

To address this potential omitted variable bias, we expand the logic outlined in Khwaja and Mian (2008) to a broader context by adding (1) country*time fixed effects for borrower's country j (FE_{j*t}) and (2) currency*time fixed effects for currency c (FE_{c*t}). The borrowers' country-specific fixed effects allow us to control for any potential direct time-varying country-level credit demand changes in the borrowers' country. Similarly, the currency specific currency*time fixed effect controls for any changes related to the use of that currency. Consequently, we drop the stand-alone macro terms for borrowers' country j ($\Delta macro_{jt}$) and the monetary policy by currency issuer c ($\Delta monetary_{ct}$) that would be subsumed by our extensive fixed effects. The resulting Equation (3) is written as:

3. $$\Delta claims_{ijct} = \sum_{k=1}^{4}(\boldsymbol{\delta_{1k} \Delta macroprudential_{it-k}} * \boldsymbol{\Delta monetary_{ct-k}} + \\ + \delta_{2k} \Delta macroprudential_{it-k} + \delta_{3k} \Delta macro_{it-k}) + FE_{j*t} + FE_i + \\ + FE_{c*t} + \varepsilon_{ijct}$$

Finally, we address the potential concern that some unobserved structural features embedded in the global cross-border bank lending system may drive our result. Technically, we introduce a fixed effect for each lending-borrowing pair to subsume such structural impact (FE_{i*j}). For instance, in our earlier example the UK-Malaysia link would receive a fixed effect. Given that our identification relies much more on cross-sectional than on time-series variation, this constitutes a demanding specification. We drop the country*time fixed effects for borrowers' countries here and reintroduce the macroeconomic controls ($\Delta macro_{it}$ and $\Delta macro_{jt}$). The resulting Equation (4) is written as:

4. $$\Delta claims_{ijct} = \sum_{k=1}^{4}(\boldsymbol{\theta_{1k}\Delta macroprudential_{it-k}} * \boldsymbol{\Delta monetary_{ct-k}}$$
$$+ \theta_{2k}\Delta macroprudential_{it-k} * \Delta monetary_{ct-k} * \Delta macroprudential_{jt-k}$$
$$+ \theta_{3k}\Delta macroprudential_{jt-k} + \theta_{4k}\Delta macro_{it-k} + \theta_{5k}\Delta macro_{jt-k})$$
$$+ FE_{i*j} + FE_{c*t} + \varepsilon_{ijct}$$

Importantly, while the extensive use of country*time and currency*time fixed effects identifies the policy interaction precisely, it also precludes us from being able to observe the impact of source (home) and borrowers' country policy measures separately. While Equations (1-4) provide some estimates for such level effects, these results should be treated cautiously due to the identification challenge that the less saturated specifications mentioned above face. Equation (4) also includes the triple interaction term ($\Delta macroprudential_{it-k} * \Delta monetary_{ct-k} * \Delta macroprudential_{jt-k}$) which allows the strength of the source macroprudential-monetary policy interaction to vary according to borrowers' country macroprudential policy.

In all estimations we apply two-way clustering of the standard errors across the source (lending) banking system and borrowers' country dimensions.

5. Results

Our estimates show consistent evidence that the monetary policy of major currency issuers and the macroprudential policies in source bank lending systems interact in a statistically and economically significant way. In our analysis, we start from relatively simple models and gradually develop more sophisticated estimates as we move from Equations (1) to (4) outlined in Section 4.2. We estimate our benchmark set of specifications first over the unconventional monetary policy period of 2012 Q2 – 2014 Q4 using both the CCFS (Table 2) and IMF iMaPP (Table 3) regulatory databases. We then extend our sample through end-2016, using the IMF iMaPP regulatory data (Table 4). We discuss economic significance in a separate subsection.

5.1 CCFS data (2012-2014)

First, we investigate the policy interaction with the help of the CCFS macroprudential database for the 2012 Q2 – 2014 Q4 period (Table 2). Our first model estimates Equation (1) (Column 1). We find a negative and insignificant coefficient for the level impact of monetary policy. The negative sign is consistent with the observation that tighter monetary policy of a currency issuer generally implies lower cross-border bank lending in that currency. The insignificance of the stand-alone term is also consistent with the CDIBL channel's prediction that monetary policy effects may not exist *on average* – it is only the funding constrained banking systems that see significant monetary policy effects on lending.

Next, we turn to estimate our main interest by adding the interaction term between monetary and macroprudential policies to our regression in Equation (2). Consistent with our hypothesis, the results show that the interaction is positive and statistically significant (Column

2). That is, macroprudential easing in a source bank lending system significantly amplifies the negative impact of a monetary tightening of the currency issuer on cross-border bank lending.[16]

Figure 2 illustrate the marginal effect of a 100 basis point tightening in the shadow interest rate over four quarters, at values of source macroprudential stringency ranging from two standard deviations below to two standard deviations above the mean. A 100 basis point tightening in the monetary policy associated with the currency of lending would lower cross-border lending outflows in that currency by nearly 9 percentage points when it is matched with macroprudential easing (two standard deviations below the mean) at the source lending system. The lending effect of monetary policy tightening decreases to nearly zero when it is matched with substantial source macroprudential tightening, consistent with our expectations.

As we discussed in the model setup, omitted variable bias might affect the results of Column (2). That is, there might be some uncontrolled demand or supply factors that could affect our interaction coefficient estimate. We address these concerns by applying a generalization of the Khwaja and Mian (2008)-style identification to address potential non-

[16] A fundamental building block of our hypothesis is that more resilient banking systems (i.e. those with macroprudential tightening) see a smaller increase in their funding costs following a tightening in the monetary policy of the currency of lending than their less resilient counterparts. To check this assertion empirically, we run the following specification:

$$\Delta funding\ cost_{ict} = \sum_{k=1}^{4}(\delta_{1k}\Delta macroprudential_{it-k} * \Delta monetary_{ct-k} + \delta_{2k}\Delta macroprudential_{it-k} + \\ + \delta_{3k}\Delta monetary_{ct-k} + \delta_{4k}\Delta macro_{it-k}) + FE_i + \varepsilon_{ict}$$

Where $\Delta funding\ cost_{ict}$ is the change in the funding cost of banking system *i* in currency *c* at time *t*. Furthermore, $\Delta macroprudential_{it}$ is the quarterly change in the macroprudential stringency index in source *i*, and $\Delta monetary_{ct}$ is the quarterly change in the short-term shadow interest rate associated with the currency of lending *c*. We proxy $\Delta funding\ cost_{ict}$ with (1) composite FX borrowing rates, and (2) FX interbank borrowing costs, collected from the IMF's International Financial Statistics (IFS). Our measures of monetary policy and macroprudential policy changes are as described in the text.

According to our assertion, after a tightening in monetary policy, funding costs in banking systems with macroprudential tightening increase by *less* than in banking systems with macroprudential easing. Therefore, we expect to find that the cumulative four-quarter sum of the δ_1 coefficients is negative and significant. Though not needed for identification, we expect the sum of coefficients δ_3 on $\Delta monetary_{ct}$ to be negative. Table A6 shows the corresponding results. Due to the limited number of countries for which data on interbank rates are available, our regression covers the 2000 Q1 to 2014 Q4 period – the full length for which the CCFS dataset is available. Consistent with our hypothesis, we find evidence that (1) monetary policy tightening increases bank funding costs (first row), and (2) this increase in funding costs is significantly lower for those banking systems that have seen macroprudential tightening (second row).

interaction related demand effects from borrowers' countries (Equation 3). The interaction results stemming from this estimation remain significant and materially unchanged from our earlier estimates (Column 3).

