Jumpstarting an International Currency*

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Abstract

While the USD dominates cross-border transactions today, a few other currencies are also used internationally. This paper shows that central bank policies that reduce the volatility of borrowing costs for foreign firms in domestic currency can trigger a jumpstart of the currency's international status, because firms' choices of the currency of their working capital complement their sales invoicing. Empirically, the creation of swap lines by the People's Bank of China between 2009 and 2018 supports this theoretical claim. Signing a swap line with a country is associated with an increase in the probability that the country would use the RMB at all by 12%, and a four-fold increase in the value of the country's RMB payments.

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1 Introduction

An international currency is a monetary unit that is used significantly in cross-border transactions. The few currencies that qualify today are the euro, the yen, pound sterling, the Swiss franc, the yuan and, of course, the US dollar, which dominates invoicing, issuance of financial assets, sovereign reserves, and almost any measure of international use. A significant literature has modeled the complementarities that make one currency dominant and has studied the privileges afforded to a country from its currency dominating.[1] But before a currency can dominate, it has to become international. Fewer studies have investigated how a currency achieves that status, and almost none have asked which government policies assist (or hinder) that jumpstart. Why have the euro, yen, sterling, and franc survived in international use despite the dollar's dominance? Why did the yuan join this group in the last decade when the Brazilian real, or the Indian rupee, have not done so? Did the deliberate policies of the People's Bank of China (PBoC) a decade ago play a role, and if so, how large was it? This paper investigates these questions.

It makes two contributions. First, in section 2 and 3, it offers an empirical analysis of the PBoC's swap lines, signed over 2009-18, that provided RMB lending of last resort to foreigners. The PBoC's publicly stated objective for providing this RMB liquidity was to support RMB-denominated trade finance and settlement.[2] We describe their properties and characterize their rapid growth. We combine them with monthly SWIFT data on payments across borders, broken down by currency and usage, for the entire globe. These data have the advantage of covering many countries over a decade, so we can exploit the cross-country variation to estimate the consequences of signing the swap lines.

Our main finding is that there was significant growth in the use of the RMB after entering a swap agreement. Comparing 21 countries that signed a RMB swap line with those that did not, while controlling for a series of confounding factors, we find that a swap line is associated at the extensive margin with an increase in the probability that the country uses the RMB for international payments by approximately 14%. At the intensive margin, RMB use rises by between 220 and 450% across specifications. Most of the effect of the swap lines on using the RMB happens within 12 months of the signature of the agreement and persists long after. The effect is visible in RMB payments that do not involve China itself, and it is not explained by the rising economic integration with China,

[1] See Prasad (2015), Gopinath (2015), Eichengreen *et al.* (2017), Ilzetzki *et al.* (2020) among many others.

[2] See Zhou (2017) for an official PBoC statement on the aims of the swap facilities. It explicitly mentions currency internationalization and the stabilization of markets for trade finance.

including under the Belt and Road initiative. Finally, this policy has spillovers: when a country enters an agreement, its neighbors' use of the RMB increases by 10%, even if they do not have a swap line.

The paper's second contribution is a model in section 4 that explains why a currency becomes international (as opposed to dominant) and, most importantly, how a central bank's lender-of-last-resort policy directed at trade finance can influence that process. In the theoretical framework, import-export firms choose the currency in which to invoice their goods in their export markets *and* the currency of denomination of their trade finance for imported inputs. While the literature has focussed on the currency of the sales and of the assets of economic agents, we focus on the currency of firms' liabilities. This provides a link to the effect of central bank policies on borrowing costs for firms, matching the policies associated with the rise in RMB in the data.

In the model, firms face uncertainty over the interest rate on trade finance. By cutting the right tail of the distribution of borrowing costs, a swap line makes finance in that currency more attractive. Sticky prices then generate a complementarity between the currency of liabilities and the currency of invoicing. The model predicts the existence of a threshold on the distribution of borrowing costs that, when cleared, leads a currency to jumpstart into international use. According to the model, the RMB was close enough to this threshold in many countries before the swap lines were signed, justifying the extensive margin effects that we estimate.

This mechanism predicted by the model comes with further predictions that we look for in the data in section 5. First, we find that the signing of a swap line stabilizes offshore RMB borrowing costs, as postulated by the theory. Second, we show that the volatility in the offshore borrowing costs affects RMB use, by looking at the 2015-16 RMB crisis, when the PBoC's attempts to manage the RMB exchange rate by draining liquidity in the offshore market caused a sharp rise in the private cost of borrowing RMB outside of China. As our model predicts, this event lowers the use of the RMB by countries without a swap line, but not by those with a swap line, which insulated them from the fluctuations in the private cost of borrowing. Third, the swap lines are associated with an increase in trade finance in the SWIFT data, which was the focus of the theory. Moreover, the effect is heterogeneous in line with the theory's predictions: stronger in countries with a higher trade share with China, that import more intermediate goods, and whose export industries require more working capital. Fourth and finally, again in line with the model, the RMB has replaced existing vehicle currencies like the USD and the EUR in

denominating payments, as opposed to the local currencies.

We conclude in section 6 by noting the strong parallels between the rise of the RMB and the rise of the USD one century earlier, and speculating on the future role of the RMB.

Related literature. A large literature has studied international currencies, mostly focussing on the causes and consequences of USD dominance (Maggiori, 2017, Gourinchas *et al.*, 2019, Gopinath *et al.*, 2020). We contribute by analyzing the early stages of adoption, when a currency goes from zero to positive use, well before it becomes dominant.

Like us, several papers put trade at the centre of the mechanism that leads to dominance (Gopinath & Stein, 2021, Chahrour & Valchev, 2022, Mukhin, 2022). Currency choice in trade has several complementarities that incentivize using relatively few currencies. There are firm complementarities in matching the currency of costs and revenues (Engel, 2006, Gopinath *et al.*, 2010), demand complementarities for firms in the same market (Bacchetta & van Wincoop, 2005, Goldberg & Tille, 2008), and complementarities between the denomination of exports and imports (Chung, 2016, Mukhin, 2022). Empirically, the literature has used microdata on invoicing to confirm that complementarities in currency choice are present in invoicing decisions (Goldberg & Tille, 2016, Chen *et al.*, 2022, Corsetti *et al.*, 2022, Amiti *et al.*, 2022), including more recently for trade denominated in RMB (Chowdhry, 2024). Our focus is on the complementarities between invoicing and trade finance, and especially on how they create a role for central bank policies that stabilize the cost of finance in a currency and jumpstart its use.

In that regard, our work is closest to the models of currency choice in Corsetti & Pesenti (2002, 2015) where self-validating currency areas can emerge depending on the policy rule for the nominal rate. Similarly, Drenik *et al.* (2021) ask how a central bank's control of inflation influences the denomination of contracts. We study a different central bank policy, the lender of last resort function extended to trade finance abroad.[3]

Using firm-level data, Salomao & Varela (2022) characterize which Hungarian firms borrow in foreign currency. Their findings support the mechanisms guiding the choices of the firms in our model. Benguria & Novy (2024) use Argentinian data on firm invoicing to study our model's predictions on the impact of the RMB swap lines. Closest to our paper is Eichengreen *et al.* (2017), which asks whether central bank's policies can jumpstart the international use of a currency in the historical context of the Federal Reserve (Fed). For

[3]Bruno & Shin (2023) also emphasize the importance of the currency of firms' working capital. Their focus, however, is on how changes in the exchange rate transmit to costs of production. Drenik & Perez (2021) also introduce a working capital channel, but their focus is on the domestic, rather than cross-border, use of an international currency.

the internationalization of the USD, it is difficult to separate the effect of policy from other factors, including World War I or rapid US growth. We provide an analogy with the PBoC, and use its swap lines as a way to test for the effects of policy.

Returning to theoretical mechanisms, Gopinath & Stein (2021) study a different complementarity between finance and invoicing for firms. They focus on the problem of local banks, who lend domestically in foreign currency in order to match the deposits of domestic households in foreign currency. In our application, there is no significant volume of RMB deposits in almost all of the countries in our sample. Moreover, because the foreign currency deposit base gives an abundant supply of foreign currency funding to banks in the model of Gopinath & Stein (2021), an international lender of last resort is unnecessary.[4] Therefore, this model does not explain our empirical results. Consistent with our focus instead on trade finance and the availability of bank loans to firms in foreign currency, di Giovanni *et al.* (2021) shows that this funding is important, volatile, and exposed to shocks from the foreign economy. Empirically, Bahaj & Reis (2024) document the sources of volatility in RMB-denominated offshore borrowing, further raising the relevance of lender-of-last-resort policies while, theoretically, Cristoforoni & Errico (2024) extend our model to study asymmetric shocks across currencies.

The role of depositors in Gopinath & Stein (2021) ties with a related literature on how international currencies act as a store of value. A currency can dominate others as an asset if it offers a hedge against consumption risk (Hassan, 2013, Gourinchas *et al.*, 2022) or if it has special features in terms of its safety or convenience (Farhi & Maggiori, 2018, Jiang *et al.*, 2021). In the data, the USD also dominates the denomination of debt securities (Maggiori *et al.*, 2019, 2020).[5] Farhi & Maggiori (2019) propose a model where the denomination of payments intersects with the denomination of reserve assets, specifically in the context of competition between the US and China. The policy we study does not directly tie into the role of the RMB as a store of value. Swap lines alter the cost of borrowing

[4]Das *et al.* (2022) extend the model to include banking crises, which creates a role for a lender of last resort in foreign currency to fund bailouts. However, the lender of last resort is the local central bank, and the relevant policy trade-offs are with reserve accumulation and macroprudential policy, unlike the borrowing costs for trade finance that we emphasize.

[5]As shown in Maggiori *et al.* (2020), access to the international bond market is relatively rare among firms, and the policy we study focuses primarily on supporting the banking system. Several papers study determinants of the denomination of bond issuance, including hedging (Coeurdacier & Gourinchas, 2016), safety and convenience premia (Caramichael *et al.*, 2021, Jiang *et al.*, 2024), carry trades and speculation (Bruno & Shin, 2017, Huang *et al.*, 2024), and signalling (Eren *et al.*, 2024). More broadly, Eren & Malamud (2022) propose that the dominance of the USD arises from its role in denominating credit and study the resulting global impact of US monetary policy.

RMB rather than the returns on holding it. Several other Chinese policies are designed to internationalize the RMB as a store of value (Naef *et al.*, 2022), including the opening up of the stock market (He *et al.*, 2023), the bond market (Clayton *et al.*, 2023), and the establishment of an offshore banking system (Bahaj & Reis, 2024). Clayton *et al.* (2023) discuss this aspect of the internationalization strategy, rationalizing China's policies as trying to build credibility as an issuer while reducing the cost of capital flight.

There is a growing literature studying swap lines (Bahaj & Reis, 2022b, 2023), but it has focused almost entirely on the swap lines established by the Federal Reserve or the ECB. Their features and aims are different from the PBoC lines studied in this paper, since they: (i) have shorter maturities, (ii) involve only a handful of advanced economies as opposed to the diverse set of countries with RMB swap lines, (iii) were designed to address the dollar funding needs of foreign banks with substantial dollar-denominated assets, in contrast to the PBoC's focus on trade finance in the context of limited RMB cross-border banking, and (iv) were needed because of the USD's dominance, as opposed to the RMB swap lines that were deployed to start the internationalization of the RMB. While the RMB's swap lines are different, they are no less economically important: their notional limit of approximately RMB 3tr is comparable to the USD 600bn of peak drawings from the Fed's swap line. Horn *et al.* (2023) aggregate public sources and argue that around half the lines have been tapped and, in keeping with the lender of last resort function, drawings are associated with times of external distress.

2 Data on RMB payments and swap lines

This section describes our two sources of data: the PBoC and multiple central banks on their swap agreements, and the Society for Worldwide Interbank Financial Telecommunication (SWIFT) on cross-border payments by currency. Formal definitions and sources are in appendix B. After discussing how many lines were signed and when between 2009 and 2018, we build an aggregate series for cross-border RMB payments, and discuss the appropriate sample of countries to connect the two.

The PBoC swap lines. A RMB swap line is an agreement between the PBoC and a foreign central bank enabling the latter to borrow RMB in order to provide RMB-denominated credit in the foreign economy to local banks. The typical agreement sets out a renewable 3-year period during which the foreign central bank can choose to activate the line. Like other central bank lending programs, swap lines put a ceiling on interest rates, thereby reducing the interest rate risk faced by commercial banks (and by extension their cus-

tomers) in dealing in RMB.[6] Therefore, the lines provide insurance against excessively high borrowing costs; we will empirically confirm this effect for the RMB in Section 5.

