ISSN 1883-1656

Центр Российских Исследований
RRC Working Paper Series No. 40

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August 2013

RUSSIAN RESEARCH CENTER
INSTITUTE OF ECONOMIC RESEARCH
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A Gravity Model of Russian Trade: The Role of Foreign Direct Investment and Socio-Cultural Similarity*

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Abstract: In this paper, we estimated a gravity model of Russian trade using panel data from Russia and 23 OECD member countries. Our estimation results indicate that foreign direct investment and socio-cultural similarity are determining factors in the trade volume between Russia and these developed economies. We also found that the trade and investment activities of Russian firms differ considerably from their counterparts in developed economies.

JEL classification numbers: F14, F21, P33

Key words: international trade, foreign direct investment, gravity model, Poisson regression, WTO, Russia

* This research was financially supported by the College of Bioresource Sciences of Nihon University and a grant-in-aid for scientific research from the Ministry of Education and Sciences of Japan (No. 23243032). We thank Tammy L. Bicket for her editorial assistance. Needless to say, all remaining errors are our sole responsibility.

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1. Introduction

In August 2012, Russia joined the World Trade Organization (WTO) as its 156th member country. In 1993, the country applied for membership in the General Agreement on Tariffs and Trade (GATT), the predecessor of the WTO, meaning that the Russian government took more than 18 years to achieve this national goal. This event symbolizes Russia's progress toward a market economy.

Accession to the WTO has unconditionally granted Russia most-favored-nation status, while at the same time imposing obligations to open its market by cutting tariffs and lowering investment barriers.[1] Moreover, after accession to the WTO, the implementation of protectionist policies that deviate from international rules is required to be strictly regulated, and thus the uncertainty risk regarding Russia's economic policies and institutions, which foreign investors and multinational companies have long been concerned about, will be substantially mitigated. As **Fig. 1** shows, Russia's trade with foreign countries increased almost constantly between the late 1990s and 2011, except for several years during which international trade was adversely affected by the 1998 financial crisis and by the US-originated Lehman Shock in 2008. According to the views and opinions of not only Russian government officials, but also a host of business people, this expansionary trend in international trade between Russia and the rest of the world is expected to gain further momentum in conjunction with more foreign capital inflow on the strength of the series of measures implemented in the wake of the accession.[2]

However, economic theories do not necessarily endorse the simultaneous expansion of international trade and foreign direct investment (FDI). This is because FDI in a country may lead to a decrease in exports from that country after a certain time lag, according to a traditional viewpoint in which offshore production is regarded as an alternative means of exporting. In contrast, according to the theory of multinational firms put forth by Marksen (2002), FDI may rather serve as a supplement to trade between countries in which the factor endowment substantially differs from each other. In sum, as pointed out by Cieślik (2009), theorists are unable to provide a definite answer to the question of whether FDI restricts or, conversely,

[1] These measures include the reduction of the average tariff rate from 10.0% to 7.8%, the lowering of the rate of the import duty on finished cars from 30% to 15%, the removal of tariffs on IT products, the relaxation of entry regulations for foreign distributors, and approval for foreign banks to set up local subsidiaries.

[2] For example, see the interview with Sergei Katyrin, President of the Chamber of Commerce and Industry of the Russian Federation as reported in the morning edition of the *Nihon Keizai Shinbun*, a Japanese economic newspaper, issued August 22, 2012.

creates trade in the real world. Therefore, this issue is left up to empirical analysis, and, of course, that does not exclude Russia as a subject.

In an attempt to predict Russia's trade activities in the future, the social and cultural gap with any of its trade partners is as big an issue as is FDI. In general, when other conditions remain constant, economic activities between countries that are socially and culturally closer to each other are conducted more actively (Kogut and Singh, 1988; Boisso and Ferrantino, 1997; Lankhuizen et al., 2011). This is because commonality in traditions, business practices, religions, and languages, etc., is considered to reduce the transaction costs for cross-border economic activities. After having broken away from the socialist system, Russia has managed to promote the "westernization" of its socio-economic system. As a result, the sense of opaqueness about the Russian society that came from the thickly veiled era of the Soviet Union has been dispelled considerably, which in turn has substantially contributed to the expansion and diversification of international trade activities. However, as symbolized by the annual state-of-the-nation address delivered by President Vladimir Putin in December 2012, the recent Russian administration has become less liberal and instead has been strengthening its tendency toward conservatism that emphasizes Russia's traditional sense of values as well as patriotism. In addition, the Putin administration has externally been clearly demonstrating authoritarian attitudes, such as overtly cracking down on non-governmental organizations that receive financial assistance from abroad, and thus there is grave concern that conflicts concerning political and human rights issues may emerge between Russia and Western countries.

