ФИНАНСЫ РЕГИОНА

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DETERMINANTS OF FDI INFLOWS: THE CASE OF RUSSIAN REGIONS [1]

This paper empirically analyses the determinants of foreign direct investment inflows into the Russian regions. This problem has become highly relevant for the necessary modernization of the Russian economy after the recent economic slowdown and sharp decrease in budget revenues. The authors model foreign direct investment flows with the use of the gravity approach according to which investment flows are positively correlated with the size of the investor's country as well as the size of the recipient region and are negatively correlated with the distance between investor and recipient. The empirical analysis is based on a constructed database consisting of the foreign direct investment flows from 179 investor countries into 78 Russian regions for the period 2006–2013. The authors apply the Poisson Pseudo Maximum Likelihood method and identify the following factors determining foreign direct investment inflows into the Russian economy: the gross domestic product of the investor's country, the gross domestic product per capita in the recipient region, the distance from the investor to Moscow, the openness of the region, the economic situation in the region, the innovative capacity of the region and the foreign direct investment of the previous period. Interestingly, the distance from the recipient region to Moscow matters for the regions in the western part of Russia (relatively close to Moscow) but is not significant for the regions in the eastern part (remote regions).

Keywords: foreign direct investment, determinants, gravity approach, Russian regions, Poisson Pseudo Maximum Likelihood method, econometric models, distance to Moscow, gravity variables, remoteness, modernization, foreign direct investment concentration

1. Introduction

FDI plays a crucial role in a country's development, since it is an efficient way to introduce new technologies and modern production technologies. Besides the direct effects (increase in GDP, budget receipts, decrease in unemployment etc.), FDI indirectly positively influences the host economy through, among others, knowledge and technology diffusion, increase in demand for local intermediate goods, investment in further training of workers.

A high level of FDI inflows is one of the key components to solve the problems of modernization and diversification of the Russian economy [1]. After very low level of FDI inflows in the 1990s, Russia became one of the major FDI recipients in the world in the first decade of the 21st century: the cumulative level of FDI inflows into the Russian economy comprises $368 billion for the period of 2001–2011 (8th place among world top FDI recipients)[2].

Because of sanctions and the subsequent economic slowdown, the Russian economy has faced a sharp decrease in FDI inflows during the last two years. According to the UNCTAD World Investment Report 2015[3], FDI flows to the Russian Federation fell by 70 per cent to $21 billion (in part as a result of an adjustment after the Rosneft—BP megadeal in 2013).

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[2] According to data retrieved from: http://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx (date of access: 06.06.2016).

[3] UNCTAD, 2015. World Investment Report. Reforming International Investment Governance. United Nations. 218. Retrieved from: http://unctad.org/en/PublicationsLibrary/wir2015_en.pdf (date of access: 06.06.2016).

Looking at the structure of FDI inflows into Russia, we can conclude that FDI is very concentrated at the regional level. During the period from 2000 to 2012, 47.8 % of foreign investment was concentrated in four regions: Moscow (31.5 %), Moscow Oblast (9.8 %), St. Petersburg (4.0 %) and Leningrad Oblast (2.5 %). However, these four regions account only for 30 % of the Russian national product and for 16 % of Russia's population. Furthermore, the top 15 Russian regions received 81 % of total FDI, while the bottom 50 regions received less than 10 %.

Therefore, determining the factors that drive FDI inflows into the Russian regions is an important and relevant objective. Defining such set of FDI determinants would help to improve the effectiveness of regional investment and industrial policy and increase amounts of incoming FDI.

The empirical analysis in this paper is based on the gravity approach. This approach is widely used to explain FDI flows between countries, while the number of papers that use the gravity approach to explain FDI determinants at the regional level is rather limited. Only few papers investigate determinants of FDI inflows into Russia at the regional level[1], however, they use old data concerning the last decade of the 20th century when the level of FDI inflows into the Russian economy was extremely low, and, thus, provide results that do not extend to our question.

