

Exorbitant privilege and economic sanctions*

Maxim Chupilkin
University of Oxford[†] and EBRD[‡]

Beata Javorcik
University of Oxford[§], EBRD and CEPR[¶]

Aleksandra Peeva
Humboldt University of Berlin^{||}

Alexander Plekhanov
EBRD

February 2024

Abstract

This paper documents a substantial change in the use of currency of invoicing in Russian import transactions, precipitated by the war on Ukraine and the subsequent introduction of trade sanctions on Russia. Over the course of 2022, the share of Russia's imports invoiced in renminbi (CNY) increased by 17% points. The use of renminbi as a vehicle currency increased on average by an extra 4% points among trading partners that have an active renminbi swap line. This effect is found only for third countries that did not impose economic sanctions on Russia. Transaction-level analysis suggests that the perceived threat of secondary sanctions and the rising fixed cost of clearing cross-border payments in US dollars both played a role. In particular, the share of CNY invoicing increased differentially more for trade in internationally sanctioned dual-use goods and for trade in goods originating in sanctioning economies or traded under Western trademarks. The number of importing firms dealing with CNY invoices increased sharply, while the numbers of importers dealing with USD and EUR invoicing dropped. While dominance of the US dollar (USD) makes international sanctions more effective, as payments denominated in USD need to be cleared through the US banking system, economic sanctions may encourage a shift away from USD as a vehicle currency thus eroding the USD dominance.

Keywords: sanctions, international trade, currency of invoicing, vehicle currency, China, Russia

JEL Classification Number: E42, F14, F31, F51

*Chupilkin email: chupilkm@ebrd.com; Javorcik email: beata.javorcik@economics.ox.ac.uk; Peeva email: peevaale@hu-berlin.de; Plekhanov email: plekhana@ebrd.com. The views are those of the authors and should not be attributed to the institutions they are affiliated with. The authors are grateful to Antoine Berthou, Ralph de Haas and Volker Nitsch for valuable comments and suggestions.

[†]Department of Politics and International Relations, Manor Rd, Oxford OX1 3UQ, United Kingdom

[‡]European Bank for Reconstruction and Development, 5 Bank St., London, E14 4BG, United Kingdom

[§]Department of Economics, University of Oxford, 10 Manor Rd, Oxford OX1 3UQ, United Kingdom

[¶]33 Great Sutton St, London, EC1V 0DX, United Kingdom

^{||}Unter den Linden 6, 10117, Berlin, Germany

1 Introduction

International trade is disproportionately denominated in US dollars (Gopinath and Stein (2020), Boz et al. (2022), Gopinath et al. (2020)), contributing to the demand for US dollars and the dollar's exorbitant privilege, that is, low interest paid on US liabilities compared with return on US dollar assets (Gourinchas et al. (2010)). The prevalence of US dollar use in trade between third countries reflects to a large extent the size of the US market and firms' efforts to keep their prices in line with those of competitors as well as input suppliers. When choosing the currency of invoicing, firms also take into consideration exchange rate risks and the dominant role of the US dollar as a store of value (Bacchetta and van Wincoop (2005), Goldberg and Tille (2008), Goldberg and Tille (2016), Amiti et al. (2022), Gopinath and Stein (2020)). For these reasons, the rising importance of China and other emerging markets as trading partners and the declining share of the US in global trade may not by themselves lead to the decline in the US dollar share of invoicing (Georgiadis et al. (2021), Mukhin (2022)).

The dominance of the US dollar makes international sanctions more effective, as firms engaged in international trade overwhelmingly require payments to be cleared through the US banking system. At the same time, the use of economic sanctions, which is becoming increasingly widespread (Felbermayr et al. (2020)), may over time reduce attractiveness of the US dollar as a vehicle currency and hence its dominance (see, for instance, Bianchi and Sosa-Padilla (2023)). Empirical evidence on such shifts is scarce, in part due to limited application of economic sanctions in the past.

This study sheds light on the impact of trade sanctions on the choice of currencies used to denominate international trade transactions. Our analysis focuses on the sanctions imposed on Russia by the European Union (EU), the United States and a number of other advanced economies in the aftermath of Russia's full-scale invasion of Ukraine on 24 February 2022.

Comprehensive economic sanctions imposed on Russia by the EU and other Western economies in response to the war on Ukraine present a unique case for studying the changes in the choice of invoicing currency. This episode stands out in terms of its size, comprehensive nature and the size of the targeted economy (see Chupilkin et al. (2023)). Russia's GDP at market exchange rates in 2021 amounted to US\$1.8 trillion making Russia 11th largest economy in the world. Sanction packages imposed restrictions on exports of various goods to Russia as well as on certain imports from Russia. They limited financial services that could be provided to Russian entities and discontinued access of some major Russian banks to SWIFT, the dominant system for cross-border payments. A major part of assets of the Russian Central Bank were frozen, and sanctions further covered transactions with more than 1,200 individual entities. In response, the BRICS economies (Brazil, China, India, Russia and South Africa) announced their intention to develop an alternative cross-border payments system, BRICS pay.

Our analysis exploits transaction-level data on Russia’s imports between January 2016 and December 2022, covering the period before and after the start of the sanctions regime. Each record includes the value of goods and information about their quantity or weight, product description and its HS code, importing firm (identified by a unique number), name of the exporting firm, country of origin of goods, currency of invoicing and the date of customs clearance.

Some remarkable shifts are already visible in summary statistics. Prior to March 2022, up to 80 percent of Russia’s imports had been invoiced in US dollars (USD) or euros (EUR). Most of these imports were coming from third countries. The shares of trade denominated in various currencies had been fairly stable over time. After Russia’s full-scale invasion of Ukraine in February 2022 and the imposition of economic sanctions by the EU, US and a number of other advanced economies, Russian imports became increasingly invoiced in renminbi (CNY). By the end of 2022, invoices in renminbi accounted for 20 percent of Russia’s imports, up from 3 percent a year earlier, while the share of the US dollar and the euro declined to 67 percent. Swift data point to a broader increase in the use of CNY in international trade (see Figure 1).

Only part of this shift reflects a drop in exports from the sanctioning economies and the rise of Russia’s trade with China and other neutral partners (see Chupilkin et al. (2023), Steinbach (2023)). Renminbi invoices accounted for 63 percent of imports from China by end-2022, up from 23 percent a year earlier, having displaced primarily the US dollar as well as the Russian rouble (RUB) as the currency of choice. In trade with third countries (i.e., other than those using the US dollar or the euro as producer currency), the share of renminbi went up from less than 1 percent before February 2022 to more than 5 percent by the end of the year.

Similar trends are observed in terms of numbers of firms dealing with invoices in a given currency. We show that the dominant switching behaviour after the imposition of sanctions was for importing firms to move from paying in USD as a vehicle currency to paying in CNY as a producer or vehicle currency.

To shed further light on the mechanisms behind this switching, our econometric analysis focuses on the share of a Russian firm’s imports of a given product from a given country in a given month, invoiced in a given currency.

We follow a difference-in-difference approach comparing (i) Russia’s imports before versus after the imposition of economic sanctions; (ii) Various characteristics of Russia’s trade in turn, for example, trade with sanctioning economies versus other (“neutral”) economies, trade with economies with and without a swap line with China, trade in sanctioned versus non-sanctioned products or trade done by large versus small firms. The use of comprehensive sets of fixed effects enables us to isolate various mechanisms driving the switching behaviour away from dealing with US dollar invoices towards the use

of producer currencies of neutral economies and CNY as a vehicle currency.

In particular, we zoom in on the impact of having an active currency swap line with the People's Bank of China (PBOC) on CNY invoicing. Our interest stems from the fact that such swap lines make it easier for an exporter to use renminbi received from, say, a Russian importer (see Bahaj and Reis (2020)). We show that the use of renminbi as a vehicle currency increased by an extra 4 percentage points, on average, for trading partners that have an active currency swap line with the PBOC, such as Mongolia or Tajikistan. This effect is found only for third countries that did not impose economic sanctions on Russia. The data also show that the use of currencies of other "neutral" exporters, such as the Turkish Lira and Indian rupee, has also increased, albeit has remained much more limited overall.

An event-study analysis shows no differential trends in the use of producer currency or US dollar in individual countries' trade with Russia before March 2022, including China's trade. This gives us confidence that the patterns captured by our analysis have indeed been precipitated by the war and the subsequent sanctions.

Transaction-level analysis suggests that the perceived threat of secondary sanctions and the rising fixed cost of clearing cross-border payments in US dollars both played a role. In particular, the shares of CNY invoicing and producer-currency invoicing increased differentially more for trade in internationally sanctioned dual-use goods (compared with non-sanctioned goods).

We further show that the shares of trade with neutral economies invoiced in CNY or producer currency were higher for goods originating in sanctioning economies or traded under "Western" trademarks, that is, in cases where a paper trail linking trades to sanctioning economies potentially exists. The shares of trade invoiced in US dollars were correspondingly lower for internationally sanctioned goods and for "intermediated" trade in goods of Western origin. In this exercise we zoom in on imports from neutral economies during the sanctions period and contrast intermediated trade involving goods originating in sanctioning economies or traded under Western trademarks with the rest of the trade.

In the final part of the analysis, we focus on characteristics of Russian importers. We show a sharp increase in the number of firms dealing with CNY invoices and a drop in the numbers of importers dealing with USD and EUR invoices. The consolidation of business dealing with USD/EUR payments likely reflects the rising fixed costs of clearing such payments under sanctions. Furthermore, switching away from the US dollar is estimated to be more prevalent for smaller firms and in the case of smaller transactions. These trends likely reflect the rising fixed costs of clearing cross-border US dollar payments under sanctions, owing to increased compliance checks. Finally, we do not find evidence that switching was driven by the hedging motive among firms already exporting in CNY.

Our paper contributes to several strands of the economic literature. First, we contribute to the literature on the choice of invoicing currency (Goldberg and Tille (2008), Gopinath et al. (2010)) by showing how trade sanctions may fundamentally affect this choice. We complement evidence in Berthou (2023) by looking at vehicle currencies other than the US dollar. We also contribute to the growing literature on factors supporting the rise of international currencies, and in particular China's (Coppola et al. (2023), Clayton et al. (2022), Bahaj and Reis (2020)), by documenting the interplay between policies to promote internationalisation of renminbi through the use of currency swap lines and an exogenous shock to trade flows arising from Russia's full-scale invasion of Ukraine.

We contribute to the literature on the effectiveness of economic sanctions (for instance, Crozet and Hinz (2020), Tyazhelnikov et al. (2023)) by showing that the effectiveness of sanctions is attenuated, among other things, by the endogenous choice of currency of invoicing of imports and exports, which diminishes the ability of sanctioning economies to monitor and restrict trade in sanctioned goods. This switching reinforces and is, in turn, reinforced by diversion of trade to neutral trading partners (Yang et al. (2009), Chupilkin et al. (2023), Babina et al. (2023)), rerouting of trade and financial flows from the sanctioning economies via third jurisdictions (Efung et al. (2023), Besedeš et al. (2017), Chupilkin et al. (2023), Crozet et al. (2021)) and misclassification of goods at customs (Chupilkin et al. (2023)).

The rest of the paper is structured as follows. Section 2 sets the stage by outlining the economic sanctions imposed on Russia in 2022, presenting the data sources and describing the broad patterns found in the data. Section 3 lays out our empirical approach, while Section 4 presents the results and discusses their implications. The last section concludes.

2 Setting and Data

2.1 Sanctions on the Russian economy: An overview

Prior to Russia's full-scale invasion of Ukraine in February 2022, a narrow set of sanction was already in place, predominantly targeting specific companies and individuals. Those earlier sanctions were introduced in response to the annexation of Crimea in 2014 and the armed conflict in Eastern Ukraine that started in the same year. In response, Russia introduced a number of trade restrictions, notably a ban on import of various food products from the EU, the US and the UK (see Peeva (2019) for an overview). Those sanctions and counter-sanctions resulted in a broad-based reduction in Russia's trade with the sanctioning countries (Crozet and Hinz (2020)), an increase in prices of the affected goods (Hinz and Monastyrenko (2022)), weaker performance of sanctioned companies (Ahn and Ludema

(2020)) and possibly an increased popular support for the government (Peeva (2019)).

The EU expanded its sanctions first on 23 February 2023 and then in subsequent multiple waves, with most export restriction being put in place already by 15 March 2022 when luxury goods were added (as part of the fourth package) to technology-related and dual-use goods. Overall, export prohibitions have covered arms, advanced and dual-use technology, quantum computing, advanced semiconductors, sensitive machinery, transportation and chemicals, goods for use in the oil industry and maritime navigation and goods seen to enhance Russia's industrial production capacity as well as luxury products (see Chupilkin et al. (2023)).

In addition to exports, sanctions have also applied to investments in a number of sectors; use of public funds; imports from Russia of certain goods such as coal, iron and steel, and wood; aviation, Russian freight operators; and financial services including transactions with Russia's Central Bank. As a result, part of foreign assets (reserves) of the Bank of Russia were frozen. Sanctions also included travel bans and financial measures targeting more than 1,200 individuals and 100 companies.