As seen from these trends, Russia has been seen to be undermining its social relations with developed countries, its major trade partners, since its accession to the WTO in August 2012. On top of this, the country's corruption problems remain extremely serious (Timofeyev, 2011; Popov, 2012). In addition, Russia differs to a considerable extent from its trading partners in terms of its organizational culture as well, since the country is characterized as having a clear power distance and strong collectivism (Hofstede, 2001; Abe and Iwasaki, 2010). Russia's social and cultural idiosyncrasies, as observed in these comparisons with developed countries, are likely to have an adverse effect on its trade activities; this point also needs to be verified.

In this paper, by performing a panel estimation of a Russian trade model, we empirically examine how FDI, as well as socio-cultural differences between Russia and any of its trade partners, will affect bilateral trade activities.[3] The next section describes our empirical

[3] Lissovolik and Lissovolik (2006) is the only preceding study that addresses a research issue similar to that of this paper. They used panel data from between 1995 and 2002 to estimate a gravity model in which Russia's export volume is adopted as a dependent variable. However, they did not examine how FDI, as well as social and cultural gaps, affects Russia's trade activities.

methodology and the data to be used for the estimation. Section 3 reports the estimation results. Section 4 summarizes our major findings and policy implications.

2. Empirical Methodology and Data

The Russian trade model to be estimated in this paper is based on the gravity equation, one of the most-employed empirical tools for explaining bilateral trade flows. The most basic gravity equation includes the scale of the Russian economy in the *t* th term (GDP_{rt}), the corresponding economic scale of the *i* th trade partner (GDP_{it}), the bilateral trade volume ($TRADE_{rit}$), and the distance between the two countries ($DIST_{ri}$); it is specified as follows:

$$TRADE_{rit} = \frac{A(GDP_{rt}GDP_{it})^{\gamma_g}}{DIST_{ri}^{\gamma_d}}, \quad (1)$$

where γ denotes the elasticity and A is treated as a constant term. However, as argued in Wang et al. (2010), it is not appropriate to assume that the coefficient A should be constant across all trade partners. Accordingly, we replaced this term with a function of the serial direct investment during the past two years and the socio-cultural similarity between Russia and its trade partners in light of the above discussion on the causal relationship between the FDI or social and cultural differences and international trade. That is:

$$A_{rit} = e^{\gamma_{ri}} FDI_{rit-1}^{\gamma_{f1}} FDI_{rit-2}^{\gamma_{f2}} SCSIM_{rit}^{\gamma_s}, \quad (2)$$

where FDI_{rit-1} and FDI_{rit-2} denote the direct investment between Russia and the *i* th trade partner during a period earlier by one year and that during a period earlier by two years, respectively. $SCSIM_{rit}$, which expresses the socio-cultural similarity between the two nations, can be specified in accordance with the following equation:

$$SCSIM_{rit} = 1 - \frac{SC_{rt}^2}{(SC_{rt} + SC_{it})^2} - \frac{SC_{it}^2}{(SC_{rt} + SC_{it})^2}, \quad (3)$$

where SC_{rt} and SC_{it} denote the social and cultural level of Russia and that of the *i* th trade partner, respectively. Substituting Equation (2) into Equation (1), we have:

$$TRADE_{rit} = exp\big(\gamma_{ri} + \gamma_g lnGDP_{rt}GDP_{it} - \gamma_d lnDIST_{ri} + \gamma_{f1} lnFDI_{rit-1} + \gamma_{f2} lnFDI_{rit-2} + \gamma_s lnSCSIM_{rit}\big). \quad (4)$$

The second term in the right-hand side of Equation (4) can be transformed further as follows:

$$lnGDP_{rt}GDP_{it} = -ln2 + 2lnGDPSUM_{rit} + lnGDPSIM_{rit}, \quad (5)$$

where

$$GDPSUM_{rit} = GDP_{rt} + GDP_{it}$$

and

$$GDPSIM_{rit} = 1 - \frac{GDP_{rt}^2}{GDPSUM_{rit}^2} - \frac{GDP_{it}^2}{GDPSUM_{rit}^2}.$$

