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The impact of exchange rate volatility on trade: The evidence from Russia☆

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Abstract

This paper analyzes the effects of exchange rate volatility on exports and imports of a range of goods between Russia and its 70 trading partners from 2004 until 2018. The goods in question fall into eight product categories, as follows: (i) agricultural raw materials; (ii) chemicals; (iii) food; (iv) fuels; (v) manufactured goods; (vi) ores and metals; (vii) textiles; and (viii) machinery and transport equipment. Exchange rate volatility is measured using the standard deviation of the first difference in the logarithmic daily nominal exchange rate. The paper concludes that exchange rate volatility had a negative impact on exports of agricultural raw materials, manufactured goods, and machinery and transport equipment. In contrast, it was found to have a positive and significant impact on trade in fuels and imports of chemicals and textiles.

Keywords: exchange rate volatility, gravity model, instrumental variable, exports, imports.
JEL classification: E0, F14, O24, Q02.

1. Introduction

International trade has dramatically increased in the last 80 years thanks to reductions in shipping and communication costs, globally negotiated reductions in tariffs in the context of multiple rounds of GATT and WTO trade negotiations, the widespread outsourcing of production activities, and a greater awareness of foreign cultures and products. Yet many impediments to trade still remain. In this vein, the link between exchange rate volatility — as a potential barrier to trade — and international trade flows remains a recurrent issue.[1] After the col-

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[1] Exchange rate volatility is generally referred to as a short-term exchange rate fluctuation (Naseem et al., 2008).

lapse of the Bretton Woods system in 1971, such major players, as the United States, Japan, and the nations of Europe, adopted a floating exchange rate where currency prices were determined by supply and demand. However, the trend over the 2004–2018 period largely was the reverse of this, namely towards more fixed regimes. While 13% of the 192 International Monetary Fund (IMF) member states were under a hard peg dollar regime in 2018, 46% were under a soft peg dollar regime, and 34% were under a floating regime; in contrast, the percentages in 2004 were 26%, 29%, and 45%, respectively (IMF, 2018).[2] This developing trend towards floating regimes drew attention to the effects of exchange rate policy and exchange rate volatility (McKenzie and Brooks, 1997).[3]

The general argument is that exchange rate volatility performs as an impediment to international trade in light of subsequent risks and transaction costs, which act as disincentives to trade. Conversely, for countries with a high level of financial development, the negative impact of exchange rate volatility should be less pronounced as these countries have access to financial instruments sufficient for them to hedge against any volatility shocks, including through the use of forward and option contracts (Dell'Araccia,1999; Héricourt and Poncet, 2013; Nicita, 2013). Notably, traders very often use the forward exchange market to hedge their currency risks but in certain countries a standard forward market does not exist.

This paper builds on earlier research in this area and aims to contribute to the understanding of the relationship between exchange rate volatility and trade and to answer the question of the impact of exchange rate volatility on trade between Russia and its trading partners, between 2004 and 2018, in the following product categories: (i) agricultural raw materials; (ii) chemicals; (iii) food; (iv) fuels; (v) manufactured goods; (vi) ores and metals; (vii) textiles; and (viii) machinery and transport equipment. In contrast to other studies, this paper focuses on the relationship between Russia and its 70 trading partners. The originality of this paper consists in disaggregating trade and evaluating the impact of exchange rate volatility on exports and imports of each of the eight product categories listed above. In addition, an instrumental variable approach has been used given the challenge of a potential reverse causality.

The remaining sections of the paper are organized as follows: section 2 provides a brief review of the literature; section 3 discusses Russia's trade environment during the period under consideration; section 4 discusses the selected data and empirical strategy and reports the estimated results; section 5 concludes the findings.

2. Literature review

Much has been written on the relationship between exchange rate volatility and international trade; indeed, studies on this topic date back to the collapse of the Bretton Woods System in 1971 (Hasanov and Baharumshah, 2011). It is

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[2] Exchange rate regime of 9% of 192 members was categorized as residual, not falling under any of the categories described above (IMF, 2018).

[3] Terms volatility, variability, and uncertainty are used interchangeably in the paper.

a subject that continues to preoccupy researchers today. The literature reviewed here is analyzed at the level of differences in methodology and results, where distinctions are drawn in relation to the following elements: (i) the empirical strategy adopted for measuring exchange rate volatility; (ii) the models used to evaluate the impact of this exchange rate uncertainty on trade flows; (iii) the employment of either nominal or real exchange rates; and (iv) the results obtained.[4]

Regarding the measurement of exchange rate volatility, a large number of studies have employed the standard deviation of the first difference of the logarithmic exchange rate, which has the property of being equal to zero if exchange rate follows a constant trend (Dell'Araccia, 1999; Rose, 2000; Tenreyro, 2003; Nicita, 2013).[5] In addition to this measure, Dell'Araccia (1999) also used the percentage difference between the maximum and minimum of the nominal spot rate over *t* years preceding the observation. All the measures used are therefore backward-looking, implying that firms would use past volatility to predict future uncertainty. Other papers have applied time series models to measure exchange rate uncertainty, such as the ARCH (McKenzie, 1999) and GARCH family models, which use higher frequency data (Naseem et al., 2008; Hasanov et al., 2011).

Several models have been used to study the impact of exchange rate volatility on trade flows; however, the most commonly used is the gravity model. This model is largely used because of its strong theoretical foundation (Dell'Araccia, 1999; Rose, 2000; Clark et al., 2004; Hasanov et al., 2011; Nicita, 2013). It is also considered to perform well empirically; it yields precise and generally reasonable estimates (Clark et al., 2004). McKenzie and Brooks (1997) employ a model that relies on the determinants of trade proposed by international trade theory, based on income, prices, exchange rate level, and level of exchange rate volatility. Naseem et al. (2008) utilize the import demand model to investigate the effect of real exchange rate volatility on Malaysian imports.

Finally, results on the impact of exchange rate volatility on trade do not appear to be unanimous in the literature. The traditional argument for the effect of uncertainty on trade suggests that higher exchange rate volatility acts as a disincentive to trade, diminishing the volume of trade and undermining future profits from international trade transactions (Naseem et al., 2008). In light of this, Dell'Araccia (1999) concluded that the impact of volatility of both nominal and real exchange rates on bilateral trade among the 15 EU members and Switzerland over the years 1975 to 1994 was negative. Subsequently, Rose (2000), estimating the impact on 186 countries over a five-year period, likewise observed a negative impact from nominal exchange rate volatility on trade flows. However, in other studies, a non-significant effect had been observed, such as in Tenreyro's (2007) investigation on the impact of uncertainty on trade between 87 countries over the years 1970 to 1997. A similar result had been obtained by Nicita (2013) evaluating the effects

[4] The differences between nominal and real exchange rates will be addressed briefly in the methodology section.