Under targeted provisions, transactions with a number of major Russian banks, including state-owned ones, were restricted (and some banks were effectively disconnected from SWIFT, an international messaging system for clearing payments). At the same time, transactions with other banks, including some major subsidiaries of international banking groups in Russia as well as certain state-owned banks remained outside the scope of sanctions (see Drott et al. (2023) for a detailed discussion and evidence that these measures were fairly effective in excluding the targeted Russian banks from clearing payments via Target2 payment system).

In addition to the members of the European Economic Area, Australia, Canada, Japan, Korea, New Zealand, Switzerland, Taipei China, the UK and the US adopted their own sanction packages incorporating some form of trade sanctions, typically closely aligned with those of the EU (in particular, as far as dual-use technology and industrial goods are concerned) as well as some form of financial-sector sanctions. Overall, our analysis includes 45 sanctioning trading partners (see Annex Table A1 for a list). At the same time, China, Turkiye, India and the UAE are among Russia's main trading partners that did not impose economic sanctions on Russia.

2.2 Data on imports

Our analysis draws on transaction-level data of imports and exports going through Russia's customs. In 2022, it contains more than 12 million import records associated with more than 74,000 unique importing firms. Over the years, the data tracks closely Russia's aggregate international trade, whether

reported by Russia or by its trading partners via UN Comtrade, both on the import side and on the export side (see Annex Figure A1). Similar data were used, for instance, by Korovkin and Makarin (2023) to analyze Ukraine-Russia trade after 2014 and by Babina et al. (2023) to examine exports of oil products from Russia in 2022-23.

Each import record has information on the product (using the Harmonized System of classification, HS), its value, quantity or weight, the sending (exporting) country, the trading company acting as a seller (and its location, referred to as trading country hereafter), the recipient of goods in Russia as well as the currency of invoicing. The data only systematically cover transactions with counterparts outside the Eurasian Economic Union – a customs-free bloc comprising Armenia, Belarus, Kazakhstan, the Kyrgyz Republic and Russia (see Isakova et al. (2016) for a discussion of the union).

In our analysis, trading partners are defined by the location of trading company, as this location seems most relevant for the choice of currency of invoicing. Where trading country is not available, it is imputed using information about the sending country (from which goods are dispatched). In around 40 percent of cases, traders are located in the country of origin of goods. However, Hong Kong SAR and Switzerland are more common as a location of a trading company than a location of origin. Table 1 summarizes descriptive statistics for Russia's imports aggregated to a partner-country-month level.

To identify products or product groups, on which the EU introduced sanctions on exports to Russia after Russia's full-scale invasion of Ukraine, we follow the approach of Chupilkin et al. (2023)). It is based on the information from the EU Council Regulation 833/2014 and its subsequent amendments as well as on the EU list of dual-technology products. We focus on the 6-digit level of disaggregation, the highest level at which HS codes used by different countries are fully aligned.

In some cases, sanctions cover HS6 codes only partially. For example, exports of "luxury" sports equipment or clothing with prices in excess of a certain threshold (typically €300) are subject to sanctions, while cheaper items belonging to the same product code may not be subject to restrictions. Numerous other exemptions may apply, for instance, in relation to goods required by Russia to fulfil its contractual obligations with respect to deliveries of gas and oil to Europe or on health and environmental grounds. For each 6-digit HS product, we record the date when sanctions enter into force and define the subsequent month as the first period when a given product is under sanctions (for instance, April 2022 for sanctions adopted in mid-March 2022).

The list of product groups partially covered by the sanctions is an eclectic mix of 2,182 HS6 codes (as of December 2022) combining: weapons (HS 9301), semi-conductor media (852352), engines and pumps (8412, 8413), containers (860900), aircraft and parts (88), ammonia (281420), steel pipes for oil pipelines (730411), navigation instruments (9014), ski suits (611220), and others. As in Chupilkin et al.

(2023), we distinguish between three major groups of sanction products: (i) luxury goods, (ii) goods critical for industrial capacity and (iii) dual-use and military technology goods.

2.3 First look at the data: Broad patterns

When looking at the currency of invoicing, we distinguish between contracts invoiced in the local currency of the importer (in our case, the Russian Rouble, RUB), producer currencies (the currencies of partner countries) and vehicle currencies (i.e., currencies not used as domestic currencies by either the exporter or the importer). Among vehicle currencies, we focus on the US dollar and the euro (historically accounting for the bulk of Russia's trade and global trade) as well as CNY, the currency that has been gaining share of central banks' international reserves over the past two decades (Arslanalp et al. (2022)).

Prior to Russia's full-scale invasion of Ukraine in February 2022, the shares of Russia's imports invoiced in each major currency were fairly stable (see Figure 2, right panel). After March 2022, the share of Chinese renminbi (CNY) in imports started rising, up from around 3 percent of total before the war to around 20 percent by the end of 2022. This trend is similar whether shares are calculated by volume of trade, by number of transactions invoiced in each currency or by number of firms dealing with invoices in each currency. The increased use of CNY is found both in exports from China (CNY as producer currency) as well as in exports from third countries (CNY as vehicle currency). Although these trends are more pronounced when looking at the shares of trade by currency, they are mirrored in trends in terms of volumes of trade invoiced in a given currency as well (see Figure 2, top left panel).

The rise of CNY was most notable in payments for goods coming from China, where renminbi overtook the US dollar in the second half of 2022. However, CNY also started being used for settling trades with third countries, such as Mongolia (where the share of CNY rose to 18 percent from nil in 2021), Taipei China, the Philippines, Malaysia, the UAE, Thailand, Japan, Tajikistan and Singapore (see Annex Figure A2). A small percentage of trades with the EU, US and UK (1-2 percent by volume or by number of transactions) also started using CNY as a vehicle currency.

This trend is also observed for Russia's exports, albeit to a lesser extent given the dominance of oil, gas, coal and other commodities typically traded in US dollars in Russia's export mix. Trading partners paying for Russia's exports in CNY are geographically more diverse, with top emerging users including Costa Rica, El Salvador, Cote d'Ivoire, Thailand, the UAE, Cameroon, Colombia and Nicaragua. Among the top users of CNY, all economies except Guatemala, El Salvador and the Philippines had currency swap lines in place with the PBOC (see Annex Table A2).

We also observe an increased use of producer currencies in Russia’s imports from major neutral trading partners, including India, Turkiye and the UAE. The amounts are considerably more modest than in the case of CNY, both in absolute terms and in relative terms (amounting to 5-15 percent of bilateral trade, see Annex Figure A3) and those currencies are rarely, if at all, used as vehicle currencies.

In the case of China, the rapid rise in imports invoiced in CNY coupled with stable imports invoiced in USD resulted in CNY displacing the US dollar in terms of the trade share (see Annex Figure A3, top panels). In the case of imports from India and Turkiye, trade denominated in all currencies increased rapidly over the course of 2022, with the rupee and the lira claiming market share primarily from the US dollar (see Annex Figure A3, middle and bottom panels).

2.4 Trade with China: Event study analysis

Our setting lends itself well to an event-study analysis given the mostly-unanticipated nature of the war and the clear-cut timing of the introduction of the sanctions. The underlying econometric specifications are a two-way fixed effects model whether the dependent variable is the share of imports from a given country (i) in a given month (t) denominated in a given currency. In this specification, we further interact a dummy variable for China as exporter with indicator variables for each month before and after the introduction of sanctions (see Equation 1). January 2022 serves as the base (omitted) period.

$$Currency_{it} = \sum_t \sum_i \beta_i Month_t * CountryGroup_i + \alpha_t + \alpha_i + \epsilon_{it} \quad (1)$$

While monthly trade is volatile, a number of distinctive patterns emerge from this analysis (see Figure 3). Up until February 2022, there had been no differential trends in the use of CNY and USD in Russia’s imports from China relative to Russia’s imports from other countries. The share of CNY has been increasing very slowly, if at all, with no clear trend for the US dollar. However, between March and December 2022, the estimated ”excess” share of CNY started rising steadily from month to month, as payment systems and mechanisms were being set up. This gradual increase in the use of CNY is mirrored by an equally gradual and significant decline in the share of US dollar in China-Russia trade relative to what could be expected based on broad import patterns. The next subsections further zoom in on the use of CNY as a vehicle currency in Russia’s imports.

2.5 Zooming in on importing firms

Historically, the numbers of firms dealing with invoices in a given currency (USD, EUR, CNY or RUB) in a given month have been fairly stable over time (see Figure 4). However, after the introduction of sanctions, the number of firms dealing with invoicing in CNY started to increase rapidly, while the numbers dealing with USD and EUR declined. Many of the firms dealing with CNY invoices were newly established (see Figure 5). In fact, the entry rate among firms dealing with invoicing in CNY has far exceeded the entry rate for importers dealing with other currencies. When it comes to rouble invoicing, we document a high turnover of firms: more firms started working with rouble invoicing even as the share of rouble invoicing declined while many firms have exited the business of rouble invoicing.

In Table 2 we further look at firms that deal with invoices in a given number of currencies (1, 2, 3 or 4 and more) in a given period (March-December 2021, the pre-sanctions baseline, versus March-December 2022, the sanctions period). Under sanctions, the shares of firms dealing in 4 or more currencies, 3 currencies and 2 currencies increased notably while the share of firms working in a single currency declined from 73 to 65 percent. The proportion of firms dealing with invoices in multiple currencies when importing the same product from the same country increased from 2.8 percent to 6.8 percent within a year.

To trace the typical switches in terms of currency of invoicing dealt with, we focus on the vast majority of firms that dealt with a single currency in 2021 when importing a given product from a given country and look at the probabilities of using a given currency in the corresponding import operations the next year (see Table 3 where rows add up to 100 percent). Unsurprisingly most firms continue dealing in the same currency but while this is true for 94 percent of firms using CNY as a vehicle currency, this holds for only 86 percent of firms dealing with the US dollar as a vehicle currency. The dominant switching patterns if from USD as a vehicle currency to CNY as a producer or vehicle currency (conditional probability of 12.5 percent). In addition, a notable share of firms historically using the rouble (local currency) switched to the euro as a vehicle currency (conditional probability of 8.5 percent, up to 11 percent including the euro as a producer currency).

3 Empirical specification

3.1 Mechanisms

In the next sections we investigate various mechanisms that may be behind the shift towards CNY and producer currencies and away from the US dollar as a vehicle currency following the introduction of trade sanctions.

Switching away from the US dollar (and the euro) may be in part driven by concerns about secondary sanctions. Indeed, in 2023 the US sanctioned a number of traders across multiple jurisdictions, from the Kyrgyz Republic to the UAE, for their role in facilitating trade in sanctioned goods with Russia. In this case, we can expect alternative currencies to disproportionately displace the US dollar in trades involving sanctioned products, in particular those classified as dual-use or crucial for industrial capacity. In addition, displacement may also be greater in the case of intermediated trade – trade by neutral traders but with a paper trail connecting it to sanctioning jurisdictions, either because goods were manufactured there or because trademarks (intellectual property) are owned by holding companies in sanctioning jurisdictions. This would hold irrespective of the characteristics of the importer – its size or ownership, for instance.

Alternatively, trade sanctions and the associated compliance checks may drive up the complexity and cost of making cross-border payments in US dollars across the board (consistent with evidence in Crozet and Hinz (2020)). These costs are largely fixed costs that apply per transaction and (or) per bank customer (when it comes to certain know-your-customer compliance procedures). They are thus likely to affect small importers to a greater extent and discourage small orders to a greater extent than large orders, irrespective of product characteristics.

Some importers may have been previously using other currencies, notably CNY, to invoice their exports. They may have additional incentives to hedge their cash flow and / or utilize available liquidity by seeking to pay imports in CNY.

On a related note, financial infrastructure may matter and, in particular, whether the partner economy has an active currency swap line with the People’s Bank of China.

To contrast these mechanisms empirically, we work with a fine where each observation is specific to an importer firm, month, partner country and product group (HS6). This grid enables us to saturate specifications with comprehensive sets of fixed effects and thus isolate various mechanisms. For example, we can zoom in on the role of firm characteristics while controlling for the types of goods

traded and partner countries and, conversely, zoom in on the currencies of invoicing used by the same firms to pay for different products.

3.2 Firm-level difference-in-difference analysis

Our analysis will typically focus on the shares of Russia’s imports of product p by firm f from trading partner i in a given month t that are denominated in a particular currency. We will tend to consider each currency or type of currency separately. The share of imports will be typically calculated in terms of value, though we will also consider shares calculated in terms of the number of import records.

We will follow a difference-in-difference approach with comprehensive sets of fixed effects. We start by looking at the role of different trading partners and their characteristics. In this case, we estimate the following specification:

$$CurrencyShare_{ipft} = \beta_1 PostSanctions_t * CountryGroup_i + \alpha_{ipf} + \alpha_{pft} + \epsilon_{ipft} \quad (2)$$

We distinguish between the pre-sanction and the post-sanction period (the latter defined from March 2022 onwards) by means of an indicator variable $PostSanctions_t$. In first instance, we group countries depending on whether they participated in sanctions, with sanctioning economies forming the base group. We separate China from the rest of neutral economies given China’s role as Russia’s main trading partner under sanctions and our interest in CNY. For country groupings, see Annex Table A1.

