European Bank
for Reconstruction and Development

Exorbitant privilege and economic sanctions

**Maxim Chupilkin, Beata Javorcik,
Aleksandra Peeva and Alexander Plekhanov**

This paper documents a substantial change in the use of currency of invoicing in import and export 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 yuan (CNY) increased by 17 percentage points. The use of yuan as a vehicle currency increased on average by an extra 4 percentage points among trading partners that have an active yuan swap line. This effect is found only for third countries that did not impose economic sanctions on Russia. The share of CNY invoicing increased differentially more for trade in internationally sanctioned dual-use and industrial-capacity goods. The number of importing firms in Russia dealing with CNY invoices increased sharply, while the numbers of importers dealing with USD and EUR invoicing dropped, likely reflecting the rising fixed costs of clearing such payments under sanctions. Thus 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, trade, international currency, China, Russia

JEL Classification Numbers: E42, F14, F31, F51

Contact details: Five Bank Street, London E14 4BG, UK.

Emails: chupilkm@ebrd.com; javorcib@ebrd.com; peevaale@huberlin.de;plekhana@ebrd.com

Maxim Chupilkin is at the University of Oxford and the EBRD; Beata Javorcik is at the University of Oxford, the EBRD and Centre for Economic Policy Research; Aleksandra Peeva is at the Humboldt University of Berlin; Alexander Plekhanov is at the EBRD

The authors are grateful to Antoine Berthou, Ralph de Haas and Volker Nitsch for valuable comments and suggestions.

Working Paper No. 281 **Prepared in September 2023**

1 Introduction

International trade is disproportionately denominated in US dollars (Gopinath and Stein (2020), Boz et al. (2022)), 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 and 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 yuan (CNY). By the end of 2022, invoices in yuan 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.

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)). Yuan 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 yuan went up from less than 1 percent before February 2022 to more than 5 percent by the end of the year.

Our econometric analysis focuses on the share of Russia's imports from a given country, invoiced in a given currency in a given month and follows a difference-in-difference approach comparing (i) Russia's imports before versus after the imposition of economic sanctions; (ii) Russia's trade with sanctioning economies versus other economies, referred to in the paper as "neutral" economies. In some exercises, we further focus on specific groups of neutral economies, for example, those with swap lines with the People's Bank of China. We control for exporter fixed effects to account for prevailing invoicing patterns in bilateral trade and for month fixed effects that capture factors affecting all Russia's trade (including the impact of the invasion and sanctions in general).

Our interest in the impact of having an active currency swap line with the People's Bank of China (PBOC) stems from the fact that such swap lines make it easier for an exporter to use yuan received from, say, a Russian importer (see Bahaj and Reis (2020)). We show that the use of yuan 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.

We extend the analysis to follow a triple-differenced approach, which adds a further comparison between trade in product whose exports from the EU/UK are subject to sanctions versus other products. Those regressions are saturated with interacted fixed effects (country-by-month; product-by-month and country-by-product). The results suggest that the share of CNY invoicing increased differentially more for trade in goods under EU sanctions. For instance, for internationally sanctioned dual-use and industrial-capacity goods the yuan shares increased by an extra 6-8 percentage points, compared with non-sanctioned goods and trends observed for other trading partners.

In the final part of the analysis, we zoom in on importing firms operating in Russia. 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. 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.

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, by documenting the interplay between policies to promote internationalisation of yuan through the use of currency swap lines and an exogenous shock to trade flows arising from Russia's full-scale invasion of Ukraine (Clayton et al. (2022)), Bahaj and Reis (2020)).

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 (Efing 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 ten 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 restrictions on 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 dataset of import and export transactions 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 Figure 1). Similar datasets were used, for instance, by Korovkin and Makarin (2023) to analyze Ukraine-Russia trade after 2014 and by Babina et al. (2023) to look at 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 of good, the sending (exporting) country, the trading company acting as a seller (and its location), the recipient of goods in Russia as well as the currency of invoicing. The dataset only systematically covers 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 the analysis of currencies of invoicing, 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 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-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 e300) 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 product line we record the date when sanctions enter into force, with the respective HS6 product line considered to be subject to sanctions starting from the following month (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 exporters) 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 yuan (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 calculated by volume of trade or by number of transactions invoiced in each currency. The increased use of CNY was mostly at the expense of the euro and the Russian rouble, while the share of US dollar has been broadly constant by value. 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. In particular, volumes of trade denominated in CNY as producer and vehicle currency rose (see Figure 2, top left panel).

The rise of CNY was most notable in payments for goods coming from China, where yuan 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 A1). 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 Figure 3) 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 A5, 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 Turkish lira claiming market share primarily from the US dollar (see Annex Figure A5, middle and bottom panels).

3 Empirical specifications

3.1 Currency of invoicing

We examine the determinants of the share of transactions invoiced in local currency, producer currency as well as major currencies used as vehicle currencies (USD, EUR, CNY) indexed j in each month t for each trading partner i. The difference-in-difference specification takes the following form:

$$Currency_{ijt} = \sum_{k} \beta_{kj} Post_t * Group_{ki} + \alpha_{tj} + \alpha_{ij} + \epsilon_{ijt} \tag{1}$$

We distinguish between the pre-war period and the post-war period (from March 2022 onwards). We also distinguish between several groups of trading partners, indexed k: for example, the sanctioning countries, neutral countries that condemned the invasion of Ukraine at the UN vote; neutral countries that did not condemn the invasion at the UN (included individually); producer currency economies and so on.

Ninety-six countries voted alongside the 45 sanctioning economies in favour of a UN resolution condemning Russia's invasion of Ukraine (resolution ES 11/1 of 2 March 2022). These economies represent the baseline group for various comparisons (see Annex Table A1, middle section).

In addition to China, 34 other countries abstained, including South Africa and Uzbekistan. Nicaragua, North Korea and Syria joined Belarus and Russia in voting against the resolution. A further 12 countries did not vote (for example, Azerbaijan and Iran, see Annex Table A1, right section). Those economies (typically more strongly geo-politically aligned with Russia than with the US or the EU) are aggregated in a ”non-condemning” group. The same framework can be used to look at further grouping of trading partners, for instance, economies that have established currency swap lines with China and those that have not.

The specification includes country fixed effects ($alpha_{ij}$) accounting for the typical use of various currencies in bilateral trade with Russia). The month fixed effects ($alpha_{tj}$) further capture shifts in the use of currencies over time, including the overall shift towards the use of CNY after the invasion, but not differential increases in the bilateral use of, say, CNY or USD.

