ISCTE IUL
REPOSITÓRIO
INSTITUTO UNIVERSITÁRIO DE LISBOA

Repositório ISCTE-IUL

Deposited in *Repositório ISCTE-IUL*:
2026-03-05

Deposited version:
Accepted Version

Peer-review status of attached file:
Peer-reviewed

Citation for published item:
Ferreira-Lopes, A., Ribeiro, G. & Martins, L. F. (2025). A new player in the international bond market: Comparing the macroeconomic determinants of foreign-currency denominated debt before the inclusion of the renminbi in the SDR. Emerging Markets Finance and Trade. 61 (6), 1782-1801

Further information on publisher's website:
10.1080/1540496X.2024.2430504

Publisher's copyright statement:
This is the peer reviewed version of the following article: Ferreira-Lopes, A., Ribeiro, G. & Martins, L. F. (2025). A new player in the international bond market: Comparing the macroeconomic determinants of foreign-currency denominated debt before the inclusion of the renminbi in the SDR. Emerging Markets Finance and Trade. 61 (6), 1782-1801, which has been published in final form at https://dx.doi.org/10.1080/1540496X.2024.2430504. This article may be used for non-commercial purposes in accordance with the Publisher's Terms and Conditions for self-archiving.

Use policy

Creative Commons CC BY 4.0
The full-text may be used and/or reproduced, and given to third parties in any format or medium, without prior permission or charge, for personal research or study, educational, or not-for-profit purposes provided that:

- a full bibliographic reference is made to the original source
- a link is made to the metadata record in the Repository
- the full-text is not changed in any way

The full-text must not be sold in any format or medium without the formal permission of the copyright holders.

Serviços de Informação e Documentação, Instituto Universitário de Lisboa (ISCTE-IUL)
Av. das Forças Armadas, Edifício II, 1649-026 Lisboa Portugal
Phone: +(351) 217 903 024 | e-mail: administrador.repositorio@iscte-iul.pt
https://repositorio.iscte-iul.pt

A New Player in the International Bond Market: Comparing the Macroeconomic Determinants of Foreign-Currency Denominated Debt Before the Inclusion of the Renminbi in the SDR*

Alexandra Ferreira-Lopes

ISCTE-IUL and BRU-IUL

Gonçalo Ribeiro (gamribeiro@outlook.com)

STOXX

Luís Filipe Martins (luis.martins@iscte-iul.pt)

ISCTE-IUL, BRU-IUL and CIMS-University of Surrey

This version: October 2024

* We thank four referees and the editors for helpful comments, as well as, Miguel Carvalho, participants at the 32nd Annual Conference of the European Economic Association (EEA) and at the 6th Annual Conference of the International Association for Applied Econometrics (IAAE). We also acknowledge financial support from FCT - Fundação para a Ciência e a Tecnologia (National Science and Technology Foundation) through project UIDB/00315/2020. The usual disclaimer applies. The corresponding author is Alexandra Ferreira-Lopes, E-mail: alexandra.ferreira.lopes@iscte-iul.pt; Address: Av. das Forças Armadas, 1649-026 Lisbon, Portugal.

Abstract

We assess how the main macroeconomic determinants of the Renminbi (CNY) internationalization compare with those of the four Special Drawing Rights (SDR) currencies, by using quarterly data for the shares of international bond issuances between 2009Q3 and 2015Q4, the period after the internationalization of the CNY and until the year before its inclusion in the SDR. We use the system-based model of Seemingly Unrelated Regressions (SUR). Results show that the CNY is the currency most affected by the determinants under study, presenting nonlinearities, indicating that its role in the International Monetary System (IMS) is evolving. Specifically, the CNY is influenced by the bilateral trade share, which exhibits evidence of an evolution from a small to a big currency. Determinants that are proxies for currency stability, such as the inflation rate and volatility against the SDR, show that the CNY has both a financing and an investment purpose, which is corroborated by the spread of government bond yields and FDI flows, which are determinants that influence currency choice in debt issuance. Stock market capitalization, representing financial market development, indicates a complementary relationship between financial assets. Furthermore, despite its growing importance in the IMS, the CNY retains a major role in Asia.

JEL Classification: C33, F40, F41, G15.

Keywords: International Currencies, International Bonds, Seemingly Unrelated Regressions, Macroeconomic Determinants of International Currencies.

1. Introduction

On 30 November 2015 the Executive Board of the International Monetary Fund (IMF) decided to include the Chinese Renminbi (CNY) in the Special Drawing Rights (SDR) currency basket as the fifth currency alongside the US Dollar (USD), the Eurozone Euro (EUR), the British Pound (GBP), and the Japanese Yen (JPY). Effective on 1 October 2016 the inclusion of the Renminbi in the SDR basket was the beginning of a new era for the Chinese currency and for the International Monetary System (IMS). There are two factors that support its inclusion in the currency basket. First, the rise of China as one of the world's largest exporters in the five-year period that preceded the review. Second, the Renminbi is now considered "freely usable" according to the definition stated on the IMF's Articles of Agreement, Article XXXf: "A freely usable currency means a member's currency that the Fund determines (i) is, in fact, widely used to make payments for international transactions, and (ii) is widely traded in the principal exchange markets." Based on the factors determining the currencies' weight in the SDR basket, the CNY represented, on 1 October 2016, 10.92% of the SDR currency basket, surpassing the JPY's weight of 8.33% and the GBP's weight of 8.09%. The USD represented 41.73% and the EUR 30.93%. The weights of the SDR basket in 2010, with only the USD, the EUR, the GBP, and the JPY included were 41.94%, 37.36%, 11.26%, and 9.44%, respectively.

In this paper we analyze the international role of the five most representative currencies of the IMS and study what economic and financial factors drive the use of these currencies at the international level, in the period following the internationalization of the Renminbi in the offshore bond markets and until the year right before its inclusion in the SDR basket. We seek to assess how the main determinants for the CNY internationalization compare with those for the four SDR currencies in the period referred to. Specifically, we analyze the CNY in terms of its macroeconomic determinants, *vis-à-vis* the other four currencies in the international context, before

the inclusion in the SDR, to assess if the macroeconomic conditions are comparable (or not). We use data from the international bond market that include both public and private issues of bonds at the international level, thus exploring the use of currencies as stores of value and units of account. We seek to understand if the economic and financial factors that influence the share of international currencies have the same impact over the share of each of the five currencies or not. Additionally, we segregate the issuances of each currency by regions, according to the region of the issuer of the bond, to assess if the determinants that influence each of the currencies' shares also differ by geographic regions to which the issuers belong.

Our work is included in the international finance literature, specifically that pertaining to international financial markets. We contribute to the literature by constructing a detailed database on international bond issuances for the five currencies of the SDR basket in the period prior to the inclusion of the Chinese Renminbi. Then, we use this database to study the determinants of currency shares in international bond markets, which is a topic still under-reported in the literature, in comparison with the domestic markets. Furthermore, we use the Seemingly Unrelated Regression (SUR) model, which allows us to distinguish the impacts of the variables between currencies, contrary to what has been done in the literature to date.

Empirical research on international currencies is often derived from the aggregated value of official currency reserves held by central banks (Chinn and Frankel, 2007, 2008; Eichengreen and Flandreau, 2008; Chinn, 2015; Eichengreen *et al.*, 2016), focusing mainly on the international prominence of currencies as a store of value at the official level. Also, international vehicle currencies - particularly, forex vehicle currencies - have been modelled theoretically (Swoboda, 1969; Krugman, 1980; Black, 1991; Matsuyama *et al.*, 1993; Devereux and Shi, 2013), but empirical evidence is scarce (Hartmann, 1998; Flandreau and Jobst, 2009, among the few).

Regarding the unit of account function, examples of empirical evidence can be found in the works of Calvo and Vegh (1992) and Goldberg and Tille (2008).

Currency considerations derived from the denomination of international bonds can be found in the work of Cohen (2005), Bobba *et al.* (2007), Chitu *et al.* (2014), and Ito and Rodriguez (2015). Cohen (2005) tries to understand the determinants of aggregate issuance of international debt securities, using data from the BIS, although not analyzing the Renminbi. Bobba *et al.* (2007) investigate the determinants of international currency choice at the time of the creation of the Euro, using the unit of account role, but not for the Renminbi. Chitu *et al.* (2014) investigate when the dollar surpassed the pound as the leading international currency using the bond market as a reference. Finally, Ito and Rodriguez (2015) use foreign-currency public debt to investigate the factors that drive the issuance of debt, with an emphasis not on the currencies' international strength, but rather on the issuance country's idiosyncrasies that justify its reliance on foreign debt at the government level.

Regarding the Chinese currency, Chinn (2015) analyzed the possibility of the Renminbi surging as a reserve currency. Li and Zhang (2017) estimated the determinants (based on Chinn and Frankel, 2007) of internationalization of (already) important international currencies (e.g., the USD and the Eurozone Euro), in order to predict the development of the Renminbi in the IMS. Cerutti and Obstfeld (2018) show that there is substantial room for improvement in terms of integration of China in international bond markets. The development of this market would help develop other financial markets, such as the foreign exchange market. Chey *et al.* (2019) claim that the internationalization process of the Renminbi has been the result more of government policies than market driving forces. The authors also uncover which "non-Chinese" factors have moved the support by foreign governments in the internationalization of the Renminbi. The authors find that a country that holds CNY reserves is more likely to build infrastructures that help its

internationalization, as well as a country that has a more sophisticated financial market. Wang *et al.* (2021) study the impact of the CNY internationalization, among other international episodes on China's foreign exchange market, specifically the USD/CNY and SDR/CNY exchange rates. As in the case of Chey *et al.* (2019) they also concluded that the CNY has been more influenced by domestic government policies than international factors, but due to the managed floating nature of the CNY, international factors are important. The authors also emphasize the relevance of further developing the Chinese financial markets, since most of the share in the SDR basket is due mainly to the relevance of the CNY in international trade. Fong and Wong (2020) assess the role of the Chinese Renminbi as a safe-haven in international markets in the perspective of dollar and euro-based investors. The authors compare this role against 20 currencies, including those in the SDR. They find consistency between dollar and euro-based investors in ranking the Chinese currency below the USD and the JPY, hence riskier, but above the GBP and the EUR, hence less risky.

