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Bargaining power, product differentiation, and currency patterns in intra-BRICS trade

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Abstract

The paper aims to model the currency structure of intra-BRICS trade using readily available data at the product-country level. The research is motivated by the existence of data availability problem that has arisen because the Bank of Russia does not publish data on invoicing currencies in a detailed breakdown by currency and partner. It involves the two factors that require only trade data: the index of trading partners' bargaining power and the degree of product quality differentiation. First, I link the hypothetical model share of trade invoiced in the producer currency to the ratio of the bargaining powers of exporter and importer countries by logistic curves with different parameters; assuming that trade in homogeneous products with low quality differentiation is invoiced in vehicle currencies, I then compare the model structure of Russia's intra-BRICS trade with the aggregated data, and choose the parameters of the logistic curve that provide the best fit. I use CEPII BACI database for 2019. The results show that the actual and the model invoicing currency structures for Russia's intra-BRICS trade are very close for exports but differ for imports, which highlights the role of the importer's foreign exchange reserves currency structure. The model share of Chinese renminbi in total intra-BRICS trade is about 47% and the model share of vehicle currencies is estimated at 38%. The long-term potential share of Chinese renminbi in total intra-BRICS trade may exceed 80% that makes it the strongest candidate for substituting vehicle currencies in intra-BRICS trade.

Keywords

BRICS, invoicing currency, model share, renminbi, trade network, vehicle currency

JEL: F14, F15, F17, F31.

Introduction

In 2022, a portion of information on the prospects of a new international currency was made available to the public. Russia informed the global community about the work on a new currency to be used within BRICS (Brazil, Russia, India, China, and South Africa); Iran proposed to establish a new currency within Shanghai Cooperation Organization (SCO). Addressing the non-financial corporations, the Bank of Russia (2022) recommended a transfer from the US dollars and euros to other, "non-toxic", currencies. That was how the Russian authorities reacted to the blocking of about $300 bln of the Russian Central Bank's assets (Dubinin, 2022) nominated in the US dollars and euros, which also led to huge growth of risks connected with international payments.

The basis for studying currency integration was formed by Robert Mundell (1961). His ideas were implemented in the EU where the policy makers have achieved high factor mobility (primarily, labor mobility) and stability of the currency. However, these positive results were produced at the expense of losing the independence of monetary and fiscal policy. This is the key limitation for full currency integration within BRICS or SCO countries, along with asymmetric shocks that may occur in individual countries of these blocs as they include both oil-importing and oil-exporting countries, in which oil price shocks produce different effects. (Lin & Su, 2020).

As noted by Liu and Papa (2022), historically all five BRICS members have experienced US sanctions and had a clear motive to de-dollarize their international settlements. There are possibly two ways for currency integration within BRICS or SCO. The first option is to create a new international currency relying on the currency basket in the form close to ECU (the currency that preceded euro), that is, a non-cash instrument focused on international payments with the weights of currencies in the basket reflecting relative sizes of the economies and their involvement in mutual trade (Louw, 1987). The second, a more straightforward way, is to promote making international payments in national currencies: Xu and Xiong (2022) expect that, as the willingness to hold foreign exchange reserves declines, developing countries may increase their tolerance of exchange rate volatility. Both options require data-informed knowledge of the proportions in which the currencies of the participating countries are used. However, the data on the currency structure of international payments are not available for most countries. In particular, the Bank of Russia publishes this data for the European Union (EU), Eurasian Economic Union (EAEU), BRICS and Turkey, while the data for SCO are not provided.

This paper is motivated by the idea that such data limitations could be mitigated by using the results of modeling the choice of currency depending on various factors. There is ample literature on this and other related subjects. The choice of currency for international payments depends on a broad set of factors that include country size (Krugman, 1984), currency risk (Donnenfeld & Haug, 2003), national inflation relative to inflation in the US (Kamps, 2006), the degree of product quality differentiation and practices of currency use among competitors (Goldberg & Tille, 2008), local competition at the importer market (Ito et al., 2010), sizes of individual trade transactions (Goldberg

& Tille, 2016), distances between countries (Witte and Ventura, 2016), market shares of exporting and importing firms (Devereux et al., 2017), the level of financial market development in the importer country (Liu & Lu, 2019), and bargaining power of trading partners at the product market (Arioldi et al., 2022).