Namely, $GDPSUM_{rit}$ expresses the combined economic scale of Russia and the i th trade partner, while $GDPSIM_{rit}$ denotes the similarity in economic scale between both countries (Wang et al., 2010). Substituting Equation (5) into Equation (4), we can further rearrange the latter into the following panel regression equation, which additionally takes into consideration the bilateral effect between Russia and the i th trade partner and the presence of a time effect:

$$TRADE_{rit} = exp(\beta_1 lnGDPSUM_{rit} + \beta_2 lnGDPSIM_{rit} + \beta_3 lnDIST_{ri} + \beta_4 lnFDI_{rit-1} + \beta_5 lnFDI_{rit-2} + \beta_6 lnSCSIM_{rit} + \vartheta_{ri} + \vartheta_t + \varepsilon_{rit}), \quad (6)$$

where β is a parameter to be estimated, while ϑ_{ri} and ϑ_t denote the bilateral effect and the time effect, respectively, and ε_{rit} is an error term.

To estimate a trade model that is based on the gravity equation, many prior studies have adopted a log-linear model and utilized the ordinary least squares (OLS) method. However, as Silva and Tenreyro (2006) argue, this traditional approach faces the problem of Jensen's inequality, in which the expected value of the logarithm of a random variable is different from the logarithm of its expected value $\big(E(ln\, y) \neq ln\, E(y)\big)$. In addition, if there are no past trade records, any log-linear model faces a problem in that it has to go through a special treatment concerning the dependent variable (Westerlund and Wilhelmsson, 2011). Therefore, a group of econometricians strongly recommends estimating a regression model, in which the trade value is adopted as a direct dependent variable, using the Poisson pseudo-maximum likelihood estimator (PPML) (Siliverstovs and Schumacher, 2009; Kucharčuková et al., 2012; Arvis and Shepherd, 2013). In this paper, following these latest findings, we estimate the fixed-effects models in Equation (6) by PPML and report White's heteroskedasticity-consistent standard errors as our basic principle for estimating the gravity model of Russian trade.

In this regard, however, the fixed-effects PPML estimation is not necessarily the best estimation method if the variance of the bilateral effect ϑ_{ri} is either zero or not correlated with the relevant independent variable.[4] In addition, any fixed-effects model is unable to estimate

[4] It is possible to estimate a random-effects model by PPML, but at least as far as STATA version 13.0 is concerned, it is unable to obtain White's heteroskedasticity-consistent standard errors as is necessary for estimating the gravity equation. Another problem with using PPML is that its panel

time-invariant variables. Therefore, in this paper, we will also estimate conventional log-linear models and then report the most appropriate results among these estimations of the pooled OLS estimator, the random-effects estimator, and the fixed-effects estimator on the basis of the results from the Breusch-Pagan test and the Hausman test. Concurrently, time-invariant variables will be estimated by either the pooled OLS estimator or the random-effects estimator on the basis of the results of the Breusch-Pagan test. We set the critical value of the null hypothesis for each model specification test at the 10% significance level. The regression equation to be estimated using these linear panel estimators is specified as follows:

$$lnTRADE_{rit} = \beta_1 lnGDPSUM_{rit} + \beta_2 lnGDPSIM_{rit} + \beta_3 lnDIST_{ri} + \beta_4 lnFDI_{rit-1} + \beta_5 lnFDI_{rit-2} + \beta_6 lnSCSIM_{rit} + \vartheta_{ri} + \vartheta_t + \varepsilon_{rit}. \quad (7)$$

In this paper, we estimate Equations (6) and (7) using panel data for Russia and 23 selected member countries of the Organisation for Economic Co-operation and Development (OECD).[5] The estimation period is the 16 years from 1995 to 2010, but the panel data for some countries are unbalanced since there are quite a number of missing values. The data for Russia and these OECD countries concerning their bilateral trade, gross domestic product (GDP), and the past records of direct investment are obtained from the official statistics of the Federal State Statistical Service of Russia and the respective public databases of the International Monetary Fund (IMF) and the OECD. As for social and cultural indicators, we adopt the following five types of indicators: (1) the *Political Rights Rating* and (2) the *Civil Liberties Rating*, both published by Freedom House; (3) the *Control of Corruption Index* published by the World Bank; and (4) the *Power Distance Index* and (5) the *Individualism Index*, both based on Hofstede's study (2001).

Table 1 lists the respective definitions, the descriptive statistics, and the correlation matrix of the above-mentioned variables. As this table shows, some of the social and cultural indicators are more likely to cause multicollinearity since a part of their correlation coefficients exceeds the threshold of 0.70. In addition, the two indicators derived from Hofstede (2001) are time-invariant variables. Accordingly, we will estimate these social and cultural indicators separately.

estimation method has so far lacked a model specification test with which the linear panel estimation method is equipped.

