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# Spatial econometric analysis of determinants and strategies of FDI in Russian regions in pre- and post-1998 financial crisis periods

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# Contents

Svetlana Ledyaeva *

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## Abstract

Using a spatial autoregressive model of cross-sectional and panel data, we study the determinants and dominant strategies of FDI inflows into Russia before and after the 1998 financial crisis. The important determinants of FDI inflows into Russian regions since transition began appear to be market size, the presence of large cities and sea ports, oil and gas availability, and political and legislative risks. Since 1998, it appears the importance of big cities, the Sakhalin region, oil and gas resources and legislation risk has increased, while the importance of political risk and port availability has decreased. Our results also reveal a shift from horizontal FDI strategy to a regional trade-platform FDI strategy. While theory anticipates combined vertical and horizontal motives for regional trade-platform strategies, the lack of evidence of a vertical motive in the Russian case suggests import substitution presently plays a significant role in regional trade-platform FDI. Using a multiple spatial lags approach, we show that neighbouring regions with ports have emerged post-crisis as competitors for FDI and identify agglomeration effects in FDI between adjacent regions with and without ports during the period 1999-2002.


Keywords: Foreign Direct Investment, Russian regions, FDI strategy, spatial autoregressive model
JEL classification: F21, E22, C21

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Svetlana Ledyaeva

# Spatial econometric analysis of determinants and strategies of FDI in Russian regions in pre- and post-1998 financial crisis periods

## Tiivistelmä

Tässä työssä tutkitaan niitä tekijöitä ja strategioita, jotka ovat vaikuttaneet Venäjälle tulleisiin suoriin sijoituksiin ennen ja jälkeen vuoden 1998 talouskriisin. Työssä käytetään spatiaalista autoregressiivistä mallia sekä poikkileikkaus- että paneelidatalla. Taloudellisen transition alun jälkeen suorien sijoitusten virtaan näyttävät vaikuttaneen markkinoiden koko, suurten kaupunkien ja satamien olemassaolo, öljy- ja kaasuesiintymät sekä poliittiset ja juridiset riskit. Vuoden 1998 kriisin jälkeen suurten kaupunkien, Sahalinin alueen, öljyn sekä kaasun ja juridisten riskien merkitys on kasvanut. Samaan aikaan poliittisten riskien ja satamien merkitys on vähentynyt. Näyttää myös siltä, että yritykset ovat siirtyneet horisontaalisesta suorien sijoitusten strategiasta käyttämään joitakin alueita tukikohtina toiminnan laajentamisessa naapurialueille. Koska tilastoaineisto ei tue hypoteesia vertikaalisesta suorien sijoitusten strategiasta, näyttää siltä, että tuontisubstituutiolla on merkittävä osa suorissa sijoituksissa. Käyttämällä useita spatiaalisia autoregressiivisiä malleja tutkimuksessa osoitetaan, että alueet, joiden naapurialueilla on satama, ovat alkaneet kilpailla suorista sijoituksista finanssikriisin jälkeen. Lisäksi työssä identifioidaan suorien sijoitusten kasautumavaikutuksia sellaisten naapurialueiden välillä, joista joillakin on satama ja joillakin ei.

Asiasanat: ulkomaiset suorat sijoitukset, Venäjän alueet, suorien sijoitusten strategiat, spatiaalinen autoregressiivinen malli

# 1 Introduction

The recent boom in theoretical and empirical research on foreign direct investment (FDI) determinants reflects the increasing significance of FDI in economic development at national, regional and global levels. For Russia, a top policy question today is how to identify the factors that either enhance or impede FDI inflows into Russia. Compared to its Central European counterparts, Russia posted a relatively poor track record at attracting FDI in the 1990s. More recently, the tide seems to be turning. The FDI stock per capita in Russia grew from $220 in 2000 to $921 in 2005. The corresponding figures were $2,108 and $5,813 for the Czech Republic, $1,935 and $9,194 for Estonia, and $2,237 and $6,047 for Hungary (UNCTAD).

Data constraints largely explain why few papers have attempted head-on empirical analyses of FDI determinants for the Russian economy.[1] With the time period of available data lengthening, however, researcher interest has grown along with the body of observations. In this study, we make consider empirical analysis of FDI determinants for Russia using regional data from 1995 to 2005.

Earlier research on FDI determinants focused on bilateral movements between source and recipient countries, and ignored third-country effects. Recent theoretical and empirical studies of bilateral FDI movements have included neighbouring countries. Here, we treat Russian regions as separate states and examine for evidence that adjacent regions have influenced FDI inflows to a particular region. We draw on the theoretical and empirical framework for spatial autoregressive relationships in FDI suggested by Blonigen et al. (2006) as it is helpful in identifying aggregate-level evidence of the prevailing, or dominant, national FDI strategy. A novel aspect of this study is that we use a multiple spatial lags approach (Davies and Naughton, 2006) to analyze the spatial relationship for FDI based on the presence of a port in a region.

As noted above, Russia's FDI stock per capita more than quadrupled between 2000 and 2005. As FDI inflows continue to rise, it seems reasonable to ask what factors might be driving this trend. To the best of our knowledge, no econometric study has yet considered this recent phenomenon.

[1] The most notable papers include Brock (1998), Broadman and Recanatini (2001), and Iwasaki and Suganuma (2005).

A second issue is whether the motives of foreign investors have changed since the 1998 financial crisis. We find just two econometric studies that tackle this question (Broadman and Recanatini, 2001; Iwasaki and Suganuma, 2005). Interestingly, the papers draw opposite conclusions. Broadman and Recanatini suggest a post-crisis shift in FDI motives, while Iwasaki and Suganuma do not. Hopefully, our findings may help resolve this contradiction.

This paper is constructed as follows. In the first section, we analyze theoretical and empirical background of spatial relationship in FDI. Section 2 summarizes empirical studies on FDI determinants in Russia and other transition and emerging economies. In section 3, we review patterns in regional and industrial distribution of FDI in Russia. Section 4 describes model and data, while section 5 explains the econometric methodology used in the study. Section 6 presents the results and section 7 concludes.

# 2 Spatial relationships in FDI

## 2.1 Theoretical background

Recent decades have seen a boom in theoretical studies on FDI drivers. While the weights given to various factors promoting or inhibiting FDI flows between countries differ, two basic types of study emerge. The first group of studies distinguish the circumstances where corporations find advantage in multinational operations. The main motivations for multinational enterprises (MNEs) to invest in another country are the opportunity to exploit factor price differences across countries (i.e. *vertically integrated* because they fragment their production process vertically across countries) or in order to avoid costs of international trade (i.e. *horizontally integrated* because they replicate an identical production process across countries).[2]

The second group of studies assess the contribution of various locational elements that make a potential host country more or less attractive as a target for the multinational to set-up its subsidiary. Chakrabarti (2003) summarizes the main existing locational theories and theoretical models of FDI:

[2] See Yeaple (2003).

*"An empirically geared theoretical model of the production location decision of multinational firms should at least capture the key features (e.g. market size, wages, tariffs, transportation costs, exchange rates, political stability, etc.) that have attracted the most attention in the literature."*[3]

Traditional theoretical work on MNEs and FDI is subject to two potential weaknesses: reliance on a two-country framework and use of simplistic binary descriptors of FDI forms such as *market-seeking production* in the case of horizontal motives and *resource-seeking investment* in the case of vertical motives. Recent studies have relaxed the two-country assumption, which, in turn, has helped in the categorization of new forms of FDI. The common feature of these studies is that they argue that a spatial relationship exists with FDI going to neighbouring markets.

Ekholm et al. (2003) pioneer the model of *export-platform FDI*. They define export-platform FDI as "investment and production in a host country where the output is largely sold in third markets, not the parents or host-country markets." From this definition, it is easy to see that export-platform FDI has elements of both horizontal and vertical FDI. Ekholm et al. also argue that "production is to serve a large integrating market with a branch plant as in horizontal investments but specific location within the region is chosen on the basis of cost considerations, as in vertical investments." Under a three-country framework and duopoly model, Ekholm et al. examine how organizational choices (including export-platform FDI) reflect transport costs, the relative cost advantages of the lower cost country and the fixed costs associated with foreign investment.

In a separate model, Yeaple (2003) emphasizes MNEs increasingly follow complex integration strategies:

*"These MNEs are both horizontally and vertically integrated, establishing affiliates in some foreign countries to conserve on transport cost and establishing affiliates in others to take advantage of factor price differentials…A three-country framework in which transport cost gives rise to the horizontal motive between one set of countries while factor price differentials give rise to the vertical motive between another. Firms from one developed country may invest in another developed (horizontal integration), or they may invest in a*

[3] Chakrabarti (2003), p. 151.

*developing country (vertical integration), or they may invest in both (complex integration).”*[4]

Yeaple (2003) further provides the useful insight that an MNE from a developed country with a plant in a developing country enjoys lower unit costs than those that do not and thus the MNE enjoys increased sales. As sales increase, they gain a unit-cost advantage from adding a plant in another developed country. The viability of different organizational forms of FDI (including complex integration), however, depends in Yeaple’s model on factor-price differentials, shipping costs and the fixed costs of establishing subsidiaries in developed and developing countries.

Blonigen et al. (2006) suggests an estimation procedure to observe the implications of various spatial FDI relationships mentioned in theoretical literature. This group focuses on “spatial autoregression,” introducing two spatial lag variables into a standard regression analysis on FDI. The variables consist of a *spatial lag dependent variable* (i.e. the estimated coefficient characterizing the contemporaneous correlation between the FDI of one region and the FDI of other geographically-proximate regions) and a *market potential variable* (the estimated coefficient characterizing the contemporaneous correlation between a region’s FDI and the market sizes of other geographically-proximate regions). Table 1 summarizes their expected signs for various forms of FDI behaviour at the firm level.

Table 1 Hypothesized spatial lag coefficient and market potential effect for various FDI forms

| FDI motivation | Sign of spatial lag variable | Sign of market potential variable |
|---|---|---|
| Pure horizontal | 0 | 0 |
| Export platform | - | + |
| Pure vertical | - | 0 |
| Vertical specialization with agglomeration | + | + |

Source: Blonigen et al. (2006).

The first three FDI motives in Table 1 have already been described. Blonigen et al. define the fourth motive, *vertical specialization with agglomeration*, as a variation on vertical in-

[4] Yeaple (2003), pp. 293-294.

tegration, whereby multinational firms separate out production activities for specific geographic regions (e.g. Baltagi, Egger and Pfaffermayr, 2004; Davies, 2005). The presence of suppliers (related or unrelated) in neighbouring regions is likely to increase this fourth form of FDI and production in a particular market. Cross-regional forces other than supplier networks may also generate agglomeration incentives. To the extent that agglomerative forces operate among foreign firms, there should be a positive spatial lag coefficient. While market potential per se should not matter, the level of industrial production in neighbouring countries/regions should correlate with the increasing opportunities for vertical suppliers. Since industrial production and market potential measures are typically highly correlated, the market potential variable likely proxies for both, which would lead us to expect a positive coefficient on market potential (Blonigen et al. (2006, p.5)).

Blonigen et al. emphasize that motives are hard to tease out from the country- and industry-level data; i.e. empirical analysis of such data only captures net effects. They further warn that "to the extent that one form dominates the others, however, confirmatory evidence of one dominant form of MNE activity in the data is possible."[5]

In our study, therefore, we restrict our use of the Blonigen scheme shown in Table 1 to finding evidence of the FDI strategies of investors during transition. We treat Russian regions as if they were separate countries. While this may be a stretch, it is indisputable that Russia is geographically huge and many of its regions are comparable in size to small countries. Moreover, every region in Russia has its own regional government responsible for conduct of regional economic and social policy, as well as the enactment and enforcement of regional legislation. Russia's regions are quite diverse from many aspects, including level of economic development, ethnic composition, industrial structure, and the availability, quality and structure of production factors.

Treating Russian regions as separate states, we substitute export-platform FDI with "regional trade-platform FDI," which is analogous to export-platform FDI proposed by Ekholm et al. (2003) and can be determined as investment and production in a host region where the output is largely sold in markets of neighbouring regions rather than the markets of the parent country or the host region. We further assume that the theoretical basis for regional trade-platform FDI is analogous to export-platform FDI.

[5] For a detailed description of the scheme, see Blonigen et al. (2006), p. 6.