This paper, however, does not aim to account for all the factors, especially because many of the factors should be considered with the detailed trade transactions data at hand. Such data are not readily available for most economists; besides, they are usually focused on a certain country, which limits cross-country studies. I therefore examine the two factors which vary at the product level and require only international trade data: bargaining power of trading partners and product quality differentiation. The first factor is the network-related index of bargaining power by Arioldi et al. (2022); for each bilateral trade flow, a country with higher bargaining power is assumed to use its own currency. As for the product quality differentiation, following Goldberg and Tille (2008) I assume that homogeneous products with low quality differentiation, such as oil, are invoiced in vehicle currencies (US dollars or euros). The homogeneous products are grouped according to Rauch's (1999) classification.

The paper aims to estimate a hypothetical currency structure of Russia's international trade with the BRICS countries using bilateral bargaining power indices at each product market and the list of homogeneous products. The paper is structured as follows: in the Methods section, I describe the methodological basis for the analysis and explain how to determine a model exporter's currency share using the logistic curve. In the Results section, I compare the model results for Russia with the data on currency structure of international trade published by Bank of Russia, and present the model structure of the total intra-BRICS trade by each BRICS country's own currency and the model shares of own currency in each country's intra-BRICS trade. In the Discussion section, I explain the implications of the obtained result and this is followed by the main conclusions of the research.

Methodology

The indices of bargaining power are calculated for each country as an exporter or importer of a certain product, according to the formulation developed by Arioldi et al. (2022):

$$\varphi_i^{(\exp)} = \frac{1}{2}\left(\frac{1}{N_{\exp}} + \frac{1}{N_{imp}}\sum_j \frac{z_{ij}}{M_j}\right), \tag{1}$$

$$\varphi_i^{(imp)} = \frac{1}{2}\left(\frac{1}{N_{imp}} + \frac{1}{N_{\exp}}\sum_j \frac{z_{ji}}{X_j}\right), \tag{2}$$

where $N_{\exp}$ and N_{imp} are the number of countries exporting or importing the product, i is the country of interest, z_{ij} is the trade flow from the reporting country i to the partner country j, z_{ji} is the reverse trade flow, M_j and X_j are total exports and imports

of the product by all partner countries, $\varphi_i^{(\exp)}$ and $\varphi_i^{(imp)}$ are the indices of bargaining power of the country i as an exporter and an importer. This formulation is derived from a bargaining model of trade in a setting close to the adapted Rubinstein–Stahl alternating offers game (Calvo-Armengol, 2001).

Arioldi et al. (2022) interpret the new indices as network-adjusted market shares and present the following link between the indices and the standard market shares:

$$\varphi_i^{(\exp)} = \frac{1}{2}\left(\frac{1}{N_{\exp}} + \sum_j \left(\frac{z_{ij}}{M}\frac{1}{\left(N_{imp}M_j\right)/M}\right)\right), \tag{3}$$

$$\varphi_i^{(imp)} = \frac{1}{2}\left(\frac{1}{N_{imp}} + \sum_j \left(\frac{z_{ji}}{X}\frac{1}{\left(N_{\exp}X_j\right)/X}\right)\right), \tag{4}$$

where M and X are total world exports and imports of the product, $\frac{z_{ij}}{M}$ and $\frac{z_{ji}}{X}$ are the contributions of exporting and importing transactions to standard market shares which does not depend on trading partner, whereas $\frac{1}{\left(N_{imp}M_j\right)/M}$ and $\frac{1}{\left(N_{\exp}X_j\right)/X}$ are the weights which depend on the importance of trading partner j relative to the world market.

Following Arioldi et al. (2022), I calculate the ratio of network-adjusted market shares of an exporter and an importer country for each product as follows:

$$\varphi_{mn}^{(ratio)} = \ln\left(\frac{\varphi_m^{(\exp)}}{\varphi_n^{(imp)}}\right), \tag{5}$$

where m is an exporter country, and n is an importer country.

Then I approximate the link between the model share of transactions invoiced in the producer currency and the ratio of network-adjusted market shares of an exporter and an importer country by the logistic curve that is consistent with the empirical results of Arioldi et al. (2022) for Italy (**Figure 1**):

$$PCP_{mn}^{(share)} = \frac{1-2s}{1+e^{-k\varphi_{mn}^{(ratio)}}} + s, \tag{6}$$

where k is the slope of the curve (from 0 to ∞), and is the shift of the minimum and the maximum of the curve to the center along the vertical axis (from 0 to 0.5). The variants of approximations for different slopes of the curve are presented in **Figures 2 – 4**.