In other cases, we estimate similar specifications where we interact the post-sanctions dummy with dummy variables for various product types or firm characteristics.

Across specifications, we look at the use of CNY as a producer currency (focusing on trade with China), CNY as a vehicle currency (focusing on trade with all other economies), USD as a vehicle currency, EUR as a vehicle currency, other producer currencies (excluding CNY, USD and EUR) and the rouble.¹

¹Vehicle currencies other than USD, EUR and CNY accounted for less than 0.5 percent of third-country trade with Russia. In addition to the US and the euro area, a number of economies use the US dollar and the euro as domestic currencies, for example Panama, Ecuador, Kosovo and Montenegro. In these cases the US dollar and the euro are considered to be producer currencies.

4 Results

4.1 Is there a shift to invoicing in producer currencies of neutral economies?

The broad trends, discussed in section 2.3, pointed to an increased usage of exporter currencies by China, UAE, India and Turkiye. We start by testing for broader shifts towards the use of producer currencies in trade with economies that did not participate in sanctions. We test this further in a difference-in-difference framework (see Table 4, where sanctioning economies represent the omitted category).

In the case of Russian imports from China, the within-firm use of producer currency (CNY) increased by an extra 16 percentage points under sanctions (relative to pre-invasion trade and trade with other economies, Column 1). This effect is statistically significant at the 1 percent level and is mirrored by the large drop in the share of the US dollar (Column 2) and a small drop in the use of the euro (Column 3).

Statistically significant differential increases in the use of producer currencies are observed for other neutral partners, mirroring stylized facts established earlier for India, the UAE and Turkiye. These increases are mirrored by the lower shares of US dollar (which decreased differentially by 3-4 percentage points).

4.2 Do swap lines help CNY to gain ground as a vehicle currency?

Prior to 2022, the use of CNY as a vehicle currency in Russia's imports was very uncommon (see Figure 2). Over the course of 2022, the share of CNY-denominated imports with third countries increased from 0.7 percent in January to 5.3 percent in December (see Annex Figure A4). What drivers were behind this trend?

Motivated by the work of Bahaj and Reis (2020) who argue that swap lines can be instrumental to jump-starting an international currency and by the earlier observation that the top users of CNY tend to have swap lines with the People's Bank of China, we further investigate this question in a difference-in-difference setting.

Swap lines make it easier for an exporter in a third country to use renminbi received from, say, a Russian importer. We update a list of swap lines in Bahaj and Reis (2020) using information from the People's Bank of China (PBOC) website (see Annex Table A2 for a list).

In the analysis, we focus on the share of trade invoiced in CNY. This share is calculated either in terms

of value or the number of transactions. We distinguish between China, economies with a swap line with PBOC, and economies without such a swap line. Among economies with a swap line, we further distinguish between those that imposed trade sanctions on Russia (a total of 31 economies) and neutral economies (a total of 25 jurisdictions).² Although the establishment of swap lines is not random as far as China’s trade patterns are concerned, it is arguably unrelated to Russia’s trade with third countries.

The specification represents a modified version of Equation 2 accounting for the fact that the swap line indicator (*Swapline*) varies by country-month and the equation thus includes all possible interactions between the swap line indicator, the country groups and the sanctions period. As far as country groups are concerned, we distinguish between sanctioning economies, China and other neutral economies (*CountryGroup*). The results are summarized in Table 5.

$$\begin{aligned}
\text{CurrencyShare}_{ipft} = & \beta_1 \text{PostSanctions}_t * \text{CountryGroup}_i * \text{Swapline}_{it} \\
& + \beta_2 \text{PostSanctions}_t * \text{Swapline}_{it} + \beta_3 \text{PostSanctions}_t * \text{CountryGroup}_i \\
& + \gamma_1 \text{CountryGroup}_i * \text{Swapline}_{it} + \gamma_2 * \text{Swapline}_{it} + \alpha_{ipf} + \alpha_{pft} + \epsilon_{ipft}
\end{aligned} \tag{3}$$

Under sanctions, the share of Russia’s CNY-denominated imports from economies with a CNY swap line (irrespective of their position on sanctions) was around 0.6 percentage points higher than could otherwise be expected at the firm level (Column 1). No positive impact of having a swap line is visible prior to the invasion. In part, this may reflect the fact that this effect is identified only based on a small subset of economies where a swap line was introduced after 2016 (for almost four fifth of economies, pre-existing swap lines are subsumed in the country fixed effect).

In column 3, we distinguish between countries participating in sanctions versus other countries. The effect of a swap line on the currency of invoicing in the post-sanction trade with Russia is only observed for economies that did not impose trade sanctions themselves. For these economies, the within-firm effect is larger, at 2.3 percentage points (Column 3). For the sanctioning economies, the corresponding effect is a fairly precisely estimated zero (this effect is defined by the sum of coefficients on the interaction term between the swap line and the post-war period, the swap line and a dummy for the sanctioning economies and the triple interaction term).

The results are thus consistent with an interplay of the sanctions regime and the existence of CNY swap lines nudging exporters towards contracts invoiced in CNY.

The combined effect of PBOC swap lines and trade sanctions can be larger if one accounts for both

²The ECB-PBOC swap line is assigned to all euro zone countries.

within-firm effects (reported above) and the turnover of firms (as firms tend to specialize in trading partners and currencies of invoicing). We thus look at trade aggregated across products and firms and calculated by country-month in column 5. Specifications similar to Equation 3 now include country and month fixed effects. The estimated effect of the swap lines is around two times larger (4.5 percent) and similarly only present for neutral economies.

This effect can also be traced in an event study format (see Figure 6, noting that the left panel (sanctioning economies) and the right panel (neutral economies) are on different scales). In this event study, we utilize a simplified two-way fixed-effects model additionally interacting the term of interest with month-specific dummy variables.

4.3 Is USD used less in trade in sanctioned goods?

Next, we turn to the role of the threat of secondary sanctions. In particular, this threat may reduce the likelihood of US dollar being used as a vehicle currency in trades involving internationally sanctioned products and / or paper trail leading to an entity in a sanctioning economy, be it manufacturer or trademark owner.

The dramatic drop of European exports to Russia was partially compensated for by an increase in exports from China and Turkiye. This effect was particularly pronounced for goods subject to the EU sanctions, though it is worth noting that neither China nor Turkiye participate in sanctions (Chupilkin et al. (2023)). Does the choice of currency of invoicing in trade with neutral economies depend on the type of goods traded? This is the question to which we turn next.

Consider China's exports to Russia first. Although the share of CNY-invoiced imports in Russia's total imports has increased for goods not under EU sanctions, the increase appears to be larger in the case of sanctioned goods (see Annex Figure A5 which distinguishes between four segments of trade, depending on the use of CNY or other currency of invoicing and whether the goods were on the EU sanctions list or not).

In a difference-in-difference framework, we consider several groups of sanctioned products – dual-use, industrial, luxury goods as well as non-sanctioned products (*Product*). In these specifications we control for country-product-firm fixed effects and country-firm-month fixed effects that capture, among other things, any particularities of invoicing of a firm's trade in a given product in general as well as particularities of invoicing of a given firm in a post-sanctions period that hold for a given trading partner across various products. We thus zoom in on differences that can be attributed to traded products while controlling for firm and country characteristics. The estimating equation is similar to

the one used in the previous exercise:

$$CurrencyShare_{pitf} = \beta PostSanctions_t * Product_p + \alpha_{ift} + \alpha_{pif} + \epsilon_{pitf} \quad (4)$$

The product group ("treated") indicator here captures products under various types of sanctions (dual use, industrial-capacity and luxury goods). The results are presented in Table 6.

In the case of trade in industrial and dual-use goods, the additional decline in within-firm share of trade invoiced in USD is mirrored by an increased use of CNY as producer currency and, in the case of dual-use goods, an increased use of CNY as a vehicle currency.

While within-firm magnitudes are relatively small, they become sizable when looking at within-firm and across-firm effects. As before, we estimate specifications similar to Equation 4 while aggregating data by product-country-month and including country-month and country-product fixed effects. The results are presented in Annex Table A6, Columns 1-3.

$$CurrencyShare_{pit} = \beta PostSanctions_t * Product_p + \alpha_{it} + \alpha_{pi} + \epsilon_{pit} \quad (5)$$

The use of USD as a vehicle currency in trade in dual-use products differentially declined by 1.1 percentage points while the use of CNY as a vehicle currency increased by 0.6 percentage points (the effects are statistically significant at the 1 percent level).

In China-Russia bilateral trade (Column 1), the use of CNY in trade in dual-use and industrial goods increased by an additional 6-7 percentage points compared with the pre-sanctions period and trade in non-sanctioned goods after the invasion.

4.4 Is US dollar used less in intermediated trade?

The introduction of trade sanctions on exports to Russia resulted in a dramatic drop in European exports to Russia and a rise of intermediated trade, that is trade routed via neutral countries (see Chupilkin et al. (2023) and Chupilkin et al. (2024)).

Intermediated trade involves exports of goods with paperwork that in some way involves sanctioning economies: these goods either originate in a sanctioning economy (for example, machinery

manufactured in Japan and exported from China) or are traded under a trademark registered in a sanctioning economy (for example, smartphones under a major US-registered brand manufactured in China and exported by a trader in the UAE in lieu of the usual distributor registered of in Ireland).

In contrast, neutral trade involves goods originating in neutral economies under neutral brands exported by traders in neutral jurisdictions (for instance, Lenovo laptops). To distinguish between neutral and intermediated trade we use information on trademarks provided as part of import transaction and follow the approach in Chupilkin et al. (2024) to identify Western trademarks as trademarks that were majority-exported by traders in sanctioning jurisdictions in 2016-21.

We focus on imports from neutral economies during the sanctions period when the distinction between intermediated and neutral trade became meaningful (intermediated trade was sparse before sanctions, see Chupilkin et al. (2024) for a discussion). We aggregate data by product, country, month, firm and type of trade (intermediated or neutral, denoted n). The modified specification takes the following form:

$$CurrencyShare_{pitfn} = \beta Intermediated_n + \alpha_{pitf} + \alpha_{pifn} + \epsilon_{pitfn} \quad (6)$$

We are interested in the coefficient on the dummy variable for intermediated trade. The specification includes product-country-firm and product-country-month fixed effects. The identification thus comes from differences in the currency of invoicing used in intermediated versus trade when it comes to imports of the same product by the same firm from the same partner country during the post-sanction period, also controlling for any product-country trends over time. The results are presented in Table 7.

These results point towards a flight away from using US dollars in transactions involving intermediated trade, with greater use of producer currencies of neutral economies in general and CNY in particular, both as producer currency and as a vehicle currency.

4.5 What kind of firms invoice imports in CNY?

We extend the regression analysis to shed light on the choice of the invoicing currency by different types of firms. In particular, we investigate whether the shift towards the use of renminbi and other alternative currencies after the introduction of sanctions was led by large companies, systemically important firms, state-owned enterprises (SOE) or new firms.

We measure firm size with the logarithm of total firm-level imports, taking the maximum value across

calendar years. We further identify 1,186 state-owned importers in our sample (those with state ownership in excess of 25 percent) based on information about ultimate owners in Bureau van Dijk’s Orbis database. We also identify 705 privately-owned importers that appear on the list of systemically important (strategic) firms published by the Russia’s Ministry of Economic Development. The enterprises on this list are important producers and employers in their industry, their region or their market (as defined by the competition authority) or if they are considered to be important for national defence, advanced technologies, information and telecommunication technologies or transport connectivity (the list also includes an additional 167 state-owned systemic importers). We define new firms as firms that are neither state-owned nor systemic and first appear in the dataset within the 12-month window preceding the transaction (for example, firms appearing between February 2019 and January 2020 for the first time are counted as new in January 2020).

We estimate a similar equation interacting the post-sanctions dummy with various firm characteristics and control for other factors that matter for invoicing under sanctions through inclusion of interacted fixed effects (product-country-month and firm-product-country).

$$CurrencyShare_{f_{pit}} = \beta PostSanctions_t * Firmtype_f + New_{ft} + \alpha_{pit} + \alpha_{fpi} + \epsilon_{f_{pit}} \quad (7)$$

The results, presented in Table 8, suggest that it is the firm size, rather than its systemically important or SOE status that is the best predictor of invoicing imports in CNY during the sanctions period. The coefficients on the interaction term between the systemic-firm dummy and the sanctions period is small and not statistically significant. The same holds for the interaction terms involving the state-owned dummy and the new firm dummy. In other words, the patterns of use of currency of invoicing in trade with China did not change significantly in 2022 for these firms (state-owned firms were significantly more likely to work with rouble invoices under sanctions, perhaps not surprisingly). As for the new firms, they are more likely to deal with CNY invoicing, but this is roughly equally true both before and after the imposition of sanctions.

In contrast, the coefficient on the interaction term between firm size and the sanctions-period dummy is negative and statistically significant at the 1 percent level when it comes to invoicing in CNY. It is positive and statistically significant for the share of US dollar invoices. In other words, under the sanctions, smaller firms disproportionately shifted towards paying for imports in CNY and away from paying in US dollars.