## 2.2 Empirical studies

Studies that empirically analyze spatial relationships in FDI are still quite rare.

Blonigen et al. (2006) include a spatial lag dependent variable and spatially weighted market potential variable into the traditional FDI gravity model specification as described in Table 1 above. Using a panel of annual data on US outbound FDI to the top forty host country destinations (measured by affiliate sales) for the period 1983 through 1998, they find that the estimated relationships of traditional determinants of FDI are surprisingly robust with inclusion of terms to capture spatial interdependence, even though such interdependence is estimated to be substantial in the data. The authors further conclude that the geographic scope of the sample can be useful in separating out various motives for FDI from simple “continental agglomeration.”

Baltagi et al. (2004) estimate a “complex FDI” version of the knowledge-capital model using a panel of annual data for the country-industry pair over the period of 1989-1999 that varies from a minimum of 331 in 1989 to a maximum of 397 in 1997. The dependent variable is the US outward FDI stock held in the country-industry pair in a particular year or the corresponding foreign affiliate’s sales. The authors include spatially weighted explanatory variables and use a spatial error model. Their key insight is that third-country effects are significant, supporting a thesis that multiple modes of FDI coexist.

Coughlin and Segev (2000) use a spatial error model to analyze FDI determinants in 29 Chinese provinces. They conclude that an FDI shock in one province has positive effects on FDI in nearby provinces.

There is as yet no study on spatial relationships in FDI inflows to Russia, so this study stands as a first attempt to cover this gap in the literature. The evidence on dominant FDI strategy suggests the leading dominant strategic interests of foreign investors in Russia. This may be useful in modelling the federal and regional policies applied to foreign investors.

# 3 Previous empirical studies on FDI determinants in Russia and other transition/emerging economies

## 3.1 Empirical research on FDI determinants in Russia

To the best of our knowledge, only four empirical studies using regional data focus on the determinants (or factors) of FDI inflows into transition-era Russia. Here, we attempt to contribute to the literature using a new methodology, while hopefully avoiding some of the pitfalls encountered in previous studies.

Brock (1998) analyzes FDI determinants during early transition (1993-1995), finding that market size and the crime situation are important influences on FDI decisions. One interesting result of this study is that education of the labour force only influenced FDI decisions for the Moscow and St. Petersburg regions.

Broadman and Recanatini (2001) analyze determinants of FDI inflows from 1995 to 1999 using a GLS estimation for panel data and an OLS estimation for cross-sectional data authors. They show that market size, the extent of infrastructure development and prevailing policy frameworks explain most of the observed variations in FDI flows across Russian regions. Their model, which does an excellent job in capturing cross-regional variation in FDI flows from 1995-1998, loses its explanatory power after the 1998 crisis. They conclude a “structural regime change” occurred in the FDI framework.

Iwasaki and Suganuma (2005) suggest a model for FDI distribution by Russian region based on panel and yearly cross-sectional data from 1996 to 2003. The authors conclude that resource endowments, market factors, degree of industrialization and infrastructure factors hold high significance and explanatory power in their empirical analysis. They further suggest that the business climate and regionally favourable FDI measures may affect investment. Their analysis finds no evidence that Russia’s 1998 financial crisis had a statistically significant influence on the decision-making process of foreign investors.

Ledyaeva and Linden (2006) estimate gravity model of inbound FDI to determine the sources of uneven distribution of FDI across Russia’s regions in recent years. The authors use OLS and binary dependent variable models to analyze the determinants of the number of foreign firms registered in 2002. The OLS results suggest that gross products of host regions and source countries, agglomeration effect, Moscow city advantages, cultural closeness and an abundance of skilled labour are positively related to the number of foreign firms in a particular Russian region. The distance between host regions and source countries is negatively related to the dependent variable. Regarding binary choice analysis, the results show that only four factors really matter in determining the probability of a foreign firm entering in a particular Russian region: gross products of host regions and source countries, distance between them and the agglomeration effect.

Previous studies on Russia typically stress the importance of such FDI determinants as market size, resource abundance, industrialization and infrastructural factors, policy framework factors and availability of skilled labour.

## 3.2 FDI determinants in transition/emerging economies

In this section, we review recent empirical studies on FDI determinants into transition/emerging economies.

Globerman, Shapiro and Tang (2006) examine the determinants of both inbound and outbound FDI for twenty emerging and transition economies over the period 1995-2001. For inward FDI determinants, they use GDP, GDP growth, a governance index, the ratio of imports to export, stock market capitalization, privatization, an oil indicator, as well as dummy variables for regions, China, EU members and future EU members, and euro currency. They find that market size, governance and privatization are positively related and that the oil indicator is negatively related to FDI inflows. A more surprising finding is the FDI inflow-promoting halo effect cast by EU membership (or even the prospect of EU membership). This phenomenon is particularly pronounced in the case of former Communist countries.

Janicki and Wunnava (2004) examine bilateral foreign direct investments (FDI) between the members of the European Union and eight Central and Eastern European countries (CEECs) awaiting EU accession. Their study reveals that the key determinants of FDI inflows in CEECs are size of the host economy, host country risk, labour costs in host country and openness to trade.

Frenkel, Funke and Stadtmann (2004) examine the determinants of FDI flows to emerging economies by analyzing a recently compiled data set of bilateral FDI flows. Using a panel approach, they investigate the home and host country factors that might play important roles in determining the level and the destination of FDI flows. On the home country side of the FDI flows, they focus on the world's five largest economies. On the host country side, they study a number of emerging economies in Asia, Latin America and Central and Eastern Europe. They find a gravity model can be successfully applied to FDI, but that, in addition to the important classical explanatory variables (e.g. market size and distance), other economic characteristics such as risk and economic growth in host countries are also crucial for attracting international investment projects. Finally, growth in countries from which FDI activities originate exerts a positive effect on the level of FDI flows and that such activities further depend on the business cycles in the home countries.

Carstensen and Toubal (2004) use dynamic panel data methods to examine the determinants of FDI into CEECs. Their empirical model shows that the traditional determinants such as market potential, low relative unit labour costs, a skilled workforce and relative endowments, have significant and plausible effects. In addition, transition-specific factors such as country risk and the level and method of privatization play important roles in determining the flows of FDI into CEECs and help explain differences in the attractiveness of countries to foreign investors.

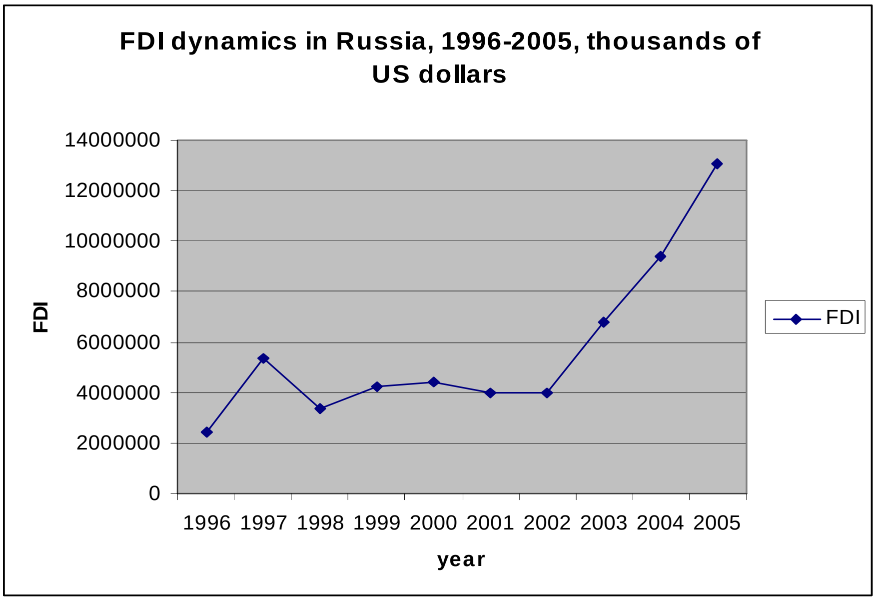
Bevan and Estrin (2002) use a panel dataset of bilateral flows of FDI to study the determinants of FDI from Western countries, mainly the EU and CEECs. They find the most important influences to be unit labour costs, gravity factors, market size, and proximity. Notably, host country risk proves not to be a significant determinant. Their empirical work also indicates that announcements about EU Accession proposals have an impact on FDI for the future member countries.

The above studies are in agreement that market size, country risk, labour costs, methods and level of privatization and future prospects of EU accession are crucial factors of FDI inflows into transition/emerging economies. Comparing empirical evidence on FDI determinants for Russia and other transition/emerging economies, we conclude that findings are generally similar. However, there are also differences that deserve further investigation. When it comes to FDI, Russia appears to be unique case among transition economies due to its huge territory and former status as a socialist block superpower.

# 4 Patterns of FDI dynamics and distribution across Russia

Aggregate FDI dynamics into Russian economy in the period of 1996-2005 is represented in Figure 1. Before 2002, aggregate FDI inflows into Russia were low, but stable, with a small spike in 1997. Since 2003, a steady increase in FDI inflows into Russia is strongly evident.

Figure 1 FDI dynamics in Russia, 1996-2005, US$ thousands




Source: Rosstat statistics

Our goal here is to shed light on the main tendencies of aggregate FDI dynamics into Russia, particularly the sharp increase since 2002.

To make preliminary conclusions on determinants of FDI distribution across Russian regions and their possible changes throughout the analyzed period, we report Russia's top ten regional recipients of FDI. These "top 10" regions have received approximately 80% of total FDI inflows into Russia. Regions that consistently make the top 10 include Moscow city, the Sakhalin region and the Moscow region. Apparently, a few regions have massive advantages over the rest in terms of FDI attractiveness. Thus, our analysis of the top 10 regional recipients of FDI should be quite representative when determining the crucial FDI determinants for Russia. The top 10 regional recipients of FDI in pre- and post-crisis periods are presented in Table 2.

Table 2 Russia's top 10 regional FDI recipients: 1995-1998 and 1999-2005

| Region | Cumulative FDI, US$ million, 1995-1998 | | Cumulative FDI, $US million, 1999-2005 | |
|---|---|---|---|---|
| | Value (%) | Rank | Value (%) | Rank |
| Moscow | 1,748 (42.7) | 1 | 4,289 (15.2) | 2 |
| Magadan region | 657 (16.1) | 2 | Not in Top 10 | |
| Sakhalin | 425 (10.4) | 3 | 13,867 (49) | 1 |
| Moscow region | 383 (9.3) | 4 | 1,999 (7.1) | 4 |
| St. Petersburg | 260 (6.4) | 5 | 471 (1.7) | 10 |
| Leningrad region | 159 (3.9) | 6 | 862 (3.1) | 7 |
| Samara region | 134 (3.3) | 7 | Not in Top 10 | |
| Orlov region | 124 (3.0) | 8 | | |
| Primorskii region | 103 (2.5) | 9 | | |
| Khabarovsk region | 102 (2.5) | 10 | | |
| Total in top 10 | 4,094 (100) | | | |
| Omsk region | | | 2,772 (9.9) | 3 |
| Tyumen region | | | 1,574 (5.6) | 5 |
| Lipeck region | | | 1,034 (3.7) | 6 |
| Krasnodar region | | | 792 (2.8) | 8 |
| Novgorod region | Not in Top 10 | | 486 (1.7) | 9 |
| Total in top 10 | | | 28,146 (100) | |

Source: Rosstat statistics

In both periods, Russia's two biggest cities, Moscow and St. Petersburg, and their surrounding regions, Leningrad and Moscow regions, are among the top 10 receivers of FDI. Big cities and close-by regions have obvious advantages for FDI in terms of market size, infrastructure and skilled labour force. Samara region (top 10 pre-crisis) and Omsk region (top 10 post-crisis) both have cities with populations exceeding 1 million. The Orlov region, which is fairly close to Moscow, also belongs to this group.

The second group of regions in the top 10 is made up of resource-abundant regions – the Sakhalin region, the Magadan region and the Khabarovsk region. The Sakhalin region has oil and gas, the Magadan region has gold, tin metal, tungsten and coal and the Khabarovsk region has big gold and forest resources. The Primorskii, Sakhalin and Krasnodar regions have large sea ports that could be important for foreign investors concerned with transportation infrastructure.

Lipeck and Novgorod regions make the top ten in the post-crisis period. Foreign investment in the Lipeck region is concentrated in the region's highly developed metallurgy industry. The Novgorod region is attractive for its low legislative risk.

