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# FOUR ESSAYS ON REGIONAL GROWTH AND OTHER RELATED ISSUES

## (Evidence from the Russian Federation and the Indian Union)


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**Abstract**

This thesis consists of four separate chapters, which are all in themselves self standing. The first three papers refer to the Russian Federation context, while the last one to the Indian Union's one. The liaison linking all the works is represented by the use of econometrics techniques, which better adapt to regional datasets and, in the most of cases, this implies the use of spatial econometrics tools. Here below I briefly summarize the contents and main findings of each of the chapters.

The first paper analyses the process of convergence across Russian regions using spatial econometrics tools in addition to the traditional $\beta$-convergence techniques as derived from the neoclassical theoretical setting. The study covers the period 1999-2004. Absolute convergence is absent, confirming the results obtained in previous studies on the Russian Federation. The $\beta$ convergence coefficient begins to be significant only after the introduction of other explanatory variables in addition to the initial level of per capita income. The neoclassical conditional convergence model is found to overestimate the absolute value of β with respect to its spatial lag model counterpart, strengthening the hypothesis of a bias due to spatial dependence in the data. When moving to the panel data analysis, the gap in convergence coefficient becomes more evident and slightly present also in the spatial error model. The spatial component appears to be non-negligible and, consequently, conventional convergence estimates suffer a bias due to spatial dependence across observations. Furthermore, variables such as hydrocarbon supply, openness to trade and FDI per capita are found to have an unambiguous, positive and statistically significant impact on growth. Results are also confirmed by the panel data specifications of the models.

The second chapter focuses on the role of hydrocarbons as a possible determinant for inequality. Already in the first chapter I showed that hydrocarbons are one of the main elements constituting the great divide across fast and slow growing Russian regions. Here we concentrate mainly on the role of oil and gas as a possible determinant of within region inequality. After having reviewed the economic literature concerning determinants of inequality across countries and within Russia, we test empirically the determinants of intra-regional inequality in Russia, applying robust dynamic panel data estimators. We find that regions where oil and gas is produced tend to experience higher levels of income inequality in striking resemblance to cross-country results.

The third chapter is devoted to the analysis foreign direct investment in Russia. More in particular, we explore the hypothesis of spatial effects in the distribution of Foreign Direct Investments (FDI) across Russian regions. We make use of a model, which describes FDI inflows as resulting from an agglomeration effect (the level of FDI in a given region depends positively on the level of FDI received by the regions in its neighbourhood) and remoteness effect (the distance of each Russian

regions from the most important outflows countries). Considering a panel of 68 Russian regions over the period 2000-2004 we find that the two effects play a significant role in determining FDI inflows towards Russia. The two effects are also robust to the inclusion of other widely used explanatory variables impacting the level of FDI towards countries or regions (e.g. surrounding market potential, infrastructures, investment climate).

The fourth and last chapter, we investigate the process of convergence/divergence across Indian states. After surveying the main economic reforms implemented during the last decades in the Indian Union, we conduct an econometric study of the determinants of economic growth in the neoclassical frame of the Solow model. One of the main novel aspects of our convergence analysis is the attention paid to the spatial pattern of growth across Indian states. Making use of spatial econometric tools, we control for two different kinds of spatial interaction: distance and neighbourhood. Our results suggest that the gap between poor and rich states has constantly increased during the 1980s and the 1990s. Specifically, we find that winners were those states that benefited the most from the recent process of reform and liberalization, thanks also to their geographical advantage and to the presence of a developed service sector. Losers were instead the landlocked and highly populated states with a predominant agricultural sector and a low level of innovation.

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[1] This paper was written with Prof. Tomasz Marek Mickievicz.
[2] This paper was written with Prof. Pasquale Scaramozzino and Michele Alessandrini.
[3] This paper was written with Francesco Sant'Angelo.

Chapter 1:

# Convergence across Russian Regions: a Spatial Econometrics Approach

## 1.1. Introduction

On December 25, 1991, the Russian communist period was officially over. This was indeed the day in which the last general secretary of the communist party Mikhail Gorbachev left the Kremlin, signing the definitive end of the central planned economy and the beginning of the transition to the market economy.

The Russian transition has been one of the most arduous that the group of former central planned economies has experienced. The sharp fall in output followed by a strong increase in unemployment, together with the explosion of inflation and the increase of government debt are some of the well known challenges Russia had to face during its first years of transition. The August 1998 financial crisis, however, represented a turning point, after which the Russian Federation started again to grow at a sustained pace.

The recovery, which started in 1999, has been mostly the result of the sharp increase in international hydrocarbons prices. Massive exports of oil and gas have restarted the engine of the Russian economy ensuring a sustained annual average rate of growth over 5% during the period 1999-2004. However, within the Russian Federation rates of growth have been highly heterogeneous across regions. Income dispersion has constantly increased over the recovery period, and, as a result , together with areas experiencing remarkably improved living standards there are still regions which appear to be trapped to poverty.

The group of regions that has experienced the highest rate of growth is the one within the Ural Federal District. This is however in line with the stylized fact of the oil export-led growth characterizing the post-financial-crisis recovery. The Tyumensk region, together with the two autonomous regions of Yamalo-Nenetskiy and Khanty-Mansiyskiy belonging to it, accounts for more than half of the total hydrocarbons production of the entire Russian Federation. The rapid pace of growth of these regions is one of the main sources of divergence in level of GDP per capita. The Ural area is indeed not only the leader in the rate of growth, but also region with the highest GDP per capita during the initial period 1999.

Besides the natural resources determinant and in strong connection with it, a key component which affects regional patterns of growth in a heterogeneous fashion is represented by the geographic location. Russia encompasses the largest territorial extension worldwide. Distances play a major role in terms of trade, knowledge spillovers and factor movements. The easiest way to highlight the

importance of geographic location for the economic performance, is to divide Russian territory into three distinct parts with respect to the Tyumensk area. All regions around this area have performed better than the others relative to their initial conditions in level of GDP per capita, which was already comparatively high. The western and the eastern parts share a common characteristic- for both of these areas regions experiencing higher rates of growth are the ones in their northern parts.

Accordingly, one of the areas which have been touched only marginally by the economic recovery is the Caucasus zone. This portion of territory includes the region which has registered the worst economic performance over the period considered, even if starting from the lowest initial level in GDP per capita, which is represented by the Republic of Ingushetia. This last one has probably suffered the most from the instability of the area induced by the Chechen war. Until 1994 Ingushetia and Chechnya constituted a single republic and after that year Ingushetia became formally independent, but effectively still very vulnerable to what happened beyond its border. Still belonging to this area but enjoying a much better performance, Dagestan Republic was able to switch its position in the distribution of income per capita across Russian regions reaching a higher percentile. However, it must be taken into account that Dagestan's major exports are oil and fuel.

The poorest area remains however the South Siberia, where a consistent part of the population lives under the poverty line. Regions such as the Republic of Altai and the Republic of Tyva appear completely locked to poverty and their inhabitants unable even to face costs barriers for migration towards more prosperous regions or countries.

The case of the capital Moscow deserves particular attention. Moscow has indeed exhibited a very high rate of growth, representing not only the administrative capital of the federation but also the financial capital and the centre of the main economic and political interests. However, the wealth is very unevenly distributed across inhabitants. The income per head has on average reached Western European standards but this is not representative for the greatest part of the population. Moscow has indeed registered the highest level of inequality in the federation-the Gini index registered by *Goskomstat* (Federal State Statistics Service) for the year 2003 has been 0.615. Such a level of inequality reflects the problem of an incomplete transition, which created an oligarchic structure of the society, leaving out of the economic transformation large parts of the population (especially elder generations). Nonetheless, in the recent years a newly-born middle class is strengthening in the urban contexts of the federation and especially in its capital, giving the perception of a more equal distribution of wealth across households.

Due to natural resources and the geographically concentrated industrial structure inherited from the Soviet era, Russia’s regions have performed heterogeneously depending on their position over the huge extension of the federal territory. Thus, many studies concerning regional patterns of growth

in Russia have assigned an important weight to the geographic factor through the introduction of control variables, such as distance from the capital Moscow, dummies for the European part, landlocked regions, permanent sea access and other geographic characteristics.

The main purpose of this paper is to explicitly relax the assumption of spatial independence across the observations. The use of a regional dataset implies consideration of the possibility that observations are not independent, as a result of the inter-connections between neighbouring regions (Anselin 1988). Many convergence studies based on the neoclassical framework (Solow 1956 and Swan 1956) rely on the assumption of closed economies. If this assumption can appropriately be applied to the datasets of countries, it instead appears more restrictive and strong for regions within a single country. Therefore, many regional studies can suffer from serious bias and inefficiency when it comes to making convergence coefficient estimates and to accounting for possible variables affecting growth rates.

In order to deal with this problem, the present paper examines the elements that enhance divergence in levels of per capita income across 77 regions of the Russian Federation. It applies cross-sectional and panel spatial econometric methods (lag and error models) to assess the impact of hydrocarbon supply and other variables relevant to regional economic growth. As will be examined in detail, oil and gas production constitute the main driving force behind divergence across regional growth patterns. The results obtained from both the cross section and the panel analysis confirm the importance of taking into account spatial interactions across regions. In particular, as one includes the spatial lag of the dependent variable in the model, the convergence coefficient assumes a lower magnitude. This seems to confirm the hypothesis that the spatial dimension cleans up the convergence coefficient from the already mentioned effects of trade, knowledge spillovers and factor movements, which become stronger among contiguous regions.

Section 2 begins to introduce the spatial econometric models to be used in addition to the traditional neoclassical convergence analysis tools; section 3 is devoted to the description of the dataset used for the empirical part of the study; section 4 illustrates results obtained by implementing an absolute convergence study and compares the results with its spatial counterparts. After providing evidence of divergence in levels of GDP per capita, Section 5 proceeds toward a conditional convergence approach, which, once again, is compared to the results obtained using spatial econometrics tools. Section 6 extends results to the panel analysis. Conclusions follow.

**1.2. The Model**

The spatial econometrics approach is increasingly being used in the study of convergence. The neoclassical approach to $\beta$-convergence (Barro and Sala-i-Martin 1991,1997, 2003) relies on the decreasing marginal productivity of capital assumption, implying that richer countries endowed with more capital tend to grow more slowly than poorer ones (absolute convergence). However, the pace of growth depends also on the distance from the country-specific steady state, i.e. the further a country finds itself from its own steady state, the faster its growth rate will be. Assuming a kind of reversed gravity law, specific factors must be considered that could potentially affect the convergence process (conditional convergence). Accordingly, the following two models have been implemented for convergence studies:

$$\frac{1}{T} \times \ln\left(\frac{y_{i,T}}{y_{i,0}}\right) = \alpha + \beta \ln(y_{i,0}) + \varepsilon_i \qquad (1)$$

$$\frac{1}{T} \times \ln\left(\frac{y_{i,T}}{y_{i,0}}\right) = \alpha + \beta \ln(y_{i,0}) + \gamma X_i^{'} + \varepsilon_i \qquad (2)$$

$\varepsilon \sim$ i.i.d$(0,\sigma^2 I_n)$

where $y_{i,t}$ is the GDP per capita of country or region i as of date t, T is the length of the period, $\alpha$ is a constant and $\beta$ is the convergence coefficient. Specification 2 also includes the matrix $X$ containing additional explanatory steady-state variables (physical or human capital, shares of production sectors to GDP, degree of political instability, ratio of public expenditures to GDP and other environmental variables) and the respective vector of associated coefficients γ. As coefficient β is negative and statistically significant, the cross section of countries or regions exhibits β-convergence.

However, both specifications 1 and 2 rely implicitly on the assumption that the observations are geographically independent. If this assumption can adapt well to cross-sections of countries, it becomes very strong for regional studies, for which it appears more plausible to assume spatial interactions among observations. In cases where spatial correlation is detected, OLS estimates turn out to be biased and thus more suitable spatial econometrics tools are required (Rey and Montoury 2000; Le Gallo, Ertur and Baoumont 2003; G. Arbia, R. Basile and G. Piras 2005).

Since the main purpose of this paper is to examine not only the convergence process in levels of GDP per capita but also to assess the impact of some environmental variables on economic growth, we will use the spatial counterparts of both absolute and conditional convergence models. For each specification we compare estimates obtained using spatial lag and spatial error models, which yielded four different benchmark models:

$$\frac{1}{T}\times\ln\left(\frac{y_{i,T}}{y_{i,0}}\right)=\alpha+\beta\ln(y_{i,0})+\rho W\left[\frac{1}{T}\times\ln\left(\frac{y_{i,T}}{y_{i,0}}\right)\right]+\varepsilon_i \qquad (1a)$$

$$\frac{1}{T}\times\ln\left(\frac{y_{i,T}}{y_{i,0}}\right)=\alpha+\beta\ln(y_{i,0})+\gamma X_i^{'}+\rho W\left[\frac{1}{T}\times\ln\left(\frac{y_{i,T}}{y_{i,0}}\right)\right]+\varepsilon_i \qquad (2a)$$

$$\varepsilon_i \sim \text{i.i.d.}\left(0,\sigma^2 I_n\right)$$

$$\frac{1}{T}\times\ln\left(\frac{y_{i,T}}{y_{i,0}}\right)=\alpha+\beta\ln(y_{i,0})+u_i \qquad (1b)$$

$$\frac{1}{T}\times\ln\left(\frac{y_{i,T}}{y_{i,0}}\right)=\alpha+\beta\ln(y_{i,0})+\gamma X_i^{'}+u_i \qquad (2b)$$

with $u_i=\lambda W u_i+\varepsilon_i$ and $\varepsilon_i \sim \text{i.i.d.}\left(0,\sigma^2 I_n\right)$

where specifications 1a and 2a represent the so called spatial lag model and 1b and 2b the spatial error model. W is a binary contiguity matrix expressing neighbouring regions by 0-1 values. The value 1 is assigned in the case that two regions have a common border of non-zero length, i.e. they

are considered first order contiguous; $\rho$ and $\lambda$ represent spatial autoregressive coefficients for the dependent variable and the error respectively, and ε is a vector of error terms considered independently and identically distributed.

Spatial lag and spatial error model represent two different approaches to address the issue of spatial heterogeneity. In the first specification, the parameter $\rho$ could be interpreted as a measure of spatial interaction across contiguous regions. In other words, the spatial lag model consents to quantify how the rate of growth in a region is affected by the one in its surrounding regions. However, the spatial lag is a stochastic regressor always correlated with ε through the spatial multiplier[4], which makes OLS estimates biased and imposes the use of more suitable Maximum Likelihood estimators. On the other hand, the coefficient $\lambda$ present in the spatial error model measures the degree of spatial autocorrelation between error terms of neighbouring regions. In this case, since the errors are non-spherical, OLS would provide inefficient estimators and Maximum Likelihood estimator is again preferable.

One possible drawback of the cross-sectional estimates could be represented by omitted variables and heterogeneity generated bias. The use of panel data allows to overcome this problem through the control of regional specific effect. It is then not surprising that growth studies have made an increasing use of fixed effect estimates to complete cross-sectional studies and to check for their robustness. The panel specification for the absolute convergence model takes the following form:

$$\ln\left(\frac{y_{i,T+k}}{y_{i,t}}\right) = \alpha_i + \beta \ln(y_{i,t}) + \varepsilon_{i,t} \qquad (3)$$

where $\ln\left(\frac{y_{i,T+k}}{y_{i,t}}\right)$ is the annual growth rate of income per head and $\ln(y_{i,t})$ is the log of per capita income at the beginning of each period. Peculiar to this model is the presence of the time invariant regional specific effect represented by the parameters $\alpha_i$. This set of parameters can be either assumed as fixed or random, generating the fixed effect and the random effect panel data models respectively. To our purposes, given that our observations are not randomly drawn but represent 77 regions composing the Russian federation, the use of the fixed-effect specification appear more suitable.

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[4] Notice that equation 1a can be rewritten as $\left[\frac{1}{T} \times \ln\left(\frac{y_{i,T}}{y_{i,0}}\right)\right] \times [I - \rho W] = \alpha + \beta \ln(y_{i,0}) + \varepsilon_i$ .

Starting from the traditional fixed-effect specification we can account for spatial dependence either introducing a time varying spatially lagged term of the dependent variable (fixed-effect spatial lag model), or leaving unchanged the systematic part of the model introducing the spatial component in the error term (fixed-effect spatial error model). Proceeding this way we obtain the two spatial counterparts of Equation 3:

$$\frac{1}{T}\times\ln\left(\frac{y_{i,T+k}}{y_{i,t}}\right)=\alpha_i+\beta\ln(y_{i,t})+\rho W\left[\frac{1}{T}\times\ln\left(\frac{y_{i,T}}{y_{i,t}}\right)\right]+\varepsilon_{i,t} \tag{3a}$$

$$\frac{1}{T}\times\ln\left(\frac{y_{i,T+k}}{y_{i,t}}\right)=\alpha_i+\beta\ln(y_{i,t})+u_{i,t}$$

$$u_{i,t}=\lambda W u_{i,t}+\varepsilon_{i,t} \tag{3b}$$

because the time invariant variables included in the cross-sectional conditional convergence analysis can not be included in the traditional fixed-effect panel data model, we will limit the panel data analysis just to the absolute convergence specification. However, being the spatial fixed effect counterpart a non-linear estimator which allows to account also for possible time invariant variables, we will display such results together with the traditional random-effect results in section 6b.

### 1.3. Data Description

The Russian Federation is characterized by a very complex administrative organization. The first major administrative division includes seven federal districts (Central Federal District, North West Federal District, South Federal District, Volga Federal District, Ural Federal District, Siberian Federal District, Far Eastern Federal District). Each federal district is sub-divided into a series of entities that can take one of three different forms: *oblast* (region, province), *kraj* (territory) and republic. Some regions are further sub-divided into entities classified as autonomous regions (*Avtonomnje Okrugi*).

The only reliable dataset for the Russian Federation is the one collected by Goskomstat providing data for 89 regions. This source however suffers from several limitations. Data are either completely missing or sporadically available for ten of the regions, which are, therefore, to be excluded from this analysis. Indeed, data on the Chechen Republic are entirely missing for all the

variables included in the analysis[5]. Data are also incomplete for nine autonomous regions-Nenetsia, Parma, Yamalo-Nenetskiy, Khanty-Mansiyskiy, Taymyr, Evenkia, Ust-Ord Buriatia, Aghin Buriatia and Koryakia-yet it must be pointed out that the majority of these are treated as parts of other Russian regions and, as a result, are included in the study, albeit at a more general level of aggregation.

The only autonomous okrug with a fully available dataset is the Chukotka region, which, nevertheless, represents an outlier for the majority of estimates performed and thus was eliminated as well. The last variable excluded from the analysis was the region of Kaliningrad, for reasons deriving directly from the spatial econometrics tools implemented, which require observations to have at least one border in common with another region. The Kaliningrad region is an enclave, which, by definition, is surrounded by other countries, representing an outpost of Russian territorial jurisdiction. In total, we end up with a dataset of 77 regions that also includes the cities of St. Petersburg and Moscow.

Remaining to be defined is the period over which the analysis can be implemented. In the case of Russia we would be tempted to use all the available data from the beginning of the transition period, but the GDP had slumped dramatically in the period leading up to the 1998 financial crisis, which was a turning point, and recovery only began in 1999. The non-monotonic growth path makes in principle critical the use of the complete series, reducing the available period after the structural break following the financial crisis of 1998.

As suggested by L. Solanko (2003), it would be more appropriate to break the series into two parts and implement separate convergence analyses for the two sub-periods. Nonetheless, data are not available for many variables over the period 1992 to1998 and the use of initial values in order to avoid possible problems of endogeneity among variables is crucial to the conditional convergence analysis.

It must also be remarked that the first period of transition is characterized by strong instability in all the principal economic indicators and, for this reason, it is difficult to be assumed as the basis for any kind of economic analysis. For all these reasons, the analysis covers the years from 1999 to 2004.

[5] The reason in this case is straightforward, as this region has been land of war since 1994.

### 1.4. Absolute convergence analysis

#### 1.4.1. Neoclassical Estimates of Absolute $\beta$-Convergence

Our empirical analysis starts with a neoclassical regression of absolute convergence across 77 Russian regions in the period 1999-2004. Hence, we consider equation 1 and we perform cross-sectional OLS estimates of unconditional $\beta$-convergence. If convergence holds, we would expect a negative and significant coefficient for the variable referring to the initial condition, considering as dependent variable the average growth rate over the period considered[6].

Illustrated in *Table 1* are the results of an OLS-based absolute β-convergence regression. The coefficient associated with the initial level of per capita income is negative but completely non-significant. It can thus be concluded that Russian regions experienced divergence during the recovery period that began in 1999. This is in contradiction with L. Solanko's detection (2003) of a significant annual convergence rate of approximately 3%. However, the number of observations used was 76 and the period considered was from 1992 to 2001, which confirms the difficulty of considering the entire series starting from 1992.

[6] The complete specification of unconditional convergence model is: $1/5*\ln(y_{i,2004}/y_{i,1999})=\alpha+\beta*\ln(y_{i,1999}))+\varepsilon_i$ where i=1,2,…,77

| Table 1: Absolute β-convergence of per-capita income in 77 Russian regions (1999-2004)-OLS Estimates (numbers in brackets refer to standard errors) | |
|---|---|
| **Constant** | .2905711** |
| | (.0808582) |
| **ln($y_{1999}$)** | -.0047008 |
| | (.0081331) |
| **Goodness of Fit** | |
| **$R^2$** | 0.0044 |
| **Observations** | 77 |
| **Log Likelihood** | 145.2157 |
| **Regression Diagnostic** | |
| **Breush-Pagan heteroschedasticity test** | 0.93 |
| | (0.3352) |
| **White heteroschedasticity test** | 22.19456 |
| | 0.000015 |
| **Moran's I spatial autocorrelation test** | 3.246 |
| | (0.001) |
| **LM test (error)** | 8.438 |
| | (0.004) |
| **LM test (lag)** | 8.424 |
| | (0.004) |
| **Jarque-Bera normality test** | 16.00371 |
| | (0.000335) |

* significant at 10%; ** significant at 5%; *** significant at 1%

*Table 1* also displays diagnostic statistics detecting possible misspecifications of the convergence regression. Two interesting considerations can be made: first, we cannot reject the null hypothesis

of homoskedasticity in a Breush-Pagan test on the residuals, while the White test exhibits opposite results; second, the Moran I test[7] significantly detects spatial autocorrelation, which is also confirmed by the two Lagrange Multiplier tests. Particular caution must, however, be used in interpreting these results because the Jarque-Bera test indicates that residuals are non-normally distributed.

At this stage we must address the problem of heteroskedasticity, considering spatial dependence as its only possible source (Anselin and Griffith 1988). We shall then proceed with our analysis by attempting to assess which of the two forms of spatial interaction is present, given that the two Lagrange Multipliers tests presented in Table 1 do not provide a clear answer to this question.

### 1.4.2. Spatial Econometrics Analysis: Spatial Lag vs. Spatial Error Model

OLS results appear to suffer from a misspecification induced by omitted spatial dependence terms, as well as other possible variables conditioning patterns of convergence (to these other variables we will address our attention in the next two sections). As already discussed, the assumption of spatial independence can often prove overly restrictive for cross-sectional studies conducted at a regional level. In this section we allow for spatial interdependence across observations, estimating models 1a and 1b for the spatial lag and spatial error models, respectively. Estimates are made through a maximum likelihood estimator in order to avoid the aforementioned problems of endogeneity and inefficiency in OLS estimates[8], which include a spatially lagged regressor among the explanatory variables.

*Table 2* displays the results implemented by considering possible interactions between observations across space. Both the coefficients of the spatial lag term and the spatial error term appear large in magnitude and very significant. The coefficients associated with the initial per capita income level remain not significant and decreased in absolute value. Though results are weakened by the low level of significance, the decreased convergence coefficient seems to confirm the presence of the positive effect induced by factor mobility, which becomes stronger among neighbouring regions.

Nonetheless, it still appears difficult to discriminate between the spatial lag and spatial error models. The only difference comes from the goodness of fit (variance ratio, squared correlation and Log likelihood, this latter component being negligible), which seems to work in favour of the spatial lag specification. To have a more accurate idea of which model fits better the dataset, it is

[7] Moran's I tests the null hypothesis of no spatial autocorrelation and has an asymptotic normal distribution.

[8] Estimates are performed using the spatial regression STATA package, elaborated by Maurizio Pisati of the Department of Sociology and Social Research at the University of Milano Bicocca .

necessary to investigate for other possible factors that exacerbate divergence across regions in order to better disentangle the effects of regions-specific characteristics and geographic interactions - in other words, it is necessary to move towards a conditional convergence analysis.

**Table 2: Absolute β-convergence of per-capita income in 77 Russian regions (1999-2004)-Spatial Lag and Spatial Error Model -Maximum Likelihood Estimates**
(numbers in brackets refer to standard errors)

| | SPATIAL LAG MODEL | SPATIAL ERROR MODEL |
|---|---|---|
| **Constant** | .1764252** | .2768313** |
| | (.08246) | (.0860501) |
| **ln($y_{1999}$)** | -.0034271 | -.0034848 |
| | (.007449) | (.0086516) |
| **Rho** | .4122768** | - |
| | (.1317984) | |
| **Lambda** | - | .4106439** |
| | | (.1319529) |
| **Goodness of Fit** | | |
| **Variance ratio** | 0.063 | 0.002 |
| **Squared corr.** | 0.172 | 0.004 |
| **Log likelihood** | 149.37195 | 149.34709 |
| **Observations** | 77 | 77 |
| **Diagnostic for the Spatial Coefficients** | | |
| **Wald test of rho/lambda=0:** | chi2(1) = 9.785 (0.002) | chi2(1) = 9.685 (0.002) |
| **Likelihood ratio test of rho/lambda=0:** | chi2(1) = 8.312 (0.004) | chi2(1) = 8.263 (0.004) |
| **Lagrange multiplier test of rho/lambda=0:** | chi2(1) = 8.424 (0.004) | chi2(1) = 8.438 (0.004) |

* significant at 10%; ** significant at 5%; *** significant at 1%

### 1.5. Conditional Convergence Analysis

#### 1.5.1. Possible Determinants of Divergence

Russian economic recovery in the period from 1999 to 2004 was mainly dependent on its hydrocarbon supplies. The price of crude oil and natural gas has risen sharply since 1999 and there is substantial evidence of a positive relationship between GDP growth in Russia and oil prices. Natural resources represent a prominent share of industrial production, 80% of which is accounted for by mining products, along with metals and precious stones. In 2003 oil and gas accounted for 49% of exports and constituted 17.1% of GDP (Gurvich 2004).

Growth driven by oil production is a phenomenon that not only characterizes Russian post-transitional recovery, but one which has historically been a primary source of economic prosperity for the Soviet Union since the 1917 revolution (J.I.Considine, W.A.Kerr and E.Elgar 2002). Oil production was already at a level of approximately 25 million barrels by 1920, and in the year 1987/88 it peaked at 4.5 billion barrels, making Russia the largest oil producer in the world. The early 1990s were characterized by a marked inefficiency in oil reserve management and Russia dropped back to third place among oil producers, behind Saudi Arabia and United States.

Natural resources represent a major portion of Russia's wealth and are very unevenly distributed across the Federation. As of 1999 nearly 58% of oil and gas production was concentrated in Tyumensk region, which, however, includes the two autonomous okrugs of Yamalo-Nenetskiy and Khanty-Mansiyskiy. The substantial heterogeneity in hydrocarbon supply is probably the first factor that exacerbates divergence among regions. In this context, geographic position takes on a very important strategic function: sharing borders with regions rich in natural resources can be considered a key asset in growth enhancement. It is not surprising then that the Tyumensk region had the highest GDP per capita throughout the period in question, nor that the regions surrounding it were among those enjoying the highest growth rates.

Other variables included in the growth regression of the conditional convergence analysis are the three most significant ones selected from a group of six. Accordingly, we consider the impact of variables such as international openness to trade (ratio of exports plus imports to GDP), R&D (share of the population employed in research and development) and FDI per capita. The three remaining variables, which appear only marginally related to growth, are: health services (numbers

of doctors per capita), crime (natural log of registered crimes out of 100,000 inhabitants) and fixed per capita investment[9].