A similar analysis is also performed with the dependent variable defined as the logarithm of the volume of bilateral trade in a given month invoiced in a given currency. Where trade diversion following imposition of sanctions is strong, the volume of trade denominated in a given currency may increase even as the share of that currency in trade in question declines (or vice versa). The extensive margin of trade invoiced in a given currency is further explored in the robustness checks.

4 Results

4.1 Producer and local currency

The results for the share and the volume of trade invoiced in producer or local currency are presented in Table 2, in columns 1-2 and 3-4, respectively. In the case of Russian imports from China, the use of producer currency (CNY) increased by an extra 29 percentage points after the invasion (relative to pre-invasion trade and to trade with other economies). This effect is statistically significant at the 1 percent level. In terms of trade volumes, the effect is much larger as the increase in the share of CNY is further amplified by the rise in China-Russia trade (see Figure 5).

Statistically significant differential increases in the use of producer currencies are observed for selected other neutral partners including India and the UAE (as well as for volumes of imports from Turkiye). Such increases are not systematically observed, however, for countries that did not condemn the invasion of Ukraine at the UN. Notwithstanding geopolitical alignment, for many of those economies currency convertibility and the ability to clear cross-border payments may be limiting factors.

The use of the euro or US dollar in trade with the US and the euro area, respectively, is in line with the previous trends, with no differential patterns in terms of shares of the US dollar or the euro used as producer currencies.[1]

Moving on to columns 3 and 4, there is some indication that the use of local currency (the rouble) became less common after the invasion, which is consistent with Figure 2. However, this was not the case for the neighbouring economies in Central Asia and the Caucasus (CCA) as well as Belarus and Moldova, all with traditionally stronger economic links with Russia. These countries seem to have increased invoicing in RUB.

4.2 Major vehicle currencies

Table 3 further summarizes the results for major currencies traditionally used as vehicle currencies, such as USD and EUR. (Vehicle currencies other than USD, EUR and CNY accounted for less than 0.5

[1] USD and EUR will also be producer currencies for a handful of other economies where they are legal tender, such as Ecuador or Montenegro.

percent of third-country trade with Russia).

The share of the USD-denominated imports from China dropped by around 30 percentage points more than could be otherwise expected in the post-invasion period (see Table 3 Columns 1 and 2). The USD share also dropped by an extra 7-17 percentage points in trade with other neutral economies. All these effects are statistically significant at the 5 percent (or higher) level. At the same time, the volume of Russia's imports from neutral economies has increased significantly owing to diversion of trade in sanctioned goods. As a result, the overall share of the US dollar in Russia's trade remained broadly constant in 2022 (see Figure 2).

The share of the EUR-denominated imports increased by an additional 6-8 percentage points in trade with a number of neutral economies. These exclude China but include the neighbouring economies in Central Asia and the Caucasus, India, Turkiye, the UAE and, more generally, neutral economies that did not condemn the invasion of Ukraine at the UN. In many of these cases, the euro displaced the use of the rouble, and in some instances it also gained market share from the US dollar.

4.3 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 similar to those considered earlier, except for an additional battery of interaction terms between the groups of countries and the indicator variables for each month before and after the introduction of sanctions (see Equation 2). January 2022 serves as the base (omitted) period.

$$Currency_{ijt} = \sum_{t}\sum_{i} \beta_{ij} Month_t * Group_i + \alpha_{tj} + \alpha_{ij} + \epsilon_{ijt} \tag{2}$$

While monthly trade is volatile, a number of distinctive patterns emerge from this analysis (see Figure 4). 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 subsection further zooms in on the use of CNY as a vehicle currency in Russia's imports.

4.4 CNY as a vehicle currency

Prior to 2022, the use of CNY as a vehicle currency in Russia's imports was 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 A2).

Motivated 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 issue in a difference-in-difference setting. Indeed, Bahaj and Reis (2020) argue that swap lines can be instrumental to jump-starting an international currency. Swap lines make it easier for an exporter in a third country to use yuans 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 empirical analysis, we distinguish between China, economies with a swap line with PBOC, and economies without 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 including those with access to the ECB swap line in their home currency) and neutral economies with a swap line (a total of 25 jurisdictions). The specifications include a set of respective indicator variables as well as their interactions with the sanctions period (March 2022 onwards). 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 results are summarized in Table 4. After the invasion, the share of Russia's CNY-denominated imports from economies with a CNY swap line was around 1.8 percentage points higher than could otherwise be expected (Column 1). No 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 relatively 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 (see Annex Table A2). 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 effect is larger, at 4.3 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 and the triple interaction term which also includes a dummy for the sanctioning economies).

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 also be traced in an event study format (see Figure A6, noting that the left panel (sanctioning economies) and the right panel (neutral economies) are on different scales).

4.5 Trade in sanctioned goods

Although the share of CNY-denominated 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 Figure 5 focusing on China to Russia trade and distinguishing between four types 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).

We further investigate if the share of CNY-denominated imports increased faster in the case of trade in sanctioned goods using a triple-difference framework (see Equation 3). The dependent variable is the share of trade in a given month coming from a given exporter in a given HS6 product line p denominated in producer currency. The regression is saturated with product-by-month, product-by-country and country-by-month fixed effects. The coefficient of interest is that on the interaction term between China as exporter ($China_i$) and a dummy variable capturing application of EU sanctions to a particular product group p starting from the month following the adoption of the respective EU package ($Sanction_{pt}$). This variable captures differential patterns in the use of currency of invoicing in China's exports to Russia for sanctioned goods, over and above any increases in the share of CNY-denominated transactions in China-Russia trade in general.

$$Currency_{itp} = \beta Sanction_{pt} * China_i + \alpha_{ti} + \alpha_{tp} + \alpha_{ip} + \epsilon_{pit} \tag{3}$$

The results are summarized in Table 5. They point to a significantly higher increase in the share of CNY invoicing for product lines that fall under EU sanctions. The differential is particularly high for industrial goods and dual-use technology goods, of an order of 7-8 percentage points, statistically significant at the one percent level. These higher shares are matched by the corresponding large increases in the volumes of trade denominated in CNY. In contrast, luxury goods are less likely to be traded in CNY than other goods.

4.6 Entry of firms

We further look at individual firms that act as importers. Around 80 percent of importers deal with invoices in a single currency only, while a small minority deal with four currencies or more (see Annex Figure A4).

