

## Re – Estimating renminbi usage in cross-border payments and trade finance: Is there evidence of export intensity for trading partners?

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### Abstract

This paper re-estimates the impact of China's central bank Bilateral Currency Swap Agreements (BSAs) on cross-border trade flows and trade finance, evaluating whether these agreements induce an export intensity effect for trading partners. Utilizing a theory-consistent Structural Gravity Model estimated via Poisson Pseudo Maximum Likelihood (PPML) to control for heteroskedasticity and zero-trade observations, the study analyzes an extensive panel dataset of 27 swap-recipient countries covering bilateral trade flows across 213 countries from 1900 to 2025. The empirical findings reveal that China's bilateral currency swap network generates substantial trade creation. Intra-member trade shares and export intensity display large positive swings—increasing counterparty trade more than threefold—without producing evidence of trade diversion away from non-member nations. These results suggest that while China's expansion of swap lines is driven in part by self-interest and intent to project financial influence, the underlying economic benefits are substantially symbiotic. By facilitating local RMB trade clearance, the arrangement mitigates dollar shortage risks, lowers transaction costs, and supports China's broader capital account liberalization. Ultimately, the strategic internationalization of the RMB serves to reform the US-centric international monetary architecture by offering a viable hedge against systemic global liquidity shocks.

**Keywords:** Export intensity, currency swap line, trade flows, renminbi internationalization

### Introduction

Over the last two decades, the Chinese authorities commenced an extensive process to liberalize and internationalize Renminbi particularly under premier Zhu Rongji since 1993. The Chinese authorities are committed to achieving full convertibility of Yuan (Renminbi) by the end of the century. Before this period, the Chinese economy had been operating under a tight capital control since the formation of the People's Republic of China (PRC) in 1949 (Cheung *et al.*, 2017; Ito, 2011; Vallee, 2012; Yu, 2012; Chen and Cheung, 2012; and Park, 2010) <sup>[27, 28, 30, 76]</sup>. However, the liberalization and financial market reform initiated in the 1980s set the center stage for the rapid expansion of the Chinese economy <sup>[1]</sup>. In the year 1994, deliberate and conscious efforts were implemented to lessen capital account restrictions in a piecemeal fashion and eventually established current account convertibility in 1996 (see Gao and Yu, 2009). The Asian financial crisis 1997-8 put a temporary halt to this objective. The Asian economic upheavals of 1997 <sup>[41]</sup>-8 has made the Chinese authorities to relax its initial target of ensuring full convertibility by the close of the century. The global financial crisis of 2008 <sup>[12]</sup> causes a decline in the overall trade financing due to US dollar shortage. In effect, this culminated to a massive decline in Chinese exports, and further exposed the unreliability of the existing international monetary system. The situation necessitates a move to safeguard against future reoccurrence, largely due to high reliance of the Chinese economy on international trade.

Consequently, as reported in Campenella, (2014) RMB internationalization is now at the apex of the economic policy of China enshrined in the codified 12<sup>th</sup> five-year plan

(for the period 2011-2015) <sup>[36, 57]</sup>. Chen *et al.* (2009) evaluate RMB internationalization process as part of the broader desire to reform and regenerate the international monetary system to represent a more diverse and interconnected global economy. The plan implementation of the plan is through the meticulous and strategic engagements of powerful economic and financial institutions of the Chinese economy: The People's Bank of China (PBOC), the Ministry of Commerce, and the Ministry of Finance. Similarly, the plan is designed to enhance the cross-border use of RMB and subsequent liberalization of its capital account. In recent years, we have witnessed a passionate commitment by the Chinese government to liberalize its capital account through gradual expansion of the Renminbi (RMB) for settlement of global trade, development of a robust offshore Renminbi environment. In the bid to facilitate this goal, firms domicile outside China can open Renminbi (RMB) accounts in mainland China (Shanghai and four cities in Guangdong province) or Hong Kong (He, 2012; Cui, 2013a; Cui, 2013b <sup>[30, 31]</sup>; and Germain, and Schwartz, 2017). Since 2009 this pilot scheme was in operation for RMB trade settlement – the scheme is the first legal framework undertaken by the authorities to use RMB for current account transactions (see Mohammed, A. A. 2024 <sup>[61]</sup>; Kwon, 2015; Bowles and Wang, 2013; Roubini, 2009; Lao and McDowell, 2015; McCauley, 2011; Cohen 2012; Mohammed, A. A. 2019a; Mohammed, A. A. 2019b; and Mohammed, A. A. 2019c) <sup>[30, 64]</sup>.