Note that the main patterns generally remain the same post-crisis. The most notable difference is the huge increase in investment in the Sakhalin region and the entry of the Tyumen region into the top 10. Sakhalin's intensive development of oil and gas minefields in Sakhalin region has been largely funded under production sharing agreements (PSA) in recent years. Indeed, the Sakhalin and Tyumen regions are the most strategically promising oil and gas regions in Russia and their attractiveness to foreign investors has gained along with rising world oil and gas prices.

On the other hand, several Far Eastern regions (Primorskii, Khabarovsk and Magadan) drop out of the top 10 post-crisis, suggesting they have slot attractiveness to foreign investors.

In percentage terms, one region garners almost half of aggregate FDI in both periods. Pre-crisis that region is Moscow, receiving about 43% of the total, and post-crisis Sakhalin receives 49%. Among other regions, FDI is distributed more or less equally.

At a glance then, we can infer that in the post-crisis period oil and gas availability and legislative risk have become increasingly important FDI determinants for Russia.

In the beginning of this section, we found strong evidence of an upward tendency in FDI flows after 2002. To shed light on this, we also report in Table 3 the top 10 Russian regions in terms of cumulative FDI inflows in the periods of 1999-2002 and 2003-2005.

Table 3 Russia's top 10 regional FDI recipients: 1999-2002 and 2003-2005

| Region | Cumulative FDI, US$ million, 1999-2002 | | Cumulative FDI, US$ million, 2003-2005 | |
|---|---|---|---|---|
| | Value (%) | Rank | Value (%) | Rank |
| Sakhalin | 3,995 (61.5) | 1 | 9,882 (44.9) | 1 |
| Moscow | 538 (8.3) | 2 | 3,750 (17.0) | 2 |
| Leningrad region | 476 (7.4) | 3 | 385 (1.7) | 7 |
| Krasnodar region | 444 (6.9) | 4 | 348 (1.6) | 9 |
| Moscow region | 227 (3.5) | 5 | 1,772 (8.0) | 4 |
| Kaluga region | 219 (3.4) | 6 | Not in Top 10 | |
| Tyumen region | 162 (2.5) | 7 | 1,412 (6.4) | 5 |
| Magadan region | 156 (2.4) | 8 | Not in Top 10 | |
| Novosibirsk region | 137 (2.1) | 9 | | |
| St. Petersburg | 133 (2.1) | 10 | 338 (1.5) | 10 |
| Total | 6,476 (100) | | | |
| Omsk region | Not in Top 10 | | 2,767 (12,6) | 3 |
| Lipeck region | | | 1,013 (4.6) | 6 |
| Novgorod region | | | 363 (1.6) | 8 |
| Total | | | 22,032 (100) | |

Source: Rosstat statistics

In 1999-2002, there are two new entrants to the top 10 – Kaluga and Novosibirsk regions. Kaluga region is close to Moscow, and Novosibirsk region includes the city of Novosibirsk, Russia's third largest city.

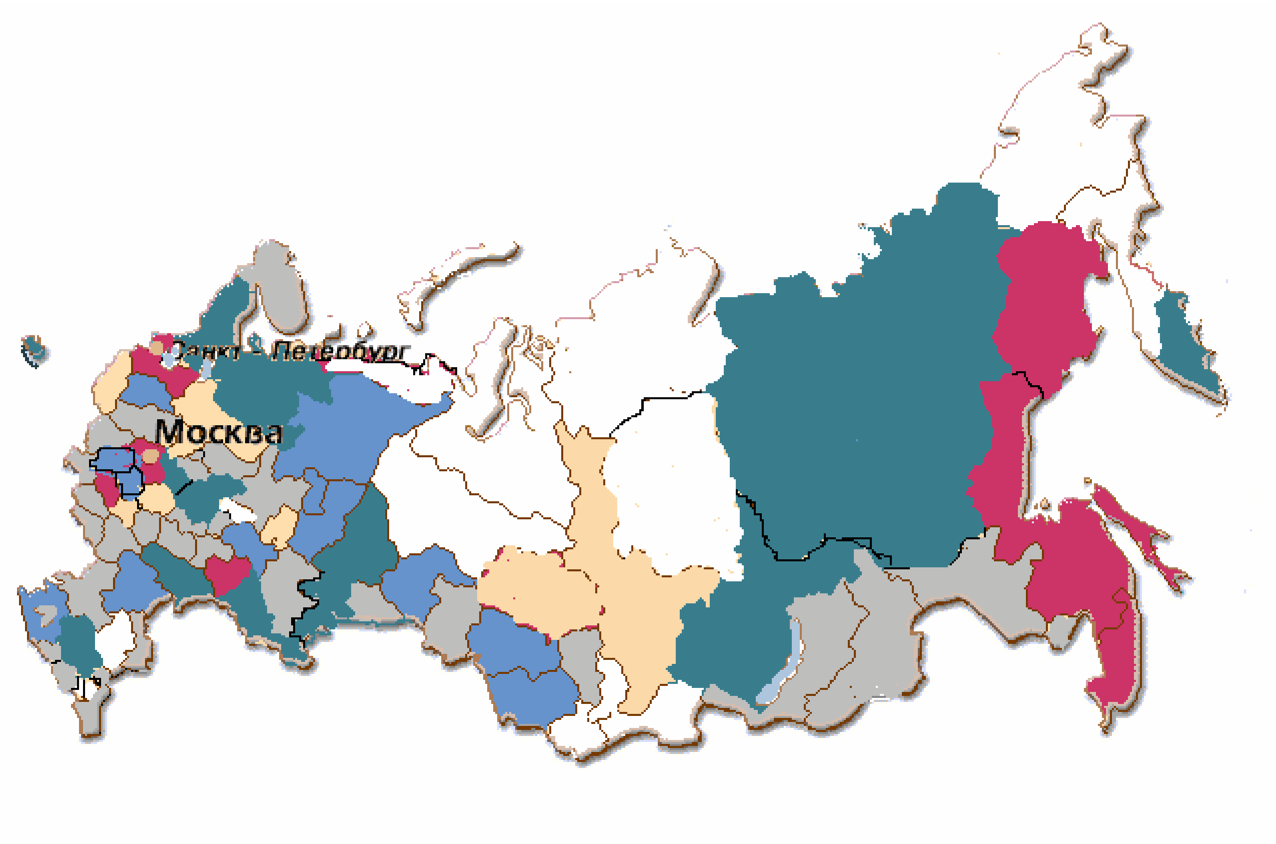
The relative increases in FDI from period to period (1999-2001 and 2002-2005) were 2.5 times for the Sakhalin region, 8.7 for the Tyumen region, 7 for Moscow city and 7.8 for the Moscow region. Moreover, considering that the first period is a year longer than the second (four versus three years), the absolute increases are actually larger. It is also evident that in recent years FDI has increased significantly in Lipeck and Novgorod regions as they appear in top 10 only in the second sub-period. From this preliminary analysis, we conclude oil availability (Sakhalin and Tyumen regions), market size and big city advantages (Moscow, Moscow region, Omsk region) and legislative risk (Novgorod region) have become increasingly important FDI determinants for Russia. Of course, further empirical investigation is needed to build a body of formal evidence as to which factors stimulated the sharp increase of FDI inflows in recent years.

The clear FDI powerhouse is the Sakhalin region, accumulating about 62% of the top 10 FDI total in 1999-2002 and 45% in 2003-2005. Over the past decade, oil and gas resources availability, big cities advantages, access to sea ports and legislative risk have been the most important factors of FDI inflows into Russia.

Our conclusions as to the top 10 regional recipients of FDI are in line with earlier findings of Bradshow (2002). He categorizes the following five types of regions as representative locations attracting FDI: (1) the Moscow region (Moscow region and the city of Moscow) as the control centre for the national economy; (2) regions that are industrial and financial centres (e.g. the city of St. Petersburg and the Leningrad, Krasnodar, Samara, Sverdlovsk and Novosibirsk regions); (3) regions that have major port or gateway function such as the city of St. Petersburg and the Leningrad, Krasnodar and Primorskii regions; (4) regions with substantial mineral wealth, represented by the Tyumen and Sakhalin regions; and (5) regions that benefited from import-substitution after the ruble devaluation in 1998 (according to Bradshow, mainly the Moscow and Leningrad regions) .

We also use a map to illustrate geographical distribution of cumulative FDI in both periods:

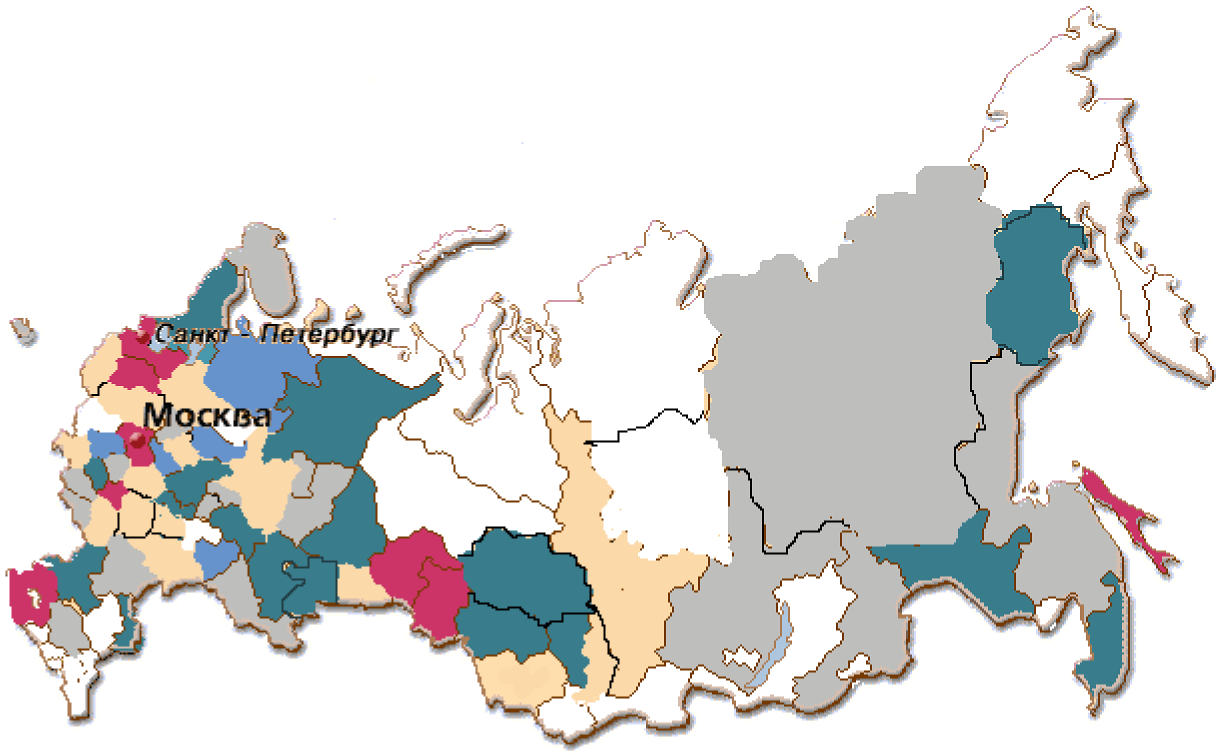
Map 1 Regional distribution of cumulative FDI across Russian regions, 1995-1998 (US$ million)




| Code | FDI range, US$ million |
|---|---|
| Red | Top 10: 100-1,750 |
| Blue | 50-100 |
| Green | 20-50 |
| Grey | 10-20 |
| Yellow | Less than 10 |
| White | Data unavailable |
| Light blue | Lakes |
| Москва | Moscow |
| Санкт-Петербург | Saint Petersburg |

Source: Author's own calculations based on Rosstat statistics

Map 2 Regional distribution of cumulative FDI across Russian regions, 1999-2005 (US$ million)




| Code | FDI range, millions of US dollars |
| --- | --- |
| Red | Top 10: 470-13870 |
| Blue | 235-470 |
| Green | 94-235 |
| Grey | 47-94 |
| Yellow | Less than 47 |
| White | Data is not available |
| Light blue | Lakes |
| Москва | Moscow |
| Санкт-Петербург | Saint Petersburg |

Source: Author's own calculations based on Rosstat statistics

In general, we conclude that there are no evident geographical patterns in FDI distribution across Russia in both periods. In any geographical part of Russia (West, East, North and

South), there are regions with differing levels of FDI. Note that the maps show little change between periods. The biggest change is the decline in investor interest in Far Eastern regions other than Sakhalin.