Appendix A describes the operational aspects of the RMB swap lines and explains how they are an extension of the PBoC's lender of last resort function abroad to support the provision of RMB-denominated trade finance by foreign banks. It also discusses the usage of the facilities. On the one hand, there is no systematic usage data, but there is scattered evidence that it is positive. On the other hand, even if a line is unused most of the time, its presence still caps interest rate risk for firms reliant upon RMB trade finance.

We collect data on each swap line agreement signed or renewed by the PBoC starting from 2009.[7] We compiled this information from the PBoC's news releases, validated against the counterparty's communications. By 2018, 38 countries had signed an agreement. The variable $\text{SwapLine}_{i,t}$ takes a value of one if country i first signed a PBoC swap agreement at or before month t. Because swap line agreements sometimes lapse and are usually renewed right away or within a few months, we keep the indicator at 1 if the agreement lapses, since the potential for renewal would maintain its insurance aspect. Hence, $\text{SwapLine}_{i,t}$ is a binary absorbing treatment variable with staggered adoption.

Figure 1a shows the evolution of the number of outstanding swap lines and the sum of their notional limits. The trend is upward-sloping. Most of the growth happened in the decade's first half, with a slowdown after 2016. Since 2018, only Saudi Arabia, Macau, and Laos signed new agreements, but many swap lines were renewed and the amount outstanding increased.

Figure 1b shows a map of outstanding lines. Large financial centres have large swap lines, as expected since their financial systems supply credit in RMB to firms around the world. Some countries with significant trade or investment relations with China also have a line. For the other swap lines, there is no obvious pattern driven by economic fundamentals. This likely reflects that the lines were partly a political endeavor. It also means that the timing in which the agreements were signed is not clearly linked to fundamentals.

SWIFT data on RMB payments. SWIFT provides a network for banks to send and receive secure and standardized messages about financial transactions. SWIFT does not settle payments, but its messages are mostly cross-border payment orders that are settled via correspondent accounts that banks hold with each other. These messages account for a

[6] See Bahaj & Reis (2022a) on this mechanism and evidence for its effectiveness.

[7] Subsequent work has expanded this data collection to cover all swap lines around the world (Bahaj *et al.*, 2024).

large share of cross-border transactions (see Rice *et al.*, 2020) across currencies, including RMB payments (see Appendix A.3).

Our data is the monthly value of messages (measured in USD) in a balanced panel between October of 2010 and October of 2018, excluding within-country messages, aggregating by country-pair (there is no information on the bank or client sending the message), and broken down by currency and message type. For most of what follows, we focus on payment orders: these are message types MT103 and MT202 in SWIFT, covering single customer and bank-to-bank payment message types, respectively. We also consider message types MT400, which are advices of payment, and MT700, which confirm the issuance of a letter of credit.[8] These messages arise directly from trade finance (the payments backing MT400 and MT700 are recorded separately as message types MT202 or MT103). However, not all international trade involves an MT400 or MT700, and not all trade finance is communicated via SWIFT. Hence, these message types have incomplete coverage and may not be representative.

Our main measure of interest is the value of RMB cross-border payments sent and received per month per country (or, equivalently, the messages related to trade finance). The aggregated series for the RMB share of payments computed from the microdata is displayed in figure 2. We show message types from payments in panel (a) and those from trade finance in panel (b). While our microdata stops in 2018, we add aggregate public data published by SWIFT on RMB payments to show more recent trends.[9]

The upward trend in the use of the RMB for payments since the PBoC started its internationalization strategy is visible. As with the number of swap lines, there is a leveling off in 2015-16 and a slight decline after, which we will discuss in detail in Section 5.2. The RMB recovered ground in 2018-22, and there was a further jump in use following the invasion of Ukraine that cannot be accounted for solely by Russia, which is too small in the global payment system.[10] In the final quarter of 2023, the RMB was the fourth most commonly used currency for payments, between the GBP and JPY, and the second most commonly used for trade finance at a similar level to the EUR. A decade prior, in 2013,

[8]Specifically, an MT400 is a message from a bank acting on behalf of an importer, confirming to a bank acting on behalf of an exporter that the importer has made payment. An MT700 is a message from a bank acting on behalf of an importer to a bank acting on behalf of the exporter that it will pay the exporter once required documents are supplied, typically upon receipt of proof of shipping.

[9]Our aggregate series differs from SWIFT's due to us consolidating jurisdictions – the Euro Area, the US and its outlying territories, the UK and the crown dependencies, and others.

[10]In subsequent work, Chupilkin *et al.* (2023) shows that the swap lines are associated with an amplification of the switch to the RMB among Russia's trading partners after 2022.

the RMB was the 12th most used currency for payments, just below the Thai Baht.

A first look at the data. Figure 3 plots the sample average RMB share of payments per country against the share of goods trade for each country with China. Three points stand out. First, there are outliers in the data. Some heavy users of RMB are large financial centres that process RMB payments, like Hong Kong or Singapore. Macau and Iran are also special cases: the former is a special administrative area of China, while the latter is under economic sanctions. Mongolia is another outlier as a neighboring country with strong links to China.

Second, the observations are above the 45-degree line: the RMB as a payment currency has punched below China's weight in international trade. By comparison, the USD has a weight of around 50% in global payments relative to a US trade share of around 15%. The USD is a dominant, as opposed to merely international, currency. The correlation in the figure is small, as some economies that are highly integrated in trade use the RMB little.

Third, for most country-month observations, the use of the RMB is zero.[11] Figure A2 in the appendix presents equivalent scatter plots for the start and end of the sample, in 2010 and 2018. A significant change between the two dates is countries starting to use the RMB in the first place, alongside an overall increase in the share of payments.

Let $\text{Rpayment}_{i,t}$ denote the value of RMB payments (MT103 and MT202) from country i in month t. Reflecting the extensive margin, our initial variable of interest is an indicator that takes a value of 1 if, in a month, the country sends or receives an RMB payment, $1(\text{Rpayment}_{i,t} > 0)$. We then turn to the share of cross-border payments in RMB, $\text{Rshare}_{i,t}$, scaled so a unit change is equivalent to one percentage point, together with other measures to assess the intensive margin.

Sample selection. Developed economies have sophisticated financial sectors that generate domestic trade finance and are often hubs for international payments. This can lead to double counting transactions in SWIFT: a payment can appear as multiple messages if routed through several jurisdictions. A payment from Chile to China may pass through New York, London, and Singapore, so payment flows to and from financial centres can be misleading.

We deal with financial centres and the concern over the outliers highlighted by Figure 3 in a few ways. First, we consolidate Hong Kong and Macau into China. Second, we

[11] SWIFT reports a zero for a country pair if there were less than four payments across all currencies in that month. So, if a country makes many payments to China, but all are in dollars, we would accurately observe RMB payments as a precise zero. If the country only makes two payments to China, but all are in RMB, then the observation would be zero as well.

drop Iran from the sample given its sanctioned status, and we consider the robustness of our results to the inclusion of Mongolia's swap line. Third, in the baseline, we exclude the financially developed countries that are hubs and focus on developing countries (average below 30,000 PPP dollars of GDP per capita over the sample) and likely rely on foreign currency credit.[12]

Finally, we exclude four countries that had a swap line before the start of the sample, as well as countries with an average population of less than half a million, and countries with missing values for our control variables to keep a balanced panel. This leaves 11,058 observations on 114 countries, of which 21 are treated during the sample period. Table 1 shows the date each country signed an agreement with the PBoC, and appendix table A1 presents summary statistics for the variables used in our baseline specification.

3 The impact of swap lines on RMB payments

This section investigates whether signing a swap line is associated with an increase in RMB usage, along both the extensive and the intensive margins, and judges how robust this relation is to controlling for several covariates.

3.1 The evolution of RMB use

Panels (a) and (b) in Figure 4 plot the mean and median RMB share of cross-border payments for all countries that signed a swap agreement against the number of months before and after the line was introduced. Noticeably, the typical country that entered a swap agreement made little use of the RMB before the policy. Afterwards, the RMB was used persistently, at a rate that grew over time.

One year prior to signing the agreement, these countries used the RMB at similar rates to other countries. Mean usage increases just a few months before the announcement, but it turns out that Mongolia drives this as an outlier: excluding Mongolia, there is no pre-trend (see Figure A4 in the appendix). It is still possible that the signing of the swap line is anticipated, since the negotiations are not always secret, and some official announcements are made in the build-up to an agreement. Considering the role of these facilities as an insurance mechanism, it would not be surprising that behavior starts to change even before the agreement is finalized.

[12] We treat the euro area's countries at the start of the sample in 2010 as a single consolidated entity, which is dropped because its per capita income exceeds the threshold. Countries that joined the euro area after 2010 are separate, but we do not treat their adoption of the euro, and resulting access to the ECB's swap line, as equivalent to signing an agreement.

Panels (c) and (d) in the Figure show the average of $1(\text{Rpayment}_{i,t} > 0)$ and $\text{Rshare}_{i,t}$, respectively, before and after a swap line is signed for each country in our sample that has an agreement. For completeness, we also add the data points for the developed countries that we excluded from our baseline estimates. Almost all the data points are above the 45-degree line, indicating that the swap line is associated with a rise in RMB use, consistent with panels (a) and (b).

The bottom line from the Figure 4 is that the swap lines are associated with a jumpstart in the use of the RMB as an international currency for payments. The rest of this section investigates whether this effect is statistically significant, and whether it may driven by other observables. We discuss RMB trade finance in particular in Section 5.

3.2 Statistical specification

Our baseline specification is a panel linear probability regression:

$$1(\text{Rpayment}_{i,t} > 0) = \varsigma_i + \tau_t + \beta \times \text{SwapLine}_{i,t} + \gamma \times \text{Controls}_{i,t} + \text{error}_{i,t}, \qquad (1)$$

An estimate of $\beta > 0$ indicates that the swap lines have a positive association with RMB use at the extensive margin. This is a difference-in-differences model with a staggered, absorbing, binary treatment. Because a recent literature has noted that there might be a bias if the treatment effect is heterogeneous across time, we use the imputation methodology from Borusyak *et al.* (2024), clustering standard errors at the country level and averaging treatment effects by cohort.

There is a causal interpretation of β if there is conditional independence: in the absence of the swap lines agreement and conditional on our control variables, the countries in our sample would have similar trends in the use of the RMB. This would be true if the countries were comparable and the swap lines were randomly assigned. Anecdotally, the agreements' timing were primarily the result of political forces in China and the counterparty rather than economic forces. However, RMB usage in a country could increase due to factors that also prompt the signature of a swap line with the PBoC. The obvious confound is rising economic, financial and political integration with China. We address this concern with a combination of controls, zooming in on payments less closely linked to economic activity with China, and looking for spillover effects on other countries. Still, to be clear, none of these are watertight identification strategies so our results should be read as documenting an association between the policy and RMB use.

Covariates. Our controls fall into three categories, reflecting different confounds. First, a swap line may be signed to facilitate trade with China and, in turn, more trade with China could encourage RMB use independently of the policy. To control for this, we include as covariates: the log of dollar exports and imports from the country to China, the ratio of Chinese imports and exports in the country's GDP, and a dummy for whether the country has a trade agreement with China. Note, however, that in the data there is no increase in trade with China following the introduction of a swap line (see appendix C.2).

Second, non-trade-related integration may lead to increased RMB payments thanks to policies distinct from, but correlated with, the swap lines. The RMB swap lines are sometimes part of a package of policies between China and other countries, and it may be these other policies that spurred the use of the RMB. To address this issue, we add four measures of Chinese economic policy towards county i as another set of controls: whether the country has a RMB clearing bank,[13] whether it is a member of the Asian Infrastructure Investment Bank, the size of infrastructure investment flows from China as ratio of GDP (both the monthly flow and the cumulative flow since the start of the sample),[14] and the similarity of the country's voting patterns to China in the UN General Assembly, to proxy for the country's overall geopolitical alignment with China.

Third, region-specific trends in RMB usage may correlate with signing a swap line, perhaps because of political or economic developments in the region and its relations with China. We control for the proportion of the country's neighbors that use the RMB in a given month. A country's neighbors are defined as all countries within 1,000km of country i if at least five are within that distance (if there are fewer than five countries, we include the nearest five countries to country i).[15] A related issue is that signing a swap agreement can spill over across borders. If an individual country signs an agreement and starts pricing trade in RMB, nearby countries that trade with it may also start using the currency. Such spillovers would reject the null hypothesis that the swap line has no effect, but they would violate the assumption of a stable unit treatment value. Appendix C.2 uses a spillover model to explore the association between a swap line and RMB use

[13] See appendix A.1 for discussion of the role played by clearing banks.