Historically, the numbers of firms dealing with invoices in a given currency in a given month (USD, EUR, CNY or RUB) have been fairly stable over time (see Figure 6). However, after the introduction of sanctions, the number of firms dealing with invoicing in CNY started increasing rapidly, while the numbers dealing with USD and EUR declined. Many of these firms were newly established (see Annex Figure A3). 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.

4.7 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) vehicle currency in Russia's imports has declined, while the use of producer currencies of neutral economies has become more widespread. Yuan has become increasingly used as a vehicle 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 Russia's trading partners that have established swap lines with the PBOC.

The results are consistent with the use of trade sanctions gradually weakening the exorbitant privilege enjoyed by the US dollar and leading to the fragmentation of international payment systems, with the emergence of alternative global currencies such as CNY.

4.8 Robustness checks

We conduct a number of robustness checks. First, we 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 A3.

Throughout the analysis, the shares of each currency of invoicing were calculated using volumes of trade in a given month. 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 Table 5, Columns 2 and 4, showing an example for the triple-differenced analysis as well as Table 4 Columns 2 and 4 showing an example for swap line analysis and Annex Table A4 looking at bilateral China-Russia trade in sanctioned and non-sanctioned goods).

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 triple-differenced exercise. 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 and quantitatively similar to those obtained using the triple-differenced framework (see Annex Table A4).

Baseline regressions looking at the volume of trade invoiced in a given currency fail to pick up shifts on the extensive margin: the use of new currencies of invoicing under the sanctions regime that were previously not used in bilateral trade. 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.

5 Conclusions

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 yuan increased by 17 percentage points. The use of yuan as a vehicle currency increased by an extra 4 percentage points, on average, for trading partners that have an active yuan 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-capacity goods. And a number of Russian importing firms working with yuan invoices has increased sharply, mirrored by a drop in numbers of firms dealing with USD and EUR invoicing, reflecting the rising fixed costs of clearing such payments under sanctions.

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.

It 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.

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

Besedeˇs, 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 C´esar 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, 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

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 C´edric 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, 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

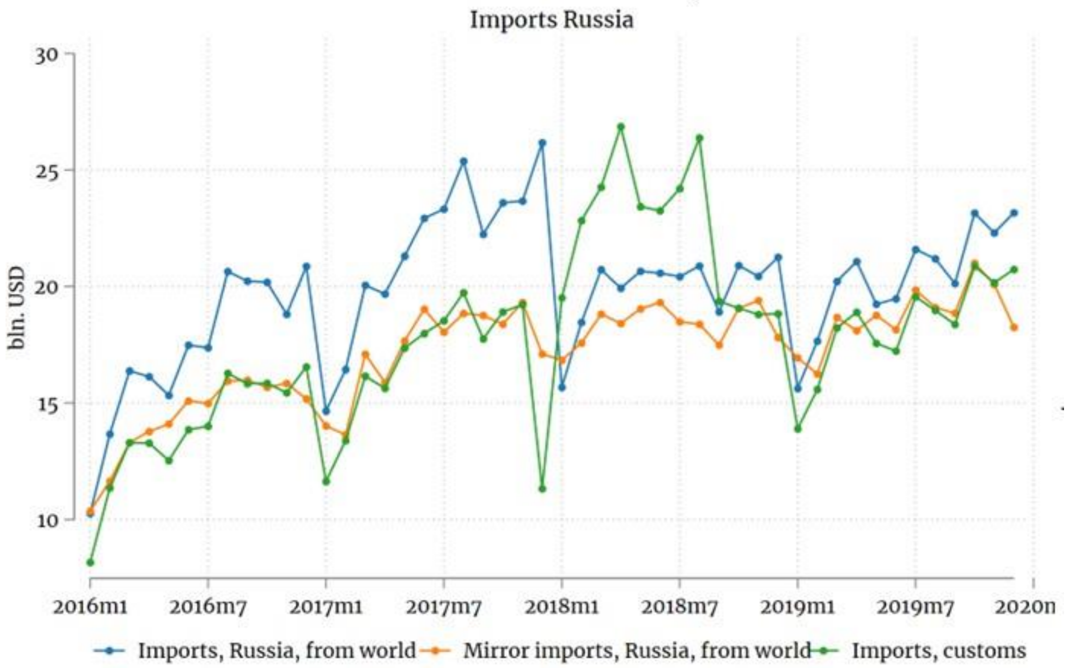
Peeva, Aleksandra (2019) 'Did sanctions help Putin?' Discussion Papers 2019/7, Free University Berlin, School of Business Economics

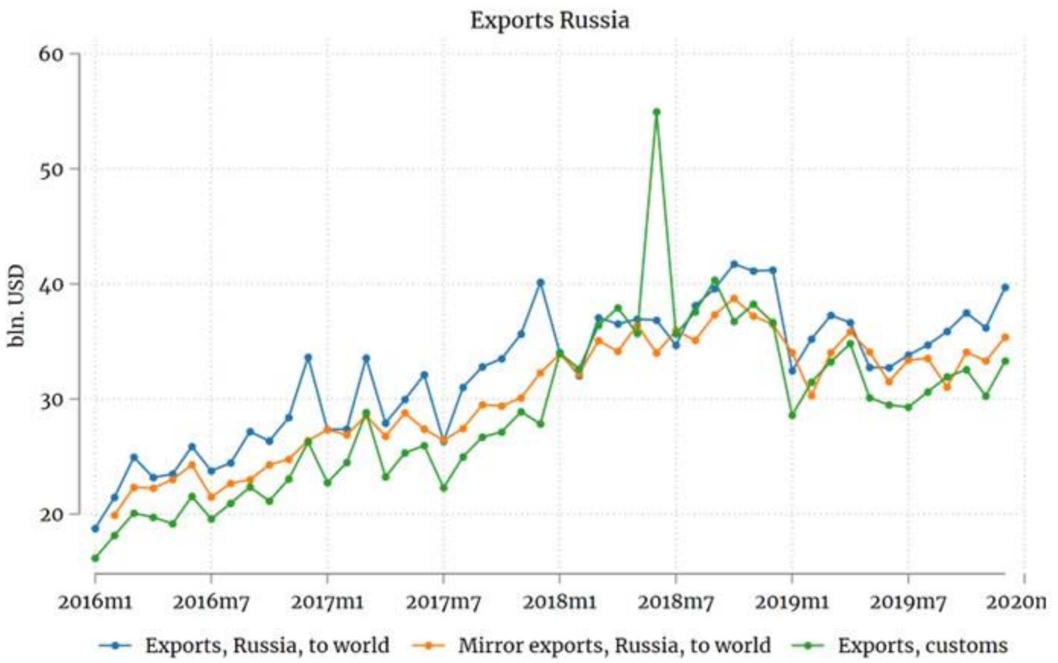
Steinbach, Sandro (2023) 'The Russia–Ukraine war and global trade reallocations.' *Economics Letters* 226, 111075