These results are consistent with increasing fixed costs and complexity of making cross-border payments

in currencies of the sanctioning economies (notably in US dollars) pushing smaller firms more strongly towards alternative currency arrangements.

4.6 Transaction size

We conduct a similar exercise looking at the size of the import order while controlling for the firm size. A single customs record in the dataset is not representative of the bank payment made by the importer – it is more akin to a single line on a supermarket receipt, in this case corresponding to a combination of a particular HS product code and a truck or a container crossing the border. To approximate an order made by an importer, we aggregate (across products) the volume of trade for a given importer, currency, partner country and month.

We take the logarithm of this transaction value (expressed in US dollars, $TransSize$) and match it back to all constituent customs records (denoted j), to be able to control for the product mix of the order, trends over time and firm characteristics. As before, we use interacted fixed effects (product-country-time and firm-product-country). The likelihood of a customs record featuring a particular currency of invoicing is estimated as a linear probability model (see Equation 8). The results are presented in Annex Table A3.

$$Currency_{fpitj} = \beta_1 PostSanctions_t * \log TransSize_j + \beta_2 \log TransSize_j + \alpha_{pit} + \alpha_{fpi} + \epsilon_{fpitj} \quad (8)$$

After the imposition of trade sanctions, larger orders are more likely to be invoiced in US dollars or euros as a vehicle currency (the magnitude of this effects is larger for the US dollar). At the same time, smaller orders are more likely to be invoiced in renminbi (as a producer currency and as a vehicle currency) or in roubles. Before the imposition of trade sanctions, if anything, the opposite patterns were observed: smaller orders were more likely to have been invoiced in US dollar as a vehicle currency while larger orders from China were more likely to be invoiced in renminbi.

These results are also consistent with higher fixed costs of making payments in US dollars (and euros) being a driver of switching towards alternative currencies.

4.7 Invoicing by exporters

Next, we investigate the extent to which currency switching by firms may be driven by a hedging motive. In particular, we look at a subset of importers in the dataset (a total of 44,889 firms) that also export their products directly. The majority of firms that deal with CNY invoicing do so only on the import side (31.4 percent of firms in the last quarter of 2022, see also Annex Figure A6). Only 0.5 percent of firms dealt with CNY invoicing of both imports and exports and a further 1.4 percent invoiced exports in CNY but did not pay for imports in renminbi.

In other words, relatively little, if any, switching from USD to CNY in import transactions reported earlier could be attributed to hedging behaviour on the part of firms invoicing their exports in CNY (or attempt by these firms to utilize spare CNY liquidity from export receipts).

Firms that start importing (but not exporting) in CNY during the sanctions period have a significantly higher conditional probability of invoicing their exports in CNY in the next quarter than firms that neither exported nor imported in CNY (6.5 and 2.3 percent, respectively), pointing to hedging behaviour and / or learning on the part of importer-exporter firms. The evidence is not fully conclusive, however, as firms only importing in CNY had a significant conditional probability of not dealing in CNY at all in the next quarter (11.6 percent, see Annex Table A4).

4.8 Discussion

Overall, the analysis suggests that the imposition of trade sanctions on Russia was followed not only by rapid changes in the geography of trade flows (as documented, for instance, in Chupilkin et al. (2023), Steinbach (2023)) but also by significant changes in the currency of invoicing. In broad terms, the use of US dollar as a dominant currency in Russia's imports has declined, while the use of producer currencies of neutral economies has become more widespread. Renminbi has become increasingly used as a vehicle currency.

As could be expected, the use of alternative currencies became more prevalent in trade with economies that did not participate in sanctions. Among neutral trading partners, the use of CNY as a vehicle currency increased significantly more in the case of countries with established swap lines with the PBOC, pointing to the importance of swap lines in promoting internationalisation of a currency.

The increases in the use of CNY were significantly more pronounced in the case of trade in industrial goods and dual-use technology goods covered by the trade sanctions imposed on Russia by Western economies and in the case of goods originating in sanctioning economies or traded under Western

trademarks and routed via neutral economies. Both results point towards the threat of secondary sanctions being a significant factor in the choice of currency of invoicing.

Keeping products and partner countries constant, smaller firms switched away from the US dollar more actively and switching was more prevalent for smaller transactions – both observations being consistent with higher fixed costs of making cross-border payments in US dollars, likely compliance-related, also impacting the choice of the currency of invoicing under sanctions. In contrast, we see no evidence of hedging behaviour by firms that both export and import playing a significant role in the choice of the currency of invoicing.

The interplay of these mechanisms means that the use of trade sanctions gradually may gradually weaken the exorbitant privilege enjoyed by the US dollar and lead to the fragmentation of international payment systems, with the emergence of alternative global currencies such as CNY.

4.9 Robustness checks

We conduct a number of robustness checks. First, we repeat the firm-level analysis on more aggregated data and the identified patterns hold. We also look at differential patterns in invoicing of sanctioned and non-sanctioned goods in bilateral monthly trade between China and Russia in a difference-in-difference setting, mirroring the general exercise and dropping the distinction between intermediated and neutral trade. In this case trade shares are calculated by product-month irrespective of whether trade involves Western trademarks or countries of origin. We find that the share of industrial and dual-use goods invoiced in CNY increased by an extra 6-8 percentage points after the invasion of Ukraine relative to what could be expected otherwise. These estimates are qualitatively similar to those obtained for neutral economies in general.

Throughout the analysis, the shares of each currency of invoicing were calculated using volumes of trade in a given month. These calculations may be affected by movements in exchange rates. The results are similar if the shares are calculated by the number of transactions using a given currency of invoicing in a given month (see, for instance, Table 5).

We also repeat the analysis of the choice of invoicing currency and CNY swap lines, looking at the countries of origin of exports rather than trading countries. This acts as a semi-placebo test: whether a country of origin has a swap line with China should not matter for the analysis, except to the extent that countries of origin and trading countries often coincide (in around 40 percent of cases). The respective coefficients are indeed close to zero and not statistically significant, as reported in Annex Table A5.

We also look at trade volumes invoiced in each currency in addition to the currency shares (see Annex Table A7). The effects typically point in the same direction. For example, for dual-use products volumes invoiced in USD dropped differentially by 11 percent while volumes invoiced in CNY as a vehicle currency and producer currencies increased sharply. Large increases in trade volumes in this case reflect the increases in the share of CNY further amplified by the rise in China-Russia trade and trade with other neutral partners. In some cases, increases in trade volumes may more than compensate for declining trade shares. This is the case for trade with neutral partners invoiced in US dollars, where volumes went up on account of trade diversion even as the share of US dollar declined.

Baseline regressions looking at the volume of trade invoiced in a given currency fail to pick up shifts on the extensive margin, for example, where trade did not take place before sanctions and was invoiced in CNY after sanctions. To account for both the intensive margin (increased use of a currency) and the extensive margin, we use the inverse hyperbolic sine transformation of the values of trade, $\log(x + \sqrt{x^2 + 1})$ (see MacKinnon and Magee (1990)). The results are qualitatively similar and the magnitudes tend to be larger than in regressions shown in Annex Table A7.

5 Conclusion

Using transaction-level data on Russia's international trade, we document a number of striking patterns with respect to the choice of currency of invoicing in the aftermath of Russia's invasion of Ukraine in 2022. The share of Russia's imports denominated in renminbi increased by 17 percentage points. The dominant switching behaviour was for importing firms to move from paying in USD as a vehicle currency to paying in CNY as a producer or vehicle currency.

The use of renminbi as a vehicle currency increased by an extra 4 percentage points, on average, for trading partners that have an active renminbi swap line. This effect, however, is present only for third countries that did not impose economic sanctions on Russia.

The increase in CNY invoicing was more pronounced for trade in internationally sanctioned dual-use (and industrial) goods as well as "intermediated" trade in goods with links to sanctioning economies, pointing to the role likely played by the perceived threat of secondary sanctions being imposed on entities facilitating trade in internationally-sanctioned goods.

The number of Russian importing firms working with renminbi invoices has increased sharply, mirrored by a drop in numbers of firms dealing with USD and EUR invoicing. This may reflect the rising fixed costs of clearing US dollar payments under sanctions, owing to increased compliance checks. Consistent

with this mechanism, switching away from the US dollar is estimated to be more prevalent for smaller firms and in the case of smaller transactions. We do not find evidence that switching was driven by the hedging motive among firms already exporting in CNY.

The analysis covers a relatively small part of international trade – bilateral transactions of the 11th largest economy in the world. At the same time, by revealing rapid shifts in the choice of currency of invoicing in response to trade and financial sanctions imposed on Russia, the paper invites further research into ways in which the use of major international currencies responds to sanctions.

The analysis also illustrates a broader point: rising geopolitical tensions in general, and the use of trade sanctions in particular, may reduce the attractiveness of the use of US dollar as a vehicle currency in international trade and facilitate the rise of new international currencies as well as greater use of producer or importer currency to settle trades. This, in turn, might lead to a greater fragmentation of global payment systems and reduce the effectiveness of economic sanctions in the future.

References

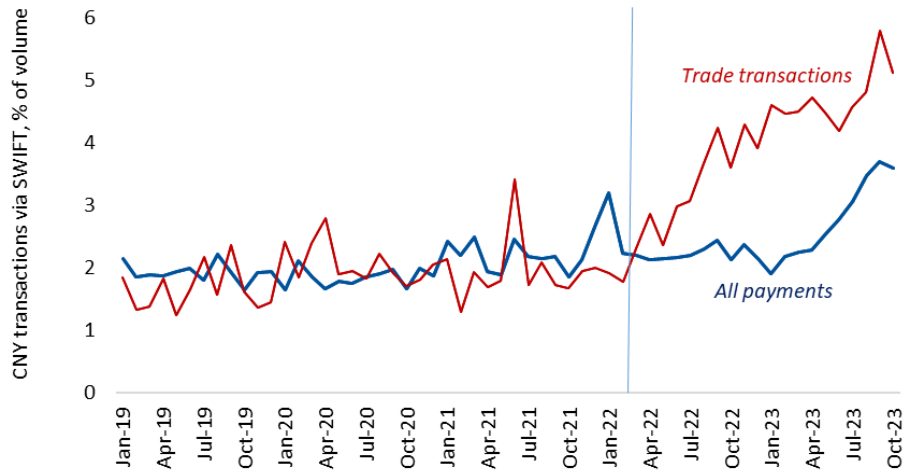
- Ahn, Daniel P., and Rodney D. Ludema (2020) ‘The sword and the shield: The economics of targeted sanctions.’ *European Economic Review* 130, 103587
- Amiti, Mary, Oleg Itskhoki, and Jozef Konings (2022) ‘Dominant currencies: How firms choose currency invoicing and why it matters.’ *The Quarterly Journal of Economics* 137(3), 1435–1493
- Arslanalp, Serkan, Barry Eichengreen, and Chima Simpson-Bell (2022) ‘The stealth erosion of dollar dominance and the rise of nontraditional reserve currencies.’ *Journal of International Economics* 138, 103656
- Babina, Tania, Benjamin Hilgenstock, Oleg Itskhoki, Maxim Mironov, and Elina Ribakova (2023) ‘Assessing the impact of international sanctions on Russian oil exports.’ CEPR discussion paper 58455, Centre for Economic Policy Research
- Bacchetta, Philippe, and Eric van Wincoop (2005) ‘A theory of the currency denomination of international trade.’ *Journal of International Economics* 67(2), 295–319
- Bahaj, Saleem, and Ricardo Reis (2020) ‘Jumpstarting an international currency.’ Bank of England working papers 874, Bank of England, June
- Berthou, Antoine (2023) ‘International sanctions and the dollar: Evidence from trade invoicing.’ Banque de France Working Paper 294, Banque de France