Finally, we add *source*borrower* fixed effects to estimate Equation (4). That is, we add a time-invariant fixed effect for each pair of source bank lending system i and borrowers' country j in our specification. Though this is a very demanding control, the interaction coefficient estimate remains consistently significant (Column 4). Furthermore, its sign and size also remains in line with our earlier models. In addition, the source macroprudential-monetary policy interaction we have identified does not vary significantly by borrowers' country macroprudential stringency (insignificant triple interaction coefficient).

As an additional exercise, we add further fixed effects to address potential omitted variables on the credit supply side from source bank lending systems. In other words, we add country*time fixed effects FE_{i*t} for source bank lending system i so as to focus attention on the interaction of macroprudential and monetary policies. This fixed effect allows us to control for any potential unrelated time-varying source banking system-specific credit supply changes. The source macroprudential-monetary policy interaction effects remain positive and highly significant, even in the presence of these very demanding controls. (These results are available upon request, but not shown in the interest of space.)

5.2 IMF iMaPP data (2012-2014)

In the next step, we use the IMF iMaPP data for the 2012 Q2 – 2014 Q4 period (Table 3). This setup allows us to broadly compare the IMF iMaPP estimates to the CCFS estimates. This "broad" comparability means that the panel is not exactly the same: even though we made the time series consistent – the cross-section differs somewhat across the CCFS and IMF iMaPP databases due to variation in country coverage.[17] We run regressions from Equation (1) to Equation (4) exactly as for the CCFS dataset. A similar picture emerges as before: the interaction term is positive and significant for all specifications, confirming our hypothesis. Notably, in the IMF iMaPP data we find a somewhat lower threshold of macroprudential tightening at which (by funding markets' perception) the source banking system becomes resilient to the point that the lending effects of monetary policy disappear.

5.3 IMF iMaPP data (2012-2016)

In the next step, we use the IMF iMaPP data for the 2012 Q2 – 2016 Q4 period (Table 4). This formulation utilizes the most recent regulatory data available. We run regressions from Equation (1) to Equation (4) exactly as before. The results are very close to the earlier findings, in particular to the short sample iMaPP results in Table 3: the source macroprudential-monetary policy interaction term is significant with a positive sign for all our specifications, again confirming our hypothesis. Therefore, the persistence of our main results in this longer sample suggest that the statistically significant policy interaction is not only a feature of unconventional monetary policy regimes. Rather, these interaction effects also generalize to the post lift-off period of US monetary policy.

5.4 Economic significance

The coefficient estimates on the interaction terms do not allow for straightforward translation to economic significance. The reason is that both macroprudential and monetary policy stances matter for characterizing the interaction effects. In addition, while we have an intuitive

[17] We address this point in our robustness checks, when we re-run our estimations now restricting the cross section to those observations which are covered by both the CCFS and the IMF iMaPP data.

understanding of how significant a given monetary tightening is, it is less clear how to assess the size of changes in macroprudential policies. Hence, we use percentile ranks to characterize the magnitude of monetary policy lending effects at various degrees of macroprudential tightening. We compare the interaction effect for a 100 basis points tightening in the shadow interest rates over the course of four quarters, evaluated in a source banking system with a substantial strengthening of regulatory policies (at the 99th percentile of macroprudential policy tightening) vs one with substantial easing in macroprudential rules (at the 1st percentile).[18]

The results show that the macroprudential-monetary policy interaction effects are economically significant (bottom of Tables 2-4). For instance, our main model estimates show that easier macroprudential policies in source bank lending systems (comparing the 1st and 99th percentile of macroprudential tightening) amplify the decline induced by a 100 basis point four-quarter cumulated monetary tightening by around 20 p.p. (bottom of Table 2). These figures imply an around 5 p.p. amplifying effect for a more moderate, 25 basis point tightening. These estimates are even larger, at around 30 p.p., when we use the IMF iMaPP data (Tables 3 and 4).

The interaction is also economically significant when we consider somewhat smaller percentile differences across macroprudential policies. For instance, our main model estimates show that easing macroprudential policies in source bank lending systems (i.e. comparing the 5th and 95th percentile of macroprudential tightening) amplifies the lending decline induced by a 100 basis point four-quarter cumulated monetary tightening by around 10 p.p. (based on the same set of equations as in Table 2). This, for example, is the comparison between India (at the

[18] We examine economic significance over a wider interval so as to capture sufficient variation in the index, given the high concentration of both our CCFS and iMaPP regulatory indices at zero (Table 1). There are two features of our regulatory indices that contribute to their narrow spread. First, our indices cumulate multiple individual macroprudential tools – as such, our index can show a value of zero simply because one tool tightens while another one eases simultaneously. Second, our indices are measured at a quarterly (rather than annual) frequency, which carries the correspondingly higher probability that in any give quarter a given country may not see a macroprudential action.

5th percentile) and the Netherlands (at the 95th percentile) in 2014 Q1. In sum, the estimated interactions are not only statistically, but also economically significant.

6. Alternative specifications and robustness checks

6.1 Borrowers' country macroprudential tools

For completeness, we also examine the role of macroprudential tools applied in borrowers' countries (Table 5). In Table 5, Columns 1-2, 3-4 and 5-6 repeat the Equations (2) and (3) estimations from Tables 2, 3 and 4, respectively. We do not find consistently significant evidence of interactions between borrowers' country macroprudential policies and the monetary policy of the currency of borrowing. Recall that our hypothesis development links macroprudential tightening to enhanced *source* banking system resilience, which then provides relative immunity against the effects of monetary policy in all cross-border lending originating from that banking system. Conversely, domestic macroprudential actions in borrowers' countries only affect the (comparably small) *domestic* segment of the international bank. Therefore, consistent with the Table 5 results, we should indeed not expect consistent, significant lending channel effects from borrowers' country macroprudential actions.

6.2 Source loan-to value ratio caps

In the next step, we focus on a single macroprudential tool: limits on Loan-to-Value (LTV) ratios in Table 6. While our initial hypothesis does not concern single tools (and rather focuses on the joint effect of macroprudential tools), the LTV is special for both economic and technical reasons. Economically, the LTV is often perceived to be very effective at constraining demand as it does not have to work through price signals (IMF-FSB-BIS, 2016). Furthermore, Alam et al (2019) show emerging evidence that the LTV ratio has a significant lending impact. Technically, the LTV is also directly comparable across the CCFS and IMF iMaPP databases.

In analyzing the LTV ratios, we replicate Equations (2) and (3) for both the short and long sample, and for both the CCFS and IMF iMaPP databases. That is, we replicate Columns 2 and 3 of Tables 2, 3 and 4 for the LTV ratio (see Columns 1-2, 3-4 and 5-6 of Table 6, respectively). Consistent with our benchmark results, we find significantly positive interactions throughout. That is, easing source LTV limits significantly amplify the cross-border lending-reducing effect of a tighter monetary policy.