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

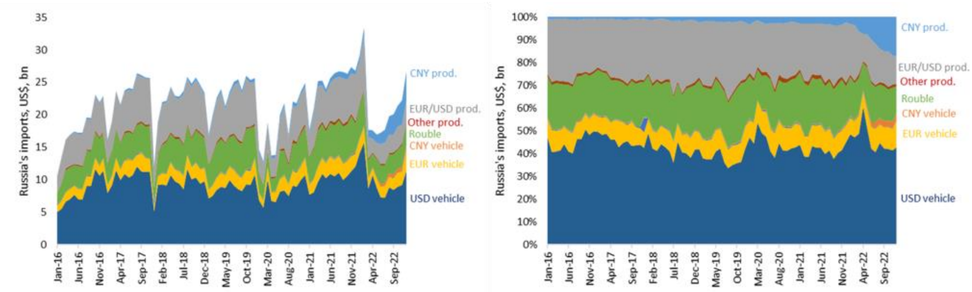
Figure 1: Russia's imports: Transaction-level data, Russia's aggregate statistics and mirror aggregate statistics





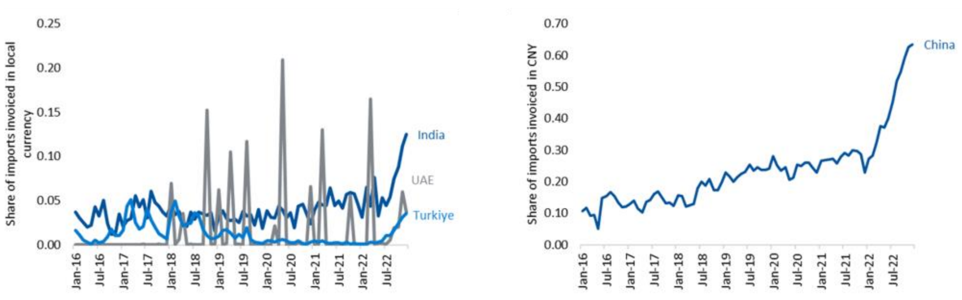
Source: Authors' calculations based on Russia customs data and UN Comtrade.
Note: Aggregate imports as reported in the transaction-level dataset and UN Comtrade. Mirror data refers to exports to Russia as reported by trading partners excluding the members of the Eurasian Economic Union. Transaction-level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

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



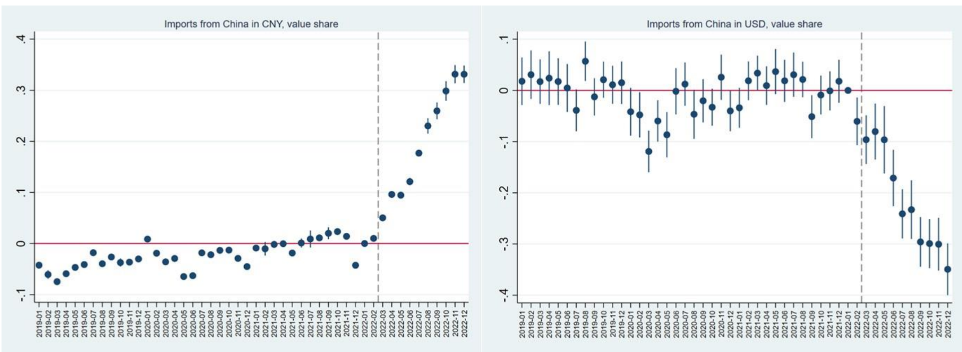
Source: Authors' calculations.
Note: The shares and volumes are calculated by month, by number of transactions.

Figure 3: Share of selected producer currencies of invoicing in Russia's bilateral imports



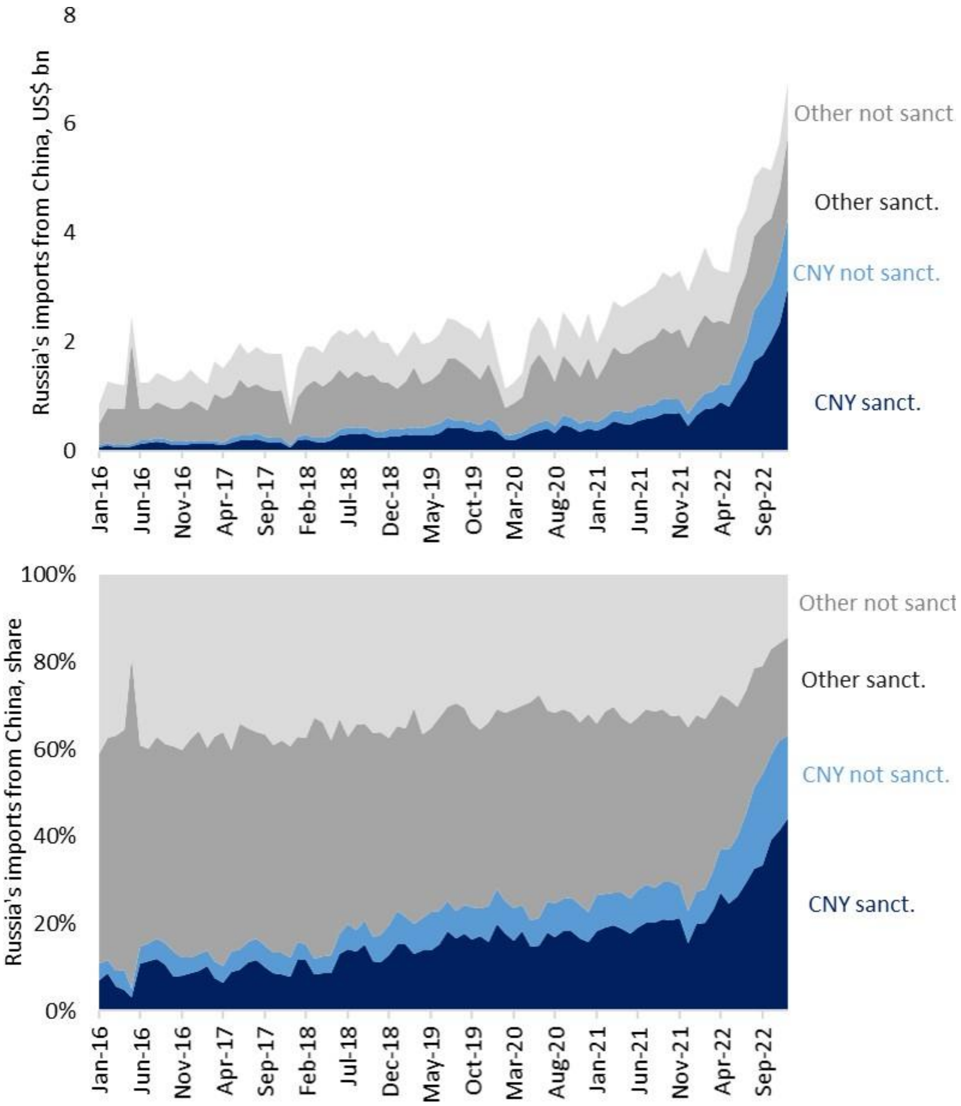
Source: Authors' calculations.
Note: The shares are calculated using bilateral imports in question, by month.