[5] This measure gives greater [disproportionate] weight to extreme observations. Its underlying assumption is that a constant trend would be perfectly anticipated; therefore, it would not affect uncertainty. An alternative variable preferred by certain authors is the standard deviation at the level of nominal exchange rate. This measure assumes that the exchange rate revolves around a constant. In this case, if there is a trend, this measure would probably overestimate exchange rate uncertainty (Dell'Araccia, 1999).

of short-term volatility on trade. Conversely, another group of authors identified a positive link between exchange rate volatility and the volume of trade. For example, McKenzie and Brooks (1997) observed a positive and significant impact from nominal exchange rate volatility on German–US bilateral trade over the years 1973 to 1992. Similarly, a positive impact on Malaysian imports was found by Naseem et al. (2008); and Kasman and Kasman (2005), who had investigated the effects of volatility on Turkey's most important trading partners, also considered the effects of that volatility to have been positive. Indeed, the latter argued that Turkish exporters did not rely solely on the domestic market to absorb any excess supply; for this reason, to prevent any revenue reduction from increased exchange rate volatility, firms actually exported more (Kasman and Kasman, 2005).

Other explanations as to why exchange rate volatility exerts less of an impact on trade flows relate to the development of relevant financial instruments on the market (Héricourt and Poncet, 2013) and the sunk costs of exporting (Krugman, 1989). The latter implies that high fixed costs of exporting make a firm less responsive to exchange rate volatility. Firms either stand ready to bear these risks, or else they have elaborated export strategies to hedge against any potential volatility shocks (Nicita, 2013).

3. Background

3.1. Economic growth

Following the collapse of the Soviet Union in 1991, the Russian Federation began to transform its economy, moving from a centrally-planned to a market-oriented economy. Having annual growth at an average of 7% over the years 2004 to 2008 was largely due to increasing oil and gas revenues, and mining investment; this economic growth then fell abruptly, down to –7.8%, in the wake of the 2008 financial crisis. In the following years, as a result of higher oil prices and stronger global demand and investment, the Russian economy turned around and expanded by an average of 3%. Nevertheless, another slowdown occurred in 2015, with a decline in consumption and investment in light of the crude oil price slump, market volatility, and policy uncertainty, which together resulted in a negative trend of –2.3%. During the 2016–2018 period, economic growth returned to a modest upward trend of 1.4% on average, driven mostly by mineral resource extraction and non-tradable sectors.

Accounting for an average of 50% of GDP during this period, international trade played an essential role in the Russian Federation's economy. Indeed, although Russia's economy was at this time declining in general terms, throughout the 2004–2018 period, Russia enjoyed a current account surplus in its trade in goods. Russia's terms of trade fluctuated significantly during this period. After modest improvements from 2004 to 2008, its terms of trade declined significantly in 2009. Consequently, following a short rise in 2010–2012, the economy situation began to deteriorate from 2012 onwards. A correlation may be drawn between these developments and the fluctuations in oil prices and the levels of certain other exports, as well as increases in import prices as a consequence of a ban on food imports (Idrisov et al., 2016).

3.2. Exchange rate policy

Regarding the Russian Federation's exchange rates policies, one of the major modifications during this time was a shift from a managed floating to a free floating exchange rate regime.[6] After the 1998 Russian financial crisis, the Central Bank of the Russian Federation (CBR) adopted a managed floating exchange rate regime. According to the BIS (2013), this policy had been intended to prevent excessive movement in the rouble exchange rate that might have threatened Russia's macroeconomic and financial stability. It was also justified by the lack of financial tools among economic participants and households to hedge against exchange rate uncertainty. From 2002 until 2005, the exchange rate continued to be tightly managed. Following the 2008 financial crisis, the CBR focused its policy on moderating depreciation of the rouble by raising interest rates and implementing control measures. During the post-crisis years, the CBR introduced greater flexibility into its exchange rate policy, and intervention volumes gradually decreased (BIS, 2013).

In November 2014, when market pressures again intensified, the CBR floated the rouble in order to facilitate a more rapid adjustment to external shocks and to curb reserve losses (WTO, 2016). Subsequently, the current regime sets no targets either for the exchange rate level or its fluctuations; it is fully determined by supply and demand on foreign exchange markets. Under normal conditions, the CBR does not intervene to influence the rouble exchange rate. However, developments in foreign exchange markets were monitored and foreign exchange operations conducted to maintain financial stability (CBR, 2017a).[7]

3.3. Developments in trade

During the 2004–2018 period, the composition of total exports and imports in goods had not significantly changed. With regard to exports, fuel represented 61% of total exports in 2018 (53% in 2004), followed by manufactured goods, at 17%; ores and metals, at 6%; machinery and transport equipment and chemicals, at 5% each in 2018; the respective numbers for 2004 were 23%, 10%, 5%, and 4%. Exports of agricultural raw materials decreased from 4% in 2004 to 2% in 2018 (Fig. 1). With regard to imports, the share of manufactured goods increased from 49% to 52% and the share of machinery and transport equipment imports from 26% to 29% in 2004 and 2018, respectively (Fig. 2). Imports of chemicals remained unchanged, at 9%; while the share of food imports declined by 5 p.p. (from 10% to 5% in 2004 and 2018).

The Russian Federation's main export markets were the following: the Netherlands (8%); Germany (7%); Italy (7%); Belarus (6%); and Ukraine (6%) in 2004; and China (12%); the Netherlands (10%); Germany (8%); Belarus (5%); and Turkey (5%) in 2018. Russia's main sources of imports were Germany (14%); Belarus (9%); Ukraine (8%); and China (6%) in 2004, and China (22%); followed by Germany (11%); Belarus (5%); and the United States (5%) in 2018.

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[6] Before 2004, de facto exchange rate regimes in Russia included the following: an intermediate regime (1995), fixed regimes (1996–1997), flexible regimes (1998), and intermediate regime (1999) (Hagen and Zhou, 2002).

[7] Although the currency interventions significantly decreased after 2014, they still remain. From November 2014 to July 2015, the CBR purchased $10,143.69 million, and sold $42,224.67 million and €1,837.77 million in contrast to $72,883.46 million and €7,668.47 million purchased during the 2010–2014 period, and $94,227.04 million and €9,227.91 million sold during the same period (CBR, 2017b).

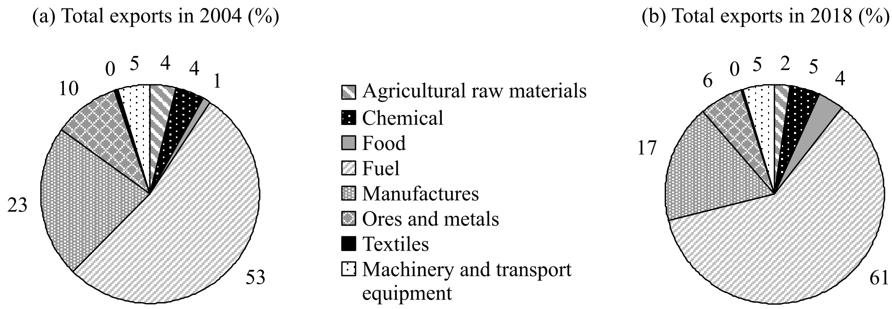

Fig. 1. Russia's merchandise trade (exports), 2004 and 2018.