Furthermore, a dummy is included for the Republic of Ingushetia. Ingushetia was the Russian region with the lowest growth rate in the period from 1999 to 2004, even though its initial conditions were very low, which is completely at odds with the neoclassical theory of convergence. This region was part of Chechnya until 1992 and is probably the one that suffered the most from the instability caused by the ongoing civil war. However, it would be improper to include Ingushetia in a war dummy, since at the moment it is separate from Chechnya. Ingushetia's economy is highly dependent on imports mainly coming out of CIS and has, by far, the highest share of imports to GDP of all the regions. The inclusion of a dummy for Ingushetia is thus important also for the sake of avoiding a series of disturbing and misleading effects on the international openness variable.

### 1.5.2. Neoclassical Conditional Convergence Analysis

The conditional convergence analysis is conducted using the specification 2 in section 2. This model is in line with the empirical growth literature, which regresses as dependent variable the average annual growth in per capita income on the initial level of per capita income and other explanatory variables assumed to be proxies of different steady states (Barro and Sala-i-Martin 2003).

*Table 3* summarizes the results of the conditional convergence implemented by using a simple OLS regression. As we consider explanatory variables as possible growth determinants, the coefficient attributed to the initial income conditions becomes very significant, its absolute size increases denoting a conditional β-convergence rate of about 3.6%. As expected, the most significant variable in conditioning growth is the share of oil and gas extraction to GDP per capita. However, the high impact emerging from the regression is mainly due to the contribution of Tyumensk[10]. Openness to trade played also an important role in enhancing growth in the five years considered in the analysis. The coefficient is positive and significant as long as we include the dummy for Ingushetia Republic in the regression. The share of employees in R&D has a positive but only marginally significant coefficient while regions able to attract more foreign capital are shown to perform better on average than the others. Openness to trade also played an important role in enhancing growth in the five years considered in the analysis. The coefficient is positive and

[9] All the figures concerning the above mentioned variables are taken from Goskomstat's Regiony Rossii 2004.
[10] The coefficient for the variable of oil and gas remains strong and significant also in a regression robust to the presence of outliers.

significant as long as we include the Ingushetia Republic dummy in the regression. The share of R&D employees has a positive but only marginally significant coefficient while regions able to attract more foreign capital displayed better performance on average than the others.

The goodness of fit undergoes a substantial increase, since now 34% of the variance of growth rates is fully explained by the variables included in the survey. Nonetheless, the regression diagnostic continues to detect the presence of heteroskedasticity and spatial autocorrelation across the observations. The Jarque-Bera statistics improve, but not sufficiently enough to state that residuals are distributed normally. Hence, test results are still to be considered with caution.

The Lagrange Multiplier spatial error and spatial lag term tests show a difference that is more marked than in the absolute convergence regression. Both spatial error and spatial lag appear to be present, but the LM-test for residual spatial lag dependence is clearly more significant. This leads to a closer consideration of the possibility that our observations have violated the independence assumption and that, therefore, the OLS estimates are biased and inefficient. However, we cannot entirely exclude the possibility of correlated error terms across space, which would produce inefficiency.

**Table 3: Conditional β-convergence of per-capita income in 77 Russian regions (1999-2004)- OLS Estimates**

(numbers in brackets refer to standard errors)

| | |
|---|---|
| **Constant** | .5871611*** |
| | (.0831493) |
| **ln($y_{1999}$)** | -.0365959*** |
| | (.0085534) |
| **Oil and Gas** | .0695902*** |
| | (.0158596) |
| **Openness to trade** | .514478** |
| | (.2016898) |
| **R&D** | .0012978* |
| | (.0007735) |
| **FDI per capita** | .0000393** |
| | (.000018) |
| **D_Ingushetia** | -.2612279*** |

| | |
|---|---|
| | (.0563711) |
| **Goodness of Fit** | |
| **$R^2$** | 0.3431 |
| **Observations** | 77 |
| **Log Likelihood** | 164.3892 |
| **Regression Diagnostic** | |
| **Breush-Pagan heteroschedasticity test** | 1.19<br>(0.2760) |
| **White heteroschedasticity test** | 44.41333<br>(0.002066) |
| **Moran's I spatial autocorrelation test** | 2.872<br>(0.004) |
| **LM test (error)** | 5.525<br>(0.019) |
| **LM test (lag)** | 7.400<br>(0.007) |
| **Jarque-Bera normality test** | 13.99277<br>(0.000315) |

* significant at 10%; ** significant at 5%; *** significant at 1%

### 1.5.3. Spatial Lag vs. Spatial Error Model for the Conditional Convergence Analysis

In this section we analyse and compare the results obtained with the spatial counterparts of the conditional convergence model. In other words we refer to specifications 2a and 2b of section 2.

Consideration must be given, first of all, to which of the two model specifications seems preferable. The addition of conditioning variables to the convergence regression has substantially improved the explicative power of the set of statistics necessary to discriminate between the two models. The goodness of fit of the lag model is admittedly better than the one obtained from the error model, both in terms of variance ratio and log likelihood. All the diagnostic tests on the spatial

coefficients indicate a higher robustness and significance of the lag coefficients. Furthermore, results obtained with the error model are much more in line with the OLS regression results.

All these results confirm that, for the cross-sectional analysis, the spatial lag model is more suitable to explaining the convergence process across Russian regions over the period considered. Noteworthy is the fact that this specification displays a lower convergence rate than the neoclassical conditional convergence model. The spatially lagged dependent variable captures positive geographic spill-over effects across regions sharing the same borders, which normal growth regressions tend to attribute to the initial conditions in per capita income. In other words, the neoclassical specification of conditional convergence tends to overestimate the β coefficient.

Interesting considerations can also be made for the coefficients attributed to the other explanatory variables included in the regression. The two variables relating to hydrocarbons and openness to trade remain both significant and positive in their impact on average growth. However, their contribution is somehow rescaled with the introduction of the spatial components. The share of R&D employees in the population becomes completely insignificant, though its level of significance was already low in the neoclassical specification of convergence. The ability to attract foreign investments is the only variable that undergoes an increase both in significance and in absolute value of the coefficient. The dummy for Ingushetia remains highly significant but with a lower coefficient in both the spatial specifications.

A further comment is required, i.e. that at this stage we are not considering other possible sources of heteroskedasticity related to causes different from spatial autocorrelation, since residual heteroskedasticity analysis is beyond the scope of this paper. Nevertheless, reported in the Appendix C are the results of estimates with robust standard errors for all the models treated and these results do not appear substantially different in their essence.

**Table 4: Conditional β-convergence of per-capita income in 77 Russian regions (1999-2004)-Spatial Lag and Spatial Error Model -Maximum Likelihood Estimates**

(numbers in brackets refer to standard errors)

| | SPATIAL LAG MODEL | SPATIAL ERROR MODEL |
|---|---|---|
| **Constant** | .4626981*** | .5852261*** |
| | (.0849754) | (.0870229) |
| **ln($y_{1999}$)** | -.0327028*** | -.036175*** |
| | (.0077305) | (.0089695) |
| **Oil and Gas** | .0637439*** | .0646275*** |
| | (.0142636) | (.0149055) |
| **Openness to trade** | .4491642** | .4074767** |
| | (.1810044) | (.178504) |
| **R&D** | .0008427 | .0009499 |
| | (.0007057) | (.0008011) |
| **FDI per capita** | .0000423 | .0000459*** |
| | (.0000161) *** | (.0000156) |
| **D_Ingushetia** | -.2393965*** | -.225246*** |
| | (.050748) | (.0503513) |
| **Rho** | .3606414** | - |
| | (.1206447) | |
| **Lambda** | - | .3970674** |
| | | (.1414236) |
| **Goodness of Fit** | | |
| **Variance ratio** | 0.434 | 0.340 |
| **Squared corr.** | 0.473 | 0.389 |
| **Log likelihood** | 168.33404 | 167.66079 |
| **Observations** | 77 | 77 |
| **Diagnostic for the Spatial Coefficients** | | |

| | | |
|---|---|---|
| **Wald test of rho/lambda=0:** | chi2(1) = 8.936 (0.003) | chi2(1) = 7.883 (0.005) |
| **Likelihood ratio test of rho/lambda=0:** | chi2(1) = 7.890 (0.005) | chi2(1) = 6.543 (0.011) |
| **Lagrange multiplier test of rho/lambda=0:** | chi2(1) = 7.400 (0.007) | chi2(1) = 5.525 (0.019) |

* significant at 10%; ** significant at 5%; *** significant at 1%

**1.6 Panel Data Convergence Analysis.**

**1.6.1. Traditional Panel Estimates**

In this section we report results of the traditional panel analysis as specified in equation 3 of section 2. *Table 5* displays results for three possible specification which are the absolute convergence with random and fixed effects and the conditional convergence with random effects. Using the random effect specification, one assumes that unobserved regional heterogeneity can be considered as uncorrelated with the included variables. If, on the other hand, unobserved component are present and are correlated with the explanatory variables, then our estimates would be biased and inconsistent and the use of fixed effects becomes preferable.

**Table 5: Absolute and conditional β-convergence of per-capita income in 77 Russian regions (1999-2004)-Random-effect and fixed-effect estimates.**
(numbers in brackets refer to standard errors)

| | **RE** | **FE** | **RE** |
|---|---|---|---|
| | **Absolute Convergence** | **Absolute Convergence** | **Conditional Convergence** |
| **Constant** | .4130138*** | 1.195535*** | .7875133 *** |
| | (.1139862) | (.2292122) | (.1405936) |
| **ln($y_{1999}$)** | -.0157698 | -.0887402*** | -.0533379*** |
| | (.0106127) | (.0213652) | (.013468) |
| **Oil and Gas** | - | - | .0909608** |

| | | | |
|---|---|---|---|
| | | | (.0287484) |
| **Openness to trade** | - | - | .7408402** |
| | | | (.3736254) |
| **R&D** | - | - | .0019138 |
| | | | (.0013936) |
| **FDI per capita** | - | - | .0000493 |
| | | | (.0000324) |
| **D_Ingushetia** | - | - | -.3422949** |
| | | | (.1058602) |
| **Goodness of Fit** | | | |
| **R2 / Variance ratio** | within=0.0532<br>between=0.0232<br>overall = 0.0057 | within = 0.0532<br>between = 0.0232<br>overall = 0.0057 | within = 0.0532<br>between = 0.2529<br>overall = 0.0595 |
| **Observations** | 385 | 385 | 385 |
| **corr(u_i, X)** | 0 (assumed) | -0.6976 | 0 (assumed) |
| **Hausman Test** | | | |
| chi2(1) | 15.49 | - | 4.56 |
| Prob>chi2 | 0.0001 | | 0.0328 |

* significant at 10%; ** significant at 5%; *** significant at 1%

The absolute convergence specification with random-effect estimator reports a coefficient associated with the initial level of per capita GDP which is completely insignificant. Considering instead the fixed-effect estimator one obtain a significant coefficient and very strong in magnitude (8.8%). Such a result is however not surprising because of the control of all possible heterogeneous effects through the use of this particular technique. In the lower part of the table we report results of an Hausman test comparing the two specifications of the absolute convergence estimates. This test allows us to discern which one is preferable. In this case it states unambiguously that the random effect, though more efficient, suffers from inconsistency and, hence, fixed-effect is preferable.

For what concerns estimates of the conditional convergence specification we will refer only to the random effect specification because of the time invariance of the control variables considered. Results are provided in the last column of *Table 5*. In this case the convergence coefficient is of the

order of 5.3% and significant at the 99% confidence level. Other variables which seem to have an important and significant impact on regional growth patterns are OIL & GAS and OPENNESS to trade. FDI per capita which is displayed as significant and having a positive impact in the cross-sectional specification, becomes now not significant. The coefficient for the Ingushetia dummy continues to be strong, negative and significant at the 99% level.

Furthermore, we compare results for the conditional convergence analysis with random-effect, to those obtained with the absolute convergence specification using the fixed-effect estimator. This allows us to investigate if the introduction of the new variables could be enough to control for regional heterogeneity. As it appears clearly from the statistics reported in *Table 5*, there is still the presence of unobserved individual heterogeneity which induces a bias in the estimate obtained with the random-effect technique.

### 1.6.2. Spatial Panel Estimates

In the present section, we compare results obtained using specification 3a and 3b described in section 2 for the panel spatial lag and panel spatial error model respectively. *Table 6* contains results referring both to the absolute and conditional convergence specification implemented controlling for time fixed effect. This allows us to directly compare the spatial counterpart with the traditional fixed, which as it appears from the previous section are preferable to the random-effect specification.

The first important finding, which confirms and strengthens cross-sectional results, is that the absolute convergence coefficient is decreased in magnitude as one controls for possible spatial dependence across observations. This finding is very clear for the spatial lag specification where the coefficient decreases from 8.8% of the traditional fixed-effect specification to 5.9% of the spatial lag one. However, also the spatial error model exhibit a convergence coefficient lightly lower than the one of simple fixed-effect. This differs from the cross-sectional results, in which the convergence coefficient experienced a lower magnitude only in the spatial lag model.

The spatial panel techniques allow for the presence of time invariant variables also when controlling for time fixed effects. We indeed report results of the conditional convergence in columns three and four for the spatial lag and the spatial error models respectively. These estimates are however not comparable with those obtained with the traditional fixed effect specification. Nonetheless, interesting considerations can be done. First, all variables affecting patterns of growth

are confirmed to play an important role with the same signs observed in previous estimates. Second, the level of significance is improved for all of them. Last but not least, variables which before where found marginally significant or completely not significant such as FDI per capita and R&D now turn out to be central in explaining heterogeneous performances in growth rates.

**Spatial Lag and Spatial Error Models with time fixed-effect**

(numbers in brackets refer to asymptotic standard errors)

| | Absolute Convergence | | Conditional Convergence | |
|---|---|---|---|---|
| | **Spatial Lag Model** | **Spatial Error Model** | **Spatial Lag Model** | **Spatial Error Model** |
| **Constant** | - | - | - | - |
| **ln($y_{1999}$)** | -0.059069*** | -0.071882*** | -0.100332*** | -0.116532*** |
| | (0.0089) | (0.0100) | (0.0101) | (0.0107) |
| **Oil and Gas** | - | - | 0.134219*** | 0.147271*** |
| | | | (0.0256) | (0.0264) |
| **Openness to trade** | - | - | 0.910013*** | 0.968385*** |
| | | | (0.3452) | (0.3494) |
| **R&D** | - | - | 0.003335*** | 0.004018*** |
| | | | (0.0013) | (0.0014) |
| **FDI per capita** | - | - | 0.000081*** | 0.000084*** |
| | | | (2.9625e-005) | (2.9736e-005) |
| **D_Ingushetia** | - | - | -0.425895*** | -0.440097*** |
| | | | (0.0963) | (0.0974) |
| **Rho** | 0.206981*** | - | 0.158982*** | - |
| | (0.0620) | | (0.0597) | |
| **Lambda** | - | 0.267943*** | | 0.215989*** |
| | | (0.0593) | | (0.0610) |
| **Goodness of Fit** | | | | |
| **R2 / Variance ratio** | 0.0661 | 0.0098 | 0.1706 | 0.1412 |
| **Rbar-squared** | 0.0513 | -0.0033 | 0.1461 | 0.1182 |
| **Sigma^2** | 0.0146 | 0.0155 | 0.0130 | 0.0134 |
| **Log likelihood** | 251.65607 | 252.78433 | 280.54627 | 281.41964 |
| **Observations** | 385 | 385 | 385 | 385 |
| **# of iterations** | 15 | 17 | 14 | 16 |

* significant at 10%; ** significant at 5%; *** significant at 1%

**1.7. Conclusions**

The main purpose of this paper has been to highlight the pattern of convergence/divergence in GDP per capita levels in the Russian Federation during the period from 1999 to 2004. Results obtained are made robust to possible spatial dependence or correlation across observations through the use of spatial econometrics tools. After having detected the presence of spatial effects in both the neoclassical models of absolute and conditional $\beta$-convergence, we proposed alternative estimates using the two different specifications of cross sectional spatial econometric models represented by the spatial lag and the spatial error models. Both the rho and lambda coefficients for the spatial lag and spatial error models respectively are found significant in all specifications. However, the spatial lag model seems to perform better, detecting a stronger presence of spatial dependence rather than spatial correlation across observations.

In order to strengthen cross-sectional results we also implement a panel data analysis. Absolute convergence is present only when controlling for heterogeneous regional characteristics through the use of traditional fixed-effect model. The introduction of the spatial component through a spatial lag in the dependent variable or the spatial lag in the error confirms and improves the cross-sectional findings.

Absolute convergence is absent, confirming the results obtained in previous studies on the Russian Federation. The $\beta$ convergence coefficient begins to be significant only after the introduction of other explanatory variables in addition to the initial level of per capita income. The neoclassical conditional convergence model is found to overestimate the absolute value of β with respect to its spatial lag model counterpart, strengthening the hypothesis of a bias due to spatial dependence in the data. When moving to the panel data analysis, the gap in convergence coefficient becomes more evident and slightly present also in the spatial error model.

Hydrocarbon production appears, among others, to be the leading factor in exacerbating divergence across regions. Natural resources, along with other variables such as openness to trade and FDI per capita, are found to play an important role. The R&D variable shows a low level of significance in neoclassical convergence regressions and becomes completely insignificant when we take into account the interaction of spatial effects across observations. However, as we move to the panel analysis accounting for spatial dependence across observation and for time fixed effects, R&D is confirmed to play an important and highly significant role in line with standard results in the growth literature.

This paper's intent has been to illustrate the importance of geographic components in studies on the Russian Federation. The spatial dimension appears to be non-negligible and plays a crucial role

in the convergence process through the channels of factor mobility, trade relationships and knowledge spill-over, the impact of which is much more evident in neighbouring regions.

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**APPENDIX A:** Measures of local spatial autocorrelation

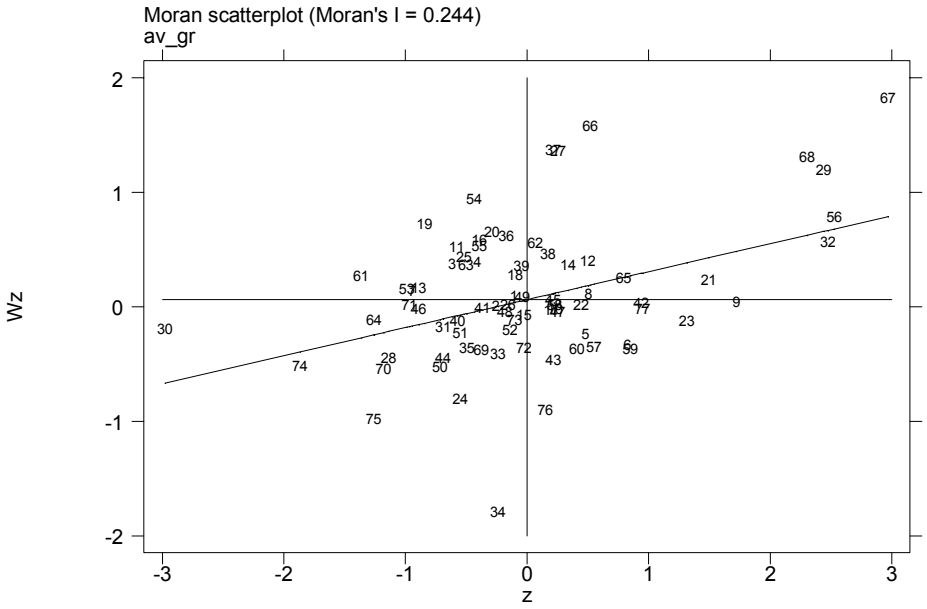
**Table 7: Moran's Ii (Average Growth 1999-2004)**

| | Region | Ii | E(Ii) | sd(Ii) | z | p-value* |
|---|---|---|---|---|---|---|
| 1 | Belgorod Region | -0.005 | -0.013 | 0.685 | 0.012 | 0.495 |
| 2 | Bryansk Region | 0.009 | -0.013 | 0.478 | 0.046 | 0.481 |
| 3 | Vladimir Region | -0.208 | -0.013 | 0.425 | -0.459 | 0.323 |
| 4 | Voronezh Region | -0.145 | -0.013 | 0.354 | -0.372 | 0.355 |
| 5 | Ivanovo Region | -0.135 | -0.013 | 0.478 | -0.255 | 0.399 |
| 6 | Kaluga Region | -0.315 | -0.013 | 0.425 | -0.711 | 0.238 |
| 7 | Kostroma Region | -0.094 | -0.013 | 0.425 | -0.19 | 0.425 |
| 8 | Kursk Region | 0.037 | -0.013 | 0.425 | 0.118 | 0.453 |
| 9 | Lipetsk Region | -0.011 | -0.013 | 0.385 | 0.005 | 0.498 |
| 10 | Moscow Region | -0.015 | -0.013 | 0.329 | -0.005 | 0.498 |
| 11 | Orel Region | -0.281 | -0.013 | 0.425 | -0.631 | 0.264 |
| 12 | Ryazan Region | 0.179 | -0.013 | 0.354 | 0.542 | 0.294 |
| 13 | Smolensk Region | -0.111 | -0.013 | 0.425 | -0.229 | 0.409 |
| 14 | Tambov Region | 0.112 | -0.013 | 0.425 | 0.294 | 0.384 |
| 15 | Tver Region | 0.003 | -0.013 | 0.385 | 0.042 | 0.483 |
| 16 | Tula Region | -0.215 | -0.013 | 0.425 | -0.474 | 0.318 |
| 17 | Yaroslavl Region | -0.015 | -0.013 | 0.385 | -0.004 | 0.498 |
| 18 | Moscow City | -0.023 | -0.013 | 0.976 | -0.01 | 0.496 |
| 19 | Karelia | -0.58 | -0.013 | 0.478 | -1.185 | 0.118 |
| 20 | Komia | -0.178 | -0.013 | 0.478 | -0.344 | 0.365 |
| 21 | Arkhangelsk Region | 0.286 | -0.013 | 0.425 | 0.704 | 0.241 |
| 22 | Vologda Region | -0.013 | -0.013 | 0.329 | 0.002 | 0.499 |
| 23 | Leningrad Region | -0.219 | -0.013 | 0.425 | -0.484 | 0.314 |
| 24 | Murmansk Region | 0.47 | -0.013 | 0.976 | 0.495 | 0.31 |
| 25 | Novgorod Region | -0.208 | -0.013 | 0.478 | -0.408 | 0.342 |
| 26 | Pskov Region | 0.005 | -0.013 | 0.478 | 0.038 | 0.485 |
| 27 | Saint Petersburg City | 0.342 | -0.013 | 0.976 | 0.364 | 0.358 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 28 | Adygeya | 0.569 | -0.013 | 0.976 | 0.596 | 0.276 |
| 29 | Daghestan | 2.844 | -0.013 | 0.685 | 4.169 | 0 |
| 30 | Ingushia | 0.72 | -0.013 | 0.976 | 0.752 | 0.226 |
| 31 | Kabard-Balkaria | 0.152 | -0.013 | 0.556 | 0.297 | 0.383 |
| 32 | Kalmykia | 1.307 | -0.013 | 0.425 | 3.105 | 0.001 |
| 33 | Karachay-Cherkessia | 0.11 | -0.013 | 0.556 | 0.221 | 0.412 |
| 34 | North Ossetia | 0.444 | -0.013 | 0.685 | 0.667 | 0.252 |
| 35 | Krasnodar Territori | 0.199 | -0.013 | 0.478 | 0.444 | 0.329 |
| 36 | Stavropol Territori | -0.1 | -0.013 | 0.385 | -0.224 | 0.411 |
| 37 | Astrakhan Region | 0.286 | -0.013 | 0.685 | 0.436 | 0.331 |
| 38 | Volgograd Region | 0.073 | -0.013 | 0.425 | 0.203 | 0.42 |
| 39 | Rostov Region | -0.015 | -0.013 | 0.425 | -0.004 | 0.499 |
| 40 | Bashkiria | 0.095 | -0.013 | 0.425 | 0.254 | 0.4 |
| 41 | Mariy-El | 0.019 | -0.013 | 0.478 | 0.067 | 0.473 |
| 42 | Mordovia | -0.012 | -0.013 | 0.425 | 0.004 | 0.499 |
| 43 | Tataria (or Tartary) | -0.112 | -0.013 | 0.329 | -0.301 | 0.382 |
| 44 | Udmurtia | 0.342 | -0.013 | 0.478 | 0.743 | 0.229 |
| 45 | Chuvashia | 0.002 | -0.013 | 0.425 | 0.036 | 0.485 |
| 46 | Kirov Region | 0.06 | -0.013 | 0.308 | 0.237 | 0.406 |
| 47 | Nizhniy Novgorod Region | -0.022 | -0.013 | 0.329 | -0.027 | 0.489 |
| 48 | Orenburg Region | 0.016 | -0.013 | 0.478 | 0.061 | 0.476 |
| 49 | Penza Region | -0.001 | -0.013 | 0.478 | 0.025 | 0.49 |
| 50 | Perm Region | 0.41 | -0.013 | 0.425 | 0.996 | 0.16 |
| 51 | Samara Region | 0.152 | -0.013 | 0.478 | 0.345 | 0.365 |
| 52 | Saratov Region | 0.035 | -0.013 | 0.385 | 0.124 | 0.451 |
| 53 | Ulyanovsk Region | -0.108 | -0.013 | 0.385 | -0.247 | 0.402 |
| 54 | Kurgan Region | -0.394 | -0.013 | 0.556 | -0.686 | 0.246 |
| 55 | Sverdlovsk Region | -0.191 | -0.013 | 0.478 | -0.372 | 0.355 |
| 56 | Tyumen Region | 1.881 | -0.013 | 0.354 | 5.344 | 0 |
| 57 | Chelyabinsk Region | -0.22 | -0.013 | 0.478 | -0.433 | 0.332 |
| 58 | Altay Republic | -0.005 | -0.013 | 0.478 | 0.016 | 0.494 |
| 59 | Buriatia | -0.351 | -0.013 | 0.556 | -0.608 | 0.272 |
| 60 | Tuva | -0.17 | -0.013 | 0.425 | -0.369 | 0.356 |
| 61 | Khakassia | -0.32 | -0.013 | 0.478 | -0.642 | 0.261 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 62 | Altay Territori | 0.035 | -0.013 | 0.556 | 0.087 | 0.465 |
| 63 | Krasnoyarsk Territori | -0.163 | -0.013 | 0.354 | -0.422 | 0.336 |
| 64 | Irkutsk Region | 0.204 | -0.013 | 0.425 | 0.511 | 0.305 |
| 65 | Kemerovo Region | 0.168 | -0.013 | 0.385 | 0.469 | 0.32 |
| 66 | Novosibirsk Region | 0.808 | -0.013 | 0.478 | 1.716 | 0.043 |
| 67 | Omsk Region | 5.366 | -0.013 | 0.556 | 9.674 | 0 |
| 68 | Tomsk Region | 2.943 | -0.013 | 0.425 | 6.955 | 0 |
| 69 | Chita Region | 0.161 | -0.013 | 0.478 | 0.363 | 0.358 |
| 70 | Yakutia | 0.703 | -0.013 | 0.385 | 1.858 | 0.032 |
| 71 | Maritime Territori | 0.027 | -0.013 | 0.976 | 0.041 | 0.484 |
| 72 | Khabarovsk Territori | 0.011 | -0.013 | 0.385 | 0.063 | 0.475 |
| 73 | Amur Region | 0.016 | -0.013 | 0.478 | 0.061 | 0.476 |
| 74 | Kamchatka Region | 1.054 | -0.013 | 0.685 | 1.557 | 0.06 |
| 75 | Magadan Region | 1.311 | -0.013 | 0.556 | 2.382 | 0.009 |
| 76 | Sakhalin Region | -0.143 | -0.013 | 0.685 | -0.189 | 0.425 |
| 77 | Jewish Autonomous Region | -0.061 | -0.013 | 0.685 | -0.07 | 0.472 |