[14] Infrastructure investment forms a key pillar of China's global development strategy under the country's Belt and Road Initiative (BRI), and we dig deeper into the role played by the BRI in appendix C.1

[15] Formally, let $\mathcal{N}_i$ denote the set of country i's neighbors. The control variable for neighbors RMB use is:

$$\text{Neighbor Use}_{i,t} = \frac{1}{|\mathcal{N}_i|} \sum_{j \in \mathcal{N}_i} 1(\text{Rpayment}_{j,t} > 0).$$

We measure distance capital to capital using great circle distance. Alternative measures and thresholds give similar results.

in neighboring countries.

3.3 Estimates

The extensive margin. Table 2 reports estimates for the extensive margin of RMB use. The first column has no covariates and shows that the swap line is associated with an 11% increase in the country's likelihood of using the RMB in a given month. The following three columns show that this finding is unaffected by incrementally adding our three sets of covariates. Column (5) confirms our coefficient of interest is similar if we use a two-way fixed effects estimator.[16]

Columns (6) and (7) split payments into those sent versus those received: for payments related to trade, the former would correspond to imports and the latter to exports. The relationship is stronger for payments sent than received, which will be consistent with our model, where the response of exports is a second-round effect. The coefficient on payments received is not distinguishable from zero in the table, but this is not true across alternative specifications, and when we consider only trade finance payments received, the coefficient is statistically significant (see appendix Table A4).

Figure 5a shows an event study plot for the specification in column (4), which has all the covariates. Most of the effect is in the vicinity of the signing of the swap line, with the coefficient stabilizing after 12 months. There is no reversion.

In line with our previous discussion of pre-trends, the event study plot suggests an effect just prior to the agreement. The formal pre-trend tests in Borusyak *et al.* (2024) reject the null of no pre-trend up to two months prior, but not for further lags. It is unlikely that an unobserved pre-treatment shock triggered both the RMB use and the signing of a swap line since it takes more than two months to negotiate an agreement. More likely, this reflects anticipation, as news about the agreement may be available before the announcement. Column (8) of Table 2 accounts for an anticipation period by shifting the treatment timing 6 months prior. This raises the coefficient estimate by 6 percentage points.

Finally, columns (9) and (10) consider the robustness of the results to sample selection. Column (9) excludes Mongolia as an outlier; this has minimal impact on our results at the extensive margin (the same is not true at the intensive margin, as we will discuss below).

[16]The number of countries that sign a swap agreement is small, so there is a large pure control group of never-treated countries. Hence, a two-way fixed effects estimator will still primarily deliver an estimate of β based on comparisons between treated observations and the never-treated and down weight "forbidden" comparisons that motivate the literature on staggered adoption. As a result, the imputation and standard least squares estimates deliver similar results.

Column (10) relaxes the selection criteria on excluding developed economies, which has little impact on the coefficient estimate.

The intensive margin. Table 3 considers the association between the swap line and the intensive margin of RMB use. This requires taking a stance on Mongolia, because it is an outlier with a large and volatile RMB usage. To be conservative, we drop Mongolia for all the specifications presented here, while appendix Table A5 includes it leading to larger estimates, since Mongolian use of the RMB rose sharply after it signed a swap agreement.

Columns (1)-(2) of Table 3 replace the left-hand side of equation (1) with $\text{Rshare}_{i,t}$, showing estimates with or without controls. Signing a swap line agreement is associated with an increase in the share of the RMB in international payments of 0.13 percentage points. Figure 5b presents the equivalent of column (2) as an event study plot. In contrast to Figure 5a, when accounting for the intensive margin, there is no evidence of pre-trends in the months immediately prior to signing an agreement. Column (3) considers the average treatment effect at different time intervals. The effect compounds over time, rising to 0.3 percentage points between years 3 and 4, or approximately one-fifth of the overall rise in RMB payments between 2010 and the end of our sample.

To reinforce the point regarding a lack of pretrends, in columns (4)-(5) we employ the synthetic control approach of Arkhangelsky *et al.* (2021) that reweights observations to ensure the pre-agreement trends are the same in the treated and control countries. This synthetic difference-in-differences methodology is also robust to staggered adoption and is well-suited for settings with relatively few treated units (as in our case).[17] The coefficient estimates are robust to this alternative approach.

Even after dropping Mongolia, it is still the case that, across countries, the volatility of $\text{Rshare}_{i,t}$ is increasing in its level. Hence, the estimates in columns (1)-(5) are weighted towards the countries that use the RMB the most. In columns (6)-(9) we present results using $\ln(1 + \text{Rpayment}_{i,t})$ as the outcome variable. This is a common and simple way to transform data that can handle zeros, retains a log-like interpretation of the coefficients, is compatible with synthetic control methods, and is more robust to volatile outliers (the inclusion of Mongolia has a minimal impact in this specification, see Table A5).[18] Across the difference-in-differences estimators, the coefficients are positive and statistically sig-

[17] Applying synthetic control methods to a binary outcome variable is problematic, so we did not use this approach for the extensive margin regressions.

[18] This log-like transformation has been criticised by Chen & Roth (2023) as not being invariant to the scaling of the data so the size of the coefficients in columns (5)-(8) lack a meaningful interpretation. Note also that, given the log-like interpretation of the outcome variable, we control for country size by augmenting the control set with the logarithm of the country's GDP and its total cross-border payments, both in USD.

nificant. In columns (10)-(11), we instead use a Poisson model (Santos Silva & Tenreyro, 2006). Interpreting the point estimates from this specification, as in Chen & Roth (2023), suggests that countries that signed a swap agreement had RMB usage between 250%-440% higher than the control countries following the policy's introduction.[19]

Additional results. Appendix C presents additional empirical exercises. First, we show that rising economic or political integration between the country and China does not explain our results. Specifically, the swap lines' association with RMB payments: (i) is present for non-Chinese counterparties; (ii) is not explained by the membership of the Belt and Road Initiative; and (iii) does not extend to trade between the country and China.

Second, we consider the association between the swap line and RMB payments in neighboring countries. Distance is a key determinant of the size of trade flows. When a country's neighbor signs a swap line with the PBoC, the country is more likely to import more inputs invoiced in RMB from this neighbor, increasing the likelihood that the country jumpstarts its own use of the RMB. A neighboring country signing a swap line is also arguably orthogonal to local economic or political confounds that simultaneously drive RMB use. In appendix C.2 we confirm this effect on neighboring countries and offer an evaluation of potential spillovers.

4 A model of currency choices

This section proposes a model to explain the association we found between RMB use and the swap lines. The setting is a small open economy where firms choose their invoicing currency, as in Engel (2006) and the literature that followed. Novel, we consider import-export firms that also choose the currency of trade finance to study the complementarity between the two currency choices and how central-bank policy can influence the cost of borrowing.

4.1 The environment

There is a continuum of firms indexed by $j \in [0,1]$. Each firm sells to a continuum of markets with zero mass, each with its own currency, indexed by $i \in [0,1]$. The firm

[19]The Poisson model does not include countries where all values for RMB payments are zero, so the control group is restricted to countries that use the RMB at least once throughout the sample. Another caveat of this model is that, unlike in the trade literature, where country-pair data is used, our specification is aggregated at the country level. Therefore, there is still an incidental parameters problem when including country-level fixed effects, which could bias the estimates. Finally, the issues surrounding a staggered difference-in-differences design in Poisson regression models have still not been thoroughly studied.

also sells to the market of the issuer of the current dominant currency, denoted with the subscript d, and to the market of a rising international currency, subscript r. These two markets have positive mass in the sales of each firm, reflecting the size of their economies.

There are three periods, distinguishing between three stages of choices that each firm must make. In period 0, the firm chooses the currency in which it pays for imported inputs. These are purchased in advance, so they require working capital, and the firm chooses a matching currency for its trade finance. Imported inputs and trade finance are available in the two international currencies, d or r. The interest rate that will later be charged for recurring finance in each currency is uncertain and can differ across firms, reflecting their reputation or (out-of-equilibrium) temptation to default.

In period 0, the firm also chooses the price in a specific currency at which it will sell its goods in each market. Prices are nominally sticky, so currency choice affects the volatility of firm sales. The firm can choose the currency of its price from: its own currency, the local currency of the market to which it is selling, the dominant currency d, or the rising international currency r.[20] The exchange rates and the level of demand in each market are uncertain.

In period 1, the firm produces using imported and local inputs. All uncertainty is resolved. The price of inputs, exchange rates, and borrowing costs are all exogenous, while the period-0 choices generate an endogenous joint distribution of future revenues and costs of production.

Finally, in period 2, each firm j satisfies demand in each market i given its sticky price. It collects revenues, pays off loans, and realizes its profits.

Functional assumptions in production. Firm j's production technology in period 0 is:

$$x^j = \min\left\{\frac{x_r^j}{\eta^j}, \frac{x_d^j}{1-\eta^j}\right\}. \tag{2}$$

The firm can choose $\eta^j \in [0,1]$ to pin down the relative shares of the input x^j denominated in currency r, x_r^j, and the share x_d^j paid for in currency d.

[20] In the model, firms choose the currency of their borrowing and their invoicing, but in the data we only observed the currency of cross-border payments. In principle, the currency used for invoicing and settling payments could differ, and the currency of credit could not be the currency used for repayment. However, studies in this topic (e.g., Friberg & Wilander, 2008) find that, in 99% of the cases, the currency used to settle payments is the same as the currency of invoicing or the one denominating the debt.

The production function in period 1 uses input x^j and other local inputs l^j:

$$y^j = (x^j)^\alpha (l^j)^{1-\alpha}. \tag{3}$$

Appendix E.4 allows for a generic, linear, homogeneous production function.

The input l^j is paid for in period 2, while the x^j input must be paid for ahead of production. Thus, the firm must borrow to finance these inputs. Using a different currency to pay for and to finance the imported inputs generates exchange-rate risk. We assume that the firm will never bear this risk, so η^j pins down both the currency of the input and the currency of its trade finance. Appendix E.3 allows these two choices to differ and shows that, in general, it is optimal for them to be the same.

Cost of finance and production. For firm j, in period 1, borrowing b_d units of d currency requires repayment of 1 unit of d currency in period 2. Borrowing b_r of r currency requires a payment of ε^j. Therefore, the interest rate on a d loan is $1/b_d$, while the interest rate on a r loan is ε^j/b_r. Both rates are known in period 1, but in period 0, firm j faces uncertainty on ε^j, which is drawn from a distribution $G^j(\varepsilon^j)$.

The difference in the cost of finance plays a role in the firm's choice of currency. For a start, a higher mean of ε^j makes it more expensive on average to use r credit than d credit. This may be the case if the dominant currency enjoys a convenience premium. Second, the larger spread of possible r interest rates relative to d rates makes r credit more risky and is a reflection of the more liquid, stable, and efficient capital markets in d currency. In our model, this is what defines d as the dominant currency. Assuming that the cost of borrowing in d is known and homogeneous is for simplicity, since it is the spread between d and r credit that matters.

In period 1, the inputs in each currency, x_d^j and x_r^j, cost ρ_d in d currency and ρ_r in r currency, respectively. Both ρ_d and ρ_r are known in period 0, so we can focus on the cost of credit. The local input costs w, which is paid in domestic currency in period 2. Also uncertain is the exchange rate s_i between domestic currency and the currency of market i. (A higher s_i is an appreciation of the foreign currency.)

The marginal cost of production for firm j depends on the choice of η^j and on all the shocks that are realized in period 1:

$$C(\eta^j, \varepsilon^j, s_r, s_d, w) = \left[\frac{\eta^j s_r \rho_r \left(\frac{\varepsilon^j}{b_r}\right) + (1-\eta^j) s_d \rho_d \left(\frac{1}{b_d}\right)}{\alpha}\right]^\alpha \left(\frac{w}{1-\alpha}\right)^{1-\alpha}. \tag{4}$$

Currency of pricing. In period 0, each firm j chooses the currency of its sticky price in market i from four options:

$$\mathcal{P}_i^j \in \{PCP, LCP, DCP, RCP\}. \tag{5}$$

Under producer currency pricing (PCP), the firm chooses a price p_i^j, in domestic currency. Under local currency pricing (LCP), p_i^j is the price in market i, so $p_i^j s_i$ is the domestic currency revenue per unit sold. Pricing in the dominant currency (DCP) in market i yields a unit revenue $p_i^j s_d$, and doing so in the rising currency (RCP) gives $p_i^j s_r$.