Source: WITS.

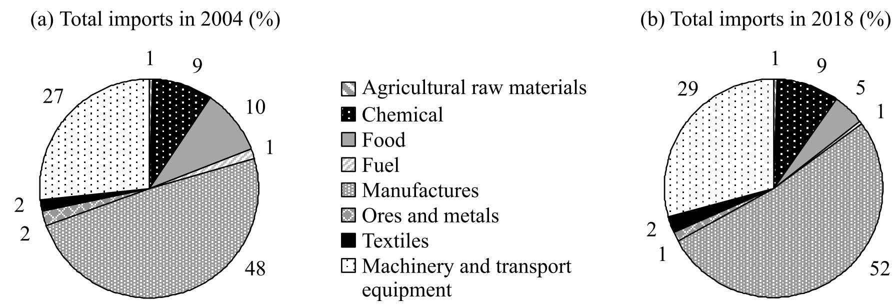

Fig. 2. Russia's merchandise trade (imports), 2004 and 2018.

Source: WITS.

4. Data and methodology

This section discusses the data and empirical strategy used in this study. The equations are estimated using: (i) real exchange rate data for the 2004–2018 period; (ii) annual disaggregated data on exports and imports of agricultural raw materials, chemicals, food, fuel, manufactured goods, ores and metals, textiles, and machinery and transport equipment; (iii) real GDP data; and (iv) geographical bilateral and cultural data (common official language, contiguity, and distance) — all for the same 2004–2018 period.[8]

The daily nominal exchange rate data (retrieved from the IMF database) are expressed in Special Drawing Rights (SDRs) per national currency unit available for 71 countries (the Russian Federation and its 70 trading partners; see Appendix A, Table A1). Then the data were converted to express the national currency units per one rouble, and consumer price index (CPI) was used to obtain real exchange rates. Annual disaggregated export and import data for goods and real GDP data are retrieved from the WITS and World Bank databases.

[8] The data for the research are retrieved from the CEPII, IMF, OECD, WITS and World Bank databases (http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp; http://data.imf.org/regular.aspx?key=60998122; https://data.oecd.org/trade/terms-of-trade.htm; http://wits.worldbank.org/#;http://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?end=2015&locations=RU&start=2004; http://data.worldbank.org/indicator/GC.DOD.TOTL.GD.ZS?end=2015&locations=RU&start=2004; http://databank.worldbank.org/data/reports.aspx?source=2&series=NY.GDP.MKTP.CD&country=). The choice of the period under consideration is based on the availability of IMF daily exchange rate data.

4.1. Exchange rate volatility

Real exchange rate volatility ($ERvol_{rit}$) was calculated employing the following formula (Dell'Araccia, 1999; Rose, 2000; Tenreyro, 2003; Nicita, 2013):

$$ERvol_{rit} = std.dev.[\ln(ER_{rit}) - \ln(ER_{rit-1})], \quad (1)$$

where ER_{rit} indicates the daily real exchange rate between Russia and country i, at time t, where t denotes days. The standard deviation is then calculated over a one-year period.

4.2. International trade and exchange rate volatility

The relationship between the exchange rate fluctuations and the levels of exports and imports of agricultural raw materials, chemicals, food, fuel, manufactured goods, ores and metals, textiles, machinery and transport equipment, is measured by a gravity model where a set of fixed effects control for all the determinants of trade flows normally included in the standard gravity model specifications. Notably, the impact of volatility on trade is based on the following specifications:

$$\log(X_{rit}) = \beta_0 + \beta_1 \log(ERvol_{rit}) + \beta_2 \log(MER_{rit}) + \beta_3 \log(GDP_{it}) + \\ + \beta_4 FD_{it} + \beta_5 \log(ERvol_{rit}) FD_{it} + \varphi_i + \omega_t + \varepsilon_{rit}; \quad (2)$$

$$\log(I_{rit}) = \beta_0 + \beta_1 \log(ERvol_{rit}) + \beta_2 \log(MER_{rit}) + \beta_3 \log(GDP_{it}) + \\ + \beta_4 FD_{it} + \beta_5 \log(ERvol_{rit}) FD_{it} + \varphi_i + \omega_t + \varepsilon_{rit}. \quad (3)$$

Both equations use annual data, where $\log(X_{rit})$ indicates the logarithm of the level of exports (that is, agricultural raw materials, chemicals, food, fuel, manufactured goods, ores and metals, textiles, machinery and transport equipment) from the Russian Federation to country i in year t, and $\log(I_{rit})$—logarithm of the level of imports (that is, agricultural raw materials, chemicals, food, fuel, manufactured goods, ores and metals, textiles, machinery and transport equipment) from a country i to Russia in year t; $\log(ERvol_{rit})$ indicates the exchange rate volatility in year t; $\log(MER_{rit})$ indicates the mean value of the exchange rate in year t; $\log(GDP_{it})$ indicates the real GDP of a country i in year t; FD_{it} indicates an OECD-dummy variable, which takes the value of 1 if a country i is an OECD member, and 0 in all other cases;[9] φ_i indicates country i fixed effects, *inter alia,* cultural, economic, and institutional-specific factors that are constant over time and not explicitly represented in the model; ω_t indicates time fixed effects; ε_{rit} is an error term.[10]

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[9] The following countries have become OECD members during the 2004–2018 period: Chile—2010, Estonia—2010, Israel—2010, and Slovenia—2010 (http://www.oecd.org/about/membersandpartners/list-oecd-member-countries.htm). Therefore, since FD_{it} changes over time, it was included in the estimate equation as a separate variable, although it should be noted that the effect is estimated only for the four countries mentioned above.

[10] In addition, in order to see whether the 2014 Central Bank policy has affected the regression results, the 2004–2018 time period was divided into two sub-periods: 2004–2013 and 2014–2018. These results, however, are not substantially different from the results obtained for the entire 2004–2018 period. Therefore, the latter results are reported further below.

5. Results and analysis

Exchange rate volatility has generally been considered to have a negative impact on the international flow of goods. In particular, this trend becomes more pronounced when countries switch to floating exchange rates as these are generally more prone to volatility. The underlying assumption is that, if exchange rate movements are not fully predicted, growing exchange rate volatility, which increases transaction costs for trading partners, will lead risk-averse agents to reduce their import/export activity, and to reallocate production towards domestic markets or other international markets (Dell'Araccia, 1999).

International trade in fuels. In 2004 and 2018, the share of fuel exports represented over 50% of total exports. In 2018, those exports totalled $203 billion, up from $65 billion in 2004 (Fig. 3). The empirical results (Appendix B, Table B1) demonstrate that exchange rate volatility had no significant impact on fuel exports.