We now turn to industrial composition of FDI. Ludvig (2003) argues that FDI inflows to Russia divide roughly into two groups. The first group consists of investments motivated by Russian natural resources, i.e. capital investment in the energy industry, wood industry, the extraction and processing of diamonds and various metals. These are pure vertical investment. The second group comprises investment based on the potentially huge Russian consumer and producer markets. These investments involve the food industry, mechanical industry, as well as service industries such as trade and catering, transport, telecommunication, financial and commercial services. Such FDI is horizontal in nature. The industrial composition of FDI in Russia in pre- and post-crisis is presented in Table 4.

Table 4. Industrial composition of FDI in Russia in pre- and post-crisis periods, %

| N | Industry | Before crisis: 1995-1998 | After crisis: 1999-2003 |
|---|---|---|---|
| 1 | Industry | 42 | 49 |
| 2 | Electric power | 0 | 0.23 |
| 3 | Fuel industry | 8 | 20 |
| 4 | Ferrous metallurgy | 2 | 1 |
| 5 | Non-ferrous metallurgy | 2 | 1 |
| 6 | Chemical and petrochemical | 2 | 2 |
| 7 | Machine-building and metal cutting | 3 | 5 |
| 8 | Logging and woodworking, pulp and paper | 4 | 4 |
| 9 | Building materials | 1 | 1 |
| 10 | Light industry | 1 | 1 |
| 11 | Food | 19 | 13 |
| 12 | Agriculture | 0 | 1 |
| 13 | Construction | 5 | 2 |
| 14 | Transport | 1 | 10 |
| 15 | Trade and catering | 13 | 20 |
| 16 | Wholesaling of producers` goods | 1 | 1 |
| 17 | General commercial activity to promote market | 10 | 5 |
| 18 | Finance, credit, insurance, pensions, securities | 21 | 1 |
| 19 | Other industries | 7 | 8 |

Source: Rosstat statistics

The table indicates that the main FDI flows went to the fuel and food industries and trade and catering. The fuel industry and trade and catering have gained importance post-crisis, while the food industry and finance sector have lost importance since the crisis. In Table 5, we summarize vertical and horizontal FDI according to the Ludvig`s classification mentioned above.

Table 5 Horizontal and vertical FDI in Russia in pre- and post-crisis periods, %

| Type of investment | Pre-crisis: 1995-1998 | Post-crisis: 1999-2003 |
|---|---|---|
| Horizontal (food (11), transport (14), trade and catering (15), commercial (17) and financial sectors (18)) | 64 | 49 |
| Vertical (fuel industry (3), metallurgy (4,5) and wood (8)) | 16 | 26 |

Source: Author`s own calculations based on Rosstat statistics

The preliminary conclusion here is that in both periods horizontal strategies strongly dominated. Post-crisis, the importance of horizontal investment decreased and vertical investment increased. Of course, such analysis of industrial decomposition of FDI is highly superficial and may ignore evidence of other FDI strategies (e.g., regional-trade platform FDI, complex vertical FDI). In this respect, empirical study can help determine more precisely the strategies that dominated pre- and post-crisis.

Finally, the industrial composition suggests that market size and oil and gas resources are key determinants of FDI inflows into Russia.

# 5 Model and data description

We start our model discussion with a look at earlier studies based on yearly FDI flows. The explanatory power of the studies of Broadman and Recanatini (2001) and Iwasaki and Suganuma (2005) suffer from the impacts of extraordinary years or projects that boost a region's gross FDI.[6] Thus, we take as our dependent variable the natural logarithm of cumulative FDI inflows in three periods (1996-1998, 1999-2002 and 2003-2005). Again, Broadman and Recanatini (2001) and Iwasaki and Suganuma (2005) are at odds as to whether there is a structural break in FDI decisions pre- and post-crisis, so we compare the results of the same specification pre- and post-crisis in hopes of resolving this issue.

We assume two post-crisis periods: 1999-2002 is a time of adjustment of FDI decisions to reflect new tendencies in economic development in post-crisis Russia, while 2003-2005 is a time when the wait-and-see attitude of investors has given way to investor enthusiasm and a sharp increase in FDI inflows.

All the explanatory variables are taken in original terms one-year lagged from the cumulative period of the dependent variable. The exception is the market size variable, which is taken as the average for the period one-year lagged from the dependent variable's period as constructed to give it greater explanatory power than market size one-year lagged from the cumulative period of the dependent variable. This might indicate flexibility in market-seeking FDI to short-term changes in market size.

The use of lagged explanatory variables helps to solve possible endogeneity problems and relates to a simple hypothesis for the foreign investor decision-making. Foreign investors are assumed to make an investment decision for a given year/period by referring to the observable variables of the previous year (e.g. Coughlin and Segev, 2000; Iwasaki and Suganuma, 2005).

Using this approach, we arrive at the following cross-sectional empirical scheme of the dependent and explanatory variables:

Table 6 Estimation scheme for cumulative FDI

| | | | |
|---|---|---|---|
| Dependent variable | 1996-1998 | 1999-2002 | 2003-2005 |
| Market size variable | 1995-1997 | 1998-2001 | 2002-2004 |
| Other time-variant explanatory variables | 1995 | 1998 | 2002 |

Most of the data used here comes from Rosstat, Russia's state statistical agency (for further details see Appendix 1).

Following Blonigen et al. (2006) on examining the impact of spatial correlations on statistical inference, we begin with a specification that ignores spatial effects.

[6] See also Xing and Kolstad (1997) and Brock (1998).

Through trial and error, seven parameters are selected. According to the survey results obtained in the previous section, these variables relate to one of the following five factors: market size, infrastructure development, policy framework, resource endowments and industrialization. Ignoring spatial effects, we specify

$$\ln FDI_i = a_0 + a_1 ms_i + a_2 port_i + a_3 bc_i + a_4 dsah + a_5 oil\_gas\_index_i + a_6 leg_i + a_7 pol_i + \varepsilon_i . \quad (1)$$

The market size variable $ms_i$ is the first principal component of three variables (gross regional product, total population and population density in a region i). The same indicator for market size is used in the study of Iwasaki and Suganuma (2005). Results from principal component analysis of market size are represented in Appendix 2. The proportion of variance of the first component reaches 80%, and furthermore, its eigenvector and component loading show that this variable is suitable as a general index of the market size. The variable is taken as average for the period one-year lagged from the dependent variable's period.

The next variable, $port_i$, is the number of ports in region i. It proxies transport infrastructure for a particular region. $bc_i$ is a dummy variable for regions that include at least one of Russia's 13 cities with populations exceeding 1 million.[7] This is a proxy for the level of industrialization in a particular region. *dsah* is a dummy variable for the Sakhalin region, where large product sharing agreements in oil and gas industries have been launched during transition. The variable $oil\_gas\_index_i$ is constructed on the basis of two variables for oil and gas production in region i (see Appendix 3 for details). $leg_i$ is the legislative risk in a region i and $pol_i$ is a political risk in region i. We use the calculation for these risks published by the Russian economic journal *Ekspert*. $a_n$ are parameter estimates and $\varepsilon_i$ is the error term.

We also estimate Equation (1) using panel structure of our data in the following way:

$$\ln FDI_{ti} = a_0 + a_1 ms_{ti} + a_2 port_{ti} + a_3 bc_{ti} + a_4 dsah_{ti} + a_5 oil\_gas\_index_{ti} + a_6 leg_{ti} + a_7 pol_{ti} + \varepsilon_{ti} , \quad (2)$$

where the dependent and explanatory variables are of a region i (i=1,…,74) and time period t (t=1996-1998, 1999-2002, 2003-2005). Equation (1) provides the baseline results against which we compare further results.

We now modify our baseline specification (1) with the inclusion of spatially lagged dependent variable $W * \ln FDI_{-i}$ and market potential variable $W * ms_{-i}$. In particular, we estimate:

$$\begin{aligned} \ln FDI_i = a_0 + a_1 ms_i + a_2 port_i + a_3 bc_i + a_4 dsah + a_5 oil\_gas\_index_i + a_6 leg_i + a_7 pol_i + \\ a_8 W * ms_{-i} + \rho W * \ln FDI_{-i} + \varepsilon_i \end{aligned} \quad . \quad (3)$$

The addition of $\rho W * \ln FDI_{-i}$ in Equation (3) reflects the spatial autoregression term, where W is the spatial lag weighting matrix and $\rho$ is a parameter to be estimated and which will indicate the strength and sign of any spatial relationship in FDI.

Following Blonigen et al. (2006), the market potential variable $W * ms_{-i}$ for region i is defined as the sum of inverse-distance-weighted market sizes of all other $k \neq j$ host regions in the sample. We use the same weights matrix for construction of this variable as we use for the spatial lag term.

# 6 Econometric methodology

For the specification (1) and (2), we use OLS estimation (cross-sectional and pooled). However, the linear combination of FDI appearing on the right-hand side of specification (3) is clearly endogenous and correlated with the error term. Formally speaking, the random component of $FDI_k$ is equal to the inner product of the kth row of the matrix $(I - \rho W)^{-1}$ and the vector of errors, ε. Thus, each element of FDI depends on all of the error terms. As a result, each $FDI_i$ on the right-hand side depends on the equation's error term and OLS estimates of specification (3) are inconsistent. As such, we follow the litera-

[7] The 13 cities are Moscow, St. Petersburg, Novosibirsk, Nizhny-Novgorod, Ekaterinburg, Samara, Omsk, Kazan, Chelyabinsk, Rostov-na-Donu, Ufa, Volgograd, Perm.

ture using the maximum likelihood (ML) method in the MATLAB Econometrics Toolbox (see Appendix 4 for details).

Specification (3) is in fact a spatial autoregressive model (or spatial lagged dependent variable model) of the form:

$$y = \rho W y + X\beta + \varepsilon \quad (4)$$
$$\varepsilon \sim N(0, \delta^2 I_n),$$

where y and X are the dependent variable's vector and explanatory variables` matrix, respectively; W is a known spatial weight matrix; and the parameter ρ is a coefficient on the spatially lagged dependent variable, Wy. The coefficient ρ measures how neighbouring observations affect the dependent variable. This effect is independent of the effects of exogenous variables. If Equation (4) is correct, then ignoring the spatial autocorrelation term means that a significant explanatory variable has been omitted. The consequence is that the estimates of ß are biased and all statistical inferences are invalid.

Following Blonigen et al. (2006), we calculate weights using a simple inverse distance function where the shortest bilateral distance receives a weight of unity and all other distances receive a weight that declines according to:

$$w(d_{i,j}) = \frac{\min\_d_{i,j}}{d_{i,j}} \forall i \neq j, \quad (5)$$

where $d_{i,j}$ is the distance between regions i and j, measured between capital cities; $\min\_d_{i,j}$ is the minimum distance in the sample (79 km). Under the above rule, a non-zero entry in the kth column of row j indicates that the kth observation will be used to adjust the prediction of the jth observation $(j \neq k)$. W is a square matrix and the diagonal elements of W are set equal to zero in order that no observation of FDI predicts itself. Thus, W appears as:

$$W = \begin{bmatrix} 0 & w(d_{2,1}) & \dots & w(d_{n,1}) \\ w(d_{1,2}) & 0 & \dots & w(d_{n,2}) \\ \dots & \dots & 0 & \dots \\ w(d_{1,n}) & w(d_{2,n}) & \dots & 0 \end{bmatrix}. \quad (6)$$

In $w(d_{i,j})$, i is the column number and j is the row number. Thus, $w(d_{1,2})=w(d_{2,1})$ would be the inverse distance function for regions 1 and 2.

A row-standardized weighting matrix is now applied. W is normalized so that each row sums to unity. Multiplied by the vector of dependent variable, the spatially-weighted dependent variable, $W * \ln FDI_{-i}$, has the simple interpretation of row-sums being a proximity-weighted average of FDI into alternative regions.