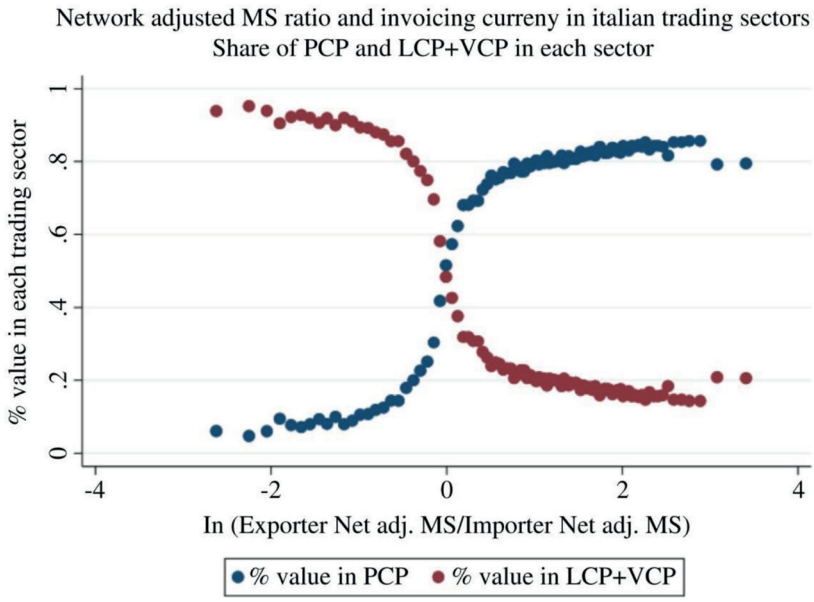

Figure 1. The model share of transactions invoiced in the producer currency (PCP) and in the importer or vehicle currency (LCP+VCP) depending on the ratio of network-adjusted market shares for Italy in 2010 (Arioldi et al., 2022). *Source*: Arioldi et al. (2022)

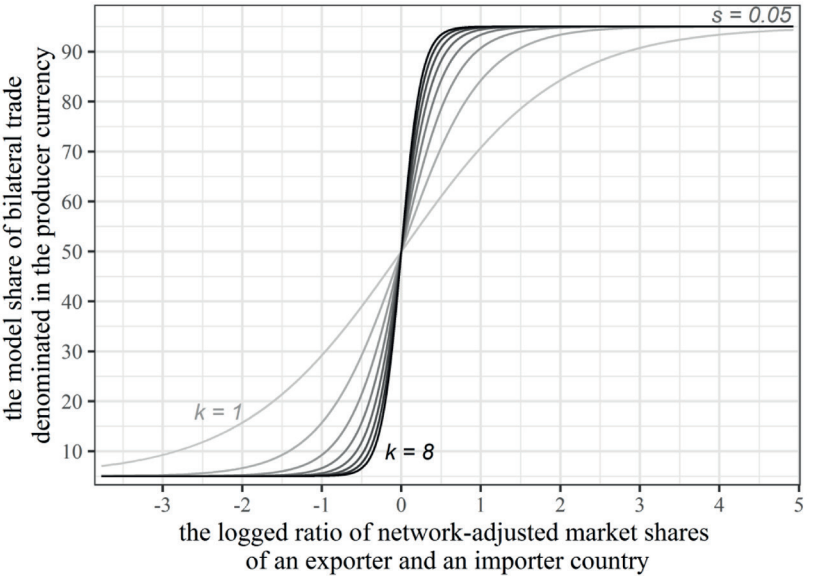

Figure 2. The link between the model share of trade transactions invoiced in the producer currency and the ratio of network-adjusted market shares for different slope parameters. *Source*: own calculations based on formula (6)