The firm faces a demand curve in each market with a constant elasticity θ. Its sales depend on the currency in which it sets its price. Under LCP, demand is given by: $y_i^j = (p_i^j/q_i)^{-\theta}$ where q_i is a stochastic market-specific demand shifter that realizes in period 1. Under PCP, changes in the exchange rate cause changes in the price facing consumers, and thus in their demand for the firm's product: $y_i^j = (p_i^j/(q_i s_i))^{-\theta}$. Under DCP, changes in the exchange rate between the i market and d, so s_d/s_i, shift demand: $y_i^j = (p_i^j s_d/(q_i s_i))^{-\theta}$. Symmetrically, with RCP: $y_i^j = (p_i^j s_r/(q_i s_i))^{-\theta}$.

The goal of each firm. We gather the shocks to exchange rates, s_i, and the demand shifters, q_i, into vectors S and Q, respectively. These contain the analogues in the r and d markets. The non-credit stochastic variables that realize in period 1 have joint density $H(S, Q, w)$.

The ex-post profits of a firm in period 2 are given by the difference between revenues and costs. In the case of choosing LCP in market i, they are:

$$\pi^{LCP}(p_i^j, \eta^j, \varepsilon^j, S, Q, w) = (p_i^j s_i)(p_i^j/q_i)^{-\theta} - C(\eta^j, \varepsilon^j, S, w)(p_i^j/q_i)^{-\theta}. \tag{6}$$

Similar expressions hold for the other three pricing cases (see appendix E.1).

Combining profit functions with the marginal cost function, the firm's problem is:

$$\max_{\eta^j} \left(\int_0^1 \max_{\mathcal{P}_i^j} \max_{p_i^j} \left(\int \int \pi^{\mathcal{P}}(p_i^j, \eta^j, \varepsilon^j, S, w) dH(S, Q, w) dG^j(\varepsilon^j) \right) di + ... \right) \tag{7}$$

The first inner maximization is over the optimal price in each market. The second is over the pricing currency for each market. The outer maximization is over the currency of credit at the firm level. The expression omits the equivalent expressions for the d and r markets that have positive mass (the whole expression is in the appendix).

4.2 The predictions of the model

We now solve the firm's problem in (7) and study how a swap line affects equilibrium.

The forces in the model. With full information, a firm would choose a price equal to a constant markup over marginal cost. The pricing currency would be irrelevant since, knowing the exchange rates, prices could adjust to deliver the optimal constant markup. As for the choice of credit, firms with $\varepsilon^j > (\rho_d/\rho_r)(b_r/b_d)(s_d/s_r)$ would choose to use d since its cost is lower, accounting for the cost of inputs, the cost of credit, and the appreciation of the currency in the three terms in parentheses, respectively.

With uncertainty, firms must form expectations of the costs of choosing a different currency. Firms are not averse to uncertainty per se: they maximize expected profits and are risk neutral, as in the standard microeconomic theory of the firm. Therefore, access to fairly priced financial hedges would not alter the firm's problem.[21] However, ex-post deviations from a constant markup over marginal cost lead to lower profits in expectation, as do ex-post changes in the costs of credit and inputs. Therefore, the firm is averse to positive co-movement between the marginal costs and demand, and between the components of marginal costs. This is the key force in the model.

To expose the mechanisms driven by this force, we start by making the simplifying assumption that the distribution $H(S, Q, w)$ is log normal with mean μ and Σ.[22] We use subscripts to indicate its elements: mean and variances of the currency of country i are μ_i and σ_i^2, covariance with currency of k is σ_{ik}, and subscripts w and q refer to domestic input costs and demand shifters. Appendix F.1 proves the following result:

Proposition 1. *The solution to the firm's problem in equation* (7) *has the following properties:*

(a) The firm will choose either to use entirely r- or d-credit and inputs, $\eta^j \in \{0, 1\}$.

(b) Consider a particular market i where the firm chooses RCP. If $\varepsilon^j = 1$ and the d and r currencies are otherwise identical in terms of mean, variance and costs, the firm's profit in market i will increase following a switch from d-credit to r-credit if:

$$\theta\left(\sigma_r^2 - \sigma_{rd}\right) > (1-\alpha)(\sigma_{rw} - \sigma_{dw}) + \theta\left(\sigma_{ri} - \sigma_{di}\right) + \theta\left(\sigma_{rq_i} - \sigma_{dq_i}\right). \tag{8}$$

[21] An alternative way of interpreting risk neutrality is to assume that the firm has already engaged in sufficient financial hedging from a competitive risk neutral intermediary such that it is indifferent between cash flows received in different states of the world.

[22] We obtain equivalent results using a second-order approximation with a general distribution in Appendix E.4). Log-normality provides simple analytical solutions.

(c) *If the firm chooses r-credit, and the d and r currencies are otherwise identical in terms of mean and variance, then RCP is preferred to LCP in market i if the variance of the local exchange rate is sufficiently high:*

$$\sigma_i^2 - 2\alpha\sigma_{ir} - 2(1-\alpha)\sigma_{iw} \geq \Phi \equiv \sigma_r^2 - 2\alpha\sigma_r^2 - 2(1-\alpha)\sigma_{rw}. \tag{9}$$

Proposition 1(a) follows from the quasi-convexity of profit functions in input prices. The firm wants to pick the currency with the lowest expected cost, and diversification is not beneficial since the marginal cost of imported inputs is linear in the two currencies. Hence, a corner solution is optimal, since one currency will (weakly) dominate the other.

Proposition 1(b) shows how the choice of the currency of credit allows the firm to hedge different risks. The firm wishes to maintain a constant mark up over marginal cost. If it uses RCP in a particular market, switching to r-credit brings the benefit of aligning one component of costs to the currency of revenues. This benefit is captured by the left-hand side of proposition 1(b), as $\sigma_r^2 - \sigma_{rd}$ is weakly positive, and reflects the alignment of prices and marginal costs in switching from d to r-credit. On the right-hand side, the first term captures the hedge for domestic input costs, which will be higher for r-credit if σ_{rw} is low relative to σ_{dw}. The second and third terms capture the hedging of shifts in demand, as the firm wishes to avoid having high marginal costs when it needs to meet high demand. Since this could happen either because s_i appreciates or because q_i is large, then r-credit is less attractive than d-credit if $\sigma_{ri} > \sigma_{di}$ or $\sigma_{rq_i} > \sigma_{dq_i}$.

Finally, proposition 1(c) considers the choice of pricing currency. Unlike the previous two results, this one follows existing well-known findings in the literature. Taking $\eta^j = 1$ as given: (i) a higher σ_i^2 relative to σ_r^2 makes choosing LCP less attractive as prices would be more volatile, (ii) a higher covariance σ_{ir} makes LCP more attractive as it would better hedge the r-component of costs, and (iii) a higher σ_{iw} relative to σ_{rw} provides a further incentive for LCP since marginal cost also depends on the local input price w.[23]

A simplification on the shocks. This paper focuses on how access to trade finance alters a firm's pricing decisions. To keep expressions more straightforward, from here onwards

[23]By assuming constant elasticity demand curves, we have ruled out demand complementarities in price setting, since the firm's optimal flexible price is unrelated to those of other firms. Therefore, neither σ_{rq_i} and σ_{iq_i} appear in proposition 1(c). Demand complementarities provide an additional force for currency dominance, as firms have an incentive to price in the same currency as their competitors. Appendix E.4 shows that, up to a second-order approximation, the main insights of our main analysis are unchanged. Novel, if the demand complementarities are sufficiently strong, this can provide a new force pushing the firm to use the rising currency following the introduction of a swap line.

we abstract from some of these hedging channels by making the following assumption:

Assumption 1. *The elements of μ and σ that relate to the currencies d and r are symmetric such that $\mu_d = \mu_r$, $\sigma_r^2 = \sigma_d^2$, $\sigma_{rw} = \sigma_{dw}$, and $\sigma_{ri} = \sigma_{di}$ and $\sigma_{rq_i} = \sigma_{dq_i}$ for all $i \in [0,1]$. The covariances between r and q_r and d and q_d are also symmetric and are restricted such that profits in the r market are higher under r-credit if borrowing costs are the same across currencies (symmetric for the d market).*

This assumption ensures that neither the r nor the d currency has an innate advantage over the other beyond the cost (and uncertainty) of borrowing in each currency. If one of the currencies is expected to depreciate relative to the other, or if it is less volatile, the firms will favor it. These effects are mostly isomorphic to altering the relative interest rates (b_d and b_r), so carrying the extra terms offers little extra insight. Moreover, in our empirical application, r stands for the RMB and d for the USD, currencies which, during our sample period, were partially pegged, so this restriction approximately held, with the USD dominance coming from its deeper financial markets in the model. The last part of assumption 1 ensures that the alternative currency is not a sufficiently good hedge against demand shocks that it overcomes the complementarity of matching currencies.

The currency of borrowing. Appendix F.2 proves the following result:

Proposition 2. *The firm will choose r-credit ($\eta^j = 1$) if:*

$$\left(\int \left(\varepsilon^j \right)^{\alpha} dG^j(\varepsilon^j) \right)^{1/\alpha} \leq \left(\frac{b_r}{b_d} \right) \left(\frac{\rho_d}{\rho_r} \right) \Psi(\mu, \Sigma, \mathcal{P}^j). \tag{10}$$

Otherwise, it will choose d-credit. Under assumption 1, $\Psi(\mu, \Sigma, \mathcal{P}^j)$ equals one if the r and d markets are the same size. Starting from here, $\Psi(\mu, \Sigma, \mathcal{P}^j)$ increases with the size of the r-market.

For intuition, consider the case where $\Psi(.) = 1$. The proposition shows that if the expected value of a concave function of the excess credit costs in r currency is below the relative interest rates and input costs in the r and d currencies, then the firm chooses r credit. The threshold is whether the cost of r-credit is low relative to d-credit.

Now, $\Psi(.)$ captures how the distribution of exchange rates (captured by Σ and μ) interacts with the endogenous choice of invoice pricing (captured by $\mathcal{P}^j$). This includes the complementarities between the currency of pricing and credit, as well as any advantages that a choice of credit has as a hedge. The exact functional form of Ψ is convoluted, and we present it in the appendix. If r and d are symmetric in every way, including market

size, and only differ in the cost of borrowing and inputs, then all these interactions cancel between the two currencies and $\Psi = 1$. However, if the r market becomes larger (or the firm prices in the r currency for another exogenous reason), the above complementarities kick in and raise Ψ, thus making r-credit more attractive.

Central bank policies to jumpstart the currency. The distribution of credit costs in the r currency, $G^j(\varepsilon^j)$, plays a central role in Proposition 2. If the expected cost and volatility of r-credit is low, the firm is likelier to borrow and price in r currency. A swap line provides a way to borrow foreign currency at a pre-announced interest rate, placing a ceiling on borrowing costs. Hence, we model its introduction as giving firms the option to always borrow r currency at a rate $\varepsilon^{\text{swap}}/b_r$, where $\varepsilon^{\text{swap}}$ is within the support of ε^j for some j. Appendix F.3 proves the following result on the impact of introducing a swap line:

Proposition 3. *The introduction of a swap line that allows firms to obtain r-credit from the central bank at a known rate ε^{swap}/q_r has the following effects:*

(a) It shifts the effective distribution of borrowing costs to

$$\tilde{G}^j(\varepsilon^j) = \begin{cases} 1 & \text{if } \varepsilon^j \geq \varepsilon^{swap} \\ G^j(\varepsilon^j)/G^j(\varepsilon^{swap}) & \text{if } \varepsilon^j < \varepsilon^{swap} \end{cases} \tag{11}$$

so that $\tilde{G}^j(\varepsilon^j)$ is first-order stochastically dominated by $G^j(\varepsilon^j)$ under the new distribution.

(b) Keeping fixed the $\mathcal{P}^j$ decision, some firms switch from $\eta^j = 0$ to $\eta^j = 1$ if the threshold on $\Psi(.)$ in proposition 2 is crossed when computed using $\tilde{G}^j(\varepsilon^j)$.