There are two other possible alternatives of spatial relationship in the data. The first is reflected by a spatial error model of the form:

$$\begin{aligned} y &= X\beta + u \\ u &= \lambda W u + \varepsilon \\ \varepsilon &\sim N(0, \delta^2 I_n), \end{aligned} \quad (7)$$

where the parameter λ is a coefficient on the spatially correlated errors. The coefficient λ measures how neighbouring observations affect the dependent variable, but the interpretation differs from that of spatial autoregressive model. In the spatial error model for FDI, a region's FDI is affected by a shock to FDI in neighbouring regions. In other words, a shock in neighbouring regions spills over to a degree depending on the value of λ through the error term. If the spatial error term is ignored, then standard statistical inferences are invalid (the parameter estimates, however, are unbiased). To test for spatial dependence in the errors of a regression without a spatially lagged dependent variable, we use Moran's I-statistics of the null hypothesis of no spatial correlation in errors in specification (1).

The alternative is a general version of the spatial model that includes both the spatial lagged term as well as a spatially correlated error structure as shown in (8):

$$\begin{aligned} y &= \rho W y + X\beta + u \\ u &= \lambda W u + \varepsilon \end{aligned} \quad (8)$$

$$\varepsilon \sim N(0, \delta_{\varepsilon}^{2} I_n)$$

Note that identification problems may arise when the weights matrix W is the same for the spatial lagged term and spatially correlated error term. The log likelihood for this model can be maximized using a general optimization algorithm on a concentrated version of the likelihood function. The parameters $\beta$ and $\delta^2$ are concentrated out of the likelihood function, leaving the parameters $\rho$ and $\lambda$. This eliminates the availability of the univariate simplex optimization algorithm used with spatial autoregressive model in the MATLAB Econometrics Toolbox.

Nevertheless, it is still possible to produce a sparse matrix algorithm for the log likelihood function and proceed in a similar fashion to that used for spatial autoregressive model. One difference is that it is hard to impose restrictions on the parameters $\rho$ and $\lambda$ to force them to lie within the ranges defined by the maximum and minimum eigenvalues from their associated weight matrices W. Thus, the results of models (4) and (8) are not directly comparable.

To test for a general version of spatial model, we use LM statistics for spatial correlation in the errors of a spatial autoregressive model (specification 3, null hypothesis of no spatial correlation in errors in SAR model).

# 7 Results

## 7.1 Baseline results

The descriptive statistics of cumulative FDI for the three periods (dependent variable) are presented in Table 7.

Table 7 Descriptive statistics of the dependent variable (in US$ million) for three periods

| Variable | Mean | Median | Minimum | Maximum |
|---|---|---|---|---|
| FDI1996-1998 | 52.0514 | 14.0366 | 0.125919 | 723.820 |
| FDI1999-2002 | 126.427 | 24.8583 | 0.514868 | 3985.11 |
| FDI2003-2005 | 388.950 | 42.5742 | 0.232288 | 9882.19 |
| Variable | Std. Dev. | C.V. | Skewness | Ex. kurtosis |
| FDI1996-1998 | 123.224 | 2.36735 | 4.31173 | 18.8459 |
| FDI1999-2002 | 501.606 | 3.96754 | 7.29394 | 53.4836 |
| FDI2003-2005 | 1361.14 | 3.49954 | 5.76493 | 35.9307 |

Table 7 suggests that cumulative FDI in general has grown throughout the analyzed period (mean, median, minimum and maximum values all increase through the period). Large differences between mean and median, minimum and maximum and the rather high standard deviation suggest that the influence of regions with extraordinarily large or small FDI inflows (i.e. outliers) may be rather significant in our data.

To check the robustness of specified FDI determinants, we estimate specification 1 without the 3-6 regions with the largest amounts of FDI. In accordance with our analysis of the top 10 regional recipients of FDI, these regions reflect the most significant patterns in FDI distribution across Russia and thus their exclusion should provide evidence of the FDI determinants that create these patterns.

Given the presence of outliers, we apply a least absolute deviations (LAD) regression to get robust estimators in respect to outliers. We also estimate LAD regressions for our data. If it is important to pay attention to any and all outliers, the least squares method is likely a better choice. In our case, outliers provide some rather important information about FDI determinants across Russia, so the LAD estimators are only indicative in this case.

We also use natural logarithm of cumulative FDI inflows as our dependent variable which helps to smooth the data.

The descriptive statistics of explanatory variables are presented in Appendix 5. No special patterns are found. All correlation coefficients of the explanatory variables for the three periods are below 0.57.

Table 8 presents cross sectional and pooled OLS results of Equations (1) and (2) for the entire sample.

Comparing cross-sectional OLS results between the periods of 1996-1998 and 1999-2002 in Table 8, we preliminarily conclude that there is (albeit informal) evidence that importance of Sakhalin region, oil and gas resources and legislation risk has increased since the financial crisis as these variables are not statistically significant in the period of 1996-1998 but become significant at the 5% level in the period of 1999-2002. In 2003-2005, as compared to 1999-2002, the big cities` variable becomes significant and port and political risk variables become insignificant. The coefficient of dummy for Sakhalin region variable almost doubles in the recent period, reflecting the increase in FDI inflows into the Sakhalin region. Pooled OLS in general confirm our findings with cross-sectional OLS regarding the magnitude and statistical significance of coefficients.

Table 8 Baseline results

| Variables | Cross – sectional OLS, Eq. (1) | | | Pooled OLS for panel dataset of three periods, Eq. (2) |
|---|---|---|---|---|
| | 1996-1998 | 1999-2002 | 2003-2005 | |
| Constant | 2.77 (4.9)*** | 4.13 (8.7)*** | 4.2 (7.2)*** | 3.35 (10.7)*** |
| MS | 0.26 (2)* | 0.22 (1.8)* | 0.35 (2.7)*** | 0.28 (3.7)*** |
| Port | 0.32 (2.4)** | 0.34 (3)*** | 0.13 (0.8) | 0.27 (3.3)*** |
| BC | 0.73 (1.4) | 0.6 (1.4) | 1.3 (2.3)** | 0.95 (3.3)*** |
| Dsah | 1.44 (0.86) | 3.04 (2.1)** | 6.1 (3)*** | 3.27 (3.11)*** |
| Nres | 0.017 (0.7) | 0.05 (2.4)** | 0.06 (2)* | 0.04 (2.5)** |
| Leg | 0.003 (0.34) | -0.014 (-2.3)** | -0.017 (-1.9)* | -0.007 (-1.5) |
| Pol | -0.015 (-1.9)* | -0.018 (-2.4)** | -0.007 (-0.8) | -0.008 (-1.8)* |
| N_obs. | 68 | 64 | 64 | 195 |

| | | | | |
|---|---|---|---|---|
| Adjusted R-square | 0.33 | 0.45 | 0.4 | 0.35 |
| Normality test | 0.9 (0.64) | 1.1 (0.6) | 3.1 (0.2) | 5.77 (0.06) |
| Heteroskedasticity test | 18.9 (0.87) | 22.9 (0.7) | 22.7 (0.7) | 22.1 (0.81) |
| Panel diagnostics | | | | |
| F test 1) | | | | 1.5 (0.03) |
| Breusch – Pagan test 2) | | | | 2.2 (0.13) |
| Hausman test 3) | | | | 4.5 (0.34) |

Note: ***, **, * denote the 1, 5 and 10 % significance levels.

1) F test: The null hypothesis is that the pooled OLS model is adequate; the alternative hypothesis is that the fixed effects model is adequate.

2) Breusch–Pagan test: The null hypothesis is that the pooled OLS model is adequate; the alternative hypothesis is that the random effects model is adequate.

3) Hausman test: The null hypothesis is that the random effects model is consistent; the alternative hypothesis is that the fixed effects model is adequate.

Our preliminary conclusions on changes of the importance of various FDI determinants throughout the period are the following. First, regions with abundant oil and gas resources attract more FDI after the financial crisis as world oil prices climb. Second, the increasing importance of legislative risk might be due to increasing investment possibilities post-crisis, so foreign investors can be more selective. Third, a possible explanation of the decreasing role of political risk is the overall improvement of political situation in post-crisis Russia, which, in turn, could be a consequence of positive economic developments and relatively stable federal government policies. Finally, the decreasing importance of sea port availability in recent years is a somewhat surprising. Sea ports should be important to the booming export-oriented industries that arose after the ruble's devaluation. One possible explanation is that the ruble has strengthened in recent years and thus eroded the FDI attraction of export-oriented industries and thereby the decreasing role of sea port availability as an FDI determinant.

To make more formal conclusions concerning possible structural break in our specification's performance between the periods, we also perform a Chow test based on cross-sectional and pooled OLS.[8] The null hypothesis of Chow test is that the parameter vectors are the same for both periods (no structural break between the periods) and the alternative hypothesis is that the parameter vectors differ significantly between the considered periods (there is structural break between the periods). The Chow test's F-statistic between pre-crisis period of 1996-1998 and first post-crisis period of 1999-2002 is 1.68 (the critical value is 2.66) and between two post-crisis periods (1999-2002 versus 2003-2005) is 1.12 (critical value 2.66). In both cases, the F-statistic does not exceed critical value and thus the hypothesis of structural break is rejected. This confirms the earlier findings of Iwasaki and Suganuma (2005), which were also based on Chow test.

Performing the Chow test between pre-crisis period of 1996-1998 and the entire post-crisis period of 1999-2005 (for the latter period we use pooled OLS of the two periods of 1999-2002 and 2003-2005), the Chow test F-statistic is 3.4 which slightly exceeds the critical value of 2.6. In this case, we cannot reject the hypothesis of a structural break between pre- and post-crisis periods and preliminarily conclude that there is some evidence of a structural break in FDI determinants` specification post-crisis. Of course, the roots of this change likely relate to particularities of Russian economic development in recent years (e.g. intensive development of oil industry in the face of rising oil prices) rather than the financial meltdown itself.

To identify other possible differences in the relative importance of FDI determinants in Russia between pre- and post-crisis periods, we estimate pooled OLS for panel data of the three periods with dummy variable for post-crisis periods and its interaction with all the explanatory variables of the following form:

$$\begin{aligned}\ln FDI_{ti} &= a_0 + a_1 ms_{ti} + a_2 port_{ti} + a_3 bc_{ti} + a_4 dsah_{ti} + a_5 oil\_gas\_index_{ti} + a_6 leg_{ti} + a_7 pol_{ti} + \\ &+ a_8 dummy_{post-crisis} + a_9 dummy_{post-crisis} * ms_{ti} + a_{10} dummy_{post-crisis} * port_{ti} + a_{11} dummy_{post-crisis} * bc_{ti} + \\ &+ a_{12} dummy_{post-crisis} * dsah_{ti} + a_{13} dummy_{post-crisis} * oil\_gas\_index_{ti} + a_{14} dummy_{post-crisis} * leg_{ti} + \\ &+ a_{15} dummy_{post-crisis} * pol_{ti} + \varepsilon_{ti}\end{aligned}, \quad (9)$$

where dependent and explanatory variables are the same as in specification (2) and $dummy_{post-crisis}$ is a dummy variable equal to zero for the period of 1996-1998 and to one for the periods of 1999-2002 and 2003-2005. Only the dummy variable itself and its interaction with the legislative risk variable are found to be statistically significant at the 10 % level. The coefficient on dummy variable for post-crisis periods is positive which indicates

[8] Panel diagnostics indicate that pooled OLS can be considered consistent and efficient at an acceptable level of significance with our data.

that FDI has increased in post-crisis period. The coefficient on dummy variable's interaction with the legislative risk variable is negative, indicating that regions with high legislative risk tended to receive less FDI post-crisis.

For robust-checking purposes, we also report the LAD estimators considered robust to outliers and cross-sectional and pooled OLS in accordance with Equations (1) and (2) for the sample without regions with extra large FDI in Appendix 6. The results enable us to preliminary conclude that most variables are quite robust to outliers. However, in the period of 1999-2002 in regression not including the largest FDI recipients (i.e. Sakhalin, Moscow, Leningrad region and Krasnodar region), market size and sea port variables become considerably less statistically significant. In general, it is quite explainable as Moscow, Leningrad region and Krasnodar region have relatively large market size and Leningrad region, Krasnodar region and Sakhalin region have big sea ports. During 2003-2005, the big cities variable becomes considerably less statistically significant when the large FDI recipients are excluded (i.e. Sakhalin, Moscow, Omsk oblast, Moscow oblast). This also looks quite plausible as Moscow, Omsk region and Moscow region have cities with populations over one million.

In table 9, we report the estimation results of Equation (3) with spatial terms.