This paper contributes to the existing literature in three ways. First, we analyse the period 2006–2013, when Russia was the largest FDI recipient among post-communist economies and one of the largest FDI recipients in the world. Second, we use the Poisson Pseudo Maximum Likelihood (PPML) method to estimate FDI determinants in Russian regions. This method is widely used in explaining FDI at country level and has proved to be one of the most efficient methods, providing unbiased and consistent estimates in the presence of an endogeneity problem caused by simultaneity. To the best of our knowledge, there is no research to date that uses PPML method to estimate FDI determinants at the regional level. Finally, we split the distance from the foreign investor's country to the recipient region into the distance from the foreign investor's country to Moscow and from Moscow to the recipient region in order to take into account the crucial role Moscow plays in channelling the FDI flows.

The structure of the paper is the following. Section 2 provides the main theoretical aspects and a literature overview. Section 3 presents the main methodological aspects for estimating the FDI determinants. Section 4 presents the empirical model and the estimation results. Section 5 concludes.

2. Theoretical background and literature overview

In the literature, the theoretical background of FDI determinants is mostly developed in the framework of microeconomic international trade models, where FDI present capital migration between countries. In the neoclassical framework, the main factor influencing the firms' decision to invest abroad is transport costs. According to the modern approach, based on monopolistic competition, market size, factor prices and product differentiation in the industry among others were shown to be significant factors. In the latest theoretical works (e.g. [9] and [10]), with firms' heterogeneity as the main feature, firms' productivity has been identified as determining the factor of the level of FDI flows[2].

One of the most popular approaches in the empirical literature to explain FDI flows is the gravity approach, first proposed by Timbergen [12] for trade flows and then applied by Brainard [13] to FDI flows. In its simplest form, it can be written as follows:

$$F_{ij} = \frac{M_i M_j}{D_{ij}}, \qquad (1)$$

where F_{ij} is the FDI flow from country j to country i, M_i and M_j are indicators of economic sizes of i and j (for example, its GDP), D_{ij} is the distance between home and host economies. Along with the development and deeper analysis of gravity model as the appropriate tool in international trade and foreign direct investment, researchers include different additional factors in order to increase the explanatory power of the model.

The gravity approach is also used to explain FDI flows at the regional level (e.g. [14] and [2]). In this case, M_i denotes the size of the region and D_{ij} the distance between the investor's country and the recipient region.

There is a wide variety of papers exploring FDI determinants between countries, whereas the number of papers related to the regional distribution of FDI is rather limited.

Empirically, additionally to distance and market sizes, several other factors might have an impact on FDI flows. The literature has considered

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[1] To the best of our knowledge, these papers are [2], [3], [4], [5], [6], [7], [8]. See Section 2 for details.

[2] See [11, p. 76–78] for a more detailed analysis of FDI determinants within these theoretical models.

different factors at country and at the regional level.

At the country level, FDI determinants could be separated into several groups. The first group consists of economic factors: such as openness of the recipient country [15], inflation rate [16], government expenditures [17], labor costs [16], external trade [18], taxes [19]. The second group consists of institutional factors: political stability [20], corruption [21], R&D in the country [22], investors' protection [23]. The third group consists of indicators that characterize the cultural similarity between the countries: common language [19], common border [24] and common historical features [24].

At regional level, the following FDI determinants have been considered: market size of host region and investor country [25]; [14]; [7], [26]; [2], remoteness of the region from the investor [25], [27]; [5], remoteness of the region from the country's capital [27], natural resource endowment [5]; [28]; [4], workforce [27]; [14], infrastructure [4]; [7]; [6], openness of the region [6], intellectual capital [29]; [6]; [5], legal and political system [30]; [2] and market potential [30], [31]; [32].

To sum up, country- and region-level FDI determinants can be separated into two groups: "hard" factors and "soft" factors[1]. "Hard" factors are defined as factors which cannot or are very costly to be changed. This group of factors includes geographical position, natural resources endowment, infrastructure (require time and resources to change), and quality of labor force. "Soft" factors could be controlled and changed by regional administration in a reasonable period of time: professional business support organized by administration, successful experience in implementing FDI projects, legal environment, financial and tax incentives and regional government commitment to FDI. The mentioned empirical evidence indicates that "soft" factors affect investment decisions more than "hard" factors do, but in any case, investment decisions result from a joint assessment of "hard" and "soft" factors, and thus can change over time with institutional development and changes in expectations.

Let us turn to the existing research of FDI determinants in Russia. Fabry and Zeghny [3] analyse why Russia was outside the trend of increasing competitiveness and integrating into the global economy, whereas initial conditions (natural resource endowments, human capital and labor force, the size of the market) were rather high.