(c) For firms that switch to $\eta^j = 1$, then RCP is always preferred to DCP as long as the correlation between s_d and s_r is smaller than one, and RCP is preferred to LCP if the condition in proposition 1(c) involving the threshold Φ is met. RCP is preferred to PCP if the covariance of the country's non-credit marginal costs with the r exchange rate is high enough:

$$\sigma_{rw} \geq \Omega \equiv \sigma_r^2 \left(\frac{0.5 - \alpha}{1 - \alpha} \right). \tag{12}$$

By only cutting the right tail of the distribution of ε^j, the swap line may end up only being used infrequently and in small volumes. Nonetheless, result (a) notes that remov-

ing rare high rates affects firms' inclination to borrow in the r currency ex-ante.[24]

Result (b) shows that $\int \left(\varepsilon^j\right)^{\alpha} d\tilde{G}^j(\varepsilon^j)$ is a sufficient statistic to assess the effectiveness of the policy that shifts the distribution of credit costs on currency choices. The firms that cross the new threshold switch from d credit to r credit.[25]

Once a firm switches the currency of its credit from d to r, the first part of result (c) notes that it will always want to switch out of the d currency for its pricing. Since its marginal costs are now partly denominated in the r currency but not in d, the firm has no reason to use DCP. The second part recalls proposition 1(c)'s result that the firm will not choose LCP as long as σ_r^2 is small enough. The third part shows that the firms will adopt RCP in some markets if σ_{rw} is high enough, crossing a third threshold Ω, which is common across markets. If $\alpha > 1/2$, the condition always holds as s_r makes up a large enough share of the firm's marginal cost that it wants to set its price in the r currency. For a smaller α, even though w makes up a more significant portion of marginal costs, as long as σ_{rw} is large enough, RCP will achieve higher expected profits.

Discussion. The model explains why the majority of the currencies in the world are not international for three complementary reasons associated with each of the three thresholds: Ψ, Φ, and Ω.[26] First, a stable exchange rate is a pre-condition for the currency's international use, but for most currencies, σ_r^2 is large, so the currency will not be used for invoicing according to proposition 1. Second, credit is expensive and illiquid in most currencies, and a distribution $G^j(.)$ skewed to the right will fail to pass the threshold in proposition 2 . Third, most countries are not large enough in international trade as export markets or as sources of intermediate imports so their Ω threshold in proposition 3 is small and hard to clear. If these countries were to try policies to jumpstart their currencies, proposition 3 predicts they would fail as the thresholds would not be overcome.

The policies of the PBoC in the 2010s had a chance to succeed because they also came with sound monetary policy, growing capital markets, and a considerable weight

[24]The same result could be achieved through a direct government subsidy of trade finance in the rising currency. This would directly shift the $G^j(\varepsilon^j)$ distribution to the left. However, this would come with potentially large costs if the subsidy is paid on all overseas credit. Instead, the swap line serves as a backstop, ex-ante lowering the risk of very high rates, but only used infrequently ex-post.

[25]One result from the empirical analysis is that the swap line does not increase trade with China. This is consistent with the model, since the swap line lowers the cost of RMB credit but not of Chinese trade. Further, in the model, we hold the size of each market, including the r-market, fixed so there is no change in trade by assumption, only a change in the denomination of prices.

[26]For example, in October 2018, the final month in our sample of Swift data, 89% of international payments were made in just six currencies: USD, EUR, JPY, GBP, CHF and CNY.

in trade.[27] Consider an initial situation where the r currency is not used outside the r-market, as was the case with the RMB before 2009. All firms use d-currency credit, and each firm uses DCP in some markets and LCP in others. If the swap line lowers expected borrowing costs enough that some firms cross the threshold in proposition 2, a mass of firms starts borrowing in r-currency. Because in some markets, the volatility of the bilateral exchange rate is above the Φ_i threshold in proposition 1(c), these firms move away from invoicing in the d currency for those markets as well. They will choose RCP instead of PCP if the country itself satisfies the Ω threshold in proposition 3(c).[28]

In the end, both payments sent and received in the r currency rise, as the two complement each other. This happens not just with respect to the r country but also to the other countries with which it trades. The currency has jumpstarted into international status, as we saw in the data with the RMB after the signature of a swap line with the PBoC.

5 Evidence on four mechanisms in the model

The model has predictions beyond a jumpstart in RMB payments. This section states them and looks at the evidence to test them.

5.1 Swap lines reduce RMB borrowing costs

The mechanism in our model relied on the distribution of borrowing costs under the swap line, $\tilde{G}^j(\varepsilon^j)$, being first-order stochastically dominated by $G^j(\varepsilon^j)$. In expectation, RMB-denominated borrowing costs should fall following the agreement of a swap line.

To our knowledge, there is no comprehensive data on country-specific interest rates for RMB-denominated trade or wholesale finance. However, instead of borrowing RMB directly in interbank markets, a local bank wishing to extend RMB-denominated trade finance to a local firm can obtain the RMB by converting local currency in the FX spot market while using an FX swap to hedge the mismatch between the RMB loan and the local currency deposit. This synthetic RMB borrowing is nearly equivalent in its cash flow to wholesale finance, so its cost should give a proxy for the cost of RMB funding for the local banking system. Since the swap line caps the cost of direct RMB borrowing, they

[27] This insight allows us to elaborate on what may initially seem a critical assumption in our model: that the firm can only buy inputs in r and d currencies. We could have allowed the firm to source inputs denominated in any of the other currencies in the model. However, the firm would never choose to do so if the threshold in proposition 2 was not satisfied. The assumption that the firm is picking between r and d inputs is simply equivalent to assuming the thresholds are not satisfied for other currencies.

[28] Appendix D displays these predictions of the model using a simple graph.

should, through competition and arbitrage, cap the cost of synthetic borrowing as well.[29]

We measure synthetic 3-month borrowing costs at a daily frequency between June 2007 and June 2021 for 23 currencies issued by central banks that enter a swap agreement with the PBoC, using data from Datastream. We consider four different potential ways of synthetic borrowing based on using onshore or offshore RMB markets, or on swapping the RMB directly or using the USD as a vehicle, and take the minimum rate as if banks always opted fot the cheapest option.[30] Appendix B has full details.

The cross-currency average of synthetic borrowing costs is shown in figure 6a, together with direct RMB borrowing costs onshore in China (the 3-month SHIBOR rate) and offshore in Hong Kong (the 3-month HIBOR rate). Outside of the period between August 2015 and April 2017, which we will discuss further below, the average synthetic rate closely tracks the offshore borrowing rate, consistent with the idea that borrowing RMB in offshore money markets is an alternative to synthetic borrowing. At the same time, there is significant cross-sectional dispersion. Even after accounting for time and currency fixed effects, the standard deviation across countries is around 100bp on a typical day, rising to around 400bp when RMB rates are volatile.

Table 4 tests for the impact of swap lines on borrowing rates using the same staggered difference-in-differences methodology. Column (1) shows that signing a swap agreement is associated with a 115bp fall in RMB borrowing rates. Figure 6b considers monthly averages and presents the equivalent specification as an event study plot. There is an immediate and sustained downward movement after the agreement, and we cannot reject the null of no pre-trends. Column (2) uses a least-squares estimator. Since now there is no never-treated group, the issues with staggered adoption are severe, and the OLS estimator delivers a materially smaller coefficient. Column (3) uses the spread between local borrowing costs and the relevant RMB interest rate as the dependent variable. This way, we control for all time variation in the underlying level of RMB borrowing costs. The result is unaffected. Column (4) uses a 1-year, as opposed to 3-month, maturity, and the results are almost unchanged. Finally, column (5) looks only at a sample of emerging market currencies in line with the sample selection criteria in the main analysis. The effect rises to 205bp, consistent with these countries experiencing more volatile funding

[29]The relevant interest rate in the model is the cost of trade finance for firms. Instead, we measure banks' wholesale funding costs, and rely on there being significant interest rate passthrough. Note, however, that the effectiveness of the swap lines themselves also rely on this passthrough. After all, the PBoC provides RMB to the local central bank, which will lend to the local banking system, who, finally, lend to firms.

[30]Markets may be segmented such that a relatively cheap option is not available and the swap line may be capping the cost of more expensive options. Our results, therefore, are a lower bound.

conditions, so that the swap line is more likely to be a valuable backstop.

5.2 Swap lines reduce tail risk of RMB use

In early 2015, macro-financial forces led the RMB-USD exchange rate to depreciate. The PBoC managed this exchange rate via a trading band with a central parity rate and, on August 11th 2015, it adjusted that rate. The RMB depreciated by 3% over the next two days, and would continue doing so for the next 18 months. Because China operates parallel offshore and onshore currency systems in order to enforce its capital controls, this devaluation caused the offshore currency to be worth less than the onshore currency. To keep the peg between the two currencies, the PBoC intervened by draining liquidity from the offshore financial system. This intervention raised the level and volatility of offshore RMB borrowing costs, visible in Figure 6a. The volatility continued until the introduction of a new currency management regime around April 2017. McCauley & Shu (2018) and Bahaj & Reis (2024) elaborate on these events.

This episode has useful features to test our model. First, the shock was primarily financial, coming with no economic slowdown in China's economy or in its global trade share. Second, the shock had its source in China, rather than being related to a specific counterparty economy. Third, the policy change in August 2015 was unanticipated; there was no movement in offshore prices beforehand. And fourth, the volumes drawn from the swap line are dwarfed by the net flows in or out of China and by Chinese FX reserves, so they are not a source of pressure on the RMB-USD exchange rate. Hence, the 2015-16 episode can be interpreted as an unexpected rightward shift in $G^j(\varepsilon^j)$. Figure 6a validates this interpretation: offshore borrowing costs were unusually volatile in 2015-16.

The model predicts that this shock would stall the use of the RMB for payments, as countries near the threshold would move away from it. Figure 2 already showed this was the case. For countries that have a swap line though, the relevant distribution, $\tilde{G}^j(\varepsilon^j)$, is capped on the right. Therefore, it will experience a smaller outward shift, and borrowing costs will not rise, so the use of the RMB would be preserved. Figure 6a supports this prediction of the model, as most of the countries in the sample had a swap line by 2015 and the mean synthetic RMB borrowing cost did not track the rise in offshore rates. Finally, figure 7 plots the average quarterly RMB usage for countries with and without a swap line before and after the crisis. (Appendix B.2 describes the sample; the key selection criteria being that all countries already used the RMB prior to 2015.) As expected, countries with swap agreements tend to use the RMB more, but the trends were parallel prior to 2015-Q4, both visually and confirmed by formal test from Borusyak *et al.* (2024).

Consistent with the predictions of the model, countries without a swap line experienced a sharp decline in RMB usage in 2015Q4 that countries with a swap line did not emulate.

Table 5 establishes this via difference-in-differences estimates of the effect of the swap line on RMB usage after 2015Q3. The first column presents a simple two-way fixed effects model with a coefficient of 2.2 log points. Column (2) includes controls for the logarithm of the country's overall payments, its nominal GDP, and its trade with China, which raises the point estimate somewhat. In columns (3) and (4), we push the event date back one quarter to 2015Q2. The crisis started at the end of Q3 and the policy change may have led to outflows from China, which would explain the uptick in payments in 2015Q3 among the control group. Shifting the event date back by one quarter lowers the point estimate but does not alter the overall message of the results. Finally, reflecting the small cross-section, columns (5)-(8) repeat the analysis using a synthetic difference-in-differences estimator. The results are similar. To conclude, since the swap line insures its recipients from spikes in private borrowing costs, we find that countries with swap lines maintained their use of the RMB relative to non-recipients.

5.3 Swap lines work through trade finance

Our model's predictions relate to the choice of currency for international trade and trade finance, as opposed to for trading financial assets. We now focus on the subset of messages that are due to bank-financed international trade (message types 400 and 700).

Table 6 shows the association between swap lines and RMB-denominated messages for trade at the extensive margin (columns (1) and (2)) and for the share of messages related to trade-finance denominated in RMB (column (3)). The coefficient estimates are quite similar to those obtained when looking at all payments. Appendix table A4 replicates our baseline table 2 in full using messages related only to trade, confirming this is true across a broad sweep of specifications. These findings are consistent with our model's predictions that stabilizing offshore funding costs can lead to a redenomination of trade finance with knock-on effects on international payments.

The focus on trade finance also ties the model's predictions to a set of country characteristics that make it more likely for the policy to be effective. We formalize these in appendix E.5. First, the larger is the r market for a country, the more likely the swap line will jumpstart RMB use. In the model, since the firm prices in RCP in the r-market, more sales to that economy lowers the threshold Ψ, and boost the relative attractiveness of using r-credit. Columns (4)-(5) in table 6 test this prediction. We split our sample into observations where the country's goods trade share with China is above or below the

sample median. While the variation for this specification is limited, the extensive margin effect is quite different between the two groups, with almost all the effect concentrated in countries with above-average trade with China.