To strengthen the internationalization process, the People's Bank of China (PBOC) declared its plan to develop and convert Shanghai into a global financial hub. In addition, new offshore clearing centers were extended in Singapore,

Malaysia, and Europe. Furthermore, negotiations to strike more offshore deals in several other countries, like Canada, Australia, and the United States, are ongoing (Cheung *et al.*, 2017) <sup>[27]</sup>. Contemporarily, the Chinese economy is an excellent specimen of export-powered growth, through learning by doing, reversing its status quo from autarkic fashion to opening up to foreign know how, and buffered by a complex and well tracked industrial policy <sup>[2]</sup>. China marked two decades of growth from (1980-2000), a quantum leap of transformation from autarkic and drudgery agricultural economy to a more sophisticated industrial sector and rising service sector in one generation (see Song and Zilibotti, 2009). In the period under scrutiny, China has recorded rapid growth in international trade, current account/GDP surpluses since the 2000s, and this is consistent with massive reserve hoarding and sterilization of expanding its trade surpluses and inflow of financial investment (Aizenman and Lee, 2008) <sup>[12]</sup>. Arguably, (Aizenman, Jinjazzak, and Zheng, 2015) stressed that these policies deliberately pursued by the Chinese authorities intend to delay and slow the real appreciation associated its rapid growth success.

The Asian region had seen the proliferation and build-up of FX reserves unprecedentedly since after the Asian financial crisis of 1997-1998. The Asia's reserve swelled from US\$202 billion in 1990 to US\$3371 billion in 2008 <sup>[1, 47]</sup>, and the growth continues to gallop at 20% per year. It is important to note that China's contribution to this buildup accounted for than 50% of the realized growth of 1990-2008 <sup>[1]</sup>. In seeking to understand the extraordinary growth of Asia's FX reserves in the post-Asian financial crisis. Aizenman *et al.* 2011 <sup>[10]</sup> opined that the Asian's crisis had a devastating impact socially and economically in the region. Even though five countries – Indonesia, Korea, Malaysia, Philippines, and Thailand bore the weight of the shock, but the psychological impact of the crisis spread to the whole region. On the precise cause of the crisis, a considerable deal of controversy clouds discussion of academics and policy circle.

However, the consensus was that of a shortage of international liquidity. Broadly speaking, the move to accumulate massive reserves and bilateral currency swapping highlights the precautionary self-insurance against the occurrence of another crisis. Aizenman *et al.* (2011) <sup>[10]</sup>, assess the prospective rise and impact of the aftermath of the 2008 <sup>[12]</sup> global financial crisis that had seen the proliferation of the currency swap agreements between major central banks like the US Federal Reserve, PBOC, ECB, some Asian economies, and later rest of world. They show that currency swaps constitute one dimension of complimenting international reserves for effective insurance against unexpected shocks. Additionally, US Federal Reserve and ECB swap line served somewhat as a substitute to the foreign reserve accumulation for some emerging markets <sup>[3]</sup>. Consequently, this piece of work seeks to explain the motive of PBOC's currency swaps from mercantilist export promotion as a way of intensifying the continuous Chinese economy's export-led drive towards growth.

Using the gravity model, we intend to show the empirical evidence of trade creation via ex-post analysis of the trade

flows. Methodologically, the theory consistent structural gravity model is an essential tool in our research kits to unbundle our goal. Regarding the sample, we drew sample 27 countries that were into China's currency swap line for empirical analysis. Similarly, our analysis relies on a panel approach which accounts for country-pair fixed effects solely to circumvent the embedded endogeneity in trade policy analysis, and phase-in effects of the bilateral currency swap agreement, which has important implication for future significance of swaps on trade.

The outcome of our empirical findings reveals an apparently large impact of bilateral currency swaps on trade flows. Succinctly, on average, the estimates suggest that bilateral currency swap increases counterparts trade more than three times. An important caveat we hold is that currency swap might be different from other forms of international trade agreements, such as the currency unions, currency peg, and dollarization, and indeed they have a different impact on trade.

This study is structured as follows. Section 1, introduces the empirical study, Section 2 provides an overview of currency swap mechanism, Section 3 describes the data and methodology used in the study and Section 4 contains main empirical results, Finally, section 5 concludes.

## Literature Review

### 1. Financial Liberalization, Central Bank Bilateral Currency Swaps and Renminbi Internationalization

Over the past three decades, the global financial architecture has undergone significant structural transformations, driven by shifting geopolitical dynamics, recurrent liquidity crises, and efforts to reform the U.S. dollar-centric monetary system. A central element of this evolution is China's gradual financial liberalization and the strategic internationalization of the Renminbi (RMB). Initiated during broader market reforms in the late 20th century, the RMB internationalization process accelerated significantly in the wake of the 2008 <sup>[1]</sup> Global Financial Crisis (GFC). The GFC exposed critical vulnerabilities in global trade clearance, where dollar shortages disrupted international commerce and highlighted the systemic risks of over-relying on a single dominant reserve currency.