[5] By limiting Russian trade partners to certain OECD countries, we try to avoid the "quasi-"direct investment problem that arises due to capital flight from Russia to Cyprus, the Cayman Islands, some of the former Soviet Republics and the like, and conversely due to capital reflux from these countries. By doing so, we expect that there is some merit in testing the real relationship between FDI and trade activities.

3. Estimation Results

Table 2 shows the estimation results. Panels (a) and (b) of this table report the estimation results of Russia's import model and export model, respectively. In the case of the linear panel estimation, we also report the results of the Breusch-Pagan test and the Hausman test. The results of these model specification tests reveal that a significant correlation between the bilateral effect ϑ_{ri} and the independent variable cannot be detected, although the variance of the bilateral effect is statistically significantly different from zero at the 10% or lower level in almost all cases. Accordingly, we report the random-effects models for these cases. The only exception is Model [6], for which we report the fixed-effects model because the Hausman test rejects the null hypothesis of the random-effects assumption.

In **Table 2**, both the combined economic scale (*GDPSUM*) and the economic scale similarity (*GDPSIM*) show significant and positive estimates in all the models except for Model [12], while the distance between the two countries (*DIST*) has significant and negative estimates in all the random-effects models in line with the theoretical expectations. These results strongly indicate that the economic theories that have been expressed in the gravity equation greatly affect Russia's trade activities with developed economies.

With regard to the impacts of FDI and socio-cultural similarity on Russian trade activities, in Panel (a) of **Table 2**, *INWFDI* is estimated to be insignificant irrespective of the degree of its time lag. In other words, FDI from the 23 OECD countries will not significantly affect Russia's imports (or the exports of the OECD countries). We conjecture that the trade substitution effects of FDI and its supplementary effects may balance each other out in terms of the flow of capital, goods, and services from the OECD countries to Russia. In this same panel, among the five types of variables that are used as proxies for socio-cultural similarity, both *POLRIGSIM* and *CIVLIBSIM* show significant and positive estimates, corresponding with our predictions. Thus, if other conditions are the same, the similarity between Russia and any trade partner in terms of political rights or civil liberties will promote the flow of goods and services from the trade partner to Russia. On the other hand, according to the estimation results of *CORCONSIM, POWDISSIM*, and *INDIVSIM*, the similarity in terms of the control of corruption or the organizational culture is not a factor that affects Russia's imports from the OECD countries. These results may indicate that firms based in developed economies have a strong tendency to be more responsive to social gaps in terms of both the political and human rights aspects rather than to corruption problems and/or cultural gaps.

Meanwhile, as shown in Panel (b) of **Table 2**, the estimation results of Russian export models imply that the trade and investment activities of Russian firms differ considerably from

their counterparts in developed economies. More specifically, the one-year lagged *OUTFDI* is estimated with a significant and positive sign in all Models from [11] to [20], and the two-year lagged *OUTFDI* is also significant and positive in Models [16] and [17], suggesting that FDI from Russia into the OECD countries is most likely to result in export growth in the future. Here, the trade supplementary effect of FDI is clearly identified. We suppose that these estimation results might capture the achievements of Russian firms that have boldly made upfront overseas investments for the sake of market development in advanced nations.

Concerning the influence of socio-cultural similarities on Russia's export, estimates of both *POLRIGSIM* and *CIVLIBSIM* are significant, as in the case of Russian import models, but their respective signs are negative. Taking into consideration the fact that Russia is far inferior to any of the 23 OECD countries in terms of its political rights and civil liberties ratings, we surmise that Russian firms tend to select as trade partners those countries that are politically more generous to their citizens and that make more efforts to protect civil liberties, as compared to their home country. On the other hand, *POWDISSIM* is estimated significant and positive in Model [19], suggesting that similarity in the organizational culture in terms of the power distance strengthens exports from Russia. Based on the above results, we infer that Russian firms have a strong tendency to export their products and services to countries that are under a more liberal business environment from the social viewpoint, but are close and familiar from the organizational culture viewpoint. These estimation results are quite interesting in helping to grasp the behavioral pattern of Russian exporters.

4. Conclusion

In this paper, we estimated the gravity model of Russian trade using panel data from Russia and 23 selected OECD countries. Our estimation results show that the impact of FDI is neutral on the trade volume from the OECD countries to Russia, while the social similarity in terms of political rights and civil liberties has a positive effect. With regard to trade from Russia to the OECD countries, we found that FDI has a trade-promoting effect. Socio-cultural similarity with the trade partner also has a significant effect on Russia's export. However, the similarity in terms of political rights and civil liberties has turned out to correlate negatively with exports from Russia, contrary to our expectations. In this sense, there is some idiosyncrasy in the behavioral patterns of Russian firms as compared with those in developed economies.