Second, the swap line is effective in the model by altering the cost of working capital and imported inputs. Therefore, countries that consume more intermediates or that produce in sectors that rely more heavily on working capital should see a stronger association between RMB use and the introduction of the policy. In the model, all imported inputs need working capital, so these two concepts are captured by the parameter α. In the data, we can separate them. Using the BEC trade classification, we measure reliance on imported inputs as the average share of imports that correspond to intermediates. We measure reliance on working capital by classifying a country's exports to industries by ISIC and then matching ISIC industries to their reliance on liquidity needs measures using average inventory-to-sales ratios in US Compustat firms from 1980-1999.[31] Combining this series with the trade data, we produce an export-weighted measure of a country's industrial reliance on working capital and divide countries depending on whether they are above or below the sample median. Columns (6)-(7) and (8)-(9) of Table 6 show that the relationship between RMB use and the swap line is generally increasing in both intermediate input intensity and reliance on working capital. These differences are quantitatively large and statistically significant.

5.4 Swap lines boost RMB use relative to other international currencies

A final prediction of the model is that the switch to the RMB should primarily come from existing international currencies, like the USD or the EUR, and not from the local currencies. The RCP choice replaces DCP as opposed to PCP or LCP according to Proposition 3c.

In the data, different countries trade in different markets. In some of them, the USD might be the usual vehicle, while in others it is the EUR or the JPY. To compare countries' payments with a common counterparty, we focus on payments to and from China. Table 7 presents results from our staggered adoption difference-in-differences estimator, where our outcome variable is the share of payments to/from China in different currencies. Column (1) shows that signing a swap agreement is associated with a rise in the RMB share of payments to and from China of 14 percentage points. Columns (2)-(5) decompose this increase: 8 percentage points are accounted for by a fall in the USD share (column

[31] This follows Manova *et al.* (2015). US public firms likely have access to finance and working capital, so this measure should capture technological differences rather than financial frictions.

(2)), 2.5 percentage points by a fall in the EUR share (column (3)), a further 0.5 percentage points is a fall in the combined share of GBP, JPY and CHF (column (4)) and the remaining three percentage points is accounted for by a decline in other currencies (mostly HKD, AUD, CAD and SGD, column (5)). As predicted by the model, the home currency of the country that receives the swap agreement (column (6)) does not experience a statistically significant decline in usage.

6 Conclusion

By extending its lender of last resort function to stabilize the supply of trade finance abroad, a central bank can influence the international status of its currency. We put forward a model of the currency choice for trade finance and invoicing. It predicts that there will be thresholds for key economic variables that a currency must meet before it becomes international. Most currencies do not meet these thresholds, explaining why so few are used internationally. However, for some, policy can shift the thresholds and jumpstart the currency. Empirically, the RMB swap lines support these theoretical mechanisms and the role of these thresholds. We estimated that a swap line is associated with a 14 percentage point increase in the probability of a country making or receiving RMB payments.

There have been so few instances of currency rising to international status that it is impossible to know if these results are specific to the RMB. However, an analogy from economic history is informative. In 1912, the United States was the world's largest exporter, but US firms used financial markets in London to access trade finance denominated in GBP. The Federal Reserve Act of 1913 allowed US banks to open branches abroad, and the first president of the FRB, New York, Benjamin Strong, had an explicit goal of internationalizing the USD. One notable measure he took was to give US banks the ability to discount USD-denominated trade acceptances—a form of trade finance— at the Federal Reserve. The Fed was aggressive in backstopping the market for USD trade finance: by some estimates, between 1923 and 1929, the Fed owned as much as half of all issued trade acceptances (Eichengreen, 2011). By 1925, the USD had become an international currency, and by World War II it had become the dominant currency.

A century later, China was also the world's largest exporter and largely reliant on foreign currency trade finance. It pursued a similar policy agenda, this time using swap lines to backstop the provision of RMB-denominated trade finance. Is it a coincidence that similar policies succeeded one century apart? The theory and empirics in this paper suggest that the answer is no. Rather, these policies and the Chinese experience with

them provide valuable lessons for why some currencies rise to international status. At the same time, this comparison suggests that China must go well beyond the swap lines for the RMB to rise further in international usage and challenge the dominant USD's status. Further policies to remove capital controls in China and some luck in a shock to the USD dominance (like World War I was for sterling) are likely required.

Is this internationalization strategy optimal? Whether the swap lines were the best tool to trigger the jumpstart and whether the costs of policies outweigh the benefits of having an international currency are questions that we did not ask or answer. Neither did we address whether the central bank is the right agent to pursue this promotion, how it should interact with fiscal authorities, and what the implications are for the exchange rate regime and capital flows. We leave these questions for future work.

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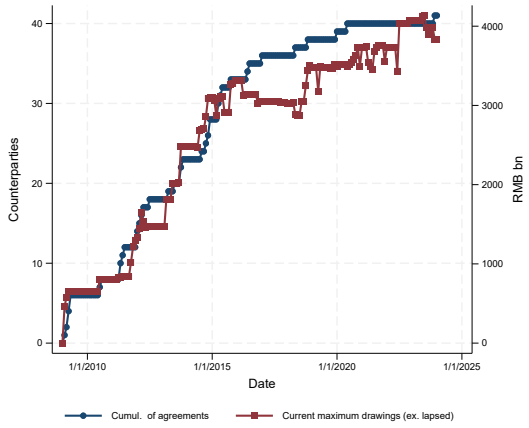
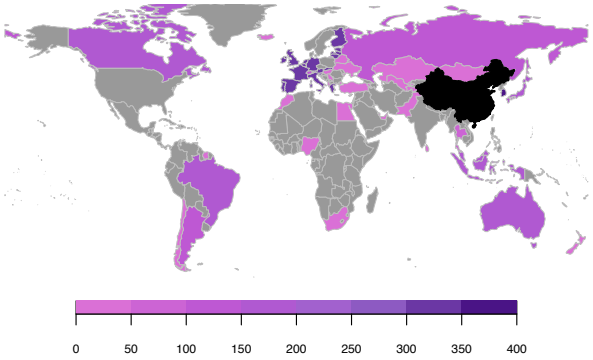
Figure 1: The PBoC swap lines

(a) Swap lines: number and amounts



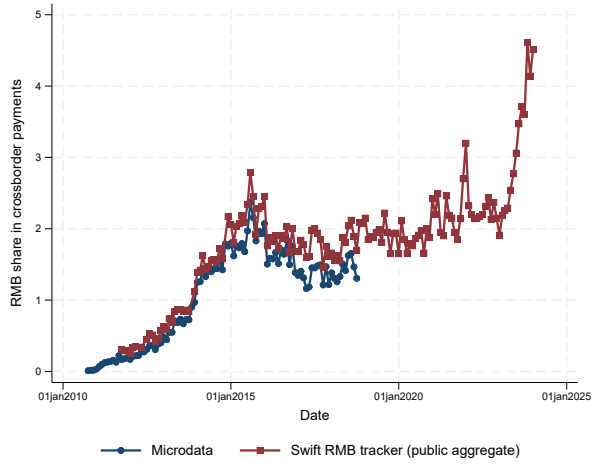
(b) The network of swap lines in 2018



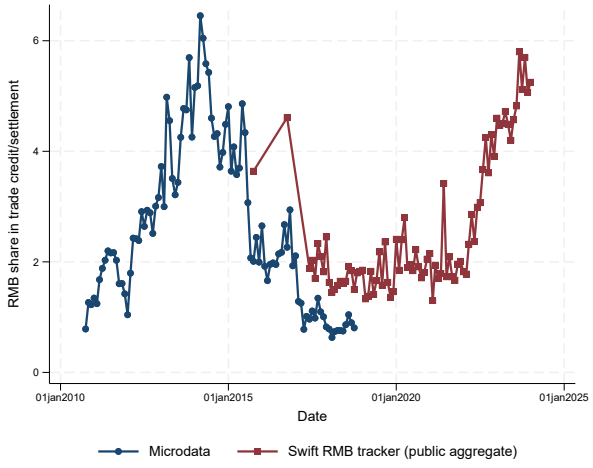
Notes: In Panel (a) the navy line shows the cumulative number of countries/central banks that had signed at least one swap agreement with the PBoC; burgundy line shows the current notional limit on all active PBoC swap lines where lines that have lapsed and have not been renewed receive a zero value. Panel (b) shows swap lines active at the end of 2018, the shade of color indicates the maximum amount the PBOC is willing to lend in RMB bn.

Figure 2: RMB share in global payments and trade finance

(a) Payments (MT103 & MT202)

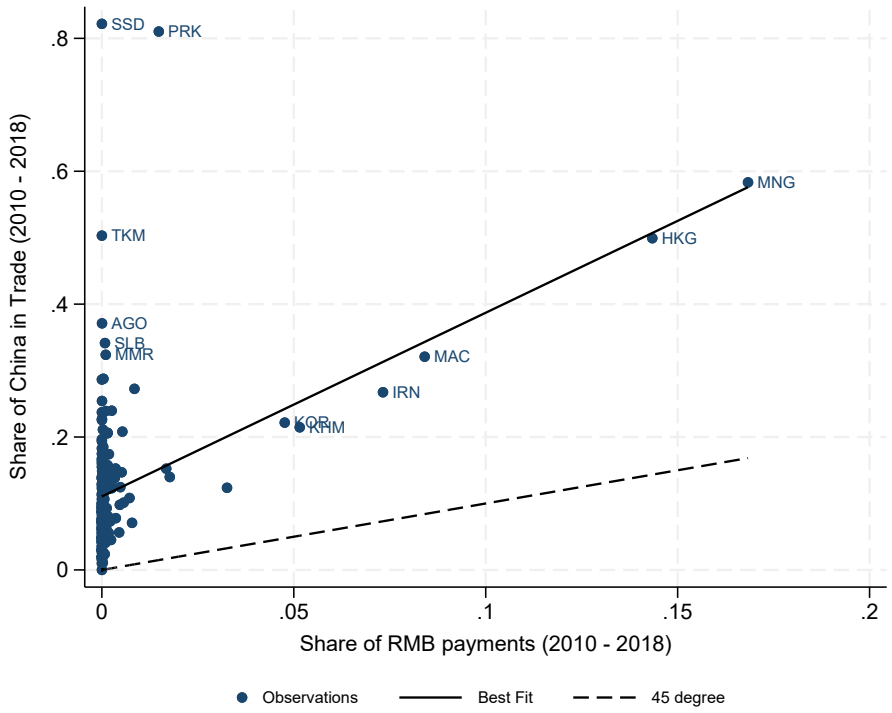


(b) Trade finance/settlement (MT400 & MT700)



Notes: In panel (a), the burgundy line shows the percentage of SWIFT messages MT102 and MT202 denominated in RMB as reported by the SWIFT RMB tracker, the navy line shows the equivalent for our microdata. Panel (b) is the equivalent but for message types MT400 and MT700, i.e. those related to trade finance. The navy and burgundy lines do not align precisely due to differences in how jurisdictions have been consolidated.

Figure 3: RMB payments per country vs. trade with China



Notes: Scatter plot showing the average share of a country's good trade with China (sum of imports and exports) on the y-axis and the equivalent share of payments in RMB (MT103 and MT202) on the x-axis. The dashed line is a 45 degree line and the solid black line is a line of best fit. Data on trade shares is from the IMF direction of trade statistics.