Figure 4: Event study estimates



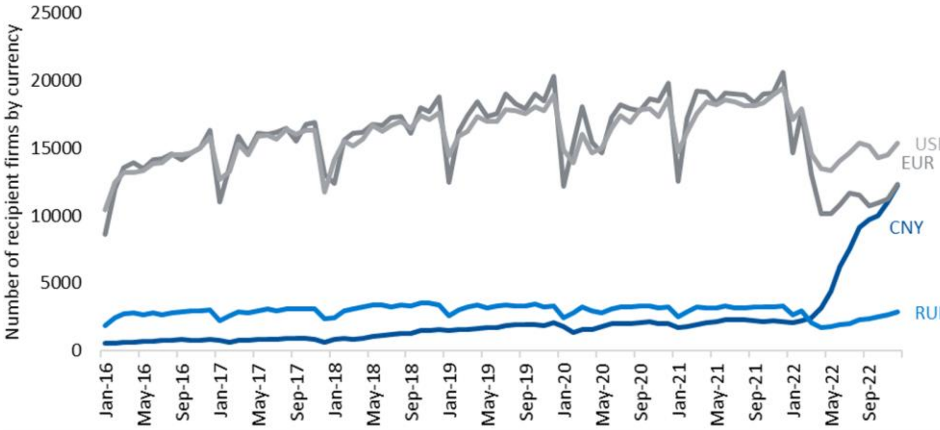
Source: Authors' calculations.
Note: The plots show regression coefficients on interaction terms between China dummy and dummy variables for each month. Linear regressions of the share of Russia's imports in bilateral trade in a given month denominated in producer currency and in USD, respectively, on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

Figure 5: 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 6: 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.

Table 1: Descriptive statistics

Variables	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: Choice of currency of invoicing: Producer and local currency

	1	2	3	4
Currency	Producer currency		Local currency	
Dep. var.: Share or volume of trade invoiced in a producer or local currency	Share	Log trade	Share	Log trade
Post-war x China	0.285***	2.461***	-0.00451	0.450
	(0.0134)	(0.728)	(0.00993)	(0.271)
Post-war x India	0.0329***	1.740**	-0.0221*	-0.0506
	(0.00986)	(0.718)	(0.0118)	(0.275)
Post-war x UAE	0.0156**	4.637***	-0.0425***	0.0252
	(0.00782)	(0.688)	(0.00870)	(0.213)
Post-war x Turkiye	0.00105	2.128***	0.0160	1.043***
	(0.00447)	(0.701)	(0.00993)	(0.260)
Post-war x CCA + Belarus + Moldova	0.00691	1.742	0.0714*	1.729***
	(0.00699)	(1.262)	(0.0423)	(0.614)
Post-war x Not condemning	0.00175	1.372	-0.0104	1.041
	(0.00429)	(1.000)	(0.0101)	(0.672)
Post-war x Sanctioning			-0.00697	-1.394***
			(0.0234)	(0.363)
Post-war x USD producers	-0.0233	0.999		
	(0.0453)	(0.827)		
Post-war x EUR producers	0.0440	0.277		
	(0.0296)	(0.754)		
Post-war x Other sanctioning	0.0179*	-0.277		
	(0.00980)	(0.823)		
Observations	12,593	4,583	12,593	6,050
R^2	0.925	0.890	0.741	0.864

Source: Authors' calculations.

Note: Standard errors are clustered two-way on exporters 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) invoiced in producer currency (or local currency, RUB, as stated) in all transactions in a given month with a given group of trading partners, or the logarithm of bilateral monthly trade denominated in a given currency. Other sanctioning economies exclude EUR or USD producer currency economies included separately, as shown.

Table 3: Choice of currency of invoicing: Vehicle currencies

	1	2	3	4
Currency	USD		EUR	
Dep. var.: Share or volume of trade invoiced in a currency	Share	Log trade	Share	Log trade
Post-war x China	-0.293***	0.328**	0.0280	0.514*
	(0.0313)	(0.140)	(0.0200)	(0.275)
Post-war x India	-0.0609***	0.323**	0.0664***	0.0138
	(0.0209)	(0.131)	(0.0198)	(0.276)
Post-war x UAE	-0.0106	0.951***	0.0523**	0.0896
	(0.0226)	(0.123)	(0.0216)	(0.212)
Post-war x Turkiye	-0.0777***	0.959***	0.0748***	1.108***
	(0.0266)	(0.134)	(0.0218)	(0.258)
Post-war x CCA + Belarus + Moldova	-0.177***	0.972***	0.0881**	1.794***
	(0.0592)	(0.326)	(0.0360)	(0.613)
Post-war x Not condemning	-0.0667**	0.298	0.0620*	1.106
	(0.0313)	(0.271)	(0.0328)	(0.674)
Post-war x USD producers	-0.0227	0.301		
	(0.0483)	(0.415)		
Post-war x EUR producers			0.0651*	-1.220***
			(0.0368)	(0.418)
Post-war x Other sanctioning	-0.00805	-0.727***	-0.000353	-1.348***
	(0.0304)	(0.238)	(0.0284)	(0.435)
Observations	12,593	11,698	12,593	6,050
R^2	0.749	0.872	0.696	0.863

Source: Authors' calculations.

