TESTING FOR STRICT EXOGENEITY AND REVERSE CAUSALITY IN THE TRADE–SWAP FACILITY LINKAGE

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Abstract

The study reassess the impact of currency swap on international trade. The study utilizes structural gravity Equation to investigate China's Renminbi and Central Bank Bilateral Currency Swap using dataset on bilateral trade data for over 180 countries and standard gravity variables comes from Glick and Rose (2016), and the data span from 1990 – 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. Our structural gravity result from the strict exogeneity test depicts a value that is economically and statistically not different from zero, which confirms the absence of reverse causality and positive trade impact of currency swap agreement of Renminbi. Therefore, it means future changes in currency swap has significant effect on trade flows. The agreement is likely to attract more trading partners. We develop and utilize a robust panel estimates in the first difference that uses exporter-time and importer-time and pair fixed effects though significant, and check the problem of reverse causality. The trade policy variable may suffer from reverse causality type of endogeneity i.e., assuming, all else constant, a country might choose to liberalize its trade with a trading partner that is hitherto a significant partner. This is known as the natural trading partner hypothesis. Therefore, we tend to have feedback from trade to our trade policy variable (swap) which is opposite to prior expectation

Keywords: International Trade Equation, Trade–Swap link and Reverse Causality

JEL CLASSIFICATION: F1, F5, F6

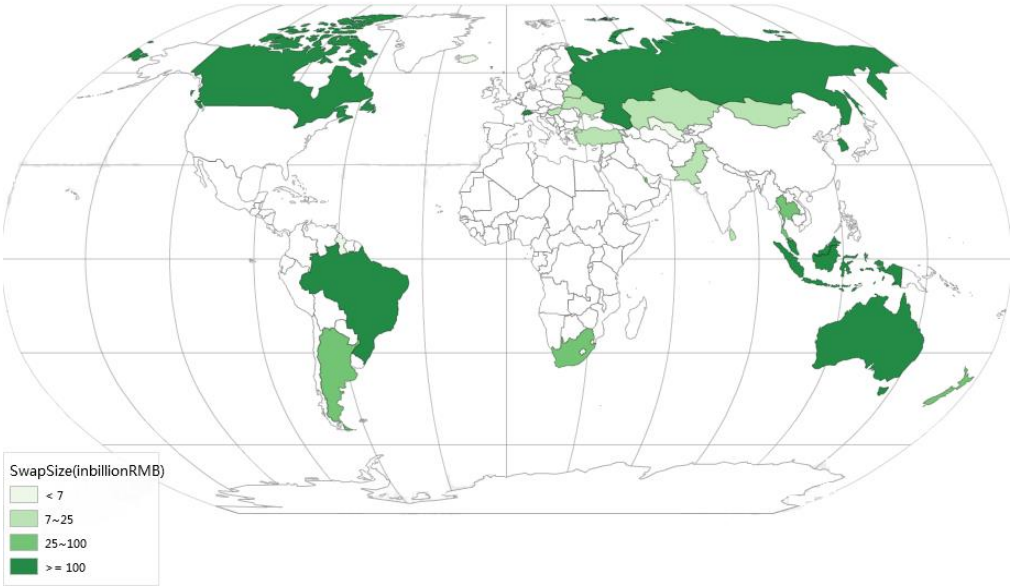
1. Introduction

Renminbi (RMB) internationalization is receiving attention on commencement comparable to some of the China's initiatives such as the Asian infrastructure investment bank (AIIB) and the one Belt, and one Road initiative scheme. The government actively engages in the efforts to internationalize its currency (RMB). Although the Chinese capital account is, still relatively closed, non-resident investors cannot have access to RMB in international markets (Lin and Cheung, 2016; Gao and Yu, 2009; Park, 2010; Yu, 2012; and Chen and Cheung, 2011). Furthermore, the usage of RMB as trade and investment currency will help in the elimination of exchange rate risk both for Chinese firms and for their trading partners that requires funding for international investment. Liao and McDowell (2015) argued that economic motivations rather than geographical considerations drive the RMB internationalization. For example, trade and

investment dependence concerns due to break off in credit market liquidity have motivated the People's Bank of China (PBOC) to provide swap line to obtain liquidity for trade and investment.

Ruan (2013), Aizenman (2011), and Ito (2011)) maintained that bilateral currency swap cooperation is mutually symbiotic mechanism that is benefit to both countries. First, it provides trade-financing insulation against international liquidity shocks. Secondly, it benefits both partners reduced transaction costs that may arise in cross-border trade and investments. Bilateral currency swaps are also an alternative means for lubricating and financing international trade.[1] The initiative of bilateral currency swap agreements (BSAs) enables China and its trading partners to revert the over-dependence on US dollar for invoicing and settlement of trade. Therefore, PBOC's initiative makes economic sense as they help to reduce the risk of abrupt shocks and shield the exporters against currency risk, by eliminating the costs of hedging against foreign exchange rate risks. As whole, this help to lower the transaction costs of trade and investments (see Wilson, 2015; Yang and Han, 2013; Mohammed 2019a;; Mohammed 2019b; Bowles and Wang, 2013 Mohammed 2019c).