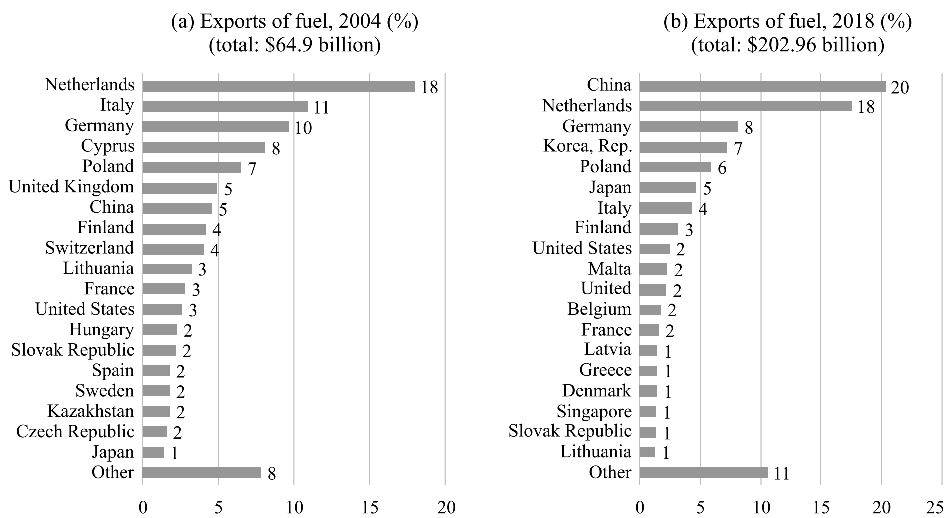

Fig. 3. Exports of fuel, 2004 and 2018.

Source: WITS.

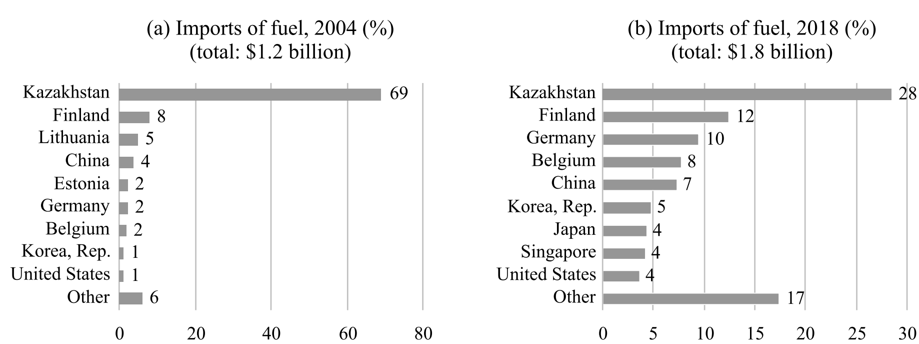

Fig. 4. Imports of fuel, 2004 and 2018.

Source: WITS.

On the import side, the share of trade represented approximately 1% in 2004 and in 2018 (Figs. 2 and 4). At a more disaggregated level, over 40% of these fuel imports are transformed furnace oil, fuel consisting mainly of residues from crude-oil distillation. It is used primarily for steam boilers in power plants, aboard ships, and in industrial plants. The empirical results demonstrate that an increase in exchange rate volatility resulted in an increase in fuel imports by an average of 0,4%. Trade with financially developed partners would decrease by an average 0.2% in the case of increased exchange rate volatility (Appendix B, Table B2).

International trade in manufactured goods. Both exports and imports of manufactured goods constituted a significant share in trade between Russia and its trading partners. Export flows of manufactured goods represented around 20% of total exports in 2004 and in 2018 (Figs. 1 and 5). The empirical results demonstrate that an increase in exchange rate volatility had resulted in a decline in exports by 0,2% on average (Appendix B, Table B3).

Import flows of manufactured goods represented 49% and 52% in 2004 and 2018, respectively (Figs. 2 and 6). The empirical results report that an increased volatility had a positive impact on the flow of imports. In particular, an increase in volatility by 1% resulted in an increase in imports by 0,16%, *ceteris paribus*. With

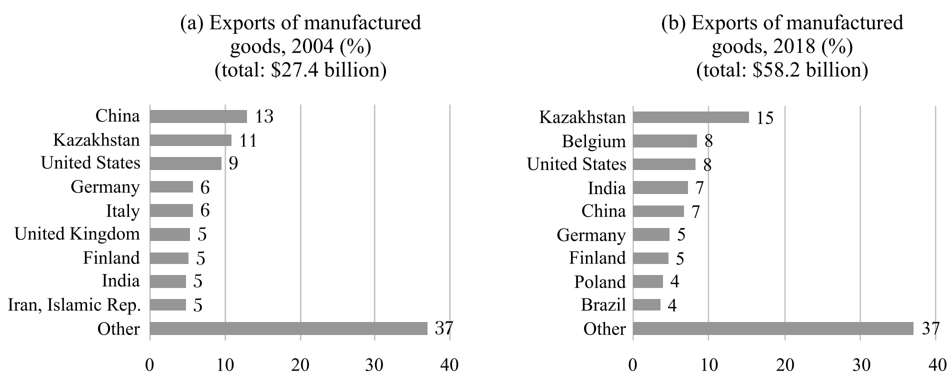

Fig. 5. Exports of manufactured goods by destination, 2004 and 2018.

Source: WITS.

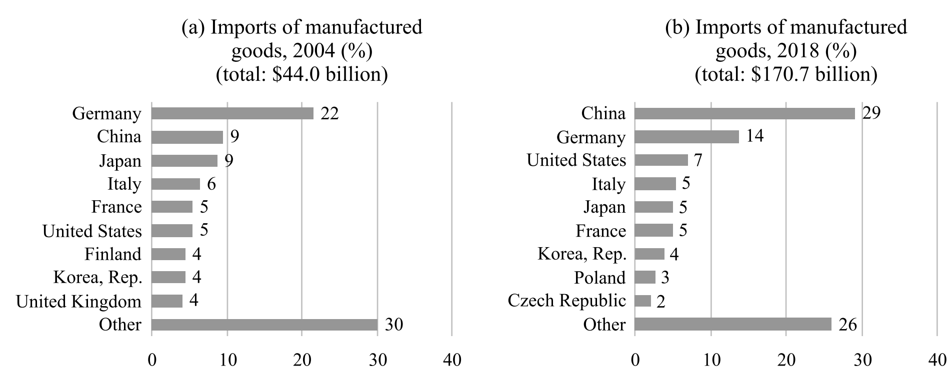

Fig. 6. Imports of manufactured goods by destination, 2004 and 2018.

Source: WITS.

respect to trade with financially developed partners, an exchange rate volatility had no impact (Appendix B, Table B4).

International trade in machinery and transport equipment. Imports of machinery and transport equipment represented approximately a quarter of all imports; its share in total exports, however, was relatively modest in both 2004 and 2018, accounting for only 5% (Figs. 1–2, and 7–8). With respect to imports of machinery and transport equipment, the empirical results indicate that an increase in exchange rate volatility had a negative impact on trade flows. Notably, a 1% increase in volatility decreased the flow of imports by 0,3% (Appendix B, Table B5).