To mitigate these vulnerabilities, the People's Bank of China (PBOC), alongside key economic ministries, institutionalized the RMB internationalization drive, codifying it within national strategic policies such as the 12th Five-Year Plan. Central to this agenda has been the rapid expansion of Bilateral Currency Swap Agreements (BSAs). These central bank liquidity networks serve as a multi-purpose economic instrument designed to facilitate cross-border trade settlement, reduce exchange rate volatility, supply emergency international liquidity, and expand China's financial footprint globally.

The literature categorizes the drivers of China's currency swap arrangements into monetary mercantilism, precautionary self-insurance, and systemic monetary reform. Following the 1997–1998 Asian Financial Crisis and the 2008 <sup>[12]</sup> GFC, emerging economies faced severe regional dollar shortages. Early literature emphasized foreign exchange (FX) reserve hoarding as a primary self-insurance mechanism against sudden capital cutoffs. However, as

highlighted by Aizenman *et al.* (2011) and Destais (2016)<sup>[10, 32]</sup>, central bank currency swap lines emerged as vital complements or direct substitutes to traditional FX reserves. While western central bank swap lines (such as those provided by the U.S. Federal Reserve and ECB) primarily stabilized short-term liquidity in developed markets during crises, China's swap network expanded across both emerging and developed nations, fulfilling both liquidity support and commercial trade functions.

Beyond emergency liquidity, China's BSAs are heavily driven by trade-centric motives. Aizenman *et al.* (2018)<sup>[11]</sup> note that China's outward financial strategies frequently bundle trade, investment, and currency arrangements to support its export-led growth model. By establishing local RMB trade clearance mechanisms, China enables importing and exporting firms to bypass intermediary currencies (such as the U.S. dollar), directly lowering exchange rate exposure and transaction costs. Authors such as Campanella (2014), Eichengreen (2011b), and Cohen (2012)<sup>[25, 30, 35]</sup> analyze RMB internationalization through the lens of international political economy. These studies argue that China's economic stature as the world's second-largest economy historically mismatched its minimal currency usage in global transactions. Promoting the RMB via bilateral swap lines and offshore clearing centers (e.g., in Hong Kong, Singapore, and Europe) represents a deliberate structural effort to move toward a multipolar international monetary system, reducing systemic dollar dependence and hedging against unilateral external monetary shocks.

Understanding the economic impact of central bank swap lines requires examining their operational mechanics. Evolution from Back-to-Back Loans: Modern currency swaps evolved from traditional back-to-back loan structures,

where two counterparty entities in different countries exchange equivalent principal amounts in their respective domestic currencies at spot exchange rates, with agreed-upon re-exchange schedules and interest rates.

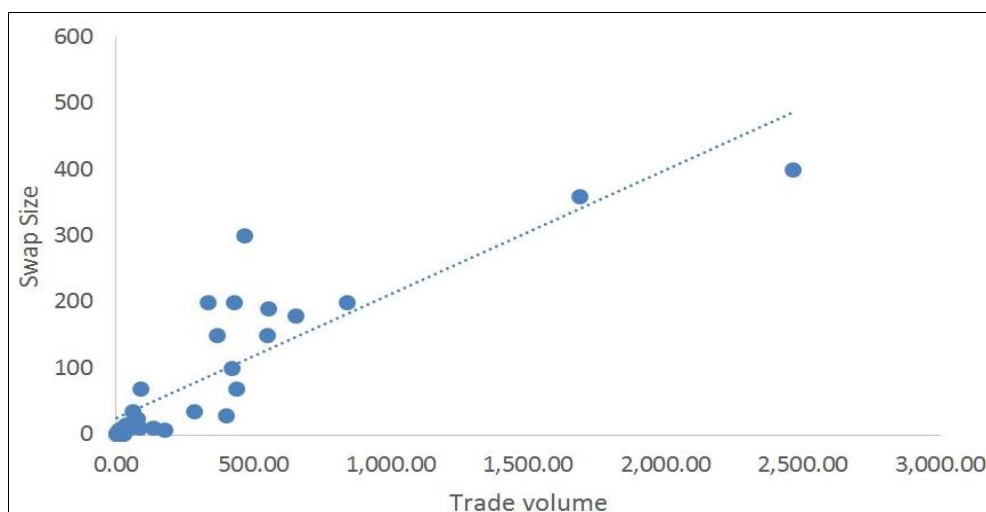
### Central Bank Conduit vs. Traditional IMF Facilities:

Unlike traditional multilateral financial conduits (e.g., IMF structural adjustment programs or regional financial arrangements), central bank currency swap lines establish a direct bilateral conduit between central banks. This structure allows liquidity to flow directly from the issuing central bank (e.g., PBOC) to participant central banks, which then distribute the local currency to domestic commercial banks and trading firms.

**Cost Efficiency and Hedging:** Swaps exploit comparative advantage in borrowing costs across distinct financial markets. They enable counterparties to transform risk exposures, secure cost-effective financing, and hedge against foreign exchange fluctuations in international commercial contracts.