- Besedeš, Tibor, Stefan Goldbach, and Volker Nitsch (2017) ‘You’re banned! The effect of sanctions on German cross-border financial flows.’ *Economic Policy* 32(90), 263–318
- Bianchi, Javier, and César Sosa-Padilla (2023) ‘International sanctions and dollar dominance.’ NBER Working Paper 31024, National Bureau of Economic Research
- Boz, Emine, Camila Casas, Georgios Georgiadis, Gita Gopinath, Helena Le Mezo, Arnaud Mehl, and Tra Nguyen (2022) ‘Patterns of invoicing currency in global trade: New evidence.’ *Journal of International Economics* 136, 103604
- Chupilkin, Maxim, Beata Javorcik, Aleksandra Peeva, and Alexander Plekhanov (2024) ‘Decision to leave: Economic sanctions and intermediated trade.’ EBRD Working Paper Forthcoming, European Bank for Reconstruction and Development
- Chupilkin, Maxim, Beata Javorcik, and Alexander Plekhanov (2023) ‘The Eurasian roundabout: Trade flows into Russia through the Caucasus and Central Asia.’ EBRD Working Paper 276, European Bank for Reconstruction and Development
- Clayton, Christopher, Amanda Dos Santos, Matteo Maggiori, and Jesse Schreger (2022) ‘Internationalizing like China.’ NBER Working Papers 30336, National Bureau of Economic Research, Inc
- Coppola, Antonio, Arvind Krishnamurthy, and Chenzi Xu (2023) ‘Liquidity, debt denomination, and currency dominance.’ Working Paper 30984, National Bureau of Economic Research, February
- Crozet, Matthieu, and Julian Hinz (2020) ‘Friendly fire: The trade impact of the Russia sanctions and counter-sanctions.’ *Economic Policy* 35(101), 97–146
- Crozet, Matthieu, Julian Hinz, Amrei Stammann, and Joschka Wanner (2021) ‘Worth the pain? Firms’ exporting behaviour to countries under sanctions.’ *European Economic Review* 134, 103683
- Drott, Constantin, Stefan Goldbach, and Volker Nitsch (2023) ‘The effects of sanctions on Russian banks in Target2 transactions data.’ Technische Universität Darmstadt Working Paper, Technische Universität Darmstadt
- Efing, Matthias, Stefan Goldbach, and Volker Nitsch (2023) ‘Freeze! Financial sanctions and bank responses.’ *The Review of Financial Studies* p. Forthcoming
- Felbermayr, Gabriel, Aleksandra Kirilakha, Constantinos Syropoulos, Erdal Yalcin, and Yoto V. Yotov (2020) ‘The global sanctions data base.’ *European Economic Review* 129, 103561
- Georgiadis, Georgios, Helena Le Mezo, Arnaud Mehl, and Cedric Tille (2021) ‘Fundamentals vs. policies: Can the US dollar’s dominance in global trade be dented?’ GRU Working Paper 28, City University of Hong Kong

- Goldberg, Linda S., and Cédric Tille (2008) ‘Vehicle currency use in international trade.’ *Journal of International Economics* 76(2), 177–192
- (2016) ‘Micro, macro, and strategic forces in international trade invoicing: Synthesis and novel patterns.’ *Journal of International Economics* 102, 173–187
- Gopinath, Gita, and Jeremy C Stein (2020) ‘Banking, trade, and the making of a dominant currency.’ *The Quarterly Journal of Economics* 136(2), 783–830
- Gopinath, Gita, Emine Boz, Camila Casas, Federico J. Díez, Pierre-Olivier Gourinchas, and Mikkel Plagborg-Møller (2020) ‘Dominant currency paradigm.’ *American Economic Review* 110(3), 677–719
- Gopinath, Gita, Oleg Itskhoki, and Roberto Rigobon (2010) ‘Currency choice and exchange rate pass-through.’ *American Economic Review* 100(1), 304–36
- Gourinchas, Pierre-Olivier, Helene Rey, and Nicolas Govillot (2010) ‘Exorbitant privilege and exorbitant duty.’ IMES Discussion Paper Series 10-E-20, Institute for Monetary and Economic Studies, Bank of Japan
- Hinz, Julian, and Evgenii Monastyrenko (2022) ‘Bearing the cost of politics: Consumer prices and welfare in Russia.’ *Journal of International Economics* 137, 103581
- Isakova, Asel, Zsoka Koczan, and Alexander Plekhanov (2016) ‘How much do tariffs matter? Evidence from the customs union of Belarus, Kazakhstan and Russia.’ *Journal of Economic Policy Reform* 19(2), 166–184
- Korovkin, Vasily, and Alexey Makarin (2023) ‘Conflict and intergroup trade: Evidence from the 2014 Russia-Ukraine crisis.’ *American Economic Review* 113(1), 34–70
- MacKinnon, James G., and Lonnie Magee (1990) ‘Transforming the dependent variable in regression models.’ *International Economic Review* 31(2), 315–339
- Mukhin, Dmitry (2022) ‘An equilibrium model of the international price system.’ *American Economic Review* 112(2), 650–88
- Peeva, Aleksandra (2019) ‘Did sanctions help Putin?’ Discussion Papers 2019/7, Free University Berlin, School of Business Economics
- Steinbach, Sandro (2023) ‘The Russia-Ukraine war and global trade reallocations.’ *Economics Letters* 226, 111075
- Tyazhelnikov, Vladimir, John Romalis, and Yongli Long (2023) ‘Russian counter-sanctions and smuggling: Forensics with structural gravity estimation.’ Working Paper, University of Sydney

Yang, Jiawen, Hossein Askari, John Forrer, and Lili Zhu (2009) ‘How do us economic sanctions affect EU’s trade with target countries?’ *The World Economy* 32(8), 1223–1244

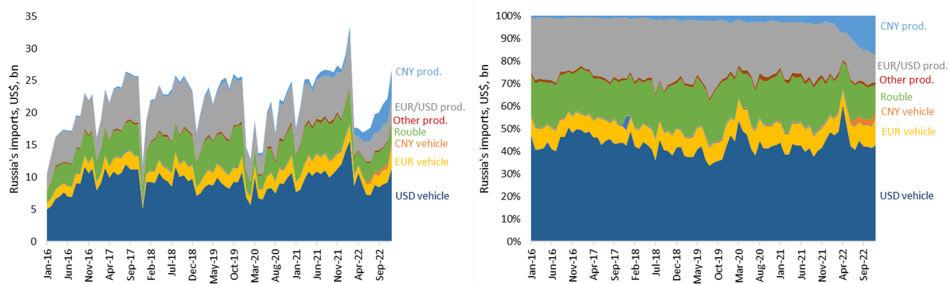
Figure 1: Share of CNY in SWIFT transactions



Source: SWIFT RMB tracker.

Note: The figure shows the share of SWIFT messages (by value) accounted for by CNY, for all messages and trade-related messages.

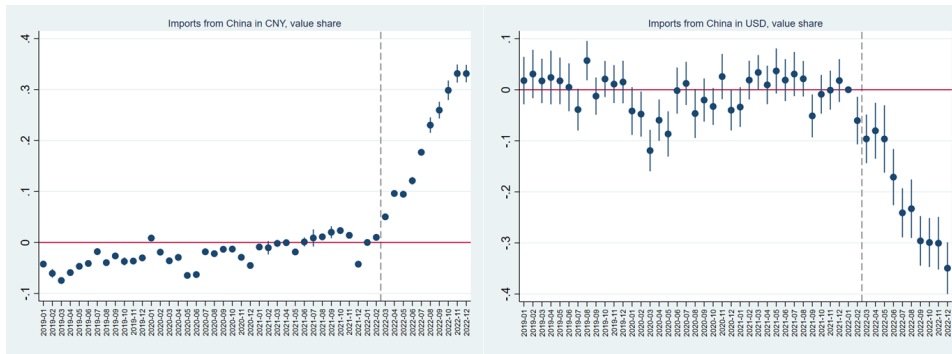
Figure 2: Share and volume of import transactions, by currency of invoicing



Source: Authors’ calculations.

Note: The shares and volumes are calculated by month, by number of transactions.

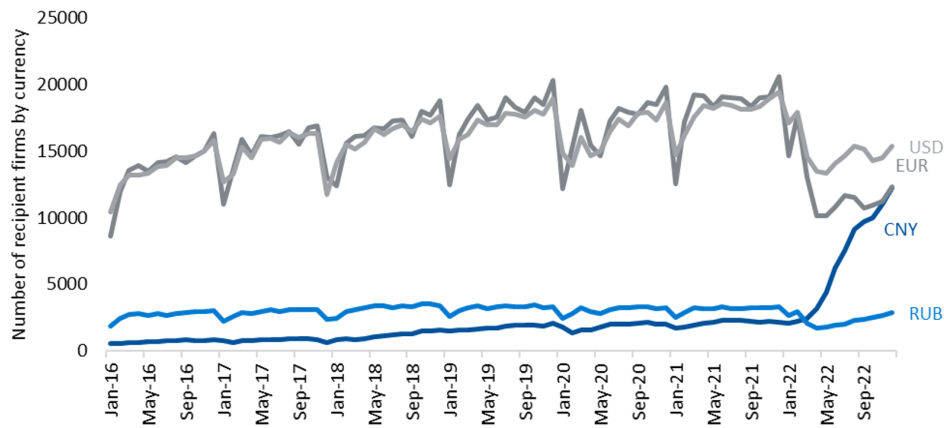
Figure 3: Event study estimates



Source: Authors' calculations.

Note: The plots show regression coefficients on interaction terms between China dummy and dummy variables for each month. Linear regressions of the share of Russia's imports in bilateral trade in a given month denominated in producer currency and in USD, respectively, on month and country fixed effects. 95 percent confidence intervals are based on standard errors clustered two-way on countries and months.

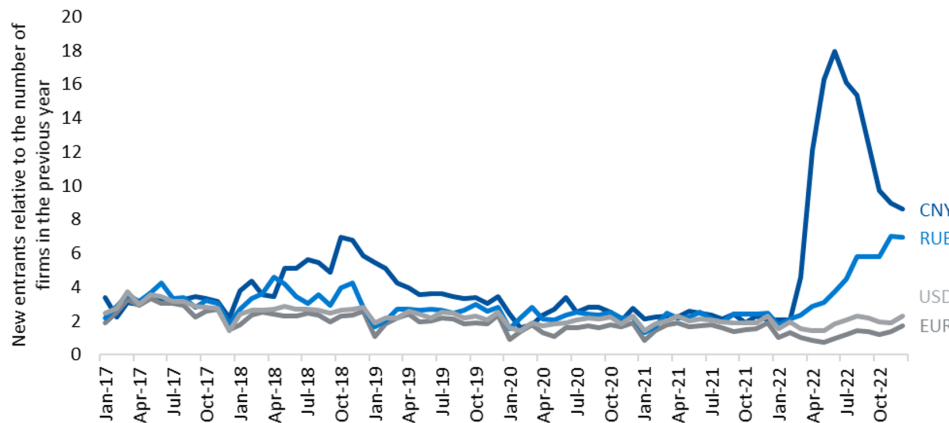
Figure 4: Number of importers dealing with invoicing in each currency



Source: Russia customs data and authors' calculations.

Note: Importers are identified by their unique tax id.

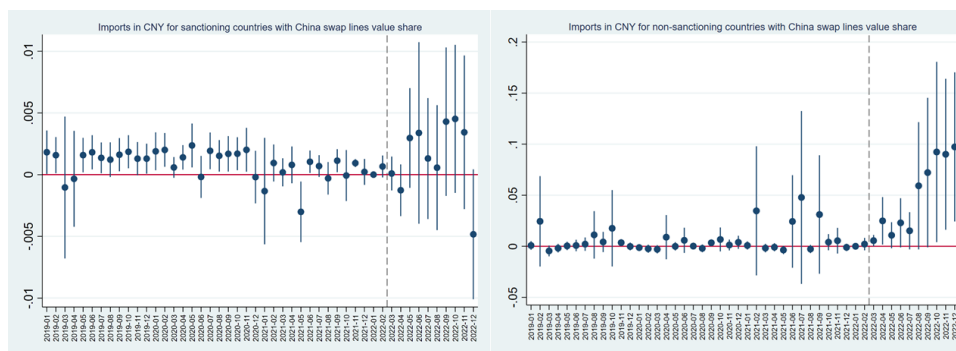
Figure 5: Number of new importers dealing with invoicing in each currency



Source: Russia customs data and authors' calculations.

Note: Importers are identified by their unique tax id. A new firm is one that has not conducted import operations in the preceding 12 months.

Figure 6: Combined effect of PBOC swap lines and trade sanctions: Event study estimates



Source: Authors' calculations.

Note: The plots show regression coefficients on interaction terms between dummy variables for sanctioning (left) or non-sanctioning (right) economy with a PBOC swap line dummy and dummy variables for each month. Linear regressions of the share of Russia's imports in bilateral trade in a given month denominated in CNY on month and country fixed effects. 95 percent confidence intervals are based on standard errors clustered two-way on countries and months.

Table 1: Descriptive statistics

<i>Variables</i>	Mean	Median	St. dev.	Min	Max
Producer currency share, by volume	0.13	0.00	0.28	0.00	1.00
Local currency share, by volume	0.13	0.00	0.24	0.00	1.00
USD currency share, by volume	0.61	0.79	0.40	0.00	1.00
EUR currency share, by volume	0.24	0.05	0.33	0.00	1.00
CNY currency share, by volume	0.005	0.00	0.04	0.00	1.00
Producer currency share, by frequency	0.14	0.00	0.29	0.00	1.00
Local currency share, by frequency	0.12	0.00	0.23	0.00	1.00
USD currency share, by frequency	0.60	0.77	0.40	0.00	1.00
EUR currency share, by frequency	0.26	0.07	0.34	0.00	1.00
CNY currency share, by frequency	0.004	0.00	0.03	0.00	1.00
Producer currency trade volume, log	15.41	16.26	3.64	0.72	22.23
Local currency trade volume, log	15.56	15.98	2.99	-0.02	21.48
USD currency trade volume, log	14.91	15.45	3.32	0.86	21.94
EUR currency trade volume, log	14.77	14.84	3.19	0.59	21.76
CNY currency trade volume, log	12.95	12.52	2.87	-0.12	22.23

Source: Authors' calculations based on customs data.

Note: Shares are calculated based on bilateral imports in a given month in a given currency of invoicing over the period Jan 2016-Dec 2022.