On the export side, the reported results are comparable to those of imports. An increase in volatility resulted in a decrease in exports by 0,24% when the trading partner was a non-OECD member (for example, Kazakhstan, China, or India); however, the decrease in exports was relatively small, by only 0,04%, if a partner was an OECD member (for example, Germany, Spain, or the United States) (Appendix B, Table B6).

International trade in chemicals. The import share of chemicals (approximately 9%) was double that of exports in both 2004 and 2018 (Figs. 1–2 and 9). The empirical results demonstrate that exchange rate volatility had a significant

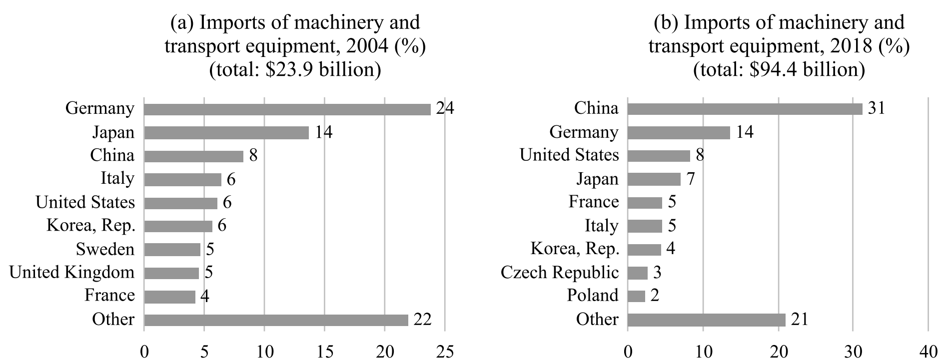

Fig. 7. Imports of machinery and transport equipment, 2004 and 2018.

Source: WITS.

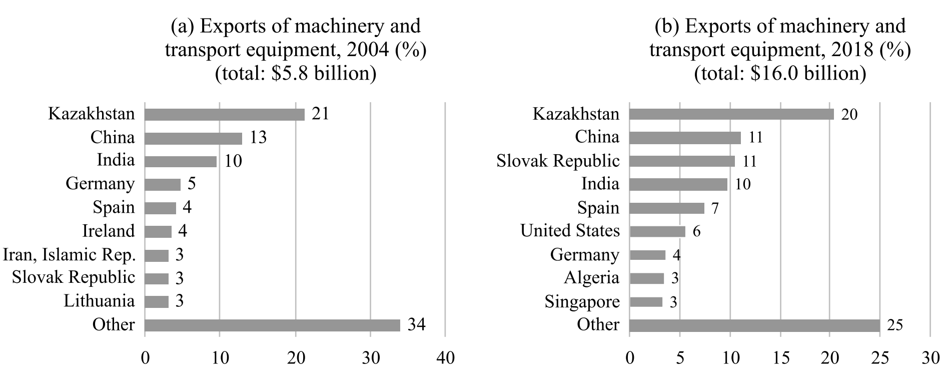

Fig. 8. Exports of machinery and transport equipment, 2004 and 2018.

Source: WITS.

impact on the imports of chemicals. A 1% increase in volatility contributed to an increase in imports of chemicals by 0,14% (Appendix B, Table B7). In the case of trade with a financially developed partner — say, Germany, France, or Poland — then the increase in volatility resulted in a drop in imports by 0,03%, *ceteris paribus*. Contrary to the impact on imports, the volatility had not had any impact on the export flows of chemicals.

International trade in textiles. The trade in textiles made up the smallest share of all traded products in both 2004 and 2018. Imports increased from $1.7 billion to $7.5 billion, and accounted for 2% of total imports in 2004 and 2018 (Figs. 2 and 10). More than a third of those imports came from China, Germany, and Italy. The empirical results demonstrate that an increase in exchange rate volatility had a positive impact on import flows — 0,2% on average (Appendix B, Table B8). If the partner was an OECD member, that is, Italy, Germany, and the Republic of Korea, exchange rate volatility had no impact on the bilateral trade.

No significant impact of volatility was observed on the trade in agricultural raw materials, food, and ores and metals. As described *supra* the empirical results differ depending on a product category. The results obtained may be summarized as follows.

First, in a number of cases, the empirical results broadly followed the prevailing economic logic, namely that growing exchange rate volatility increased

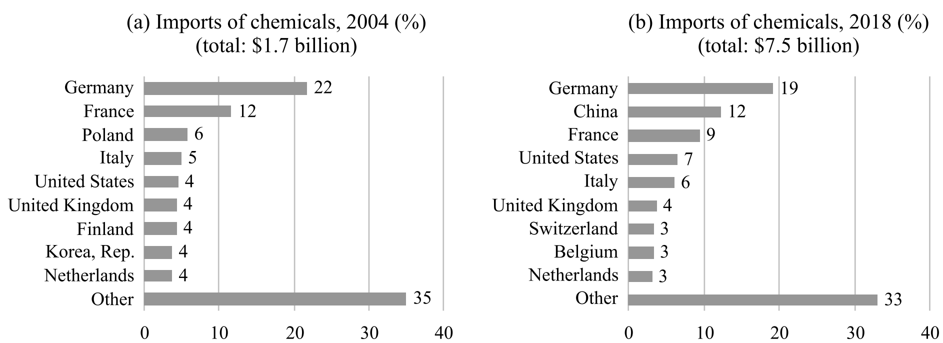

Fig. 9. Imports of chemicals, 2004 and 2018.

Source: WITS.

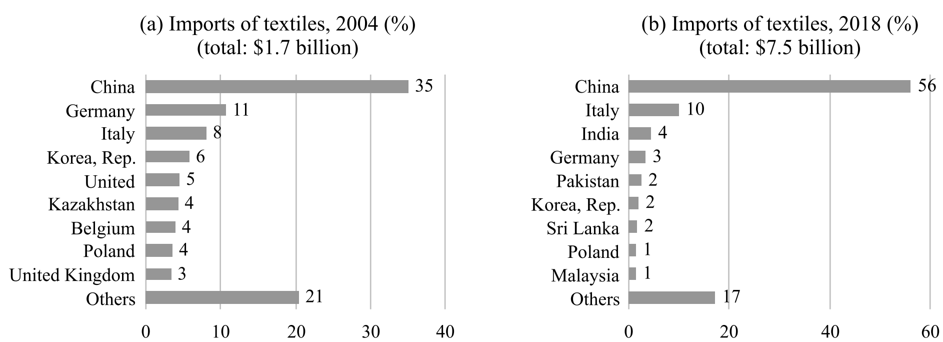

Fig. 10. Imports of textiles, 2004 and 2018.