**Figure 1:**



**APPENDIX B:** Definition of Variables and Descriptive Statistics

| Variables | Definition of variables | Mean | St.Dev. |
|---|---|---|---|
| | | | |
| **Average Growth (1999-2004)** | Difference in natural logs between the final and the initial value of per capita income of the sample period. The difference is divided by the number of periods, which is five in our analysis. | .2439012 | .0370273 |
| **$\ln(y_{1999})$** | Natural log of per capita income in 1999 expressed in roubles. | 9.928166 | .5245283 |
| **Oil and Gas (1999)** | Ratio of extracted oil and gas expressed in thousands of tons to per capita income, both referring to year 1999. | .0733565 | .2491162 |
| **Openness to trade (1999)** | Sum of total export and total import both within and outside of the CIS, all weighted by the regional GDP. | .0224945 | .0311809 |
| **R&D (1999)** | Share of employees in research and development in the total population. | 3.394136 | 4.839115 |
| **FDI per capita (1999)** | Ratio of the amount of incoming FDI (expressed in US dollars) to | 60.63902 | 203.4259 |

| | | | |
|---|---|---|---|
| | the population. | | |
| **Health Services (1999)** | Number of doctors out of 1000 inhabitants obtained as the ratio of general medical practitioners to the population. | 4.434739 | .9822847 |
| **Crime (1999)** | Natural log of number of crimes perpetrated out of 100000 inhabitants. | 7.581 | .3674174 |
| **Fixed per capita Investment (1999)** | Natural log of fixed per capita investment as provided by *Goskomstat*. | 8.033061 | .6429101 |

**APPENDIX C:** Estimates with robust standard errors.

**Table 8: Conditional β-convergence of per-capita income in 77 Russian regions (1999-2004)**

(numbers in brackets refer to standard errors)

| | GLS | SPATIAL LAG | SPATIAL ERROR |
|---|---|---|---|
| **Constant** | .5871611*** | .4626981*** | .5852261*** |
| | (.0833918) | (.073248) | (.0838599) |
| **Initial Conditions** | -.0365959*** | -.0327028*** | -.036175*** |
| | (.0084365) | (.0068094 ) | (.0085052) |
| **Oil and Gas** | .0695902*** | .0637439*** | .0646275*** |
| | (.0155713) | (.0121373) | (.0136208) |
| **Openness to trade** | .514478*** | .4491642*** | .4074767*** |
| | (.1306624) | (.1336178) | (.1397637) |
| **R&D** | .0012978** | .0008427* | .0009499 |
| | (.0005393) | (.0005062) | (.0006232) |
| **FDI per capita** | .0000393* | .0000423** | .0000459** |
| | (.000022) | (.0000177) | (.0000215) |
| **D_Ingushetia** | -.2612279*** | -.2393965*** | -.225246*** |
| | (.0272987) | (.0288216) | (.031317) |
| **Rho** | - | .3606414** | - |
| | - | (.1476823) | |
| **Lambda** | | - | .3970674** |
| | | | (.1875813) |
| **Goodness of Fit** | | | |
| **R2 / Variance ratio** | 0.3950 | 0.434 | 0.340 |
| **Squared corr.** | - | 0.473 | 0.389 |
| **Log likelihood** | - | 168.33404 | 167.66079 |
| **Observations** | 77 | 77 | 77 |

| Diagnostic for the Spatial Coefficients | | | |
|---|---|---|---|
| **Wald test of rho/lambda=0:** | - | chi2(1) = 5.963 (0.015) | chi2(1) = 4.481 (0.034) |
| **Lagrange multiplier test of rho/lambda=0:** | - | chi2(1) = 7.400 (0.007) | chi2(1) = 5.525 (0.019) |

* significant at 10%; ** significant at 5%; *** significant at 1%

**APPENDIX D:** Estimates with robust standard errors obtained adding all the explanatory variables.

**Table 9: Conditional β-convergence of per-capita income in 77 Russian regions (1999-2004)**

(numbers in brackets refer to standard errors)

| | GLS | SPATIAL LAG | SPATIAL ERROR |
|---|---|---|---|
| **Constant** | .5448928*** | .442487*** | .6018475*** |
| | (.1261058) | (.0995164) | (.1377157) |
| **Initial Conditions** | -.0354156** | -.0290916** | -.0347382** |
| | (.0156383) | (.0140769) | (.014849) |
| **Oil and Gas** | .0721856*** | .0664372*** | .0650719*** |
| | (.0166628) | (.0127286) | (.013697) |
| **Openness to trade** | .5149044*** | .4542725*** | 4106888*** |
| | (.1409182) | (.1371747) | (.1357645) |
| **R&D** | .0012162* | .0006935 | .000663 |
| | (.0006991) | (.0007155) | (.0008647) |
| **FDI per capita** | .0000419 | .0000464** | .0000479* |
| | (.0000264) | (.0000208) | (.0000251) |
| **D_Ingushetia** | -.2453186*** | -.2299396*** | -.2237862*** |
| | (.0427802) | (.0400559) | (.0376915) |
| **Health Services** | .0029145 | .0026673 | .0018967 |
| | (.0041111) | (.0036077) | (.0033) |
| **Crime** | .0064835 | .0022729 | -.0034133 |
| | (.0145508) | (.0122841) | (.0147323) |
| **Fixed per capita Investment** | -.003961 | -.0055671 | -.0015911 |
| | (.0138629) | (.0121983) | (.0121492) |
| **Rho** | - | .3599804** | - |
| | | (.1450109) | |
| **Lambda** | - | - | .4028359** |
| | | | (.1952522) |

| Goodness of Fit | | | |
|---|---|---|---|
| **R2 / Variance ratio** | 0.4025 | 0.440 | 0.339 |
| **Squared corr.** | - | 0.478 | 0.387 |
| **Log likelihood** | - | 168.75578 | 167.84786 |
| **Observations** | 77 | 77 | 77 |
| **Diagnostic for the Spatial Coefficients** | | | |
| **Wald test of rho/lambda=0:** | - | chi2(1) = 6.162 (0.013) | chi2(1) = 4.257 (0.039) |
| **Lagrange multiplier test of rho/lambda=0:** | - | chi2(1) = 7.178 (0.007) | chi2(1) = 4.239 (0.040) |

* significant at 10%; ** significant at 5%; *** significant at 1%

Chapter 2:

# Oil and Gas: a Blessing for Few
# Hydrocarbons and Within-Region Inequality in Russia

## 2.1. Introduction

Since 1999, growth in Russian GDP has gone along with continued high levels of inequality[11]. Russia is now characterised by more dramatic social differences than most of the other transition economies. The inequality has stabilised at a level comparable to some Latin American countries, like Venezuela, African economies like Nigeria and Middle Eastern ones like Iran (all net oil exporters). Among possible causal factors, hydrocarbons revenues seem to have played an important role in affecting the heterogeneity of incomes across the population. Oil and gas, as with other natural resources, represent an easily appropriable and excludible source of wealth. The privileged, who have gained access to oil and gas revenues, have enjoyed a disproportionate increase in their living standards enlarging the gap with the rest of the population.

In this paper, we investigate the hypothesis that the natural resources led growth could be associated not only with the widening in differences of living standards across Russian regions but also within regions. In particular, we demonstrate that regions rich in oil are characterised by a higher level of income inequality. We also discuss possible geographic, economic and political explanations for this phenomenon.

We argue that some theoretical intuitions drawn from cross-country comparisons may also apply to the cross-regional comparisons, given the geographical, economic and social diversity and the federal character of Russia.[12] In particular, some of the theoretical explanations linking the presence of subsoil hydrocarbons with differences in within-country inequality may also apply to differences in within-region inequality. In the economic literature, the role of oil, gas, and - more generally - of natural resources has been broadly discussed as having an ambiguous impact on economic prosperity, development and long run growth (Corden and Neary 1982, Eastwood and Venables 1982, Corden 1984, Sachs and Warner 2001, Davis and Tilton, 2005). While, positive effects of natural resource endowment on growth are likely (Sala-i-Martin *et al.*, 2004), this may not always be the case, and more importantly the gains from growth may not be equally shared. There are

[11] Over the period 2000-2006 the income-based Gini index had remained at the level of 0.40-0.41 (Source: *Goskomstat*). See also: Svedberg *et al.* (2006).

[12] Popov (2001) makes a similar argument.

several factors that may be inducing the latter phenomenon. Boom in the hydrocarbons sector may affect other sectors negatively, including the shift of investments towards traded natural resources and non-tradable sectors preventing diversified economic growth.[13] High concentration of rents in the hydrocarbons sector, where not accompanied by efficient institutions and government policy, may result in a skewed distribution of income (Davis and Tilton, 2005). In addition, natural resource abundance may stimulate rent-seeking behaviour that, together with highly concentrated bureaucratic power, induces corruption in the economy and hence, lowers the quality of institutions (Leite and Weidmann 1999; Davis and Tilton, 2005). The latter may enhance income inequality via its negative effect on entrepreneurial entry (see also Gylfason and Zoega, 2002). This strand of the literature demonstrates that focus on the link between natural resource endowment and inequality is important not only because the question itself matters, but also because inequality may have implications for other aspects of economic development, including poverty.[14]

In this paper we are interested to which degree some of these country level phenomena are applicable to the regions of Russia. We focus on the local effects of oil and gas, that is, we investigate if their presence results in a less equal income distribution within the Russian regions. We achieve this aim by an empirical analysis. We establish that the link between oil and inequality as seen in the cross-country perspective has its counterpart in a similar link detectable in Russia.

Economic transition in Russia has caused shifts in allocation of wealth and resources both across regions (*between*) and among their population (*within*). The former aspect of inequality was investigated by Fedorov (2002), Bradshaw and Vartapetov (2003) and others. Here, we focus on the determinants of the latter; that is, on the factors affecting *within*-region dimension of inequality. We divide the regional populations into five income quintiles and use the shares in income of each of those in our analysis. We find oil and gas play a prominent and significant role in the process of wealth redistribution and accumulation *within* the Russian regions.

The next section summarises briefly some relevant literature concerning the issues of inequality and hydrocarbons resources, mainly referring to the Russian post-transitional experience. In section 3 we move towards the econometric analysis and present the dataset used, variables included and results obtained. Concluding remarks follow.

[13] Also, given the international volatility of resource prices, the resource-based economy may ultimately be likely to suffer seriously in the case of price shocks (Sachs and Warner 2001).

[14] On the impact of inequality on poverty in Russia, in regional perspective, see Kolenikov and Shorrocks (2005). However, due to data limitations their estimations are based on one year only.

## 2.2 Literature Review and Motivation: Hydrocarbons and Inequality in Russia

Oil and gas played an important part in Russian economic performance far before the beginning of transition. Hydrocarbons were a primary source of economic prosperity for the Soviet Union since the 1917 revolution. Oil production was already at a level of approximately 25 million barrels by 1920, and in the year 1987/88 it peaked at 4.5 billion barrels, making the USSR the largest oil producer in the world. However, the early 1990s were characterised by a marked inefficiency in oil management in Russia. As a result of that, but also of the separation of some oil-producing former Soviet republics, production dropped back to third place among oil producers, behind Saudi Arabia and United States (Considine and Kerr, 2002).

It is more controversial to assess how much inequality there was in the Soviet era and to what extent it was linked to the natural resource endowment. Generally, during Soviet times, a very small share of incomes was derived from rents officially, as private property of natural resources and capital was almost non-existent (Milanovic, 1998). On the one hand, this limited the impact of natural resources on inequality, on the other, the lack of private ownership rights facilitated enormous transfers of wealth from the extracting regions to the population centres in the European part of the country. Nevertheless, during the Soviet period, the production of oil and gas shifted gradually both to the East and to the South, and this has been seen as having a positive impact on equalisation of average income between the Soviet republics (but not necessary within-republics), via new investment and improved technical and social infrastructure (Liebowitz, 1987; see also: Nechemias, 1980)[15]. Commander *et al.* (1999) argue that Russia entered the transition period already with a significantly high level of inequality, which has then further increased as a result of the wealth transfers realised through the privatisation (especially in the energy sector), the changes in government expenditure and the growth in earnings dispersion.

### *2.2.1 Between-region disparities in oil and gas production and between-region income inequality in Russia*

Below, we present location (Figure 1) and basic economic and social data (Table 1) of the sixteen Russian regions with the largest oil and gas production per head. These are concentrated in the central part of Russia, along both sides of the Ural, with some extension towards the south, and

[15] However, it is far from obvious to which extent the shift towards the East (i.e. Siberia and the Russian Far East) represented an efficient development path. The Soviet Union's central planners did not have effective optimisation criteria at their disposal. The geographical allocation of investment was disputed during the Soviet period (see Schiffer, 1985).

Sakhalin in the Far East. Western Russia has no hydrocarbons. The largest producers per head are the Nenetskiy AO and the sub-regions of the Tyumen Oblast (Yamalo-Nenetskiy AO Khanty-Mansiyskiy AO). It is also in the Tyumen oblast, where we find the highest values of the indicators of inequality.

Figure 1. Regions of Russia with large production of oil and gas per head


Table 1. Regions of Russia with largest oil and gas production per head. Basic socio-economic data

| | oil & gas production (tonnes) / population (2000-2005 average) | share of income: richest 20% population (2000-2005 average) | share of income: poorest 20% population (2000-2005 average) | total population in thousands (2002 census) | population as % of Russia (2002 census) | % share of services in production (2000-2005 average) | % sha agric in produc (2000- avera | |
|---|---|---|---|---|---|---|---|---|
| Astrakhanskaya Obl. | 3.9 | 41.7% | 7.0% | 1,005 | 0.69% | 41.7% | 5.5 | |
| Evenkiyskiy AO | 3.1 | 44.3% | 6.1% | 18 | 0.01% | 78.9% | 5.1 | |
| Khanty-Mansiyskiy | 155.0 | 48.8% | 4.9% | 1,433 | 0.99% | 23.4% | 0.3 | |
| Nenetskiy AO | 176.2 | 46.8% | 5.4% | 41 | 0.03% | 15.5% | 0.9 | |
| Orenburgskaya Obl. | 3.8 | 40.3% | 7.5% | 2,180 | 1.50% | 48.8% | 5.5 | |
| Permskaya Oblast | 6.9 | 46.1% | 5.6% | 1,449 | 1.00% | 46.8% | 14.7 | |
| Resp. Bashkortostan | 2.8 | 44.3% | 6.1% | 4,104 | 2.83% | 34.1% | 10.9 | |
| Respublika Komi | 9.6 | 47.1% | 5.3% | 1,019 | 0.70% | 42.4% | 1.8 | |
| Respublika Tatarstan | 7.7 | 44.4% | 6.1% | 3,779 | 2.60% | 32.6% | 8.0 | |
| Sakhalinskaya Oblast | 6.5 | 42.5% | 6.7% | 547 | 0.38% | 36.9% | 2.9 | |
| Samarskaya Oblast | 3.4 | 48.3% | 5.0% | 3,240 | 2.23% | 39.0% | 5.9 | |
| Tomskaya Oblast | 10.7 | 43.1% | 6.5% | 1,046 | 0.72% | 41.7% | 4.8 | |
| Tyumenskaya Oblast | 81.8 | 50.1% | 4.5% | 1,325 | 0.91% | 27.2% | 0.9 | |
| Udmurtskaya Resp. | 5.5 | 38.9% | 8.0% | 1,570 | 1.08% | 35.0% | 8.6 | |
| Volgogradskaya Obl. | 1.3 | 41.2% | 7.1% | 2,699 | 1.86% | 38.9% | 14.2 | |
| Yamalo-Nenetskiy AO | 85.7 | 47.7% | 5.2% | 507 | 0.35% | 23.7% | 0.1 | |

Notes: Tomskaya Oblast refers to the area excluding the autonomous regions, apart from the data of shares of agriculture and services, which relate to all its teritory. On the 1st of December 2005, Permskaya Oblast was merged with Komi-Permyak Autonomous Okrug into Permskyi Krai. The data refer to the period before the merger. Source: Goskomstat Rosii.

Below, we discuss briefly some of the key contributions on between-region inequality and polarisation in Russia[16]. Next, we will turn to the *within* dimension concerning the heterogeneous impact of oil and gas on income groups within the regions that has not been explored much in the existing literature.

Regional inequality across Russian regions may be explained using an array of factors. Fedorov (2002) considers polarisation between Western and Eastern regions, specificity of the national republics and ethnic Russian *oblasts*, urbanised versus rural areas, and finally the role of export-orientation and economic openness of the regions. Using a dataset provided by Goskomstat Rosii, Fedorov (2002) carries a multidimensional analysis of inequality across Russian regions over the period 1990-99. He confirms a continuous increase of inequality over the period 1991-96. After 1996 the upward inequality trend became less steep and even reversed slightly in 1998. He

[16] For the discussion on the differences between the concepts of regional inequality and regional polarisation, see Fedorov (2002).

establishes that between-regional differences were increasing due to the fact that both urbanised and exporter regions have grown faster with comparison to closed rural areas.

However, given the structure of Russian exports, exporting is the dimension which is closely related to the natural resource endowment. The share of hydrocarbons in total exports started from a level of 32% in 1998 and constantly increased until 49.2% in 2003 (Gurvich, 2004). Its share in merchandise exports reached over 60% in 2006 (Hanson, 2007; see also OECD, 2006). Also the ratio of hydrocarbons exports to GDP has been very high: it ranged from 10.4% in 1998 to 17.1% in 2003. These figures are probably underestimated. The World Bank (2004) states that a consistent part of gas and oil revenues are misattributed to wholesale trade in order to escape taxation (see also: Bradshaw 2006).

Bradshaw and Vartapetov (2003) confirm that inequality assumes a strong geographic connotation, with poorly performing regions facing problems in ensuring minimum living standards. Such a situation could be alleviated by the intervention of the central state administration smoothing the differences. However, state intervention has been insufficient. The allocation of federal assistance funds had not been based on clear principles, which has left the doors open to the development of a system of lobbying activities. In particular, the introduction of the Fund for Financial Support of the Regions (FFSR) in the mid 1990s has indeed failed to alleviate the spatial dimension of inequality. During the 1990s, the lack of economic and social logic in fiscal transfers between the federal government and the regions resulted from the chaotic nature of *ad hoc* compromises between the federal government and the regions, with national republics (such as Tatarstan, Bashkortostan and Yakutia) being the key winners (Hahn, 2005; Yenikeyeff, 2008; see also: Treisman, 1998).

Using data provided by Goskomstat Rosii, Bradshaw and Vartapetov (2003) find for 1990-2001 that standard deviation in income falls sharply as one drops from the sample the city of Moscow, the region of Tyumen (richest regions) and Ingushetia (the poorest). Similarly, for consumption, there was an increase in inequality led by prosperous regions such as Moscow, Samara, Tyumen, Perm and Lipetsk. In contrast, the spatial distribution of social and infrastructure indicators remained more equal.

Starting with the discussion of Russia in terms of the resource-based economy, Bradshaw (2006) discusses the role of the production of oil and gas and its regional aspects. Already during the Soviet era, natural resource rents were diverted from the oil and gas producing regions towards the European part of the Soviet Union. The implementation of this redistribution process was realised through the imposition of low prices on natural capital and high prices on machine capital. The hard currency inflows generated by the trade of natural resources were concentrated in the capital Moscow, to be then allocated strategically to the military industrial complex and to be used in

exchange for grain and western technologies to compensate for the failings of domestic agriculture and innovation processes correspondingly.

On the other hand, in the producing regions, the development of oil and gas was implemented "at the expense of socio-economic infrastructure, not to speak of the environment, resulting in an extremely lopsided regional economy" (Glatter, 2003, p.402).

More importantly, a similar mechanism of regional relocation of rents can be detected after the transition, both by use of transfer pricing and through the taxation mechanism, where revenues are not channelled back to the regions of origin: "the transfers involved are far more significant than any equalization payments through the fiscal federal structure" (Bradshaw, 2006, p. 742).

Gaddy and Ickes (2005) explore the network of informal rent sharing, which developed around the hydrocarbons production and trade. There is no exact information on the true value of hydrocarbon rents and on the way they are redistributed. Both during the Soviet Era and after the transition to market economy, one of the main characteristics of value distribution has been non-transparency. An important channel of informal rent sharing is represented by corruption, which is taking the form of a tax system parallel to the official one (Dininio and Orttung, 2004). Furthermore, the constant and wide gap between the domestic and international price of natural resources has contributed to the development of a complex price subsidies system. Companies also distort extraction cost to avoid formal taxation and use various forms of transfer prices to channel wealth away from where it could be taxed at source. Until the early 2000s, the oil companies were also highly effective in influencing the tax law for their benefit (Fortescue, 2006; Yenikeyeff, 2008).

Spatial dimension plays a major role in enhancing inequality in Russia. In general, among transition economies, the territorial extension has been found to be positively correlated with the level of inequality (Gerry and Mickiewicz 2008; see also Bradshaw 2006): the larger the extension of a country, the higher the impact of regionally specific effects on income distribution. Thus, it is not surprising that in Russia the regional patterns of GDP per capita diverged dramatically from the beginning of the 1990s (see also: Buccellato 2007).

It is interesting to compare the nature of regional disparities in Russia with the other two major emerging economies: India and China. As Russia, they have experienced a significant dose of central-planning, where the role of communist parties or left-orientated governments has been dominant. All the three countries were characterised by significant disparities between regions. One common feature has been the increasing gap dividing rural and urban areas. In India and China, a great divide has been also arising between landlocked regions and coastal ones. The latter adapted better to the increased exposure to international markets. For Russia, as already discussed, natural

resources have played a more significant role, affecting divergence in terms of both economic performance across regions and the disparities in income.

*2.2.2 Within-region inequality: rent seeking and political corruption*

We now turn to the within-region dimension of inequality paying particular attention to the role of oil and gas. According to Svedberg *et al.* (2006), within-region inequality dominates the between-regional dimension. Marginally high or low average indicators computed at regional level can indeed mask significant inequality on the lower level. For instance, the Tyumen region, which hosts much of the oil and gas administration has a low average poverty rate (12%). Yet, in its Southern, rural part, the poverty rate increases to 18% (UNDP, 2007).

As discussed above, in the cross-country context, it has been found that large endowments of natural resources tend to go hand in hand with rent seeking behaviour. The natural resource sector is usually protected by huge barriers to entry, which leads to the strong position of producers. Where formal institutions are weak, strong, hydrocarbon-related rents may fuel corruption (Dininio and Orttung, 2004). In the Russian case, in the hydrocarbons-rich regions, the power struggle was typically limited to a few key players within the local oligarchy, and after the initial wave of democratisation in the early 1990s, the position of members of the political elite was increasingly defined by their relation to productive assets in the hydrocarbons sector (Glatter, 2003)[17]. As documented by Glatter (2003) for the Tyumen Regional Duma, in 1990-1993, 23% of seats were taken by employees and workers, 23% by professionals, 29% by economic leaders and middle level managers and 10% by administration officials. By 1997-2001, the representation of the first two groups fell to zero, and the representation of "economic leaders" increased to 40% and of local administration to 20%. Representation of big business in local institutions was also typical for other regions (Sakwa, 2008). In the context of our discussion, the key issue is that the concentrated wealth generated in the oil and gas sector made it particularly easy for the businessmen to form the 'mutual hostages' structures with the local government (Dininio and Ortung, 2004).

The recentralisation programme implemented in Russia in the early 2000s led to the loss of influence of regional leaders on the federal level, but in exchange, those local politico-economic elites that were co-opted by Kremlin consolidated their position on the local level. The emerging model is described by Dininio and Orttung (2004) as a situation of "mutual hostages". "As Russian critics of the [recentralisation] plan have pointed out, only partly facetiously, there are not enough KGB operatives from 1980s Leningrad to fill 89 top posts. (…) Putin has ceded to regional leaders

[17] A well-publicised case of an oil oligarch who became a governor of one of the Russian regions (Chukotka) was that of Mr. Roman Abramovich, who was also one of the two controlling shareholders of Sibneft (with Boris Berezovsky), before the sale of the company to Gazprom in September 2005.

much leeway to run their regions as they see fit." (Slider, 2005, pp. 183-184; see also Yenikeyeff, 2008). As noticed by Svedberg *et al.* (2006), "Since September 2004 new gubernatorial appointments were made in 35 regions. In most cases, the governors have been appointed for a third or even fourth term, meaning that the new scheme has allowed them to bypass the two-term limit that existed under the previous system." (*Ibid.*, p. 10). This pattern implies more stability in the local political and economic structures of power and their increasingly undemocratic character.

To summarise the argument, we posit that local economic structures dominated by oil rents endowed business elites with enormous resources for forming the 'mutual hostages' structures with the state administration and for the corresponding distortion of democratic processes. That enabled big business to protect its economic interests. The only change in 2000s was that the economic power was typically consolidated at the hands of federal corporate groups at cost of the regional corporate groups, many of which lost their autonomy (Yenikeyeff, 2008). Evidence provided by Svedberg *et al.* (2006) shows that Khanty-Mansi Autonomous Okrug, which is the main centre of the Russian oil industry, takes fourth place on the regional list of state capture[18], and the neighbouring Tyumen, where the oil and gas administration offices are located, takes the first place. Tyumen moved up to the top of the list in 2003, from a relatively low position in the mid 1990s.

One of the key channels through which state capture (or, rather: 'mutual hostages' structure) affects income distribution is through its detrimental effects on entry and entrepreneurship. Preferential treatment of big players crowds out new entrants while (i) entrepreneurship could play a critical role as an escape route out of low-income/poverty traps (Berkovitz and Jackson, 2006) and (ii) demand for labour and wage competition from new big entrants could have positive effects on incomes. Low entry coupled with a trend towards recentralisation is also very typical for the oil and gas industry in 2000s (Kryukov and Tokarev, 2007). The negative association between entry and state capture for Russian regions is documented by Yakovlev and Zhuravskaya (2004).

Obviously, the local political elites dominated by big business may opt for social support programmes, as the latter are beneficial from the point of view of social and political stability, yet only to the extent to which their share in hydrocarbons rents remains protected.

In general, income distribution is shaped by the way the political process modifies primary economic distribution. Accordingly, the link between authoritarian political structures and skewed income distribution documented for transition economies in cross country perspective by Gerry and Mickiewicz (2008) is likely to be found in the regional Russian perspective.

[18] State capture is measured by preferential treatment obtained by firms and defined by "tax breaks, investment credits, subsidies, subsidised loans, loans with a regional budget guarantee, official delays in tax payments, subsidised licencing free grants of state property, and special "open economic zone" status. (Svedberg *et al.*, 2006). The results discussed here are based on an earlier empirical study by Yakovlev and Zhuravskaya (2004).