Note: Standard errors are clustered two-way on exporters 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, unless otherwise specified) invoiced in the specified currency in all transactions in a given month with a given group of trading partners, or the logarithm of bilateral monthly trade denominated in a specified currency. Other sanctioning economies exclude EUR or USD producer currency economies included separately, as shown.

Table 4: Invoicing in CNY: The role of swap lines

	1	2	3	4
Sample split	Swap lines		Swap lines and sanctioning vs neutral	
Dep. var.: Share or volume of trade invoiced in CNY	By volume	By number	By volume	By number
Swap line	0.0128	0.00937	0.0147	0.0105
	(0.00929)	(0.00614)	(0.0108)	(0.00678)
Post-war x Swap line	0.0176**	0.0160**	0.0434***	0.0385***
	(0.00673)	(0.00687)	(0.0152)	(0.0145)
Post-war x Sanctioning			0.00262	0.00268
			(0.00567)	(0.00699)
Swap line x Sanctioning			-0.0132	-0.00901
			(0.0109)	(0.00706)
Post-war x Swap line x Sanctioning			-0.0453***	-0.0398**
			(0.0166)	(0.0160)
Post-war x China	0.282***	0.265***	0.283***	0.266***
	(0.0178)	(0.0172)	(0.0220)	(0.0191)
Observations	12,588	12,588	12,588	12,588
R^2	0.465	0.439	0.476	0.452

Source: Authors' calculations.

Note: Standard errors are clustered two-way on exporters 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. Sanctioning refers to 45 economies with sanctions on Russia, neutral are the rest.

Table 5: Invoicing in CNY: The role of economic sanctions

	1	2	3	4
Currency	Sanctioned or not		Sanctioned, by type	
Dep. var.: Share of trade invoiced in producer currency	By volume	By number	By volume	By number
Goods under sanctions x China	0.0292***	0.0257***		
	(0.00601)	(0.00570)		
Luxury under sanctions x China			-0.0559***	-0.0932***
			(0.00888)	(0.00917)
Industrial under sanctions x China			0.0718***	0.0803***
			(0.0127)	(0.0109)
Dual-use/military under sanctions x China			0.0630***	0.0742***
			(0.00694)	(0.00599)
Observations	4,596,644	4,598,308	4,596,644	4,598,308
R^2	0.833	0.861	0.833	0.861

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 (or by number of transactions) in bilateral monthly trade in a certain product group invoiced in producer currency. All regressions include exporter-by-month, exporter-by-product and product-by-month fixed effects. Goods under sanctions are those where EU sanction apply at least partially, from the month following the adoption of the relevant package of EU sanctions. The three categories shown are mutually exclusive and cover all goods under EU sanctions.

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	**Abstained**
Australia	Andorra	Micronesia	Algeria
Austria	Antigua and Barbuda	Moldova	Angola
Belgium	Argentina	Myanmar	Armenia
Bulgaria	Bahamas	Nauru	Bangladesh
Canada	Bahrain	Nepal	Bolivia
Croatia	Barbados	Niger	Burundi
Cyprus	Belize	Nigeria	Central African Republic
Czech Republic	Benin	Oman	China
Denmark	Bhutan	Palau	Congo
Estonia	Bosnia and Herzegovina	Panama	Cuba
Finland	Botswana	Papua New Guinea	El Salvador
France	Brunei	Paraguay	Equatorial Guinea
Germany	Cambodia	Peru	India
Greece	Cape Verde	Philippines	Iran
Hungary	Chad	Qatar	Iraq
Iceland	Chile	Rwanda	Kazakhstan
Ireland	Colombia	Saint Kitts and Nevis	Kyrgyzstan
Italy	Comoros	Saint Lucia	Laos
Japan	Costa Rica	Saint Vincent	Madagascar
Latvia	Côte d'Ivoire	Samoa	Mali
Liechtenstein	Djibouti	San Marino	Mongolia
Lithuania	Dominica	São Tomé and Príncipe	Mozambique
Luxembourg	Dominican Republic	Saudi Arabia	Namibia
Malta	DR Congo	Serbia	Nicaragua
Monaco	Ecuador	Seychelles	Pakistan
Montenegro	Egypt	Sierra Leone	Senegal
Netherlands	Fiji	Solomon Islands	South Africa
New Zealand	Gambia	Somalia	South Sudan
North Macedonia	Gabon	Suriname	Sri Lanka
Norway	Georgia	Thailand	Sudan
Poland	Ghana	Timor-Leste	Tajikistan
Portugal	Grenada	Tonga	Tanzania
Romania	Guatemala	Trinidad and Tobago	Uganda
Singapore	Guyana	Tunisia	Vietnam
Slovakia	Haiti	Turkey	Zimbabwe
Slovenia	Honduras	Tuvalu	**Absent**
South Korea	Indonesia	United Arab Emirates	Azerbaijan
Spain	Israel	Uruguay	Burkina Faso
Sweden	Jamaica	Vanuatu	Cameroon
Switzerland	Jordan	Yemen	Ethiopia
Taipei China	Kenya	Zambia	Eswatini
Ukraine	Kiribati		Guinea
United Kingdom	Kuwait		Guinea-Bissau
United States	Lebanon		Morocco
	Lesotho		Togo
	Liberia		Turkmenistan
	Libya		Uzbekistan
	Malawi		Venezuela
	Malaysia		**Voted with Russia**
	Maldives		Belarus
	Marshall Islands		Eritrea
	Mauritania		North Korea
	Mauritius		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: Swap lines and the currency of invoicing: Country of origin view (semi-placebo)

	1	2	3	4
Sample split	Swap lines		Swap lines and sanctioning vs neutral	
Dep. var.: Share or volume of trade invoiced in CNY	By volume	By number	By volume	By number
Swap line	-0.00164	-0.000544	-0.00270	-0.00228
	(0.00224)	(0.00135)	(0.00186)	(0.00189)
Post-war x Swap line	-0.00416	0.000447	0.00131	0.00830
	(0.00604)	(0.00695)	(0.0102)	(0.0128)
Post-war x Sanctioning			-0.00141	0.00154
			(0.00920)	(0.00810)
Swap line x Sanctioning			0.00276	0.00578
			(0.00695)	(0.00383)
Post-war x Swap line x Sanctioning			-0.00844	-0.0149
			(0.0136)	(0.0148)
Post-war x China	0.240***	0.230***	0.240***	0.230***
	(0.0125)	(0.00703)	(0.0147)	(0.0101)
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 are clustered two-way on exporters 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.