## 2. Currency Swap Mechanism

Currency swaps evolved from back to back loans. In a back to back loan, two parties in different countries make loans to one another, of equal value, each denominated in the currency of the lender and each maturing on the same date. The two loans are covered by separate agreements. The initial loan will be transacted at the spot rate, the interest payments and principal repayment would be carried out at formal rates (Destais, 2016; Sivaprakasam, and Mathew, 1996; and Close, 2001)<sup>[16]</sup>.

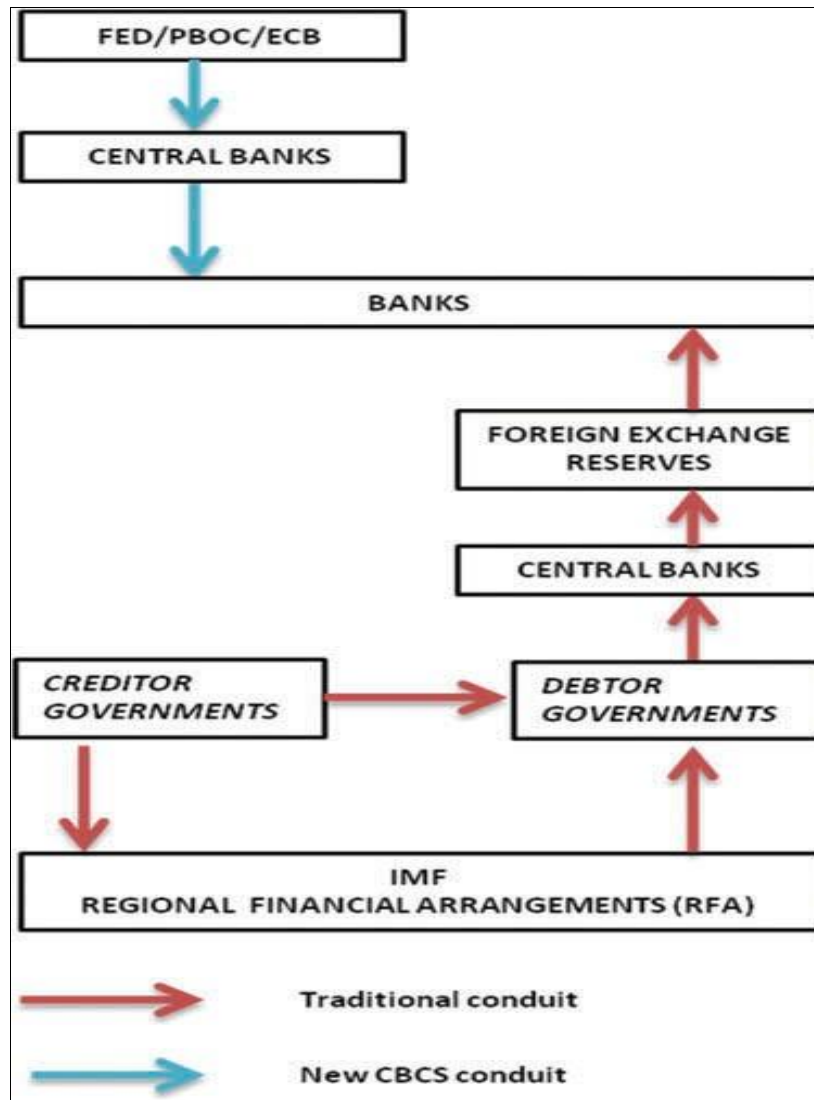


Source: People's Bank of China's News Release.

Fig 1: Correlation Between Trade Volume and Swap Size (in billion RMB)

Moreover, currency swaps are cost effective ways to transform risk exposures and alter future cash flows of firms. Similarly, comparative advantage is the fundamental motivation for wide area swap – covered foreign currency borrowing like the central bank bilateral currency of route of China and United States that covered many countries with

large volumes swap – covered borrowing. Suppose the borrowing cost differ across markets, issuers as firms or central banks are likely to ameliorate their overall financing cost initiating swaps agreement in a manner in each party signatories to the swap financial contract has an incentive or comparative advantage using the funds and proceeds<sup>[4]</sup>.



Source: Adopted from Details (2016)

Fig 2: International Liquidity Swap Scheme

Significantly, currency swap has two major uses, firstly, it enables the parties to secure a cheaper debt (i.e. to borrow at best available rates irrespective of currency and swapping debt in the desired currency via back to back loans). Secondly, swaps are effective mechanisms for hedging against exchange rate exposure and fluctuation.