6.3 Weighting estimations by cross-border bank lending volumes

Our main analysis equally weights all source-borrower lending relationships. For robustness, we also repeat our Table 2 estimations, now weighting each observation by the *volume* of the bilateral lending relationship – thus differentiating large (such as the UK-US lending pair) from small-volume connections.

The weighted regressions confirm our benchmark results (Table A3, Columns 1-3). The interaction coefficient estimates remain similar in magnitude and statistical significance as in our main specifications. These results give further evidence that the interaction of monetary and macroprudential policies is relevant in economically significant cross-border bank lending relationships.

6.4 Cross-currency substitution

In our main analysis, we have focused on the response of cross-border lending in a currency to monetary policy changes associated with that same currency. For instance, for USD lending we have considered the effects of US monetary policy. Yet, bank lending in a given currency might react to changes in the monetary policies of other currencies as well. Banks might substitute away from USD and toward EUR lending on the margin if US monetary policy tightens, even if monetary policy in the euro-zone is unchanged.

In order to check the implications of such marginal currency substitutions for our main results, we modify our benchmark setup to allow monetary policy changes associated with all three currencies to affect lending flows in all three currencies. We find that our main macroprudential-monetary policy interaction results are robust to this modification (Table A3, Columns 4-6). The interaction term estimates remain positive and significant, albeit their size declines slightly. The result of this robustness exercise is also consistent with the CDIBL channel findings in Takats and Temesvary (2020).

6.5 Level of initial macroprudential stringency

As described above, both the CCFS and IMF iMaPP macroprudential databases provide information on *changes* in regulatory stringency over time, but not on the *level of the policy stance*. While focusing on *changes* in regulatory stringency, as we do, is consistent with the approach in the related literature, a concern remains on possible non-linearities. Thus, the level might be relevant in conjunction with the change in analyzing macroprudential policy effects.

To address this feature, we use historic macroprudential changes to create a proxy for the level of macroprudential stance by country in Table A4. Consistent with Cerutti et al (2017), we define a new level variable *(Level of Initial Macroprudential Stringency)* as the cumulative sum of regulatory changes in each source banking system from 2000 Q1 to 2012 Q1. We define this *Level of Initial Macroprudential Stringency* both for the CCFS and the IMF iMaPP databases. Naturally, this variable should only be seen as a proxy and interpreted cautiously, as the “true” macroprudential policy level, the stance, remains unobserved.

To examine the impact of this *Level of Initial Macroprudential Stringency* variable, we interact this *Level of Initial Macroprudential Stringency* with our standard change in *Source Regulatory Stringency* measure and horserace this interaction with the macroprudential-monetary policy interaction that has been our main focus (Table A4). The results confirm that the significance of our macroprudential-monetary policy interaction is generally robust to explicitly controlling for cross-sectional differences across countries in the level of macroprudential stringency.

6.6 Common CCFS – IMF iMaPP Sample

We address the possible role that the differing cross-sectional coverage of the CCFS and IMF iMaPP databases may play in our results. While in Section 5.2 we already estimated our interaction results on the same time series for the two databases, as we noted there, the cross sections remain slightly different due to data coverage. We re-estimate Equations (2), (3) and (4) from Tables 2 and Table 3, restricting the estimation sample to a common set of observations across the CCFS and IMF iMaPP databases for each equation (Table A5). The positive sign and high significance of the policy interaction term is consistent with our main findings.

6.7 Interaction term-implied model restriction

The standard estimation technique implies that policy interactions have the same sign and size, irrespective of the direction of monetary policy. In additional specifications, we allow the interaction effects to vary depending on the stance of monetary policy. That is, we separately estimate an interaction coefficient for monetary policy easing and tightening, and test their statistical equivalence. Doing so, we find that the standard Wald tests cannot reject the null hypothesis that the interaction coefficient estimates are equal. This provides further evidence that our interaction model is well-specified. (These results are available upon request, but not shown in the interest of space.)

6.8 Endogeneity of macroprudential policies to monetary policy

The main advantage of our identification strategy is that macroprudential policies enacted in source lending systems are almost fully exogenous to the monetary policy of the issuers of the three reserve currencies – thereby avoiding the endogeneity pitfall of studying policy interaction effects in a domestic setting. We further ensure the clarity of our identification strategy by excluding "same country lending" and "own currency lending" from our specifications. However, a potential concern that may remain is the extent to which the macroprudential policies of a reserve currency issuer may be endogenous to the monetary policies of other reserve currency issuers.

To address this issue, we exclude completely the US, the euro area and Japan (home regions of the reserve currency issuers). Given the limits imposed by the resultant reduction in the cross-section of our dataset, we focus on the long IMF iMaPP (2012-2016) series. Our findings remain robust to this exclusion. (These results are available upon request, but not shown in the interest of space.)

6.10 Additional robustness checks

Our benchmark results are also robust to further specification changes. First, using the CCFS pre-defined macroprudential index construction that includes minimum capital requirements (Cerutti et al, 2017) does not materially affect our main results. In other words, our exclusion of capital requirements, which allows us to hone in precisely on our focus of macroprudential policies, does not materially affect our quantitative results. Second, we exclude the euro area and, later, emerging market borrowers from our sample to ensure that the results hold in major subsamples as well. (These results are available upon request, but not shown in the interest of space.)

7. Conclusion

We apply a novel identification strategy to a unique and rarely accessed dataset to examine the interactions between monetary policy and macroprudential policy in cross-border bank lending. We find strong evidence that macroprudential policy easing amplifies the lending effect of monetary policy – whereas tighter macroprudential policy mitigates it. Based on the operation of the bank lending channel, these results are consistent with the resilience-enhancing role of macroprudential policy tightening. The results are robust and economically significant.

The interaction results are policy relevant. First, they help policymakers assess credit supply changes in those countries where cross-border bank lending plays a major role in credit provision. Consider the example of USD-denominated lending from UK banks to Malaysia. Understanding the policy interactions helps Malaysian authorities gauge the impact on domestic credit conditions. Second, the results are important for regulators of major international banks in assessing the effect of their macroprudential regulation on lending outflows. In our example, understanding the policy interactions can help UK policymakers assess the impact on USD-denominated lending outflows. Third, the results are also policy relevant from the perspective of major currency issuer countries. In our example, understanding the policy interactions can help US policymakers evaluate potential spillbacks.