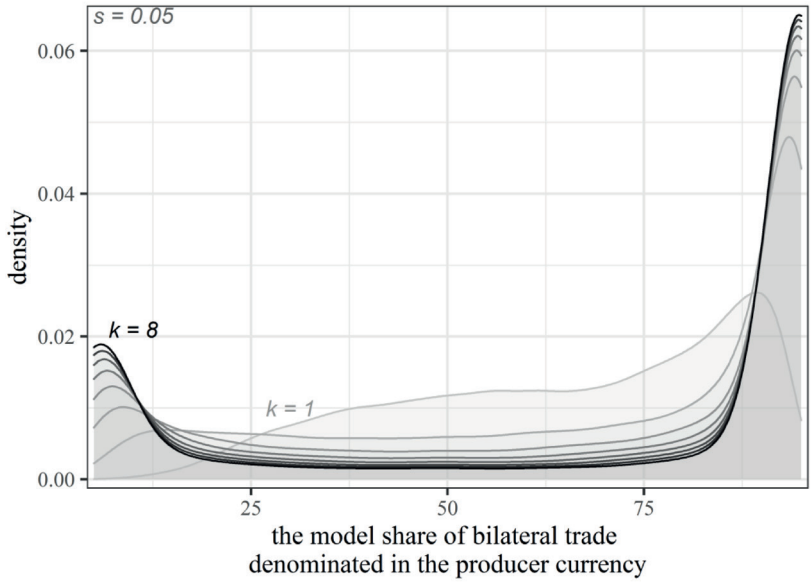

Figure 3. Density distribution of the model share of trade transactions invoiced in the producer currency for different slope parameters of the logistics curve. *Source*: own calculations based on CEPII BACI data for 2019 across all intra-BRICS bilateral trade flows

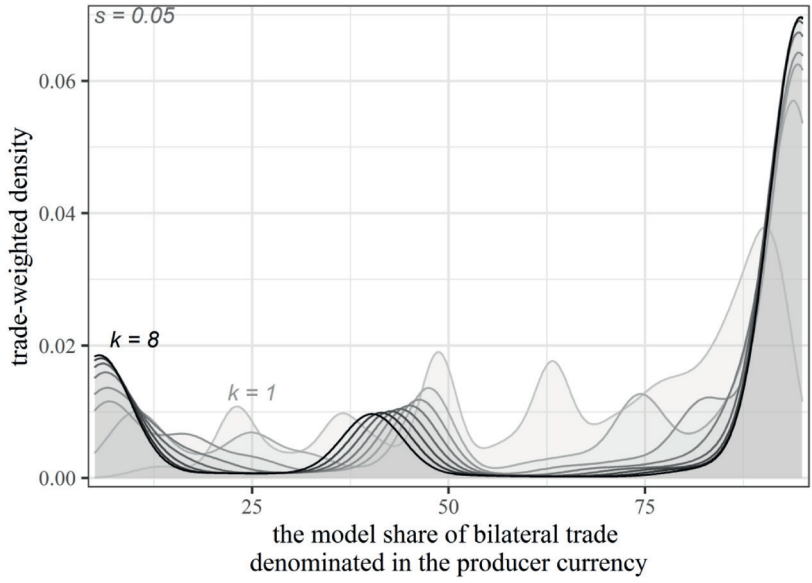

Figure 4. Weighted density distribution of the model share of trade transactions invoiced in the producer currency for different slope parameters of the logistics curve. *Source*: own calculations based on CEPII BACI data for 2019 across all intra-BRICS bilateral trade flows

Additionally, I account for the product quality differentiation, as trade in homogeneous products such as oil is typically invoiced in vehicle currencies (Goldberg & Tille, 2008). To facilitate using this information, I mark all homogeneous products, which, according to Rauch's (1999) classification, are products invoiced in US dollars or euros. For all other products, the model share of invoicing in model currency is determined based on a set of principles described earlier.

Further, I refer separately to the initial model and the resulting model. The initial model is the model without accounting for product quality differentiation that ignores the possibility of trading in vehicle currencies and assumes that all trade is invoiced in the currencies of trade partners. The resulting model is the model that accounts for product quality differentiation allowing for intra-BRICS trade in the currencies of trade partners and in vehicle currencies.

In this paper, I use the data for 2019 as the last pre-COVID year from CEPII BACI database that documents bilateral trade flows for all 6-digit HS products between all country pairs. Such data are convenient due to their harmonized nature: for each traded product, exports from country A to country B is equal to imports to country B from country A. This is not the case with raw data published in the UN COMTRADE database due to various methodological differences.