Figure 1: Geographical Location of China's RMB Swap lines



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

Significantly, another important factor that provides stimulus for China's volume of trade growth was the accession of China into World Trade Organization (WTO) in 2001. Similarly, synthesis of these factors has driven the emergence of China as a global player on a world economics scale

[1]The BSAs approach supplies RMB to central banks of China's trade partners for clearing trade.

(see Mohammed, 2024; Kwon, 2015; Bowles and Wang, 2013; Roubini, 2009; Lao and McDowell, 2015; McCauley, 2011; Cohen 2012; Mohammed, 2019a; Mohammed, 2019b; and Mohammed, 2019c). Among those countries that join PBOC's swap line deals include some European countries such as Albania, Belarus, Iceland, Hungary, Kazakhstan, Ukraine, United Kingdom, Russia, and Turkey. The Asian countries include Hong Kong, South Korea, Mongolia, Singapore, Malaysia, Indonesia, Pakistan, Uzbekistan, Thailand, Sri Lanka, Qatar, and United Arab Emirate. Some countries in the South America include Argentina and Brazil. Again, countries from Australia and Oceania continent include New Zealand and Australia (Lin and Cheung, 2016).

The paper seeks to explain the ex-post behavior of China's Renminbi trade policy and the pattern of world trade using structural gravity, an essential novelty in this piece of work is to investigate the effect of currency swap on trade empirically. The literature of international trade provides a scanty evidence in this area. Therefore, our empirical investigation provides more elaborate discussion on currency swap and trade which will be of interest and relevance to the world. There are two novelties to this study. First, we take a line variant of the previous studies, and the foremost objective is to investigate empirically trade creation and trade diversion effect of the RMB-based trade policy-the bilateral currency swap agreements (BSAs) on bilateral trade. The study examines the positive impact on the counterparties to the agreement (trade creation) and the adverse effect on non-partner countries (trade diversion). Using the gravity model, we intend to show the empirical evidence of trade creation via ex-post analysis of the trade flows.

It is important to note that the positive and highly significant effects of the currency swap (RMB-trade policy) found are relatively in accordance with the impacts of other kind of trade agreements like the Currency Union (CU). In studies such as Glick and Rose (2016) who found a fairly large impact currency union on trade in the magnitude of 114%. Earliest literature began with Rose (2001) that found triple effects CUs on trade, though this sound suspiciously large, and preceded empirical findings even set out a more dampening effect.

This study is structured as follows. Section 1, introduces the empirical study, Section 2, provides literature, an overview of the trade-swap facility linkage and renminbi internationalization Section 3 describes the data and structural gravity methodology used in the study and Section 3 contains main empirical results, 4 contains strict exogeneity test for potential "reverse causality" between trade and currency swap agreement, 5accounting for "phasing in" effect of swap line and lagged terms trade effects and finally, section 6 concludes

2. Literature Review

2.1 The Trade-Swap Facility Linkage and Renminbi Internationalization

The literature examining the relationship between monetary policy tools, trade facilitation, and international currency adoption has grown significantly alongside the expansion of China's Bilateral Swap Agreements (BSAs). Using the reference base provided in Mohammed (2024), this review synthesizes the key themes, empirical frameworks, and academic debates surrounding China's Renminbi (RMB) internationalization, liquidity provision mechanisms, structural gravity modeling, and the econometrics of endogeneity in international trade. The

internationalization of China's Renminbi is widely evaluated alongside global economic initiatives such as the Belt and Road Initiative (BRI) and the Asian Infrastructure Investment Bank (AIIB). Despite maintaining a relatively closed capital account that restricts non-resident access to onshore capital markets, China has actively promoted cross-border RMB usage for trade settlement and investment. Utilizing local currency in bilateral cross-border trade minimizes transaction costs and shields domestic and foreign firms from foreign exchange volatility. Economic dependencies and systemic credit market disruptions motivate the People's Bank of China (PBOC) to deploy currency swap facilities. Liao & McDowell (2015) argue that strategic economic considerations—rather than simple geographical proximity—drive RMB internationalization.