We use a system-based model of Seemingly Unrelated Regression (SUR) and reject the hypothesis of independence of the errors across equations. Since contemporaneous correlation exists across the equations of the model, we therefore estimate the model using the feasible generalized least squares (FGLS) estimator, thereby obtaining more precise point estimates for the parameters.

Results suggest that the determinants of international bonds shares do not present a homogenous pattern. There are different impacts across currencies and, in some cases, also at different issuance regions for the same currency. Determinants such as the GDP share of a currency's country, the bilateral trade share between the currency's country and the region of the issuer, the inflation rate, the yield spread, the FDI flows, stock market capitalization, the economic policy uncertainty index, and the volatility of the currencies against the SDR basket are all found to be statistically significant. The increasing and recent use of the Chinese currency in international

trade transactions makes for an increase in the issuance of international foreign currency bonds, while the USD and the Euro are already established currencies in international transactions, reducing the need for risk-sharing since there is trust for these currencies.

In our benchmark estimated model, the CNY, the GBP, and the JPY are by far the currencies most affected by the main determinants of the model. Nonetheless, these currencies do not respond in the same way to the macroeconomic determinants. For example, CNY and JPY bonds are used for financing purposes (inflation rate), contrary to what happens to the GBP currency. But more than all other factors, of these three currencies only the CNY depends essentially on its region and continent and includes nonlinearities in the relationships (bilateral trade share, spread between bonds, and FDI flows), thereby suggesting that its role in the IMS is evolving. The GBP depends very much on the American continent and the JPY on Europe.

This work is structured as follows. In Section 2 we describe the data set and the methodology. Section 3 analyzes the empirical results of our model using the SUR methodology. Section 4 presents the conclusions.

2. Empirical Approach

In this section we describe the model as well as the data that we use in our estimations. The model includes all the determinants as defined in the literature. The list of countries is in Table A6 in the Online Appendix. For the period following the internationalization of the Renminbi and until the year right before its inclusion in the SDR basket, only a small number of countries in the world issued debt in CNY uninterruptedly for all quarters. By aggregating the countries' data at each quarter, we have time series data and not panel data. Although the first issuance occurred in 2007, between the last quarter of 2008 and the third quarter of 2009 there were no issuances. Therefore, our analysis starts in the third quarter of 2009, the date from which the CNY offshore bonds have been issued ever since. The last observation is the fourth quarter of 2015, the period in which the

IMF's Executive Board decided to include the CNY in the SDR currency basket. Finally, we use quarterly data because a higher frequency would make it impossible to use GDP and the bilateral trade share as key determinants in the model and would also cover periods in which only a few transactions had occurred. The main descriptive statistics of all variables are in Table A7 in the Online Appendix.

2.1.The Model

Our main goal is to understand if the aforementioned macroeconomic determinants affect differently the currencies of interest and across different regions, specifically the Chinese Renminbi vis-à-vis the other four currencies of the SDR basket. To do so we estimate general systems of equations with a Seemingly Unrelated Regressions (SUR) specification originally developed by Zellner (1962). The SUR model is composed of 5, 10, or 15 equations, depending on how we disaggregate the data by regions, representing the different share of international bonds for each pair of currency *c*/region *j* combinations possible (*c,j*). The shares vary through time and for the benchmark model are modelled as a SUR with 5 equations as follows:

$$log\left(\frac{Debt\ Share_{ct}}{1-Debt\ Share_{ct}}\right) = a_{c+}\,\beta_{1c}GDP\ Share_{ct} + \beta_{2cj}Trade\ Share_{c,t-1} +$$

$$\delta_{2c}Trade\ Share^2_{c,t-1} + \beta_{3c}Inflation_{c,t-1} + \beta_{4c}Spread_{ct} + \delta_{4c}Spread^2_{ct} + \beta_{5c}FDI_{ct} +$$

$$\delta_{5c}FDI^2_{ct} + \beta_{6c}Market\ Cap_{ct} + \beta_{7c}Vol_{ct} + \beta_{8c}EPU_{ct} + u_{ct} \qquad (1)$$

c = *CNY;EUR;GBP;JPY;USD;* t=*2009Q3,…,2015Q4,*

where $\delta_{2c}=\delta_{4c}=\delta_{5c}=0$ for $c\neq CNY$. In this benchmark SUR model with 5 equations we aggregate over *j*, i.e., we have worldwide $Debt\ Share_{ct}$, and the coefficients vary by currency *c*. Furthermore, to understand how the shares depend on the issuances region, we disaggregate the data by regions and also by continents. In the SUR with 10 equations we distinguish the issuances inside and outside

the region of the currency of interest, i.e., Debt Share$_{cjt}$, $j=r,nr$, where r stands for inside region and nr for outside region. With 15 equations we separate the issuances by continents, i.e., *Debt Share*$_{cjt}$, *j=America; Europe; Asia, Oceania, and Africa*. For example, *Debt Share*$_{CNY,r,t}$ represents issuances in CNY in China whereas *Debt Share*$_{CNY,America,t}$ represents the percentage of issuances in CNY from the total issuances in the American continent. The corresponding model is given by

$$log\left(\frac{Debt\ Share_{cjt}}{1-Deb\ \ Sha\ \ _{cjt}}\right) = a_{cj}\ \ \beta_{1cj}GDP\ Share_{ct} + \beta_{2cj}Trade\ Share_{cj,t-1} +$$

$$\delta_{2cj}Trade\ Share^2_{cj,t-1}\ \ + \beta_{3cj}Inflation_{c,t-1} + \beta_{4cj}Spread_{ct} + \delta_{4cj}Spread^2_{ct}\ \ +$$

$$\beta_{5cj}FDI_{ct} + \delta_{5cj}FDI^2_{ct}\ \ + \beta_{6cj}Market\ Cap_{ct} + \beta_{7cj}Vol_{ct} + \beta_{8cj}EPU_{ct} + u_{cjt} \qquad (2)$$

where, for all j, $\delta_{2cj}=\delta_{4cj}=\delta_{5cj}=0$, $c\neq CNY$. In the next Section we give more details about what we consider international bonds to be, according to the BIS definition, and from that we provide an expression for the corresponding share (the *Debt Share*). More specifically, *Debt Share* is the share of international bonds in currency *c* issued by agents in region *j* at time *t*, GDP Share is the variation in the share of the GDP of the currency *c*'s country at time *t*, *Trade Share* is the average bilateral trade share between the currency *c*'s country and the countries of the region *j* at time *t*, *Stability* is measured using two different variables: the lagged average quarterly inflation rate (*Inflation*, in percentage points) and volatility of the currency *c*'s country at time *t* against the SDR (*Vol*, in percentage points), Market Cap is the stock market capitalization share of currency *c'*s country at time *t* in the World's total stock market capitalization, *Spread* is the difference between the interest rate of the benchmark government bond of currency *c*'s country and the US government yield (in percentage points) with the same maturity, *FDI* is the Foreign Direct Investment flows in each of the currency *c*'s local economies at time *t*, and *EPU* is the Economic Policy Uncertainty Index of currency *c*'s country at time *t*. The GDP share is measured in first-differences and the FDI in flows

to guarantee that all variables in the model are weakly stationary. More details about all these variables are provided below.

The literature in international finance has discussed the issues of reverse causality and endogeneity. In the context of our topic, almost all studies find no evidence of such problems (Bobba *et al.*, 2007, Chinn and Frankel, 2007, 2008, Chitu *et al.*, 2014, and Eichengreen, Chitu, and Mehl, 2014). The only exception is Li and Zhang (2017), but even in this case the evidence is not based on a formal specific test, as in Eichengreen, Chitu, and Mehl (2014), but rather by the comparison of measures of goodness of fit.[2]

An interesting novel feature of our model is the presence of nonlinearities in the equation for the CNY currency. This is an empirical result that follows from applying the Regression Specification Test (RESET) to check for the omission of non-linear terms and thereby avoiding this sort of endogeneity in the model. For the linear model (without any squared terms) the pvalues of the RESET with two fitted terms are the following: 0.000 for the CNY, 0.790 for the EUR, 0.410 for the GBP, 0.413 for the JPY, and 0.678 for the USD. Based on these results we tested for nonlinear components in the CNY equation and found significance for the squares of Trade Share, Spread, and FDI. For this final nonlinear model all pvalues of the RESET became larger than 5%, thus giving support to the proposed functional form.[3] In terms of economic interpretation, we have a quadratic relationship between Debt Share and Trade Share, Spread, and FDI, in the CNY

[2] We considered the introduction of a dynamic term in the model (lag of the share in its own equation) but the results came out to be worse, i.e., all of the past shares are not statistically significant. The p-values of the t-test are 0.289 for the lag of the CNY share, 0.817 for the lag of the EUR share, 0.280 for the lag of the GBP share, 0.911 for the lag of the JPY share, and 0.460 for the lag of the USD share. In other words, contrary to some of the papers cited before, in our model, the shares are not persistent.

[3] For the CNY equation, the pvalue of the RESET is 0.071. Individually, the squared term has a pvalue of 0.326 and the cubed term of 0.465.

equation, with the extremes (maximum or minimum, depending on the sign of δ) at the amounts of $-\frac{\beta_h \text{CNYj}}{2\delta_h \text{CNYj}}$, $h = 2,4,5$, units, for each j.