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Table 1: Summary Statistics

	[1] Mean	[2] S.D.	[3] Min	[4] p1	[5] p5	[6] p25	[7] p50	[8] p75	[9] p95	[10] p99	[11] Max	[12] N
Panel A: CCFS Database 2012 Q2 -2014 Q4												
Dependent variable:												
Total Currency-specific Cross-border Lending Flows	1.24	32.98	-86.88	-86.88	-57.61	-10.80	-0.03	12.49	66.54	93.51	93.51	8,155
Regulatory measures:												
Δ Source Macropru Stringency	0.06	0.29	-1	-1	0	0	0	0	1	1	1	8,155
Δ Source Loan-to-Value Cap	0.05	0.21	0	0	0	0	0	0	0	1	1	3,518
Δ Source FX Reserve Requirements	0.01	0.13	-1	0	0	0	0	0	0	1	1	8,155
Δ Borrower Macropru Stringency	0.05	0.26	-1	0	0	0	0	0	1	1	1	8,155
Macro variables:												
Δ Shadow Interest Rate	0.23	1.18	-1.88	-1.88	-1.84	-0.52	0.36	1.29	1.7	2.25	2.25	8,155
Δ Source Policy Interest Rate	-0.02	0.37	-1.25	-0.50	-0.25	-0.10	0	0	0.15	1	5.5	8,155
Source Real GDP Growth	1.57	1.90	-5.96	-2.69	-1.30	0.39	1.61	2.45	5.01	7.06	7.99	8,155
Borrower Real GDP Growth	1.76	2.28	-14.78	-3.75	-1.45	0.31	1.71	2.86	6.03	7.50	7.90	8,155
Δ Source - Borrower Exchange Rate	-0.67	9.37	-33.30	-25.58	-17.28	-4.70	0	3.16	13.72	26.24	67.95	8,155

Table 1: Summary Statistics

	[1] Mean	[2] S.D.	[3] Min	[4] p1	[5] p5	[6] p25	[7] p50	[8] p75	[9] p95	[10] p99	[11] Max	[12] N
Panel B: IMF iMapp Database 2012 Q2 - 2014 Q4												
Dependent variable:												
Total Currency-specific Cross-border Lending Flows	1.19	49.84	-103.60	-103.60	-103.60	-18.36	-0.03	18.91	105.00	105.00	105.00	6,304
Regulatory measures:												
Δ Source Macropru Stringency	0.00	0.19	-1	-1	0	0	0	0	0	1	1	6,304
Δ Source Loan-to-Value Cap	0.00	0.14	-1	0	0	0	0	0	0	1	1	6,304
Δ Source FX Reserve Requirements	0.00	0.06	-1	0	0	0	0	0	0	0	0	6,304
Δ Borrower Macropru Stringency	0.02	0.20	-1	0	0	0	0	0	0	1	1	6,304
Macro variables:												
Δ Shadow Interest Rate	0.23	1.18	-1.88	-1.88	-1.84	-0.52	0.36	1.29	1.7	2.25	2.25	6,304
Δ Source Policy Interest Rate	-0.02	0.45	-1.25	-1.00	-0.25	-0.10	0	0	0.15	1	5.5	6,304
Source Real GDP Growth	1.97	1.73	-3.59	-2.02	-0.91	1.11	2.05	2.71	5.08	7.06	7.99	6,304
Borrower Real GDP Growth	1.75	2.23	-14.78	-5.31	-1.45	0.42	1.73	2.82	6.02	7.40	7.90	6,304
Δ Source - Borrower Exchange Rate	-0.23	10.12	-33.30	-25.58	-17.38	-4.98	0	4.22	16.35	27.57	67.95	6,304

Table 1: Summary Statistics

Panel C: IMF iMapp Database 2012 Q2 - 2016 Q4												
Dependent variable:												
Total Currency-specific Cross-border Lending Flows	0.34	49.31	-103.60	-103.60	-103.60	-18.97	-0.19	18.63	105.00	105.00	105.00	10,794
Regulatory measures:												
Δ Source Macropru Stringency	0.01	0.22	-1	-1	0	0	0	0	0	1	1	9,967
Δ Source Loan-to-Value Cap	0.00	0.14	-1	0	0	0	0	0	0	0	1	9,967
Δ Source FX Reserve Requirements	0.00	0.05	-1	0	0	0	0	0	0	0	0	9,967
Δ Borrower Macropru Stringency	0.03	0.22	-1	-1	0	0	0	0	0	1	1	9,967
Macro variables:												
Δ Shadow Interest Rate	-0.12	1.36	-3.62	-3.62	-2.4	-0.77	0.19	0.95	1.84	2.62	2.62	9,967
Δ Source Policy Interest Rate	-0.03	0.37	-1.25	-0.70	-0.38	-0.05	0	0	0.15	1	5.5	10,794
Source Real GDP Growth	1.93	1.83	-5.40	-2.89	-0.91	1.06	1.94	2.68	5.32	7.60	8.30	9,954
Borrower Real GDP Growth	1.78	2.32	-17.16	-5.40	-1.45	0.57	1.73	2.85	6.15	7.40	7.90	9,891
Δ Source - Borrower Exchange Rate	0.65	11.54	-48.30	-26.31	-17.66	-4.98	0	6.09	20.18	38.92	76.08	9,878

Table 2: Main specifications: Source Macroprudential Stringency - CCFS Database; 2012 Q2 - 2014 Q4

Model	[1]	[2]	[3]	[4]
ΣΔ Shadow Interest Rate {t-1 to t-4}	-3.319	-4.342		
	[2.25]	[2.304]*		
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency		9.791	10.733	10.09
		[4.672]**	[5.453]**	[6.134]*
ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4}* ΣΔ Borrower Macropru Stringency {t-1 to t-4}				0.634
				[17.43]
Constant	1.792	1.579	2.64	-0.735
	[1.962]	[2.162]	[2.752]	[1.981]
Source Macro Controls	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	Yes	n/p	Yes
Source Fixed Effects	Yes	Yes	Yes	--
Time Fixed Effects	Yes	Yes	--	--
Borrower Fixed Effects	Yes	Yes	--	--
Currency Fixed Effects	Yes	Yes	--	--
Source * Borrower Fixed Effects	No	No	No	Yes
Borrower * Time Fixed Effects	No	No	Yes	No
Currency * Time Fixed Effects	No	No	Yes	Yes
ΣΔ Source Macropru Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes
ΣΔ Borrower Macropru Stringency {t-1 to t-4} included	Yes	Yes	n/p	Yes
R - squared	0.07	0.06	0.10	0.07
Number of Observations	8,155	9,173	9,173	9,173
Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing macroprudential rules (at the 1st percentile of the Source Macropru Stringency index) vs a source banking system with tightening macroprudential rules (at the 99th percentile).				
		19.58	21.47	20.18
		[9.344]**	[10.91]**	[12.27]*

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system I to a borrower country j, denominated in one of the three reserve currencies (USD, EUR, JPY). The coefficients shown are cumulative over the preceding four quarters. Source Macropru Stringency is an index of several macroprudential tools enacted at the level of the source banking system (as shown in Table A1) that we construct from the CCFS database over the 2012 Q2 - 2014 Q4 period. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 3: Main specifications: Source Macroprudential Stringency - IMF iMapp Database; 2012 Q2 - 2014 Q4