Table 9 Cross-sectional results of the model with spatial terms: maximum likelihood estimation

| Variables | 1996-1998 | 1999-2002 | 2003-2005 |
|---|---|---|---|
| Constant | 2.45 (1.9)* | 6.3 (3.4)*** | 7.9 (3.4)*** |
| MS | 0.26 (1.94)* | 0.28 (2.5)** | 0.35 (3)*** |
| Port | 0.32 (2.4)** | 0.4 (3.7)*** | 0.14 (0.98) |
| BC | 0.76 (1.6) | 0.57 (1.5) | 1.2 (2.4)** |
| Dsah | 1.42 (0.9) | 2.8 (2.1)** | 5.4 (3)*** |
| Nres | 0.02 (0.77) | 0.05 (2.4)** | 0.05 (2)** |
| Leg | 0.004 (0.43) | -0.01 (-2.5)** | -0.017 (-21.)** |
| Pol | -0.02 (-2.1)** | -0.02 (-2.4)** | -0.006 (-0.7) |
| SPMS | 0.023 (0.02) | 1.52 (1.9)* | 0.4 (0.45) |

| | | | |
|---|---|---|---|
| SPFDI | 0.11 (0.26) | -0.7 (-1.3) | -0.99 (-1.6)* |
| N_obs. | 68 | 64 | 64 |
| Adjusted R-square | 0.33 | 0.46 | 0.38 |
| Log-likelihood | -89.4 | -73.1 | -92 |
| Moran test | 1.58 (0.11) | 0.39 (0.69) | -0.48 (0.63) |
| LM test | 1.96 (0.16) | 1.8 (0.18) | 8.6 (0.003) |
| FDI strategy | Horizontal | Regional trade-platform | Vertical |

Note: ***, **, * denote 1, 5 and 10 % levels of significance.

From Table 9, we conclude that inclusion of spatial terms does not generally affect other coefficients. This result is in line with the conclusion of Blonigen et al. (2006). Moran's test shows that there is no evidence of spatial error model of the form (7) for our data. The LM test results suggest that a general version of spatial model of the form (8) might be more appropriate for the period of 2003-2005. However, as we met identification problems in using the same weights matrix for the spatially lagged dependent variable and spatially correlated error (see section 5) and the results are still unbiased in the presence of spatial correlation in errors, we here assume that neglecting this fact does not seriously influence our conclusions. Even so, we must accept that statistical inferences can be biased in this case.

There are some interesting findings concerning post-crisis changes in FDI strategies. Pre-crisis, it appears that horizontal FDI strategies dominated in Russia. Post-crisis, two competing strategies emerge: regional trade-platform FDI (although without evident vertical motivation as we cannot reject the hypothesis that the coefficient on the spatially lagged dependent variable is zero) and vertical FDI.

In particular, the evidence suggests that just after the crisis regional trade-platform FDI gained importance. As mentioned earlier, regional trade-platform FDI is analogous to export platform-FDI described by Ekholm et al. (2005). In their theoretical model of export-platform FDI, Ekholm et al. consider three countries: two developed countries with high production costs and high demand for final goods and a developing country with low production costs and low demand for final goods (set to zero in their model for the sake of simplicity). Export-platform FDI is the situation where developed country 1 has a plant producing intermediates at home and a plant producing final goods in a low-cost developing country. Final goods are then sold at the market of developed country 2. In general, export-platform FDI is preferred by the developed country when component trade costs to developing country are low and the developing country has a large cost advantage.

If to consider a situation of regional trade-platform FDI into Russia the model should be modified. Here we have one developed country (potential foreign direct investor) and a cluster of neighbouring Russian regions. Regional-trade platform FDI is a situation when a developed country has a plant producing intermediates at home and a plant producing final goods at one region from the cluster of neighbouring regions. This region is chosen from the cluster on the basis of lowest production costs (vertical motivation). Final goods are largely sold at neighbouring regions (horizontal motivation).

Taking the conclusions of Ekholm et al. (2005) on regional trade-platform FDI and applying them to Russia, the possibility of such an FDI strategy increases when 1) component trade costs from the FDI home country to a Russian region (host region) are low, 2) production costs in a host region are low (and considerably lower than in the developed country providing FDI), 3) final goods transportation costs from a host region to neighbouring regions with relatively large market size are low, and 4) the costs of final goods trade with Russia from the FDI home country are high.

Theory says that post-crisis changes in Russian tariff policies would promote regional trade-platform FDI as component trade costs from the FDI home country to Russia could become lower relative to the costs of final goods trade in the same direction (item 1 and 4). However a detailed analysis of tariff policy in Russia during transition (not the subject of this paper) would be needed to establish this fact.

The increasing importance of regional trade-platform FDI can also be due to reduced production costs (item 2 above) and improvements in interregional transport infrastructure (item 3). While the devaluation of the ruble caused a reduction in real wages and therefore lowered production costs, the effect was short-lived (real wages generally recovered by 26% within five months)[9] and basically the same for all Russian regions. Therefore, it could not influence spatial distribution of FDI across Russian regions significantly. Furthermore, improvement of interregional transport infrastructure is a long-range task and thus not pertinent to the short-term analysis here.

[9] Galiev (2000).

One of the more plausible explanations of increasing importance of regional trade-platform FDI in post-crisis Russia is the rise of import-substitution industries. The dramatic devaluation of ruble made imports much more expensive and stimulated the revival of import-substitution industries. The food processing industry, the IT sector and many other businesses received a tremendous boost as foreign competitors (traders) were suddenly priced out of the market. This created opportunities for FDI into import-substitution production oriented to selling in the host region market and the markets of neighbouring regions.

Signs of strong economic growth may also provide an explanation here as the existence of clusters of regions with relatively large market size becomes evident to investors.

Our results show regional-trade platform FDI without evident vertical motivation as the coefficient on spatial lagged dependent variable is not significant. In other words, FDI into a particular Russian region in the post-crisis period is positively related to potential market size of neighbouring regions but not influenced by FDI inflows into the neighbouring regions. This could be due to agglomeration effects of regional trade-platform FDI flows into neighbouring regions and/or the persisting importance of horizontal FDI strategies. It also can be explained by the reasonable suggestion that neighbouring regions in Russia do not differ much in production costs, so the vertical motive of trade-platform FDI emphasized by Ekholm et al. (2005) is not evident in the Russian case. The import-substitution nature of regional trade-platform FDI could also explain the lack of vertical motivation as import-substitution production in Russia is largely based on connections with suppliers; regional production cost differences are not particularly important for such FDI.

There is also some a small body of evidence that vertical FDI strategies gained dominance 2003-2005. This may be due to increasing FDI inflows to the fuel industry in recent years. Moreover, the oil and gas industry has developed rapidly since the financial crisis due to favourable oil prices in the world market. As Russia’s energy industry is export-oriented, the increase in exports has strengthened the ruble. The rise of the ruble, in turn, has eroded motivation for development of import-substitution industries and thus for regional-trade platform FDI.

There are several arguments that might explain the dominance of horizontal strategy in the pre-crisis period. First, FDI inflows to resource industries were restrained by officially imposed restrictions on foreign investment. Thus, vertical strategies had little chance of prevailing. Unfavourable tariff policies in pre-crisis period (especially for exports) may have also impaired vertical FDI strategies and favoured horizontal FDI strategies. Second, the imposition of a nominal exchange rate fluctuation band from mid-1995 to 1998 kept the ruble's nominal exchange rate artificially high. This restrained development of import-substitution industries and consequently regional trade-platform FDI. Finally, our analysis of industrial composition of FDI showed that horizontal strategies strongly dominated in Russia pre-crisis (64% according to our calculations in Table 5). While these calculations are quite crude, they likely reflect the dominant tendency.

## 7.2 Spatial relationship in FDI between Russian regions with ports and without ports: a multiple spatial lags approach

In our baseline analysis, we found that port availability has become less important in recent years. To explore this issue, we use multiple spatial lags approach (see Davies and Naughton, 2006) to analyze spatial relationship in FDI, first, within the group of regions with ports only, and, second, between regions with and without ports. In first case we want to know how FDI in a particular region with a port is affected by FDI in neighbouring regions with ports. Such an analysis seems to be quite reasonable as regions with ports in Russia are grouped in three clusters as it is evident from the Map 3.

Map 3 Russian regions with ports


Note: Regions with at least one port are marked in blue.

Source: http://www.transrussia.net/ports/port.aspx

In the second case, we analyze how FDI in a particular region with a port ( "port" regions) is affected by FDI in neighbouring regions without ports ("non-port" regions) and the reverse situation of how FDI in a particular "non-port" region is affected by FDI in neighbouring "port" regions.

We expect the spatial relationship in FDI to be negative in the first case, since neighbouring regions with ports likely compete with each other for FDI. Thus, a foreign investor deciding to invest in neighbouring regions with ports (if to assume that port availability is a crucial FDI factor for investment decision) will likely look to other regional characteristics such as legislative risk, labour costs, general infrastructure or market size.

In the second case, both positive and negative spatial relationship in FDI has reasonable explanations. A positive spatial relationship implies an agglomerative effect between "port" and "non-port" regions. Increased FDI to a port/non-port region enhances FDI in the neighbouring non-port/port regions. Thus, if a foreign investor has a facility in a "port" region, he may invest in neighbouring regions to sell products in neighbouring regions directly through subsidiary or for a production purpose such as having his own supplier of components nearby. By the same token, a foreign investor with facilities in a "non-port" region may want to invest in a neighbouring "port" region to take advantage of the port's proximity.

Correspondingly, when the spatial relationship in FDI is negative between “port” and “non-port” regions, it indicates that the “port” and neighbouring “non-port” regions compete with each other for FDI as foreign investors treat all of them as regions proximal to sea port and their final investment decision depends on other regional characteristics.

In both cases we estimate the SAR model of the form:

$$\ln FDI_i = a_0 + a_1 ms_i + a_2 port_i + a_3 bc_i + a_4 dsah + a_5 oil\_gas\_index_i + a_6 leg_i + a_7 pol_i + \rho W_{mult} * \ln FDI_{-i} + \varepsilon_i , \quad (10)$$

where the meaning of all variables is the same as in Equations (1) and (3) above. However, the weighting matrix is different. For illustrative purposes, imagine we have only four regions: regions 1 and 3 have ports and regions 2 and 4 do not. This yields the following weighting matrix:

$$W = \begin{bmatrix} 0 & w(d_{2,1}) & w(d_{3,1}) & w(d_{4,1}) \\ w(d_{1,2}) & 0 & w(d_{3,2}) & w(d_{4,2}) \\ w(d_{1,3}) & w(d_{2,3}) & 0 & w(d_{4,3}) \\ w(d_{1,4}) & w(d_{2,4}) & w(d_{3,4}) & 0 \end{bmatrix}. \quad (11)$$

If we analyze the spatial relationship within the group of regions with ports only, then we must replace all port/non-port and non-port/non-port inverse distance functions with zeros. Thus, the resulting weighting matrix for the first case would be:

$$W_{mult1} = \begin{bmatrix} 0 & 0 & w(d_{3,1}) & 0 \\ 0 & 0 & 0 & 0 \\ w(d_{1,3}) & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}. \quad (12)$$

If we analyze spatial relationship between “port” and “non-port” regions, then we must replace all port/port and non-port/non-port inverse distance functions with zeros. The resulting weighting matrix for the second case would be:

$$W_{mult2} = \begin{bmatrix} 0 & w(d_{2,1}) & 0 & w(d_{4,1}) \\ w(d_{1,2}) & 0 & w(d_{3,2}) & 0 \\ 0 & w(d_{2,3}) & 0 & w(d_{4,3}) \\ w(d_{1,4}) & 0 & w(d_{3,4}) & 0 \end{bmatrix}. \quad (13)$$

We modified our weighting matrices for the analyzed three periods in the described way and estimated specification (4) for both considered cases. As the results for common FDI determinants are actually the same as in Tables 8 and 9, we only report the results for spatially lagged dependent variable and relevant statistics. These results appear in Table 10.