Swap facilities function as a mechanism to bypass reliance on third-party vehicle currencies (primarily the US Dollar), protecting signatories from abrupt liquidity shocks. Bilateral currency swaps provide liquidity insulation, reduce cross-border transaction costs, and serve as financial mechanisms to stabilize trade flows during external credit stress. Aizenman et al. (2011) note that countries may utilize swap lines as substitutes or complements for foreign exchange reserves, mitigating illiquidity risks or supporting public investment financing. The trade-creating effect of monetary and financial arrangements is traditionally evaluated within the theoretical architecture of the structural gravity model. Grounded in trade theory, gravity formulations isolate policy intervention effects while controlling for economic sizes and multilateral resistance terms.

The empirical literature extensively leverages broad panel datasets. Following dataset conventions established by Glick & Rose (2016), bilateral trade flows sourced from the IMF's Direction of Trade Statistics (DOTS) are combined with macro indicators from the World Bank's World Development Indicators (WDI) and geographical controls. Structural gravity estimations allow researchers to isolate the trade impact of policy variables against baseline determinants such as gross domestic product, geographic distance, common borders, and historical trade agreements. A central concern in evaluating policy variables—such as currency swaps, Currency Unions (CUs), or Free Trade Agreements (FTAs)—within trade equations is the presence of endogeneity. OLS estimators often fail to yield unbiased parameters due to omitted variable bias, simultaneity, and selection bias. Unobserved factors (e.g., country-level financial depth or political affinities) can simultaneously drive trade volume and the likelihood of entering a swap agreement. Reverse causality arises if countries systematically negotiate trade-facilitating agreements with partners with whom they already maintain extensive commercial ties.

Following Baier & Bergstrand (2007), standard practice to resolve cross-sectional endogeneity involves applying panel data estimators equipped with exporter-time, importer-time, and country-pair fixed effects. To test for reverse causality, empirical designs incorporate lead values of the policy dummy. A statistically insignificant coefficient on future policy implementations confirms strict exogeneity, demonstrating that existing trade volumes do not systematically cause policy adoption. Similar to FTAs, the economic impact of currency facilities typically exhibits institutional lag. Empirical work by Anderson & Yotov (2011) and Baier & Bergstrand (2007) demonstrates that trade policies require multi-year "phase-in" periods (often evaluated at 4-year intervals) to fully manifest in cross-border trade statistics.

2.2 Comparative Evidence across Currency and Trade Agreements

The trade-creation estimates for RMB currency swaps are frequently benchmarked against the broader empirical literature on currency unions, exchange rate pegs, and trade agreements

Table 1: Comparative Evidence across Currency and Trade Agreements

Agreement Type / Study	Main Findings & Empirical Magnitudes	Methodological Considerations
Early Currency Union (CU) *(Rose, 2000; 2001)*	Found that currency unions tripled bilateral trade volumes.	Critiqued for potential omitted variable bias and overestimating policy impacts.
Refined Currency Union *(Glick & Rose, 2002; 2016)*	Showed CUs double trade (~114% to 100% increase) using expanded panel datasets.	Utilizes pair fixed effects to control for time-invariant pair characteristics.
Free Trade Agreements *(Baier & Bergstrand, 2007)*	Showed FTAs double trade over a 10-year period after controlling for endogeneity.	Replaced IV/control functions with differenced panel data and pair fixed effects.
Heterogeneous Limited CU *(Nitsch, 2005; Santos Silva &Tenreyro, 2006)*	Identified negligible or muted effects of Euro adoption and dollarization.	Emphasized Poisson Pseudo-Maximum Likelihood (PPML) to handle zero-trade values.
RMB Currency Swap Lines *(Mohammed, 2024)*	Finds strong, positive trade creation (expanding trade up to three-fold in baseline PPML models), with persistent lagged effects at 4 years.	Employs strict exogeneity testing to rule out reverse causality.

The literature places bilateral currency swap facilities within a broader framework of international financial integration, credit constraints, and sovereign balance-sheet management. Research by Manova (2012) and Antràs & Caballero (2009) underlines that financial market imperfections and credit constraints act as substantial barriers to international trade. By providing liquidity directly to banking systems, central bank swap lines alleviate financial distortions and facilitate trade clearance. Beyond immediate trade settlement, China's expanding bilateral swap network acts as an alternative international safety net. Horn et al. (2023) highlight China's emerging role as an international lender of last resort, where swap lines provide emergency balance-of-payments support to developing and emerging market economies. Recent contributions (e.g., Jiang et al., 2023; Lu et al., 2023) demonstrate that China's swap lines promote real economic linkages beyond goods trade, positively influencing cross-border direct investments and broader foreign capital inflows.

The literature surrounding China's central bank currency swap agreements confirms their growing role as both a monetary policy instrument and a catalyst for international trade. By controlling for structural multilateral resistance, unobserved heterogeneity, and reverse causality through advanced gravity modeling, empirical findings demonstrate that RMB swap facilities generate substantial trade-creation effects. Future research continues to focus on general equilibrium comparative statics, regional spillovers, and the long-term structural welfare implications for signatories and non-partner countries alike.