Model	[1]	[2]	[3]	[4]
ΣΔ Shadow Interest Rate {t-1 to t-4}	-15.51	-3.104		
	[9.757]	[5.509]		
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency		25.2	20.51	16.17
		[10.13]**	[8.481]**	[7.896]**
ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4}* ΣΔ Borrower Macropru Stringency {t-1 to t-4}				-82.13
				[59.71]
Constant	-7.883	-6.838	-7.536	-2.51
	[17.2]	[5.693]	[3.529]	[5.854]
Source Macro Controls	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	Yes	n/p	Yes
Source Fixed Effects	Yes	Yes	Yes	--
Time Fixed Effects	Yes	Yes	--	--
Borrower Fixed Effects	Yes	Yes	--	--
Currency Fixed Effects	Yes	Yes	--	--
Source * Borrower Fixed Effects	No	No	No	Yes
Borrower * Time Fixed Effects	No	No	Yes	No
Currency * Time Fixed Effects	No	No	Yes	Yes
ΣΔ Source Macropru Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes
ΣΔ Borrower Macropru Stringency {t-1 to t-4} included	Yes	Yes	n/p	Yes
R - squared	0.08	0.08	0.13	0.08
Number of Observations	5,393	5,440	5,440	5,393
Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing macroprudential rules (at the 1st percentile of the Source Macropru Stringency index) vs a source banking system with tightening macroprudential rules (at the 99th percentile).				
		50.4	41.02	32.35
		[22.26]**	[16.96]**	[15.79]**

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system *I* to a borrower country *j,* denominated in one of the three reserve currencies (USD, EUR, JPY). The coefficients shown are cumulative over the preceding four quarters. Source Macropru Stringency is an index of several macroprudential tools enacted at the level of the source banking system (as shown in Table A1) that we construct from the IMF iMap database over the 2012 Q2 - 2014 Q4 period. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 4: Main specifications: Source Macroprudential Stringency - IMF iMapp Database; 2012 Q2 - 2016 Q4

Model	[1]	[2]	[3]	[4]
ΣΔ Shadow Interest Rate {t-1 to t-4}	1.916	2.789		
	[5.736]	[7.066]		
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency		15.253	14.02	14.72
		[6.00]***	[6.10]**	[6.694]**
ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4}* ΣΔ Borrower Macropru Stringency {t-1 to t-4}				-28.84
				[29.1]
Constant	9.94	12.682	-2.65	6.386
	[10.26]	[5.805]**	[1.540]*	[3.092]**
Source Macro Controls	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	Yes	n/p	Yes
Source Fixed Effects	Yes	Yes	Yes	--
Time Fixed Effects	Yes	Yes	--	--
Borrower Fixed Effects	Yes	Yes	--	--
Currency Fixed Effects	Yes	Yes	--	--
Source * Borrower Fixed Effects	No	No	No	Yes
Borrower * Time Fixed Effects	No	No	Yes	No
Currency * Time Fixed Effects	No	No	Yes	Yes
ΣΔ Source Macropru Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes
ΣΔ Borrower Macropru Stringency {t-1 to t-4} included	Yes	Yes	n/p	Yes
R - squared	0.08	0.08	0.13	0.08
Number of Observations	9,875	10,076	10,076	9,887
Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing macroprudential rules (at the 1st percentile of the Source Macropru Stringency index) vs a source banking system with tightening macroprudential rules (at the 99th percentile).				
		30.51	28.04	29.44
		[12]***	[12.20]**	[13.39]**

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system *I* to a borrower country *j,* denominated in one of the three reserve currencies (USD, EUR, JPY). The coefficients shown are cumulative over the preceding four quarters. Source Macropru Stringency is an index of several macroprudential tools enacted at the level of the source banking system (as shown in Table A1) that we construct from the IMF iMap database over the 2012 Q2 - 2016 Q4 period. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 5: Selected specifications: Borrower Macroprudential Stringency

Model	[1]	[2]	[3]	[4]	[5]	[6]
Database	*CCFS*		*IMF iMap*		*IMF iMap*	
Time period	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2016 Q4*	*2012 Q2 - 2016 Q4*
ΣΔ Shadow Interest Rate {t-1 to t-4}	-3.692		-6.466		2.145	
	[2.610]		[4.315]		[3.567]	
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Borrower Macropru Stringency	8.326	9.788	-8.77	-9.929	4.36	5.303
	[4.513]*	[6.042]*	[14.51]	[14.80]	[12.30]	[10.67]
Constant	0.21	0.788	-7.372	-2.893	11.26	5.33
	[2.386]	[0.964]	[4.526]	[2.782]	[3.660]***	[1.804]***
Source Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	n/p	Yes	n/p	Yes	n/p
Source Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	--	Yes	--	Yes	--
Borrower Fixed Effects	Yes	--	Yes	--	Yes	--
Currency Fixed Effects	Yes	--	Yes	--	Yes	--
Borrower * Time Fixed Effects	No	Yes	No	Yes	No	Yes
ΣΔ Borrower Macropru Stringency {t-1 to t-4} included	Yes	n/p	Yes	n/p	Yes	n/p
R - squared	0.06	0.12	0.08	0.12	0.08	0.12
Number of Observations	9,173	9,173	5,440	5,440	10,076	10,089
Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, to borrowers in a Borrower country with easing macroprudential rules (at the 1st percentile of the Borrower Macropru Stringency index) vs a Borrower country with tightening macroprudential rules (at the 99th percentile).						
	24.98	29.36	-17.54	-19.86	8.719	10.61
	[13.54]*	[18.13]*	[29.02]	[29.60]	[24.59]	[21.33]

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system I to a borrower country j, denominated in one of the three reserve currencies (USD, EUR, JPY). The coefficients shown are cumulative over the preceding four quarters. Borrower Macropru Stringency is an index of several macroprudential tools enacted at the level of the Borrower country of borrowers (as shown in Table A1) that we construct from the CCFS database (Models 1-2) and the IMF iMapp database (Models 3-6) over the time period indicated at the top of each column. Models 1-2 replicate the Model 3-4 specifications from Table 2. Models 3-4 replicate the Model 3-4 specifications from Table 3 and Models 5-6 replicate the Model 3-4 specifications from Table 4. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 6: Selected specifications: Source Loan-to-Value Cap Stringency

Model	[1]	[2]	[3]	[4]	[5]	[6]
Database	*CCFS*		*IMF iMapp*		*IMF iMapp*	
Time period	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2016 Q4*	*2012 Q2 - 2016 Q4*
ΣΔ Shadow Interest Rate {t-1 to t-4}	-1.079		-22.14		-1.389	
	[5.808]		[4.571]***		[2.15]	
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Loan-to-Value Cap Stringency	15.27	16.23	49.56	44.12	33.48	21.77
	[8.548]*	[7.533]**	[12.46]***	[15.56]***	[18.88]*	[26.57]
Constant	6.506	-11.51	-7.055	-7.923	12.33	-3.509
	[5.567]	[2.629]***	[2.13]***	[2.748]***	[1.227]***	[1.368]**
Source Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	n/p	Yes	n/p	Yes	n/p
Source Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	--	Yes	--	Yes	--
Borrower Fixed Effects	Yes	--	Yes	--	Yes	--
Currency Fixed Effects	Yes	--	Yes	--	Yes	--
Borrower * Time Fixed Effects	No	Yes	No	Yes	No	Yes
Currency * Time Fixed Effects	No	Yes	No	Yes	No	Yes
ΣΔ Source Loan-to-Value Cap Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes	Yes	Yes
ΣΔ Borrower Loan-to-Value Cap Stringency {t-1 to t-4} included	Yes	n/p	Yes	n/p	Yes	n/p
R - squared	0.07	0.15	0.08	0.14	0.07	0.13
Number of Observations	3,796	3,785	5,440	5,440	10,076	10,076

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing Loan-to-Value cap rules (at the 1st percentile of the Source Loan-to-Value cap index) vs a source banking system with tightening Loan-to-Value cap rules (at the 99th percentile).