Table 10 Spatial relationship in FDI between Russian regions with and without ports: Multiple spatial lags approach, MLE results

| Spatial relationship in FDI within the group of regions with ports | | | |
|---|---|---|---|
| Variables | 1996-1998 | 1999-2002 | 2003-2005 |
| SPFDI | 0.05 (0.26) | -0.23 (-1.8)* | -0.32 (-1.78)* |
| Moran test | 2.09 (0.04) | -0.14 (0.89) | -0.56 (0.58) |
| LM test | 1.1 (0.29) | 0.11 (0.74) | 0.31 80.64) |
| Spatial relationship in FDI between regions with and without ports | | | |
| SPFDI | 0.03 (0.1) | 0.37 (1.7)* | 0.18 (0.63) |
| Moran test | -1.1 (0.27) | 0.66 (0.51) | 0.17 (0.86) |
| LM test | 1.19 (0.28) | 0.16 (0.69) | 0.02 (0.9) |

The Moran test for the period of 1996-1998 for spatial relationship in FDI within the group of regions with ports shows that spatial error model in Equation (6) is more appropriate in this case. We estimate the spatial error model for this period and find that the parameter λ (a coefficient on spatially correlated errors) is significant at the 5% level and equals to 0.58 with asymptotic t-statistic equal to 2.3. In other words, a shock in FDI in neighbouring regions with ports had a positive effect on FDI inflows to a particular port region in this period.

The evidence suggests that generally regions with ports have become competitors for FDI with neighbouring regions with ports after crisis. The significant negative spatial relationship in FDI within the group of regions with ports indicates that if one region with a port can offer additional advantages in other FDI determinants from what is offered by neighbouring port regions, foreign investors will tend to choose that region. Thus, while port availability is important, its importance has become less determinative since the 1998 financial crisis. This may indicate that after financial crisis foreign investors have become more cautious in choosing the place to invest in Russia and consider other factors in making investment decisions.

As for the spatial relationship in FDI between "port" and "non-port" regions, there is evidence that in 1999-2002 there were agglomeration effects between neighbouring regions from the presence of a sea port. Thus, we preliminarily conclude that in the early post-crisis period, the presence of a sea port in the cluster of neighbouring Russian regions was an important FDI determinant. Most likely the ruble's devaluation stimulated FDI into export-oriented industries that valued sea port access. However, as the ruble's exchange rate has stabilized, the motivations for export-oriented FDI have evaporated and with them the agglomeration effects between "port" and "non-port" regions. (Note that in our baseline estimation, the port variable becomes insignificant only in the period of 2003-2005).

## 7.3 Sensitivity analysis

For robust checking purposes, we also estimate cross-sectional regressions with spatial dependence in Equation (3) for three-year, four-year and five-year cumulative FDI dependent variable throughout the analysed periods of 1996-2005. Table 11 breaks down the estimation scheme for the three-, four- and five-year cumulative FDI dependent variable from 1996 to 2005.

Table 11.1 Three-year cumulative FDI dependent variable

| The dependent variable | 1996-1998 | 1997-1999 | 1998-2000 | 1999-2001 | 2000-2002 | 2001-2003 | 2002-2004 | 2003-2005 |
|---|---|---|---|---|---|---|---|---|
| Market size variable | 1995-1997 | 1996-1998 | 1997-1999 | 1998-2000 | 1999-2001 | 2000-2002 | 2001-2003 | 2002-2004 |
| Other time-variant explanatory variables | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |

Table 11.2 Four-year cumulative FDI dependent variable

| The dependent variable | 1996-1999 | 1997-2000 | 1998-2001 | 1999-2002 | 2000-2003 | 2001-2004 | 2002-2005 |
|---|---|---|---|---|---|---|---|
| Market size variable | 1995-1998 | 1996-1999 | 1997-2000 | 1998-2001 | 1999-2002 | 2000-2003 | 2001-2004 |
| Other time-variant explanatory variables | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 |

Table 11.3 Five-year cumulative FDI dependent variable

| The dependent variable | 1996-2000 | 1997-2001 | 1998-2002 | 1999-2003 | 2000-2004 | 2001-2005 |
|---|---|---|---|---|---|---|
| Market size variable | 1995-1999 | 1996-2000 | 1997-2001 | 1998-2002 | 1999-2003 | 2000-2004 |
| Other time-variant explanatory variables | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |

In analysing estimation results, we assume that the first 2-3 periods in each sub-table reflects the pre-crisis period, the second 2-3 periods – first post-crisis period of 1999-2002 and the third 2-3 periods – second post-crisis period of 2003-2005.

In Table 12, we report only the results for spatial variables and corresponding statistics as the results for basic FDI determinants are quite similar to those for the baseline estimation (see Tables 8 and 9).

Table 12.1 Cross-sectional results for spatial relationship for three-year cumulative FDI dependent variable (maximum likelihood estimation)

| Variables | 1996-1998 | 1997-1999 | 1998-2000 | 1999-2001 | 2000-2002 | 2001-2003 | 2002-2004 | 2003-2005 |
|---|---|---|---|---|---|---|---|---|
| SPMS | -0.02 (-0.02) | 0.6 (0.56) | 0.25 (0.7) | 1.6 (1.5) | 1.6 (2)** | 1. 4 (1.8)* | 1.2 (1.3) | 0.4 (0.45) |
| SPFDI | 0.12 (0.3) | -0.25 (-0.5) | -0.45 (0.8) | -0.99 (-1.7)* | -0.2 (-0.4) | -0. 6 (-1.1) | -0.6 (-1.1) | -0.99 (-1.6)* |
| Moran test | 1.6 (0.11) | 1.3 (0.18) | 0.86 (0.39) | -0.08 (0.94) | 0.2 (0.83) | -0.3 (0.8) | 0.18 (0.9) | -0.48 (0.63) |
| LM test | 2.1 (0.15) | 0.03 (0.85) | 0.49 (0.48) | 4.4 (0.04) | 1.9 (0.17) | 6.2 (0.013) | 4 (0.05) | 8.6 (0.003) |
| FDI strategy | Horizontal | Horizontal | Horizontal | Vertical | RTP* FDI without evident vertical motivation | RTP* FDI without evident vertical motivation | Horizontal | Vertical |

Table 12.2 Cross-sectional results for spatial relationship for four-year cumulative FDI dependent variable (maximum likelihood estimation)

| Variables | 1996-1999 | 1997-2000 | 1998-2001 | 1999-2002 | 2000-2003 | 2001-2004 | 2002-2005 |
|---|---|---|---|---|---|---|---|
| SPMS | -0.29(-0.28) | 0.48 (0.47) | 0.8 (0.7) | 1.54 (1.9)* | 1.5 (2.2)** | 0.76 (0.9) | 1.47 (1.5) |
| SPFDI | 0.24 (0.63) | -0.3 (-0.6) | -0.7 (-1.2) | -0.75 (-1.4) | -0.32 (-0.63) | -0.33 (-0.63) | -0.96 (-1.6) |
| Moran test | 2.6 (0.01) | 1.5 (0.13) | 0.24 (0.8) | 0.39 (0.69) | -0.33 (0.74) | 0.62 (0.53) | -0.2 (0.8) |
| LM test | 10 (0.002) | 0.06 (0.8) | 2.24 (0.13) | 1.8 (0.18) | 4.6 (0.03) | 0.9 (0.35) | 5.3 (0.02) |
| FDI strategy | Horizontal | Horizontal | Horizontal | RTP* FDI without evident vertical motivation | RTP* FDI without evident vertical motivation | Horizontal | Horizontal |

Table 12.3 Cross-sectional results for spatial relationship for four-year cumulative FDI dependent variable (maximum likelihood estimation)

| Variables | 1996-2000 | 1997-2001 | 1998-2002 | 1999-2003 | 2000-2004 | 2001-2005 |
|---|---|---|---|---|---|---|
| SPMS | -0,2 (-0,2) | 0,74 (0,74) | 1,26 (1,4) | 1,16 (1,7)* | 1,2 (1,7)* | 0,73 (1) |
| SPFDI | 0,11 (0,27) | -0,69 (-1,2) | -0,28 (-1,1) | -0,98 (-1,7)* | -0,98 (-1,7)* | -0,99 (-1,7)* |
| N_obs. | 64 | 63 | 61 | 62 | 62 | 61 |
| Moran test | 2,5 (0,01) | 0,85 (0,4) | -0,09 (0,93) | -0,53 (0,59) | -0,53 (0,6) | -1,1 (0,28) |
| LM test | 7,1 (0,01) | 0,64 (0,42) | 2,9 (0,09) | 7,5 (0,006) | 7,4 (0,006) | 12,5 (0,0004) |
| FDI strategy | Horizontal | Horizontal | Horizontal | Regional-trade platform | Regional-trade platform | Vertical |

Note: ***, **, * denote 1, 5 and 10% levels of significance.

In general, these results do not contradict our baseline findings. Prior to the crisis, horizontal strategies firmly prevail. Post-crisis, the results are quite mixed. The most convincing result is that sensitivity estimations confirm the importance of regional trade-platform FDI without evident vertical motivation in after crisis period.

# 8 Conclusions

In the paper, we empirically analyzed the determinants and spatial relationships of FDI inflows into Russian regions during transition (1996-2005). Using cross-sectional and panel data, OLS and spatial autoregressive model we obtained the following results.

First, the important determinants of FDI inflows into Russian regions during transition have been market size, the presence of big cities and sea ports, oil and gas resources and political and legislative risks. The hydrocarbon-endowed Sakhalin region almost stands as an FDI determinant unto itself.

Second, comparing the results between the periods pre- and post-crisis, we preliminarily conclude that the importance of big cities, the Sakhalin region, oil and gas resources and legislation risk has increased, while the importance of political risk and port availability has decreased. Our Chow test showed modest evidence of a structural break between the pre-crisis (1996-1998) and post-crisis (1999-2005) periods.

Third, there is evidence to suggest that the leading factors stimulating the sharp FDI increase in 2003-2005 were market size, big city advantages and Sakhalin region's production sharing agreements in the oil industry.

Fourth, the inclusion of spatial variables into analysis enabled us to investigate why horizontal FDI strategies dominated in Russia pre-crisis while post-crisis the evidence is quite mixed. We found fairly convincing evidence that regional trade-platform FDI strategies have become important, most likely without vertical motivation. Our findings indicate that neighbouring regions in Russia do not differ much in production costs and thus the choice of FDI location is based on factors other than regional production costs (e.g. supplier proximity).

There are several possible explanations for the shift in FDI strategies. Pre-crisis, unfavourable tariff policies and restrictions on FDI into resource industries inhibited vertical FDI strategies. Moreover exchange rate policy kept the ruble's exchange rate artificially high, favouring imports and hurting domestic producers.

The ruble's devaluation made imports very expensive and stimulated the revival of import-substitution industries. This initially created opportunities for FDI into import-substitution production as companies in Russia are oriented to not only for the selling their host region's market but also in the markets of neighbouring regions. Such regional trade-platform FDI into import-substitution production also explains the lack of vertical motivation of foreign investors (the insignificance of spatially weighted lagged dependent variable) found in our study as import-substitution production is largely based on connections with suppliers and thus production cost differences are not overly critical for such FDI.

Economic growth in post-crisis Russia has likely enhanced regional trade-platform FDI as the appearance of clusters of regions with large market size has become more likely with positive economic development.

The evidence that vertical FDI strategies have come to dominate in recent years may reflect increasing focus on FDI in resources industries (especially the fuel industry, which development has been enhanced by favourable oil prices in world market in recent years). Moreover, fast development of export-oriented fuel industry has strengthened the ruble and correspondingly weakened investor motivation to get involved in import-substitution industries.

Using multiple weighting matrices, we also found evidence that in the post-crisis period neighbouring regions with ports have become competitors for FDI. Thus, authorities in regions with ports need to examine the overall FDI determinants of neighbouring regions with ports as well to determine their relative advantages and disadvantages if they hope to be successful in attracting FDI. Moreover, in the early post crisis period of 1999-2002, there is evidence of agglomeration affects between neighbouring regions with and without ports. The most plausible explanation is that sharp devaluation of ruble after crisis stimulated FDI into export-oriented industries where the presence of sea port was a significant competitive factor. In recent years, the ruble's exchange rate has stabilized, eroding the motives for export-oriented FDI and eliminating agglomeration effects between "port" and "non-port" regions.

Before considering the policy implications of these findings, we must emphasize the following observations. First, regional legislative risk has become an important factor of FDI inflows into Russia in recent years. This means regional authorities must pay increased attention as to how legislative initiatives are crafted if they wish to attract FDI. Second, market size and the presence of large cities are important factors for FDI inflows into Russia, especially in recent years. Thus, managed growth and urbanization will assure cities remain attractive destinations for foreign investors. Indeed, FDI can help them in emerging as leaders of industrial and economic development in Russia. Therefore, federal and regional authorities need to take measures that protect and promote favourable investment climates. Moreover proximal regions can also benefit from FDI, so improving transport connections between urban centres and nearby regions, along with improving the general investment climate in nearby regions, should also be noted.