Using a cross-section data, instrumental variable method is one of the recommended econometric approaches to address the endogeneity problem. However, no exogenous, strong and reliable instrument are available. For example, (Magge, 2003; and Baier and Bergstrand 2004) were among the early studies that instruments with little success. Magge (2003) conclude, “We should be cautious in using gravity equation estimates to draw strong conclusions the effect of PTA on trade.” Similarly, Baier and Bergstrand (2007) surveyed and summarize most of the existing findings of IV studies, at best, they found mixed evidence in trying to isolate the effect of FTAs on trade flows. However, same authors argued that one could draw strong and reliable influence about the average treatment effect of FTAs on trade using panel data. Particularly using country-pair fixed effects and first differencing eliminates or account for the likely unobserved linkages between the endogenous trade policy covariates and the error in the gravity regression. Egger and Nigai (2015) and Agnosteva et al. (2014) show that the country-pair fixed effects will absorb all bilateral time invariant covariates and therefore, account for any unobservable time invariant trade cost components, they argued that pair-fixed effects are a better measure of bilateral trade costs than the set of standard gravity regressors.

3. Data and Methodology

The framework of theoretical structural gravity system suggests the following;

$$X_{ij,t} = \frac{Y_i E_j}{Y}\left(\frac{\tau_{ij}}{\Pi_i P_j}\right)^{1-\sigma} \qquad (1)$$

$$\Pi_i^{1-\sigma} = \sum_j \left(\frac{\tau_{ij}}{P_j}\right)^{1-\sigma} \frac{E_j}{Y} \; and \; P_j^{1-\sigma} = \sum_i \left(\frac{\tau_{ij}}{\Pi_i}\right)^{1-\sigma} \frac{Y_i}{Y} \qquad (2)$$

Equation (1) is the representation of the theoretical gravity system that derives trade flows between pair of countries, conveniently we can decompose the size term, $Y_i E_j / Y$, and the trade cost term, $\left(\tau_{ij}/\left(\Pi_i P_j\right)\right)^{1-\sigma}$

Our dataset on bilateral trade data for over 180 countries and standard gravity variables comes from Glick and Rose (2016), and the data span from 1948 – 2013. 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. Our definition of 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. The analysis covers over 180 countries, out of which 27 countries are the counterparty to the China's bilateral currency swap agreement (RMB-trade based policy).

4. Empirical Results and Discussion

4.1 Addressing Potential Endogeneity Bias

In the estimation of the gravity model, we must give attention to the likely problem of endogeneity, more especially the inclusion of policy variable in the model. From an econometric consideration, the existence endogeneity violates the orthogonality assumption of pooled OLS, by creating a correlation between the right-hand variables and the error term. The potential sources of endogeneity bias of the right-hand side variable's coefficient estimates fall under omitted variable bias, simultaneity bias, and measurement error (see Wooldridge, 2002), believing that these factors can severely be a potential source of bias caused by the RMB-trade policy (swap line).[2] Similarly, reverse causality can ensue as another source of this type econometric problem. For instance, the accession trade policy like the renminbi currency swap may be determined by the degree of country's overall integration in the global markets. Similarly, open economies have incentives to subscribe more to liberal policies, in this case, one has to be cautious in drawing firm conclusion about the impact of such kind of policies on trade. Baier and Bergstrand (2004) empirically examine the economic determinants of RTAs and show that there is a robust cross-sectional evidence that most countries select well their partners, say country pairs are signing RTAs to some extent share some economic traits capable of enhancing the benefit of RTAs. Indeed, it is reasonable to note that there remains large unobserved heterogeneity, for example, suppose exporting firms from a given country suffers from inadequate sources of financing their business activity, because international trade requires additional cost such as shipping, foreign exchange risk among others. Here the anticipated gains from bilateral currency swap between China its counterparts would be substantial, and therefore,

[2]This issue endogeneity of trade policy in the trade literature can be trace since (Trefler, 1993).

governments of countries with this type of weak financial depth would be more likely to select into the swap line. Similarly, as shown in Aizenman (2011) countries use the swap line as a way of complimenting reserves to guide against the unforeseen contingency of illiquidity or complimenting some fiscal spending in infrastructure since the swap funds are not restricted to trade financing.