A series of institutional changes in the wake of Russia's accession to the WTO have created expectations that trade and investment activities will simultaneously expand between Russia and the rest of the world. However, according to the empirical results of this paper, there cannot

be any expectation of a strong synergistic effect between trade and FDI from developed countries to Russia, in contrast to the positive relationship between trade and FDI from Russia to the OECD trade partners. In addition, the obvious tendency toward conservatism and the current externally authoritarian attitude of the Russian administration raises concern that trade from advanced nations to Russia might be inhibited. If Russia aims to make a major national goal of further integrating itself into the world economy, the Putin administration should immediately change its inward-looking policy attitudes.

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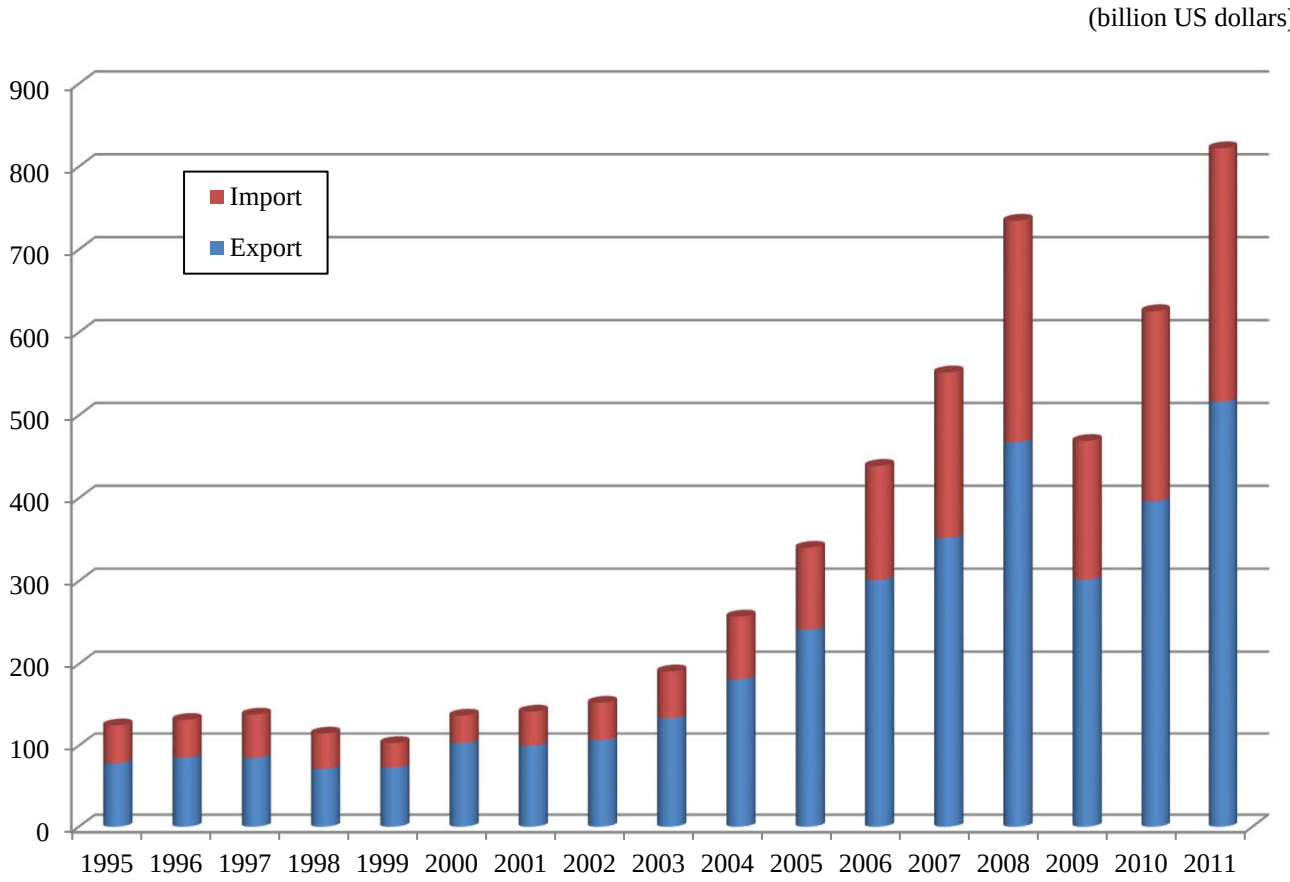