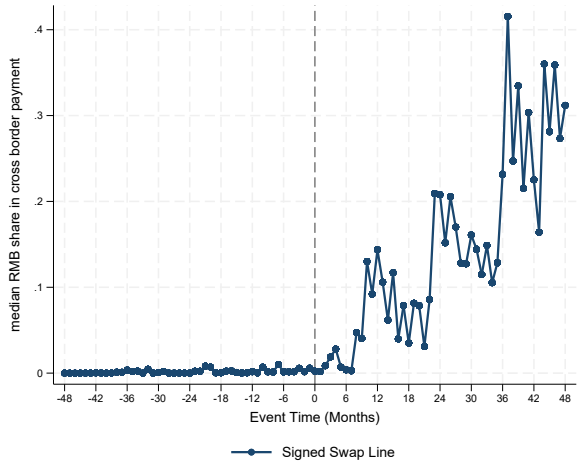
Table 1: The PBoC's swap line agreements as of end 2018

Country	In Baseline Sample	Date of 1st Agreement	Notional Amount (RMB mn) as of 1st Agreement	Country	In Baseline Sample	Date of 1st Agreement	Notional Amount (RMB mn) as of 1st Agreement
Albania	✓	12/09/2013	2000	Malaysia		08/02/2009	80000
Argentina		02/04/2009	70000	Mongolia	✓	06/05/2011	5000
Armenia	✓	25/03/2015	1000	Morocco	✓	11/05/2016	10000
Australia		22/03/2012	200000	New Zealand		18/04/2011	25000
Belarus		11/03/2009	20000	Nigeria	✓	27/04/2018	15000
Brazil	✓	26/03/2013	190000	Pakistan	✓	23/12/2011	10000
Canada		08/11/2014	200000	Qatar		03/11/2014	35000
Chile	✓	25/05/2015	22000	Russia	✓	13/10/2014	150000
ECB		08/10/2013	350000	Serbia	✓	17/06/2016	1500
Egypt	✓	06/12/2016	18000	Singapore		23/07/2010	150000
Hong Kong		20/01/2009	200000	South Africa	✓	10/04/2015	30000
Hungary	✓	09/09/2013	10000	Sri Lanka	✓	16/09/2014	10000
Iceland		09/06/2010	3500	Surinam	✓	18/03/2015	1000
Indonesia		23/03/2009	100000	Switzerland		21/07/2014	150000
Japan		26/10/2018	200000	Tajikistan	✓	03/09/2015	3000
Kazakhstan	✓	13/06/2011	7000	Thailand	✓	22/12/2011	70000
Korea		20/04/2009	180000	Turkey	✓	21/02/2012	10000
Malaysia		08/02/2009	80000	Ukraine	✓	26/06/2012	15000
Mongolia	✓	06/05/2011	5000	UAE		17/01/2012	35000

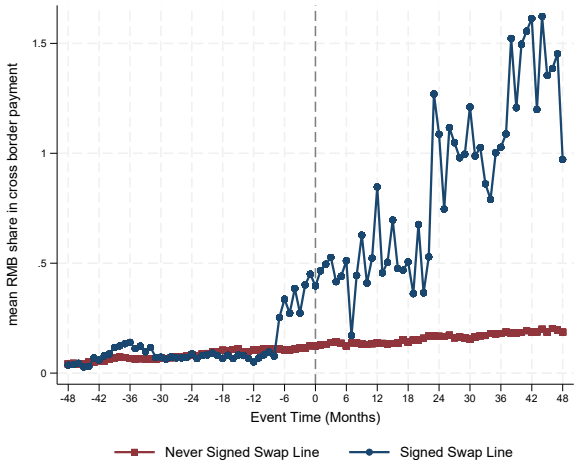
Notes: This shows all the countries that signed swap agreements with the PBoC until the end of our sample in 2018. The second column indicates whether the country enters our baseline regression sample (i.e. column (4) of Table 2); countries can be excluded if they signed an agreement before the start of our sample in October 2010 or are above the per capita income threshold. Column (10) of Table 2 relaxes this income threshold filter for the main empirical analysis.

Figure 4: RMB payments before and after a swap line is signed

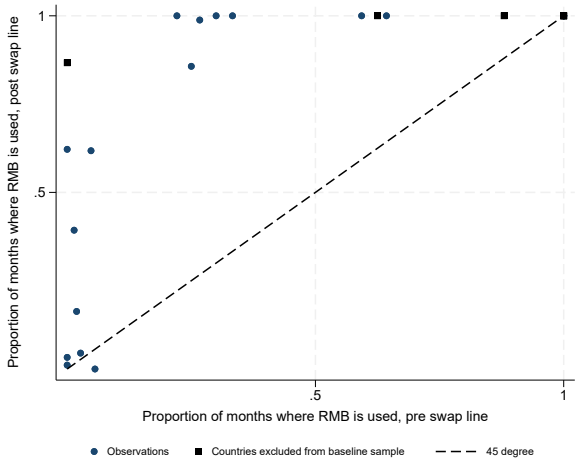
(a) Median of $\text{Rshare}_{i,t}$



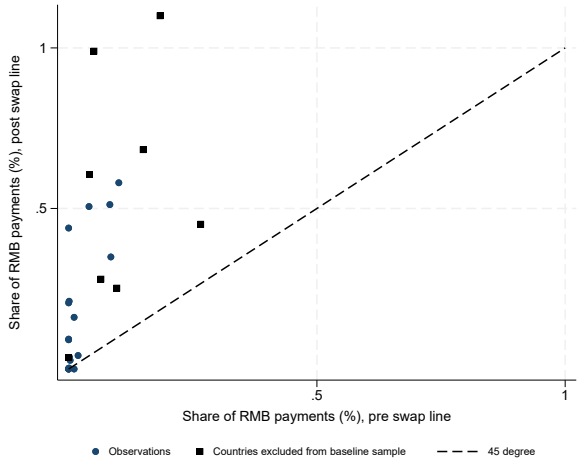
(b) Mean of $\text{Rshare}_{i,t}$



(c) Country means of $1(\text{Rpayment}_{i,t} > 0)$ before and after first swap line agreement



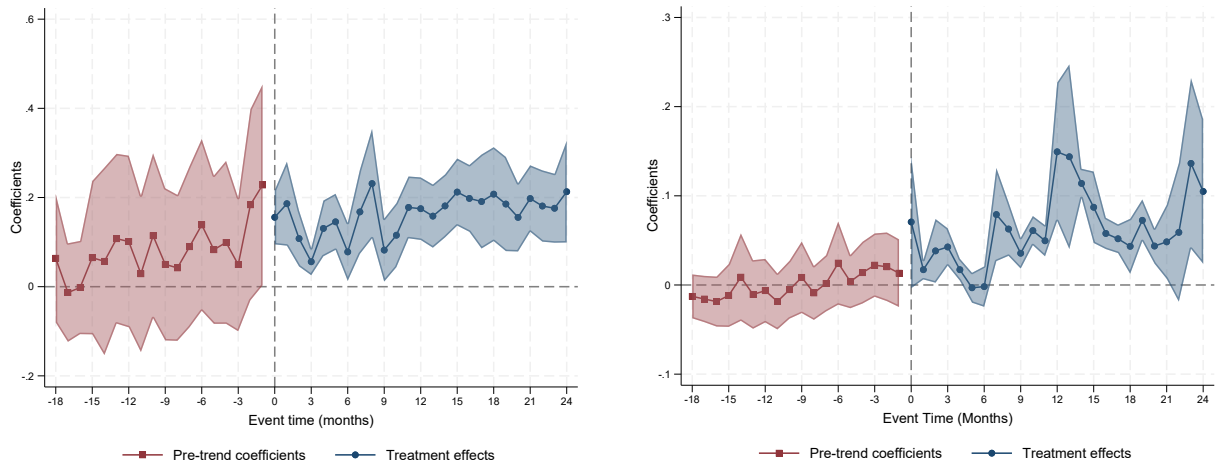
(d) Country means of $\text{Rshare}_{i,t}$ before and after first swap line agreement



Notes: Panels (a) and (b) plots of $\text{Rshare}_{i,t}$ against event time. Event time is defined such that month zero corresponds to the month when the country first signs a PBoC swap line. Panel (a) plots, for each event time period, the median value of $\text{Rshare}_{i,t}$ for all countries that have signed a swap agreement in our sample. The navy line in panel (b) presents the equivalent value for the mean of countries that have signed swap line agreements. The burgundy line in panel (b) corresponds to a control group based on countries that have never signed swap agreements. To produce it, for each country that signed an agreement, we take a mean of $\text{Rshare}_{i,t}$ for the countries who never entered an agreement in the same event time period. This forms a control group for each country that entered an agreement. We then take a second mean of these control series across the swap line countries for each event time period. This second mean is the burgundy line. The median RMB usage for countries that have not signed a swap line is nil for all time periods so we do not present an equivalent series for panel (a). Panel (c) plots, for each country that has signed an agreement, the average level of $1(\text{Rpayment}_{i,t} > 0)$ before and after signing a swap line. Navy circles indicate countries that enter our baseline sample, burgundy squares indicate developed economies and financial centres that we drop in the baseline specification. Panel (d) plots the equivalent for $\text{Rshare}_{i,t}$.

Figure 5: Event study plots

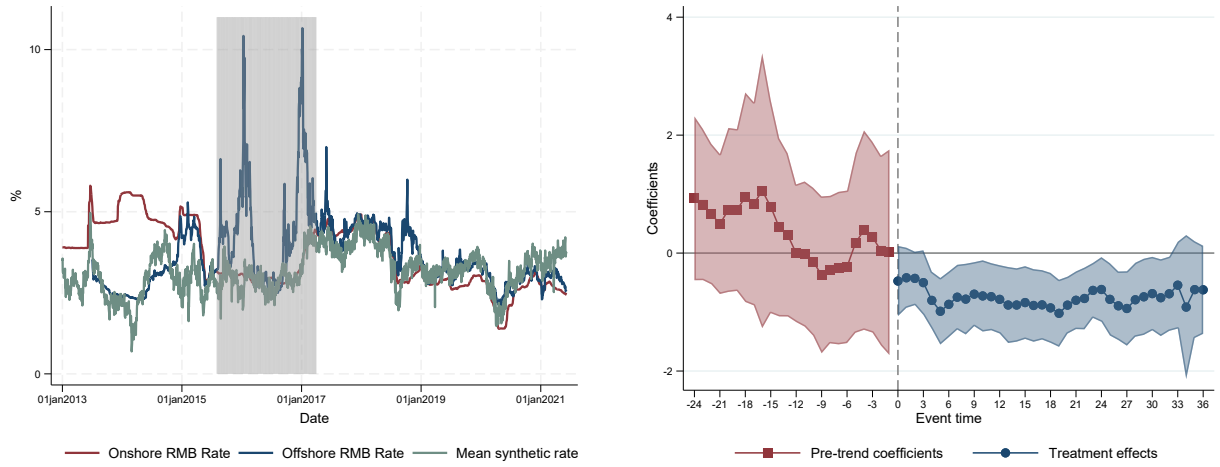
(a) $1(\text{Rpayment}_{i,t} > 0)$ (b) $\text{Rshare}_{i,t}$



Notes: Event study plots using the methodology of Borusyak *et al.* (2024). Panel (a) present event study plots between horizons -18/+24 months for the specification in column (4) of table 2. Panel (b) presents to equivalent for column (2) of table 3. The shaded areas represent 95% confidence intervals.

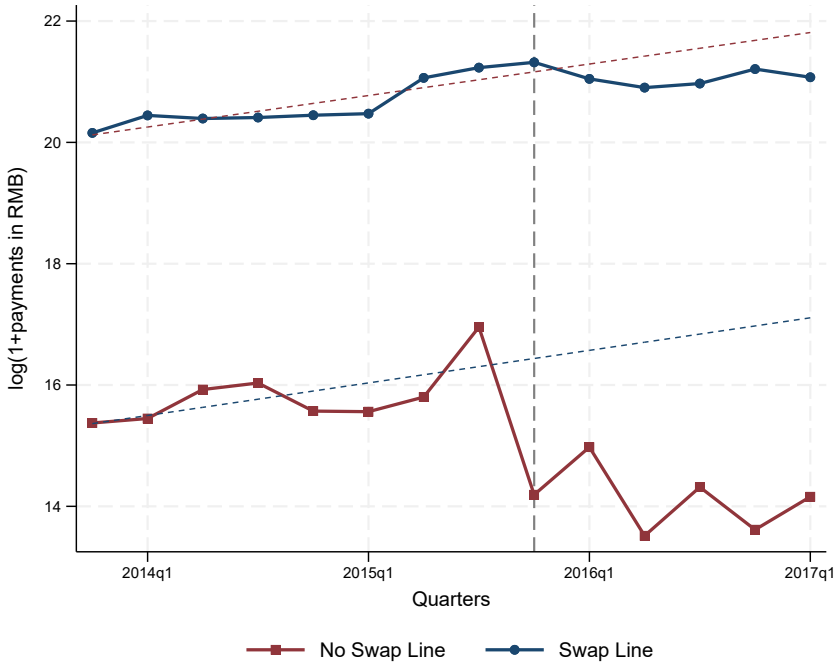
Figure 6: RMB borrowing costs

(a) Time series of borrowing costs (b) Event study around swap agreements



Notes: Panel (a) presents times series plots of the 3-month RMB SHIBOR rate, the 3-mth HIBOR rate and the average of the synthetic RMB borrowing costs we compute for countries in our sample as discussed in appendix B. Panel (b) is an event study plots using the methodology of Borusyak *et al.* (2024) based on the equivalent specification to column (1) of table 4 with observations aggregated to a monthly frequency by taking averages. Shaded areas represent 95% confidence intervals.

Figure 7: RMB payments before and after the 2015-2016 RMB crisis



Notes: The figure plots $ln(1 + \text{Rpayment}_{i,t})$ for countries with and without swap agreements as of August-2015. $\text{Rpayment}_{i,t}$ has been aggregated to a quarterly frequency. To be included in the sample a country must make positive RMB payments in all quarters between 2013-Q4 and 2015-Q3 as well as meet our standard sample selection criteria. Dashed lines show linear trend lines computed over 2013-Q4 and 2015-Q3. Lines colored in navy relate to countries with a swap agreement, lines burgundy to those without.