In fact, these traits are unobservable to the econometrician; these factors may likely correlate with decision into Renminbi swap line. In this sense, swap line and goal of complimenting reserves of fiscal spending may exhibit a positive correlation in the cross-section of the data. But that create a negative error term $\epsilon_{ij,t,}$ in the gravity equation, and the swap line coefficient may be underestimated. Also, assuming unobserved cultural or historical features shared between China and its swap counterparts increase concomitantly with trade flows and the likelihood of entering into a bilateral swap agreement, by reducing cost-related barriers compared to when this type of corporation does not exist, this will make the estimated coefficients to exhibit upward bias. Since we care about the consistency, efficiency, and unbiasedness of our coefficient estimates, it is important to note that failure to account for potential endogeneity of $\mathrm{CSWAP}_{ij,t}$, may bias our gravity estimates. Comparable to other trade policy analysis like currency unions (CUs), free trade agreements (FTAs), our approach of dealing with the problem follows that of Baier and Bergstrand (2007) to address some of the endogeneity in FTA regressions: they propose the use panel data with country-pair fixed effects and country-time fixed effects or using first differenced panel with country-and-time fixed effects. Showing that the inclusion of country-pair fixed effects or differencing the data removes the bias attributed to the omission of the unobserved variables affecting bilateral trade and the explaining variable ($\lambda'_{ij,t,}$ membership dummy) which also considers the endogeneity related to selection, since it's mainly a cross-sectional issue.[3]

Table 2: Structural Gravity Estimates with Restricted Sample

	Time Fixed effects	Bilateral Fixed Effects	Pair Fixed effects	PPML Pair Fixed Effects	PPML Phase-in Effects
Currency Swap	1.714***	1.409***	1.409***	1.578***	1.520***
	(0.198)	(0.199)	(0.199)	(0.0612)	(0.0747)
	(0.0195)				
currency Swap_{t-4}					0.313***
					(0.0684)
Observations	564,384	564,384	562,647	562,647	562,647
R-squared	0.713	0.689	0.689	0.672	0.678

Table 2 reports the estimates of structural gravity model with some controls, column (2) depicted results when bilateral fixed effects were included, i.e., both exporter-time and importer-time respectively in the specification (5). To obtain theory consistent estimates, these terms are particularly relevantto account for both outward and inward multilateral resistant terms properly and more inclusively to absorb other unobservable characteristics that are exporter and importer specific likely to influence bilateral trade. We noted earlier failure to account for the endogeneity of λ'might bias the gravity estimates. Column (3) and (4) reports results that are augmented by pair fixed effects in the gravity equation to control for endogeneity in line with the specification (4) via alternative estimators (OLS and the PPML). The estimated coefficient of the CSWAP variable is statistically significant and positive as much large as 1.409 and 1.578 in absolute value for the pooled OLS and PPML estimation results respectively, though with a difference from the specification that imposes time fixed effect. Thissuggests that all else equal, currency swap formation leads to an average increase in trade of [exp(1.578)-1] = 3.80 more than three times with members, though the magnitude is reasonablylarge but empirically closer to other existing findings of other type of international agreements in the literature. Column 3 of table 2 depict the results of the restricted sample (1990 – 2025) of the structural gravity estimates, all else constant currency swap increase trade at least three times [exp(1.286)-1] = 3.61.

4.2 Strict Exogeneity Test for Potential "Reverse Causality" between Trade and Currency Swap Agreement

Furthermore, we set to test equation (4) for the possibility of reverse causality because obtaining a reliable estimate is our major concern within the gravity model.[4] The trade policy $\text{CSWAP}_{ij,t}$, may suffer from reverse causality type of endogeneity i.e., assuming, all else constant, a country might choose to liberalize its trade with a trading partner that is hitherto a significant partner. This is known as the natural trading partner hypothesis. Therefore, we tend to have feedback from trade to our trade policy variable (swap) which is opposite to prior expectation. Through the pair fixed effects, we further implement the strict exogeneity test of $\text{CSWAP}_{ij,t}$by adding a new future level of swaps, $\lambda'_{ij,t+1}$, to specification (5) (Wooldridge, 2002; and Baier and Bergstrand, 2007). Suppose the swap line variable is exogenous to trade flows, the coefficient of the parameter associated to$\lambda'_{ij,t+1}$, should be statistically and economically different from zero. If this is true, swap line is uncorrelated with the concurrent level of trade flow, which is suggestive of confirming the absence of this type endogeneity.

$$\ln(X_{ij,t}) = \pi_{I,t} + \chi_{j,t} + \mu_{ij} + \rho_1 \ln Y_i + \rho_2 \ln E_j + \rho_3 \ln \Gamma'_{ij,t} + \rho_4 \lambda'_{ij,t} + \rho_5 \lambda'_{ij,t+1} + \epsilon_{ij,t} \quad (3)$$

In column (5) of table 1 we show the results of specification (4) considers reverse causality between trade and currency swap agreement (trade policy) through pair fixed effects. This assessment is implemented through strict exogeneity test of λ' by adding a new variable that captures the future level of λ'. Suppose λ' are exogenous to trade flows the parameter associated with the future level of currency swap in specification (4) should not be different from zero. Our result from the strict exogeneity test depicts a value that is economically and statistically not

different from zero, which confirms the absence of reverse causality in the results related to specification (4). Therefore, it means future changes in currency swap has no significant effect on trade flows. Similarly, our panel estimates in the first difference that uses exporter-time and importer-time and pair fixed effects were negative though significant, and the results are omitted for brevity.