Fig. 1. Trends in Russia's international trade: 1995–2011

Source : Authors' illustration based on the official statistics of the Federal State Statistical Service of Russia (http://www.gks.ru/)

Table 1. Definition, descriptive statistics, and correlation matrix of variables used for estimation of the gravity model of Russian trade

	Variable name	Definition	Descriptive statistics			Correlation matrix													
			Mean	S. D.	Median	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]
[1]	$IMPORT_{ri}$	Russia's imports from the i th trade partner[a, b]	2575.139	3889.473	1186.000	1.00													
[2]	$lnIMPORT_{ri}$	Russia's imports from the i th trade partner (natural logarithm)[a]	7.154	1.179	7.078	0.77	1.00												
[3]	$EXPORT_{ri}$	Russia's exports to the i th trade partner[a]	5499.790	7588.753	2947.500	0.59	0.59	1.00											
[4]	$lnEXPORT_{ri}$	Russia's exports to the i th trade partner (natural logarithm)[a]	7.976	1.167	7.989	0.58	0.75	0.77	1.00										
[5]	$lnGDPSUM_{ri}$	Combined economic scale of Russia and the i th trade partner (natural logarithm)[c]	7.096	0.914	7.090	0.58	0.76	0.42	0.58	1.00									
[6]	$lnGDPSIM_{ri}$	Economic scale similarity between Russia and the i th trade partner (natural logarithm)[d]	-1.213	0.675	-0.957	0.04	0.05	0.12	-0.06	-0.16	1.00								
[7]	$lnDIST_{ri}$	Linear distance between Russia's capital and the i th trade partner's capital (natural logarithm)[e]	7.655	0.578	7.485	0.16	0.21	0.01	0.07	0.61	0.01	1.00							
[8]	$lnINWFDI_{ri}$	The i th trade partner's annual net direct investment into Russia (natural logarithm)[f]	3.310	3.584	4.222	0.24	0.29	0.12	0.18	0.20	0.15	0.03	1.00						
[9]	$lnOUTFDI_{ri}$	Russia's annual net direct investment into the i th trade partner (natural logarithm)[f]	0.827	3.446	0.943	0.19	0.16	0.24	0.22	0.16	0.01	-0.02	0.10	1.00					
[10]	$lnPOLRIGSIM_{ri}$	Political rights similarity between Russia and the i th trade partner (natural logarithm)[g]	-0.907	0.142	-0.868	-0.40	-0.50	-0.41	-0.51	-0.47	0.00	0.00	-0.19	-0.13	1.00				
[11]	$lnCIVLIBSIM_{ri}$	Civil liberties similarity between Russia and the i th trade partner (natural logarithm)[g]	-0.819	0.055	-0.811	-0.23	-0.33	-0.26	-0.32	-0.30	-0.01	0.08	-0.12	-0.03	0.77	1.00			
[12]	$lnCORCONSIM_{ri}$	Control of corruption similarity between Russia and the i th trade partner (natural logarithm)[h]	-0.825	0.082	-0.818	-0.29	-0.39	-0.26	-0.19	-0.32	-0.19	0.10	-0.25	-0.19	0.44	0.56	1.00		
[13]	$lnPOWDISSIM_{ri}$	Power distance similarity between Russia and the i th trade partner (natural logarithm)[i]	-0.879	0.215	-0.815	0.04	0.03	0.09	0.23	0.10	-0.13	0.23	-0.05	-0.14	0.03	0.24	0.53	1.00	
[14]	$lnINDIVSIM_{ri}$	Individualism similarity between Russia and the i th trade partner (natural logarithm)[i]	-0.768	0.051	-0.769	-0.13	-0.31	-0.16	-0.19	-0.30	-0.02	-0.29	-0.10	-0.01	0.04	0.22	0.27	0.05	1.00

Notes:

[a] Based on the official statistics of the Federal State Statistical Service of Russia (Rosstat). Unit is million US dollars.

[b] Russia's trade partners consist of 19 European countries (Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, the Netherlands, Norway, Poland, Slovakia, Spain, Sweden, Switzerland, and the United Kingdom) and 4 non-European countries (Japan, Korea, Turkey, and the United States of America). All of these 23 countries belong to the OECD. The same definition applies hereafter.