The SUR model allows the errors to be correlated between different equations in the same period of time, that is, $E(u_{cjt}u_{klt})\neq 0$. Since our dependent variable is measured in percentages, bounded between zero and 1, and since increases in one share imply decreases in at least one of the remaining shares, the estimation method allows us to investigate the correlation and the relationship between the errors of the different shares, something we find less recommendable through individual regressions or standard panel data methods.[4] Additionally, we apply a logarithmic transformation that allows us to use standard linear SUR methods, in line with Chinn and Frankel (2008) and Bobba *et al.* (2007). Hence, the dependent variable is measured as $log(Debt\ Share_{cjt}/(1-Debt\ Share_{cjt}))$, which lies in the real line. More details are below. Because our variable of interest lies in the real line we do not consider the alternative specification of a Tobit as in Ito and Rodriguez (2015).

2.2.Data and Variables

2.2.1. Dependent Variable

The variable we model is the share of international bonds issued in a given currency. By studying the international bond market, we are essentially studying two roles of a given currency: first, the use of a currency as an investment currency, i.e., its capacity to serve as a store of value; second, the capacity of a currency to function as a unit of account, allowing agents (both private and public) to quote debt in that currency. Moreover, with a greater volume of debt in a given currency, it becomes more likely for a currency to emerge as a forex vehicle currency, contributing

[4] See Rua (2018) for an example of a work about currency demand that also uses the SUR methodology.

to the success of the currency as a medium of exchange. Therefore, by studying the issuance of international bonds we are able to cover a wider perspective that encompasses more than a single role and takes into account the private sphere of financial markets. Additionally, other arguments reveal the importance of the bond market. Mehl *et al.* (2004) argue that "with increasing capital mobility, central bank reserve holdings and interventions are smaller in volume than private transactions in international financial markets and are likely to have less bearing on a currency's international status", adding that bonds play an important role due to the size and volume of the market. Moreover, the majority of the foreign reserves held by central banks are bonds, because even though the main goal is to intervene in the exchange markets, central banks meanwhile want to get some return. As Ma and Yao (2016) state, "currency markets on their own are the largest financial markets, but currency trades typically involve bond purchases and sales. Thus, what we mean by a liquid and actively traded currency is primarily one backed by a big and liquid bond market".

The definition of what might be considered an international bond is far from being consensual. The BIS defines International Debt Securities as "debt securities issued in a market other than the local market of the country where the borrower resides. They capture issues conventionally known as Eurobonds and foreign bonds".[5] The definition we use in our work is closely related to the one used by the BIS. In the online Appendix B we explain in detail how the data was obtained.

In order to calculate a share, we take into account all international bonds issued by issuers of a specific region regardless of the currency of issuance:

$$Debt\ Share_{cjt} = (Debt_{cjt}/(\sum_{c} Debt_{cjt}) \quad (3)$$

$$c = CNY\ ;\ EUR;\ GBP;\ JPY;\ USD$$

[5] See www.bis.org/statistics/about_securities_stats.htm.

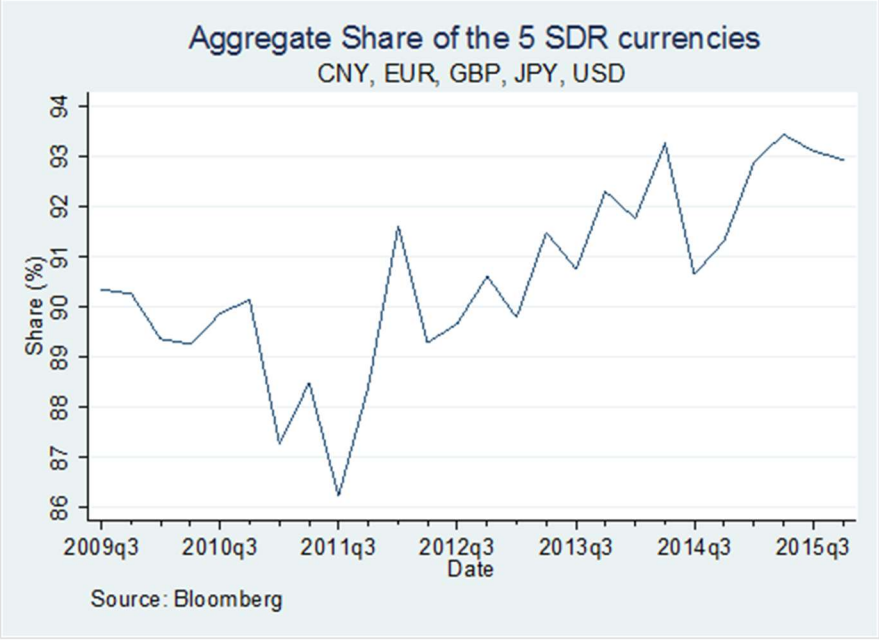
j = America; Europe; Asia, Oceania, and Africa or region; outside region

t = 2009Q3,..., 2015Q4

The full list of currencies that were used to calculate the shares can be found in Table A3, in the Online Appendix, although the value of the other currencies is very small in comparison with the five currencies mentioned. From $Debt\ Share_{cjt}$, we obtain the dependent variable, $log(Debt\ Share_{cjt})/(1\text{-}Debt\ Share_{cjt}))$, from which we distinguish the SUR models with 5, 10, and 15 equations, as explained above.

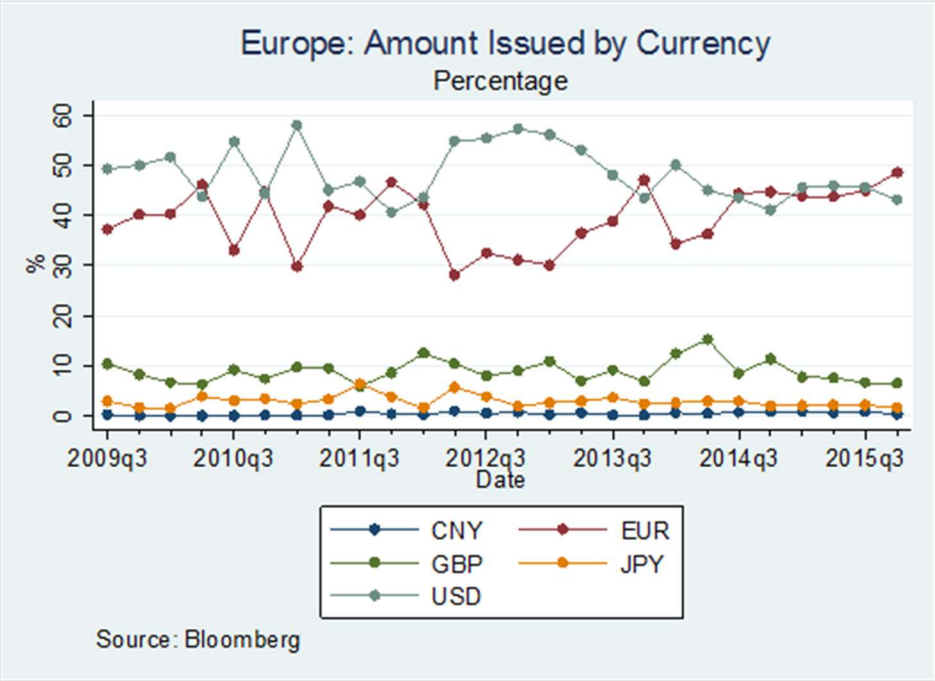
The following four figures exhibit the evolution of the shares of international bonds issued for the five currencies of our work for the aggregate share, issued by European agents, issued by American agents, and issued by A&O&A agents, respectively. The dominance of the five currencies under analysis in the international scene is evident, as seen in Figure 1. On average, 90.55% of the amount issued was denominated in one of these currencies.

FIGURE 1 - Aggregate Share of the five SDR Currencies



Despite the dominance of the five currencies, the extent of their dominance differs depending on the location of the issuer agent. Based on the ultimate parent country of risk, we consider three geographic areas: Europe, America (North, Central, and South America), and Asia plus Oceania plus Africa. Among European agents, the Dollar and the Euro were the two main currencies of issuance, representing more than 80% of the issuances among European agents, where for most of the time the dollar surpassed the euro, as seen in Figure 2 (at the end of 2015 the euro was the first-rank currency). The GBP, the JPY, and the CNY averaged 8.88%, 2.87%, and 0.38%, respectively.

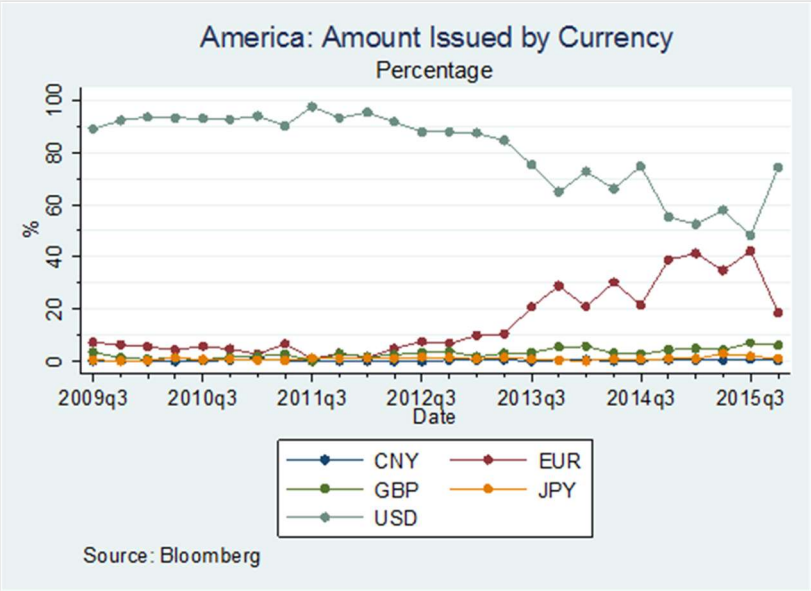
FIGURE 2 - Percentage of the Amount Issued by European Agents



Looking at international bonds issued by American agents, we can conclude that the dollar remains the main currency, despite the constant downward trend of the dollar that started in 2010 as a consequence of the increase in the share of euro-denominated international bonds among American issuers (especially in the euro-area), as seen in Figure 3. The other three currencies

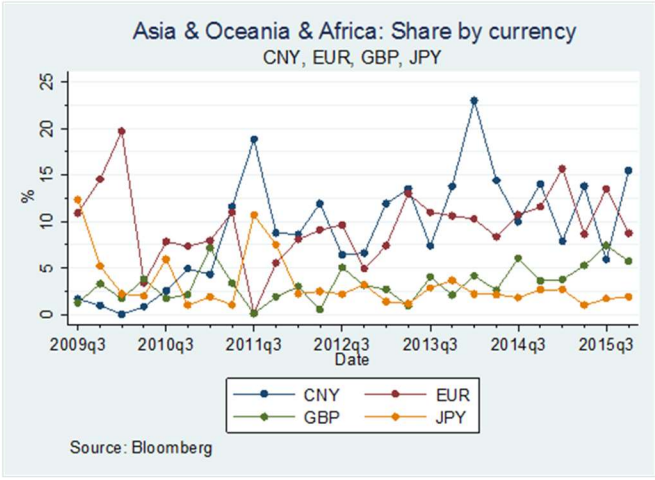
account for a tiny share of the total of international bonds issued. On average, between 2009 and 2015 the GBP, the JPY, and the CNY comprised together only 4.1% of the issuances.