## The Data and Econometric Methodology

### 1. Data.

Our dataset on bilateral trade data for 213 countries and standard gravity variables comes from Glick and Rose (2016)<sup>[44]</sup>, and the data span from 1900 – 2025. In the data set, trade data relies on the direction of trade statistics (DOTs), real GDP and population come from the World Bank's *World Development Indicators*, augmented with the Penn World Table 7.1 as well as the IMF's International Financial Statistics. Glick and Rose exploit CIA's *World Factbook* for some country-specific variables such as latitude, longitude, landlocked, island status, contiguous border, shared language, colonizers. Information on regional trade agreements originates from the World Trade Organization. The dummy variable captures the China's RMB-swap is that Renminbi serves as a clearing trade

currency between China and counterparties to the swap agreement or among whole signatories.

### 2. Empirical Structural Gravity Equation

The study applied OLS estimator in log linear form. Econometric theory suggests that pooled or cross section regression satisfy the classical assumptions. Hence, OLS is unbiased, consistent and efficient estimator. However, as discussed in Santos Silva and Tenreiro (2006)<sup>[7]</sup> standard log linearization is inappropriate and infeasible. First, the dependent variable can be 0.

Second, even if all the observations of the dependent variable are strictly positive, the expected value of the log-linearized error will overall the depend on the covariates and therefore OLS will be inconsistent (Santos Silva and Tenreiro, 2006<sup>[7]</sup>, p.644). Similarly, the error terms are heteroskedastic and therefore its variance depends on the exponential function of the independent variable. Therefore, the pattern of heteroscedasticity, makes all the higher moments of the conditional distribution of the error term to affect the consistency of the estimator. In a nutshell, log linearization process drives the inconsistent estimates because of the correlation of the error term with explanatory variables.



**For robust estimation, we also consider the following PPML regression:**

$$X_{ij,t} = \exp[\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \beta_1 \ln Y_i + \beta_2 \ln E_j + \rho_1 \ln \Gamma'_{ij,t} + \rho_2 \lambda'_{ij,t}] + \epsilon_{ij,t} \quad (1)$$

Our alternative econometric specification that investigates trade diversion effect of RMB currency swap agreement of China follows Ghosh and Yamarik (2004) <sup>[42]</sup>, Dai, *et al.* (2014), Baier and Bergstrand (2007) <sup>[18]</sup> that seek to identify the impact of FTAs on trade flows which generally based on gravity model. The approach fits the recent development in the application of empirical gravity to account for multilateral resistant term which had proven efficiency in the prediction of trade flows. The framework is given by:

$$X_{ij,t} = \exp[\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \rho_1 \lambda'^{in}_{ij,t} + \rho_2 \lambda'^{out}_{ij,t}] + \epsilon_{ij,t} \quad (2)$$

Here,  $\ln(X_{ij,t})$ , is the bilateral trade between partners  $i$  and  $j$  at time  $t$ .  $\pi_{i,t}$  is a set of timevarying exporter (destination) fixed effects. They also control for all unobservable inward multilateral resistances including all total expenditure in line with structural model of Anderson and van Wincoop (2003).

In similar vein  $\chi_{j,t}$  indicates all set of time varying exporter (source) fixed effects, which also account for outward multilateral resistances and total shipments form the structural gravity model. Consequently,  $\mu_{ij}$ , represent a set country-pair fixed effects that follow Baier and Bergstrand (2007) <sup>[18]</sup>, are utilized to address endogeneity of bilateral currency swap. While  $\ln Y_i$ ,  $\ln E_j$ , and  $\ln \Gamma'_{ij,t}$  captures the economic sizes and all trade cost related variables conventional considered within the intuitive gravity structure. To robustly confirm our empirical investigation on trade diversion and trade-creation effects we adopt both the intuitive and structural economic gravity as in specification (1) and (2) using the PPML estimator.

$$X_{ij,t} = \exp[\pi_{i,t} + \chi_{j,t} + \mu_{ij} + \rho_1 \lambda'^{in}_{ij,t} + \rho_2 \lambda'^{out}_{ij,t}] + \epsilon_{ij,t} \quad (3)$$

We include two set of zero-one dummy variables to depict whether two trading partners are joining the RMB swap agreement in year  $t$ ,  $\lambda'^{in}_{ij,t}$  or whether only one trading partner has joined,  $\text{CSWAP}^{outimp}_{ij,t}$ . These dummies allow us to isolate the effects swaps may exert on the level of trade flows <sup>[5]</sup>.