4.3 Accounting for "Phasing in" Effect of Swap Line and Lagged Terms Trade Effects

Furthermore, we conjecture that swap line may exhibit phase in effect on trade in the manner of free trade agreements. For example, (Anderson and Yotov, 2011; and Baier and Bergstrand 2007) argued that free trade agreement has a strong phase in effect due to its institutional nature, and therefore capturing the lagged changes of FTA on trade provides more information about the impact. Baier and Bergstrand (2007) show that the entire economic treatment effect is hardly measured wholly in the concurrent year of which FTA came into force, and typical FTA "phase in" over ten years. Moreover, this type of agreements tends to alter terms of trade, is well known in the large empirical literature on international economics; terms of trade changes tend to have lagged effects on trade volumes. For instance, FTA entered legally in 2000 may not yield impact on the trade until 2010. In accounting for the phase in effect of this type of agreement, three lagged terms for the bilateral swap agreements are imposed in equation (11) with four years interval.

$$\ln (X_{ij,t}) = \pi_{I,t} + \chi_{j,t} + \mu_{ij} + \rho_1 \ln Y_i + \rho_2 \ln E_j + \rho_3 \ln \Gamma'_{ij,t} + \rho_4 \lambda'_{ij,t} + \rho_5 \lambda'_{ij,t-4} + \rho_6 \lambda'_{ij,t-8} + \rho_7 \lambda'_{ij,t-12} + \epsilon_{ij,t} \quad (4)$$

The motivation for the choice of alternative panel methodologies relied on conceptual and empirical grounds. We apply fixed effects estimation rather random effects estimations based on the following argument. Wooldridge (2002, p.252) show that in econometric parlance random effect is equivalent to assuming a zero correlation between the observed explanatory variable, say in our case the swap variable and the unobserved heterogeneity say v_{ij}, and that a strong conditional mean independence assumption is required to fully justify the statistical inference. In most applied papersv_{ij}, or the individual random effect is assumed to be uncorrelated with the explanatory variable, which seems implausible in gravity equation. Since the unobserved effect v_{ij}, are likely correlated with our policy variable (swap), therefore, bilateral fixed effects estimations best control for any unobservable effects in the gravity equation (see Baier and Bergtrand, 2007; Anderson and Yotov, 2011; Egger and Nigai, 2015 and Egger, 2003). Empirically, recent econometric investigation of the gravity equation using panel data revealed a striking evidence for the rejection of random effect gravity model in comparison to a fixed effects model, which applies the use of country-pair fixed effects. In addition, Wooldridge (2002, p.284) offer standard econometric discussions on the choice of fixed effect and first differencing estimations especially in the treatment of the endogeneity problem. Showing that the choice of fixed effects or first differencing hinges on the assumption of the idiosyncratic term, $\epsilon_{ij,t}$. The fixed effect estimator is more efficient under the assumption that the error term $\epsilon_{ij,t}$ are serially uncorrelated, when *(T)* exceed two. On the Other hand, first difference estimator is more efficient when $\epsilon_{ij,t}$, is assume follow a random walk (i.e., the difference in the error term follow a

white noise, $\epsilon_{ij,t} - \epsilon_{ij,t-1}$) when $T > 2$. Baier and Bergstrand (2007) shows first differencing panel data has some merits over fixed effects. For example, it is quite plausible and foreseeable that the unobserved effects in trade flows, and $\epsilon_{ij,t}$, exhibit contemporaneous correlation overtime. Given the high serial correlation, the inefficiency of fixed effects exacerbates, as *T* gets larger. In this case, first differencing the data enhance the efficiency of our estimation. Similarly, using fixed effects is almost equivalent to differencing the data around the mean, and this is problematic, as *T*gets large in our panel, because the data may tend to follow unit root process, and cause the problem of spurious regression. Using first differencing yields data that departs from the previous period of our panel, which is close to unit root process. Nevertheless, choosing between these methods is difficult, therefore, as a form of robustness check, reporting both methods will offer reassuring estimates.[5]