FIGURE 3 - Percentage of the Amount issued by American Agents



The majority of the international debt issued by agents from Asia, Oceania, and Africa (A&O&A) is dollar-denominated, although the share has been decreasing (see Figure 4). The fall in the overall share occurred mainly due to the emergence of Renminbi-denominated international bonds.

FIGURE 4 - Percentage of the Amount Issued by Agents from A&O&A, except the USD



2.2.2. Independent Variables

In this section we describe each of the independent variables used in the model. The choice of the independent variables is supported by the literature review on the main determinants of currencies' international use. Since this work focuses on the store of value and unit of account roles of a currency, we present the economic and financial determinants identified in the literature on international currencies, focusing on the study of these roles (see the online Appendix C). Additionally, to analyze the particular dimension of international bonds we complete the list of determinants influencing international currencies with those that influence the issuance of international bonds, namely borrowing costs and hedging motives. Details can be found in Table A4 in the Online Appendix.

GDP Share In order to measure the size of the economy of currency c's country we constructed the GDP share of the G20 total GDP for each of the five economies under study. [6] The GDP share of each country is the quarterly real GDP value in USD, with 2010 as the base year. All time series with a different base year were transformed using the OECD deflator and those denominated in other currencies were transformed into dollars using the average annual exchange rate of the given currency against the dollar in the base year. The full detailed list of the GDP variables used is in Table A5. Since this time-series is non-stationary we applied first-differences (FDs) to it.

Bilateral Trade Share We produce regional data instead of country level data, since our quarterly data at a country level had a considerable number of zeros for the CNY. Therefore, in order to avoid this issue, we define three regions: Europe, America, and Asia & Oceania & Africa. The regions represent the total amount of issues from countries (firms) that belong to that specific region. The countries that are included in each region are reported in Table A6 (naturally they differ

[6] The G20 total GDP is the sum of the Real GDP of all the G20 countries, except Saudi Arabia, due to lack of data.

across currencies). For the SUR with 5, 10, and 15 equations we consider trades of the region of the currency with the rest of the world, but for robustness check, for the SUR with 15 equations we also disaggregate trade of the region of the currency with each of the three regions (Europe, America, and Asia & Oceania & Africa).

The data were collected from the bilateral trade historical series database developed by the CEPII. We take the average bilateral share of all the countries that comprise the respective regions in each currency:

$$Bilateral\ Trade\ Region_t = \frac{\sum cBilatera\ \ Trade\ Share\ Countryct}{Number\ of\ Countries} \quad (4)$$

Additionally, since the data are annual, we use the value obtained for the last quarter of the year and interpolate linearly for the remaining quarters. Following Bobba *et al.* (2007), we use lagged trade in order to avoid reverse-causality.

Stability For the inflation rate we used currency c's country's seasonally adjusted monthly year-on-year inflation rate data. Then we computed the average inflation value of the quarter using the monthly data. The last observation of the quarter was also tested instead of the averaged value.[7] Data for the UK and China had to be seasonally adjusted. The inflation rate for the currency c's country does not vary with the region. This variable is in percentage points. Inflation is lagged because the fit of all equations is better compared to having the current level of inflation in the model.

We constructed a variable defined as volatility against the SDR by collecting data for the monthly exchange rates of each currency against the SDR basket, from which we calculated the

[7] We tested models with both averaged value and using the last observation of the quarter and the results had no significant differences.

quarterly standard deviation (volatility), using the IMF International Financial Statistics. As is the Inflation Rate, this variable is in percentage points.

Financial Markets Development We use stock market capitalization data produced by Bloomberg to create shares for each of the currency c's countries. As a denominator we use the World stock market capitalization, also produced by Bloomberg. For the Eurozone we compute the sum of the stock market capitalization for each of the 19 countries of the Euro Area.

Policy Control We use the Economic Policy Uncertainty (EPU) index as a proxy for a policy control variable. We take the data for our countries/regions from www.policyuncertainty.com, which constructs these indexes based on research by Arbatli *et al.* (2022) and Baker *et al.* (2016). The indexes have a monthly frequency, which we turned into a quarterly frequency by averaging the months. A high value for this index means that policy uncertainty is high.

Borrowing Costs In order to analyze borrowing costs, we use 5-year government bond yields of each of the currencies' countries and compute their differences against the US Government bonds. In the case of the USD, the spread between German Bonds and US Government Bonds is used. This variable is in percentage points.

Hedging Motives We decided to use a variable that could enable us to test the existence of hedging motives at the aggregate level. Our choice was to include the first differences of the foreign direct investment (FDI) stock, i.e., the FDI flows, in the currency's country. We seasonally adjusted the data and used the first differences of FDI stock to have stationarity of the observed series.

3. Results

In this section we present the results derived from the several estimated SUR models. In Table 1 we have the 5-equations benchmark SUR model (Model 1) of the shares of international bonds per currency without any disaggregation per regions; in Table 2, a 10-equations SUR model per currency and two regions (Model 2), the one in which the currency belongs and all the other regions

in the world; in Tables 3 and 4, a 15-equations model per currency and three regions (Europe, America, and Asia&Oceania&Africa) in which for Table 4 we consider the bilateral trade share disaggregated by each of these three regions as well (Models 3 and 4, respectively). The estimations were adjusted for small samples using STATA options.

We present some SUR model specification results and the estimated deterministic components before we compare the determinants of the CNY with the determinants of the other four currencies. The first important specification result is that we clearly reject the null hypothesis of no contemporaneous cross-equation correlations between errors. All the Breusch-Pagan tests of independence have pvalues less than 5% (Model 1 is 0.018, Model 2 is 0.019, Model 3 is 0.000, and Model 4 is 0.000). For most of the cases the USD and the EUR residuals possess the largest amount of correlation. These two main currencies at the international level present negative correlations of -0.559 in Model 1, and -0.748 and -0.776 in Models 3 and 4, respectively, among European issuers. In Model 2, the largest correlation is between CNY and GBP in all regions other than the one to which the currency belongs (-0.520).

In general, the R-squared of each SUR equation is quite large, varying from 0.596 (GBP) to 0.967 (CNY) in Model 1; 0.484 (EURr) and 0.916 (CNYr) in Model 2; 0.284 (GBPas) and 0.927 (CNYas) in Model 3; and 0.288 (GBPas) and 0.923 (EURam) in Model 4. The models perform most poorly, in terms of fit, in the case of the GBP. Moreover, the GBP presents one equation (Asia&Oceania&Africa) that is overall nonsignificant, in Models 3 and 4, as well as CNY in America. Additionally, the standard F-type results strongly indicate the existence of heterogeneity across coefficients. In all specifications the estimated joint impact of the explanatory variables across currency shares differs statistically (all pvalues equal to zero). Moreover, individual impacts of any particular covariate across currency shares also differ statistically (pvalues smaller than 0.05,

except for GDP Share and Volatility against the SDR currencies, which are significant for a 10% level). These results demonstrate and justify the relevance of using a SUR specification.

We included quarter time dummies in order to understand if the shares of the international bonds are influenced by seasonality. GBP in the third quarter (fewer shares, compared to the other quarters) and the JPY in the second (larger shares, compared to the other quarters) present statistically significant seasonal dummies. Additionally, we tested dummies for the first quarter of 2011 and 2012 for issuances from European Agents for all of the five currencies under study because the graphs presented spike at those dates. However, none of the dummies ended up being statistically significant. Moreover, because of the rise of China as one of the world's largest exporters in the five-year period that preceded the review, we constructed a dummy variable that takes the value of 1 for all quarters in the years 2011, 2012, 2013, 2014, and 2015. The introduction of this variable turned out to be not statistically significant in all five equations: pvalues of the t-tests of 0.161 for CNY, 0.364 for EUR, 0.958 for GBP, 0.747 for JPY, and 0.141 for USD.

3.1.The Benchmark Model

In this section we mainly discuss similarities (and differences) between determinants for the CNY and the other four currencies. Our estimated worldwide benchmark model is presented in Table 1. We present two sensitivity analyses in the online Appendix D.