Source: WITS.

uncertainty and posed risks to traders, thereby resulting in a decrease in the flow of goods. In this case, volatility had a negative impact on trade flows, such as in the case of exports of manufactured goods, and machinery and transport equipment. Notably, with regard to manufactured goods and machinery and transport equipment, the level of financial development also played a role. In particular, countries that were OECD members presumably experienced a less marked decrease in trade flows during the period of volatility.

Second, certain results demonstrate that exchange rate volatility can have a positive impact on trade flows. Specifically, a positive impact from trade volatility was found with regard to imports of fuels, textiles, chemicals, and manufactured goods. These results may appear to be counterintuitive; however, they are not unique. Comparable conclusions were found by Naseem et al. (2008), McKenzie and Brooks (1997) and Kasman and Kasman (2005). Reportedly, an increase in uncertainty hastened the flow of trade, which had previously been relatively stable. The volatility caused traders to increase their activities in order to avoid any reduction in revenues arising from an increased exchange rate risk in a context where they were otherwise risk averse. In addition, the reasons for increased trade may include the fact that some firms, for example in Turkey, had little alternative but to confront increased exchange rate risks and to continue their exporting activities regardless. This result does not mean that exchange rate volatility promotes trade; but it implies that a negative or zero effect of volatility on trade, particularly in the context of specific products, is not always robust.

5.1. Price elasticity and competitiveness

The empirical results obtained *supra* are also subject to the price elasticity of demand for these product categories.[11] Depending on a product category, price level and the availability of substitutes, price elasticity differs. Various studies have shown that different types of fuel products — namely, petroleum and natural gas — are largely price inelastic to price variations due to their relevance for the functioning of the world economy. Similarly, high tech products — these are products with a high-tech added value (e.g., chemicals, manufactured goods) — are also price inelastic (García and Corrasco, 2019). While textiles and apparel generally tend to have a high price elasticity of demand (Coface, 2021), this varies substantially depending on the geographical location and the product segment. For example, according to the Insight's research, the women's apparel is relatively price inelastic compared to the children's and men's (First Insight, 2017).

5.2. Financial market development and hedging instruments

In addition, the results of the analysis are also subject to the level of development of the financial markets both in Russia and in partner countries. This level of development determines the ability to use different hedging instruments to address potential volatility.

[11] A more detailed analysis of price elasticities in the analyzed sectors may be conducted in further research.

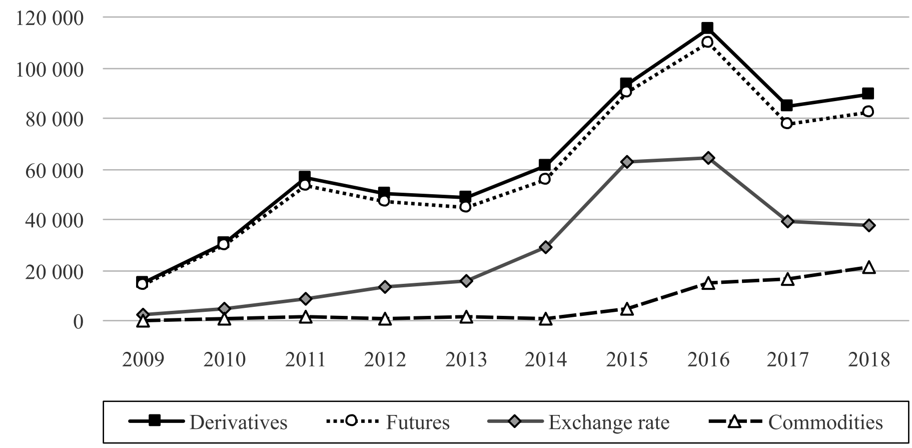

Fig. 11. Financial instruments, trading volume, 2009–2018 (RUB billion).
Source: Moscow Exchange data, 2021.

The development of the financial market in Russia is still ongoing. According to the Bank of Russia and the joint IMF and WB evaluation, a number of fundamental characteristics determine the financial market development in Russia; these include, *inter alia*, the country's socio-economic standing, such as diversity of economy, standard of living, maturity of government and law institutions, and the level of integration of the domestic financial market into the global economy. The current status of Russia's financial market is characterized by (i) poor capital market development; (ii) absence of a solid institutional investor base; (iii) high concentration in certain sectors; (iv) continued presence of misconducting players; and (v) weak financial market regulation and supervision (CBR, 2019; IMF, 2016).

In this context, an extensive use of various financial instruments to hedge against exchange rate volatility shocks remains questionable. Even though the trading volume has been growing during recent years, there is still a significant room for improvement. According to Moscow Exchange[12] data (Fig. 11), the trading volume of commodities' futures increased from 2% to 25% of all derivatives instruments from 2009 to 2018, while exchange rate futures increased from 15% to 46% during the same period. In addition to the low financial development issue, the relatively modest use of financial development instruments is also explained by the low volatility of currency exchange rate and indices in the 2009–2018 period (MOEX, 2018).

5.3. Potential challenges and instrumental variable approach

It is important to note that the results obtained in this paper may also be subject to endogeneity.[13] Notably, it is likely that exchange rate volatility is

[12] Moscow Exchange Group manages Russia's main trading platform for equities, bonds, derivatives, currencies, money market instruments and commodities. It was formed in December 2011 from a merger of Russia's two main exchange groups: MICEX Group, the oldest domestic exchange and operator of the leading equities, bonds, foreign exchange and money markets in Russia; and RTS Group, which at that time operated Russia's leading derivatives market.

[13] Generally, endogeneity may be caused by simultaneity, measurement error, and omitted variable bias.

endogenous to levels of international trade. Specifically, in this research, endogeneity might potentially originate from reverse causality and/or simultaneity. On the one hand, as discussed previously, exchange rate volatility creates risk for firms and investors — therefore risk-averse companies would presumably trade less; on the other hand, in cases where there is trade between parties, countries might wish to further boost their mutual trade through the elimination of both tariff and non-tariff barriers, which in turn would have an impact on exchange rate volatility and result in an alignment of exchange rate regimes (Dell'Ariccia, 1999; Rose, 2000; Teneyro, 2007). Traditionally, this problem relating to simultaneity and/or reverse causality has been resolved through an instrumental variable approach (IV).

Indeed, although being widely used in econometric, if rarely elsewhere, the IV approach is conceptually difficult and easily misused (Cameron and Triverdi, 2005) because good instruments are hard to find. Theoretically, an instrumental variable (Z_{rit}) must satisfy two conditions: first, the variable must be uncorrelated with the error term ($\mathrm{E}(\varepsilon_{rit}|Z_{rit})) = 0$; and, second, it must be correlated with the independent variable — endogenous variable — exchange rate volatility ($\mathrm{E}(ERvol_{rit}\ Z_{rit})) \neq 0$. In this research paper, partners' exchange rate regimes were used in an effort to correct for potential endogeneity problems. During the 2004–2018 period under consideration, some countries changed their regimes from various categories of fixed to floating and vice versa.[14]

The results of the IV approach, on the one hand, confirm the results obtained *supra*. Notably, in line with previous results, IV estimation coefficients also demonstrate that exchange rate volatility had a positive impact on imports of fuels, textiles, chemicals and manufactured goods.