*2.2.3 Within-region inequality: labour market effects*

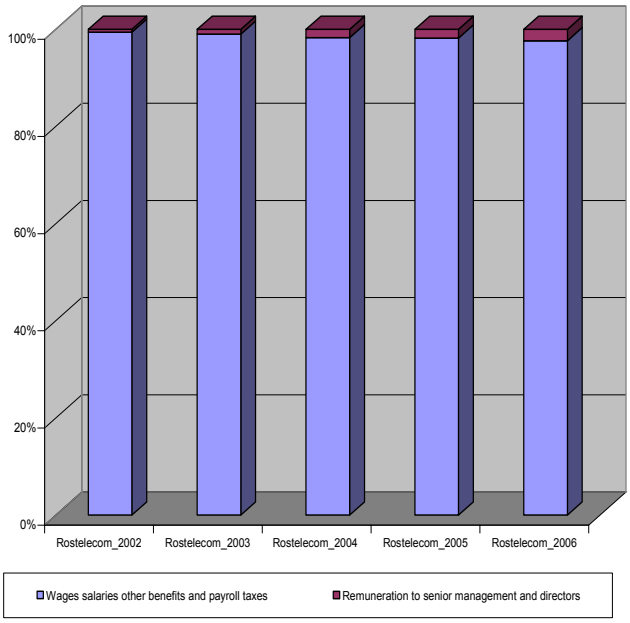
The political argument is directly connected with the economic one. Russia has inherited a very concentrated industrial apparatus from the Soviet period. A difficult, protracted and painful process of reallocation of labour from obsolete industries to more profitable new ones followed. In particular, the Stalinist central planned system implied the allocation of blue collar workers and engineers to isolated mono-structural regions. In sharp contrast, the transition brought more dynamism into the metropolitan areas. Crucially, the scarce inter-regional labour mobility coupled with regional protectionist policies impeded a natural process of arbitrage, making the regional factor endowment predominant in shaping wage disparities. The competition in some sectors remained inadequate, especially where privatisation was not coupled with new entry, and the local structures were dominated by one sector, hydrocarbons in particular (see for ex. Glatter, 2003). This situation led to forms of local monopsony in the labour market (Svedberg *et al.*, 2006; Bignebat 2003). With respect to oil and gas industry, the process of concentration and increasing entry barriers led to the spatial segmentation of production, where different companies enjoyed quasi-monopolies within their respective territory of operation in 2000s (Kryukov and Tokarev, 2007). Oil companies enjoy a monopsony position in recruiting labour, placing workers in a condition of dependency and weak bargaining power. This is an important factor which helps to explain why the local population is not sharing in the rents generated by the extracting industry as a result of direct, primary income distribution. In general, monopsony power leads to the persistence of wage differentials representing an important component of inequality (Bignebat 2003; Kislitsyna, 2003). The factors contributing to this situation include low mobility of labour within the Russian borders, due to the high cost of migration (including administrative costs), lack of financial liquidity amongst workers and underdeveloped housing markets. In addition, local large firms provide fringe benefits and in-kind payments, which can "be explained as an attachment strategy of firms: paying wages in non-monetary forms makes it hard for workers to raise the cash needed for leaving the firm/region." (Svedberg *et al.*, 2006, p.14-15). Low mobility affects also high-skilled workers, and as a result, the regional labour market may exhibit characteristics of the segmented labour markets, where the shortage of high-skilled workers coupled with the abundance of low-skilled workers leads to wage inequality (Svedberg *et al.*, 2006). Given the technological characteristics of the oil and gas industry and its organisational structures that emerged from the process of consolidation in 2000s, local outcomes of this nature are likely.

To shed some further light on the monopsony issue we carry out a comparison between two of the most important Russian companies - Gazprom and Rostelecom, both operating in sectors characterised by large rents (hydrocarbons and telecommunication). Controlling more than 60% of Russian gas reserves and 84.7% of the national gas production, Gazprom alone now accounts for 10.6% of Russian GNP (source: Gazprom in figures 2002-2006 and Gazprom's Financial Reports). Rostelecom is the country's leading fixed-line telecommunications company, one of the biggest telecommunication companies in Russia and operates nationwide with a network reaching approximately 200,000 kilometres in length (Source: Rostelecom's Financial Reports).

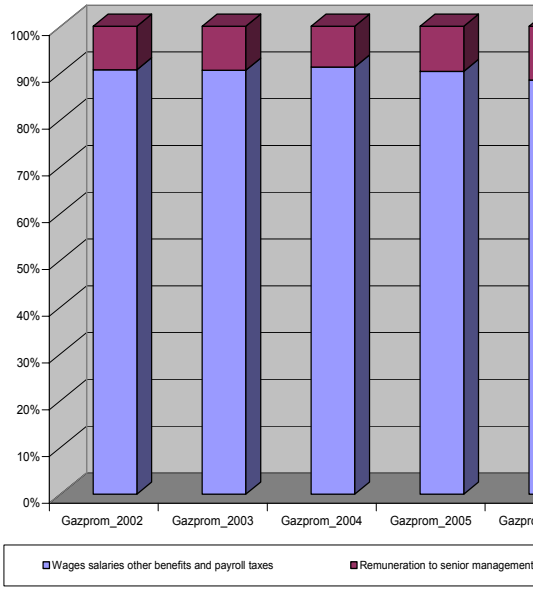
Based on the Financial Statements of the two companies over the period 2002-2006, it clearly emerges that the share of profits in value-added as compared with the corresponding share of wages is much higher in Gazprom. In the case of Rostelecom the wages cost is always higher than the amount of gross profits. That amounts to a striking inter-sectoral difference, which is further reinforced by the differences in the internal composition of wage expenses, i.e. the share of the remuneration of senior management and directors in the total amount of wages and salaries. Over the period 2002-2006 this share ranged from 0.6 to around 2.4% for Rostelecom and from around 10% to approximately 13% for Gazprom, implying a much lower share of workers in comparison with the management apparatus in value-added in the hydrocarbons sector (*Figure 2*).

**Figure 2.2**: The remuneration of senior management and directors compared with wages and salaries of wor Rostelecom and Gasprom over the period 2002-2006.

**ROSTELECOM**



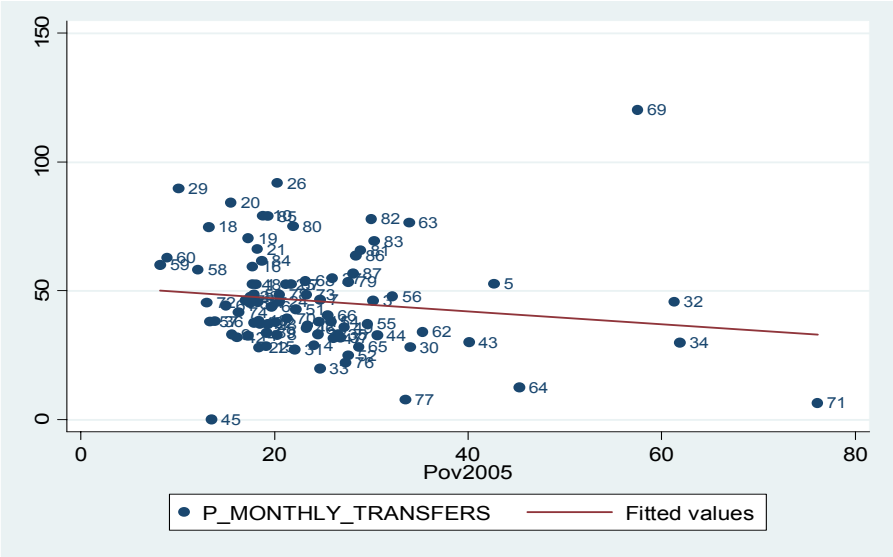

**GAZPROM**



*2.2.4 Redistribution*

Disparities generated in the labour market could be offset by redistribution through the tax system and government expenditure. Due to the general increase of international hydrocarbon prices (until 2008 reversal), revenues from custom duties have strongly increased in early 2000s and as a result their share in total revenues went up from 7.1% in 1999 to 15.8% in 2004 (Ellman, 2006). While oil price growth amounted to 191% between 2002 and 2007, the corresponding growth in custom duty was 982%. A parallel growth in tax on mineral production between 2002 and 2007 amounted to 353% (Kryukov and Tokarev, 2007). Hydrocarbon revenues have been targeted for the creation of the so-called stabilisation fund, set up to prevent a new financial crisis similar to the one experienced in August 1998. In January 2006 the stabilisation fund reached the amount of 1,459.1 billion Rubles (Ellman, 2006, p.41-43). DeBardeleben (2003) considers the balance of financial flows between the regions and the centre (i.e., difference between the total amount of tax revenues collected in the regions and expenditure of the regional government) in four different regions (Stavropol'skii *krai,* Orlovskaya *oblast*, Nizhegorodskaya *oblast* and Khanty-Mansiiskii *avtonomnyi okrug)* over the period 1996-1998. The region of Khanty-Mansiiskii *avtonomnyi okrug*, which is the main centre of the Russian oil industry, contributes far more to the federal budget than the three remaining regions. However, despite the relevant amount of tax revenues generated by the hydrocarbons sector, it is not clear how they are redistributed, especially across regions. Performing a simple OLS regression with robust standard errors on a cross-section of 87 Russian regions for the year 2005, we find an insignificant negative (sic!) relation between average monthly transfers to households per capita and percentage of people living under the poverty threshold (*Figure 3)*. Due to a possible problem of endogeneity deriving from the use of two variables that are simultaneously determined, we also computed a Bonferroni-adjusted index of correlation, which does not imply any direction of causality. We found an insignificant negative correlation in the order of -0.1431. These results seem to suggest that the fiscal transfers are not targeting the poor, and are therefore not decisive in reducing the gap separating the richest and the poorest, which is likely to be the highest in hydrocarbons producing regions due to the economic and political factors discussed above.

**Figure 2.3:** Per capita average monthly transfers in roubles and percentage of people living below the poverty threshold in 87 Russian regions in 2005.




| REGION | ID | REGION | ID | REGION | ID |
|---|---|---|---|---|---|
| Belgorodskaya Oblast | 1 | Respublika Adygeya | 30 | Khanty-Mansiyskiy AO | 59 |
| Bryanskaya Oblast | 2 | Respublika Dagestan | 31 | Yamalo-Nenetskiy AO | 60 |
| Vladimirskaya Oblast | 3 | Respublika Ingushetia | 32 | Chelyabinskaya Oblast | 61 |
| Voronezhskaya Oblast | 4 | Kabardino-Balkarskaya Respublika | 33 | Respublika Altay | 62 |
| Ivanovskaya Oblast | 5 | Respublika Kalmykia | 34 | Respublika Buryatia | 63 |
| Kaluzhskaya Oblast | 6 | Karachaevo-Cherkesskaya Respublika | 35 | Respublika Tyva | 64 |
| Kostromskaya Oblast | 7 | Respublika Severnaya Osetija-Alaniya | 36 | Respublika Khakasia | 65 |
| Kurskaya Oblast | 8 | Krasnodarskiy krai | 37 | Altayskiy Krai | 66 |
| Lipetskaya Oblast | 9 | Stavropolskiy krai | 38 | Krasnoyarskiy krai | 67 |
| Moskovskaya Oblast | 10 | Astrakhanskaya Oblast | 39 | Taymyrskiy AO | 68 |
| Orlovskaya Oblast | 11 | Volgogradskaya Oblast | 40 | Evenkiyskiy AO | 69 |
| Ryazanskaya Oblast | 12 | Rostovskaya Oblast | 41 | Irkutskaya oblast | 70 |
| Smolenskaya Oblast | 13 | Respublika Bashkortostan | 42 | Ust-Ordynskiy Burjatskiy AO | 71 |
| Tambovskaya Oblast | 14 | Respublika Mari El | 43 | Kemerovskaya Oblast | 72 |
| Tverskaya Oblast | 15 | Respublika Mordovia | 44 | Novosibirskaya Oblast | 73 |
| Tulskaya Oblast | 16 | Respublika Tatarstan | 45 | Omskaya Oblast | 74 |
| Yaroslavskaya Oblast | 17 | Udmurtskaya Respublika | 46 | Tomskaya Oblast | 75 |
| G. Moskva | 18 | Chuvashskaya Respublika | 47 | Chitinskaya Oblast | 76 |
| Respublika Karelia | 19 | Kirovskaya Oblast | 48 | Aginskiy Burjatskiy AO | 77 |
| Respublika Komi | 20 | Nizhegorodskaja Oblast | 49 | Respublika Sakha (Jakutija) | 78 |
| Arkhangelskaya Oblast | 21 | Orenburgskaya Oblast | 50 | Primorskiy krai | 79 |
| Nenetskiy AO | 22 | Penzenskaya Oblast | 51 | Khabarovskiy krai | 80 |
| Vologodskaya Oblast | 23 | Permskaya Oblast | 52 | Amurskaya Oblast | 81 |
| Kaliningradskaya Oblast | 24 | Samarskaya Oblast | 53 | Kamchatskaya oblast | 82 |
| Leningradskaya Oblast | 25 | Saratovskaya Oblast | 54 | Koryakskiy AO | 83 |
| Murmanskaya Oblast | 26 | Ulyanovskaya Oblast | 55 | Magadanskaya Oblast | 84 |
| Novgorodskaya Oblast | 27 | Kurganskaya Oblast | 56 | Sakhalinskaya Oblast | 85 |
| Pskovskaya Oblast | 28 | Sverdlovskaya Oblast | 57 | Evreyskaya avtomnaya oblast | 86 |
| G. Sankt-Peterburg | 29 | Tyumenskaya Oblast | 58 | Chukotskiy Avtonom. Okrug | 87 |

*Source: The graph is based on data as provided by the Russian State Statistic Service ( Goskomstat).*

To summarise, we posit the following. The distribution of income both between and within regions is strongly affected by the rents generated by hydrocarbons extraction and trade, which are supported by the economic and political structures. The distributional effects are partly driven by the technological characteristics of the extraction processes, where capital-intensive firms create pockets of limited numbers of well-paid jobs. However, they are enhanced by the monopsonistic position of these companies against both the bulk of their workers and the local labour force, from which the employees are drawn. The strong local position of these companies is protected by the dominant position of the key big business players in the political structures.

In addition, a significant part of resource rents is transferred away from the extraction region, leaving less to be shared directly with local communities. This would not be a problem *per se*, and could even be welcomed if the federal spending would compensate for the local distortions. However, existing evidence demonstrates that while the government share in the oil and gas rents has been on the increase, it has not been accompanied by well-targeted social transfers, which would return back to the communities some of the wealth from the actual physical resources in their neighbourhood. Taking all these factors together, we can explain the paradox, which is that the regions where the oil and gas resources are located, are also characterised by the more extreme social contrasts.

The literature provides *cross-country* evidence that oil and gas endowment is associated with an increase in inequality, and the same factor may play a significant role in the *cross-regional* perspective for Russia. Accordingly, we intend to establish empirically if, in addition to the *between* regions dimension of hydrocarbons-driven inequality in Russia, we also see an increase in inequality within the regions of extraction. In the next section we introduce the empirical methodology we wish to implement for this purpose.

## 2.3 Hydrocarbons and Inequality in the Russian Regions

### *2.3.1 Measuring Inequality between and within Russian Regions*

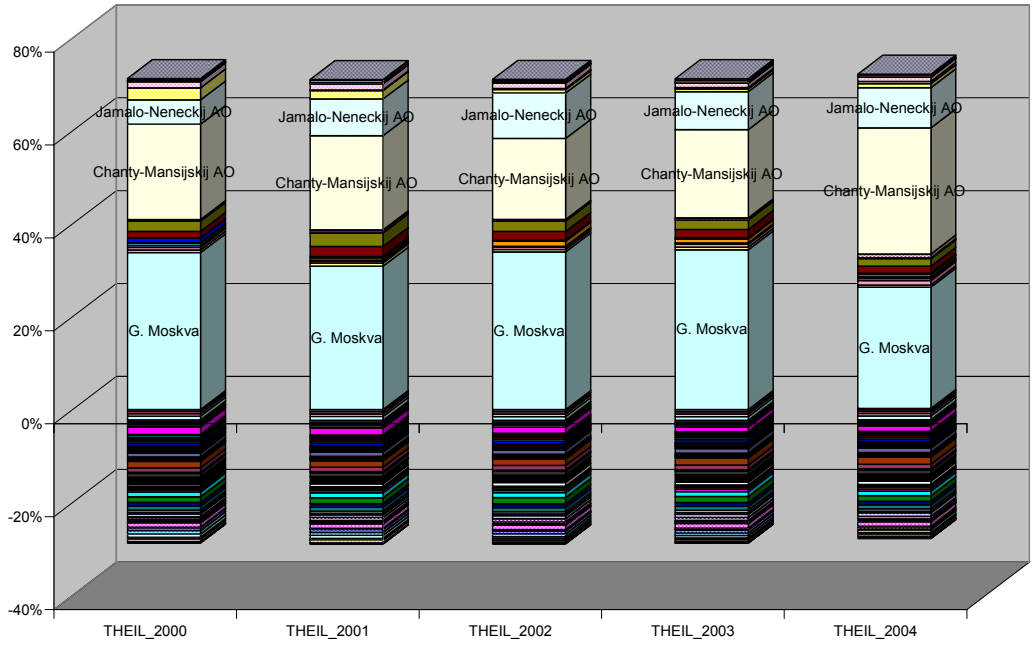
In most of the studies, inequality refers to disparities in income. However, inequality is a multidimensional concept. It includes a much wider range of aspects, such as wealth, consumption, access to health, education and other public services. Any empirical analysis is always limited by the availability of data and in our study we use the broadest and the most used concept of inequality, that is the one concerning divergence in income levels. Relying on it, we first construct a bi-dimensional measure of inequality *between* and *within* regions to demonstrate the role played by

oil and gas. For the *between*-dimension, we use the Theil Statistic, which is being increasingly used in economic literature. Theil's T statistic can be easily constructed with just two bits of information, that in the case of Russian federation are: the share of each region's population in the Russian population and the ratio of the average regional income to the average income in the country. Correspondingly, the formula is:

$$Theil = \frac{\mathrm{Re}gion\_Population}{Total\_Population} \times \frac{Average\_\mathrm{Re}gional\_Income}{Average\_Country\_Income} \times \ln\left(\frac{Average\_\mathrm{Re}gional\_Income}{Average\_National\_Income}\right)$$

Theil's measure of inequality we derived is capturing the spatial component of inequality, stating how large is the contribution of each individual region to the total amount of the *between* inequality in the Russian federation. *Figure 4* below shows how important is the role played by the west Siberian region (two autonomous administrative entities of Khanty-Mansiskiy Autounomous Okrug and Yamalo-Nenetskiy Autonomous Okrug, both in the Tyumen Oblast), which is the one from where approximately one half of the total amount of hydrocarbons id produced in Russia. The administrative organisation of the Tyumen area is deeply connected with the distribution of natural resources and with the economic structure of their production. The Khanty-Mansiskiy Autounomous Okrug represents the main centre of the Russian Oil industry, while Yamalo-Nenetskiy Autonomous Okrug is the area where the highest share of gas production takes place. The remaining portion of the territory is the 'proper' Tyumenskaya Oblast, mainly consisting of the town Tyumen (the capital) and playing the complementary role of onward hydrocarbons transmission and strategic basis of oil and gas administration offices (Glatter 2003). Galbraith *et al.* (2004) argues that the prominent contribution of the Tyumen region to Russia between inequality reflects the advantage of export oriented areas with respect to other regions in attracting strong currency revenues and of urban entities with developed systems of services. However, we demonstrate below that also when controlling for the general amount of exports and the share of services, oil and gas still continue to play an important role in explaining inequality.

**Figure 4: Theil's T statistic computed for 87 Russian regions over the period 1995, 2000-2004.**




*2.3.2 Within-Region Inequality: Data, Model Specifications and Methodology*

Goskomstat Rossii provides data at the regional level for the annual share of income acquired by each quintile of the population. Data is available for the period 2000-2004. Our measure of inequality can now be computed alternatively either as a share acquired by the top (bottom) quintile or the difference between the share of income owned by the richest quintile of the population in each of the regions and the shares of the remaining four quintiles of the population, separately considered.

Over the period 2000-2004 we can rely on a complete balanced panel for 86 Russian regions. To avoid double counting, where both regional level data and sub-regional level data (like autonomous regions) are reported, we use the residuals obtained from subtracting the reported lower level units from the higher level regional units (for example, we use a residual obtained by deducting the figures for Khanty-Mansiyskiy Autounomous Okrug and Jamalo Nenetskiy Autonomous Okrug from the figures provided for the whole Tyumen region, instead of using the latter).We also have to drop the Chechen Republic because of the lack of data. The other observation dropped from the

analysis is the capital Moscow, which is an outlier and presents specific characteristics not comparable with the rest of the Russian Federation.[19]

One further remark is necessary. The quality of data at a regional level raises questions and hence the reliability of regional datasets is often considered problematic. In the case of the Russian federation, Goskomstat Rossii provides data as collected by the local authorities. Solanko (2003) raises doubts about the precision of regional data collection in Russia. Yemtsov (2003) also raises the possibility of inconsistencies between national and regional methodologies of producing data, preventing for example disaggregation of national data into regional components. However, the methodology used by *Goskomstat* has constantly improved and has been standardised getting closer to international benchmark over time and the period we consider is relatively recent. While recognising the possible drawbacks in using *Goskomstat* data, it is the only complete dataset that can be used for our purposes.

As dependent variables we first use the percentage shares of income for each regional population quintile. In particular, the share of income of the richest 20% is an important indicator of income distribution (see for instance Reuveny and Li, 2003). As our robustness check, we also utilise the differences between the percentage shares of highest income quintile of the population and the corresponding shares of the lower quintiles. All are computed at the regional level, that is, they capture the within-region inequality.

We consider the production of oil and gas tonnes standardised by the number of people living in each region **(P_OIL&GAS)** as the core variable for our analysis.

To reinforce our results, we introduce some control variables that have been shown in the economic literature as playing an important role in affecting both income growth and distribution across individuals and spatial entities. We end up by considering five control variables.

First, differences in wages and hence income inequality can be explained as a consequence of the heterogeneous distribution of human capital across people and space. Lukyanova (2006) concludes that inequality becomes more severe where the share of low educated workers is higher. However, the relation between inequality and investment in human capital is documented as ambiguous in the economic literature (Aghion *et al.*, 1999). Despite the uncertainty related to the long-run impact of investment in human capital on inequality, the link between these two variables has been widely

[19] We run our models both without Moscow and with Moscow dummy variable. There is little difference between the results. All are available on request. Consistent with the previous discussion, it is important to note that Moscow remains a major beneficiary of hydrocarbons-related rents.

discussed and we introduce the corresponding variable using a proxy (**ENROLMENT_RATE**). This variable represents the percentage of children enrolled in primary school out of the population of children at the corresponding age. The primary education variable has been used in empirical studies on determinants of economic development (eg. Barro, 1991; Alesina and Rodrik, 1994).

Furthermore, we introduce two other control variables. The first is the logarithm of the regional GDP **(l_RGDP)**. After Kuznets (1955; 1963) revealed the inverted U-shaped relationship between the two variables, there have been numerous studies testing the link. If the debate about the direction by which one variable affects the other remains still open, the emerging consensus in the recent literature is that income and inequality seem to vary endogenously (Lundberg and Squire, 2003). In order to alleviate the problem we will make use of the System GMM econometric methodology, which has been proved to be robust with respect to the endogeneity across variables.

In addition, we control the natural logarithm of total exports denominated in dollars **(l_EXPORT)**. After the 1998 financial crises and the consequent strong devaluation of the rouble, the increase in inequality has been affected by the polarisation between regions with access to international trade and those that relied on internal market economic activities. The gap has increased especially when goods have been produced at costs denominated in roubles and sold at hard currency prices on the international markets. Galbraith *et al.* (2004) conclude that relative income rose more sharply in regions enjoying hard currency export earnings. However, this increase in income was not necessarily shared evenly by the local population, which could lead to higher *within* inequality. Controlling for exports is important, otherwise testing of our hypothesis on the impact of hydrocarbons could suffer from omission of a related variable creating a bias.
The results of Fedorov (2002) suggest that together with export, the degree of urbanisation has played a very important role in enhancing disparities across regions. Such a result can be explained by the existence of more developed services sectors in regions with higher degrees of urbanisation. People working in new privatised services usually benefit from higher wages with respect to workers in manufacturing industries and especially to low-skilled labour in rural areas. Hence, we include also the share of services in total production **(SERV)** as our explanatory variable for the *within*-region dimension of inequality.

Summarising, we end up with the following two main specifications. The first one is where the dependent variables are the shares in regional income of the five quintiles of the regional

population. The second relates to the differences between the shares of the top quintile and the lower ones. That is we have:

$$Qunt\_j-th = \alpha_1 + \alpha_2(\text{P\_OIL \& GAS})_{i,t} + \alpha_3(\text{ENROLMENT\_RATE})_{i,t} + \alpha_4(\text{l\_RGDP})_{i,t} + \alpha_5(\text{l\_}EXPORT)_{i,t} + \alpha_6(\text{S}ERV)_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$Dist\_5-th\_j-th = \alpha_1 + \alpha_2(\text{P\_OIL \& GAS})_{i,t} + \alpha_3(\text{ENROLMENT\_RATE})_{i,t} + \alpha_4(\text{l\_RGDP})_{i,t} + \alpha_5(\text{l\_}EXPORT)_{i,t} + \alpha_6(\text{S}ERV)_{i,t} + \varepsilon_{i,t} \quad (2)$$

where *i* represents a region, *t* a year and *j* the income quintile (1-5). *Qunt_j-th* relates to the share in income of the corresponding quintile. $Dist\_5-th\_j-th$ relates to the four differences of percentage GDP share between the fifth percentile and each of the remaining lower four income groups (with $j$=1,2,3,4) . For the five years considered we can rely on a complete balanced panel for 86 Russian regions.

We now briefly discuss the choice of the appropriate methodology to obtain estimates of the models presented above. We need to control for regional specific effects unaccounted for by our set of explanatory variables. In addition we face a potential simultaneity bias, as some of our explanatory variables may be affected by our dependent variable (ENROLMENT_RATE and l_RGDP for example). We address both problems by choosing the *System GMM* methodology as introduced by Arellano and Bover (1995) and Blundell and Bond (1998; 2000). In addition, with *System GMM*, we also apply the robust standard errors, implying a further improvement in the quality of our estimations.

In addition to our preferred models, we also show results obtained by testing for alternative dependent variables using the same benchmark model as specified in equation (1). In particular we use (a), the Gini index **(GINI)**, (b) the coefficient of differentiation in income between the richest 10% and the poorest 10% of the population **(Coeff_Diff_Income)** and (c) the Theil statistic (calculated using the formula as depicted in Section 3.1 above based on data on regional GDP and population as provided by *Goskomstat*) **(THEIL)**. The first two measures have been discussed already. Data for the third proxy for inequality is provided by *Goskomstat* together with the Gini

Index and we use it just as an alternative measure of the gap between poorest and richest percentile of the population. However, for the Gini index and the coefficient of differentiation in income we only have three years (2003-2005) available and this prevents us from applying the dynamic panel data specifications. For such a short span of time we apply so called *between effects* estimator, based on three years averages of all the variables included in the model.

*2.3.3 Results*

Our main hypothesis relates to the hydrocarbons as a factor enhancing within-regional inequality. All our specifications confirm the important role of oil and gas production in enhancing divergence and inequality within regions.

We start with presenting results obtained with the percentage shares of each quintiles of the population as the dependent variables and implementing the *System GMM* methodology (*Table 2.2*). It turns out clearly that oil and gas **(P_OIL&GAS)** tend to enrich the highest quintile of the population most; in contrast, for all the remaining four quintiles of the population the variable exhibits a negative relation with the correspondent share of wealth. The effect of the variable representing the hydrocarbons production is also robust to the introduction of additional control variables such as the logarithm of regional GDP **(l_RGDP)** and the logarithm of the amount of exports **(l_EXPORT)**. Interestingly, the gains from export are more widely shared. On the other hand, the share of services in total regional production **(SERV)** seem to benefit the richest percentile of the population most, a result that could be linked to the presence of entry barriers.