Table 1. SUR Model of the Shares of International Bonds *per* Currency

	CNY	EUR	GBP	JPY	USD
GDP	-48.959	31.541	885.09**	73.956***	8.241
	(163.159)	(57.436)	(413.826)	(18.559)	(20.956)
L.Trade	2541.554***	-9.069	-139.351**	143.248**	21.827
	(576.534)	(17.589)	(59.495)	(68.043)	(70.760)
L.Trade_Sq	-23066.04***				
	(5501.716)				
L.Infl	0.211***	0.046	-0.147**	0.154***	-0.015
	(0.066)	(0.114)	(0.069)	(0.037)	(0.027)
Spr	1.245**	-0.302	-0.741*	-0.057	0.021
	(0.588)	(0.216)	(0.406)	(0.090)	(0.089)
Spr_Sq	-0.303**				
	(0.148)				
FDI	-0.070***	4.09e-04	0.020*	-0.040**	-2.74e-04
	(0.010)	(1.27e-03)	(0.010)	(0.010)	(1.99e-04)
FDI_Sq	4.51e-4**				
	(1.80e-4)				
MCap	17.647***	-3.469	74.262**	0.654	-2.260
	(6.019)	(9.470)	(30.412)	(9.649)	(2.770)
Vol	0.678	-10.332	-5.961	-0.062***	9.270**
	(1.602)	(7.427)	(13.113)	(0.023)	(3.753
EPU	-0.008***	-0.064	0.0006	0.005***	0.001
	(0.002)	(0.102)	(0.001)	(0.001)	(0.0008)
Q2				0.330***	
				(0.090)	
Q3			-0.290**		
			(0.119)		
C	-72.434***	6.609	-4.716**	-7.266***	0.550
	(14.625)	(11.563)	(1.896)	(1.553)	(4.605)
Rsq	0.967***	0.722***	0.596***	0.804***	0.849***

NOTES: Standard errors in parentheses; C is the constant; Q2 and Q3 are dummies for quarters 2 and 3, respectively; Rsq is the equation R-squared; ∗,∗∗, ∗∗∗ stands for statistically significant at 10%, 5%, 1% levels, respectively.

The significance of a negative quadratic term in the CNY estimation, means that the relationship between lagged bilateral trade and the share of CNY in foreign currency debt presents an inverted U-shape, i.e., is non-linear. This means that the relationship between lagged bilateral trade share and the share of CNY foreign debt is positive up until a certain value of the lagged bilateral trade share (the estimated maximum is 0.055) and negative thereafter. Thus, an increase in the bilateral trade share, after some level, reduces the need to issue in Renminbi-denominated

international bonds, showing that the Chinese economy already has its currency widely used in international trade and financial transactions in the IMS, which is a relationship also found by Ito and Rodriguez (2015) regarding other currencies. In the data the bilateral trade share became larger than 0.055 in 2014 and 2015. The lagged bilateral trade share presents a positive sign for the Japanese currency, supporting previous empirical evidence that an increase in trade leads to an increase in bonds, due to a risk sharing perspective (Bobba *et al.*, 2007; Chinn and Frankel, 2007, 2008; Eichengreen *et al.*, 2016; Eichengreen and Lombardi, 2017), but it is negative for the GBP.

Regarding lagged inflation, the CNY and the JPY present significant positive signs. Bobba *et al.* (2007) also found a positive (and significant) effect of inflation on international bonds, for developed countries. Although inflation undermines a currency's value, higher inflation levels can benefit the share of bonds issued in that currency, since it diminishes the real value of the debt. This means that these currencies are used with financing purposes. For the GBP, lagged inflation presents a negative sign, which means that it influences negatively the value of the GBP as a store of value, as also found in Chinn and Frankel (2007), which reflects the role of international bonds issued in GBP as financial assets.

The relationship between the share of foreign-debt denominated in CNY and the spread between the returns of Chinese and US government bonds is once again a non-linear relationship, also with a negative quadratic term, which means that the relationship becomes negative only after a certain value for the spread (the estimated maximum is 2.051). Before that the value is positive (the observed spreads are smaller than around 2 until mid-2011 and in 2015). This non-linear relationship means that up to a certain spread, the bonds are considered a financial asset, and thereafter are used for hedging against risk. For the GBP this relationship is negative, signaling a hedge function of the foreign-debt bonds denominated in GBP.

Relative to FDI flows, in the case of the CNY, we have again a non-linear relationship, but this time a U-shape, which means that the relationship between FDI flows and the share of CNY foreign debt is negative up until a certain rate of FDI flows and positive thereafter. The estimated minimum is 80.470 and in the sample we observe values that range from 5.858 to 81.408. Therefore, we expect a non-linear and almost always decreasing relationship (only in 2013Q4 do we observe an FDI flow greater than 80.470). This evidence seems to point to a role of foreign-debt bonds denominated in CNY as a financial asset mostly. The JPY presents a negative relationship, while for the GBP it is positive.

Market capitalization always presents a positive sign when significant, for the CNY and the GBP, which is according to the literature, reflecting the complementarity between different financial assets (international bonds and the stock market).

Concerning the policy control variable, the EPU presents a negative relationship in the case of the CNY, which is according to theory, and a positive one in the case of the JPY.

In sum, after the inclusion of the Renminbi in the IMS, this is the currency most affected by the main determinants under study, followed by the GBP and the JPY, the two currencies with smaller shares. As the Renminbi is a new currency in the IMS, the presence of nonlinearities indicates that its role is evolving. The estimation for the EUR does not present any significant determinant and for the USD, only volatility of the USD against the SDR currencies is a significant determinant, with a positive sign. These last two currencies have the biggest weights in the SDR basket.

3.2. Analysis by Regions

In Table 2 we report the disaggregation of the currencies between the region in which they belong and all other regions. The signs of the variables that were already significant in Table 1 remain the same, revealing the coherence of the aggregated results and allowing us to better

understand from where they occur: inside or outside the region. Based on Table 2, we focus the analysis on the cases in which there is statistical significance for the CNY currency.

Table 2. SUR Model of the Shares of International Bonds *per* Currency and Two Regions

	CNYr	CNYnr	EURr	EURnr	GBPr	GBPnr
GDP	-694.213	683.221**	40.590	-242.496**	803.158**	518.667
	(484.790)	(322.967)	(78.966)	(101.756)	(386.144)	(1191.386)
L.Trade	3260.129**	1286.647	42.427**	-91.037***	-108.849*	-400.880**
	(1591.245)	(1050.258)	(20.695)	(25.472)	(62.942)	(188.721)
L.Trade_Sq	-30308.62**	-11464.73				
	(15200.58)	(10039.46)				
L.Infl	0.236	-0.061	0.006	-0.825***	0.037	-0.554**
	(0.192)	(0.129)	(0.143)	(0.172)	(0.077)	(0.225)
Spr	6.707***	1.927*	-0.316	0.767**	-0.445	-1.967*
	(1.708)	(1.129)	(0.259)	(0.314)	(0.375)	(1.130)
Spr_Sq	-1.687***	-0.560**				
	(0.423))	(0.280)				
FDI	-0.500	-0.100	2.16e-03	-8.53e-03***	0.010*	0.040
	(0.300)	(0.200)	(1.45e-03)	(1.85e-03)	(0.010)	(0.030)
FDI_Sq	3.74e-03	9.07e-04				
	(2.64e-03)	(1.72e-03)				
MCap	35.785*	5.778	-6.984	-35.820**	24.003	176.532*
	(18.631)	(12.921)	(11.476)	(14.737)	(31.318)	(95.197)
Vol	-0.206	6.136**	-14.964*	-25.846**	-7.629	-10.907
	(4.463)	(2.939)	(8.751)	(10.951)	(12.703)	(38.280)
EPU	-0.012**	0.003	-0.037	-0.494***	-0.001	0.003
	(0.005)	(0.003)	(0.120)	(0.157)	(0.001)	(0.003)
Q2						
Q3					-0.207*	-0.632*
					(0.109)	(0.328)
C	-80.958*	-42.980	-2.441	63.177***	-2.759	-7.23
	(41.496)	(27.515)	(13.438)	(17.760)	(2.030)	(6.076)
Rsq	0.916***	0.634***	0.484**	0.895***	0.515**	0.578***

NOTES: See Table 1. "r" is inside region; "nr" is outside region

Table 2. SUR Model of the Shares of International Bonds *per* Currency and Two Regions (cont.)

	JPYr	JPYnr	USDr	USDnr
GDP	70.873	48.514**	-42.551	6.916
	(60.500)	(24.055)	(37.238)	(28.584)
L.Trade	-207.276	188.33**	-129.9	-109.643
	(200.778)	(77.796)	(132.369)	(97.853)
L.Infl	0.095	0.161***	0.085	-0.130**
	(0.115)	(0.044)	(0.074)	(0.053)
Spr	(0.289)	-0.060	0.276*	-0.168
		(0.113)	(0.155)	(0.115)
FDI	9.46e-03	-0.050**	-1.11e-03***	1.16e-04
	(0.050)	(0.020)	(4.19e-04)	(3.03e-04)
MCap	-13.057	13.915	-11.083**	0.350
	(30.163)	(11.917)	(4.875)	(3.731)
Vol	0.038	-0.075***	14.824**	-1.457
	(0.0069)	(0.027)	(7.023)	(5.361)
EPU	0.002	0.004**	0.001	-0.002**
	(0.004)	(0.002)	(0.001)	(0.001)
Q2	-0.333	0.471***		
	(0.281)	(0.111)		
Q3				
C	-0.684	-9.249***	11.634	4.857
	(4.605)	(1.797)	(8.522)	(6.346)
Rsq	0.654***	0.820***	0.910***	0.740***

NOTES: See Table 1. "r" is inside region; "nr" is outside region

Regarding the currencies in their own regions, the relationship of the lagged bilateral trade share with the share of international bonds is nonlinear for the CNY and comes from its own region. The quadratic relationship has an estimated maximum of 0.053, which is about the same as in Table 1. For the EUR this relationship is positive, which is natural considering that in the Eurozone an increase in the bilateral trade share increases the share of international euro-denominated bonds because that region almost coincides with the European Continent itself. However, for the GBP, which is usually used as a financial asset, the corresponding sign is negative.