	[1]	[2]	[3]	[4]	[5]	[6]
	15.27	16.23	99.12	88.25	66.97	43.53
	[8.548]*	[7.533]**	[24.93]***	[31.12]***	[37.76]*	[53.14]

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system I to a borrower country j, denominated in one of the three reserve currencies (USD, EUR, JPY). The coefficients shown are cumulative over the preceding four quarters. Source Loan-to-Value Cap Stringency captures limits imposed on Loan-to-Value ratios at the level of the source banking system (as shown in Table A1) that we construct from the CCFS database (Models 1-2) and the IMF iMapp database (Models 3-6) over the time period indicated at the top of each column. Models 1-2 replicate the Model 3-4 specifications from Table 2. Models 3-4 replicate the Model 3-4 specifications from Table 3 and Models 5-6 replicate the Model 3-4 specifications from Table 4. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A1: Construction of Macroprudential Indices

	Panel A: CCFS Macroprudential Subcategories
sscb_res	Change in sector specific capital buffer: Real estate credit. Requires banks to finance a larger fraction of these exposures with capital.
sscb_cons	Change in sector specific capital buffer: Consumer credit Requires banks to finance a larger fraction of these exposures with capital.
sscb_oth	Change in sector specific capital buffer: Other sectors. Requires banks to finance a larger fraction of these exposures with capital.
Concrat	Change in concentration limit. Limits banks' exposures to specific borrowers or sectors.
Ibex	Change in interbank exposure limit. Limits banks exposures to other banks.
ltv_cap	Change in the loan-to-value ratio cap. Limits on loans to residential borrowers.
rr_foreign	Change in reserve requirements on foreign currency-denominated accounts.
rr_local	Change in reserve requirements on local currency-denominated accounts.
	Panel B: IMF iMapp Macroprudential Subcategories
CCB	Changes in countercyclical capital buffers based on various private sector credit exposures.
LCG	Changes in limits and penalties on banks' household-sector and corporate-sector credit growth.
LTV	Changes in limits to the loan-to-value ratios, including thosetargeted at housing, automobile and commercial real estate loans.
RR	Changes in ieserve requirements (domestic or foreign currency) for macroprudential purposes.

Table A2: Characterization of the BIS IBS Stage 1 Enhanced Banking Statistics

	Currency composition (A)	Residence of borrower (B)	Nationality of lending bank (C)
Consolidated Data	No	Yes	Yes
Locational Data			
by Residence	Yes	Yes	No
by Nationality	Yes	No	Yes
Stage 1 data	**Yes**	**Yes**	**Yes**

Table A3: Selected specifications: Weighted Estimations and Cross-currency Substitutions; 2012 Q2 - 2014 Q4

Model	[1]	[2]	[3]	[4]	[5]	[6]
Specifications		*Weighted Estimations*			*Including Macroprudential-Monetary Policy Interactions with All Three Currencies*	
ΣΔ Shadow Interest Rate {t-1 to t-4}	-5.458			-3.308		
	[2.99]*			[2.339]		
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency	18.63	17.33	17.71	11.12	11.39	9.887
	[6.628]***	[7.221]**	[7.977]**	[5.075]**	[6.589]*	[6.863]
ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4}* ΣΔ Borrower Macropru Stringency {t-1 to t-4}			26.13			22.63
			[27.43]			[15.08]
ΣΔ USD Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency				-0.373	2.367	1.71
				[5.751]	[5.654]	[5.85]
ΣΔ EUR Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency				19.08	16.65	19.89
				[9.855]*	[10.8]	[10.75]*
ΣΔ JPY Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency				1.663	2.029	1.838
				[3.379]	[3.616]	[3.992]
Constant	-1.112	0.738	-5.031	1.171	2.469	-1.087
	[2.677]	[3.125]	[3.267]	[2.179]	[2.673]	[1.839]
Source Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	n/p	Yes	Yes	n/p	Yes
Source Fixed Effects	Yes	Yes	--	Yes	Yes	--
Time Fixed Effects	Yes	--	--	Yes	--	--
Borrower Fixed Effects	Yes	--	--	Yes	--	--
Currency Fixed Effects	Yes	--	--	Yes	--	--
Source * Borrower Fixed Effects	No	No	Yes	No	No	Yes
Borrower * Time Fixed Effects	No	Yes	No	No	Yes	No
Currency * Time Fixed Effects	No	No	Yes	No	No	Yes
ΣΔ Source Macropru Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes	Yes	Yes
ΣΔ Borrower Macropru Stringency {t-1 to t-4} included	Yes	n/p	Yes	Yes	n/p	Yes
R - squared	0.09	0.13	0.09	0.07	0.11	0.07
Number of Observations	9,173	9,173	9,173	9,173	9,173	9,173
Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing source macroprudential stringency (at the 1st percentile of the Source Macropru Stringency) vs a source banking system with tightening macroprudential rules (at the 99th percentile).						
	37.26	34.67	35.42	22.25	22.78	19.77
	[13.26]***	[14.44]**	[15.95]**	[10.15]**	[13.18]*	[13.73]

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system I to a borrower country j, denominated in one of the three reserve currencies (USD, EUR, JPY). Source Macropru Stringency is an index calculated from the CCFS database. The coefficients shown are cumulative over the preceding four quarters. Models 1-3 show weighted estimations, where each observation is weighted by that bilateral lending relationship's share in total cross-border claims. Models 4-6 show specifications including interactions of source maropru stringency changes with changes in the shadow interest rates associated with all three currencies (USD, EUR and JPY). Models 1-3 and Models 4-6 replicate the Model 2-4 specifications from Table 2, respectively. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A4: Selected specifications: Role of Initial Macropru Stringency

Model	[1]	[2]	[3]	[4]	[5]	[6]
Database	*CCFS*		*IMF iMapp*		*IMF iMapp*	
Time period	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2014 Q4*	*2012 Q2 - 2016 Q4*	*2012 Q2 - 2016 Q4*
ΣΔ Shadow Interest Rate {t-1 to t-4}	-4.602		-26.79		-4.198	
	[2.628]*		[6.008]***		[4.629]	
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency	10.37	11.38	-5.801	-3.611	14.2	13.75
	[6.082]*	[5.556]**	[20.95]	[20.15]	[7.606]*	[7.844]*
ΣΔ Source Macropru Stringency * Level of Initial Macropru Stringency	-1.635	-1.662	7.567	5.808	0.445	0.642
	[1.238]	[1.366]	[9.922]	[10.52]	[2.318]	[2.281]
Constant	0.883	2.587	-5.952	-7.743	11.89	-2.627
	[2.541]	[2.855]	[5.569]	[3.31]**	[6.756]*	[2.868]
Source Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	n/p	Yes	n/p	Yes	n/p
Source Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	--	Yes	--	Yes	--
Borrower Fixed Effects	Yes	--	Yes	--	Yes	--
Currency Fixed Effects	Yes	--	Yes	--	Yes	--
Borrower * Time Fixed Effects	No	Yes	No	Yes	No	Yes
Currency * Time Fixed Effects	No	Yes	No	Yes	No	Yes
ΣΔ Source Macropru Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes	Yes	Yes
ΣΔ Borrower Macropru Stringency {t-1 to t-4} included	Yes	n/p	Yes	n/p	Yes	n/p
R - squared	0.06	0.10	0.08	0.14	0.08	0.14
Number of Observations	9,173	9,173	5,440	5,440	10,076	10,076
Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing Loan-to-Value cap rules (at the 1st percentile of the Source Loan-to-Value cap index) vs a source banking system with tightening Loan-to-Value cap rules (at the 99th percentile).						
	20.74	22.76	-11.6	-7.223	28.41	27.5
	[12.16]*	[11.11]**	[41.89]	[40.31]	[15.21]*	[15.69]*