**Table 2.2:** Determinants of percentage shares of income across population quintiles for 86 Russian regions over 2000-2004.

| -System_GMM- | | | | | |
|---|---|---|---|---|---|
| | FIRST | SECOND | THIRD | FOURTH | FIFTH |
| L. dep_var | 0.742 | 0.721 | 0.781 | 0.873 | 0.851 |
| | (0.088)*** | (0.097)*** | (0.098)*** | (0.089)*** | (0.087)*** |
| P_OIL&GAS | -0.004 | -0.005 | -0.003 | -0.001 | 0.008 |
| | (0.002)** | (0.002)** | (0.002) | (0.001)* | (0.006) |
| ENROLMENT_RATE | -0.002 | -0.002 | -0.003 | -0.001 | 0.008 |
| | (0.004) | (0.004) | (0.003) | (0.001) | (0.01) |
| l_RGDP | -0.08 | -0.093 | -0.058 | -0.015 | 0.155 |
| | (0.056) | (0.061) | (0.044) | (0.013) | (0.157) |
| l_EXPORT | 0.009 | 0.022 | 0.002 | 0.008 | 0.017 |
| | (0.035) | (0.037) | (0.027) | (0.007) | (0.107) |
| SERV | -0.007 | -0.006 | -0.003 | -0.001 | 0.013 |
| | (0.003)** | (0.003)* | (0.002) | (0.001) | (0.01) |
| YEAR==2001 | 0.044 | 0.066 | 0.014 | 0.017 | 0.032 |
| | (0.061) | (0.069) | (0.046) | (0.009)* | (0.191) |
| YEAR==2002 | -0.049 | -0.037 | -0.046 | -0.004 | 0.285 |
| | (0.053) | (0.06) | (0.042) | (0.01) | (0.143)** |
| YEAR==2003 | -0.196 | -0.181 | -0.162 | -0.024 | 0.656 |
| | (0.036)*** | (0.041)*** | (0.032)*** | (0.010)** | (0.128)*** |
| Constant | 2.874 | 4.393 | 4.44 | 3.077 | 3.776 |
| | (0.854)*** | (1.368)*** | (1.797)** | -2.07 | -3.863 |
| Observations | 337 | 337 | 337 | 337 | 337 |
| Number of ID | 86 | 86 | 86 | 86 | 86 |
| Number of instruments | 86 | 86 | 86 | 86 | 86 |
| **Arellano-Bond test for AR(1) in first differences:** | | | | | |
| z = | -2.93 | -2.91 | -3.23 | -3.70 | -3.08 |
| Pr > z = | 0.003 | 0.004 | 0.001 | 0.000 | 0.002 |
| **Arellano-Bond test for AR(2) in first differences:** | | | | | |
| z = | -0.75 | -0.31 | -0.34 | -0.41 | -0.72 |
| Pr > z = | 0.452 | 0.753 | 0.737 | 0.682 | 0.473 |
| **Hansen test of over-identifying restrictions:** | | | | | |
| chi2(22) | 36.28 | 36.88 | 34.83 | 47.88 | 38.20 |
| Prob > chi2 | 0.455 | 0.428 | 0.524 | 0.089 | 0.370 |

Robust standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

We move next to the analysis based on the gaps between the share of wealth owned by the richest quintile and the remaining four quintiles individually taken (*Table 2.3*). As this is a more restrictive test of our hypotheses, the services indicator is no longer significant, but the key variable which remains very significant in exacerbating differences across different quintiles is oil and gas. We should also emphasise that for both models, all the tests seem to confirm validity of specification: the lag of the dependent variable is always very significant, the autocorrelation of the first order is

always significant but, importantly, the second order autocorrelation is in contrast never detected, and the over-identifying restriction test always provides good results.

**Table 2.3:** Determinants of the gap in shares of income across population quintiles. All differences are computed with respect to the richest percentile for 86 Russian regions over 2000-2004.

| -System_GMM- | | | | |
|---|---|---|---|---|
| | DIST_FIRST_FIFTH | DIST_SECOND_FIFTH | DIST_THIRD_FIFTH | DIST_FOURTH_FIFTH |
| L.dep_var | 0.533 | 0.537 | 0.551 | 0.574 |
| | (0.126)*** | (0.126)*** | (0.126)*** | (0.123)*** |
| P_OIL&GAS | 0.03 | 0.031 | 0.028 | 0.023 |
| | (0.012)*** | (0.012)*** | (0.011)** | (0.009)** |
| l_RGDP | 0.274 | 0.311 | 0.311 | 0.28 |
| | (0.222) | (0.224) | (0.217) | (0.184) |
| ENROLMENT_RATE | 0.011 | 0.011 | 0.013 | 0.012 |
| | (0.013) | (0.014) | (0.012) | (0.01) |
| l_EXPORT | -0.044 | -0.051 | -0.047 | -0.043 |
| | (0.11) | (0.112) | (0.106) | (0.089) |
| SERV | 0.028 | 0.028 | 0.024 | 0.019 |
| | (0.019) | (0.019) | (0.017) | (0.014) |
| YEAR==2001 | -0.834 | -0.811 | -0.7 | -0.534 |
| | (0.421)** | (0.418)* | (0.385)* | (0.305)* |
| YEAR==2002 | -0.298 | -0.275 | -0.229 | -0.146 |
| | (0.342) | (0.34) | (0.317) | (0.256) |
| YEAR==2003 | 0.445 | 0.453 | 0.454 | 0.396 |
| | (0.207)** | (0.207)** | (0.195)** | (0.159)** |
| Constant | 12.619 | 9.889 | 7.319 | 4.305 |
| | (5.505)** | (4.887)** | (4.236)* | -3.184 |
| Observations | 330 | 330 | 330 | 330 |
| Number of ID | 86 | 86 | 86 | 86 |
| Number of instruments | 86 | 86 | 86 | 86 |
| | **Arellano-Bond test for AR(1) in first differences:** | | | |
| z = | -2.35 | -2.41 | -2.45 | -2.56 |
| Pr > z = | 0.019 | 0.016 | 0.014 | 0.010 |
| | **Arellano-Bond test for AR(2) in first differences:** | | | |
| z = | -0.24 | -0.18 | -0.18 | -0.22 |
| Pr > z = | 0.813 | 0.855 | 0.856 | 0.822 |
| | **Hansen test of over-identifying restrictions:** | | | |
| chi2(22) | 58.92 | 60.29 | 59.23 | 59.91 |
| Prob > chi2 | 0.268 | 0.229 | 0.259 | 0.239 |

Finally, in *Table 2.4* we present results obtained with three additional dependent variables as proxies for inequality implementing the *between effect* regression. The three columns of the table reports results for (1) the Gini index, (2) the coefficient of differentiation in income between the richest 10% and the poorest 10% of the population and (3) the Theil't statistic, respectively. The only variable which exhibits a positive and highly significant impact on inequality is again the

hydrocarbons production. Services and the regional output are found to have a positive and significant impact on inequality in two out of three specifications. The enrolment rate and exports lose their explanatory power.

**Table 2.4:** Testing different dependent variables on the model. The time span is 2003-2005 for the Gini index and for the ratio between the income perceived by the richest ten percent and the poorest ten percent (diff_income). For the Theil it is instead 2000-2004.

**-Between Effects-**

| | GINI | Coef_Diff_Income | THEIL |
|---|---|---|---|
| P_OIL&GAS | 0.001 | 0.063 | 0.053 |
| | (0.0001)*** | (0.008)*** | (0.006)*** |
| l_RGDP | 0.011 | 0.928 | 0.298 |
| | (0.004)*** | (0.279)*** | (0.188) |
| ENROLMENT_RATE | 0.000 | 0.01 | -0.009 |
| | (0.000) | (0.016) | (0.01) |
| l_EXPORT | -0.003 | -0.232 | 0.004 |
| | (0.002) | (0.163) | (0.108) |
| SERV | 0.001 | 0.051 | 0.01 |
| | (0.000)*** | (0.018)*** | (0.012) |
| Constant | 0.216 | -1.201 | -3.265 |
| | (0.036)*** | (2.878) | (1.869)* |
| Observations | 255 | 255 | 411 |
| Number of ID | 86 | 86 | 86 |
| R-squared | 0.66 | 0.86 | 0.75 |

Standard errors in parentheses* significant at 10%; ** significant at 5%; *** significant at 1%

## 2.4. Concluding remarks

Russia is the largest country on earth (11.5% of its surface, 17,075,200 $km^2$, 6,591,027 $mi^2$), almost twice as large as Canada, US and China, and more than twice as large as Brazil and Australia. Despite the recent recentralization, its geographical diversity is still matched by institutional, economic and social diversity. It is for this reason that some of the theoretical tools developed to understand cross-country variation may be applied to analyse variation on the regional level in Russia (Popov, 2001), and this is what we do.

We focus on hydrocarbons endowment and argue that the regularities observed on the cross-country level apply to Russian regions as well. In the novel perspective, we test empirically the determinants of intra-regional inequality in Russia, applying robust dynamic panel data estimators. We find that regions, where oil and gas is produced tend to experience higher levels of income inequality in striking resemblance to cross-country results.

Why do our findings matter? Even though inequality is not the same as poverty, Kolenikov and Shorrocks (2005) documented that along the low level of income, inequality is also an important determinant of poverty in Russia. In the hydrocarbons perspective, these two factors work in the opposite direction. On the one hand, the oil- and gas- rich regions are characterised by higher average incomes, on the other, they are characterized by important intra-regional disparities. This is well understood in Russia, and one can also see government initiatives address some of the problems, examples of which include a 'self-sufficiency' target programme launched in Tyumen Region in 2007 (UNDP, 2007). More could be done in this respect and the efficient solution would require tackling the problems at their roots. We argue, that in striking resemblance to country-level analysis, hydrocarbons rents provide big business with concentrated wealth which has been used to derail the democratic processes initiated in Russia in early 1990s. Glatter (2003) provides a striking example of how this mechanism had operated at the local level and resulted in a high level of integration between the local oil industry and local political elites achieved by early 2000s. It seems that recent recentralisation drive changes the local balance of power, with a shift from regional corporate groups to federal corporate groups and a stronger position of the federal government (Yenikeef, 2008). However, while the local elites co-opted by the federal administration give up their ambitions at the federal level and help the president and the ruling party to achieve the expected elections results at the local level, they are becoming more protected from the potential local political competition under a new implicit political contract (or 'mutual hostages' situation, to use the terminology of Dininio and Orttung, 2004).

Thus, with the return to statism from 2003 onwards (Hanson, 2007; OECD, 2006), the organizational features of the big players evolve, but the mechanism remains similar. Åslund (2005) states that after the new reorganisation of the energy sector, the huge oil revenues corrupt the top of the state administration and the market reforms needed to enhance economic efficiency had become suboptimal for the top officials. There is a danger of renewed state energy monopoly, implying the shift from a system of oligarchs' control to a system of *bureaugarchs'* control of hydrocarbons revenues. The identity of the key players could change at the local level, but not the basic mechanism of political capitalism. As documented by Svedberg *et al.* (2006), oil and gas regions open the ranking of regions ordered by the extent of state capture. This pattern became clearer now then it was in the late 1990s. Big companies may follow a seemingly paternalistic approach offering fringe benefits and in-kind payments to its employees. However, the problem is that this policy has a detrimental effect upon the labour mobility and therefore – indirectly – upon the income distribution. Even more seriously, state capture on regional level is strongly correlated with weak

entrepreneurship and low entry (Svedberg *et al.*, 2006). This produces inequality as it closes some efficient channels to exit poverty and make the monopsonistic features of the labour market even stronger. As explicitly explained by one of the regional officials in an interview, entry is perceived as bad to local businesses as it may create competition driving wages up (Estrin and Prevezer, 2006).

There are some important extensions to our analysis that we have not yet followed. It would be an interesting extension of current research to investigate to what degree the same pattern applies to other post-Soviet republics. In particular, there is evidence that a similar situation of regional inequality associated with oil extraction may be present in Kazakhstan (Kaiser, 2006). In addition, it would also be interesting to explore if some effects similar to country-level "Dutch disease" operate at the regional level via differences in regional price level. And finally, as of the end of 2008, the hydrocarbons-related rents are shrinking due to lower world market prices. It would be fascinating to see, what would be the impact of this on between-region and within-region inequality in the Russian Federation. This is beyond the scope of the current analysis.

In summary, we stress the interactions between economic structures, political processes and social outcomes. We demonstrate that oil and gas leads to inequality at the local level and argue that there is evidence that the link between the two is via corrupted political mechanism and distorted economic institutional frameworks. However, as observed by Bradshaw (2006), the example of Norway demonstrates that oil does not need to produce socially undesirable effects if coupled with an efficient political mechanism. There is nothing deterministic or inevitable about the future in our conclusions. Russia is too large and complex to make strong assumptions about the sustainability of the current trends. Its potential for change should not be underestimated.

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Chapter 3:

# Foreign Direct Investments Distribution in the Russian Federation: Do Spatial Effects Matter?

## 3.1. Introduction

Global flows of foreign direct investment (FDI) have grown rapidly ever since the late 1980s. However, the cross-country distribution of FDI has remained highly skewed, with mature economies which are both, largest recipient and source countries. Even more striking is the disparity within the group of emerging economies, with China standing out as the largest recipient[20].

It has been widely recognised that Russia attracts a low level of inward FDI if compared with other former communist countries. With respect to other emerging markets Russia has attracted a modest amount of FDI, which in 2004 accounted for 16.9% of the GDP, against the 25% of Poland and Brazil. FDI attractiveness of Russian Federation seems quite low also with regards to the country's potential. Russia enjoys indeed a huge domestic market, an impressive natural resources endowments and the presence of a skilled and relatively cheap labour force. However a broadly recognized refrain for foreign investors is the institutional environment, which has been characterized by the fragility of property rights, the arbitrariness of fiscal policy and the unpredictability of the trade policies.

There are at least three arguments for which Russia should seek to increase its share of inward FDI. The first is based on the standard arguments applying to transition economies, for which inward investment boosts employment, output and lead to innovation in production and management processes. Second, improved inward investment is an indicator of openness and integration in the international economic environment, which have been both proved to be beneficial to economic growth. Third, Russia is in constant need for renewing its infrastructure to improve the efficiency of the obsolete extractive industry inherited from the Soviet era. In general, the importance of foreign fresh capital for Russia has been largely recognized both in political recommendations by international institutions and in the economic literature as witnessed by a number of research papers and books published on this subject[21].

FDI distribution in Russia is particularly skewed. As pointed out by Broadman and Recanatini (2001) during the period between 1995 and 1999, 62% of the foreign investments concentrated in four regions: Moscow (44.2%), Moscow Oblast (9.8%), St. Petersburg (5.3%) and Leningrad Oblast (2.7%). However,

[20] For a comparison between Chinese and Russian path of economic development and their consequences, also in terms of FDI, see Buck et al., 2000.
[21] See Iwasaki & Suganuma (2005), pp. 169 for some references.

these four regions account for 22% of the Russian national product and for 13% of Russia's population. With the exception of Sakhalin Oblast (7.4%) and Krasnodar Krai (4%), the remaining regions account for no more than 2.5% of foreign investments. Also in the following years the FDI distribution has remained persistently skewed across Russian regions. The top five regions have received 69,7% and 69,5% of the whole cross-border investment toward Russian Federation in 2000 and 2001 respectively; in 2002 the top five share has continued to increase (76,5%) until reaching more than 80% in 2003 and 2004. As for the previous period, Moscow remain the major recipient, but Sakhalin Oblast increased considerably its relative attractiveness and in 2004 and 2005 it received the largest amount of foreign investments.

Russia does not seem to show a clear spatial FDI distribution for which costal and border regions tend to exhibit higher flows of FDI, especially when compared with China, India and other CEE countries. Russia is a natural resource based economy and this tends to induce spatial effects in the regional patterns of growth (see Buccellato 2007) and in the distribution of wealth between regions (Buccellato and Mickiewicz 2008). We argue that the pervasive role of hydrocarbons in the Russian economy could represent also a major determinant in the spatial allocation of foreign investments across Russian regions.

Previous studies on the FDI distribution in the Russian Federation have provided mixed evidence concerning the possible presence of spatial effects. Iwasagi and Suganuma (2005), for example, have advocated the absence of any spatial pattern. Opposite results have been found by others, who have established both evidence for gravity effects and for agglomeration effects (Ledyayeva and Linden, 2006b; Ledyayeva, 2007). In this paper we investigate whether and to what extent spatial effects matter for FDI distribution in Russian Federation. In doing so we also control for the distance from the source countries, which would otherwise bias the analysis of the *within* country spatial effects. Building up on previous studies which considered spatial and gravity effects separately, we build up a model which allow to control for the two effects simultaneously.

The remaining of the paper is organized as follows. In the next section we provide an overview of the spatial features of FDI location and refer to some empirical studies based on different geographic areas. In section 3.3 we summarize major findings of previous empirical studies on FDI distribution in the Russian Federation. Section 3.4 presents our model to control simultaneously for the two kinds of spatial effects examined, i.e. the agglomeration effect and distance from the source countries. Section 3.5 discusses other control variables and section 3.6 describes the data. Section 3.7 reports results and section 3.8 concludes.

### 3.2. Spatial interdependence in foreign direct investments

From both, empirical and theoretical economic literature, it is possible to advocate that spatial interdependence is likely to play a role in FDI location. In order to point out the influence and consequences of spatial interdependence in FDI distribution, we provide a brief review of theoretical contributions on the nature and motivation of FDI and then we illustrate some findings from previous empirical studies.

The development of a formal theory concerning cross-border investment decisions stems from Markusen (1984) and Helpman (1984). Markusen (1984) provides a model where FDI is designed to enter local markets in order to substitute for export flows: FDI driven by such a motivation is denominated "horizontal" FDI. Helpman (1984) develops a general-equilibrium model where FDI is due to the fragmentation of production across different hosts, which is motivated by taking advantage of differences in production costs: these are known as "vertical" FDI.

More recently, it has been relaxed the assumption of two-country model with the inclusion of a third market. This leads to two further motivations for multinational enterprises (MNEs) activities other than the above mentioned – horizontal and vertical. First, the "export platform" frame in which FDI takes place in order to realize a production which is largely sold in third markets. This implies that the recipient country is used as platform to serve other markets through exports (Yeaple, 2003; Ekholm et al., 2003; Bergstrand and Egger, 2004). Second, the "vertical-complex" frame in which production is fragmented across multiple locations in order to exploit the comparative advantages of various regions.

Blonigen et al. (2007), proposed two spatial effects which can affect FDI location in a given area. The first is related to the fact that the presence of foreign firms in a region can be affected by FDI inflows in its neighbourhood. The second source of spatial interdependence is represented by the so called "surrounding market potential" and it is associated to the market size of other geographically-proximate regions. The authors also discuss how the economic theory on FDI can be adapted to allow for the presence of spatial effects.

Theory suggests that according to the "pure horizontal" FDI hypothesis, there would be no spatial relationship between FDI into the host market and FDI into the surrounding regions, because foreign investors are expected to take independent decisions about a given regional market. Also surrounding market potential is expected to have no influence since horizontal FDI are motivated by access to a

certain region, without taking into account the opportunity to export in close regions (indeed, in this case it would occur export-platform FDI).

Vertical FDI would predict a negative coefficient for the spatially lagged FDI because the FDI going into a certain region is at the expense of that going into surrounding regions. Market potential is expected not to be significant because the output of foreign affiliates would be exported in the home country.

The export-platform hypothesis would imply a negative impact on the amount of FDI inflows towards the neighbours of the regions where foreign investors locate their production activity. In other words, the destination market represents a substitute for investment towards alternative destination markets. Instead it would predict a positive coefficient for surrounding market potential as the presence of large and relatively close regional markets, should make more profitable to invest in a region.

Finally, complex vertical FDI would predict positive coefficients for both spatial effects. When a multinational firm splits the production process in different regions, the presence of foreign investors in proximate regions is a clear incentive in undertaking an investment activity. In other word in this frame it enters an agglomeration effect by which the accessibility of supplier networks in the neighbouring regions is likely to increase FDI in a given location.

However, the four mentioned effects are virtually impossible to be disentangled. This implies that mixed evidence in support of one motivation over the others indicates just a relative prevalence of one over the others. Furthermore, some effects that theoretically appear to be working in opposite directions, in practice tend to be found together reinforcing each others. For example in the case of vertical fragmentation the surrounding market potential *per se* should not matter. In actual facts industrial production and market size are often highly correlated and an improved industrial production level in neighbouring regions would constitute also an incentive for vertical fragmentation.

Empirical studies relating to FDI, which relax the assumption of randomly distributed boundaries have recently experienced a considerable increase. The availability of more precise and timely regional dataset from emerging economies has represented one of the most important factors contributing to the development of this research stream. In this section we report some of the latest contributions briefly summarizing their main results.
Coughlin and Segev (2000) use a spatial error model to analyze US cross-border investments across 29 Chinese provinces. They find that an increase of FDI flows towards one province has positive effects on

FDI in nearby provinces (i.e. a positive spatial-lag coefficient in the error term). Hong *et al*, (2007) analyse foreign investments for 29 Chinese provinces over the period of 1990-2002. They use a spatial dynamic panel data model to explain the FDI location, including a spatial lag dependent variable and a market potential variable. They find evidence of spatial interdependence as expressed by the fact that recipient province FDI responds positively to FDI received by neighbouring provinces but negatively to GDP of these neighbours.

Baltagi et al. (2004) analyse US outbound FDI for seven manufacturing industries. They include spatially weighted explanatory variables making use of a spatial error model. Their results find substantial evidence of spatial interactions. Blonigen et al. (2007) include a spatial lag dependent variable and spatially weighted market potential variable into a gravity paradigm. Using a panel of annual data on US outbound FDI to the top forty recipient countries over the period 1983-1998, they find that the estimated relationships of traditional determinants of FDI are robust to the inclusion of spatial effects.

Only very recently spatial econometric approaches have been used with reference to the Russian Federation. Buccellato (2007) conducts a study on spatial lag and spatial error models to study the process of absolute and conditional convergence across 77 Russian regions. FDI in this case are considered among the regressors and are found to play a significant and positive role in enhancing divergence in GDP per capita in the regional panel considered.

### 3.3 Previous studies on FDI distribution across Russian regions

In order to provide a solid background to our empirical analysis and to highlight some of the most important determinants of foreign investment flows towards Russia, we devote this section to review some relevant literature concerning FDI in the Russian Federation.

Ahrend (2000) conducted a questionnaire survey based on 50 European companies that have been engaging activities in various Russian regions in order to find those factors that European investors considered as major determinants of investment decision. According to this investigation there are four major factors affecting the distribution of FDI across Russian regions: the presence of a large market; the existence of previous investments made by other entrepreneurs; the presence of a partner company necessary for business development; the endowment of row materials or other production factors in the target region.

Bradshaw (2002) groups Russian regions in five broad categories with respect to their attractiveness for foreign investors: first, the Moscow region (Moscow region and the city of Moscow) as the control centre for the national economy; second, regions that are relevant as industrial and financial centres (e.g. the city of St. Petersburg and the Leningrad and Samara regions); third, regions that have major port or gateway function such as the city of St. Petersburg; fourth, regions with substantial mineral wealth (as Sakhalin region); and fifth, regions which have benefited from substitutes for the previous imports due to dramatic depreciation of the rouble after the August 1998 financial crisis.

Brock (1998) has produced econometric evidence for some determinants of the FDI distribution across Russian regions. In his analysis he considered eight variables - market size, crime rate, work force education, private sector's development, level of local taxation, infrastructures, property rights protection and risk ranking. He found that the two leading factors which have been proved to be significant in attracting FDI are the market size and the crime rate[22].

Manaenkov (2000) has analysed the determinants of the choice of the region and industry by a foreign entrant using a firm-level panel-data approach. His research suggests that economic reform progress is an important explanatory variable of FDI inflow into the Russian economy. Improved level of institutions efficiency represents a precondition for the implementation of economic reforms, which in turn embodies a key aspect to boost the FDI. Another interesting finding is that foreign investors are attracted by more protected and monopolized industries which are more difficult to be served by export. Finally, he also found that gravity variables does not succeed in describing FDI pattern in the Russian Federation, once that Moscow is excluded.

Broadman and Recanatini (2001) insist again in the weight of the political and institutional environment in explaining FDI inflow differentials across Russian regions. Using data for the period 1995-1999, the econometric analysis is based on two models, which consider alternatively the FDI as stock and as flow. Four variables are indicated to play a significant role – GRP, kilometres of paved Road, domestic Investment and investment Rating interacted with Domestic Investment – and to account for 80% of regional differentials in cumulative FDI. For what concerns the flows, it is found that a structural break in foreign investors attitudes occurred in correspondence of the August 1998 financial crisis[23].

[22] He has also found that education play a role in attracting FDI, even if with less relevance if compared with market size and crime rate (p. 354).
[23] Also Iwasaki and Suganuma (2005) and Ledyaeva (2007) investigated about the presence of a structural break in foreign investors' behaviour after 1998 crisis. Iwasaki and Suganuma (2005) found no evidence of a structural break meanwhile Ledyaeva (2007) found some evidence of a structural break, confirming the earlier findings of Broadman and Recanatini (2001). Anyway we will not deal with this issue in our work.

Iwasaki & Suganuma (2005) assume the absence of any geographical pattern in the Russian FDI regional distribution. Consequently they conduct an analysis on eight variables not allowing for the presence of spatial interactions among spatial observations. The survey includes variables such as climate, natural resources, market size, industrial production, urban population. The empirical part also includes dummy variables to categorize regions according to political measures implemented to favour FDI inflows (regional foreign investment law, taking part to a free economic zone or applying the product-sharing law[24]). Using data for 69 regions from 1996 to 2003[25], they obtain two main results. First, it is established the key role of natural resources endowments, market size and socio-economic development[26] (also the climate, less relevant but still significant). Second, using the three above mentioned dummy variables, they show that foreign investment law and free economic zones have some positive effects on foreign investment, but the influence of the latter tends to decrease over time. Product-sharing law is not found significant[27].

Ledyaeva and Linden (2006) test whether a gravity model can explain FDI distribution across Russian regions. They make use of a gravity model based on the usual variables: market size of both, recipient region and source country, and the distance between source country and recipient region. To the core gravity model they also add some control variables: a proxy for agglomeration[28], one for skilled labour, endowments of natural resources and some dummy variables for Moscow and Russian speaker countries. The main finding of the paper is that the gravitational paradigm seems to adapt well to FDI distribution across Russian regions.

Ledyaeva (2007) analyses the determinants of FDI since 1995 to 2000. She has tested the relevance of two spatial effects introduced by Blonigen et al. (2007). First, a spatial lag dependent variable characterizing the contemporaneous correlation between FDI of one region and FDI of proximate regions. Second, a market potential variable, which characterizes the contemporaneous correlation between a FDI and the market sizes of neighbours. In order to evaluate their relevance, she run a first regression without spatial effects and a second with the inclusion of both spatial effects. As explanatory variables she also consideres the market size, infrastructures (number of ports in the region), the level of industrialization (a dummy variable for those regions that includes at least one of Russia's 13 cities that

[24] See Iwasaki & Suganuma (2005, p. 162) for the regions which undertook these measures.
[25] They did two estimations: panel and cross-section (for each year); anyway both lead to same results.
[26] That is represented, in their work, by industrialization and urbanization.
[27] The effective sign (negative) is not the expected one and they commented that it shows that "PS law was a desperate measure introduced under pressure to attract foreign capital to the notably underdeveloped regions of Russia" (p. 164).
[28] The proxy for agglomeration is the ratio between gross regional product and the square of each region's territory.

exceed 1 million habitants), legislative risk (rating from magazine "Ekspert"), political risk (rating from "Ekspert"), natural resources and a dummy variable for Sakhalin. She found that the most important determinants in FDI are market size, level of industrialization and Sakhalin region's production sharing agreements in the oil industry. Comparing the results with and without the inclusion of spatial effects, she found that the inclusion of spatial effects, even when significant, does not affect general results[29].

To summarize, previous empirical studies found that the most important determinants in explaining FDI allocation in Russian regions are market size, infrastructures, natural resources and various indicator of socio-economic development and institutions' quality; *Table 3.1* summarizes main findings of these studies. Little evidence was found for spatial effects.

[29] She did a comparison between different period in order to test whether or not financial crisis produced some changes in foreign investors' strategies: see Ledyaeva (2007), p. 32-33.