To check the output of the resulting model, I also use the data from the Bank of Russia (see **Table 1**). I estimate the resulting model for the wide set of parameters of the logistics curve (all combinations of the slope parameter from 1 to 10 and the shift parameter from 0 to 0.3). Then I aggregate the product-partner level estimations for Russia by the three types of currency: Russia's own currency, vehicle currencies (US dollars and euros), and other currencies, which are limited to currencies of the BRICS countries. Although the data from the Bank of Russia include the full set of currencies it is natural to assume that intra-BRICS trade is only minimally invoiced in the currencies of non-BRICS countries other than US dollars or euros. Finally, I calculate the modules of the differences between the actual and the model share for each of the two trade destinations and each of the three types of currency, and sum them up. The set of parameters that generates the minimal sum is considered to be the best.

Table 1. The invoicing currency structure of Russia's trade with BRICS countries, %

Invoicing currency	Bank of Russia		Model estimations	
	Exports	Imports	Exports	Imports
Russian roubles	21.3	6.6	x	x
US dollars and euros	73.0	70.8	x	x
Other currencies	5.7	22.6	x	x

Source: Bank of Russia

Results

After checking the output of the resulting model according to the framework described in the Methods section, I used the following parameters of the logistics curve that

approximates the link between the model share of trade transactions invoiced in the producer currency and the ratio of network-adjusted market shares: the slope parameter k=8, and the shift parameter s=0.05. This set of parameters generated the minimal sum of the modules of the differences between the actual and the model shares of invoicing currencies in Russia's trade with the BRICS countries (**Figure 5**).

The resulting model described in the Methods section allowed me to obtain the final estimations of the invoicing currency structure for Russia by three types of currency – Russian rubles, vehicle currencies, and other currencies (**Table 2**). The actual and the model invoicing currency structures for export transactions are nearly identical. In both cases, the bulk of exports is invoiced in the US dollars or euros and a considerable fraction of exports is invoiced in the Russian rubles while the share of other currencies is fairly small. The actual import transactions, however, are primarily invoiced in vehicle currencies although the model estimation results indicate that in such transactions other currencies should dominate and the share of the US dollars and euros should not exceed 5%. We will examine these facts in the Discussion section and now return to the presentation of results for the BRICS countries.

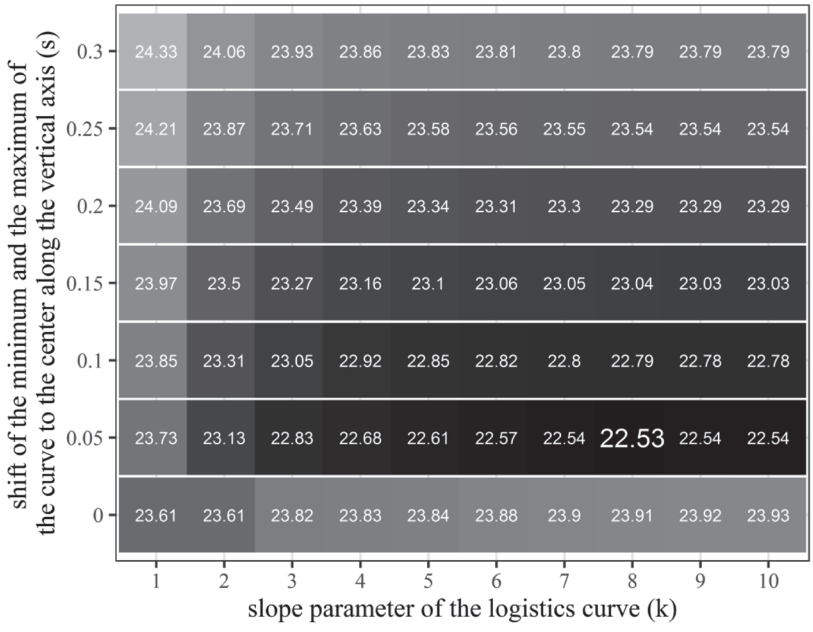

Figure 5. The mean value of the modules of the differences between the actual and the model shares of invoicing currencies in Russia's trade with BRICS countries depending on the parameters of the logistics curve, %. *Source*: own calculations based on data from CEPII BACI and Bank of Russia for 2019

Table 2. The invoicing currency structure of Russia's trade with BRICS countries in comparison with the resulting model estimations, %

Invoicing currency	Bank of Russia		Model estimations	
	Exports	Imports	Exports	Imports
Russian roubles	21.3	6.6	20.9	6.6
US dollars and euros	73.0	70.8	71.9	4.8
Other currencies	5.7	22.6	7.2	88.6

Source: Bank of Russia

The estimations based on the initial model (no intra-BRICS trade invoiced in vehicle currencies) demonstrate that the share of Chinese renminbi in total intra-BRICS trade may exceed 66% (**Figure 6**) even though the share of China in intra-BRICS total exports and imports equals only 47% and 43%, respectively (**Figure 7**). Applying the resulting model (homogeneous products invoiced in vehicles currencies) lowers the estimation of the share of Chinese renminbi in total intra-BRICS trade to 47%, and the share of vehicle currencies is estimated at 38%. The resulting model shares of own currencies of other BRICS countries do not exceed 15% in aggregate.