The results in table 1 somewhat corroborates those obtained from table 4. More so, the impact of phase-in agreement was realize as captured by BcSwap_lag4 variable in the second row of table 1 and 2 respectively, which means that the bilateral currency swap agreement manifested a mild impact on trade [exp(0.3)-1 = 34%] four years from the RMB-swap inception.To test for reverse causality and Strict Exogeneity, the empirical designs incorporate lead values of the policy dummy. A statistically insignificant coefficient on future policy implementations confirms strict exogeneity, demonstrating that existing trade volumes do not systematically cause policy adoption. Similarly we check for Phase-in and lagged effects similar to FTAs, the economic impact of currency facilities typically exhibits institutional lag. Empirical work by Anderson & Yotov (2011) and Baier & Bergstrand (2007) demonstrates that trade policies require multi-year "phase-in" periods (often evaluated at 4-year intervals) to fully manifest in cross-border trade statistics. The empirical results reported in the provided paper demonstrate a positive and statistically significant impact of China's Renminbi (RMB) bilateral currency swap agreements on bilateral trade flows, while confirming the absence of reverse causality endogeneity.

From the Pooled OLS Estimates, the presence of a bilateral currency swap agreement produces a positive coefficient of 1.409 when using bilateral (exporter-time and importer-time) fixed effects and pair fixed effects (Table 1, Columns 2–3). Similarly, PPML (Poisson Pseudo-Maximum Likelihood) Estimates: Under the PPML specification, the coefficient increases to 1.578 (Table 2, Column 4). In addition, the economic magnitude is computed using the log transformation, the PPML estimate implies that entering into a currency swap agreement leads to an average increase in bilateral trade of 3.80 times (or 380%) with swap member countries, all else being equal. Restricted Sample (1990–2025): In the restricted sample period, the PPML coefficient is 1.286 (Table 2, Column 4), indicating a positive average trade expansion of [exp(1.286) - 1].

The Core Trade-Creation Impact can be deduced from the PPML Estimates. From table 2 and 3 the Pooled OLS Estimates, when controlling for exporter-time, importer-time, and pair fixed effects, China's Bilateral Swap Agreements (BSAs) yield a statistically significant positive coefficient of 1.409. More so, the PPML Estimates, using the Poisson Pseudo-Maximum

[5]Wooldridge (2003) recommends reporting results using both. However, if the number of periods is large enough; first differencing is likely to be more efficient especially when the error terms exhibit substantial positive serial correlation.

Likelihood (PPML) specification with pair fixed effects, the coefficient increases to 1.578. In terms of economic magnitude, A PPML coefficient of 1.578 indicates that entering a currency swap agreement leads to an average increase in bilateral trade of 3.80 times ([exp(1.578) - 1] = 3.80, or a 380% increase) with member countries.

Similarly, the restricted sample (1990–2025), the restricted sample period, the PPML coefficient is 1.286, representing an average bilateral trade expansion of 3.61 times ([exp(1.286) - 1] = 3.61, or a 361% increase). In addition, we test the existence of Strict Exogeneity & Reverse Causality Testing. For example, exogeneity test (lead variable) test for reverse causality (e.g., whether countries sign swap agreements with existing major trading partners), a future lead variable was added to the coefficient on the future lead variable is statistically and economically not different from zero. This confirms the absence of reverse causality, proving that future changes in currency swaps do not impact current trade flows and that existing trade volumes do not systematically drive policy adoption.

We account for phase-in and lagged trade effects, that are institutional lag, in evaluating the policy at 4-year intervals demonstrates that currency swap agreements exhibit a multi-year "phase-in" effect. The 4-year lag Result is depicted by the lagged term (Currency Swap *(t-4)* yields a statistically significant positive coefficient (0.313 in Table 2 and 0.337 in Table 3). This indicates a persistent, mild secondary expansion in trade of approximately 34% ([exp(0.3) - 1] approximately 34%) four years after the swap's inception. However, 8- and 12-Year Lags, Coefficients for 8-year and 12-year lags were found to be not statistically different from zero.

Table 3: Structural Gravity Estimates with Restricted Sample

	Time Fixed Effects	Bilateral Fixed Effects	Pair Fixed Effects	PPML Pair Fixed Effects	PPML Phase-in Effects
Currency Swap	1.258***	0.986***	0.986***	1.286***	1.223***
	(0.196)	(0.196)	(0.196)	(0.0751)	(0.0876)
Currency Swap$_{t-4}$					0.337***
Observations	444,290	444,290	442,584	442,584	442,584
R-squared	0.587	0.653	0.653	0.676	0.664

It is important to note that the positive and highly significant effects of the currency swap (RMB-trade policy) found are relatively in accordance with the impacts of other kind of trade agreements like the Currency Union (CU). In studies such as Aitken (1973) Glick and Rose