They define the concept of attractiveness and try to understand why Russia is less attractive from a foreign investor's point of view. They identify business climate as well as institutional and transitional precondition for FDI as determinants. They conclude that FDI in Russia is strongly influenced by the institutional context and reform process, and Russia appears to foreign investors as an important potential market and a prospective future production place.

Focusing on regional factors of FDI inflows in Russia, Iwasaki and Suganuma [4] and Broadman and Recantini [2] focus on market factors, resource endowments factors and social development factors. Iwasaki and Suganuma [4] claim that contrary to Central and Eastern European countries and China, Russia has no clear geographical pattern of the FDI distribution, although there is a notable variation of FDI in Russia between regions. In contrast to Broadman and Recantini [2], Iwasaki and Suganuma [4] found no evidence that the Russian financial crisis in 1998 had an effect on the regional selection of foreign investors.

Further, some other papers consider the impact of structural breaks: Ledyaeva [7] as well as Gonchar and Marek [27] take into account the 1998 financial crisis and the 2003 Yukos trial. Both confirm the dynamic nature of FDI choices in Russian regions and find that composition and relevance of FDI determinants have changed over time. Gonchar and Marek [27] show that proximity and neighbourhood are important factors for attracting FDI. Their main finding is that both natural resources and market seeking factors explain the geographical pattern of foreign investment in Russia.

Besides Ledyaeva [7], also Ledyaeva and Linden [5] and Buccellato and Santangelo [6] stress the importance of agglomeration effects and spatial interdependence.

3. Methodology

Gravity-type models can be estimated by both standard and more advanced econometric methods.

A simple and widely used method is OLS, applied to the linear regression derived by taking logarithms of the gravity equation (1). However, estimation results are biased and inconsistent because of missing data implied by the logarithmic transformation[2], heteroskedasticity and unobserved heterogeneity. Despite not being applicable to the gravity model estimation, OLS is used

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[1] KPMG and Committee on International Cooperation (2010). Increasing FDI in the Russian regions, 1–57.

[2] Data on FDI flows at country level usually consist of a large number of negative and zero observations.

in many research papers at both country and regional level (e.g. [24]; [5]; [33]).

The other standard estimation approach is panel data estimation, both with fixed effects (FE) and random effects (RE). By dealing with country specific effects, the panel FE method solves the inconsistency problem of the OLS estimation in the gravity model. Cheng and Wall [36] use the FE approach to eliminate the heterogeneity bias present in the other methods. However, Folfas [35] and Egger and Pfaffermayr [36] notice that the presence of the distance variable in the gravity model might make it inappropriate to use either FE method (because there are time invariant variables in the regression) or RE method (because the individual effects could correlate with some explanatory variables). To solve this problem, they suggest using the Hausman—Taylor approach [37]. At the regional level, the method of panel data estimation with fixed and random effects was used by Hejazi [25].

In the context of gravity models, the most widely used non-linear methods are Generalized Least Squares (GLS), Heckman two-step procedure, Gamma Pseudo Maximum Likelihood Method, Generalized Method of Moments (GMM), and Poisson Pseudo Maximum Likelihood method. The specificity of these methods is the use of a constant-elasticity model instead of a model in logarithms. All these methods have different advantages and shortcomings, therefore the selection of the optimal method might have to be based on the specific features of the data. These methods also solve to some extent the other data problems, namely heteroscedasticity, multicollinearity, and simultaneity bias problem. For example, Fabry and Zeghny [3] apply GLS to avoid heteroscedasticity in the constructed model. Iwasaki and Suganuma [4] try to solve the multicollinearity and simultaneity bias by means of the Principal Component Analysis. A similar approach is used by Ledyaeva [7]. In addition, the model was estimated by GLS taking into account the presence of the cross-section heteroscedasticity detected by both White test and Goldfeld—Quandt test. GMM is also applied in an analysis at regional level [6] in order to control for spatial effects. Also, Strasky and Pashinova [38] employ the GMM estimator as the better choice in comparison with the FE estimator, because a standard fixed-effects method would yield biased estimates.