**Table 3.1: Main findings of previous studies on FDI distribution in Russian regions**

| AUTHOR | VARIABLE | PROXY | SIGN | MAIN FINDINGS |
|---|---|---|---|---|
| Brock (1998) | Market size | Gross Regional Product | + | Market size and crime are the most important determinants in the regional distribution of foreign capital in Russia |
| | Crime | Number of registered crimes per 100.000 inhabitants | - | |
| | Education | Employed work force with higher education | + | |
| Broadman and Recanatini (2001) | Market size | Gross Regional Product | + | Market size, infrastructure development, and policy framework factors (interaction variable of domestic investment and investment rating) explain much of the variation of FDI across Russian regions |
| | Infrastructures development | Paved roads | + | |
| | Investment climate | Investment rating x Domestic investment | + | |
| Iwasagi and Suganuma (2005) | Market size | PCA | + | The most important factors for FDI location are natural resources, market size and socio-economic development factors (industrialisation and urbanisation). Climate and some of the favourable regionally discriminatory FDI measures may display a certain effect. |
| | Climate | Temperature in January | + | |
| | Natural resources | Rating by Ekspert magazine | + | |
| | Degree of urbanisation | Ratio of urban population to total population | + | |
| | Degree of industrialisation | Ratio of industrial production to GRP | + | |
| Ledyaeva and Linden (2006) | Market size | Gross Regional Product | + | The most important factors in explaining the number of foreign firms in a particular Russian region are: gross products of host regions and source countries, agglomeration effect and an abundance of skilled labour. |
| | Distance | Distance | - | |
| | Agglomeration | Ratio of GRP on region's surface (square km.) | + | |
| | Natural resources | Ratio of graduated in total population | + | |
| Ledyaeva (2007) | Market size | PCA | + | The most important determinants of FDI inflows into Russian regions are: market size, presence of big cities, presence of sea ports, natural resources and political risk. |
| | Presence of port | No. of sea ports in a region | + | |
| | Presence of big cities | Dummy variable of 13 biggest cities in Russia | + | |
| | Natural resources | Oil and gas index | + | |
| | Political risk | Rating by Ekspert magazine | - | |

### 3.4. The core specification with spatial effects

Main purpose of our empirical analysis is to highlight the impact of spatial effects on the distribution of FDI across Russian regions. We assign to distance a twofold importance. We indeed consider both, distances across Russian regions and distances of each region with respect to the main source countries investing in the Russian Federation. The contemporaneous use of these two variables represents a necessary requirement in order to precisely assess the net impact of each of the two variables themselves. In other words, our aim is to disentangle possible effects of agglomeration in FDI between Russian regions from effects of remoteness induced by prohibitive distance from the main foreign investors.

We end up by modelling the level of FDI going into the recipient region $i$ at time $t$ as resulting from a combined effect of agglomeration, inverse distance from the most relevant foreign investors and other

control variables which have been found to play an important role in attracting foreign investments. We consider the following Cobb Douglas function to provide a synthetic baseline framework:

$$FDI_{i,t} = (Agglomeration_{i,t})^{\alpha} (Dis\tan ce_{i,j,t})^{\beta} (Other\_Factors_{i,t})^{\gamma} \qquad (1)$$

Equation (1) can be easily rewritten in a logarithmic form, which includes an error term and a constant allowing for the estimation of the parameters through regression analysis,

$$\log\_FDI_{i,t} = k + \alpha(\log\_Ag_{i,t}) + \beta(\log\_Dis_{i,j,t}) + \gamma(\log\_Other\_Fac_{i,t}) + \varepsilon_{i,t} \qquad (2)$$

The degree of agglomeration is well captured by the inclusion of a spatial lag of FDI. If agglomeration takes place, then the level of FDI towards a given recipient region should be positively affected by the amount of FDI going towards its closer neighbours.

For what concerns the distance from the foreign investors, we make use of the inverse of the distance between any given recipient regions and the principal investor countries multiplied by the ratio of FDI originated by a given country to the total amount of FDI towards the Russian Federation. This particular weighting system is introduced to have a manageable dimension of the matrices and requires an assumption of a priori homogeneous distribution of FDI across Russian regions.

Among the *Other Factors* we include some specific regional characteristics that have been found significant in the economic literature. The inclusion of such variables is crucial to our extent in order to show that the effect of agglomeration does not appear significant for the omission of other variables which might induce an artificial spatial autocorrelation in FDI across regions. The other factors can be categorized in three main blocks. First, we include the group of variables classified as important in characterizing the host regions; second, we include a proxy for the surrounding market effect; third and last we add some variables which mainly refer to the Russian context. A detailed discussion of all these variables is postponed to next section. We can now rewrite the model as follows,

$$\log\_FDI_{i,t} = k + \alpha\log(W_1 * FDI_{i,t}) + \beta\log(W_2 * \frac{FDI_{j,t}}{FDI_t}) + \gamma(\log\_Other\_Fac_{i,t}) + \varepsilon_{i,t} \qquad (3)$$

where $W_1$ is a 77x77 row standardized inverse distance spatial matrix with all zeroes on the diagonal. $W_1$ has also been defined the spatial lag weighting matrix and its associated coefficient $\alpha$ captures the magnitude effect, the significance and sign of the autoregressive term $W_1 * FDI_{i,t}$. $W_2$ is a 77x7 matrix containing the inverse of the distance between each of the 77 Russian regions and each of the 7 countries

which over the period considered are constantly investing in the Russian Federation. *Table 3.2* shows the distribution of FDI inflows by major contributors.

***Table 3.2: FDI Inflows in the Russian Federation by major contributors (1995, 200-2004)***

| COUNTRY | FDI (MILLION US$) | % SHARE | | COUNTRY | FDI (MILLION US$) | % SHARE |
|---|---|---|---|---|---|---|
| **1995** | | | | **2000** | | |
| All | 2020 | 0.73713 | | All | 4429 | 0.84218 |
| USA | 638 | 0.31584 | | USA | 1241 | 0.2802 |
| Switzerland | 202 | 0.1 | | Cyprus | 678 | 0.15308 |
| Germany | 200 | 0.09901 | | Netherlands | 610 | 0.13773 |
| France | 106 | 0.05248 | | Germany | 341 | 0.07699 |
| Belgium | 88 | 0.04356 | | Great Britain | 262 | 0.05916 |
| Great Britain | 77 | 0.03812 | | Sweden | 257 | 0.05803 |
| Austria | 60 | 0.0297 | | Switzerland | 115 | 0.02597 |
| Sweaden | 52 | 0.02574 | | Japan | 107 | 0.02416 |
| Netherlands | 48 | 0.02376 | | France | 97 | 0.0219 |
| Japan | 18 | 0.00891 | | Austria | 22 | 0.00497 |
| | | | | | | |
| **2001** | | | | **2002** | | |
| All | 3980 | 0.83518 | | All | 4002 | 0.7961 |
| USA | 1084 | 0.27236 | | USA | 603 | 0.15067 |
| Netherlands | 575 | 0.14447 | | Cyprus | 571 | 0.14268 |
| Cyprus | 512 | 0.12864 | | Netherlands | 504 | 0.12594 |
| Germany | 495 | 0.12437 | | Germany | 410 | 0.10245 |
| Great Britain | 273 | 0.06859 | | Great Britain | 327 | 0.08171 |
| Japan | 184 | 0.04623 | | Japan | 260 | 0.06497 |
| British Virgin Islands | 63 | 0.01583 | | Finland | 151 | 0.03773 |
| France | 51 | 0.01281 | | British Virgin Islands | 137 | 0.03423 |
| Switzerland | 51 | 0.01281 | | Luxemburg | 107 | 0.02674 |
| Austria | 36 | 0.00905 | | Switzerland | 67 | 0.01674 |
| | | | | France | 49 | 0.01224 |
| | | | | | | |
| **2003** | | | | **2004** | | |
| All | 6781 | 0.78971 | | All | 9420 | 0.86847 |
| Cyprus | 977 | 0.14408 | | Netherlands | 3479 | 0.36932 |
| Japan | 828 | 0.12211 | | Cyprus | 2688 | 0.28535 |
| Netherlands | 818 | 0.12063 | | Germany | 428 | 0.04544 |
| Great Britain | 747 | 0.11016 | | USA | 419 | 0.04448 |
| Germany | 687 | 0.10131 | | British Virgin Islands | 375 | 0.03981 |
| USA | 632 | 0.0932 | | Switzerland | 341 | 0.0362 |
| Switzerland | 292 | 0.04306 | | Great Britain | 192 | 0.02038 |
| British Virgin Islands | 278 | 0.041 | | France | 157 | 0.01667 |
| France | 75 | 0.01106 | | Austria | 62 | 0.00658 |
| Luxemburg | 21 | 0.0031 | | Luxemburg | 40 | 0.00425 |

*Source: Russian Federal Statistic Service – Goskomstat*

The seven countries we considered for our analysis are, in alphabetical order: Cyprus[30], France, Germany, Japan, Netherlands, United Kingdom and United States. The remaining term $\gamma(\log\_Other\_Factors_{i,t})$ contains the other control variables briefly introduced above and systematically presented in the next section. $\gamma$ represents the vector of associated coefficients to the other factors.

The model as depicted in (3) cannot be estimated using a simple OLS. The spatial lag is indeed a stochastic regressor always correlated with ε through the spatial multiplier, which makes OLS an inconsistent estimator (see Anselin 1998). The best way to address this problem is to instrument the right-hand-side variables with their lagged values. This procedure has been first implemented through a GMM estimator by Arellano and Bond (1991), which has been recently readapted to allow for the presence of spatial effects (see Mutl 2006). Furthermore, we have to address the high persistency of FDI over time. The issue of possible persistence in the dependent variable that leads to a downwards bias in Arellano-Bond estimator has been highlighted in the economic literature (see for instance Hayakawa, 2007). Hence, we end up by choosing the *System GMM* methodology as introduced by Arellano and Bover (1995) and Blundell and Bond (1998; 2000). Making use of a wider set of instruments with respect to the Arellano and Bond (1991), this method has been proven to result in greater precision for the estimates of autoregressive parameters. It indeed combines the differenced estimator and the level estimator of Arellano-Bover (1995), for which corresponding biases work in opposite directions (downwards in the former, upwards in the latter) and the weights adjust the final estimation for the relative difference of the magnitudes of the biases. This is particularly important in the presence of persistent series, especially when the time span of the data is small as it is in our case. In addition, with *System GMM*, we also apply the robust standard errors, implying a further improvement in the quality of our diagnostics.

[30] About Cyprus it has to be pointed out that many investments from Cyprus might be ascribed to Russian entrepreneurs which choose to establish abroad their headquarter.

### 3.5. The Control Variables

The control explanatory variables we consider in addition to our core model are part of the widely used set of variables impacting the level of FDI towards countries or regions and environmental variables which adapt well to the Russian context. In this section we present and briefly discuss these variables and provide all the relevant information to interpret our results. As usual in the literature, all the variables are considered in natural logarithms, therefore coefficients can be interpreted as partial elasticises.

***Market size***

The Market size of the recipient region would have a positive impact on FDI inflow because it meets the motivation of MNEs to look for potential new markets and to maximize the expected revenue of the investment. We use natural logarithm of the regional GDP expressed in million roubles as provided by Goskomstat to capture the market size effect.

***Distance***

Distance as to be indented as geographical distance between source and recipient country. It is included in order to represent the influence of various frictions that are likely to affect incoming FDI. From a theoretical viewpoint, the expected sign is negative[31] as physical distance is assumed to increase several costs (transport, information, monitoring). Although new technologies (both in communication and transport) are changing distance's relative importance, this variable is still a fundamental in empirical investigation on FDI determinants[32].

***Skilled labour***

Skilled labour represents the quality of labour force and it can be important in attracting those foreign investors which search for competitive advantages or seek to establish activities that requires high level of human capital. Access to skilled labour is usually an important determinant of foreign investors' strategies and we could expect that it is particularly valid for an economy as Russian Federation, which is characterized by a well educated and relatively cheap labour force. Empirical evidence suggests that in transition economies there is a positive relationship between education level of employees and FDI inflow (Carstensen and Toubal, 2004; Hong et al., 2007). In our analysis we use school release of qualified workers at the end of year, out of thousand people, as provided by Goskomstat.

[31] We considerer the inverse for the distance and hence the expected sign would be positive.
[32] As Grosse and Trevino (1996, p.153) point out: " [A]lthough we theorized that geographic distance should be an impediment to foreign direct investment, it could be that the decreased cost of international telecommunications and travel argues for a diminished role for geographic distance as an explanatory factor of FDI. However, it is precisely these changes in the global competitive environment that justify the testing of this variable today."

***Infrastructures***

Another important factor that has to be taken into account is the transport system as a proxy for infrastructures quality. Well-developed infrastructures, and particularly superior transportation options, can improve the effectiveness of MNEs operations in the host region and reduce transport costs. Presence of good infrastructures can be considered a determinant of FDI incoming since an adequate infrastructures system is a fundamental service for firms' activities and because it is expected to reduce the distribution costs. Infrastructures quantity is generally assumed as representative of both, quality and quantity, of infrastructures system[33]. As a proxy for transports, we assume density of railways at the end of the year (kilometres of ways out of 10,000 square kilometres of territory) as provided by Goskomstat.

***Market Potential***

For surrounding market potential we assume regional GDP weighted by the spatial matrix constituted by inverse distances among regions constructed exactly in the same way as the one for the spatial lag of FDI. This variable represents a third source of spatial interdependence and its associated coefficient captures the extent to which the FDI in a given region is affected by the market sizes of close regions. This variable represents a more appropriate measure for market size than the sole Gross Regional Domestic Product (RGDP), since the latter takes into account only regional market considered as isolated, as opposed to the surrounding market potential, which takes into account also the market potential of proximate regions.

***Natural resources***

We also include natural resources, which are arguably a strong motivation for MNEs to invest in a recipient region and, moreover, relative abundance of natural resources strongly characterizes the economy and industrial production in certain Russian regions. To include natural resources in our empirical analysis, we use tonnes of oil and gas extracted in the region weighted by the regional population as provided by Goskomstat.

***Openness***

We then consider a measure of integration of each region in international economic context. Indeed, a number of theoretical and empirical studies have suggested that the degree of openness is positively associated with the level of foreign investments (Singh and Jun, 1995; Caves, 1996), suggesting that foreign investors prefer countries with a liberal trade regime. The degree of openness of Russian regions

[33] Another difficulty in dealing with this variable is that infrastructures have a multidimensional nature because it is constituted by road, rail, port and airport. It has to be also pointed out that in present analysis we are including only transport *infrastructures* but not *communication* infrastructures (e.g. phone lines and broadband internet) and *basic* infrastructures (e.g. electricity and waterways).

is included using as a proxy the regional exports at current prices in million US dollars as provided by Goskomstat.

***Investment risk***

Finally, we include a measure of investment risk. The underlying hypothesis is that quality of public institutions and investment climate are very likely to affect FDI incoming and, therefore, firms would be adverse to invest in relatively less stable economies. The quality of institutions is likely to be an important determinant of FDI activity, particularly for transition economies, for a variety of reasons: poor legal protection of assets increases the chance of expropriation of a firm's assets; poor quality of institutions and/or corruption affects markets efficiency and increases costs of doing business; finally, poor institutions often lead to poor infrastructure (i.e., public goods). However, estimating investment risk's influence in an empirical analysis presents some problems. First, inclusion of qualitative and multidimensional concept in a quantitative analysis is difficult and not always meaningful. Second, these measures often present little changes over time being, therefore, not so informative in a dynamic panel data setting. Third, these investment risk indexes are usually composite measures and in some cases their components are the same or similar to other regressors, thus generating multicollinearity (for instance, there might be an investment climate composite index including GDP, usually included in the analysis as market size measures).

As previous studies on FDI across Russian regions, we make use of the index provided by the rating agency of "Ekspert" magazine. "Ekspert" is a well known Russian language magazine[34] created in 1995; from 1996 it publishes a synthetic index that rank Russian regions investment attractiveness. "Ekspert" publishes two indeces: investment risk and investment potential. The first is composed by seven different risks: legislative, political, economic, financial, social, criminal and ecological; the latter is a weighted average of eight dimensions: labour, consumption, production, financial, institutional, innovative, infrastructural, natural resources. In our empirical analysis we consider the investment risk. Higher values of the index indicate worse investment environment.

[34] For the data, see www.gateway2russia.com.

**Table 3.3: Summary statistics for the variables included in the analysis by year**

| Year | 2000 | | | | | Year | 2003 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Min** | **Max** | **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| FDI | 77 | 57437.69 | 201420.2 | 0 | 1472807 | FDI | 77 | 87883.57 | 366861.8 | 0 | 2482963 |
| Regional DGP | 77 | 80398.35 | 163972.7 | 3638.7 | 1308901 | Regional DGP | 77 | 149590.5 | 309834.6 | 4852.3 | 2458483 |
| Transport | 70 | 160.9429 | 106.1669 | 9 | 583 | Transport | 70 | 160.5143 | 104.3386 | 9 | 574 |
| Skilled Labour | 77 | 9.818182 | 6.858297 | 0.6 | 33.8 | Skilled Labour | 77 | 9.238961 | 6.226728 | 0.9 | 29 |
| Oil&Gas | 75 | 1.609397 | 7.758213 | 0 | 66.00773 | Oil&Gas | 77 | 2.019075 | 9.99894 | 0 | 86.0696 |
| Investment Risk | 77 | 1.076221 | 0.254891 | 0.759 | 2.359 | Investment Risk | 77 | 1.076221 | 0.254891 | 0.759 | 2.359 |
| | | | | | | | | | | | |
| **Year** | **2001** | | | | | **Year** | **2004** | | | | |
| **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Min** | **Max** | **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| FDI | 77 | 51646.23 | 161207.5 | 0 | 1154657 | FDI | 77 | 122049.5 | 451444.8 | 0 | 3272077 |
| Regional DGP | 77 | 99992 | 198577.9 | 4624.4 | 1551179 | Regional DGP | 77 | 187979.1 | 377651 | 6022.2 | 2759101 |
| Transport | 70 | 160.6 | 105.4383 | 9 | 574 | Transport | 70 | 160.3429 | 104.3074 | 9 | 574 |
| Skilled Labour | 77 | 9.750649 | 6.739546 | 0.7 | 31.6 | Skilled Labour | 77 | 9.074026 | 6.009782 | 1 | 28.7 |
| Oil&Gas | 77 | 1.693115 | 8.259307 | 0 | 71.13288 | Oil&Gas | 77 | 2.188427 | 10.89377 | 0 | 93.71281 |
| Investment Risk | 77 | 1.076221 | 0.254891 | 0.759 | 2.359 | Investment Risk | 77 | 1.156117 | 0.245385 | 0.861 | 2.493 |
| | | | | | | | | | | | |
| **Year** | **2002** | | | | | **Year** | **2005** | | | | |
| **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Min** | **Max** | **Variable** | **Obs** | **Mean** | **Std. Dev.** | **Min** | **Max** |
| FDI | 77 | 51904.29 | 197824 | 0 | 1508680 | FDI | 77 | 169523.5 | 607406.2 | 0 | 3800751 |
| Regional DGP | 77 | 121520.4 | 248480.6 | 3704.4 | 1975649 | Regional DGP | 0 | --- | --- | --- | --- |
| Transport | 70 | 159.8571 | 105.0668 | 9 | 575 | Transport | 70 | 160.1 | 103.6256 | 9 | 574 |
| Skilled Labour | 77 | 9.551948 | 6.456486 | 1 | 31.1 | Skilled Labour | 77 | 8.975325 | 5.904908 | 1 | 27.8 |
| Oil&Gas | 77 | 1.830219 | 9.023225 | 0 | 77.7263 | Oil&Gas | 77 | 2.213418 | 11.1555 | 0 | 96.36985 |
| Investment Risk | 77 | 1.076221 | 0.254891 | 0.759 | 2.359 | Investment Risk | 77 | 1.156117 | 0.245385 | 0.861 | 2.493 |

*Source: Russian Federal Statistic Service – Goskomstat*

## 3.6. The data

The Russian Federation is characterized by a very complex administrative organization. The first major administrative division includes seven federal districts (Central Federal District, North West Federal District, South Federal District, Volga Federal District, Ural Federal District, Siberian Federal District, Far Eastern Federal District). Each federal district is sub-divided into a series of entities that can take one of three different forms: *oblast* (region, province), *kraj* (territory) and republic. Some regions are further sub-divided into entities classified as autonomous regions (*Avtonomnje Okrugi*).

The only reliable dataset for the Russian Federation is the one collected by Goskomstat providing data for 88 regions. This source however suffers from several limitations. Data are either completely missing or sporadically available for ten of the regions, which are, therefore, to be excluded from this analysis.

Indeed, data for the Chechen Republic are entirely missing for all the variables included in the analysis[35]. FDI data are not available for ten autonomous regions – Nenetsia, Parma, Yamalo-Nenetskiy, Khanty-Mansiyskiy, Taymyr, Evenkia, Ust-Ord Buriatia, Aghin Buriatia and Koryakia – yet it must be pointed out that the majority of these are treated as parts of other Russian regions and, as a result, are included in the study, albeit at a more general level of aggregation. Not considering the breakdown of the regions in their autonomous parts represent undoubtedly a remarkable loss of information. However, from en econometric point of view it prevents to incur the problem of double counting which is implicit in the Goskomstat dataset. To avoid double counting, where both regional level data and sub-regional level data (like autonomous regions) are reported, we use aggregate obtained as the sum of the reported lower level units and the higher level regional units (for example, we use the sum of the figures for Chanty-Mansijskij Autounomous Okrug, Jamalo Nenetskij Autonomous Okrug and the proper Tyumen region, when referring to the latter). Overall we end up by including in our analysis a panel of 77 (the number of regions reduces to 70 when including the variable for transport) Russian regions for the period 2000-2004.

A discussion a part deserves the data for FDI. International investments towards Russia are categorized into three different types: foreign direct investment, portfolio investment and others (these latter includes mainly bank deposit and trade credits). Generally speaking, FDI data suffer of general restrictions[36]. The most common problem of FDI data which is also present in the Russian Federation, is the bias deriving by the fact that most companies have their headquarters in capital cities, even if they operate elsewhere (with a consequent overstatement of FDI inflows in Moscow) and the level of aggregation of data. Indeed, firm level data are preferable to regional level data.

As reported by Iwasaki & Suganuma (2005, p. 169-170), a legal definition of FDI in Russia can be found in Article II of the Law on Foreign Investment in the Russian Federation (9 July 1999), which states that "FDI is defined as (1) a 10% or higher investment by a foreign investor in share capital, (2) fixed capital investment in an affiliate of a foreign company established in Russia, (3) a lease by a foreign investor of an article classified in the list of external transaction goods between CIS states, which exceeds 100 million roubles"[37].

[35] The reason in this case is straightforward, as this region has been land of war since 1994.
[36] For further discussion on FDI data restriction and pitfalls, see Stephan and Pfaffmann (2001).
[37] This definition s to be in line with the general international definition, as it comes from IMF Balance of Payment Handbook.

*Table3.4* summarizes the distribution of FDI across the top 25 recipients regions[38] and *Table 3.5* all the synthetic explanation of all the variables included in the different specifications of the model.

**Table 3.4 (continues): Distribution of Foreign Direct Investments across the top 25 recipient regions (2000-2005, thousands US Dollars)**

| REGION | FDI 2000 | % | REGION | FDI 2001 | % | REGION | FDI 2002 | % |
|---|---|---|---|---|---|---|---|---|
| G. Moskva | 1.472.807 | 33,25% | G. Moskva | 1.154.657 | 29,01% | G. Moskva | 1.508.680 | 37,70% |
| Krasnodarskij kpaj | 958.892 | 21,65% | Krasnodarskij kpaj | 686.311 | 17,24% | Sachalinskaja Oblast | 679.771 | 16,99% |
| Sachalinskaja Oblast | 246.131 | 5,56% | Sachalinskaja Oblast | 374.597 | 9,41% | Moskovskaja Oblast | 589.146 | 14,72% |
| Leningradskaja Oblast | 205.462 | 4,64% | Moskovskaja Oblast | 312.663 | 7,86% | Tjumenskaja Oblast | 168.733 | 4,22% |
| Moskovskaja Oblast | 204.938 | 4,63% | Leningradskaja Oblast | 238.193 | 5,98% | Leningradskaja Oblast | 115.352 | 2,88% |
| Novosibirskaja Oblast | 151.782 | 3,43% | Samarskaja Oblast | 117.611 | 2,96% | Sverdlovskaja Oblast | 99.719 | 2,49% |
| Tjumenskaja Oblast | 147.996 | 3,34% | G. Sankt-Peterburg | 114.081 | 2,87% | Samarskaja Oblast | 97.721 | 2,44% |
| G. Sankt-Peterburg | 146.681 | 3,31% | Tjumenskaja Oblast | 110.284 | 2,77% | Apchangelskaja Oblast | 96.452 | 2,41% |
| Volgogradskaja Oblast | 76.943 | 1,74% | Sverdlovskaja Oblast | 101.606 | 2,55% | Krasnodarskij kpaj | 90.003 | 2,25% |
| Kalužskaja Oblast | 74.241 | 1,68% | Novosibirskaja Oblast | 89.077 | 2,24% | G. Sankt-Peterburg | 84.082 | 2,10% |
| Sverdlovskaja Oblast | 73.550 | 1,66% | Orenburgskaja Oblast | 82.517 | 2,07% | Rostovskaja Oblast | 52.650 | 1,32% |
| Samarskaja Oblast | 59.630 | 1,35% | Primorskij kraj | 65.812 | 1,65% | Kalužskaja Oblast | 35.412 | 0,88% |
| Respublika Tatarstan | 53.655 | 1,21% | Permskaja Oblast | 60.916 | 1,53% | Stavropolskij kpaj | 33.933 | 0,85% |
| Orenburgskaja Oblast | 51.157 | 1,16% | Respublika Karelija | 34.311 | 0,86% | Astrachanskaja Oblast | 31.367 | 0,78% |
| Rostovskaja Oblast | 40.819 | 0,92% | Respublica Komi | 34.142 | 0,86% | Penzenskaja Oblast | 27.448 | 0,69% |
| Orlovskaja Oblast | 40.346 | 0,91% | Volgogradskaja Oblast | 31.853 | 0,80% | Primorskij kraj | 25.834 | 0,65% |
| Permskaja Oblast | 37.109 | 0,84% | Kalužskaja Oblast | 31.472 | 0,79% | Kirovskaja Oblast | 25.705 | 0,64% |
| Primorskij kraj | 30.488 | 0,69% | Novgorodskaja Oblast | 23.839 | 0,60% | Vladimirskaja Oblast | 18.854 | 0,47% |
| Murmanskaja Oblast | 29.250 | 0,66% | Rostovskaja Oblast | 20.292 | 0,51% | Irkutskaja oblast | 18.142 | 0,45% |
| Nižegorodskaja Oblast | 27.513 | 0,62% | Nižegorodskaja Oblast | 19.828 | 0,50% | Tomskaia Oblast | 16.279 | 0,41% |
| Celjabinskaja Oblast | 27.069 | 0,61% | Tverskaja Oblast | 19.398 | 0,49% | Nižegorodskaja Oblast | 15.101 | 0,38% |
| Respublica Komi | 23.226 | 0,52% | Respublika Baškortostan | 19.360 | 0,49% | Kostromskaja Oblast | 13.102 | 0,33% |
| Stavropolskij kpaj | 21.753 | 0,49% | Cuvašskaja Respublika | 18.169 | 0,46% | Novgorodskaja Oblast | 12.085 | 0,30% |
| Tulskaja Oblast | 20.467 | 0,46% | Orlovskaja Oblast | 17.972 | 0,45% | Tulskaja Oblast | 11.775 | 0,29% |
| Novgorodskaja Oblast | 19.699 | 0,44% | Stavropolskij kpaj | 17.577 | 0,44% | Lipeckaja Oblast | 10.494 | 0,26% |
| OTHER REGIONS | 187.396 | 4,23% | OTHER REGIONS | 183.462 | 4,61% | OTHER REGIONS | 124.160 | 3,10% |
| **TOTAL RUSSIAN FEDERATION** | **4.429.000** | | **TOTAL RUSSIAN FEDERATION** | **3.980.000** | | **TOTAL RUSSIAN FEDERATION** | **4.002.000** | |

[38] Foreign capital flow in Russia are monitored by Goskomstat and by Central Bank of Russia. The two methods are different: Goskomstat relies on custom statistics and on questionnaires and its methods are sometimes changing; Central Bank uses its own system for monitoring capital inflow and adheres to international standard for FDI data collection as indicated by international Monetary Fund. Due to different computation methods, the two sources may differ but, as Broadman and Recanatini (2001) point out, generally they have the same magnitude. In the present work we rely on Goskomstat data.