[c] Based on the IMF's *World Economic Outlook* database (http://www.imf.org/external/pubs/ft/weo/2012/01/weodata/index.aspx). Unit is billion US dollars. The combined economic scale is obtained by calculating the sum of Russia's gross domestic products (GDP) and that of the i th trade partner.

[d] The economic scale similarity is computed by: $1-GDP_r^2/(GDP_r+GDP_i)^2-GDP_i^2/(GDP_r+GDP_i)^2$, where GDP$r$ denotes Russia's GDP and GDPi denotes the GDP of the i th trade partner.

[e] Unit is kilometers.

[f] Based on the OECD's *OECD.StatExtracts* database (http://stats.oecd.org/index.aspx?r=346981#). Unit is million US dollars.

[g] Based on the Freedom House's public database *Freedom in the World Country Ratings* (http://www.freedomhouse.org/report-types/freedom-world). The values of the variable are obtained as follows: First, the original ratings (maximum 1.0, minimum 7.0) are substracted from 8. Then, the resultant values are assigned to the same equation as in the economic scale similarity between Russia and the i th trade partner.

[h] Based on the World Bank's public database *Worldwide Governance Indicators* (http://info.worldbank.org/governance/wgi/sc_country.asp#). The values of the variable are obtained as follows: First, the value of 2.5 is added to each of the original Control of Corruption index values (maximum 2.5, minimum -2.5) for Russia and its trade partners. Then, the resultant values are assigned to the same equation as in the economic scale similarity between Russia and the i th trade partner. Russia's partially missing values are complemented by linear estimation.

[i] Based on Hofstede (2001, Appendix 5, p. 500, p. 502). The values of the variable are obtained by assigning it to the same equation as in the economic scale similarity between Russia and the i th trade partner.

Table 2. Estimation results of the gravity model of Russian trade

(a) Russian import model

Dependent variable	$IMPORT_{rit}$				$lnIMPORT_{rit}$					
Estimator [a]	PPML				RE	FE	RE			
Model	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
$lnGDPSUM_{rit}$	1.5340 ***	1.6605 ***	1.5836 ***	1.5078 ***	1.5550 ***	1.7001 ***	1.6055 ***	1.4751 ***	1.5546 ***	1.5549 ***
	(0.058)	(0.084)	(0.061)	(0.083)	(0.054)	(0.073)	(0.056)	(0.080)	(0.054)	(0.054)
$lnGDPSIM_{rit}$	1.1351 ***	1.2283 ***	1.1716 ***	1.1190 ***	1.0834 ***	1.2266 ***	1.1213 ***	1.0432 ***	1.0880 ***	1.0842 ***
	(0.229)	(0.200)	(0.226)	(0.208)	(0.218)	(0.205)	(0.218)	(0.177)	(0.220)	(0.218)
$lnDIST_{ri}$					-0.8969 ***		-0.9608 ***	-0.8053 ***	-0.9403 ***	-0.9446 ***
					(0.183)		(0.187)	(0.208)	(0.181)	(0.190)
$lnINWFDI_{ri\,t-1}$	-0.0008	-0.0018	-0.0016	-0.0011	-0.0019	-0.0021	-0.0023	-0.0017	-0.0019	-0.0020
	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$lnINWFDI_{rit-2}$	-0.0014	-0.0034	-0.0025	-0.0012	0.0005	-0.0011	0.0002	0.0001	0.0005	0.0004
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$lnPOLRIGSIM_{rit}$		0.6208 **				0.6414 *				
		(0.314)				(0.353)				
$lnCIVLIBSIM_{rit}$			1.2346 ***				1.2368 ***			
			(0.310)				(0.328)			
$lnCORCONSIM_{rit}$				-0.3645				-1.1684		
				(0.627)				(1.107)		
$lnPOWDISSIM_{ri}$									0.5104	
									(0.370)	
$lnINDIVSIM_{ri}$										-1.8970
										(3.087)
Constant term					4.2153 ***	-2.9407 ***	5.4209 ***	3.0714 *	5.0035 ***	3.1245
					(1.478)	(0.408)	(1.506)	(1.843)	(1.542)	(2.392)
Bilateral effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	242	242	242	242	242	242	242	242	242	242
Log pseudolikelihood / R^2 [b]	-12146.32	-11784.96	-11822.85	-12123.65	0.73	0.59	0.73	0.72	0.74	0.73
Breusch-Pagan test (χ^2) [c]					557.50 ***	551.82 ***	550.72 ***	539.02 ***	555.62 ***	580.59 ***
Hausman test (χ^2) [d]					7.25	10.32 *	7.34	0.83	5.17	7.20
Wald test (χ^2) / *F* test [e]	1355.95 ***	2013.63 ***	1409.39 ***	1550.00 ***	1160.33 ***	236.04 ***	1120.24 ***	1108.39 ***	1237.80 ***	1197.59 ***