Regarding the spread, the CNY presents a nonlinear relationship in its own region and outside the region (estimated maximums of 1.987 and 1.720, respectively), presenting a change in the role of international bonds from a financial asset to a hedge against risk product. The spread has a

positive relationship with the international bond share for the JPY and the USD, reflecting the roles of the international bonds as financial assets for these regions.

Market capitalization presents a positive significant sign for the CNY, representing complementarity between these two assets, while for the USD the significant sign is negative, reflecting a possible substitutability, in their own regions. The policy control variable, i.e., the Economic Policy Uncertainty index, obtains a significant negative sign only in the region of the CNY.

Concerning the determinants outside the currencies' regions, we find the following for the GDP share: the relationship for the CNY and JPY is positive whereas for the EUR it is negative. The EUR region (Eurozone) is one of the largest economies in the world, which gives this region a higher probability of being able to issue debt in its own currency, i.e., it is less reliant on other major foreign currencies.

The spread shows for the CNY, as in the case of its own region, a non-linear relationship. The EUR presents a positive sign and the GBP a negative one, giving evidence of different roles in the markets outside their regions, financial asset and hedge against risk, respectively. Volatility of the CNY against the remaining SDR's currencies has a positive sign outside its region, while it is negative for the EUR and the JPY.

The CNY seems to be most affected by the main determinants under study, but more in its region than outside of its region, as well as the USD. On the contrary, the EUR, the GBP, and the JPY seem to be most affected outside their own regions, although for the GBP the difference is not as notable as for the other two currencies.

3.3.Analysis by Continents

Tables 3 and 4 present the estimation results for the five currencies divided by the American, European, and Asia&Oceania&Africa continents. The results in Tables 3 and 4 are very similar

(when the same determinants are statistically significant). Again, we discuss only the cases of significant determinants of the CNY vis-à-vis other currencies.

Table 3. SUR Model of the Shares of International Bonds *per* Currency and Three Regions

	CNYam	CNYe	CNYas	EURam	EURe	EURas	GBPam
GDP	916.156	410.155	-76.331	-80.070	14.148	69.16	1090.426
	(955.487)	(317.143)	(132.582)	(96.290)	(47.423)	(181.870)	(969.883)
L.Trade	2286.213	939.403	2116.541***	-186.996***	34.701**	17.833	-506.317***
	(3371.958)	(1110.029)	(458.837)	(26.902)	(14.215)	(45.904)	(155.093)
L.Trade_Sq	-20394.25	-7931.928	-19183.62***				
	(32198.42)	(10615)	(4395.362)				
L.Infl	-0.367	0.134	0.317***	-1.155***	0.109	-0.514*	-0.573***
	(0.402)	(0.130)	(0.054)	(0.169)	(0.098)	(0.298)	(0.181)
Spr	2.401	5.015***	-0.593	0.875***	-0.518***	0.855	-1.877*
	(3.404)	(1.120)	(0.450)	(0.325)	(0.183)	(0.565)	(0.980)
Spr_Sq	-0.739	-1.212***	0.141				
	(0.852)	(0.279)	(0.112)				
FDI	0.070	-2.31e-03	-0.020*	-6.06e-03***	2.09e-03**	-0.010***	0.040*
	(0.100)	(0.030)	(0.010)	(1.87e-03)	(9.61e-04)	(3.26e-03)	(0-020)
FDI_Sq	1.53e-03	-5.14e-05	4.33e-05				
	(1.04e-03)	(3.27e-04)	(1.33e-04)				
MCap	2.187	12.254	11.475**	-29.914*	7.736	-80.719***	169.392**
	(37.391)	(12.602)	(5.067)	(15.229)	(7.504)	(27.882)	(82.405)
Vol	7.121	4.496	-0.133	2.959	2.936	-54.692***	10.973
	(9.298)	(3.043)	(1.227)	(10.924)	(5.476)	(18.150)	(28.636)
EPU	0.008	0.002	-0.007***	-0.326**	0.118	-1.010***	0.003
	(0.012)	(0.003)	(0.001)	(0.163)	(0.078)	(0.286)	(0.002)
Q2							
Q3							-0.780***
							(0.266)
C	-74.940	-40.052	-58.721***	58.184	-17.801**	107.966***	-4.135
	(85.534)	(28.277)	(11.656)	(18.556)	(8.712)	(32.408)	(4.686)
Rsq	0.364	0.907***	0.927***	0.925***	0.405***	0.544***	0.634***

NOTES: See Table 1. "am" is America; "e" is Europe; "as" is Asia&Oceania&Africa

Table 3. SUR Model of the Shares of International Bonds *per* Currency and Three Regions (cont.)

	GBPe	GBPas	JPYam	JPYe	JPYas	USDam	USDe	USDas
GDP	526.236*	1493.216	49.915	76.064***	53.677	-7.701	-49.636	79.178*
	(308.874)	(1145.018)	(58.294)	(21.567)	(60.851)	(79.635)	(30.647)	(45.169)
L.Trade	-85.946*	-63.932	-506.073**	478.061***	-143.800	-161.776	-130.494	93.287
	(46.367)	(176.486)	(224.225)	(81.871)	(223.237)	(261.317)	(104.820)	(158.136)
L.Infl	-0.019	-0.550***	-0.006	0.303***	-0.042	0.202*	-0.081*	0.050
	(0.053)	(0.218)	(0.120)	(0.045)	(0.121)	(0.105)	(0.041)	(0.061)
Spr	-0.405	-0.437	1.310***	-0.322***	0.147	-0.007	-0.159	0.383**
	(0.302)	(1.149)	(0.302)	(0.113)	(0.298)	(0.333)	(0.143)	(0.190)
FDI	-6.71e-04	0.010	-0.080	-0.050**	0.010	-1.49e-03**	-1.89e-04	-4.72e-04
	(8.37e-03)	(0.030)	(0.050)	(0.020)	(0.050)	(7.33e-04)	(3.11e-04)	(4.51e-04)
MCap	57.085**	107.744	21.925	30.417***	-6.054	-16.085	-0.959	-7.666
	(24.679)	(91.605)	(30.429)	(10.923)	(31.284)	(9.925)	(4.104)	(6.029)
Vol	-19.624**	-9.859	0.113	-0.168***	0.067	-2.027	1.723	-6.241
	(8.950)	(35.277)	(0.075)	(0.029)	(0.076)	(14.486)	(5.655)	(8.368)
EPU	-0.0004	-0.0002	-0.006	0.006***	0.013**	0.003	0.0002	0.003**
	(0.0008)	(0.003)	(0.005)	(0.001)	(0.005)	(0.003)	(0.001	(0.001)
Q2			0.752***	0.453***	-0.631**			
			(0.279)	(0.097)	(0.293)			
Q3	-0.137*	-0.127						
	(0.081)	(0.324)						
C	-3.833***	-7.526	4.170	-15.013***	-2.093	19.218	7.643	-0.331
	(1.45)	(5.505)	(5.030)	(1.824)	(5.052)	(16.871)	(6.811)	(10.182)
Rsq	0.464***	0.284	0.588***	0.812***	0.562***	0.864***	0.406*	0.537***

NOTES: See Table 1. "am" is America; "e" is Europe; "as" is Asia&Oceania&Africa

First, we analyze the CNY in its own continent (in this case the A&O&A) in comparison with the other currencies in their own continents as well. Results for the lagged bilateral trade share, market capitalization, and the Economic Policy Uncertainty index are the same as in the last section. In addition to these results, new determinants become significant when we consider A&O&A. The relationship between the lagged inflation rate and the international bond share is positive for both the CNY (as it was in the benchmark model) and the USD in their respective continents. Regarding FDI flows, the relationship is negative for the CNY and the USD, but positive for the EUR.

Next, we turn to the analysis of each currency (except the USD) in the American continent. Since we are always comparing the CNY with other currencies, we can see in Tables 3 and 4 that for this currency there is no significant determinant. This is not the case for the European continent,

for which Tables 3 and 4 report a positive sign for the GDP share, a nonlinear relationship for the spread, and a positive sign for the volatility against the SDR currencies, as we have seen in Table 2. These are the same results we have obtained in Table 2, which seems to indicate that the European continent is more important for the share of CNY bonds than the American continent.

Tables 3 and 4 allow us to further identify the continents that have more significant determinants impacting each share of international bonds. Once again, for the CNY the "regional" factor (A&O&A continents) is very important, with a few in the European continent and none in the American continent. The EUR has more significant determinants in the American continent, followed by the A&O&A. For the GBP there are more significant determinants in the American continent, followed by Europe. For the JPY the difference between the European continent and the other continents is very significant, with the European continent occupying a very strong role in explaining its international bond share. For the USD, the A&O&A and the American continents are the ones with more significant determinants, although the determinants differ.