**Table 3.4 (end): Distribution of Foreign Direct Investments across the top 25 recipient regions (2000-2005, thousands US Dollars)**

| REGION | FDI 2003 | % | REGION | FDI 2004 | % | REGION | FDI 2005 | % |
|---|---|---|---|---|---|---|---|---|
| G. Moskva | 2.482.963 | 36,62% | Sachalinskaja Oblast | 3.272.077 | 34,74% | Sachalinskaja Oblast | 3.800.751 | |
| Sachalinskaja Oblast | 2.007.726 | 29,61% | G. Moskva | 1.857.211 | 19,72% | Omskaia Oblast | 3.081.021 | |
| Moskovskaja Oblast | 706.769 | 10,42% | Lipeckaja Oblast | 1.077.771 | 11,44% | G. Moskva | 2.060.419 | |
| Tjumenskaja Oblast | 178.340 | 2,63% | Tjumenskaja Oblast | 776.637 | 8,24% | Moskovskaja Oblast | 1.098.218 | |
| Krasnodarskij kpaj | 143.911 | 2,12% | Moskovskaja Oblast | 762.905 | 8,10% | Tjumenskaja Oblast | 734.690 | |
| Leningradskaja Oblast | 118.156 | 1,74% | Samarskaja Oblast | 159.864 | 1,70% | Krasnodarskij kpaj | 298.032 | |
| Apchangelskaja Oblast | 105.895 | 1,56% | Kostromskaja Oblast | 144.136 | 1,53% | G. Sankt-Peterburg | 249.439 | |
| Novgorodskaja Oblast | 101.085 | 1,49% | Leningradskaja Oblast | 132.575 | 1,41% | Leningradskaja Oblast | 222.290 | |
| Respublika Tatarstan | 77.054 | 1,14% | G. Sankt-Peterburg | 111.909 | 1,19% | Novgorodskaja Oblast | 178.733 | |
| Sverdlovskaja Oblast | 75.599 | 1,11% | Celjabinskaja Oblast | 104.259 | 1,11% | Vladimirskaja Oblast | 137.319 | |
| Samarskaja Oblast | 72.077 | 1,06% | Respublika Baškortostan | 89.005 | 0,94% | Kostromskaja Oblast | 136.389 | |
| G. Sankt-Peterburg | 70.283 | 1,04% | Respublika Tatarstan | 79.225 | 0,84% | Apchangelskaja Oblast | 99.533 | |
| Astrachanskaja Oblast | 54.767 | 0,81% | Novgorodskaja Oblast | 71.154 | 0,76% | Kemerovskaja Oblast | 98.696 | |
| Omskaia Oblast | 44.270 | 0,65% | Krasnodarskij kpaj | 62.692 | 0,67% | Amurskaja Oblast | 95.330 | |
| Primorskij kraj | 42.406 | 0,63% | Sverdlovskaja Oblast | 62.579 | 0,66% | Rostovskaja Oblast | 60.185 | |
| Vladimirskaja Oblast | 42.257 | 0,62% | Primorskij kraj | 60.814 | 0,65% | Respublika Tatarstan | 54.520 | |
| Nižegorodskaja Oblast | 41.469 | 0,61% | Citinskaja Oblast | 50.574 | 0,54% | Respublika Baškortostan | 51.465 | |
| Kostromskaja Oblast | 39.472 | 0,58% | Vladimirskaja Oblast | 50.058 | 0,53% | Stavropolskij kpaj | 48.039 | |
| Tomskaia Oblast | 38.860 | 0,57% | Nižegorodskaja Oblast | 42.719 | 0,45% | Tomskaia Oblast | 47.068 | |
| Rostovskaja Oblast | 30.801 | 0,45% | Amurskaja Oblast | 42.569 | 0,45% | Nižegorodskaja Oblast | 39.705 | |
| Irkutskaja oblast | 26.122 | 0,39% | Jaroslavskaja Oblast | 34.322 | 0,36% | Samarskaja Oblast | 38.336 | |
| Respublika Sacha (Jakutija) | 22.894 | 0,34% | Kurskaja Oblast | 26.828 | 0,28% | Respublika Mordovija | 34.124 | |
| Vologodskaja Oblast | 18.860 | 0,28% | Rostovskaja Oblast | 26.206 | 0,28% | Respublica Komi | 32.444 | |
| Celjabinskaja Oblast | 17.684 | 0,26% | Kpasnojarskji kraj | 25.682 | 0,27% | Lipeckaja Oblast | 27.655 | |
| Respublika Mordovija | 15.788 | 0,23% | Tulskaja Oblast | 23.158 | 0,25% | Tulskaja Oblast | 25.599 | |
| OTHER REGIONS | 205.492 | 3,03% | OTHER REGIONS | 273.071 | 2,90% | OTHER REGIONS | n.a. | |
| **TOTAL RUSSIAN FEDERATION** | **6.781.000** | | **TOTAL RUSSIAN FEDERATION** | **9.420.000** | | **TOTAL RUSSIAN FEDERATION** | **n.a.** | |

*Source: Russian Federal Statistic Service – Goskomstat*

**Table 3.5: Explanation of the variables included in the survey**

| | |
|---|---|
| **FDI** | Natural logarithm of regional Foreign Direct Investments in thousand US dollars as provided by *Goskomstat*. |
| **Spatial lag FDI** | Natural logarithm of the regional Foreign Direct Investments weighted by the spatial lag matrix constituted by the inverse of the distances among 77 Russian regions |
| **Distance source country** | Distance between recipient regions and principal source countries weighted by the ratio of FDI originated by the individual countries to the total amount of FDI. |
| **Market size** | It is the natural logarithm of the regional GDP expressed in million rubles as provided by *Goskomstat*. |
| **Skilled labour** | Release of qualified workers (At the end of year; out of thousand people) as provided by *Goskomstat*. |
| **Transport** | Density of Railways (at the end of the year; Kilometres of ways out of 10,000 square kilometres of territory) as provided by *Goskomstat*. |
| **Export** | Logarithm of regional exports measured in current prices in million US dollars as provided by *Goskomstat*. |
| **Surrounding market potential** | Regional GDP weighted by the spatial matrix constituted by inverse distances among regions as provided by *Goskomstat*. |
| **Natural resources** | Tonnes of oil and gas produced in the region weighted by the regional population as provided by *Goskomstat*. |
| **Investment risk** | Investment rating of Russia's regions as provided by the national rating agency "Expert RA". |

## 3.7. Results

In this section we illustrate our results obtained through the use of a system GMM estimator *à la* Blundell and Bond (1998). *Table 3.6* displays results for 5 different specifications of our baseline model. We start presenting results for a simple spatial lag estimation in which we include both the time and the space lag of the level of FDI. the two variables turn out to be very significant and confirm the hypothesis of a high persistency of FDI both over time and across space (column 1). The spatial dimension of the analysis is completed with the inclusion of our variable which accounts for the distance from the main source countries. This last appears also to be very significant and with the expected sign (the sign is positive because we are considering as weights the inverse of the distances). Remarkable is also the effect on the spatial lag, which remains significant and with same sign but rescaled in magnitude (column 2). This confirms the importance of considering the two spatial effects simultaneously.

**Table 3.6: Determinants of FDI across 77 Russian regions over the period 2000-2004**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | l_fdi | l_fdi | l_fdi | l_fdi | l_fdi |
| Lag Dependent Variable | 0.113 | 0.119 | 0.082 | 0.072 | -0.021 |
| | (0.020)*** | (0.017)*** | (0.021)*** | (0.023)*** | (0.019) |
| Spatial Lag | 3.03 | 2.784 | 2.288 | 2.147 | 1.391 |
| | (0.102)*** | (0.089)*** | (0.098)*** | (0.152)*** | (0.227)*** |
| Distance Source Countries | | 97.707 | 69.463 | 45.534 | -7.666 |
| | | (4.618)*** | (20.095)*** | (24.683)* | (16.37) |
| Market Size | | | -0.168 | -0.144 | -0.345 |
| | | | (0.147) | (0.152) | (0.113)*** |
| Skilled Labour | | | 0.269 | 0.27 | 0.181 |
| | | | (0.011)*** | (0.010)*** | (0.014)*** |
| Transport | | | 0.004 | 0.005 | 0.006 |
| | | | (0.001)*** | (0.002)*** | (0.002)*** |
| log Export | | | 0.174 | 0.157 | 0.304 |
| | | | (0.062)*** | (0.067)** | (0.071)*** |
| Surrounding Market | | | | 1.18 | 1.007 |
| | | | | (0.377)*** | (0.281)*** |
| Oil & Gas | | | | | -0.021 |
| | | | | | (0.013) |
| Investment Risk | | | | | -5.669 |
| | | | | | (0.281)*** |
| Constant | -26.218 | -25.615 | -21.841 | -33.442 | -13.324 |
| | (1.144)*** | (1.029)*** | (1.337)*** | (3.028)*** | (1.705)*** |
| Observations | 340 | 340 | 315 | 315 | 313 |
| Number of Years | 5 | 5 | 5 | 5 | 5 |
| Number of Instruments | 313 | 323 | 315 | 315 | 313 |
| | | | | | |
| **Diagnostic Tests** | | | | | |
| **Arellano-Bond test for AR(1) in first differences:** | | | | | |
| z = | -2.22 | -2.22 | -2.17 | -2.17 | -2.12 |
| Pr > z = | 0.027 | 0.026 | 0.03 | 0.03 | 0.034 |
| **Arellano-Bond test for AR(2) in first differences:** | | | | | |
| z = | 1.01 | 0.23 | -1.56 | -1.46 | -1.12 |
| Pr > z = | 0.311 | 0.818 | 0.119 | 0.143 | 0.263 |
| **Hansen test of over-identifying restrictions:** | | | | | |
| chi2(22) | 4.61 | 4.5 | 0 | 0 | 0 |
| Prob > chi2 | 1 | 1 | 1 | 1 | 1 |

Robust standard errors in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%

To our core specification we then add other control variables to account for important factors affecting FDI as highlighted in the literature and some control variables which have been found relevant for the Russian context. Column 3 displays results for the market size, skilled labour, transport and export (as a proxy for openness). The market size and the skilled labour are both not significant. Transport and export are instead found to be strongly significant with the expect positive signs. This would confirm the hypothesis of the export platform as a driving force to attract FDI. Such a result is confirmed by the

fourth column of *Table 3.6*, where also the surrounding market potential is found very significant and with the expected sign.

We conclude the analysis by including the production of hydrocarbons (Oil & Gas) and the indicator for investment risk (Column 5). Quite striking is the insignificant negative sign relating oil and gas, which are pervasive in all the aspects of the Russian economy. This could be explained by the high level of capture that the state has been implementing with respect to the natural resource sector, preventing the penetration of foreign investors. The investment risk is instead found to play significantly a negative role in reducing the attractiveness of Russian regions as a possible location for foreign investors. It is worth to remark that when adding the effect of the investment risk, the effect of the distance from the source countries becomes insignificant, suggesting that the more a region is remote from the principal international investor, the more it is exposed to a qualitatively and institutionally poor investment environment.

The lower part of *Table 3.6* reports all the diagnostics which are necessary to assess the quality of the estimates through a dynamic GMM estimator. It should be first noticed that the number of observations decrease as we add new variables due to the missing values reported for some of them. Second, it is important to be noticed that all the test provide satisfactory results for the estimates: autocorrelation of the first order is always present as it should be by construction; second order autocorrelation always absent; and the model is not overidentified.
Referring to the Bloningen framework as synthesized in *Table3.7,* our econometric analysis suggests that in Russia the main driving force attracting foreign investor is a vertical specialisation with agglomeration (as expressed by the always positive significant coefficient associated to the special lag) coupled with a market potential in the surroundings of the recipient region.

**Table 3.7: Summary of hypothesized spatial lag coefficient and market potential effect for various forms of FDI**

| FDI MOTIVATION | Sign of spatial lag | Sign of market potential |
|---|---|---|
| Pure Horizontal | 0 | 0 |
| Export-platform | - | + |
| Pure Vertical | - | 0 |
| Vertical Specialization with Agglomeration | +*** | +*** |
| *** significant at a 1% level in our analysis | | |

*Source: Blonigen et al., 2007*

### 3.8. Concluding remarks

In this paper we conducted an analysis of the determinants of FDI towards the Russian Federation. We started providing a background for our analysis highlighting main findings of both the economic literature concerning FDI and the literature pertaining to the FDI in the Russian context. We then introduced our methodology, which encompasses simultaneously two spatial effects, distances among the 77 Russian regions and distance of the recipient regions from to the source countries.

Our results suggest that in the Russian context FDI are mainly driven by vertical specialization with agglomeration motivation. In addition, more remote (with respect to source countries) regions tend to be also less legally prepared to attract foreign investors. This raises a possible strand of research for further work in the field, in order to assess how the presence of foreign investors is beneficial to the institutional environment of Russian regions. Strikingly we have not found evidence of a positive correlation between FDI and the regional endowment of hydrocarbons and market size.

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Chapter 4

# Whither the Indian Union? Regional Disparities and Economic Reforms

## 4.1. Introduction

The issue of whether states and regions at different levels of development tend to converge to a common growth pattern has attracted considerable attention since the pioneering work by Barro and Sala-i-Martin in the early 1990s (see Barro and Sala-i-Martin, 2003). This original line of enquiry was mainly aimed at testing the prediction of (conditional) convergence to a common equilibrium growth path implied by the exogenous growth model by Solow (1956), as contrasted to the prediction of no convergence that was implied by most growth models of the endogenous growth variety.

Several studies covering different time periods have investigated whether per capita income levels have been converging or diverging in India. Most of them tend to lend support to the view that the recent pattern of growth in the Indian Union has been characterised by an increasing *divergence* across States in terms of GDP per capita[39]. A number of possible explanations have been put forward to account for this inequality in economic performance. The ability of individual states to attract foreign investors appears to have been greater for richer states, and this could have contributed to widen the gap with the poorer states (Bhattacharya and Sakthivel, 2004, and Purfield, 2006). A further element of divergence could be traced to the heavy backwardness of rural areas, which combined with an excessive rate of population growth could have trapped them into a vicious circle of poverty the. Under this respect, Besley and Burgess (1998) argue that poverty has decreased more markedly in States where land reform on tenancy and the abolition of intermediaries have been pursued more rigorously. Finally, divergence could have resulted from differences in the quality of infrastructures. Nagaraj, Varoudakis and Véganzonès (2000) carry out a multidimensional analysis of the long-run sources of growth across Indian States to show that infrastructures are the single most important determinant of success or failure in economic

[39] However, the economic literature appears to be far from conclusive in stating whether the economic growth pattern in India, especially before the 1990s, has been univocally characterized by convergence or divergence in terms of per capita income, For example, Cashin and Sahay (1996), controlling for internal migration, support the idea of a slow convergence pace characterizing the pre-reform period (1961-1991), while Das (2002) shows that regional wage rate per capita converged across Indian states between 1956-57 to 1992-93. Bandyopadhyay (2003) establishes the existence of two income convergence clubs over the period 1965 to 1998 and finds that income disparities across states had declined during the 1960s but have increased over the following three decades. Finally, Adabar (2003), making use of data from 1976-77 to 2000-01, provides evidence of a conditional convergence rate in the order of 12% across the 14 major states of the Union.

performance. This could also explain why some States like Haryana and Punjab have performed relatively well when compared to other areas of the country with a similar share of agriculture.

Particular attention has been paid to the role of the economic reforms implemented since the economic recession in 1991. If at the aggregate level the reforms have unambiguously stimulated growth, at the regional level their effect has been much more controversial. Kochhar *et al.* (2006) argue that consequences of reforms and of increased decentralisation have been twofold. At the level of the overall economy, liberalisation measures have improved India's economic performance. At the state level, however, they have generated disparities in the levels of income through the differential impact of liberalisation across regions (see also Ahluwalia, 2000). Fast growing peninsular states appear to have reached production standards not too far from Western ones, while states of the hinterland continue to be relatively poor.

The purpose of this paper is to explore the main determinants of long-run growth across Indian states both before and after the reforms launched in the early 1990s. One of the main novel aspects of our convergence analysis is the attention paid to the spatial pattern of growth across Indian states. The spatial effects are introduced in a twofold setting. We indeed consider both distances (measured in highway kilometres between the capitals of the states) and neighbourhood (common borders among states) as possible factors affecting the rate of growth of individual states. It will be found that the location of states is an important factor affecting their performance, and that the neglecting spatial effects can contribute to the overestimation of the convergence rate. Another innovative contribution is the dynamics of sectoral shares during the two and half decades, and their specific role on state growth performance.

Our results seem to go in favour of the hypothesis that Indian States experienced divergence in the 1980s and 1990s, but at a more pronounced pace since the trade liberalization reforms. We argue that the pattern of divergence has acquired a very significant spatial connotation. Coastal states have benefited the most from the increased level of openness. By contrast, landlocked rural areas have fared worse and have generally lagged behind. However, states like Haryana and Punjab have been able to attain high levels of performance despite their mainly rural production structure and their landlocked status, due to the successful implementation of rural reforms together with improved irrigation systems and high availability of arable land.

The structure of this paper is as follows. Section 2 looks at the main characteristics of Indian States, with particular regard to the process of reforms that has accompanied the acceleration in growth of the Indian economy. Section 3 analyses the pattern of convergence or divergence across Indian states both for the whole period since 1980 and separately for the pre- and post-reform periods. Section 4 explores the geographical dimension of the dynamics of divergence by

introducing spatial econometric models. We can thus carry out a three-dimensional analysis of divergence patterns by considering differences over time, sectors and space. Section 5 draws the main conclusions.

## 4.2. Facts and data about Indian states

### 4.2.1. The Indian states: an overview

The Indian Union is constituted by twenty-eight states and seven federally governed Union Territories, populated by more than one billion people. Due to the sheer size and complexity of its territory, together with its highly heterogeneous socio-economic and cultural background, India appears to have the characteristics of a continent rather than a single country. The Indian Union includes more than one third of the poor people in the world. Despite this, India is the main exporter of highly-skilled software engineers, financial service analysts and pharmaceutical researchers. India is a nation with 35 towns exceeding 1 million people, but, at the same time, a country where 70% of the population live in rural areas and are still extremely dependent on the luck of the rainfall every year. Furthermore, India is the nation with the highest number of official languages in the world. Nonetheless, thanks to the young and educated generations who are fluent in English, the Indian economy is an attractive destination for global companies, which increasingly are outsourcing their customer services and technical support and have also started to channel foreign direct investment into the Union.

The heterogeneity that characterizes India emerges also at a regional level. For example, one difference across the states concerns their size and their population density. The population of India amounted to 1.1 billion people in 2004, but around 450 million of them were concentrated in just 4 states: Uttar Pradesh, Maharashtra, Bihar and West Bengal. Uttar Pradesh, one of the poorest states of the Union, is the most populated state of India, with 179 million inhabitants. Other states, as Goa, Manipur or Meghalaya accounted for few millions of people. The average population of the 24 states in the sample was 46 million, comparable to larger European countries. As noted by Bhattacharya and Sakthivel (2004), the size of population can impact negatively on economic growth, in particular in rural areas where the demographic growth rate is still high relative to the national average. Numerous other differences stem from institutional, political and cultural factors. First, the nature of India's federal system assigns different taxation powers to the Central

Government and to the States, depending on whether the source of income is agriculture or non-agriculture (Rao and Singh, 2006). For example, states are allowed to levy taxes on the sale and purchase of goods but not on services, and therefore this could have a different impact on economic performance depending on the regional specialization. Secondly, there are wide differences in the political composition of the state governments. Two extreme cases are represented by Kerala, where communist parties have been in power since the 1950s, and Maharashtra, where the BJP, the principal opponent to the Congress Party, has guided the state during the liberalization process in the 1990s. The nature and the quality of institutions can induce profound differences in policy choices, especially during the years of liberalisation of trade and factor markets, with significant effects on the growth process (Rodrik and Subramanian, 2004, and Purfield, 2006). Moreover, a further element of heterogeneity across states is the continued presence of caste and ethnicity systems (Gang, Sen and Yun, 2002) that still appear to play a strong role mainly in rural states, contributing to trapping them in a persistent condition of backwardness (see also Mehta and Shah, 2003). Finally, differences can emerge from the presence of large metropolitan areas that operate as industrial districts (*e.g.* Ahmedabad, Gujarat), poles of attraction for FDI (Mumbai, Maharashtra) and sites for IT companies (Bangalore, Karnataka). The positive impact of the degree of urbanization becomes even stronger when coupled with a strategic geographic position. For example, access to the sea seems to play a key role. This was especially evident during the liberalization process in the 1990s that opened India's market to the rest of the world. In general, the presence of these centres "can serve both the internal market and the international market, and can more make logistical links with foreign suppliers and customers[40]" than interior areas.

A more detailed picture of the Indian Union can be obtained by looking at the evolution of the set of economic policies implemented in the last three decades. After the Green Revolution that virtually eliminated famine in India, the next big push took place under the governments of Indira and Rajiv Gandhi during the 1980s and especially since the early 1990s with the process of trade liberalisation. These reforms not only influenced the rhythm of economic growth of the country, but also produced deep transformations into the structure of the Indian economy, and the changes in the specialisation of states have played a significant role in explaining their economic performance in the more recent period.

*The 1970s*

The process of reforms in India can be traced back to the agricultural policies under the Green Revolution period. Between 1967 and 1978 important efforts were made to reduce the gap between

[40] Sachs, Bajpai and Ramiah (2002).

population growth and food production, through the introduction of high-yielding seed varieties and through the implementation of tenancy and ceiling-redistributive reforms and of land consolidation. The process of modernization of agriculture has ensured that Indians have more food on average, and the impact of land reforms on poverty has been positive leading to a rise in agricultural wages (Besley and Burgess, 2000). However, it would appear that the Green Revolution has not produced even results across all rural areas (Ghatak and Roy, 2007), and that greater efficiency in redistribution policy is still needed (Land Research Action Network, 2003). The highest increment in agricultural production was registered in Punjab, where it grew at an annual rate of 4.5% on average between 1970-1994. Successful reforms have also been implemented in Haryana, but other States, like Bihar, that were poorer and still largely dependent on rural sectors, recorded a rate of growth of just 1.5% (see Table 2 in Mearns, 1999).

*The 1980s*

The second wave of reforms is identified with the "pro-business" policies initiated by Indira[3] and accentuated by Rajiv Gandhi during the 1980s (see De Long, 2003, Panagariya, 2004, Rodrik and Subramanian, 2004 and Kohli, 2006*a*). These policies were mainly directed at increasing the productivity of firms through the simplification of the licence system and the relaxation of industrial controls, thereby allowing new investments and product diversification and letting private companies enter into those sectors that used to be monopolies of the Centre. This strategy was accompanied by high trade barriers in order to promote the creation and consolidation of firms and shield them from foreign competition. Chari (2007) estimates that relative Total Factor Productivity (TFP) improvement in the deregulated industries was about 32% over a period of ten years following the licence reform. The industrial sector experienced a sustained growth in states like Gujarat, Punjab and Maharashtra (Bhide, Chadha and Sakthivel, 2005). States specialising in manufacturing activities appear to have played a key positive role in driving and sustaining Indian growth in the 1980s, while in the previous decades their impact on growth had been opposite in

[3] It is interesting to underline that, after returning to power in 1980, Indira Gandhi made a break with the democratic socialist content of Nehru's statist model of development, abandoning the redistributive thrust of her rhetoric and policies and prioritising economic growth as the state's main goal. As written by Kohli (2006a, pp. 1255-1256) "What eventually triggered the upward shift in the growth rate of the Indian economy around 1980 was a slow but sure adoption of a new model of development. Instead of the statist and the nationalist model of development of the Nehru era, that was then accentuated in a populist direction by Indira Gandhi during the 1970s, Indira Gandhi herself shifted India's political economy around 1980 in the direction of a state and business alliance for economic growth. This change was not heralded loudly and has often been missed by scholars, especially because Indira Gandhi remains deeply associated with the politics of 'garibi hatao'. Nevertheless […] evidence shows that the post-Emergency Indira Gandhi was a different Indira Gandhi: she downplayed redistributive concerns and prioritised economic growth; sought an alliance with big business; adopted an anti-labour stance; put brakes on the growth of public sector industries; and demoted the significance of economic planning and of the Planning Commission. […] Starting in the early 1980s then, Indira Gandhi's government initiated a series of pro-business policy reforms."

sign. In addition, it has been noted that the manufacturing industry exerted a positive impact on the convergence process if the registered or large scale sector is considered, while unregistered or small scale manufacturing, which constitute the majority of the secondary sector, showed no clear sign towards convergence or divergence in the Indira and Rajiv Gandhi's period (Nair, 2004).

*The 1990s.*

This policy stance changed with the "pro-market" attitude of the new governments in the aftermath of the financial and political crisis in 1991[4] (Kohli, 2006*b*). The pro-liberalization reforms opened the Indian market to foreign competition. Even if trade barriers were lowered very gradually (Ahluwalia, 2002*a*), these new policies stimulated an increase in Indian trade and a jump in FDI inflows. In particular, some states like Karnataka, Andhra Pradesh and Tamil Nadu, thanks to the foreign investments[5] experienced a sustained growth of the IT activities, especially in towns like Bangalore, Hyderabad and Chennai where a highly mobile skilled and low-wage labour force was present. The activities in these areas have permitted India to become the major exporter of IT products in the world at the beginning of the new millennium (Chauvin and Lemoine, 2003). Even though this new wave of reforms also affected the deregulation of industry, most of the emphasis was placed on the liberalization of trade in services. This was achieved by opening up the insurance, banking, telecommunications and infrastructure sectors to the private sector, including foreign investors. The expansion of services during the 1990s seems to replace manufacturing as the engine of Indian growth, although an effective introduction of the new technologies into the rest of the economy must still be implemented (D'Costa, 2003, and Dasgupta and Singh, 2005).

The Green Revolution, the "pro-business" and the "pro-market" policies have drastically changed the pattern of growth of India, transforming what still is a rural country into one of the fastest growing economies in the world. The impact of these changes on the performance and on the economic structure of the states is the topic of next section.

[4] In this year India recorded a negative growth of about 1% in terms of per capita income mainly due the unsustainable external borrowings and public expenditure of the previous years. Furthermore, the crisis was emphasized by the assassination of Rajiv Gandhi, by the collapse of Soviet Union that was one of the main India's trade partners and by the oil price shock connected with the Gulf war. Basu and Maertens (2007) provide a useful account of the events that led up to the crisis.

[5] One hundred percent foreign investment was permitted in information technology units set up exclusively for exports. These units can be set up under several schemes, including Export Oriented Units, Export Processing Zones, Special Economic Zones, Software Technology Parks, and Electronics Hardware Technology Parks (Panagariya, 2004).

### 4.2.2. State-level growth performance and sector specialization

India's new accelerated pattern of growth can be traced back to the beginning of the 1980s under the Indira Gandhi's government. The economy started to grow at about 6% per year, leaving behind the "Hindu rate" of growth of the previous decades, which stagnated at around 3.5% between 1950 and 1980. As a consequence of the expansion of the economy, the average Net State Domestic Product (NSDP) per capita of the 24 states of our sample increased from 1,756 rupees in 1980 to 3,967 rupees in 2004 (Table 4.1). The most striking aspect of the table is that the six richest states at the beginning of the period – Delhi, Goa, Punjab, Maharashtra, Haryana and Gujarat – maintained the top positions in 2004. Similarly, the group of the six poorest states also remained very stable, with Bihar, Uttar Pradesh, Madhya Pradesh, Orissa and Assam locked in the bottom positions (even if these two last states left the bottom group in the first half of the 1980s and Madhya Pradesh entered in 1985). In the most recent period, after a long period of slow growth because of the continued tensions between India and Pakistan for the control of the territory, Jammu and Kashmir joined the group of the six poorest states. Important considerations also emerge from the middle part of the table, where states like Tamil Nadu and Karnataka gained positions during the period. Furthermore, the north-eastern state of Arunachal Pradesh appears in the top group in the first half of 1990s replacing Gujarat, while between 1985 and 1990 Tripura, Meghalaya and Rajasthan leave the bottom group and maintain middle and middle-low positions in the next years.