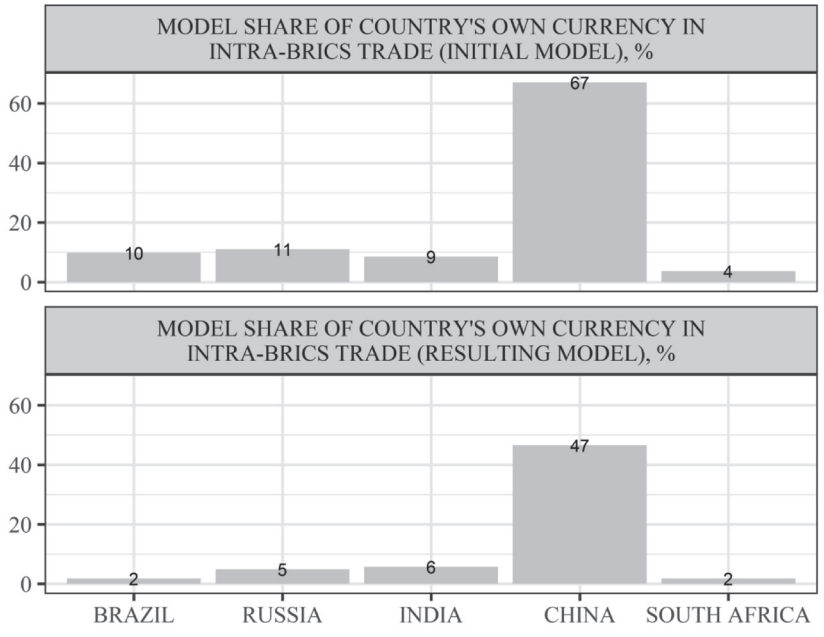

Figure 6. The model structure of total intra-BRICS trade by each country's own currency, %. *Source*: own calculations based on data from CEPII BACI for 2019

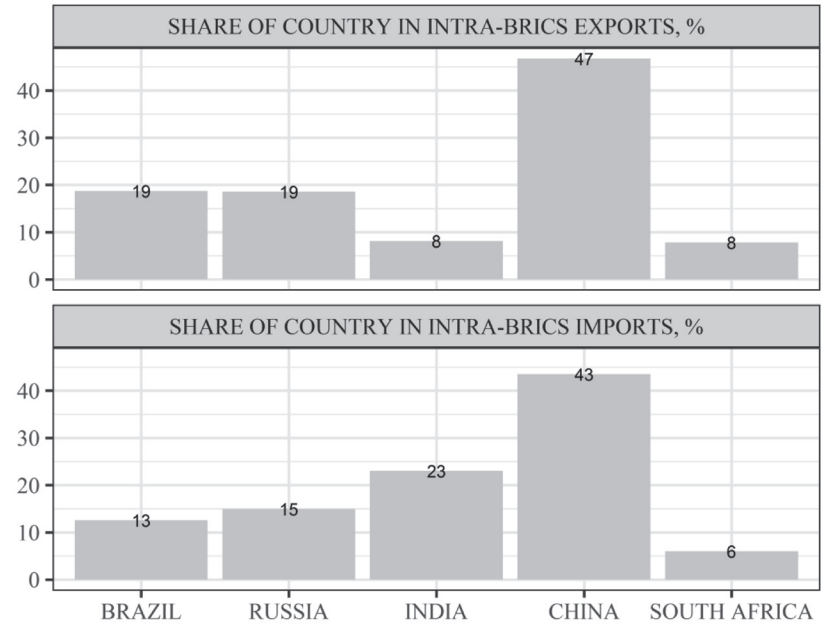

Figure 7. The actual structure of total intra-BRICS exports and imports by country, %. *Source*: own calculations based on data from CEPII BACI for 2019