## Empirical Results

In effect, a positive coefficient on both  $\lambda'^{in}_{ij,t}$  and  $\lambda'^{out}_{ij,t}$  captures trade creation among the swap recipients, while trade diversion is suggestive of negative coefficient in  $\lambda'^{out}_{ij,t}$ . Table B8 in the Table 1 reports the results of the intuitive gravity equation without country-pair fixed effects, this is to allow us to compare the alternative variation in specification 3 to gauge the robustness of the findings. The coefficients of the intuitive gravity relatively have the expected signs as shown in Table 1. More so, Equation (1) is used following the recommendation Santos Silva and

Tenreiro (2006) <sup>[7]</sup>, we estimate an alternative model using Poisson Pseudo Maximum-likelihood (PPML) estimator to account for the pattern of heteroskedasticity imbedded in trade data. The benchmark model is as follows, we estimate the gravity model and discusses the estimation results via pooled OLS and Poisson Pseudo likelihood (PPML) followed by alternative variations of the benchmark model. We further proceed to discuss estimates related to the theoretical (structural) gravity model à la Anderson and Van wincoop (2003) model. It is relevant to note that the significant variance between the two approaches is the way estimates rely on many controls using econometric panel techniques to account for the multilateral resistance term (price indices). Given that, the price indices derived from the theoretical model are not observable. We discussed these two sets of techniques in equation (6), i.e., the fixed effects and the first difference estimation. Subsequently, we address an important issue of concern especially in the estimation of gravity model for applied trade policy research, namely, the possibility that some our explanatory variables may be endogenous in equation (2).

**Table 1:** Poisson Pseudo Maximum Likelihood (PPML) Intuitive Gravity Estimates

|                 | PPML [1]             | PPML [2]              | PPML [3]              | PPML [4]              |
|-----------------|----------------------|-----------------------|-----------------------|-----------------------|
| Exp Income      | 0.806***<br>(0.0241) | 0.857***<br>(0.0198)  | 0.854***<br>(0.0174)  | 0.829***<br>(0.0163)  |
| Imp Expenditure | 0.813***<br>(0.0273) | 0.859***<br>(0.0234)  | 0.857***<br>(0.0217)  | 0.840***<br>(0.0208)  |
| Distance        |                      | -0.834***<br>(0.0443) | -0.873***<br>(0.0345) | -0.740***<br>(0.0300) |
| Border          |                      | 0.590***<br>(0.173)   | 0.428***<br>(0.118)   | 0.411***<br>(0.105)   |
| Colony          |                      | 0.590***<br>(0.0782)  | 0.182<br>(0.117)      | 0.231**<br>(0.102)    |
| Island          |                      | 0.537***<br>(0.0776)  | 0.516***<br>(0.0779)  | 0.549***<br>(0.0748)  |
| Landlocked      |                      |                       | -0.348***<br>(0.0609) | -0.334***<br>(0.0611) |
| Common language |                      |                       | 0.623***<br>(0.106)   | 0.596***<br>(0.0926)  |
| Common nation   |                      |                       | 0.0629<br>(0.483)     | -0.0100<br>(0.500)    |
| Regional        |                      |                       |                       | 0.484***<br>(0.0487)  |
| Currency swap   |                      |                       |                       | 0.649**<br>(0.271)    |
| TD_Swap         |                      |                       |                       | 0.216<br>(0.201)      |
| Observations    | 635,137              | 635,137               | 635,137               | 635,137               |
| R-squared       | 0.522                | 0.593                 | 0.671                 | 0.726                 |

In addition, this makes our regression to rely on time series variation, and it compares the pair observations of each country before and after swap line accession to determine the  $\lambda'_{ij,t}$  coefficient. In both equation (2) and (3),  $\lambda'_{ij,t}$  captures intra-  $\lambda'_{ij,t}$  trade creation. The inclusion of fixed effects specification and country-pair fixed effects represent a theory consistent structural gravity formulation to account for unobserved heterogeneity (see Baier and Bergstrand, 2007; Feenstra, 2004 <sup>[17, 18]</sup>; Anderson and Yotov, 2011; Olivero and Yotov, 2012) <sup>[74]</sup>. In the context of estimating average treatment effects of swap agreement on trade across swap member countries, the specification is in line with

Baier and Bergstrand (2007)<sup>[18]</sup> to yield unbiased coefficient estimates<sup>[6]</sup>.

The gravity equation provides an avenue for revealed evidence of trade diversion through an ex-post analysis of trade flow. Our empirical results confirm that RMB bilateral currency swap network is trade-creating, without evidence of trade diversion. Specifically, we find that RMB bilateral currency swap network rarely divert the trade signatories to the swap agreement away from the non-member countries. Specification 2 in Table 2 maintains that bilateral currency swap has significant effects on trade creation, this is evidenced by the positive signs of Currency Swap.