(Continued)

(b) Russian export model

Dependent variable	$EXPORT_{rit}$				$lnEXPORT_{rit}$					
Estimator [a]	PPML				RE					
Model	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]	[19]	[20]
$lnGDPSUM_{rit}$	1.4555 ***	1.1445 ***	1.3931 ***	1.3474 ***	1.2748 ***	0.8308 ***	1.1448 ***	1.2340 ***	1.2729 ***	1.2749 **
	(0.148)	(0.112)	(0.147)	(0.092)	(0.117)	(0.117)	(0.118)	(0.101)	(0.115)	(0.117)
$lnGDPSIM_{rit}$	0.7269 ***	0.4173	0.6430 ***	0.7213 ***	0.8631 ***	0.5350 ***	0.7222 ***	0.8486 ***	0.8673 ***	0.8684 ***
	(0.243)	(0.270)	(0.242)	(0.267)	(0.160)	(0.141)	(0.154)	(0.159)	(0.149)	(0.161)
$lnDIST_{ri}$					-0.9529 ***	-0.5109 **	-0.7489 ***	-0.9123 ***	-1.1254 ***	-0.8737 ***
					(0.208)	(0.224)	(0.226)	(0.182)	(0.156)	(0.248)
$lnOUTFDI_{ri\ t-1}$	0.0097 ***	0.0090 **	0.0120 ***	0.0090 ***	0.0154 ***	0.0115 **	0.0185 ***	0.0149 ***	0.0158 ***	0.0154 ***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
$lnOUTFDI_{rit-2}$	0.0012	0.0081	0.0038	-0.0018	0.0132	0.0206 **	0.0165 *	0.0121	0.0137	0.0132
	(0.007)	(0.007)	(0.006)	(0.008)	(0.010)	(0.009)	(0.010)	(0.011)	(0.010)	(0.010)
$lnPOLRIGSIM_{rit}$		-1.6310 ***				-2.1352 ***				
		(0.288)				(0.328)				
$lnCIVLIBSIM_{rit}$			-1.8996 ***				-3.4516 ***			
			(0.313)				(0.648)			
$lnCORCONSIM_{rit}$				-1.6429				-0.6575		
				(1.186)				(1.188)		
$lnPOWDISSIM_{ri}$									2.2076 ***	
									(0.758)	
$lnINDIVSIM_{ri}$										2.5225
										(3.180)
Constant term					7.2699 ***	4.6803 ***	3.6076 **	6.6962 ***	10.5416 ***	8.6158 ***
					(1.498)	(1.460)	(1.778)	(1.470)	(1.167)	(1.909)
Bilateral effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	179	179	179	179	180	180	180	180	180	180
Log pseudolikelihood / R^2 [b]	-34382.94	-30413.65	-33038.55	-33531.54	0.53	0.54	0.53	0.51	0.63	0.51
Breusch-Pagan test (χ^2) [c]					459.26 ***	501.71 ***	473.11 ***	473.50 ***	464.82 ***	413.70 ***
Hausman test (χ^2) [d]					2.13	0.68	0.96	7.74	1.43	1.73
Wald test (χ^2) / F test [e]	188.10 ***	163.92 ***	125.15 ***	1518.02 ***	197.51 ***	265.66 ***	203.98 ***	361.01 ***	223.03 ***	369.58 ***

Notes :

[a] PPML, RE, and FE denote Poisson pseudo-maximum likelihood estimator, random-effects estimator, and fixed-effects estimator, respectively. Figures in parentheses beneath regression coefficients correspond to White's heteroskedasticity-consistent standard errors. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

[b] The pseudo-maximum likelihood is reported in the case of the Poisson estimation, while the coefficient of determination is reported in the case of the linear panel estimation.

[c] The model specification test for selection between the pool OLS model and the random-effects model that tests the null hypothesis that the variance of the individual effects is zero

[d] The model specification test for selection between the fixed-effects model and the random-effects model that tests the null hypothesis that individual effects do not correlate with any independent variable

[e] Null hypothesis: All coefficients are zero. The result of the Wald test is reported in the case of the Poisson and random-effects estimations, while the result of the F test is reported in the case of the fixed-effects estimation.

Source : Authors' estimation