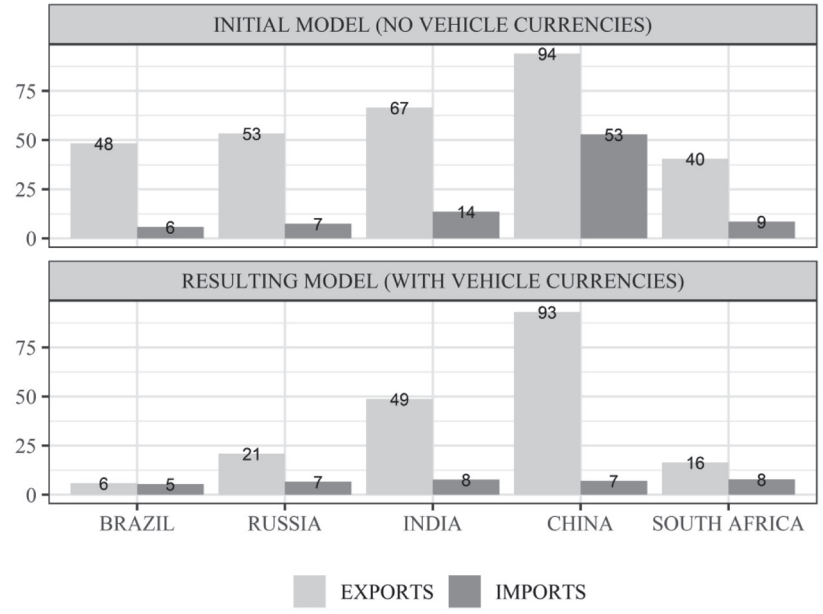

Figure 8. The model shares of own currency in each country's intra-BRICS trade, %. *Source*: own calculations based on data from CEPII BACI for 2019

Invoicing in its own currency may be important for each country as an individual unit, especially for export transactions (**Figure 8**). Even controlling for trade in vehicle currencies, the model suggests that over 90% of Chinese export transactions and almost half of Indian export transactions may be invoiced in Chinese renminbi and Indian rupees, respectively. Export revenues of Russia, South Africa and especially Brazil may be less likely to be denominated in their own currencies. Finally, invoicing in a country's own currency is only marginally important for import transactions even for large economies such as China and India.

Discussion

The results presented in the previous section are ambivalent. On the one hand, the model invoicing currency structure for Russia's export transactions with other BRICS countries is very close to the actual structure (see **Table 2**). This means that bargaining power of countries and product quality differentiation may be regarded as really important factors determining the choice of invoicing currency. The first factor is affected by both product and country dimensions, while the second factor is completely determined by product dimension.

On the other hand, the model invoicing currency structure for Russia's imports from the BRICS countries differs from the actual structure significantly. The model share of the vehicle currencies in Russia's payments for imports is below 5%, while the actual share exceeds 70%. The model suggests that almost 90% of Russia's imports from other BRICS countries should be invoiced in the currencies of these countries, but the actual share is only 23%. It is interesting, however, that the model and actual shares of the Russian rouble are absolutely identical, which means that the difference boils down to the proportion between vehicle currencies and own currencies of other BRICS countries.

The interpretation of this discrepancy is straightforward. The model does not account for the currency structure of the importing country's foreign exchange reserves. Russia, at least until 2022, stored the bulk of its foreign exchange reserves in the US dollars and euros as export revenues were basically denominated in vehicle currencies. Russia was unable to actively pay for imports from BRICS in Chinese renminbi, Indian rupee or other BRICS currencies except the Russian rouble. The model share of the rouble in the country's payments for imports from BRICS turned out to be identical to the actual share, thanks to the absence of such restrictions for Russia's own currency.

The obtained result has a significant implication. In the model world, only 5% of Russia's imports should be invoiced in US dollars and euros. However, in the real world Russia pays for more than 70% of its imports in vehicle currencies, as 72% of export revenues are denominated in US dollars or euros (the data for 2019). If the key obstacle to using BRICS currencies is the lack of foreign exchange reserves in these currencies, proliferation of invoicing export transactions with the BRICS countries in their own currencies should stimulate a subsequent increase in the share of payments for imports in these currencies.