**Table 2:** Structural Gravity: Trade Effects of Chinas' Bilateral Currency Swap

|                     | PPML                 | PPML                 | PPML                 | PPML                 | PPML                 |
|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| Currency Swap       | 1.974***<br>(0.201)  | 1.681***<br>(0.203)  | 1.681***<br>(0.203)  | 1.823***<br>(0.101)  | 1.775***<br>(0.118)  |
| TD_Swap             | 1.968***<br>(0.0531) | 1.697***<br>(0.0542) | 1.697***<br>(0.0542) | 1.805***<br>(0.0781) | 1.804***<br>(0.0781) |
| Swap <sub>t-4</sub> |                      |                      |                      |                      | 0.256***<br>(0.0954) |
| Observations        | 731,826              | 731,826              | 730,063              | 730,063              | 730,063              |
| R-squared           | 0.687                | 0.690                | 0.6541               | 0.711                | 0.685                |

Santos Silva and Tenreyro (2006)<sup>[7]</sup> applied Poisson Pseudo Maximum Likelihood estimator to estimate gravity model; they show that the PPML estimator performs reasonably well even in the presence of high proportion of zero<sup>[7]</sup>. Estimating the empirical gravity in multiplicative is the convenient way to deal with the significant number of zeros, instead of logarithmic form. Similarly, heteroscedasticity is another major concern in dealing with trade data. The problem is important because in the presence of heteroscedasticity and Jensen's inequality as pointed by Silva and Tenreyro (2006)<sup>[7]</sup>, the gravity model estimates of the effects of trade policy and trade costs are likely to be biased and inconsistent with OLS estimator in logarithmic form.

For example, the mean of  $\ln \epsilon_{ijt}$  depends on a higher moment of  $\ln \epsilon_{ijt}$ , therefore, including its variance is important. Suppose  $\ln \epsilon_{ijt}$  is heteroskedastic, and in practice this possibility might be prevalent. Then the expected mean of the error term depends on one or more covariates due to inclusion of variance term. Therefore, this tends to violate the first assumption of OLS which is suggestive of the fact that the estimator may be biased and inconsistent. More so, this kind of heteroskedasticity is not address simply by applying a covariance matrix estimator, because it affects the parameter estimates in addition to standard errors. Our investigation of currency swap on trade applied structural gravity using both OLS and PPML in order to gauge between the two alternative approaches. To evaluate the empirical impact of currency swap agreements on trade flows, the literature heavily relies on the Structural Gravity Model of International Trade. Early trade studies utilized intuitive gravity formulations incorporating distance, economic size (GDP), and cultural/geographical proximity dummies. However, as established by Anderson and van Wincoop (2003) and expanded by Feenstra (2004) and Baier and Bergstrand (2007)<sup>[18, 40]</sup>, theory-consistent estimation requires

accounting for Inward and Outward Multilateral Resistance Terms (MRTs)—representing unobserved relative trade barrier price indices.

## 1. Methodological Concerns

PPML and Fixed Effects the estimation of gravity equations poses specific econometric challenges: we address the concerns as follows:

**Endogeneity and Phase-In Effects:** Bilateral agreements are inherently endogenous, as trading partners with high baseline trade volumes are more likely to execute currency swap agreements. Scholars address this by introducing country-pair fixed effects alongside time-varying exporter and importer fixed effects, isolating intra-pair temporal variation before and after swap accession.

**Heteroskedasticity and Zero Trade Values:** As demonstrated by Santos Silva and Tenreyro (2006)<sup>[7]</sup>, standard log-linearized Ordinary Least Squares (OLS) estimation generates biased and inconsistent parameters in the presence of heteroskedastic error terms and zero trade flows due to Jensen's inequality. Consequently, the Poisson Pseudo Maximum Likelihood (PPML) estimator in multiplicative form has become the standard technique to ensure consistent and unbiased policy parameter estimates.

## 2. Trade Effects: Trade Creation, Trade Diversion, and Capital Inflows

Empirical studies investigating the ex-post trade effects of China's bilateral currency swap network provide robust evidence regarding trade creation and trade diversion dynamics: Applying structural gravity models via PPML estimators across large global panel datasets, empirical findings demonstrate that China's bilateral currency swap network generates substantial trade creation among participant countries. Relative trade shares and export intensities demonstrate large positive swings, particularly favoring export expansion for the swap provider while delivering symbiotic settlement benefits to recipient nations. Crucially, ex-post analyses (incorporating intra-member and extra-member trade dummies à la Ghosh & Yamarik, 2004; Magee, 2008)<sup>[42, 60]</sup> indicate an absence of significant trade diversion. Bilateral currency swap networks do not divert trade away from non-signatory nations, distinguishing swap agreements from restrictive regional trade blocs or preferential trade agreements. The literature also links currency swap arrangements to wider macroeconomic outcomes, including financial development, cross-border investment, and capital flows:

### Capital Inflows & Foreign Direct Investment (FDI):

Recent empirical work (e.g., Jiang *et al.*, 2023; Lu *et al.*, 2023)<sup>[53]</sup> demonstrates that China's BSAs significantly stimulate bilateral direct investment and capital inflows by reducing currency risk and improving investor confidence. **Financial Development Intermediary Role:** Studies examining finance and trade interactions (e.g., Beck, 2002; Baltagi *et al.*, 2009; Kiendrebeogo, 2012)<sup>[20, 23, 54]</sup> emphasize that developed domestic financial markets enhance the trade-expanding benefits of currency agreements. Currency swaps complement financial market depth, easing credit constraints for cross-border trade clearance.