The PPML method, which was originally applied by Silva and Tenreyro [39] to the analysis of trade flows, has widely been applied to gravity models at the country level. This method solves the main problems present in gravity model testing (the presence of zeros and heteroskedasticity), provides unbiased and consistent estimators (even in the case of endogeneity). Silva and Tenreyro [39] showed that in the presence of heteroskedasticity the estimation of the log-linearized form changes the properties of the error term, which becomes correlated with the explanatory variables. PPML is applied to the model with constant elasticity of the form:

$$y_i = \exp(x_i\beta) + \varepsilon_i, \qquad (2)$$

where $E[\varepsilon_i \mid x] = 0$.

PPML is a GMM interpretation of ML method, whereas the GMM estimator is typically used to correct for bias caused by endogenous explanatory variables. PML with instrumental variables estimates the parameters of a Poisson regression model in which some of the regressors are endogenous. The model is also known as an exponential conditional mean model in which some of the regressors are endogenous[1].

Applied to FDI flows at country level the PPML method was used in several papers: Kleinert and Toubal [40] estimate several specifications of the gravity equation, derived from different theoretical models. Paniagua [41] compares this method with OLS and so-called HMR (Helpman—Melitz—Rubinstein) method [42] and concludes that PPML delivers more consistent and intuitive results in the case of a large number of zero observations. Moreover, while HMR estimates are very similar to the (inconsistent) OLS ones, PPML results are different. Another disadvantage of the HMR method is the elimination of variables for identification goals [42, P.460]. Paniagua [41], therefore, concludes that, for gravity models, PPML is preferable over HMR: the former is found to deliver consistent and intuitive economic results with a solid theoretical background.

For these reasons, PPML is used in the empirical research in Section 4. So far, our paper is the first to apply PPML at the Russian regional level.

4. Empirical model and estimation results

The empirical model is based on the gravity approach, which postulates that the flow of foreign direct investment positively correlates with the sizes of investing country and recipient region and negatively depends on the distance between them.

The main purpose of this section is twofold. First, we test the main predictions of the gravity model regarding the Russian regions. Second, we

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[1] Stata manual.

examine which other regional characteristics determine FDI inflows into Russia.

The dependent variable in our model is FDIijt—the level of FDI investment inflow from country j into region i in year t.

Following the present array of the empirical research listed in Section 2, the following explanatory variables and implied research hypotheses are chosen on an ad hoc basis:

— $LGDP_{jt}$—logarithm of GDP of the investing country j in year t. We expect a positive correlation between the size of investing economy and FDI flows because in larger countries more firms are able to invest abroad. In addition, due to the increasing returns to scale, companies from larger countries are usually more effective compared to companies from smaller countries.

— $LGRP_{it}$—logarithm of GRP per capita of the recipient region i in year t. We expect a positive correlation between the size of recipient region and FDI flow because the size of the particular market attracts foreign investors. In larger markets, foreign companies get higher profits not only because of higher sales, but also because of the possibility to decrease their average costs due to increasing returns to scale.

— $LDIST\_INV_j$—logarithm of the distance between the capital of investor's country j and Moscow. The distance between countries should have a negative influence in FDI inflows for two reasons. First, an increase in distance leads to an increase in transport and communication costs. Second, an increase in distance usually implies an increase in differences between countries that makes investments more risky.

— $LDIST\_MSC_i$—logarithm of the distance between region i and Moscow. The Moscow agglomeration, with a population more than 20 million, is the largest economic area in Russia. Consequently, all foreign investors consider the Moscow region as the territory of primary interest. Besides, all federal executive and legislative decisions are made in Moscow. Therefore, an increase in the distance from the region to Moscow should negatively affect FDI inflows into the region.

— $LOPEN_{it}$—logarithm of the trade openness of region i (calculated as the sum of export and import divided by GRP) in year t. The level of trade openness is supposed to influence FDI inflows positively, reflecting the involvement of the region in global processes, particularly in international trade.

— $LCRIME_{it}$—logarithm of registered number of crimes in region i in year t. The number of registered crimes in the region should negatively influence FDI inflows because of the implied exces-

sive administrative costs and/or existing threats for doing business by foreign investors.

— $LRDST_{it}$—logarithm of R&D personnel in region i in year t. Investors may consider workers employed in R&D departments to easily adopt new technologies and innovative techniques, implying an important positive role of this factor.

— $LUNEMPL_{it}$—logarithm of the unemployment rate in region i in year t. A higher unemployment rate indicates economic problems and a potentially unstable regional situation, and thus should have a negative effect on the investors' decision.