The dominating FDI strategies in Russia hold several policy implications. First, unfavourable tariff policies, particularly poorly considered export tariffs, can dampen enthusiasm for vertical FDI strategies. Correspondingly, well-targeted reductions in export tariffs on components and intermediates could enhance vertical FDI.

WTO membership may further erode the position of companies involved in import substitution, an issue frequently mentioned in conjunction with the lowering of import tariffs as part of Russia's WTO commitments. As this is likely to impede regional trade-platform FDI into import-substitution production, policy-makers might seek to reduce import tariffs for component trade to a greater extent than for final goods trade.

These results also suggest that clusters of Russian regions with large market size are important destinations for regional trade-platform FDI. In this context, policy could be geared to 1) promoting interregional connections within these clusters, 2) developing transport infrastructure between regions in the clusters, and 3) promoting cooperation on FDI policy among neighboring regions.

# Appendix 1

Table A1.1 Explanatory variables used in basic specification

| No | Name | Data source |
|---|---|---|
| **Explanatory variables included into final estimation** | | |
| 1 | Market size – first principal component of three variables – GRP, total regional population and regional population density (for calculation details, see section 4, Table 9) | Rosstat |
| 2 | Number of sea ports in a region | http://www.transrussia.net/ports/port.aspx |
| 3 | Dummy variable of 13 biggest cities in Russia | http://wgeo.ru/russia/table.shtml?id=25 |
| 4 | Dummy for Sakhalin region | Equal to 1 for Sakhalin region, 0 otherwise |
| 5 | Oil and gas index (for calculation details see Appendix 2) | Rosstat |
| 6 | Legislation risk | Russian economics journal *Ekspert* |
| 7 | Political risk | Russian economics journal *Ekspert* |

# Appendix 2

Table 2.1 Results from principal component analysis of market size

| **Principal components/correlation** | | | | |
|---|---|---|---|---|
| Component | Eigenvalue | Difference | Proportion | Cumulative |
| Comp 1 | 2.39692 | 2.02709 | 0.7990 | 0.7990 |
| Comp 2 | .369832 | .136588 | 0.1233 | 0.9223 |
| Comp 3 | .233244 | | 0.0777 | 1.0000 |
| **Principal components (eigenvectors)** | | | | |
| Variable | Comp1 | Comp2 | Comp3 | Unexplained |
| GRP | 0.5950 | -0.0739 | -0.8003 | 0 |
| Pop | 0.5650 | 0.7467 | 0.3511 | 0 |
| Pop_density | 0.5717 | -0.6611 | 0.4860 | 0 |

Note: PCA is based on panel data set for 74 Russian regions over the period 1995-2004 (740 observations). The resulting panel vector of first principal component was used to construct final market size variables as averages of the corresponding periods (see Table 6).

# Appendix 3

The oil and gas index was calculated using the following formula of integrated coefficient:

$$Oil\_gas\_index_{it} = \frac{1}{m}\sum_{j=1}^{m}\left[100*\left(\frac{F_{j,it}}{\overline{F_{jt}}}\right)\right],$$

where *i=1,…,74* in period *t=1996,…,2004.* $F_{j,it}$ is the actual resource indicator j for a region i in period t, $\overline{F_{jt}}$ is the sample mean of the indicator in period t [here, the mean value for Russian regions, which is $\overline{F_{jt}} = \frac{1}{n}\sum_{i=1}^{n} F_{ijt}$, where n is the number of Russian regions involved in computation (74)], m is the number of indicators included in the index computation (adopted from Ndikumana, 2000). Indicators included in the computation of the resource index are presented in Table A1.1.

Table A3.1 Indicators included in the Resource Index

| **N** | **Indicator** |
|---|---|
| 1 | Oil output including gas condensate per capita, thousands of metric tons |
| 2 | Natural gas output per capita, millions of cubic meters |

## Appendix 4

Maximum likelihood estimation (MLE) of the spatial autoregressive model (SAR) implemented using LeSage's Econometrics Toolbox for MATLAB.

MLE of the SAR is based on a concentrated likelihood function based on eliminating the parameter $\delta^2$ for the variance of the disturbances. A few regressions are carried out along with a univariate parameter optimization of the concentrated likelihood function over values of the autoregressive parameter $\rho$. The steps are enumerated in Anselin (1988) as:

1. Perform OLS for the model: $y = X\beta_0 + \varepsilon_0$
2. Perform OLS for the model $Wy = X\beta_L + \varepsilon_L$
3. Compute residuals $e_0 = y - X\hat{\beta}_0$ and $e_L = Wy - X\hat{\beta}_L$
4. Given $e_0$ and $e_L$ find $\rho$ that maximizes the concentrated likelihood function:

$L_C = C - (n/2)\ln(1/n)(e_0 - \rho e_L)`(e_0 - \rho e_L) + \ln|I - \rho W|$

5. Given $\hat{\rho}$ that maximizes $L_C$, compute $\hat{\beta} = (\hat{\beta}_0 - \rho\hat{\beta}_L)$ and

$\hat{\delta}_\varepsilon^2 = (1/n)(e_0 - \rho e_L)`(e_0 - \rho e_L)$

The expression in (4) is maximized with respect to $\rho$ using a simplex univariate optimization routine.

Two implementation details arise with this approach to solving for maximum likelihood estimates. First, there is a constraint that we need to impose on the parameter ρ. This parameter can take on feasible values in the range (Anselin and Florax, 1994):

$$1/\lambda_{\min} < \rho < 1/\lambda_{\max} \qquad (3.1)$$

where $\lambda_{\min}$ represents the minimum eigenvalue of the standardized spatial contiguity matrix W and $\lambda_{\max}$ denotes the largest eigenvalue of this matrix. Thus we constrain our optimization procedure search over values of ρ within this range.

Second, we face the problem that using a univariate simplex optimization algorithm to find a maximum likelihood estimate of ρ based on the concentrated log likelihood function leaves us with no estimates of the dispersion associated with the parameters. For small problems (less than 500 observations) in MATLAB, this is overcome through the use of a theoretical information matrix (Fisher information matrix).

# Appendix 5

Table A5.1. Descriptive statistics of explanatory variables

| Variable | Mean | Median | Minimum | Maximum | Std. Dev. |
|---|---|---|---|---|---|
| For the period of 1996-1998 | | | | | |
| Ms | 0.0799047 | -0.325839 | -1.00574 | 10.5977 | 1.48806 |
| Port | 0.648649 | 0.000000 | 0.000000 | 8.00000 | 1.52991 |
| Bc | 0.202703 | 0.000000 | 0.000000 | 1.00000 | 0.404757 |
| Nr | 1.00000 | 0.000000 | 0.000000 | 58.2615 | 6.76961 |
| Dsah | 0.0135135 | 0.000000 | 0.000000 | 1.00000 | 0.116248 |
| Leg | 31.6081 | 27.5000 | 1.00000 | 83.0000 | 20.3536 |
| Pol | 44.6164 | 43.5000 | 2.00000 | 86.0000 | 24.0124 |
| For the period of 1999-2002 | | | | | |
| Ms | -0.115084 | -0.482976 | -1.01518 | 10.1589 | 1.38276 |
| Nr | 1.00000 | 0.000000 | 0.000000 | 58.1430 | 6.75444 |
| Leg | 41.3649 | 39.0000 | 1.00000 | 88.0000 | 25.2774 |
| Pol | 44.0000 | 44.5000 | 1.00000 | 87.0000 | 23.7717 |
| For the period of 2003-2005 | | | | | |
| Ms | 0.0769217 | -0.399051 | -1.00368 | 13.6213 | 1.81212 |
| Nr | 1.00000 | 0.000000 | 0.000000 | 58.4858 | 6.79518 |
| Leg | 39.6486 | 39.5000 | 1.00000 | 86.0000 | 23.3358 |
| Pol | 47.2838 | 48.5000 | 1.00000 | 87.0000 | 25.1170 |

# Appendix 6

Table A6.1 LAD estimators of the specification (1) and (2)

| Variables | 1996-1998 | 1999-2002 | 2003-2005 | Pooled OLS for the three periods |
|---|---|---|---|---|
| Constant | 3.2 (3.4)*** | 4.6 (7.4)*** | 3.9 (6.5)*** | 3.6 (8.2)*** |
| MS | 0.27 (0.87) | 0.25 (1.8)* | 0.28 (2.02)** | 0.25 (2.4)** |
| Port | 0.24 (1.4) | 0.33 (2.27)** | 0.3 (1.75)* | 0.32 (2.6)*** |
| BC | 0.58 (0.72) | 0.91 (1.4) | 1.1 (1.6) | 0.96 (2.3)** |
| Dsah | 0.02 (0.6) | 0.06 (2.9)*** | 0.05 (1.77)* | 0.05(1.7)* |
| Nres | 1.9 (1.05) | 3.25 (2.03)** | 4.02 (1.94)* | 3.15 (2.4)** |
| Leg | 0.001 (0.07) | -0.03 (-2.9)*** | -0.005 (-0.54) | -0.012 (-1.8)* |
| Pol | -0.02 (-1.95)* | -0.02 (-2.25)** | -0.006 (-0.67) | -0.008 (-1.3) |
| N_obs. | 67 | 64 | 64 | 195 |

Table A6.2. Cross-sectional OLS and panel estimation results for sample not including regions with extra-large FDI

| Variables | Cross-sectional OLS without regions with extra large FDI | | | Panel estimation results | |
|---|---|---|---|---|---|
| | Without Moscow, Magadan region, Sakhalin | Without Sakhalin, Moscow, Leningrad region, Krasnodar region | Without Sakhalin, Moscow, Omsk region, Moscow region | Pooled OLS | Random effects model 1) |
| | 1996-1998 | 1999-2002 | 2003-2005 | | |
| Constant | 2.7 (4.9)*** | 4.1 (8.1)*** | 4.5 (8)*** | 3.6 (11.5)*** | 3.4 (10.3)*** |
| MS | 0.26 (0.8) | -0.03 (-0.1) | 0.76 (1.9)* | 0.29 (1.3) | 0.32 (1.3) |
| Port | 0.25 (1.8)* | 0.22 (1.5) | 0.1 (0.7) | 0.21 (2.4)** | 0.22 (2.1)** |
| BC | 0.81 (1.4) | 0.7 (1.1) | 0.38 (0.54) | 0.70 (1.9)* | 0.72 (1.7) |
| Nres | 0.02 (0.7) | 0.06 (2.3)** | 0.03 (0.8) | 0.04 (2.24)** | 0.038 (1.8)* |
| Leg | 0.001 (0.1) | -0.012 (-1.8) | -0.018 (-2.1)** | -0.009 (-1.86)* | -0.006 (-1.3) |
| Pol | -0.012 (-1.6) | -0.02 (-2.7)** | -0.01 (-1.2) | -0.012 (-2.77)*** | -0.012 (-2.55)** |
| N_obs. | 65 | 60 | 60 | 185 | 185 |
| Adjusted R-square | 0.23 | 0.23 | 0.23 | 0.22 | |
| Normality test | 1.1 (0.58) | 0.9 (0.63) | 2.5 (0.29) | 3.8 (0.15) | |
| Heteroskedasticity test | 16.7 (0.9) | 26.3 (0.45) | 22.7 (0.65) | 32.2 (0.19) | |
| Panel diagnostics | | | | | |
| F test 2) | | | | 1.7 (0.01) | |
| Breusch – Pagan test 3) | | | | 4.7 (0.03) | |
| Hausman test 4) | | | | 2.7 (0.6) | |

Note: ***, **, * denote 1, 5 and 10 % levels of significance, correspondingly

1) Random effects model was chosen on the basis of panel diagnostics.

2) F test: The null hypothesis is that the pooled OLS model is adequate; the alternative hypothesis is that fixed effects model is adequate.

3) Breusch–Pagan test: The null hypothesis is that the pooled OLS model is adequate; the alternative hypothesis is that random effects model is adequate.

4) Hausman test: The null hypothesis is that random effects model is consistent; the alternative hypothesis is that fixed effects model is adequate.

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