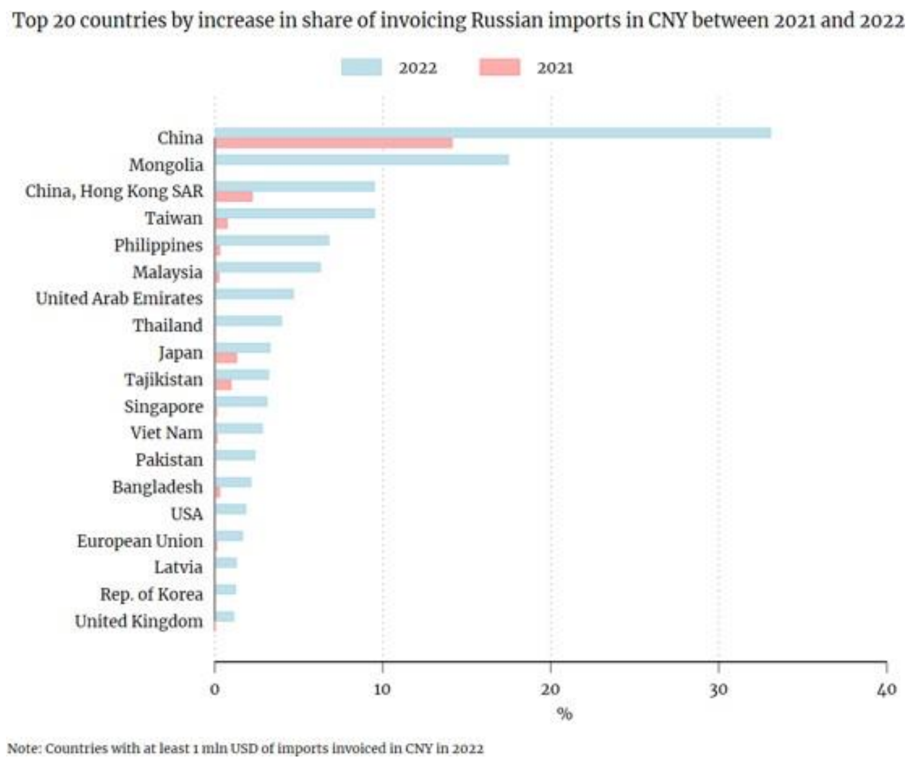
Table A4: Invoicing in CNY: Sanctioned vs other goods, bilateral view

	1	2	3	4
Currency	Sanctioned or not		Sanctioned, by type	
Dep. var.: Share of trade invoiced in CNY	By volume	By number	By volume	By number
Goods under sanctions	0.0318***	0.0283***		
	(0.00592)	(0.00556)		
Luxury goods			-0.0512***	-0.0860***
			(0.00890)	(0.00903)
Industrial capacity			0.0669***	0.0725***
			(0.0122)	(0.0107)
Dual-use and military technology			0.0624***	0.0721***
			(0.00687)	(0.00597)
Observations	240,753	240,798	240,753	240,798
R^2	0.389	0.425	0.391	0.429

Source: Authors' calculations.

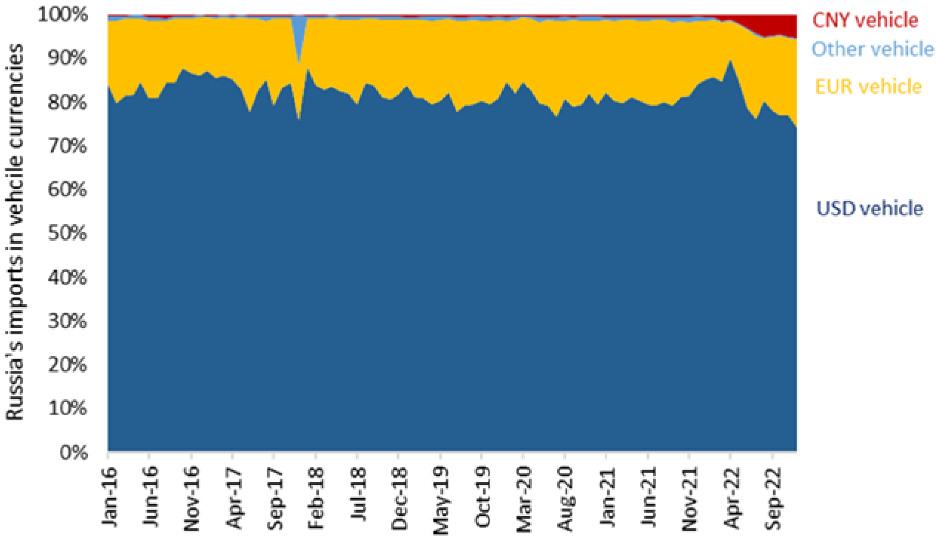
Note: Standard errors are clustered on product groups. *, **, *** denote statistical significance at the 10%, 5% and 1% levels, respectively. All regressions include month and HS6 fixed effects. The dependent variable is the share of transactions, by volume (or by number of transactions) invoiced in CNY in a given month for a given HS6 product line. Goods under sanctions goods are those where EU sanctions apply at least partially, from the month following the adoption of the relevant package of EU sanctions. The three categories shown are mutually exclusive and cover all goods under EU sanctions.

Figure A1: Top 20 trading partners where Russia's imports were invoiced in CNY in 2022



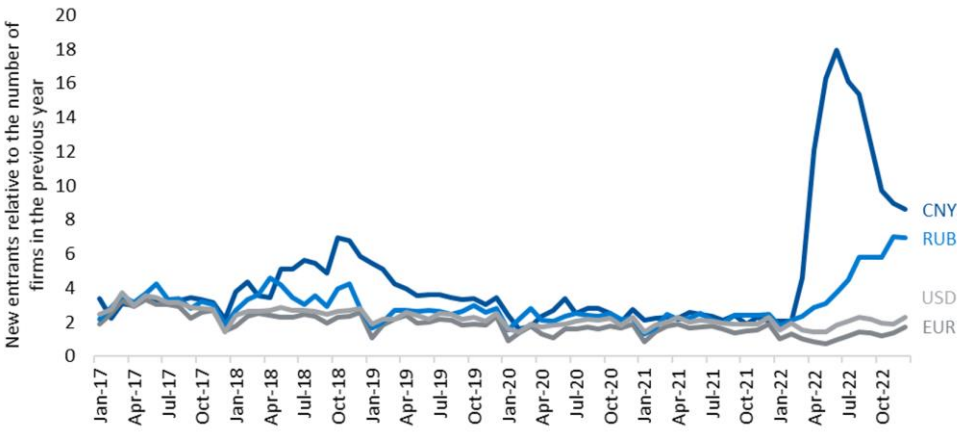
Source: Authors' calculations based on customs data.
Note: Based on volume of transactions, restricted to the economies with trade invoiced in CNY of at least US$1 million equivalent in 2022.