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system *I* to a borrower country *j,* denominated in one of the three reserve currencies (USD, EUR, JPY). The coefficients shown are cumulative over the preceding four quarters. Level of Initial Macropru Stringency captures regulatory actions (ΔSource Macropru Stringency) cumulated over the full 2000 2012 period for each source country. Models 1-2 replicate the Model 3-4 specifications from Table 2. Models 3-4 replicate the Model 3-4 specifications from Table 3 and Models 5-6 replicate the Model 3-4 specifications from Table 4. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A5: Selected specifications: Source Macroprudential Stringency - CCFS and IMF iMapp Common Sample; 2012 Q2 - 2014 Q4

Model	[1]	[2]	[3]	[4]	[5]	[6]
Database		*CCFS*			*IMF iMapp*	
ΣΔ Shadow Interest Rate {t-1 to t-4}	5.686			-25.92		
	[5.854]			[10.61]**		
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency	24.78	26.29	26.28	31.66	34.74	7.64
	[7.782]***	[10.73]**	[10.21]***	[12.76]**	[7.471]***	[9.817]
ΣΔ Shadow Interest Rate* ΣΔ Source Macropru Stringency {t-1 to t-4}* ΣΔ Borrower Macropru Stringency {t-1 to t-4}			17.53			88.11
			[45.67]			[54.88]
Constant	3.23	0.859	-0.504	-7.004	-2.291	-5.423
	[4.571]	[9.275]	[5.175]	[9.666]	[4.015]	[9.676]
Source Macro Controls	Yes	Yes	Yes	Yes	Yes	Yes
Borrower Macro Controls	Yes	n/p	Yes	Yes	n/p	Yes
Source Fixed Effects	Yes	Yes	--	Yes	Yes	--
Time Fixed Effects	Yes	--	--	Yes	--	--
Borrower Fixed Effects	Yes	--	--	Yes	--	--
Currency Fixed Effects	Yes	--	--	Yes	--	--
Source * Borrower Fixed Effects	No	No	Yes	No	No	Yes
Borrower * Time Fixed Effects	No	Yes	No	No	Yes	No
Currency * Time Fixed Effects	No	No	Yes	No	No	Yes
ΣΔ Source Macropru Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes	Yes	Yes
ΣΔ Borrower Macropru Stringency {t-1 to t-4} included	Yes	n/p	Yes	Yes	n/p	Yes
R - squared	0.11	0.18	0.11	0.10	0.19	0.12
Number of Observations	2,787	2,784	2,787	2,787	2,784	2,787

Economic significance: Difference (in percentage points) in the impact of a 100 basis point change in the short-term shadow interest rate associated with the currency of lending, originating from a source lending system with easing source macroprudential stringency (at the 1st percentile of the Source Macropru Stringency) vs a source banking system with tightening macroprudential rules (at the 99th percentile).

	[1]	[2]	[3]	[4]	[5]	[6]
	49.56	52.58	52.56	63.33	69.48	15.28
	[15.56]***	[21.46]**	[20.42]***	[25.52]**	[14.94]***	[19.63]

The dependent variable is the quarterly change in the bilateral cross-border lending flows (to both bank and non-bank borrowers) from a source lending system I to a borrower country j, denominated in one of the three reserve currencies (USD, EUR, JPY). This table shows results of estimations on a data sample that was constructed so that each datapoint is present in both the CCFS and IMF iMapp estimations samples (from Tables 2 and 3, respectively). The coefficients shown are cumulative over the preceding four quarters. Source Macropru Stringency is an index of several macroprudential tools enacted at the level of the source banking system (as shown in Table A1) that we construct from the CCFS database (Models 1-3) and the IMF iMap database (Models 4-6) over the 2012 Q2 - 2014 Q4 period. Models 1-3 replicate the Model 2-4 specifications from Table 2. Models 4-6 replicate the Model 2-4 specifications from Table 3. "--" indicates the given fixed effects are subsumed by a more extensive set of fixed effects. "n/p" indicates the inclusion of the controls are not possible due to the simultaneously included fixed effects. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A6: Banks' FX Funding Costs, Monetary Policy and Source Macroprudential Stringency (CCFS); 2000 Q1 - 2014 Q4

Model	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Dependent variable:	*Δ FX Interbank Borrowing Rate*				*Δ FX Composite Rate*			
Monetary policy associated with currency:	*Composite of USD, EUR, JPY*	*USD*	*EUR*	*JPY*	*Composite of USD, EUR, JPY*	*USD*	*EUR*	*JPY*
ΣΔ Shadow Interest Rate {t-1 to t-4}	1.307	0.773	0.309	1.21	0.763	0.421	0.267	1.144
	[0.155]***	[0.0648]***	[0.104]***	[1.152]	[0.122]***	0.0777]**	[0.0596]***	[0.448]**
ΣΔ Shadow Interest Rate {t-1 to t-4} * ΣΔ Source Macropru Stringency	-0.839	-0.596	-1.188	-9.134	-0.295	-0.385	-0.0685	-3.383
	[0.411]**	[0.0363]***	[0.737]	[4.204]**	[0.282]	[0.173]**	[0.141]	[1.53]**
Constant	-0.0334	-0.0463	-0.0441	-0.0368	-0.00244	-0.00974	-0.00591	-0.000704
	[0.00448]***	[0]***	[0.00284]***	[0.00909]***	[0.00138]*	[0]***	[0.00189]***	[0.00353]
Source Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
ΣΔ Source Macropru Stringency {t-1 to t-4} included	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R - squared	0.25	0.25	0.16	0.18	0.16	0.15	0.08	0.07
Number of Observations	199	199	199	193	569	569	569	551

This table shows the results of estimating the relationship between source banking systems' FX borrowing costs and the monetary policy associated with the three reserve currencies (USD, EUR and JPY - as shown in the column headings). The estimated equation is:

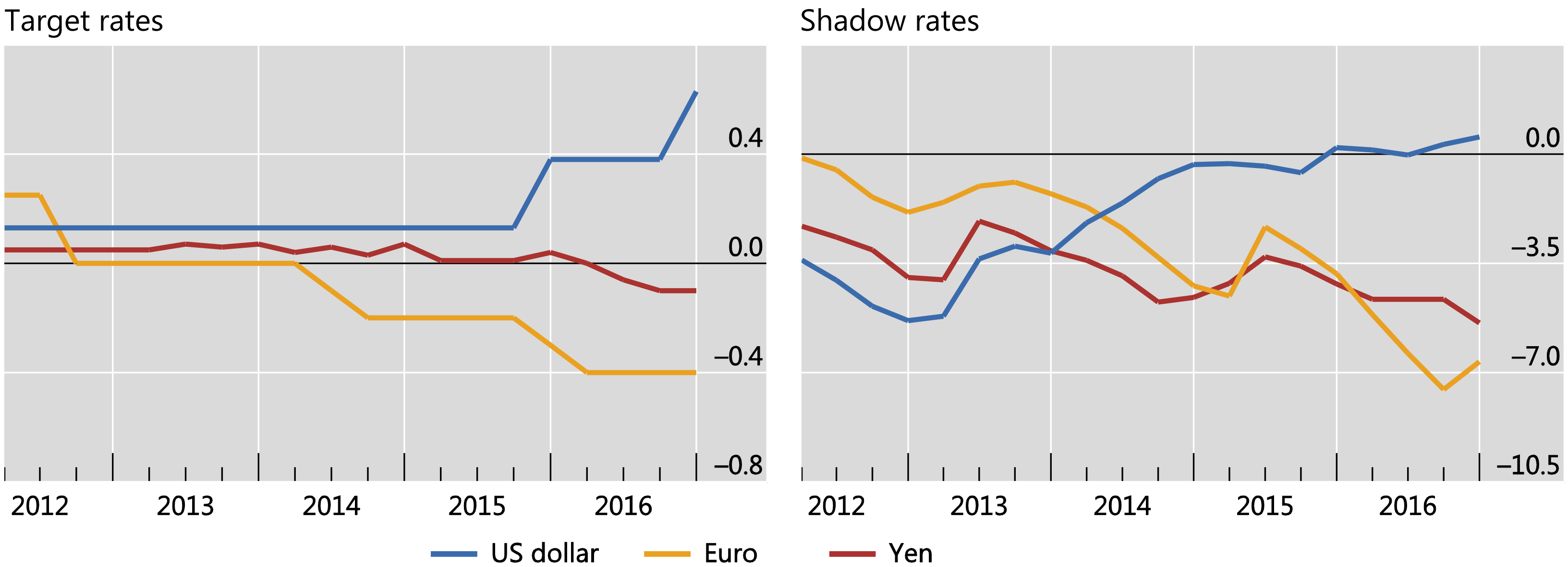
$$\Delta funding\ cost_{ict} = \sum_{k=1}^{4}(\delta_{1k}\Delta macroprudential_{it-k} * \Delta monetary_{ct-k} + \delta_{2k}\Delta macroprudential_{it-k} + \delta_{3k}\Delta monetary_{ct-k} + \delta_{4k}\Delta macro_{it-k}) + FE_i + \varepsilon_{ict}$$

The dependent variable is the quarterly change in the FX interbank borrowing rate (Models 1-4) or the FX composite borrowing rate (Models 5-8) in source lending system I, denominated in FX (collected from the IMF International Financial Statistics). The coefficients shown are cumulative over the preceding four quarters. Source Macropru Stringency is an index of several macroprudential tools enacted at the level of the source banking system (as shown in Table A1) that we construct from the CCFS database over the 2000 Q1 - 2014 Q4 period. Two-way clustered standard errors are shown in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Short –term policy and shadow interest rates

In per cent

Figure 1



Sources: Krippner (2016); national data.

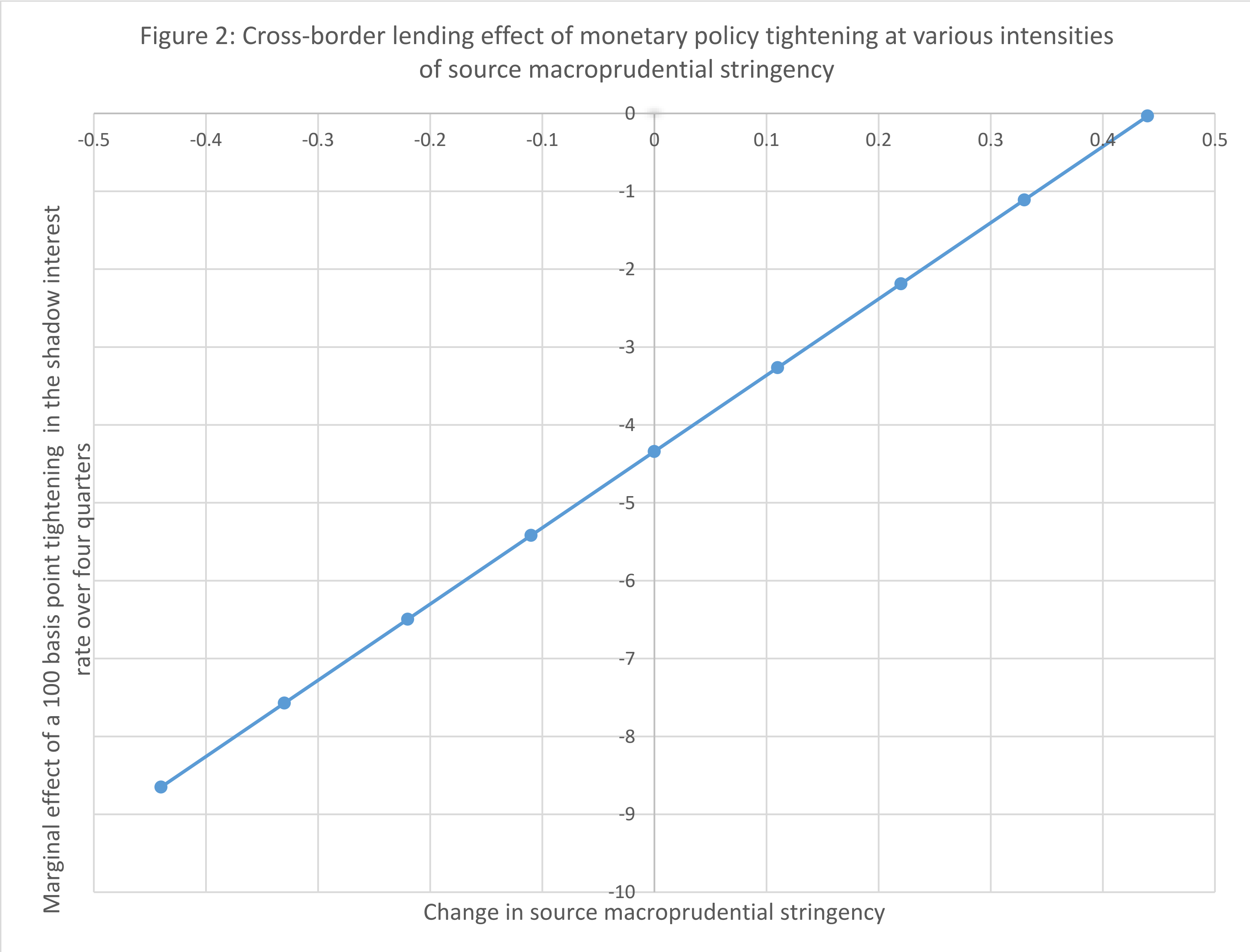


Figure 2: Cross-border lending effect of monetary policy tightening at various intensities of source macroprudential stringency
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
Marginal effect of a 100 basis point tightening in the shadow interest rate over four quarters
Change in source macroprudential stringency