Table 4. SUR Model of the Shares of International Bonds *per* Currency and Three Regions (also in Bilateral Trade Share)

	CNYam	CNYe	CNYas	EURam	EURe	EURas	GBPam
GDP	686.975	578.839*	-144.548	-127.085	3.607	-2.287	1361.471
	(966.917)	(320.666)	(132.218)	(90.837)	(50.935)	(184.430)	(1361.471)
L.Trade	-1068.199	1248.337	1347.123***	-171.460***	27.256	4.930	-977.606***
	(13478.29)	(1052.923)	(277.521)	(23.483)	(16.616)	(46.629)	(312.996)
L.Trade_Sq	23074.6	-29763.13	-7358.194***				
	(243891.1)	(28632.38)	(1597.114)				
L.Infl	-0.219	0.143	0.300***	-1.161***	0.049	-0.554**	-0.493***
	(0.392)	(0.121)	(0.056)	(0.171)	(0.110)	(0.280)	(0.183)
Spr	5.212	5.387***	-0.446	1.136***	-0.320*	0.899	-2.316**
	(3.193)	(1.009)	(0.460)	(0.355)	(0.190)	(0.590)	(1.006)
Spr_Sq	-1.337	-1.269***	0.110				
	(0.816)	(0.262)	(0.115)				
FDI	-0.070	-1.34e-04	-0.020	-5.17e-03***	1.90e-03*	-0.010***	0.040*
	(0.100)	(0.030)	(0.010)	(1.77e-03)	(1.03e-03)	(3.40e-03)	(0.020)
FDI_Sq	1.47e-03	-6.55e-05	2.44e-05				
	(1.06e-03)	(3.20e-04)	(1.39e-04)				
MCap	12.596	15.008	13.775**	-27.217*	-0.443	-72.809**	239.244***
	(29.806)	(9.685)	(5.665)	(14.319)	(8.558)	(29.085)	(88.846)
Vol	4.868	4.900*	-0.578	4.415	3.274	-53.893***	7.557
	(9.003)	(2.955)	(1.260)	(10.092)	(6.052)	(19.259)	(30.135)
EPU	0.006	0.0009	-0.007***	-0.301*	0.026	-0.923***	0.003
	(0.013)	(0.004)	(0.001)	(0.163)	(0.084)	(0.301)	(0.002
Q2							
Q3							-0.886***
							(0.280)
C	-3.199	-26.316***	-62.157***	40.052**	-8.219	100.252***	-12.620***
	(182.344)	(8.909)	(11.802)	(17.819)	(9.909)	(33.011)	(4.606)
Rsq	0.327	0.904***	0.922***	0.923***	0.360*	0.535***	0.651***

NOTES: See Table 1. "am" is America; "e" is Europe; "as" is Asia&Oceania&Africa

Table 4. SUR Model of the Shares of International Bonds *per* Currency and Three Regions (also in Bilateral Trade Share) (cont.)

	GBPe	GBPas	JPYam	JPYe	JPYas	USDam	USDe	USDas
GDP	411.427	1658.316	84.935	26.139	35.181	-2.611	-39.952	50.839
	(320.081)	(1207.31)	(62.706)	(28.181)	(60.624)	(70.716)	(30.840)	(41.173)
L.Trade	-98.249*	44.841	-169.625	949.498***	-122.680	84.540	-34.339	-16.263
	(51.589)	(110.625)	(228.428)	(338.568)	(100.528)	(117.795)	(100.842)	(46.969)
L.Infl	-0.003	-0.521**	0.159	0.236***	-0.083	0.291***	-0.047	0.022
	(0.056)	(0.210)	(0.107)	(0.063)	(0.113)	(0.093)	(0.039)	(0.060)
Spr	-0.481	-0.708	0.974***	-0.138	0.231	-0.083	-0.238*	0.494**
	(0.328)	(1.173)	(0.296)	(0.155)	(0.293)	(0.305)	(0.133)	(0.200)
FDI	-5.77e-03	8.41e-03	-0.090	-0.060**	0.0100	-2.94e-04	1.18e-04	-8.52e-04**
	(8.67e-03)	(0.030)	(0.060)	(0.030)	(0.050)	(1.22e-03)	(4.58e-04)	(3.96e-04)
MCap	51.414**	99.187	42.405	10.777	-10.551	-19.966*	1.945	-9.445
	(25.411)	(92.924)	(34.073)	(14.780)	(31.440)	(10.386)	(4.349)	(6.057)
Vol	-22.642**	-24.944	0.067	-0.147***	0.079	2.298	-1.225	-4.464
	(10.246)	(34.716)	(0.079)	(0.038)	(0.076)	(13.101)	(5.977)	(8.018)
EPU	-0.0004	-0.0007	-0.008	0.011***	0.013**	0.0002	0.0006	0.003*
	(0.0009)	(0.003)	(0.005)	(0.002)	(0.005)	(0.003)	(0.001)	(0.001)
Q2			0.819***	0.307**	-0.647**			
			(0.310)	(0.141)	(0.293)			
Q3	-0.169*	-0.156						
	(0.092	(0.333)						
C	-2.249	-8.451	-3.185	-12.364***	-0.001	1.135	0.126	6.839*
	(1.798)	(5.267)	(5.384)	(2.890)	(4.609)	(11.799)	(3.080)	(3.781)
Rsq	0.435***	0.288	0.545***	0.759***	0.542***	0.863***	0.383	0.506***

NOTES: See Table 1. "am" is America; "e" is Europe; "as" is Asia&Oceania&Africa

3.4.Discussion

In this section we discuss the main results of the previous subsections, focusing on the general behavior of the determinants, which help to explain the role of the new player Renminbi in the international bond market vis-à-vis the other four currencies in the SDR basket.

The GDP share and the lagged bilateral trade shares are proxies for the size of the economy. Regarding the GDP share, the CNY, just like the GBP and the JPY, behaves like a small currency, relying on foreign currency denominated debt. The size of the Euro Area economy seems to be reducing the need for foreign international currency bonds denominated in EUR. Regarding the lagged bilateral trade share, the nonlinearity implies that the role of the CNY, especially in terms

of international trade, is evolving, although it is still mostly at the regional level. At some point an increase in the lagged bilateral trade share reduces the need to issue in Renminbi-denominated international bonds, showing that the Chinese economy already has its currency widely used in international trade and financial transactions in the IMS, which is a relationship also found by Ito and Rodriguez (2015) regarding other currencies. The JPY presents a positive sign, also for outside its region (Europe). For the GBP all estimations deliver a significant negative sign. For the case of the EUR we confirm a positive result for its own region and continent, but outside its region (America) the sign is negative. In fact, this negative relationship is extended to the GBP and the JPY. It seems that when these countries/regions trade more with the USA, the need to issue international bonds in their currencies diminishes, implying that the USD is still the most important vehicle currency of the IMS. A positive impact of lagged bilateral trade share on foreign currency bonds is also reported in previous empirical literature (Chinn and Frankel, 2007, 2008; Bobba *et al.*, 2007; Ito and Rodriguez, 2015, Eichengreen *et al.*, 2016, Eichengreen and Lombardi, 2017).

The lagged inflation rate and the volatility against the SDR are used as measures of currency stability. Concerning lagged inflation rate, the CNY's (aggregated sample and in Asia&Oceania&Africa), the JPY's (aggregated sample and outside its region, in Europe), and the USD's (America) foreign-currency denominated bonds seem to be used with a financing purpose, since the coefficients for these three currencies exhibit a positive sign. That is, inflation reduces the value of the debt issued in these currencies and because of that, foreign-currency denominated debt increases, a result also found by Bobba *et al.* (2007). The reverse happens for the EUR and the GBP outside the European continent, as well as for the USD outside the American continent (in Europe), where the negative sign implies that investors are concerned about the erosion of the currencies' value, treating those bonds as a financial asset. An interesting conclusion arises for the USD. The dollar-denominated international bonds are used for different purposes inside and

outside the American continent: for financing purposes in the American continent and having an investment role (financial asset) in non-USD regions. For the volatility against the SDR, the positive sign for CNY (in Europe) and also for the USD (aggregated sample and its region) seems to indicate speculation motives. For the other three currencies it is according to the behavior of risk-averse economic agents.

The spread of government bonds yields (proxy for interest rate differentials) and the FDI flows (proxy for hedging motive) are factors that influence currency choice in debt issuance. Regarding the spread, we can conclude that the CNY (aggregated sample and in Europe) is used as an asset for small values of the spread (positive relationship), although for large ones this role changes, so the issue of international bonds for this currency can be made to reduce borrowing costs (negative relationship). The nonlinearity is supported by Cerutti and Obstfeld (2018), who conclude that in terms of financial stability, there is a long way to go before China can claim to be a stable financial market. The GBP is used for reducing borrowing costs, while for the other three currencies, their roles change according to the continent.[8] The nonlinear relationship between FDI flows and the international foreign currency-denominated bonds for the CNY is such that hedging is not yet a concern, especially in the Asia&Oceania&Africa continents. According to information from the Ministry of Commerce of the People's Republic of China, among the biggest FDI investors to China are Hong Kong S.A.R., Taiwan Province, and Singapore. [9] Most of the FDI from these regions is considered to be "round tripping", i.e., investment from Chinese domestic residents who want to receive incentives available only to foreign investors, but also from other countries and from

[8] For the EUR, the JPY, and the USD, in the European continent the spread is used with the goal of reducing borrowing costs; for the EUR in America and the USD in the American and the Asia&Oceania&Africa continents, the spread is used as an investment decision tool (hence, these currencies are used as financial assets).
[9] See http://english.mofcom.gov.cn/article/statistic/foreigninvestment/201801/20180102693997.shtml.

Taiwan and Singapore, which use Hong Kong intermediaries (Graham and Wada, 2001). For these investors hedging is not a priority. For the FDI flows, we claim that only for the GBP (aggregated sample, its own region, and in the American continent), and the EUR (for European issuers) is hedging against future risks a concern. In all other situations hedging is not a concern.

The stock market capitalization represents financial market development. Results for the CNY (aggregated sample, its own region, and in the Asia&Oceania&Africa continents) show that the Chinese stock market is already seen as a complement for foreign currency-denominated international bonds, at least at the regional level. Fatum *et al.* (2017) state that although the Chinese stock market is the second largest in the World, the Chinese currency has not yet achieved safe haven status, due to some restrictions in capital mobility. We also conclude that the European (especially for investors outside the European continent) and American stock markets (especially in the America continent) are good substitutes for issuing foreign currency-denominated international bonds in these currencies, while the UK and Japanese (in Europe) stock markets are seen as complements of the foreign currency-denominated bonds in their currencies.

Regarding the policy control variable, the EPU, while for the CNY (aggregated sample and in the Asia&Oceania&Africa continents), and the EUR (outside its region) the sign is the expected one (negative), for the JPY (aggregated sample and the European and Asia&Oceania&Africa continents) the sign is positive, contrary to the findings reported in the literature.