Therefore, we estimate the following econometric equation:

$$FDI_{ijt} = \exp(\alpha_0 + \alpha_1 LGDP_{jt} + \alpha_2 LGRP_{it} +$$
$$+\alpha_3 LDIST\_INV_j + \alpha_4 LDIST\_MSC_i +$$
$$+\alpha_5 LOPEN_{it} + \alpha_6 LCRIME_{it} + \alpha_7 LRDST_{it} +$$
$$+\alpha_8 LUNEMPL_{it})\varepsilon_{ijt}. \qquad (4)$$

We construct a dataset consisting of about 14,000 observations, including data on FDI flows from 179 investing countries to 78 Russian regions during the period of 2006–2013. All data is publicly available. Data on the dependent variable as well as regional characteristics are obtained from the Russian United System of Information and Statistics[1] and from the Russian Central Bank[2]. Data on investor country GDP are taken from the World Bank website[3]. The distance between the investor and the particular region as well as the distance from Moscow to the center of the region are calculated using distance calculator website[4].

We drop offshore zones (such as Cyprus, British Virgin Island etc.) from the dataset, because such investment is often the form national capital repatriation, previously exported from the country (especially in the case of Russia). We also drop Moscow region as a recipient region because it appears to be an outlier.

For the reasons discussed in Section 3, we estimate the gravity model with the Poisson Maximum Likelihood method[5].

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[1] Retrieved from: https://fedstat.ru/indicator/31338.do (date of access: 06.06.2016).

[2] Retrieved from: http://www.cbr.ru/statistics/?PrtId=svs (date of access: 06.06.2016).

[3] Retrieved from: http://data.worldbank.org/indicator/NY.GDP.MKTP.CD (date of access: 06.06.2016).

[4] Retrieved from: http://www.distancecalculator.ru (date of access: 06.06.2016).

[5] While the standard Stata poisson command does not converge (there are instances in which the estimates do not exist, and this command is very sensitive to numerical problems), the Stata command ppml, developed by Silva and Tenreyro, checks

Table 1 presents the estimation results. The gravity variables are significant and have the expected signs. Both GDP of the investor country and GRP per capita of the recipient region positively affect FDI inflows. Both the distance from investing country to Moscow and the distance from Moscow to the center of host region are significant and have the expected negative signs.

All examined regional characteristics have a significant effect on FDI inflows into the region: trade openness and the number of people in R&D departments positively affect FDI, the latter because it reflects the ability of workers to implement innovative technologies; the region's unemployment negatively affects FDI, because it reflects unstable economic situation in the region.

In contrast to our predictions, the number of registered crimes in the region is positively correlated with the level of FDI inflows. A possible explanation is that the number of registered crimes is an indirect indicator of the effectiveness of the law enforcement system in the region and it is vital for the investor to be confident in the security of his assets.

When including the lagged value of FDI (lag is one year) into the model, we see that previous experience in attracting regional FDI plays an important role for an investor. We estimate the following form of the gravity model with the lagged value of FDI:

$$FDI_{ijt} = \exp(\alpha_0 + \alpha_1 LGDP_{jt} + \alpha_2 LGRP_{it} +$$
$$+ \alpha_3 LDIST_{INVj} + \alpha_4 LDIST_{MSCi} + \alpha_5 LOPEN_{it} +$$
$$+ \alpha_6 LCRIME_{it} + \alpha_7 LRDST_{it} + \alpha_8 LUNEMPL_{it} +$$
$$+ FDI_{ijt-1})\varepsilon_{ijt} \qquad (5)$$

Next, we test the importance of the distance from the centre of the region to Moscow as a determinant of FDI. Presumably, in remote Russian regions (e.g. in Siberia and the Far East) the distance to the capital of Russia is of minor importance for the investor. Thus the investor, intending to build a plant in Siberia will not prefer Krasnoyarsk (3360 km to Moscow) to Irkutsk (4200 km to Moscow) because of the proximity of the former to the capital. For this investor other factors, for example, the degree of social development of the region are important. To test this hypothesis we divide our database into two parts: regions close to Moscow (western part of Russia) and remote regions (eastern part). Table 2 presents the results of this estimation exercise.