Table 2: Share of importing firms, by number of different currencies of invoicing used

Number of currencies	1	2	3	4+
By importing firm				
<i>March-December 2021</i>				
Import value	21.1	23.1	21.4	34.3
Transaction records	25.5	28.2	21.7	24.6
Number of firms	72.9	20.9	4.8	1.4
<i>March-December 2022</i>				
Import value	22.4	25.3	23.4	29.0
Transaction records	32.8	29.9	19.1	18.2
Number of firms	64.8	24.4	8.4	2.3
By importing firm, product group and partner country				
<i>March-December 2021</i>				
Import value	77.9	13.0	1.1	8.1
Transaction records	86.8	12.0	0.9	0.3
Number of firms	97.2	2.7	0.1	0.0
<i>March-December 2022</i>				
Import value	78.9	19.6	1.4	0.1
Transaction records	79.5	17.4	2.9	0.2
Number of firms	93.2	6.6	0.2	0.0

Source: Authors' calculations.

Note: Each panel shows the share of firms dealing with 1, 2, 3 or 4 and more different currencies of invoicing during the period shown. Rows add up to 100% and show shares of these firms by number of firms, number of customs transaction records and the total value of imports. Top panels track the number of currencies used by each firm; the bottom panels track the number of currencies used by a firm for a combination of HS6 product group and partner country.

Table 3: Probability of working with imports in a given currency conditional on previously working with imports in a certain currency

Mar-Dec 2021	March-December 2022						
	CNY producer	CNY vehicle	USD vehicle	EUR vehicle	EUR/USD producer	Other	RUB
CNY producer	97.8	0.0	1.9	0.1	0.0	0.0	0.2
CNY vehicle	0.0	94.1	5.5	0.1	0.2	0.0	0.1
USD vehicle	11.1	1.4	85.8	0.6	0.3	0.4	0.4
EUR vehicle	1.0	0.8	3.1	93.6	0.1	0.6	0.7
EUR/USD producer	0.0	0.0	0.5	0.0	99.4	0.0	0.1
Other	0.1	0.3	3.3	4.0	0.3	91.8	0.2
RUB	1.0	0.3	2.4	2.8	8.5	0.2	84.7

Source: Authors' calculations.

Note: Each column of the table shows probability of having imports invoiced in a certain currency in Mar-Dec 2022 for a given partner country and HS6 product group conditional on having had imports invoiced in a currency shown in the left column during Mar-Dec 2021. Rows correspond to invoicing patterns in 2021 and conditional probabilities in each row add up to 100%. The sample is restricted to firms that exported and imported in both years and used a single currency of invoicing for a combination of product group and country.

Table 4: Partner countries' position on sanctions and the choice of currency of invoicing

	CNY	USD vehicle	EUR vehicle	Producer	RUB
Post-sanctions x China	0.164*** (0.00441)	-0.157*** (0.00455)	-0.00681*** (0.00258)	0.192*** (0.00423)	0.0102*** (0.00137)
Post-sanctions x Neutral	0.0321*** (0.00274)	-0.0346*** (0.00396)	-0.0112*** (0.00335)	0.00853*** (0.00183)	0.00775*** (0.00150)
Observations	5,191,160	4,739,909	2,011,381	5,191,160	5,191,160
R^2	0.893	0.964	0.969	0.925	0.968

Source: Authors' calculations.

Note: Standard errors in parentheses are clustered on products. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variable is the share of transactions, by volume, in bilateral monthly imports of a given product by a given firm, invoiced in a given currency. All regressions include month-product-firm and country-product-firm fixed effects. Post-sanctions refers to the time period from March 2022 onwards. The base category are 45 economies that imposed sanctions on Russia.

Table 5: Invoicing in CNY: The role of swap lines

<i>Sample split</i>	1	2	3	4	5
<i>Dep. var.: Share of trade invoiced in CNY</i>	Swap lines Share of volume	Swap lines Share of transactions	Swap lines and sanctioning vs neutral Share of volume	Swap lines and sanctioning vs neutral Share of transactions	Swap lines and sanctioning vs neutral Share of volume, aggregated cells
Post-sanctions * Swap line	0.00649*** (0.00169)	0.00435** (0.00177)	0.0225*** (0.00448)	0.0155*** (0.00479)	0.0453*** (0.0159)
Post-sanctions * Swap line * Sanctioning			-0.0206*** (0.00451)	-0.0139*** (0.00480)	-0.0473*** (0.0172)
Post-sanctions * Sanctioning			-0.0168*** (0.00374)	-0.0224*** (0.00411)	0.00199 (0.00568)
Post-sanctions * China	0.154*** (0.00466)	0.145*** (0.00522)	0.148*** (0.00564)	0.135*** (0.00652)	0.282*** (0.0214)
Swap line	-0.00204*** (0.000417)	-0.00228*** (0.000417)	-0.00262 (0.00233)	-0.00231 (0.00235)	0.0133 (0.0108)
Swap line * Sanctioning			0.000837 (0.00236)	0.000145 (0.00239)	-0.0118 (0.0109)
Observations	5,191,160	5,193,633	5,191,160	5,193,633	12,397
R^2	0.893	0.897	0.893	0.897	0.479

Source: Authors' calculations.

Note: Standard errors are clustered on products. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. Sanctioning refers to 45 economies with sanctions on Russia, neutral are the rest. Post-sanctions refers to the time period March 2022 onwards. In columns 1-4, the dependent variable is the share of transactions, by volume, in bilateral monthly imports of a given product by a given firm, invoiced in CNY. In columns 1-4, all regressions include month-product-firm and country-product-firm fixed effects. In the last column ("aggregated cells") trade is aggregated by country * month (that is, across products and firms) and standard errors are clustered two-way on countries and months.

Table 6: Internationally sanctioned goods and the choice of currency of invoicing

<i>Dep. var.: Share of trade invoiced in the currency shown</i>	1 CNY producer	2 CNY vehicle	3 USD vehicle	4 EUR vehicle	5 Other producer	6 RUB
Post-sanctions * Dual-use	0.00227** (0.00114)	0.000337*** (0.000105)	-0.000932** (0.000404)	-0.000119 (0.000311)	0.000275 (0.000331)	0.000116 (0.000175)
Post-sanctions * Industrial	0.00455*** (0.00174)	0.0000539 (0.000161)	-0.00180*** (0.000674)	0.000496 (0.000584)	0.000806 (0.000576)	-0.000102 (0.000321)
Post-sanctions * Luxury	-0.00445* (0.00233)	-0.000469 (0.000285)	0.00217** (0.000866)	0.00136** (0.000557)	0.0000815 (0.000554)	-0.00126*** (0.000301)
Observations	4,022,404	19,640,186	22,797,008	13,333,837	8,445,851	23,662,590
R^2	0.922	0.957	0.977	0.980	0.974	0.985

Source: Authors' calculations.

Note: Standard errors are clustered on product groups. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variable is the share of transactions, by volume, in bilateral monthly imports of a given product by a given firm, invoiced in a given currency. All regressions include product-country-firm and country-firm-month fixed effects. Goods under sanctions are those where EU sanction apply at least partially, post-sanctions refers to the period from March 2022 onwards. The three categories shown are mutually exclusive and cover all goods under EU sanctions.

Table 7: Currency choice in intermediated versus neutral trade

<i>Dep. var.: Share of trade invoiced in the currency shown</i>	1 CNY producer	2 CNY vehicle	3 USD vehicle	4 EUR vehicle	5 Other producer	6 RUB
Intermediated	0.0108*** (0.00256)	0.00235** (0.00109)	-0.0111*** (0.00245)	0.00400* (0.00217)	0.00194*** (0.000499)	0.000447 (0.000389)
Observations	653,601	405,170	1,057,424	1,057,297	402,349	1,058,771
R^2	0.809	0.852	0.848	0.931	0.825	0.885

Source: Authors' calculations.

Note: Standard errors are clustered on product groups. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variable is the share of transactions, by volume, in bilateral monthly trade in a certain product group, either of intermediated type or neutral type, invoiced in a given currency. Neutral exporting countries and post-sanctions period only. Intermediated trade involves goods originating in a sanctioning economy or traded under a Western trademark. All regressions include firm-product-country and product-country-month fixed effects.

Table 8: Firm characteristics and the choice of currency of invoicing under sanctions

<i>Variables</i>	CNY producer	CNY vehicle	USD vehicle	EUR vehicle	Other producer	RUB
Post-sanctions * Firm size, log	-0.00944** (0.00381)	-0.000923 (0.000677)	0.00528*** (0.00147)	0.000956* (0.000531)	-0.00258*** (0.000899)	-0.00293*** (0.000803)
Post-sanctions * New firm	-0.00494 (0.0115)	0.00156 (0.00312)	0.00419 (0.00675)	0.000687 (0.00288)	-0.00492 (0.00445)	-0.00463* (0.00250)
Post-sanctions * Strategic private	-0.0384 (0.0311)	0.00278 (0.00371)	0.0127 (0.0130)	-0.00148 (0.00466)	0.00474 (0.00393)	0.0121 (0.00790)
Post-sanctions * State-owned	-0.00403 (0.105)	0.00106 (0.00547)	0.0105 (0.0369)	-0.0256* (0.0137)	0.0233 (0.0180)	0.0180*** (0.00687)
New firm	0.0116** (0.00454)	0.000231 (0.000427)	-0.000737 (0.00168)	0.00150 (0.00138)	-0.00199 (0.00176)	-0.00101 (0.00136)
Observations	4,257,916	18,404,484	21,806,504	12,509,264	8,141,729	23,408,677
R^2	0.786	0.796	0.944	0.963	0.933	0.950

Source: Authors' calculations.

Note: Standard errors in parentheses are clustered on products. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variable is the share of imports invoiced in a given currency, observation is bilateral monthly imports at the HS6 level by a given firm. All regressions include product-country-month and product-country-firm fixed effects.

Annex

Table A1: Country groups based on sanctions and UN voting

Sanctioning	Neutral Condemned the invasion at the UN	Neutral Did not condemn
Albania	Afghanistan	Mexico
Australia	Andorra	Micronesia
Austria	Antigua and Barbuda	Moldova
Belgium	Argentina	Myanmar
Bulgaria	Bahamas	Nauru
Canada	Bahrain	Nepal
Croatia	Barbados	Niger
Cyprus	Belize	Nigeria
Czech Republic	Benin	Oman
Denmark	Bhutan	Palau
Estonia	Bosnia and Herzegovina	Panama
Finland	Botswana	Papua New Guinea
France	Brunei	Paraguay
Germany	Cambodia	Peru
Greece	Cape Verde	Philippines
Hungary	Chad	Qatar
Iceland	Chile	Rwanda
Ireland	Colombia	Saint Kitts and Nevis
Italy	Comoros	Saint Lucia
Japan	Costa Rica	Saint Vincent
Latvia	Côte d'Ivoire	Samoa
Liechtenstein	Djibouti	San Marino
Lithuania	Dominica	São Tomé and Príncipe
Luxembourg	Dominican Republic	Saudi Arabia
Malta	DR Congo	Serbia
Monaco	Ecuador	Seychelles
Montenegro	Egypt	Sierra Leone
Netherlands	Fiji	Solomon Islands
New Zealand	Gambia	Somalia
North Macedonia	Gabon	Suriname
Norway	Georgia	Thailand
Poland	Ghana	Timor-Leste
Portugal	Grenada	Tonga
Romania	Guatemala	Trinidad and Tobago
Singapore	Guyana	Tunisia
Slovakia	Haiti	Turkiye
Slovenia	Honduras	Tuvalu
South Korea	Indonesia	United Arab Emirates
Spain	Israel	Uruguay
Sweden	Jamaica	Vanuatu
Switzerland	Jordan	Yemen
Taipei China	Kenya	Zambia
Ukraine	Kiribati	
United Kingdom	Kuwait	
United States	Lebanon	
	Lesotho	
	Liberia	
	Libya	
	Malawi	
	Malaysia	
	Maldives	
	Marshall Islands	
	Mauritania	
	Mauritius	
		Abstained
		Algeria
		Angola
		Armenia
		Bangladesh
		Bolivia
		Burundi
		Central African Republic
		China
		Congo
		Cuba
		El Salvador
		Equatorial Guinea
		India
		Iran
		Iraq
		Kazakhstan
		Kyrgyzstan
		Laos
		Madagascar
		Mali
		Mongolia
		Mozambique
		Namibia
		Nicaragua
		Pakistan
		Senegal
		South Africa
		South Sudan
		Sri Lanka
		Sudan
		Tajikistan
		Tanzania
		Uganda
		Vietnam
		Zimbabwe
		Absent
		Azerbaijan
		Burkina Faso
		Cameroon
		Ethiopia
		Eswatini
		Guinea
		Guinea-Bissau
		Morocco
		Togo
		Turkmenistan
		Uzbekistan
		Venezuela
		Voted with Russia
		Belarus
		Eritrea
		North Korea
		Syria

Source: Authors based on United Nations General Assembly Resolution ES-11/1 adopted on 2 March 2022 and sanctions lists.