In sum, after the inclusion of the Renminbi in the IMS, this is the currency most affected by the main determinants under study, but more in its region/continent than outside of its region/continent, followed by the GBP and the JPY, the two currencies with the smallest shares. The Renminbi a new currency in the IMS and the presence of nonlinearities indicates that its role is evolving. In fact, during the period under analysis the CNY changed from the typical behavior of a new currency to an established currency (when we analyze the impact of the lagged bilateral

trade share),and changed from being demanded as a financial asset to financing purposes (responding to lagged inflation, spread, and FDI flows). Apart from the (non)linearities, the currency that seems to be the closest in behavior to CNY is the JPY. The evolving trajectory of the CNY is reflected in terms of its current weight in the SDR basket, being the currency with the third greatest weight.

4. Conclusion

The CNY is now considered a "free usable" currency by the IMF. How much this currency will be used outside its borders is still uncertain. However, according to the data that we collected, the CNY was able, after only a few years of its introduction in the international markets, to be the second most used currency -- after the USD -- among issuers from Asia&Oceania&Africa. Offshore bonds denominated in CNY appeared in 2007 and since then the IMS seems to be in a continuous process of adaptation to the internationalization of the Renminbi. As proof of that, the CNY is now part of the SDR basket with the third greatest weight, after the USD and the EUR.

We constructed a detailed database on international bond issuances for the five currencies of the SDR basket in the period prior to the inclusion of the Chinese Renminbi. Our aim with this database was to study the determinants of currency shares in international bond markets and their impact on the five currencies considered. We want to assess how the main determinants for the CNY internationalization compare with those for the four SDR currencies in the period studied. Specifically, we analyze the CNY situation in terms of macroeconomic determinants, vis-à-vis the other four currencies in the international context, before the inclusion in the SDR, to assess if the macroeconomic conditions are comparable (or not). When studying the determinants that influence the strength of a currency at the international level, the literature analyzes the currencies altogether and does not distinguish among currencies. In this paper we model the shares of international currencies using SUR specifications and data observed between 2009Q3 and 2015Q4. The SUR

specification allows us to distinguish the impacts of the variables between currencies. The data are composed of international debt shares of each of the five currencies of the current SDR basket, which are subsequently divided into two and three regions (America; Europe; and Asia plus Oceania plus Africa), based on the country of the parent company of issuance.

We find strong evidence supporting the hypothesis of distinct coefficients across equations, thus justifying our modeling technique based on SUR models. The share of international bonds is influenced by the size of the economy (changes in the GDP share and the bilateral trade share), stability of a currency's value (the inflation rate and the volatility against the SDR), financial market developments, the economic policy uncertainty index, the yield spread, and hedging motives. In our benchmark estimated model, the CNY, the GBP, and the JPY are by far the currencies most affected by the main determinants of the model. These are the currencies with the smallest shares in the SDR basket. Nonetheless, these currencies do not respond in the same way to the macroeconomic determinants. For example, CNY and JPY bonds are used for financing purposes (inflation rate), contrary to what happens to the GBP currency. Of these three currencies only CNY depends essentially on its region/continent and includes nonlinearities in the relationships (bilateral trade share, spread between bonds, and FDI flows), thus suggesting that its role in the IMS is evolving. The GBP depends very much on the American continent and the JPY on Europe. The increasing and recent use of the Chinese currency in international trade transactions makes for an increase in the issuance of international foreign currency bonds, while the USD and the Euro are already established currencies in international transactions, reducing the need for risk-sharing since there is widespread trust in these currencies. However, the USD is still a distinctive reference currency at the global level.

The different results for different currencies in terms of the impact of the determinants and also the relevance of the location for these determinants leads us to believe that economic policy

should be tailor-made to the purposes that each country/region wants its currency to have in the International Monetary System.

Despite these interesting findings, our empirical approach has some limitations. Further research could consider the exchange venues where these bonds are traded and analyze the shares based on the exchanges rather than on the country of the issuer. Although many bonds end up being traded over-the-counter, we believe that further research on this could also bring interesting results. Moreover, as a follow-up to this paper, we suggest studying the macroeconomic determinants of foreign-currency denominated debt for the five currencies of the SDR basket. After 2015 there should exist quarterly data for the currency shares in international bond markets for many countries in the World. A panel database would give us a perspective on how the inclusion of the Renminbi in the SDR was important to define the current role of the five main currencies in the World.

References

- Arbatli Saxegaard, E. C., Davis, S.J., Ito, A., and Miake, N., 2022. Policy Uncertainty in Japan. Journal of the Japanese and International Economies, 64, https://doi.org/10.1016/j.jjie.2022.101192.
- Baker, S. R., Bloom, N., and Davis, S.J., 2016. Measuring Economic Policy Uncertainty. Quarterly Journal of Economics, 131 (4): 1593-1636.
- Black, S. 1991. Transactions costs and vehicle currencies. Journal of International Money and Finance, 10 (4): 512-526.
- Blinder, A. 1996. The role of the dollar as an international currency. Eastern Economic Journal, 22 (2): 127-136.
- Bobba, M., Corte, G., and Powell, A. 2007. On the Determinants of International Currency Choice: Will the Euro Dominate the World? Inter-American Development Bank Working Paper 611.
- Calvo, G. and Vegh, C. 1992. Currency Substitution in Developing Countries: An Introduction. IMF Working Paper 92/40.
- Cerutti, E. and Obstfeld, M. 2018. China's Bond Market and Global Financial Markets. IMF Working Paper 18/253.
- Chey, H.-k., Kim, G.-Y., and Lee, D. H. 2019. Which Foreign States Support the Global Use of the Chinese Renmimbi? The International Political Economy of Currency Internationalisation. World Economy 42: 2403-2426.
- Chinn, M. and Frankel, J. 2007. Will the Euro Eventually Surpass the Dollar as Leading International Reserve Currency? Clarida R. H. (ed). G7 Current Account Imbalances. 284--323. The University of Chicago Press.

- Chinn, M. and Frankel, J. 2008. Why the Euro Will Rival the Dollar. International Finance, 11 (1): 49-73.
- Chinn, M. 2015. Emerging Market Economies and the Next Reserve Currencies. Open Economics Review, 26: 155-174.
- Chitu, L., Eichengreen, B., and Mehl, A. 2014. When Did the Dollar Overtake Sterling As the Leading International Currency? Evidence from the Bond Markets. Journal of Development Economics 111: 225-245.
- Cohen, B. 2005. Currency choice in international bond issuance. BIS Quarterly Review, 53-66, June.
- Devereux, M. and Shi, S. 2013. Vehicle currency. International Economic Review, 54 (1): 97-133.
- Eichengreen, B., Chi, L., and Mehl, A. 2016. Stability or Upheaval? The Currency Composition of International Reserves in the Long Run. IMF Economic Review 64 (2): 354-380.
- Eichengreen, B. and Lombardi, D. 2017. RMBI or RMBR: Is the Renminbi Destined to Become a Global or Regional Currency? Asian Economic Papers, 16 (1): 35-59, MIT Press.
- Eichengreen, B. and Flandreau, M. 2008. The rise and fall of the dollar, or when did the dollar replace sterling as the leading reserve currency? European Review of Economic History, 13: 377-411.
- Fatum, R., Yamamoto, Y., and Zhu, G. 2017. Is the Renminbi a Safe Haven? Journal of International Money and Finance, 79: 189-202.
- Flandreau, M. and Jobst, C. 2009. The Empirics of International Currencies: Network Externalities, History and Persistence. The Economic Journal, 119 (537): 643-664.
- Fong, T. P. W. and Wong, A. Y. T. 2020. Safehavenness of the Chinese Renmimbi. International Finance, 23: 215-233.
- Goldberg, L. and Tille, C. 2008. Vehicle currency use in international trade. Journal of International Economics, 76 (2): 177-192.
- Graham, E. M. and Wada, E. 2001. Foreign Direct Investment in China: Effects on Growth and Economic Performance. Peter Drysdale (ed), Achieving High Growth: Experience of Transitional Economies in East Asia, Oxford University Press, Oxford.
- Hartmann, P. 1998 Currency competition and foreign exchange markets. The dollar, the yen, and the Euro. Cambridge University Press.
- IMF, European Central Bank, Bank of International Settlements. 2015. Handbook on Securities Statistics. Washington, D.C.
- Ito, H. and Rodriguez, C. 2015. Do We Like the Greenback or Something Else? An Analysis on the Determinants of Reliance on Foreign-Currency Denominated Debt. Mimeo.
- Krugman, P. 1980. Vehicle Currencies and the Structure of International Exchange. Journal of Money, Credit and Banking, 12 (3): 513-526.
- Li, C. and Zhang, X. 2017. Renminbi Internationalization in the New Normal: Progress, Determinants and Policy Discussions. China & World Economy, 25 (2): 22-44.
- Ma, G. and Yao, W. 2016. Can the Chinese Bond Market Facilitate A Globalizing Renminbi? BOFIT Discussion Papers No. 1/2016.
- Matsuyama, K., Kiyotaki, N., and Matsui, A. 1993. Toward a theory of international currency. Review of Economic Studies, 60: 283-307.

- Mehl, A., Geis, A., and Wredenborg, S. 2004. International Role of the Euro Evidence from bonds issued by non-euro area residents. ECB Working Paper No. 18.
- Rua, A. 2018. Modelling currency demand in a small open economy within a monetary union. Economic Modelling, 74: 88-96.
- Swoboda, A. 1969. Vehicle currencies in the foreign exchange market: the case of the dollar. R.Aliber (ed), The International Market for Foreign Exchange, Praeger, New York.
- Wang, Y.-C., Tsai, J.-J., and Chen, X. 2021. The Impact of RMB Internationalization and International Situations on Chinas's Foreign Exchange Market: Dynamic Linkages between USD/CNY and SDR/CNY. Emerging Markets Finance and Trade, 57 (5): 1437-1454.
- Zellner, A. 1962. An efficient method of estimating seemingly unrelated regressions and test for aggregation bias. Journal of the American Statistical Association, 57 (298): 348-368.