Table 2: Swap lines and the prob. the RMB is used

	Baseline Specification				Robustness					
	Time & Country f.e.	Incl. China Trade	Incl. China Policy	Incl. Neigh Share	Least Squares	Payments Sent	Payments Rec'd	6 Month Shift	Ex Mongolia	Incl. Developed
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\text{SwapLine}_{i,t}$	0.1065**	0.1069**	0.1229***	0.1179***	0.1548**	0.1168**	0.0551	0.1780***	0.1479***	0.0983**
	(0.046)	(0.045)	(0.044)	(0.046)	(0.071)	(0.046)	(0.039)	(0.048)	(0.047)	(0.049)
N treated	21	21	21	21	21	21	21	21	20	29
N control	93	93	93	93	93	93	93	93	93	107
T	97	97	97	97	97	97	97	97	97	97
Time f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trade Controls	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Policy Controls	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Neighbor Control	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Method	BJS(24)	BJS(24)	BJS(24)	BJS(24)	OLS	BJS(24)	BJS(24)	BJS(24)	BJS(24)	BJS(24)

Standard errors clustered by country in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Estimates of equation (1). In all specifications the outcome variable is an indicator variable for whether the country makes a payment denominated in RMB in a particular month where payment is defined by SWIFT message types MT 103 and MT 202. The treatment variable is a dummy variable indicating whether the country's central bank, as of month t, has ever signed a swap line agreement with the PBoC ($\text{SwapLine}_{i,t}$). Sample period is October 2010 to October 2018. BJS(24) refers to the did imputation method from Borusyak *et al.* (2024). Column (1): includes only country and time fixed effects and no further controls. Column (2): as previous, as but includes as controls a Chinese FTA dummy and trade flows with China. Column (3), as previous, but includes as extra controls dummies for membership of the AIIB and the presence of an RMB clearing bank and Chinese investment flows into the country. Column (4): as previous, but includes Neighbor $\text{Use}_{i,t}$ as an extra control. Column (5): as column (4), but uses a two way fixed effects estimator. Column (6): as column (4), but only considers payments sent. Column (7): as column (4), but only considers payments received. Column (8): as column (4), but shifts treatment back by six months. Column (9): as column (4), but shifts treatment back by six months. Column (10): as column (4), but relaxes sample selection criteria based on country GDP per capita.

Table 3: Swaplines and the intensive margin of RMB use

Outcome Variable:	Rshare$_{i,t}$					$ln(1+\text{Rpayment}_{i,t})$				Rpayment$_{i,t}$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
SwapLine$_{i,t}$	0.1289***	0.0948***		0.1106**	0.1003**	3.7154***	3.4019***	3.2354**	2.4507*	1.6831***	1.2454***
	(0.019)	(0.011)		(0.043)	(0.045)	(0.720)	(0.773)	(1.482)	(1.449)	(0.298)	(0.318)
0-11 months			0.0391***								
			(0.009)								
12-23 months			0.0839***								
			(0.007)								
24-35 months			0.0894*								
			(0.054)								
36-48 months			0.2951***								
			(0.015)								
N treated	20	20	20	20	20	20	20	20	20	20	20
N control	93	93	93	93	93	93	93	93	93	58	58
T	97	97	97	97	97	97	97	97	97	97	97
Time f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trade Controls	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Policy Controls	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Neighbor Control	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Log Controls	No	No	No	No	No	No	Yes	No	Yes	No	Yes
Method	BJS(24)	BJS(24)	BJS(24)	SDID	SDID	BJS(24)	BJS(24)	SDID	SDID	PPML	PPML

Standard errors clustered by country in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Estimates of equation (1) with different outcome variables reflecting the intensive margin of RMB use, i.e. the value of RMB payments in particular month where payment is defined by SWIFT message types MT 103 and MT 202. The treatment variable is a dummy variable indicating whether the country's central bank, as of month t, has ever signed a swap line agreement with the PBoC (SwapLine$_{i,t}$). Sample period is October 2010 to October 2018, Mongolia is excluded from the set of treated countries. BJS(24) refers to the did imputation method from Borusyak *et al.* (2024). SDID corresponds to a synthetic difference in differences estimator from Arkhangelsky *et al.* (2021), in which case bootstrapped standard errors are reported. PPML corresponds to a psuedo Poisson maximum likelihood estimator (Santos Silva & Tenreyro, 2006). Trade Controls are a Chinese FTA dummy and goods imports and exports from/to China in log terms and as a share of country total. Policy Controls are dummies for membership of the AIIB and the presence of an RMB clearing bank and variables capturing Chinese investment flows into the country. Neighbor control captures the share of neighboring countries using the RMB. Log Controls are the logarithm of the country's GDP and the logarithm of its total cross border payments, both in USD. Column (1): $Rshare_{i,t}$ is the outcome variable, specification includes only country and time fixed effects and no further controls. Column (2): as previous, but includes all controls. Column (3) as previous, but shows treatment effects after years 1, 2 and 3. Column (4)-(5): as columns (1) and (2) but uses a synthetic difference in differences estimator. Column (6)-(9): as column (1)-(2) and (4)-(5), but uses a two way fixed effects estimator but the outcome variable is $ln(1+\text{Rpayment}_{i,t})$. Column (9): uses a PPML estimator on the value of payments with no control variables and time and country fixed effects. Column (10): as column (9) but augments specification with controls. Since the outcome variable has a log interpretation, to control for country size we augment the control set to include the logarithm of the country's GDP and the logarithm of its total cross border payments, both in USD.

Table 4: Swap lines and RMB borrowing costs

	Baseline	Least Squares	Spread v China Rate	1 year Tenor	Emerging Markets Only
	(1)	(2)	(3)	(4)	(5)
$\text{SwapLine}_{i,t}$	-1.1539***	-0.4953*	-1.1967***	-0.9415***	-2.0505*
	(0.425)	(0.288)	(0.425)	(0.321)	(1.090)
N	23	23	23	23	13
T (trading days)	3506	3506	3506	3506	3506
Time f.e.	Yes	Yes	Yes	Yes	Yes
Country f.e.	Yes	Yes	Yes	Yes	Yes
Method	BJS(24)	OLS	BJS(24)	BJS(24)	BJS(24)

Standard errors clustered by country in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Sample covers 23 currencies in a balanced panel covering trading days from 1st June 2007-8th June 2021. The outcome variable is the country specific estimate of the synthetic RMB borrowing cost as computed in Appendix B. The treatment variable is a dummy variable indicating whether the country's central bank, as of trading day t, has ever signed a swap line agreement with the PBoC. Column (1): baseline specification estimated using the imputation method of Borusyak *et al.* (2024). Column (2): uses a two way fixed effects estimator rather than a the imputation method. Column (3): redefines the the outcome variable to be the spread over the equivalent offshore or onshore Chinese borrowing cost. Column (4): uses a one year tenor rather than a three month tenor. Column (5): restricts the sample only to the emerging markets countries used in the main analysis sample reduced to 13 currencies.

Table 5: Swap lines and RMB payments during the August 2015 episode

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Swap Line Aug-15_i	2.2141*	2.9380**	1.7645*	2.4037*	2.5698**	2.7251**	1.9584*	2.1613
$\times \text{Post}_t$	(1.181)	(1.399)	(1.068)	(1.243)	(1.203)	(1.341)	(1.095)	(1.331)
N treated	12	12	12	12	12	12	12	12
N control	17	17	17	17	17	17	17	17
T	14	14	14	14	14	14	14	14
Time f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country f.e.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Event Date	2015Q4	2015Q4	2015Q3	2015Q3	2015Q4	2015Q4	2015Q3	2015Q3
Method	OLS	OLS	OLS	OLS	SDID	SDID	SDID	SDID

Standard errors clustered by country in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Difference-in-differences estimates based on an outcome variable of $ln(1 + \text{Rpayment}_{i,t})$, where $\text{Rpayment}_{i,t}$ is the total value of payments in RMB made by country i in quarter t. The treatment variable is a dummy that takes a value of one if the country has a PBoC swap line in August 2015. The sample period is 2013:Q4 - 2017:Q1. The sample applies the same selection criteria as in the main analysis, in addition all included countries must have made use of the RMB in every quarter between 2013:Q4 and 2015:Q2. Column (1) presents results with country and time fixed effects and event date of 2015 Q3; Column (2) adds controls equivalent to Column (4) in table 2. Column (3) and (4) repeat prior two columns with an event date of 2015 Q4. Columns (5)-(8) repeat the prior estimation using a synthetic differences-in-differences estimator (Arkhangelsky *et al.*, 2021).

Table 6: Swaplines, RMB trade finance and country characteristics

Partition				China Trade Share		Intermediate Imports		Export Working Capital Needs	
	$1(\text{Rtradecredit}_{i,t} > 0)$		$\text{RtradecreditShare}_{i,t}$	below median	above median	below median	above median	below median	above median
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$\text{SwapLine}_{i,t}$	0.1496***	0.1262***	0.1313**	0.0234	0.1804***	0.0523**	0.1670***	0.0772***	0.1445***
	(0.009)	(0.022)	(0.055)	(0.016)	(0.025)	(0.024)	(0.021)	(0.023)	(0.022)
Difference in coefficients				0.1571***		0.1146***		0.0673***	
				(0.010)		(0.006)		(0.004)	
N treated	21	21	21	21		21		21	
N control	93	93	93	93		93		93	
T	97	97	97	97		97		97	
Time f.e.	Yes	Yes	Yes	Yes		Yes		Yes	
Country f.e.	Yes	Yes	Yes	Yes		Yes		Yes	
Trade Controls	No	Yes	Yes	Yes		Yes		Yes	
Policy Controls	No	Yes	Yes	Yes		Yes		Yes	
Neighbor Control	No	Yes	Yes	Yes		Yes		Yes	
Method	BJS(24)	BJS(24)	BJS(24)	BJS(24)		BJS(24)		BJS(24)	

Standard errors clustered by country in parentheses, * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Estimates of equation (1) with different outcome variables reflecting the intensive margin of RMB use, i.e. the value of RMB payments in particular month. In this table, payments are defined as messages related to trade finance and or settlement, that is message types MT400 and MT700 in SWIFT. The treatment variable is a dummy variable indicating whether the country's central bank, as of month t, has ever signed a swap line agreement with the PBoC ($\text{SwapLine}_{i,t}$). Sample period is October 2010 to October 2018. BJS(24) refers to the did imputation method from Borusyak *et al.* (2024). Columns (1) and (2) consider the extensive margin effect with and without the control variables defined in the main text. Column (3) repeats the exercise with the share of messages related to trade finance that are denominated in RMB as the outcome variable. If the country reports no MT400 or MT700 messages in any currency we code the outcome variable to nil. Column (4)-(5), as column (3) but averages treatment effects depending on whether a country is above or below the sample median in terms of its trade share with China. Columns (6)-(7) repeats the exercise for the intermediate import share and columns (8)-(9) for the working capital of exports. See B for exact definitions of these variables.

Table 7: Swap lines and currency choice in payments with China

	RMB	USD	EUR	GBP/JPY/CHF	Other	Home
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{SwapLine}_{i,t}$	14.046***	-7.898***	-2.627**	-0.493***	-2.796**	-1.527
	(2.29)	(2.49)	(1.04)	(0.09)	(1.25)	(1.19)
N treated	20	20	20	20	20	20
N control	93	93	93	93	93	93
T	97	97	97	97	97	97
Time f.e.	Yes	Yes	Yes	Yes	Yes	Yes
Country f.e.	Yes	Yes	Yes	Yes	Yes	Yes
Method	BJS(24)	BJS(24)	BJS(24)	BJS(24)	BJS(24)	BJS(24)

Standard errors clustered by country in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: Estimates of equation (1) with the outcome variable being the currency composition of payments made to China (inclusive of Hong Kong and Macau). A payment is defined by SWIFT message types MT 103 and MT 202. The treatment variable is a dummy variable indicating whether the country's central bank, as of month t, has ever signed a swap line agreement with the PBoC ($\text{SwapLine}_{i,t}$). Sample period is October 2010 to October 2018, Mongolia is excluded from the set of treated countries. BJS(24) refers to the did imputation method from Borusyak *et al.* (2024). Column (1): the outcome variable is the share of payments in RMB. Column (2)-(5): the outcome variable is the share of payments in USD; EUR; GBP, JPY and CHF; all other currencies. The coefficients on columns (1)-(5) must by definition sum to nil. Column (6) is the share of payments in the currency of the counterparty.