Table A2: CNY swap lines

Sanctioning economies					
Country	Date	Amount	Country	Date	Amount
South Korea	20.04.2009	180-400	Iceland	9.06.2010	3.5
Singapore	23.07.2010	150-300	New Zealand	18.04.2011	25
United Kingdom	22.06.2013	350	Australia	22.03.2012	200
ECB	08.10.2013	350	Hungary	09.09.2013	10-40
Canada	8.11.2014	200	Albania	12.09.2013	2
Switzerland	21.07.2014-21.07.2020	350	Ukraine	26.06.2012-10.12.2021	15
Japan	26.10.2018	200			
Neutral economies					
Country	Date	Amount	Country	Date	Amount
Hong Kong SAR	20.01.2009	200-500	Malaysia	08.02.2009	80-180
Argentina	02.04.2009	70-130	Belarus	11.03.2009	7-20
Indonesia	23.03.2009	100-250	Mongolia	06.05.2011	5-15
Kazakhstan	13.06.2011	7	Uzbekistan	19.04.2011-19.04.2014	0.7
Pakistan	23.12.2011	10-30	Thailand	22.12.2011	70
UAE	17.01.2012-14.12.2018	35	Turkiye	21.02.2012	10-35
Qatar	03.11.2014	35	Brazil	26.03.2013-26.03.2016	190
Sri Lanka	16.09.2014	10	Armenia	25.03.2015-25.03.2018	1
Chile	25.05.2015	22-50	South Africa	10.04.2015	30
Tajikistan	03.09.2015-03.09.2018	3	Morocco	11.05.2016-11.05.2019	10
Serbia	17.06.2016-17.06.2019	1.5	Egypt	06.12.2016	18
Nigeria	03.05.2018	15	Macau SAR	05.12.2019	30
Laos	20.05.2020	6			
Country	Date	Amount			
Russia	13.10.2014	150			

Source: Authors based on Bahaj and Reis (2020) and People's Bank of China.

Note: As of end-2022; amounts in CNY billion. If end date is not specified, the line is ongoing. In regression analysis ECB swap line is applied to Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, the Slovak Republic, Slovenia and Spain.

Table A3: Transaction size and the currency of invoicing

Variables	CNY producer	CNY vehicle	USD vehicle	EUR vehicle	Other producer	RUB
Post-sanctions * Transaction size, log	-0.00517*** (0.00122)	-0.00210*** (0.000626)	0.00480*** (0.000683)	0.00148*** (0.000513)	-0.000291 (0.000358)	-0.00781*** (0.000651)
Transaction size, log	0.0113*** (0.00179)	0.00000791 (4.88e-05)	-0.00169*** (0.000614)	0.00103 (0.000916)	-0.00364*** (0.000570)	0.0115*** (0.000949)
Observations	13,786,404	114,774,231	124,671,226	66,662,473	48,986,660	128,560,635
R ²	0.804	0.799	0.948	0.952	0.927	0.964

Source: Authors' calculations.

Note: Estimated by linear probability model, standard errors in parentheses are clustered on products. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. The dependent variable is an indicator variable for imports invoiced in a given currency, observation is on the level of the individual customs record. Transaction sums up imports by the same firm from the same partner country in the same month (across products). All regressions include product-country-month and product-country-firm fixed effects.

Table A4: Conditional probability of having imports and / or exports invoiced in CNY

Q3 2022	Q4 2022			
	Both	Export	import	Neither
Both	72.0	5.0	21.1	1.9
Export	23.2	57.9	9.5	9.5
Import	5.9	0.6	81.9	11.6
Neither	0.6	1.7	13.8	83.9

Q3 2021	Q4 2021			
	Both	Export	import	Neither
Both	70.2	3.5	26.3	0.0
Export	2.4	73.2	4.9	19.5
Import	2.8	0.4	83.2	13.6
Neither	0.0	0.2	1.5	98.3

Source: Authors' calculations.

Note: Each column of the table shows probability of having imports and / or exports invoiced in CNY in Q4 2022 for a given partner country and HS6 product group conditional on having had imports only, exports only, both imports and exports or neither invoiced in CNY in the previous quarter. Rows correspond to invoicing patterns in Q3 2022 and conditional probabilities in each row add up to 100%. The sample is restricted to firms that exported and imported in both quarters and used a single currency of invoicing for a combination of product group and country. The bottom panel shows a similar transition matrix for the last quarters of 2021 (pre-sanctions baseline).

Table A5: Swap lines, country of origin and the currency of invoicing (semi-placebo)

Sample split Dep. var.: Share of trade invoiced in CNY	Swap lines		Swap lines and sanctioning vs neutral	
	1 By volume	2 By number	3 By volume	4 By number
Post-sanctions * Swap line	-0.00416 (0.00604)	0.000447 (0.00695)	0.00131 (0.0102)	0.00830 (0.0128)
Post-sanctions * Swap line * Sanctioning			-0.00844 (0.0136)	-0.0149 (0.0148)
Post-sanctions * Sanctioning			-0.00141 (0.00920)	0.00154 (0.00810)
Post-sanctions * China	0.240*** (0.0125)	0.230*** (0.00703)	0.240*** (0.0147)	0.230*** (0.0101)
Swap line	-0.00164 (0.00224)	-0.000544 (0.00135)	-0.00270 (0.00186)	-0.00228 (0.00189)
Swap line * Sanctioning			0.00276 (0.00695)	0.00578 (0.00383)
Observations	15,214	15,215	15,214	15,215
R ²	0.205	0.196	0.205	0.196

Source: Authors' calculations.

Note: Standard errors in parentheses are clustered two-way on countries and months. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. All regressions include month and country fixed effects. The dependent variable is the share of transactions, by volume (or the logarithm of the volume of bilateral monthly trade) invoiced in CNY in a given month with a given group of trading partners. Trading partners are defined by the record of the country of origin instead of the record of trading firm in each transaction-level record.

Table A6: Sanctioned products and the currency of invoicing: Aggregated analysis

In the currency shown	CNY	CNY	USD	EUR	Other	RUB
	producer	vehicle	vehicle	vehicle	producer	
Post-sanctions x Dual-use	0.0628*** (0.00687)	0.00603*** (0.000664)	-0.0114*** (0.00211)	-0.00177 (0.00231)	0.00653*** (0.00132)	-0.00231 (0.00161)
Post-sanctions x Industrial	0.0670*** (0.0122)	0.00437*** (0.00122)	-0.00928** (0.00389)	-0.00287 (0.00452)	0.00403* (0.00227)	-0.00387 (0.00313)
Post-sanctions x Luxury	-0.0512*** (0.00890)	-0.00429*** (0.000782)	0.00930*** (0.00286)	0.0177*** (0.00356)	-0.00487*** (0.00177)	-0.0341*** (0.00234)
Observations	240,255	4,353,377	4,428,958	2,755,898	2,350,969	4,593,632
R ²	0.392	0.432	0.723	0.704	0.561	0.699

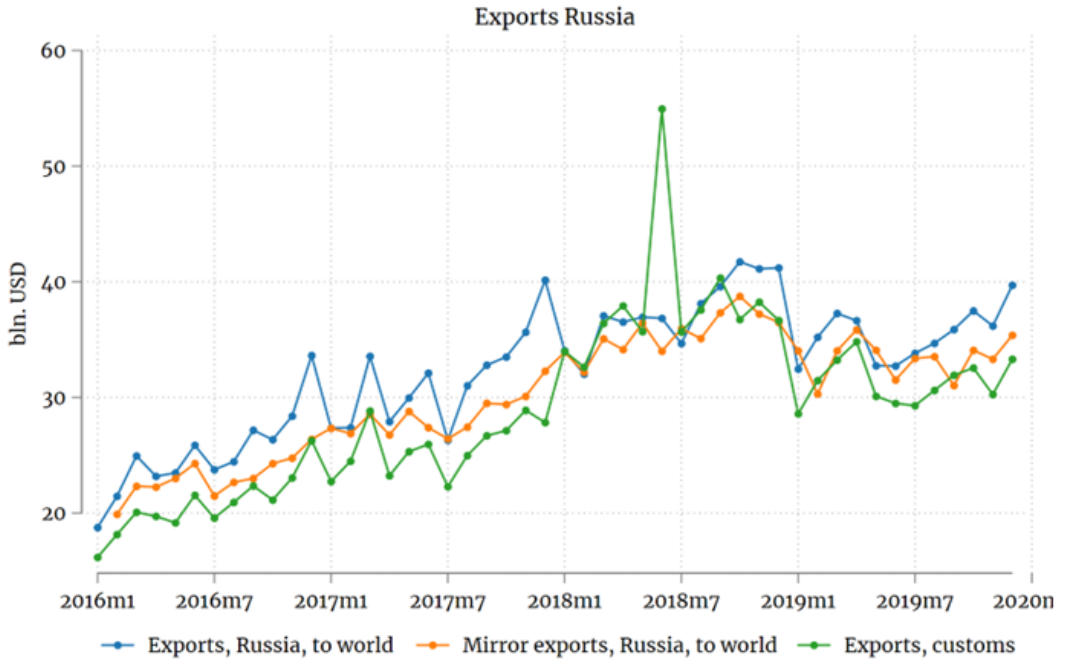
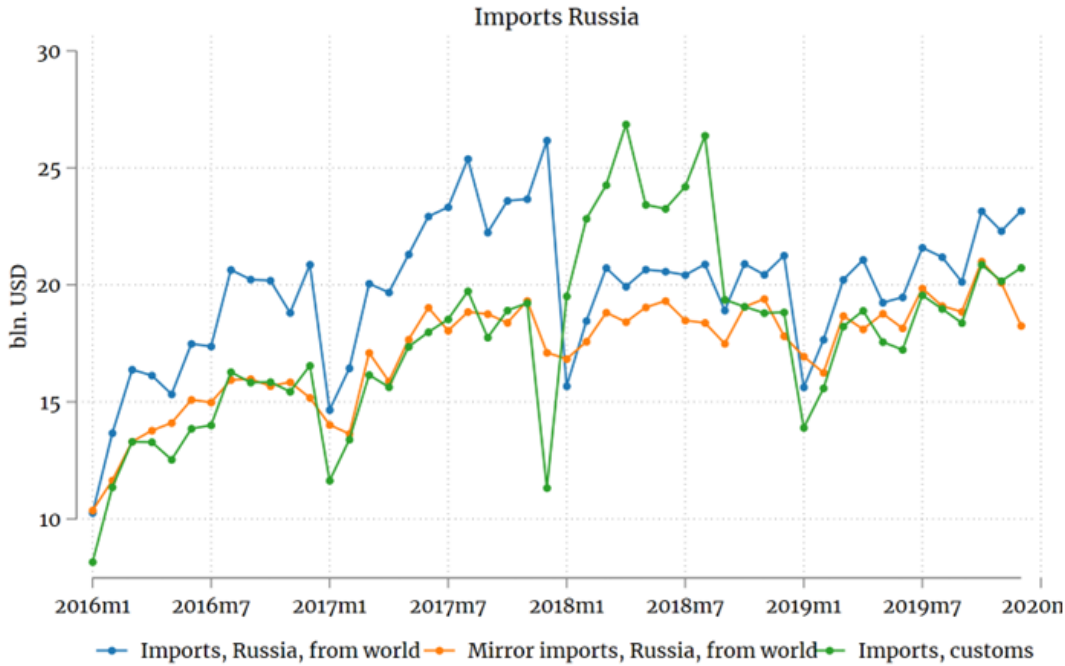
Note: Standard errors in parentheses are clustered on products. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. The dependent variable is the currency share of invoicing (by value) in bilateral monthly imports of a given product group. Specifications include country-product and country-month fixed effects. Goods under sanctions are those where EU sanction apply at least partially, post-sanctions refers to the period from March 2022 onwards. The three categories shown are mutually exclusive and cover all goods under EU sanctions. The base category are 45 economies that imposed sanctions on Russia.