Performing the endogeneity test confirmed that in 15 specifications (out of a total of 16) exchange rate volatility is an endogenous variable. The only exception is the specification in which imports of fuels are regressed on exchange rate volatility and other variables. In other specifications, the instrument was found to be weak due to a relatively low correlation between exchange rate volatility and an instrumental variable: ($\mathrm{E}(ERvol_{rit}\ Z_{rit})) \neq 0$.

For these reasons, endogeneity remains a key challenge in fully assessing the impact of exchange rate volatility on the flow of both exports and imports.

6. Conclusion

This paper has examined the relationship between exchange rate volatility and trade. It has also examined the impact of volatility on exports and imports between the Russian Federation and each of its 70 trading partners during the 2004–2018 period. In particular, the impact of volatility was evaluated on imports and exports of eight product categories, namely: (i) agricultural raw materials; (ii) chemicals; (iii) food; (iv) fuels; (v) manufactured goods; (vi) ores and metals; (vii) textiles; and (viii) machinery and transport equipment.

[14] Exchange rate regimes were based on countries' de facto arrangements. A dummy variable was constructed which categorized types and categories of Exchange Rate Arrangements into fixed (hard and soft pegs) and floating. More information is available at: https://www.imf.org/external/np/mfd/er/2006/eng/0706.htm

The empirical results obtained in the research demonstrate that exchange rate volatility has a different impact on different product categories. In a number of cases, these results indicate that exchange rate volatility has a negative impact on exports of manufactured goods, and machinery and transport equipment. However, a positive and significant impact of volatility on trade is observed in both imports of fuels, textiles, chemicals, and manufactured goods.

Bearing these results in mind, it is important to note that they may be subject to price elasticities, level of financial development and an endogeneity distortion. With regards to the endogeneity issue, exchange rate volatility is potentially an endogenous variable. This endogeneity might originate from reverse causality. An instrumental variable approach was used in an attempt to address this issue. However, the selected instrument, namely changes in countries' exchange rate regimes, may be relatively weak due to its poor correlation with the endogenous variable, which is exchange rate volatility. Therefore, further research is needed to define a stronger instrument to tackle the endogeneity issue.

References

BIS (2013). Market volatility and foreign exchange intervention in EMEs: What has changed? *BIS Papers*, No. 73, 293–299.

Cameron, A. C., & Triverdi, P. K. (2005). *Microeconomics. Methods and applications*. New York: Cambridge University Press.

CBR (2017a). *The Bank of Russia foreign exchange policy*. Moscow: Bank of Russia.

CBR (2017b). *Data on the Bank of Russia currency interventions (monthly)*. Moscow: Bank of Russia.

CBR (2019). *Russian financial market development program for 2019–2021*. Moscow: Bank of Russia.

Clark, P., Tamirisa, N., Wei, S.-J., Sadikov, A., & Zeng, L. (2004). *Exchange rate volatility and trade flows—some new evidence*. Washington, DC: International Monetary Fund.

Coface (2021). Economic analysis, textile–clothing. https://www.coface.ro/en/Economic-Analysis/Textile-Clothing

Dell'Ariccia, G. (1999). Exchange rate fluctuations and trade flows: Evidence from the European Union. *IMF Staff Papers*, *46*(3), 315–334.

First Insight (2017). *Decoding price elasticity to unlock revenue and minimize risk*. https://cdn.nrf.com/sites/default/files/2018-10/FirstInsight-Elasticity%20Report-Oct-2017_Interactive.pdf

García, E. D., & Corrasco, C. (2019). The balance of payments and Russian economic growth. *HSE Economic Journal, 23*(4)*,* 524–541. https://doi.org/10.17323/1813-8691-2019-23-4-524-541

Hagen, J., & Zhou, J. (2002). De facto and official exchange rate regimes in transition economies. *Centre for European Integration Studies Working Paper*, No. B13.

Hasanov, A. S., & Baharumshah, A. Z. (2011). Exchange rate risk and trade flows: The case of Belarus, Kazakhstan, Russia, and Ukraine. *EERC Working Paper*, No. 11/09E.

Hasanov, A. S., Baharumshah, A. Z., Shitan, M., & Eshkuvatov, Z. K. (2011). Exchange rate risk and trade flows: A gravity equation approach. In: *2nd International conference on business and economic research proceeding* (pp. 1784–1795). Conference Master Resources.

Héricourt, J. & Poncet, S. (2013). Exchange rate volatility, financial constraints and trade: Empirical evidence from Chinese firms. *CESifo Working Paper*, No. 4303.

Idrisov, G., Ponomarev, Y., & Sinelnikov-Murylev, S. (2016). Terms of trade and Russian economic development. *Russian Journal of Economics*, *2*(3), 279–301. https://doi.org/10.1016/j.ruje.2016.09.002

IMF (2016). *Russian Federation: Financial system stability assessment*. Washington, DC: International Monetary Fund. https://doi.org/10.5089/9781498363068.002

IMF (2018). *Annual report on exchange arrangements and exchange restriction 2017*. Washington, DC: International Monetary Fund.

Kasman, A., & Kasman, S. (2005). Exchange rate uncertainty in Turkey and its impact on export volume. *METU Studies in Development*, *32*(1), 41–58.

Krugman, P. (1989). The case for stabilizing exchange rates. *Oxford Review of Economic Policy*, *5*(3), 61–72. https://doi.org/10.1093/oxrep/5.3.61

McKenzie, M. D. (1999). The impact of exchange rate volatility on international trade flows. *Journal of Economic Surveys*, *13*, 71–106. https://doi.org/10.1111/1467-6419.00075

McKenzie, M. D., & Brooks, R. (1997). The impact of exchange rate volatility on German–US trade flows. *Journal of International Financial Markets Institutions and Money, 7*(1), 73–87. https://doi.org/10.1016/S1042-4431(97)00012-7

MOEX (2018). *Moscow Exchange annual report, 2018. Open markets, new opportunities*. Moscow: Moscow Exchange.

Naseem, N. A. M., Tan, H.-B., & Hamizah, M. S. (2008). Exchange rate misalignment, volatility and import flows in Malaysia. *International Journal of Economics and Management*, *1*(3), 130–150.

Nicita, A. (2013). Exchange rates, international trade and trade policies. *International Economics*, *135–136*, 47–61. https://doi.org/10.1016/j.inteco.2013.10.003

Rose, A. K. (2000). One money, one market: Estimating the effect of common currencies on trade. *NBER Working Papers,* No. 7432. https://doi.org/10.3386/w7432

Tenreyro, S. (2007). On the trade impact of nominal exchange rate volatility. *Journal of Development Economics, 82*, 485–508. http://personal.lse.ac.uk/tenreyro/variability.pdf

WTO (2016). *Trade policy review: Russian Federation* (WTO document No. WT/TPR/S/345). Geneva: World Trade Organization.