Figure A2: Shares of vehicle currencies in Russia's imports using vehicle currencies



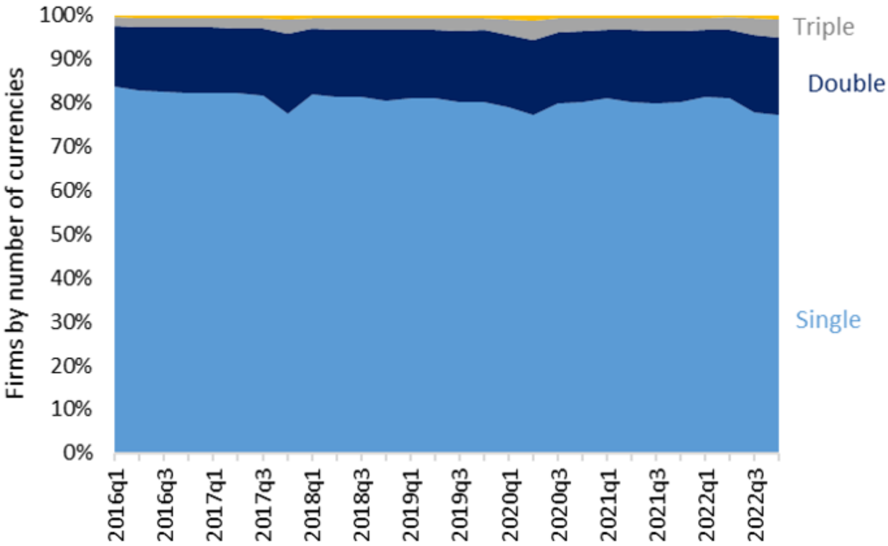
Source: Authors' calculations based on customs data.
Note: Based on volume of transactions, by month, excluding transactions where local currency or producer currency is used.

Figure A3: Number of new importers dealing with invoicing in each currency



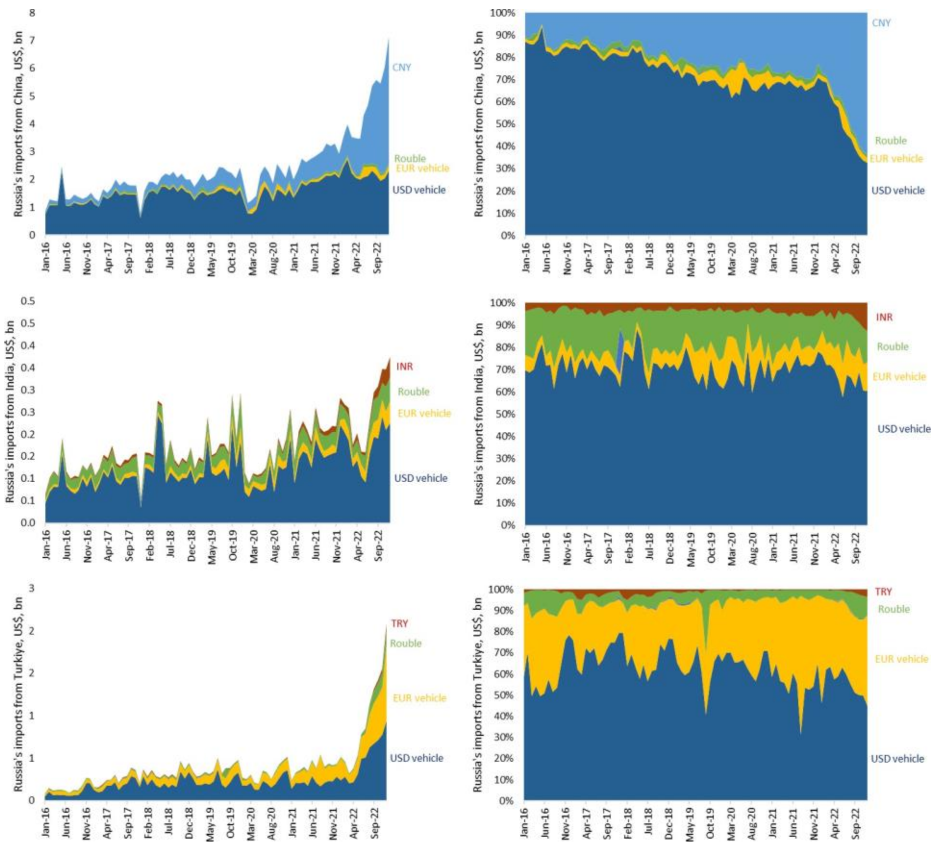
Source: Russia customs data and authors' calculations.
Note: Importers are identified by their unique tax id. A new firm is one that has not conducted import operations in the preceding 12 months.

Figure A4: Share of importers with trade invoiced in more than one currency



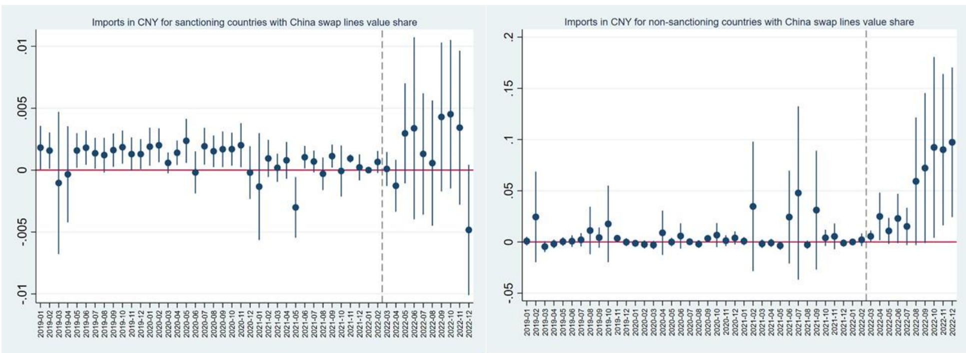
Source: Russia customs data and authors' calculations.
Note: Importers are identified by their unique tax id. A share of importing firms that dealt with invoices in a single currency in a given month, two currencies, three currencies and 4 or more currencies.

Figure A5: 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 A6: 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.