## Conclusion

The study shows that the use of RMB in trade financing has rapidly increase in recent years. In the same vein, another concern that leads to China's combined efforts to promote the cross-border use of RMB relates to the overall move to improve its financial liberalization program. In effect, to reduce China's reliance on the US-centric global financial system. Therefore, the RMB internationalization is to support the international monetary system reform. For example, the pace at which dollar accumulation expose many countries running surpluses in the current account, and by implication stand the risk of sudden dollar shortage. Internationalization of RMB in the subsequent years ahead is an alternative solution to this form of currency risk. In a way, this could help the move towards rebalancing the international monetary system that relies on few de facto currencies (Detais, 2016; and Eichengreen, 2011<sup>[35]</sup>; and Chen and Cheung, 2009; Gao and Yu, 2009) argued that challenges still lie ahead for RMB; crucially the question is whether Chinese authorities will sequentially alter the status quo by ensuring more flexibility of the RMB exchange rates and full liberalization of the financial markets among factors others is key for RMB internationalization and becoming entirely part of the international monetary system reform. Nevertheless, along with the desire to fulfil the objective of international monetary reform several reasons account for the RMB internationalization. For example, Cheung *et al.* (2011)<sup>[10]</sup> stressed that RMB's status does not match China's positioning in the world economy, as the second-largest economy. Among other reasons mainly advanced in the literature, including the following:

RMB internationalization will help in the reduction of currency risk for both the exporter and importer so that the acceptance of RMB as trade settlement currency would promote international trade and investment, which is beneficial for both China and its global trading partners. Similarly, RMB internationalization will reduce high exposure to dollar exchange rate volatility, given China's position as the holder of foreign exchange rate reserves and the lion share of the stockpile reserve is in US dollar (the dominant international reserve currency). Therefore, China's US dollar accumulation will likely reduce downward or reverse as RMB gains acceptance for global trade and investment.

The literature collectively underscores that China's bilateral currency swap agreements represent a pivotal innovation in the modern international monetary architecture. By blending precautionary liquidity mechanisms with commercial trade settlement frameworks, the PBOC has effectively leveraged BSAs to promote RMB usage, lower transaction friction, and cushion participant economies against global liquidity shocks.

While empirical results consistently validate the trade-creating efficacy of currency swaps without inducing trade diversion, scholars highlight ongoing challenges. The long-term trajectory of RMB internationalization and its integration into a truly multipolar global monetary system will depend on continued capital account reforms, financial market depth, exchange rate flexibility, and the institutional resilience of offshore RMB clearing networks.

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1. The global financial crisis of 2008 nearly put a halt to China's export-led and current account surpluses trajectory, in 2007 China's current account surplus fell from 10% of GDP to about 2% in 2013.
2. Learning via experimental approach greatly help China to poster its rapid productivity growth.
3. In bilateral currency swap, on the trade date, counter parties exchange notional amounts in two different currencies. For instance, one party receives 30 million British pounds while the other receives 3.3 million Chinese Renminbi. This implies a GBP/RMB exchange rate of 1.1, and at the end of the deal they swap again using the same exchange rate. Evidently, the currency bilateral swap agreements signed by the People's Bank of China and some Central Banks in advanced, emerging markets and developing economies is reinforcing the trend of Renminbi internationalization in global trade.
4. For example, comparative advantage exists in financial market if similar risk is priced differently in different market, in this situation central banks and firms stand to gain from currency swapping. The benefit of swap more generally helps countries regulate their exposure to exchange rate uncertainty and interest rate risk.
5. See Anderson (2001) for in depth review of the theoretical foundation of economic gravity. Our analysis follows the literature of FTAs for our empirical investigation of bilateral currency configured as a form of trade policy (Frankel 1997; Magee, 2003; Baier and Bergstrand, 2002, 2004; and Baier and Bargstrand, 20007). Recently, Baier and Bergstrand (2007) utilize a gravity set up with fixed effects and successfully account for the endogeneity of FTAs. They showed that on the average, FTAs doubles member countries trade with phase-in effect of ten years. Similarly, Anderson and Yotov (2011) use structural gravity model to estimate terms of trade and efficiency gains form FTAs in the world. The central objective of this paper is to obtain trade diversion and trade-creation effects of a newly emerging trade agreement (RMB bilateral currency swap route of China) within the same similar framework.
6. Essentially, the omission of this control will make the  $\lambda'_{i,t}$  coefficient to have upwards bias because they tend to pick up trade creation that is unrelated to  $\lambda'_{i,t}$  simply due to unobservable factors. Therefore, the introduction of country-pair fixed effects absorbs all the non-time varying variables that are likely to bias our coefficient of interest.
7. Silva and Tenrenyro (2006) depicts the multiplicative gravity expressed as an exponential function of the gravity equation, which provides a nonlinear least square estimator (NLS).
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