Table 1

Estimation results of the basic equation

Variable	PPML	PPML with lagged FDI
Distance from region to Moscow	−0.181*** (0.058)	−0.189*** (0.051)
Distance from investor to Moscow	−0.642*** (0.115)	−0.657*** (0.133)
GDP of investor	0.459*** (0.052)	0.456*** (0.059)
GRP per capita of the region	1.246*** (0.136)	1.143*** (0.172)
Trade openness of the region	0.608*** (0.114)	0.414*** (0.102)
Workers employed in R&D	0.378*** (0.058)	0.337*** (0.059)
Unemployment rate	−0.466*** (0.086)	−0.295*** (0.058)
Number of registered crimes	1.068*** (0.3306)	0.529** (0.222)
Lag of FDI		0.001*** (0.00007)

Source: Calculated by the authors in Stata. Coefficients marked with *** (**) are significant at the 1 % (5 %) level. Standard errors are given in brackets.

Table 2

FDI determinants in eastern and western regions of Russia

Variable	Regions in the western part of Russia	Regions in the eastern part of Russia
Distance from region to Moscow	−0.216*** (0.043)	0.001 (0.282)
Distance from investor to Moscow	−1.074*** (0.152)	−0.446** (0.182)
GDP of investor	0.687*** (0.065)	0.262*** (0.069)
GRP per capita of the region	1.1001*** (0.204)	0.598** (0.298)
Trade openness of the region	0.462*** (0.093)	0.966*** (0.308)
Workers employed in R&D	0.412*** (0.056)	−0.237 (0.188)
Unemployment rate	−0.249*** (0.073)	−0.298** (0.128)
Number of registered crimes	0.547** (0.259)	0.357 (0.663)

Source: Calculated by the authors in Stata. Coefficients marked with *** (**) are significant at the 1 % (5 %) level. Standard errors are given in brackets.

for the existence of the (pseudo) maximum likelihood estimates and offers two methods to drop regressors that may cause the nonexistence of the estimates and thus converges [43].

As expected, the distance to Moscow is not a determinant of FDI in the remote Russian regions but it is one in the regions close to Moscow, stressing the importance of Moscow as a facilitator of FDI in these Russian regions.

5. Conclusion

This paper investigates the determinants of FDI inflows into the Russian regions and should be of high relevance for the understanding of the Russian economy for three reasons: FDI is one of the key factors of the modernization and diversification of the Russian economy; FDI inflows into Russia are concentrated only in few regions; the set of FDI determinants could be used to increase efficiency of regional programs aiming at improving investment attractiveness of Russian regions. There are very few papers on FDI determinants in Russia and to the best of our knowledge, all of them use old data concerning the last decade of the 20th century.

The gravity model is widely used approach to determine the factors of FDI inflows. While standard methods such as OLS or FE panel regression lead to biased estimates, the Poisson Pseudo Maximum Likelihood method has proven to be one of the most effective to work with gravity models. To the best of our knowledge, this paper is the first one to use the PPML method to identify FDI determinants at the regional level.

For our empirical research, we construct a database consisting of more than 14,000 observations covering 78 Russian regions and 179 investor countries for the period of 2006–2013. We identify the following factors as determining FDI inflows into the Russian economy: the investor country's GDP, GDP per capita in the recipient region, distance from the investor to Moscow, the openness of the region, the economic situation in the region, the innovative capacity of the region and the FDI inflow in the previous period. To estimate the importance of distance between the investor's country of origin and the recipient Russian region we split the overall distance into the distance from the investor's country's capital to Moscow and from Moscow to the recipient region. The former distance negatively affects FDI inflows into the region. The latter distance is significant only for the western regions of Russia. For the remote eastern regions, this variable is insignificant. To the best of our knowledge, this idea of separating the distance was not used before in related research while improving the quality of the model and providing further evidence of the special role Moscow plays in the Russian economy.

To continue this line of research, we could calculate FDI levels predicted by the model, and thus identify the potentially most attractive regions. This would give an indication of which regions policy regulations should target (and with which measures).

Other regional characteristics (e.g. focusing on the effectiveness of local authorities) could be considered as well.

Finally, this research does not take into account the calculation and estimation of multilateral resistance terms, i.e. the influence of the proximity of neighbouring regions to investor decisions, which could be a relevant factor as well.

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