The next question is what currencies should be primarily regarded as the substitutes of the US dollar and euro in the intra-BRICS trade. The strongest candidate is obviously the Chinese renminbi and the resulting model shows that it may be used for almost half of the total intra-BRICS trade transactions (**Figure 6**). Hypothetically, if invoicing in the US dollars and euros in the post-sanction world is forbidden for the intra-BRICS trade, 38% of such trade should be invoiced in BRICS currencies. Comparing the estimations of the initial and the resulting models, one can break down the whole amount by currency: Chinese renminbi (19%), Brazilian real (8%), Russian ruble (6%), Indian rupee (3%), and South African rand (2%). The question arises if such a proportional division is realistic and the correct answer is "no".

This simple breakdow n, again, has a drawback of ignoring the currency structure of the importer country's foreign exchange reserves. For example, Brazil can't easily raise the share of its intra-BRICS export revenues denominated in its own currency from 6% to 48% (**Figure 8**), because other BRICS countries do not have the required amount of Brazilian reals. It means that the way to radically decrease payments in the US dollars and euros is to use another reserve currency, or, less likely, create a new international currency.

The most natural choice is Chinese renminbi – this is the only BRICS currency that is already actively used as reserve currency; the role of Chinese renminbi may further increase as China is gaining position as one of the leading importers, in addition to the long established leadership as exporter. The obstacles to the rise of the Chinese renminbi are, first, the absence of a fully open capital account and a flexible exchange rate in China, and, second, limited development of its financial market, especially the insufficient amounts of debt securities available to foreign investors (Prasad, 2016). Gopinath and Stein (2021) point out that a currency's role as a unit of account for invoicing is complementary to its role as a safe store of value; they argue that it is hard to replace the US dollar in international payments because of its dominance in global finance. All this makes the US dollar and, to a lesser extent, euro strong competitors for the Chinese renminbi. The BRICS countries except Russia may still prefer to invoice their transactions in the US dollars or euros and continue to fill their reserves with these currencies as it is easier to find financial instruments linked to the US dollars and euros.

However, the dominance of the US dollar is gradually eroding: the global share of reserves held in this currency dropped from 71% in 1999 to 59% in 2021 (Arslanalp et al., 2022). After blocking Russia's international reserves nominated in the US dollars and euros, many countries may reconsider their policy concerning the risks of accumulating foreign exchange reserves in these currencies. This may lead to the acceleration of the "dollar erosion."

Besides, China is aspiring to keep its currency under control and simultaneously internationalize it by developing the renminbi currency swaps with the central banks of other countries. These swap lines boost bilateral trade and increase the Chinese share in international trade, especially with smaller economies, trade-deficit economies, and economies with smaller reserves (Hao et al., 2022).

This discussion leads to the conclusion that an increase in invoicing in BRICS currencies, especially in Chinese renminbi, is a natural prospect for intra-BRICS trade, but the required timeline for the transformation is still vague. In the long term, evidence strongly supports the dominant role of Chinese renminbi in intra-BRICS trade transactions. In the medium term and especially in the short term, the obstacles may remain strong.

Conclusion

In this paper, I develop the model for estimating the currency structure of intra-BRICS trade relying on the bilateral bargaining power indices on each product market and the list of homogeneous products with low quality differentiation (such as oil and gas). The mechanism of the model is approximating the link between the share of transactions invoiced in the producer currency and the ratio of the bargaining power indices of the exporter and importer country by the logistic curve. The model helps to mitigate the limitations of data availability concerning the structure of the invoicing currencies.

The procedure presented in this paper generates the invoicing currency structure for Russia's intra-BRICS export transactions that is nearly identical to the actual invoicing currency structure, although the model and actual invoicing currency structures for import transactions are drastically different. The discrepancy allows us to get an indirect estimate of the role of the currency structure of the importer country's foreign exchange reserves that is not accounted for in the model. At the same time, the perfect match between the model and actual currency invoicing structures for exports demonstrates that the two factors which vary at the product level and require only trade data, namely, the bargaining power indices and product homogeneity, are important determinants of the choice of the invoicing currency.

The model share of the Chinese renminbi in the total intra-BRICS trade is estimated at 47%, and the model share of the vehicle currencies (US dollars and euros) is estimated at 38%. So, if the US dollars and euros are fully replaced by the Chinese renminbi, the potential share of Chinese renminbi in total intra-BRICS trade may exceed 80% in the long term. In the short and medium term, however, there are strong obstacles to rapid expansion of the use of this currency.

The promising area for further research is combining the results of the model developed in this paper with the firm-level detailed trade transactions microdata for one of the BRICS countries. This would make it possible to compare the model results aggregated at the industry level with actual data.

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