Appendix A

Table A1
List of Russian trading partners.

Algeria	Indonesia	Peru
Australia	Iran, Islamic Rep.	Philippines
Austria	Ireland	Poland
Bahrain	Israel	Portugal
Belgium	Italy	Qatar
Botswana	Japan	Saudi Arabia
Brazil	Kazakhstan	Singapore
Brunei	Korea, Rep.	Slovak Republic
Canada	Kuwait	Slovenia
Chile	Latvia	South Africa
China	Libya	Spain
Colombia	Lithuania	Sri Lanka
Cyprus	Luxembourg	Sweden
Czech Republic	Malaysia	Switzerland
Denmark	Malta	Thailand
Estonia	Mauritius	Trinidad and Tobago
Finland	Mexico	Tunisia
France	Montenegro	United Arab Emirates
Germany	Nepal	United Kingdom
Greece	Netherlands	United States
Greenland	New Zealand	Uruguay
Hungary	Norway	Venezuela
Iceland	Oman	
India	Pakistan	

Sources: IMF; WITS; UN Comtrade.

Appendix B

Table B1
Dependent variable: log of exports of fuel.

Variable	Model 1	Model 2	Model 3
lnrervlt	0.057	0.057	0.504
	(0.579)	(0.580)	(0.584)
lnrermean	–0.019	–0.018	0.046
	(0.132)	(0.132)	(0.131)
lngdp	1.428	1.441	–0.548
	(1.540)	(1.550)	(1.620)
findev	–0.156	–10.069	
	(1.130)	(2.930)	
interactio~d	–1.908		
	(0.522)		
cons	–27.549	–27.800	27.040
	(41.400)	(41.500)	(43.500)
Observations	468	468	468
Adjusted R^2	0.076	0.076	0.106

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

Table B2
Dependent variable: log of imports of fuel.

Variable	Model 1	Model 2	Model 3
lnnervlt	–0.131	–0.139	0.405*
	(0.112)	(0.112)	(0.228)
lnnermean	0.090	0.089	0.104
	(0.101)	(0.101)	(0.0995)
lngdp	1.889**	1.863**	0.600
	(0.923)	(0.924)	(1.030)
findev	0.672	–2.227*	
	(0.707)	(1.28)	
interactio~d	0.600***		
	(0.221)		
cons	–44.943*	–44.730*	–8.224
	(13.600)	(13.600)	(14.900)
Observations	632	632	632
Adjusted R^2	0.080	0.081	0.098

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

Table B3
Dependent variable: log of exports of manufactured goods.

Variable	Model 1	Model 2	Model 3
lnnervlt	–0.059	–0.062	–0.117*
	(0.038)	(0.038)	(0.608)
lnnermean	–0.004	–0.004	–0.007
	(0.0339)	(0.0339)	(0.034)
lngdp	0.857***	0.843***	0.968***
	(0.261)	(0.261)	(0.382)
findev	0.355	0.660*	
	(0.225)	(0.349)	
interactio~d	0.066		
	(0.058)		
cons	–11.451*	–11.287*	–14.816**
	(6.780)	(6.780)	(7.440)
Observations	912	912	912
Adjusted R^2	0.117	0.119	0.121

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

Table B4
Dependent variable: log of imports of manufactured goods.

Variable	Model 1	Model 2	Model 3
lnnervlt	0.015	0.016	0.158**
	(0.401)	(0.402)	(0.0646)
lnnermean	–0.047	–0.047	–0.039
	(0.0357)	(0.0357)	(0.0357)
lngdp	1.574***	1.577***	1.240***
	(0.276)	(0.276)	(0.300)
findev	–0.071	–0.863**	
	(0.237)	(0.369)	
interactio~d	–0.172***		
	(0.0616)		
cons	30.581***	–30.610***	–21.093***
	(7.180)	(7.180)	(7.920)
Observations	902	902	902
Adjusted R^2	0.366	0.372	

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations

Table B5
Dependent variable: log of imports of machinery and transport equipment.

Variable	Model 1	Model 2	Model 3
lnnervlt	–0.048	–0.056	–0.265***
	(0.0589)	(0.0579)	(0.0947)
lnnermean	–0.039	–0.039	–0.050
	(0.0514)	(0.0513)	(0.0512)
lngdp	1.470***	1.427***	2.023***
	(0.453)	(0.452)	(0.499)
findev	0.853**	2.027***	
	(0.340)	(0.540)	
interactio~d	0.255***		
	0.0914)		
cons	–29.402**	–28.745**	–45.418***
	(11.800)	(11.800)	(13.200)
Observations	873	873	873
Adjusted R^2	0.183	0.189	0.197

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

Table B6
Dependent variable: log of exports of machinery and transport equipment.

Variable	Model 1	Model 2	Model 3
lnnervlt	–0.074	–0.073	–0.236***
	(0.0532)	(0.0533)	(0.0854)
lnnermean	–0.030	–0.030	–0.040
	(0.047)	(0.047)	(0.0465)
lngdp	0.239	0.242	0.618
	(0.365)	(0.366)	(0.396)
findev	–0.078	0.833*	
	(0.315)	(0.490)	
interactio~d	0.198**		
	(0.0816)		
cons	2.433	2.398	–8.245
	(9.510)	(9.520)	(10.500)
Observations	905	905	905
Adjusted R^2	0.102	0.102	0.109

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

Table B7
Dependent variable: log of imports of chemicals.

Variable	Model 1	Model 2	Model 3
lnnervlt	–0.000	0.000	0.138**
	(0.0414)	(0.0415)	(0.0691)
lnnermean	–0.024	–0.024	–0.017
	(0.0368)	(0.0368)	(0.0368)
lngdp	1.072***	1.074***	0.726**
	(0.295)	(0.295)	(0.326)
findev	–0.053	–0.823**	
	(0.241)	(0.391)	
interactio~d	–0.166**		
	(0.0665)		
cons	–18.677**	–18.706**	–8.847
	(7.740)	(7.740)	(8.670)
Observations	843	843	843
Adjusted R^2	0.298	0.298	0.304

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.

Table B8
Dependent variable: log of imports of textiles.

Variable	Model 1	Model 2	Model 3
lnnervlt	0.030	0.037	0.224***
	(0.0428)	(0.0426)	(0.072)
lnnermean	–0.047	–0.047	–0.039
	(0.0376)	(0.0375)	(0.0374)
lngdp	0.315	0.351	–0.196
	(0.332)	(0.331)	(0.370)
findev	–0.746***	–1.785***	
	(0.245)	(0.405)	
interactio~d	–0.224***		
	(0.0696)		
cons	–0.439	–0.951	14.332
	(8.700)	(8.650)	(9.820)
Observations	845	845	845
Adjusted R^2	0.175	0.185	0.196

Note: Standard errors in parenthesis; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
Source: Author's calculations.