(2016) who found a fairly large impact currency union on trade in the magnitude of 114%. Earliest literature began with Rose (2001) that found triple effects CUs on trade,though this sound suspiciously large, and preceded empirical findings even set out a more dampening effect. For example, Glick and Rose (2002) responded with larger data sets, and still found that currency unions double trade even with the inclusion of country-pair fixed effects.[6] Thom and Walsh (2002) took into consideration several CU exits and argued that omitted variable bias lingers, such as wars of independence and communist takeovers. Klein and Shambaugh (2006) found striking evidence that hard currency pegs have a more significant impact on trade than currency unions and show that indirect pegs do not affect trade. Baeir and Bergstrand (2007) addressed econometrically the endogeneity of free trade agreements (FTAs), and further demonstrate that control function and instrumental variable techniques over time do not work reasonably well for endogeneity, but panel data does. Accounting econometrically the endogeneity of FTAs, they found yet another striking empirical evidence of quintupled impact of FTAs on trade flows. Similarly, accounting for phase-in effect on the average FTAs doubles members' bilateral trade after ten years. Barro and Tenreyro (2007) relied on the use of some geographic instrumental variables technique and found that CUs increases trade up to 14 folds. Baldwin (2006) discussed several reasons why the more significant impact of currency union on trade may likely be suspicious and concluded that on the average Euro increased trade in the magnitude of 5-10%. More so, Bun and Klaassen (2007) incorporate dynamic controls to shrink the high impact of currency union on trade, and the effect is still relatively substantial at 25%. Campbell (2013) also apparently showed the impact of currency unions on trade to have declined over ten years. The findings were the sensitive to exclusion of the CU observations coterminous with some political events or missing data. Similarly, the paper included UK colony time trend, thus accounting for the negative pre-trend, one could find a point estimates of currency unions on trade that is negative and insignificant. The mixed findings in the literature of currency unions made Glick and Rose (2016) respond again with updated data set from 1997 to 2013 and considering some modifications such as switches of around 423 compared to 136 in Glick and Rose (2002).

Nonetheless, some level of doubt lingers, Nitsch (2005) found the absence impact for currency union entries on trade. Similarly, for dollarization episode, Klein (2005) found that their no strong evidence that dollarized countries of western hemisphere have seen an increase in trade with the United States. Also, Santos and Tenreyro (2009) showed that euro has no effect on trade, using meta-analysis Havranek (2010) found a great deal of publication bias for euro studies, and a low impact of 3.8% compared to old 60% for non-euro episodes. We allow for non-linear effects of CSWAP and attempt to capture the possibility that the effects of CSWAP variable may change over time, results are based on the specification (4), and we impose three lags with four years interval up to 12 years of the currency swap agreement. At a glance, column (5) of table 2 shows the estimated coefficients CSWAP at lag four. While lag eight and twelve were not different from zero, and we omit the values for brevity. Notably, the results suggest relatively mild average treatment effects of Bcswap over the first four years from the inception

[6]The findings of Rose (2000) was so robust and remarkable, in 2005 Harvard's Jeffrey Frankel called the large and significant impact of currency union on trade the most significant finding in international macroeconomics in the preceding 10 years. Rose himself has this to say "I have always maintained that the measured effect of a single currency on trade appears implausibly large…."

of the bilateral currency swap of China (Bcswap-trade policy). Hence, the effects CSWAP maintain significance over four years after the commencement of the RMB-trade policy which explains that currency swap (Bcswap-trade policy) is economically and statistically buoyant in increasing the level of trade flows.

5. Conclusion and Recommendation

We square the results with other forms of international trade agreements in the literature to gauge a possibility that lie in between. For example, Glick and Rose (2016) found a fairly large impact currency union on trade in the magnitude of 114%. Earliest literature began with Rose (2000) that found triple effects CUs on trade though this sound suspiciously large, and subsequent empirical finding even set out a more dampening effect. Baeir and Bergstrand (2007) addressed econometrically the endogeneity of free trade agreements (FTAs), and further demonstrate that control function and instrumental variable techniques over time do not work fairly well for endogeneity, but panel data does. Accounting econometrically the endogeneity of FTAs, they for found yet another striking empirical evidence of the quintupled impact of FTAs on trade flows

Although the results are quantifiably remarkable, we believe they are relatively reasonable in the light of why various international trade policies appeared to have a varied impact on trade flows. However, though we have addressed the (multilateral resistance) terms of a given country pair using the exporter-time and importer-time fixed effects, which technically accounts for outward and inward multilateral resistances. We have not address general equilibrium "comparative statics" effects of bilateral currency swaps on two members' trade nor the effects of the agreement on non-members' trade and the possible welfare implication of currency swaps. These possible limitations are left for future research. Our centrifugal focus in this study has mainly been to explore a novelty that the provides policymakers and academics alike an unbiased estimate of the average treatment effect of currency swaps on trade flows of signatories to this emerging international trade agreement.

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