Table A7: The volume of trade invoiced in a given currency

<i>Dep. var.: Volume of trade invoiced, log in the currency shown, log</i>	By product type			By country position		
	CNY producer	CNY vehicle	USD vehicle	CNY	USD vehicle	Producer
Post-sanctions x Dual-use	0.443*** (0.0537)	0.626*** (0.0984)	-0.112*** (0.0268)			
Post-sanctions x Industrial	0.333*** (0.0947)	0.251 (0.181)	0.0835 (0.0535)			
Post-sanctions x Luxury	-0.452*** (0.0657)	0.00360 (0.112)	-0.0370 (0.0312)			
Post-sanctions x China				0.697** (0.347)	1.069*** (0.179)	2.475*** (0.155)
Post-sanctions x Neutral				0.897* (0.470)	0.910*** (0.213)	1.406*** (0.428)
Observations	136,038	58,535	2,245,265	1,623	11,096	4,469
R^2	0.615	0.612	0.702	0.798	0.879	0.900

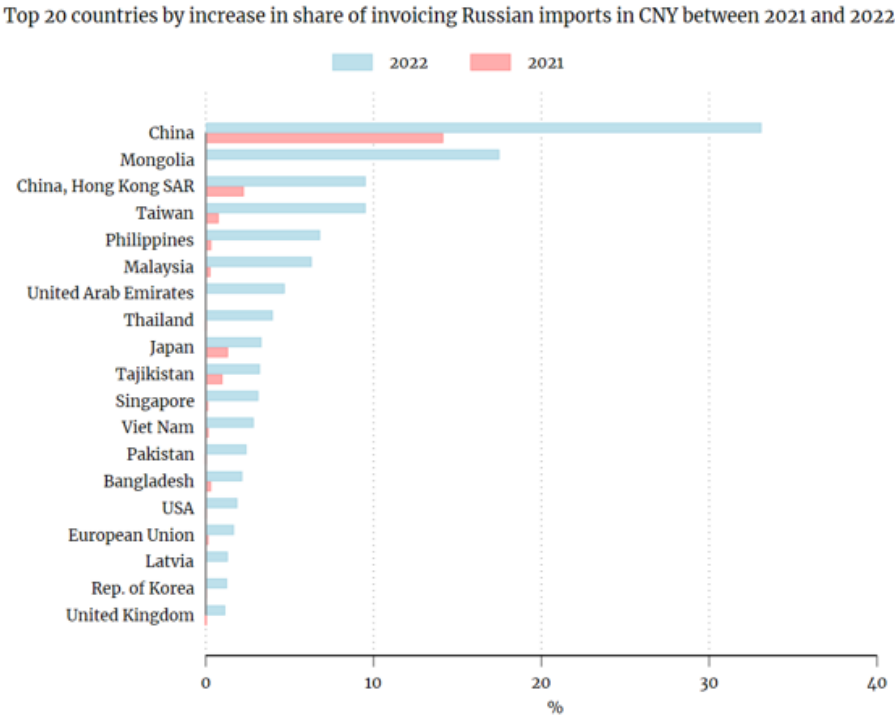
Note: Standard errors in parentheses are clustered on products, with the exception of columns 4-6 where they are clustered on countries. *, **, *** denote statistical significance at the 10%, 5%, and 1% levels, respectively. In columns 1-3, the dependent variable is the logarithm of bilateral monthly imports of a given product group invoiced in a given currency. Specifications include country-product and country-month fixed effects. In columns 4-6, the dependent variable is the logarithm of bilateral monthly imports invoiced in a given currency. Specifications include country and month fixed effects. Goods under sanctions are those where EU sanction apply at least partially, post-sanctions refers to the period from March 2022 onwards. The three categories shown are mutually exclusive and cover all goods under EU sanctions. The base category are 45 economies that imposed sanctions on Russia.

Figure A1: Russia's imports: Transaction-level data, Russia's aggregate statistics and mirror aggregate statistics



Source: Authors' calculations based on Russia customs data and UN Comtrade.
 Note: Aggregate imports as reported in the transaction-level dataset and UN Comtrade. Mirror data refers to exports to Russia as reported by trading partners excluding the members of the Eurasian Economic Union. Transaction-level data are aggregated bottom-up from customs dataset.

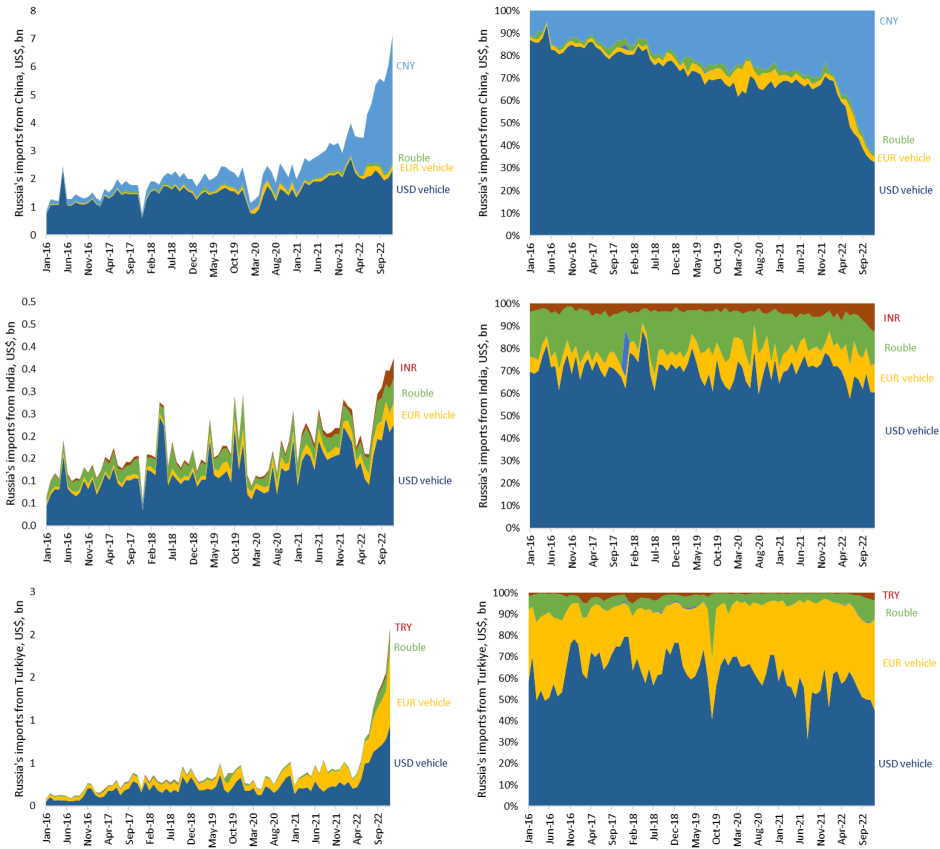
Figure A2: Top 20 trading partners where Russia’s imports were invoiced in CNY in 2022



Note: Countries with at least 1 mln USD of imports invoiced in CNY in 2022

Source: Authors’ calculations based on customs data.
 Note: Based on volume of transactions, restricted to the economies with trade invoiced in CNY of at least US\$ 1 million equivalent in 2022.

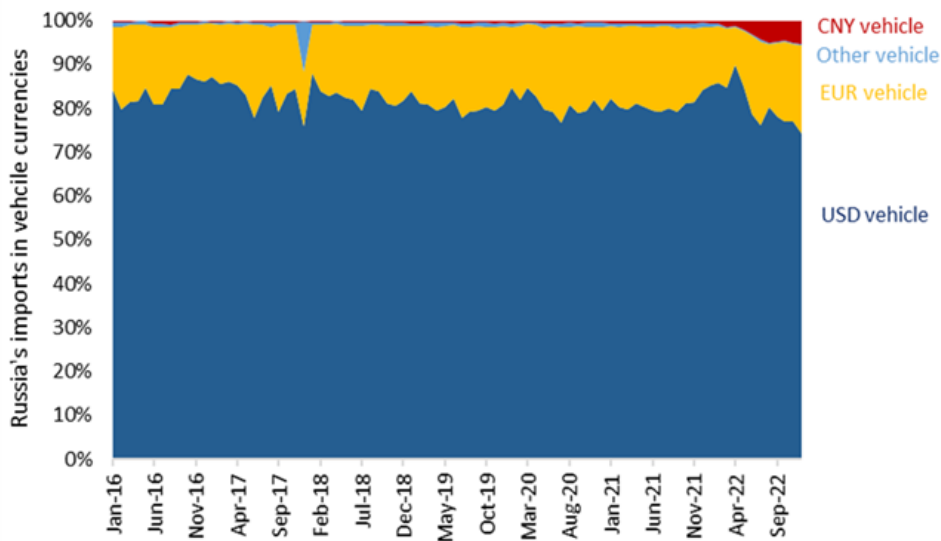
Figure A3: Share of import transactions, by currency of invoicing



Source: Authors' calculations.

Note: The shares and volumes are calculated by month, by number of transactions.

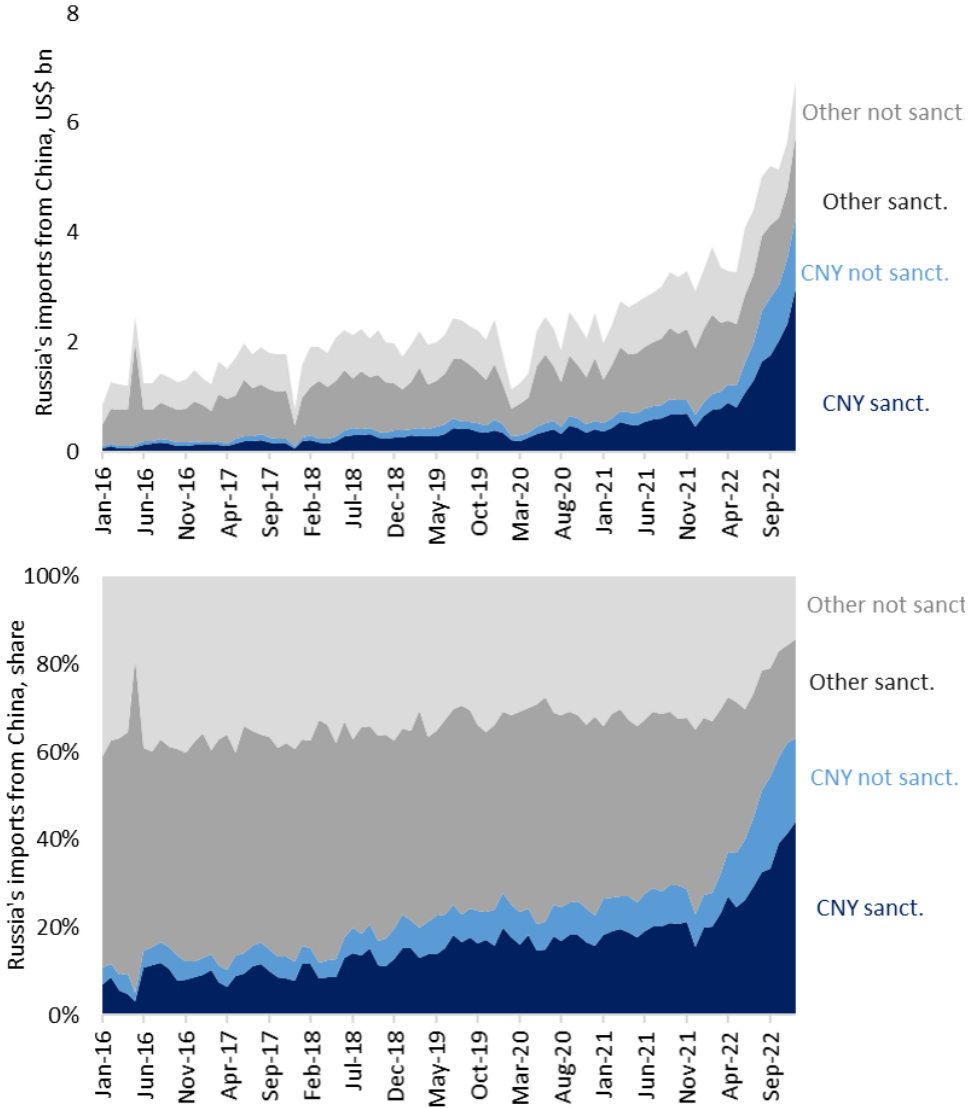
Figure A4: Shares of vehicle currencies in Russia's imports using vehicle currencies



Source: Authors' calculations based on customs data.

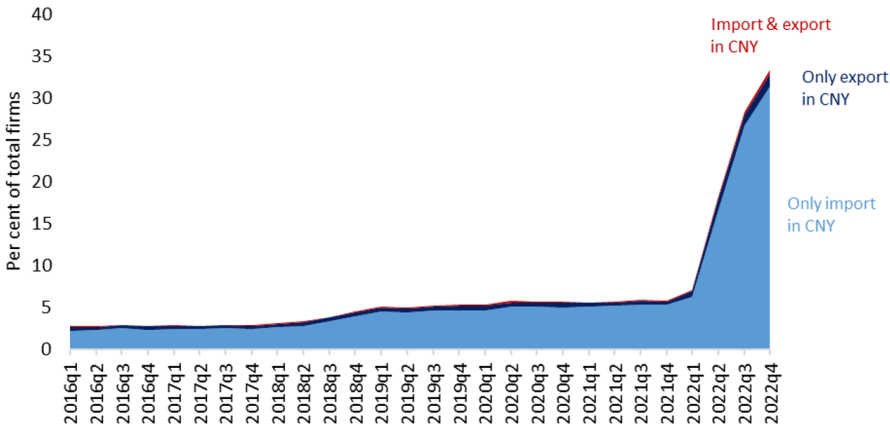
Note: Based on volume of transactions, by month, excluding transactions where local currency or producer currency is used.

Figure A5: Russia’s imports from China, by type of goods and currency of invoicing



Source: Russia customs data and authors’ calculations.
 Note: Sanctioned goods refer to EU sanctions that apply at least partially to a given HS6 code.

Figure A6: Share of firms that have exports and / or imports invoiced in CNY, by quarter



Source: Authors' calculations.
 Note: The figure shows the shares of firms that only have imports invoiced in CNY in a given quarter, only exports invoiced in CNY, both imports and exports invoiced in CNY, or neither, in the total number of firms that import and export in that quarter.