## Table 4.1. Per Capita Net State Domestic Product (NSDP) at constant (1980) Indian Rupees

| | 1980 | | 1985 | | 1990 | | 1995 | | 2000 | | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Delhi** | 4030 | **Delhi** | 4665 | **Delhi** | 5447 | **Delhi** | 6580 | **Delhi** | 9108 | **Delhi** | 10764 |
| **Goa** | 3145 | **Punjab** | 3249 | **Goa** | 4883 | **Goa** | 5952 | **Goa** | 8535 | **Goa** | 8232 |
| **Punjab** | 2674 | **Goa** | 3091 | **Punjab** | 3730 | **Maharashtra** | 4533 | **Maharashtra** | 4880 | **Maharashtra** | 6125 |
| **Maharashtra** | 2435 | **Haryana** | 2893 | **Haryana** | 3509 | **Punjab** | 4120 | **Punjab** | 4774 | **Haryana** | 5327 |
| **Haryana** | 2370 | **Maharashtra** | 2705 | **Maharashtra** | 3483 | **Haryana** | 3645 | **Haryana** | 4372 | **Punjab** | 5308 |
| **Gujarat** | 1940 | **Gujarat** | 2186 | **Arunachal Pradesh** | 2709 | **Arunachal Pradesh** | 3607 | **Gujarat** | 3753 | **Gujarat** | 5072 |
| Jammu and Kashmir | 1776 | Arunachal Pradesh | 2119 | Gujarat | 2641 | Gujarat | 3501 | Tamil Nadu | 3691 | West Bengal | 4394 |
| West Bengal | 1773 | West Bengal | 1929 | Himachal Pradesh | 2241 | Tamil Nadu | 2883 | Karnataka | 3645 | Karnataka | 4249 |
| Himachal Pradesh | 1704 | Jammu and Kashmir | 1832 | Tamil Nadu | 2237 | West Bengal | 2683 | Arunachal Pradesh | 3530 | Arunachal Pradesh | 3991 |
| Arunachal Pradesh | 1571 | Tamil Nadu | 1798 | West Bengal | 2145 | Himachal Pradesh | 2589 | West Bengal | 3507 | Tamil Nadu | 3977 |
| Karnataka | 1520 | Himachal Pradesh | 1781 | Andhra Pradesh | 2060 | Karnataka | 2573 | Himachal Pradesh | 3261 | Himachal Pradesh | 3963 |
| Kerala | 1508 | Nagaland | 1653 | Karnataka | 2039 | Andhra Pradesh | 2429 | Tripura | 3070 | Andhra Pradesh | 3718 |
| Tamil Nadu | 1498 | Karnataka | 1644 | Nagaland | 1976 | Kerala | 2336 | Andhra Pradesh | 3068 | Tripura* | 3638 |
| Manipur | 1419 | Manipur | 1598 | Rajasthan | 1942 | Nagaland | 2293 | Kerala | 2822 | Kerala | 3509 |
| Andhra Pradesh | 1380 | Andhra Pradesh | 1573 | Kerala | 1815 | Rajasthan | 2073 | Nagaland | 2727 | Nagaland** | 2922 |
| Meghalaya | 1361 | Assam | 1510 | Jammu and Kashmir | 1784 | Jammu and Kashmir | 1915 | Rajasthan | 2349 | Rajasthan | 2831 |
| Nagaland | 1361 | Kerala | 1507 | Manipur | 1739 | Tripura | 1865 | Meghalaya | 2311 | Meghalaya | 2750 |
| Madhya Pradesh | 1358 | Orissa | 1442 | Meghalaya | 1733 | Meghalaya | 1838 | Manipur | 2204 | Manipur | 2579 |
| *Orissa* | 1314 | *Meghalaya* | 1412 | *Madhya Pradesh* | 1696 | *Madhya Pradesh* | 1809 | *Jammu and Kashmir* | 2100 | *Jammu and Kashmir* | 2297 |
| *Tripura* | 1307 | *Madhya Pradesh* | 1409 | *Uttar Pradesh* | 1652 | *Manipur* | 1807 | *Madhya Pradesh* | 1917 | *Orissa* | 2262 |
| *Assam* | 1284 | *Uttar Pradesh* | 1375 | *Tripura* | 1642 | *Uttar Pradesh* | 1687 | *Uttar Pradesh* | 1789 | *Madhya Pr.* | 2195 |
| *Uttar Pradesh* | 1278 | *Rajasthan* | 1338 | *Assam* | 1544 | *Orissa* | 1640 | *Orissa* | 1749 | *Uttar Pradesh* | 1970 |
| *Rajasthan* | 1222 | *Tripura* | 1240 | *Orissa* | 1383 | *Assam* | 1595 | *Assam* | 1646 | *Assam* | 1862 |
| *Bihar* | 917 | *Bihar* | 1074 | *Bihar* | 1197 | *Bihar* | 915 | *Bihar* | 1285 | *Bihar* | 1266 |
| Average 24 states | 1756 | | 1959 | | 2384 | | 2786 | | 3421 | | 3697 |

Source: CSO

Notes:

- * 2003
- ** 2002

A clearer picture of the economic performance of the states is obtained by looking at the evolution of the growth rates of the NSDP per-capita. Table 2 ranks the states from the fastest to the slowest and emphasises in bold and in italics the performance of the six richest states and of the six poorest states respectively at the beginning of the five-years period. For instance Maharashtra, which was the fourth richest state in 1980, grew at 2.2% per year between 1980 and 1985. Overall, the table reveals some mixed results. During the 1980s, all the six richest states in 1980 show a rate of growth above the rate of 3.1% per year, which was the average growth rate among the 24 states, whereas five of the six poorest states experienced a growth path under the average. This may have contributed to exacerbating the income inequalities across states. Rajasthan, that had the 23$^{rd}$ income level in 1980, is the only exception with 5.6% average growth per year, the second highest rate after Arunachal Pradesh. It is interesting to underline that the only rich state that grows at a higher rate in the first half of the 1980s relative to the second half is Punjab. This may be due to the lasting effects of the Green Revolution. All the other five richest states increase or maintain their rate of growth: for example, Goa jumps from a negative rate to 9.8% in the second half of the 1980s. Among the poorest states, Assam, Bihar and Orissa face a decline between 1985 and 1990, but Meghalaya, Madhya Pradesh, Uttar Pradesh and, in particular, Rajasthan and Tripura show an increase in their rate of growth.

The following decade sees the poorest states continuing to grow below the national average, with the exception of Tripura, which experienced a remarkable performance between 1995 and 2000. Some of the richest states however face a decline in their growth. By contrast, the middle-income and coastal states of Kerala, Karnataka, West Bengal and Tamil Nadu exhibited an increasing rate of growth, possibly due to the liberalization process of the Indian economy and to the amount of new FDI inflows. It is also important to underline the performance of Bihar in the second half of the 1990s, when its economy grew at 7.5% per year after negative growth in the first half. The last four years see Gujarat and Maharashtra growing at a fast rate together with the poor state of Orissa, while West Bengal, Kerala and Tripura managed to maintain the pattern of growth of the previous years. Goa and Tamil Nadu have displayed a fall in the rate, while Bihar interrupts the positive trend of the late 1990s.

## Table 4.2. Per Capita NSDP average annual growth (in percentage)

| | 80-85 | | 85-90 | | 90-95 | | 95-00 | | 00-04 | | 80-90 | | 90-00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arunachal Pr. | 6.2 | **Goa** | 9.8 | Gujarat | 6.8 | Tripura | 10.5 | **Gujarat** | 7.9 | Arunachal Pr. | 5,7 | *Tripura* | 6.6 |
| **Haryana** | 4.2 | *Rajasthan* | 8.9 | **Arunachal Pr.** | 6.1 | **Goa** | 7.9 | *Orissa* | 6.8 | *Rajasthan* | 5,6 | Karnataka | 6.0 |
| Nagaland | 4.2 | *Tripura* | 5.8 | **Maharashtra** | 5.6 | *Bihar* | 7.5 | **Maharashtra** | 5.9 | **Goa** | 4,8 | **Goa** | 6.0 |
| **Punjab** | 4.0 | Andhra Pr. | 5.8 | Tamil Nadu | 5.3 | Karnataka | 7.3 | West Bengal | 5.8 | Andhra Pr. | 4,3 | **Delhi** | 5.4 |
| Tamil Nadu | 3.9 | **Maharashtra** | 5.3 | Kerala | 5.2 | **Delhi** | 6.8 | Tripura* | 5.8 | **Haryana** | 4,3 | Tamil Nadu | 5.2 |
| *Assam* | 3.4 | Arunachal Pr. | 5.2 | Karnataka | 4.8 | West Bengal | 5.5 | Kerala | 5.6 | Tamil Nadu | 4,2 | West Bengal | 5.0 |
| *Bihar* | 3.3 | **Gujarat** | 5.1 | West Bengal | 4.6 | Tamil Nadu | 5.1 | Rajasthan | 5.6 | Nagaland | 3,9 | Kerala | 4.5 |
| **Delhi** | 3.2 | Himachal Pr. | 4.8 | **Goa** | 4.1 | Andhra Pr. | 4.9 | **Haryana** | 5.1 | **Gujarat** | 3,9 | Gujarat | 4.2 |
| Andhra Pr. | 2.8 | Tamil Nadu | 4.5 | **Delhi** | 4.0 | Himachal Pr. | 4.8 | Himachal Pr. | 5.0 | **Maharashtra** | 3,7 | Andhra Pr. | 4.2 |
| **Gujarat** | 2.7 | Karnataka | 4.4 | *Orissa* | 3.6 | Meghalaya | 4.7 | Andhra Pr. | 4.9 | **Punjab** | 3,4 | Himachal Pr. | 3.9 |
| Manipur | 2.4 | **Haryana** | 4.3 | Andhra Pr. | 3.5 | Nagaland | 4.5 | Meghalaya | 4.4 | **Delhi** | 3,2 | Nagaland | 3.8 |
| *Orissa* | 2.3 | *Meghalaya* | 4.3 | Nagaland | 3.1 | *Manipur* | 4.2 | **Delhi** | 4.3 | Karnataka | 3,1 | **Maharashtra** | 3.6 |
| *Rajasthan* | 2.3 | *Madhya Pr.* | 4.0 | Himachal Pr. | 3.0 | Kerala | 3.9 | Manipur | 4.1 | Himachal Pr. | 3,0 | Meghalaya | 3.0 |
| **Maharashtra** | 2.2 | Kerala | 3.9 | *Tripura* | 2.7 | **Haryana** | 3.8 | Karnataka | 4.0 | *Bihar* | 2,8 | **Arunachal Pr.** | 2.9 |
| West Bengal | 1.8 | *Uttar Pradesh* | 3.8 | **Punjab** | 2.0 | **Punjab** | 3.0 | Nagaland** | 3.8 | *Uttar Pradesh* | 2,6 | *Orissa* | 2.6 |
| Karnataka | 1.7 | Nagaland | 3.7 | Rajasthan | 1.9 | Rajasthan | 2.7 | *Madhya Pr.* | 3.8 | Meghalaya | 2,5 | Manipur | 2.5 |
| *Uttar Pradesh* | 1.5 | **Delhi** | 3.2 | *Madhya Pr.* | 1.5 | J & K | 1.9 | Arunachal Pr. | 3.1 | *Tripura* | 2,4 | **Punjab** | 2.5 |
| Himachal Pr. | 1.1 | **Punjab** | 2.8 | J & K | 1.4 | Gujarat | 1.6 | *Assam* | 3.1 | Madhya Pr. | 2,4 | Rajasthan | 2.3 |
| Madhya Pr. | 0.8 | *Bihar* | 2.4 | Meghalaya | 1.3 | **Maharashtra** | 1.6 | **Punjab** | 2.7 | Manipur | 2,1 | **Haryana** | 2.3 |
| Meghalaya | 0.7 | West Bengal | 2.1 | Manipur | 0.8 | *Orissa* | 1.5 | *Uttar Pradesh* | 2.4 | West Bengal | 2,0 | J & K | 1.7 |
| J & K | 0.6 | Manipur | 1.7 | **Haryana** | 0.8 | *Madhya Pr.* | 1.4 | *J & K* | 2.3 | Kerala | 2,0 | *Madhya Pr.* | 1.5 |
| Kerala | 0.1 | Assam | 0.5 | *Assam* | 0.7 | *Uttar Pradesh* | 1.3 | Tamil Nadu | 2.0 | *Assam* | 1,9 | *Bihar* | 1.4 |
| **Goa** | -0.1 | Orissa | -0.1 | *Uttar Pradesh* | 0.4 | *Assam* | 0.6 | *Bihar* | 0.4 | *Orissa* | 1,1 | *Uttar Pradesh* | 0.9 |
| *Tripura* | -0.9 | J & K | -0.2 | *Bihar* | -4.8 | **Arunachal Pr.** | -0.3 | **Goa** | 0.4 | J & K | 0,2 | *Assam* | 0.7 |
| Average 24 states | 2.3 | | 4.0 | | 2.8 | | 4.0 | | 4.1 | | 3,1 | | 3,4 |

**Comment:** This column has been changed due to an error occurred in Delhi

Source: authors' calculations based on CSO data

Notes:

- * 2000-2003
- ** 2000-2002
- Based on table 1, richest states at the beginning of the period are in bold, while the poorest ones in italics.

These data yield some interesting conclusions that are summarized in Table 3. First of all, the six richest states have displayed, on average, a higher rate of growth than the six poorest ones in all the sub-periods analyzed. Furthermore, the second half of the 1980s is the best period in terms of growth for both groups, which displayed a very similar growth pattern. Finally, the ratio between the average per capita NSDP of the richest and of the poorest countries increased sharply during the second decade, especially in early 1990s when poorest states probably suffered the most from the crisis in 1991.

**Table 3. Per-capita NSDP comparison between richest and poorest states**

| **Average per-capita NSDP** | **1980** | **1985** | **1990** | **1995** | **2000** |
|---|---|---|---|---|---|
| 6 richest states | 2766 | 3132 | 3960 | 4740 | 5904 |
| 6 poorest states | 1220 | 1308 | 1519 | 1576 | 1748 |
| ratio | 2.27 | 2.39 | 2.61 | 3.01 | 3.38 |
| richest states exc. Delhi | 2513 | 2825 | 3663 | 4371 | 5263 |
| poorest states exc. Bihar | 1281 | 1355 | 1583 | 1708 | 1840 |
| ratio | 1.96 | 2.09 | 2.31 | 2.56 | 2.86 |
| **5-years average growth** | | | | | |
| 6 richest states | | 2.7% | 5.1% | 3.8% | 3.8% |
| 6 poorest states | | 2.0% | 4.9% | 0.7% | 2.8% |
| **Population ('000)** | **1980** | **1985** | **1990** | **1995** | **2000** |
| 6 richest states | 132541 | 148082 | 125856 | 141157 | 206245 |
| 6 poorest states | 258816 | 301276 | 345355 | 332966 | 379155 |
| richest states exc. Delhi | 126450 | 140536 | 116592 | 129874 | 192661 |
| poorest states exc. Bihar | 189575 | 224050 | 259698 | 261174 | 297282 |

Source: see Table 2

Even if fast and sustained growth of the Indian economy in the last twenty-five years has produced different results in terms of state-level performance, changes in its sectoral structure seem to have affected all the states, with a general shift form agriculture activities to the service sector (Table 4). Economic growth has been accompanied by a sharp reduction of the share of primary sectors on NSDP, from 43% of 1980 to 26% in 2004. This decrease has been absorbed by the growth of the manufacturing sector, especially in the second half of the 1980s – its share, stable at around 20% till 1985, jumps to 23% at the end of the decade and reaches 24% in 1995 – and by a rapid expansion of service activities. The tertiary sector, that experienced a stable growth pattern during the 1980s, has risen rapidly in the last ten years, and its share has reached 51% in 2004. These changes are confirmed by looking at the growth of the states with the highest share in the three sectors. The growth process has been principally driven by the states specialising in industry in the late 1980s, when also agricultural states registered a rate of growth of 4.4% per year, and in the early 1990s. During the second half of the 1990s states specialising in service have grown at a rate of 6% per year, and are still experiencing the fastest rate of growth in the more recent years.

Other interesting aspects emerge by looking at the evolution of the economy of some states. The share of agriculture is still high in the poor states of Orissa, Assam, Uttar Pradesh, and the production of primary items continues to have a strong impact on growth performance. This was the case for Bihar, which experienced a decrease in agricultural share from 47% to 41% and a negative growth between 1990 and 1995. However, agriculture seems to play a key role also in the rich state of Punjab, where its share is still about 40%. Among the most industrialized state, Gujarat is the only one that has experienced an increase of manufacturing share on NSDP. In Maharashtra and Tamil Nadu the manufacturing sector declined to the benefit of services in the last ten years. Furthermore, the share of manufacturing is also high in small states like Nagaland, Goa and Himachal Pradesh. It is interesting to underline that none of the poorest states appears in the top positions of the manufacturing shares rank, excluding Madhya Pradesh in 2000. However, this state experienced, as the previous case of Bihar, a fall in agricultural production, and consequently a slow rate of growth, between 1995 and 2000, and therefore a rise of non-agriculture share.

**Table 4.4. States specialization: shares of the six most specialized states in agriculture, manufacturing and services**

| | 1980 | | 1985 | | 1990 | | 1995 | | 2000 | | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Agriculture** | | | | | | | | | | | |
| Tripura | 0.559 | Orissa | 0.545 | Rajasthan | 0.486 | Punjab | 0.460 | Punjab | 0.421 | Punjab | 0.389 |
| Madhya Pradesh | 0.556 | Madhya Pradesh | 0.545 | Madhya Pradesh | 0.485 | Madhya Pradesh | 0.459 | Uttar Pradesh | 0.410 | Madhya Pradesh | 0.378 |
| Orissa | 0.553 | Arunachal Pradesh | 0.529 | Punjab | 0.483 | Orissa | 0.424 | Bihar | 0.374 | Uttar Pradesh | 0.374 |
| Bihar | 0.552 | Punjab | 0.511 | Bihar | 0.466 | Uttar Pradesh | 0.420 | Assam | 0.371 | Orissa | 0.354 |
| Haryana | 0.546 | Tripura | 0.509 | Arunachal Pradesh | 0.462 | Haryana | 0.418 | Orissa | 0.358 | Jammu and Kashmir | 0.352 |
| Uttar Pradesh | 0.523 | Rajasthan | 0.503 | Haryana | 0.457 | Rajasthan | 0.417 | Arunachal Pradesh | 0.357 | Rajasthan | 0.338 |
| Aver. 24 states | 0.433 | | 0.407 | | 0.362 | | 0.323 | | 0.283 | | 0.259 |
| NSDP per-capita average growth*** | 1.9% | | 4.4% | | 1.5% | | 2.3% | | 3.1% | | |
| **Manufacturing** | | | | | | | | | | | |
| Maharashtra | 0.351 | Maharashtra | 0.351 | Goa | 0.354 | Nagaland | 0.471 | Goa | 0.430 | Gujarat | 0.391 |
| Tamil Nadu | 0.335 | Gujarat | 0.331 | Maharashtra | 0.349 | Gujarat | 0.397 | Nagaland | 0.386 | Goa | 0.389 |
| Goa | 0.297 | Tamil Nadu | 0.314 | Gujarat | 0.346 | Maharashtra | 0.334 | Gujarat | 0.380 | Himachal Pradesh | 0.357 |
| West Bengal | 0.293 | Goa | 0.289 | Tamil Nadu | 0.331 | Tamil Nadu | 0.325 | Himachal Pradesh | 0.343 | Nagaland** | 0.311 |
| Gujarat | 0.272 | West Bengal | 0.265 | Nagaland | 0.299 | Himachal Pradesh | 0.322 | Madhya Pradesh | 0.291 | Maharashtra | 0.271 |
| Delhi | 0.249 | Delhi | 0.262 | Delhi | 0.290 | Goa | 0.321 | Tamil Nadu | 0.285 | Arunachal Pradesh | 0.270 |
| Aver.24 states | 0.197 | | 0.203 | | 0.225 | | 0.241 | | 0.236 | | 0.234 |
| NSDP per-capita average growth*** | 2.3% | | 5.0% | | 4.8% | | 4.2% | | 3.8% | | |
| **Services** | | | | | | | | | | | |
| Delhi | 0.708 | Delhi | 0.694 | Delhi | 0.677 | Delhi | 0.752 | Delhi | 0.746 | Delhi | 0.786 |
| Nagaland | 0.534 | Meghalaya | 0.489 | Meghalaya | 0.542 | Tripura | 0.596 | Manipur | 0.596 | Tripura* | 0.643 |
| Meghalaya | 0.436 | Goa | 0.487 | Manipur | 0.518 | Meghalaya | 0.578 | Tripura | 0.590 | Maharashtra | 0.603 |
| Manipur | 0.432 | Nagaland | 0.475 | Tripura | 0.507 | Manipur | 0.571 | Maharashtra | 0.555 | Manipur | 0.594 |
| Goa | 0.418 | Manipur | 0.472 | Goa | 0.488 | Goa | 0.544 | Meghalaya | 0.548 | Tamil Nadu | 0.593 |
| Tamil Nadu | 0.406 | Tripura | 0.446 | Assam | 0.457 | Maharashtra | 0.476 | Tamil Nadu | 0.539 | Kerala | 0.586 |
| Aver. 24 states | 0.370 | | 0.391 | | 0.413 | | 0.436 | | 0.481 | | 0.506 |
| NSDP per-capita average growth*** | 2.4% | | 4.7% | | 2.3% | | 6.0% | | 4.4% | | |

Source: see Table 2

Notes:

- * see table 1.
- ** see table 1.
- *** The average annual growth is referred to the next years

The poor states seem to suffer from an insufficient industrialization process, with 18% of the NSDP coming from secondary sector against 29% for the rich states. However, the expansion of the service sector appears to have affected both groups (Table 4.5): its share in the poor states jumped from 33% in 1980 to 47% in 2004, mirroring the increase in the rich states. Furthermore, while small states, like Goa and the western states Meghalaya, Manipur and Tripura, were overrepresented among the most specialized in services during the 1980s, the service expansion of the 1990s is mostly concentrated in bigger states like Tamil Nadu and Maharashtra. In the latter one, the share of the tertiary sector reached 60% of NSDP in 2004.

These aspects need further investigation, especially concerning the type of service activities in which the states specialize. In poorer states, the incidence of public administration and expenditures in health, education and poverty alleviation programmes are high and have displayed an increase in states like Orissa and Assam. Similar situations can be found in the small and middle-low income states of Western India. In the case of Goa or Tripura, over 25% of service activities are represented by tourism activities. By contrast, the growth of services in middle-high and high income states, notably in Maharashtra or Gujarat, has mainly been driven by banking, insurance and other financial activities, or by business services, including IT, such as in Tamil Nadu or Karnataka.

The description of the states' economic structure suggests some tentative conclusions. First, the economy of the poorer states still appears to be heavily dependent on agricultural activities. The low share of the secondary sector seems to be a reasonable cause of their persisting backwardness. These states probably have not taken advantage of the reforms, in particular in agriculture, where they failed to follow the successful example of Punjab or Haryana. Second, service expansion has been uneven across the states in terms of sub-sectors: the richest and most industrialized states appear to benefit the most from the support of growth-driven activities. Finally, business services and IT industry are mainly concentred in the south of India, where coastal and middle income states are located.

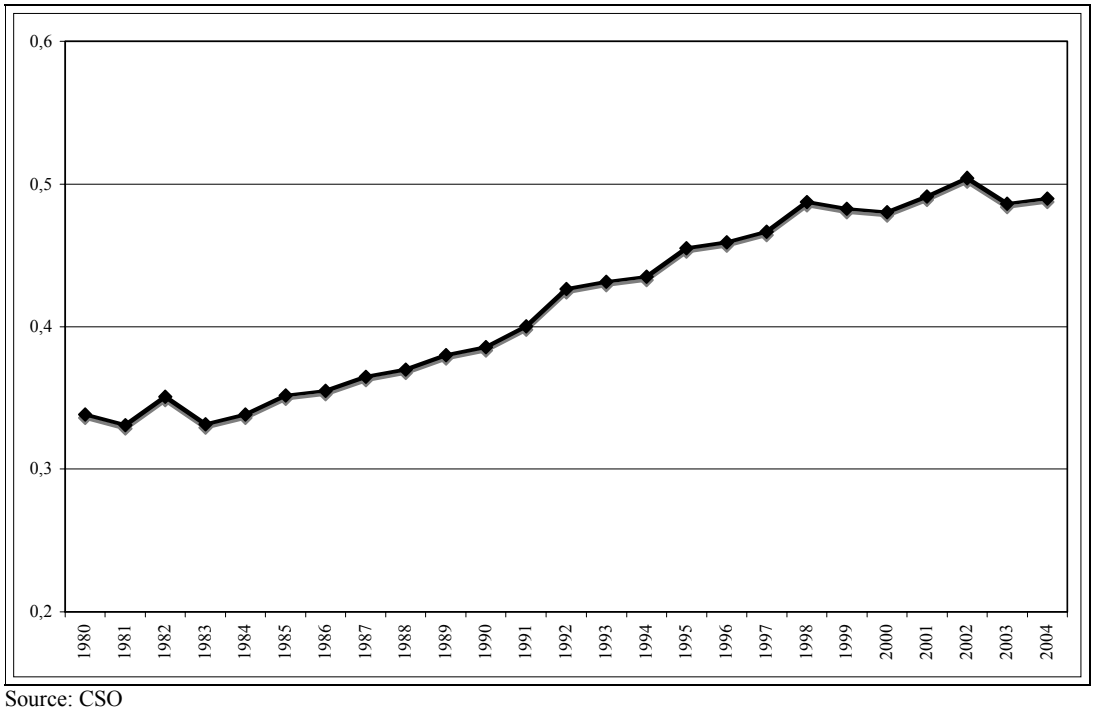
**Table 4.5. Average shares in agriculture, manufacturing and services of the richest and poorest states.**

| **Agriculture** | **1980** | **1985** | **1990** | **1995** | **2000** | **2004** |
|---|---|---|---|---|---|---|
| richest | 0.34 | 0.30 | 0.30 | 0.27 | 0.20 | 0.18 |
| richest without Delhi | 0.40 | 0.35 | 0.36 | 0.32 | 0.23 | 0.22 |
| poorest | 0.53 | 0.49 | 0.45 | 0.41 | 0.37 | 0.35 |
| **Manufacturing** | | | | | | |
| richest | 0.26 | 0.28 | 0.28 | 0.28 | 0.30 | 0.29 |
| poorest | 0.14 | 0.15 | 0.16 | 0.17 | 0.18 | 0.18 |
| **Services** | | | | | | |
| richest | 0.40 | 0.42 | 0.42 | 0.45 | 0.50 | 0.53 |
| richest without Delhi | 0.34 | 0.37 | 0.37 | 0.39 | 0.45 | 0.47 |
| poorest | 0.33 | 0.36 | 0.39 | 0.42 | 0.45 | 0.47 |

Source: see Table 2

To sum up, all the aspects emerged from this discussion underline how the growth process in India and the changes in the structure of its economy have been highly uneven among the states. There are strong signals of divergence during the period 1980-2004. Table 4.3 shows the ratio between rich and poor states in terms of per-capita NSDP. Even when we exclude Bihar and Delhi, respectively the poorest and the richest state in all sub-periods, this ratio increases from 1.96 in 1980 to 2.84 in 2004. This means that 410 million of people in the poorest states have, on average, only around one third of the income of the 221 million of inhabitants in the richest states. Furthermore, the divergence between economic regions has been steadily increasing since the early 1990s. Figure 4.1 shows the standard deviation of per-capita NSDP in a log-scale. Its value increases from 0.34 in 1980 to 0.39 in 1990, but then reaches 0.5 in 2002. It is important to note that the rise in the standard deviation during the 1980s mostly happened in the second half of the decade, suggesting that not only the "pro-market" but also the "pro-business" reforms have produced larger benefits for the rich states than for the poor ones.

**Figure 4.1. Per-capita NSDP standard deviation (log-scale).**




Source: CSO

These results are confirmed by transition matrices[6] (Table 4.6) that display the estimated probabilities that states can become relatively richer or poorer conditional on their initial level of per-capita NSDP. States are grouped into four quartiles, from the poorest ones to the richest ones, depending on their initial level of income. The states present a very high degree of persistence over the whole period. However, low and middle-low NSDP states display more dynamism in the 1980s, when, for instance, the probability for the poorest states to increment their position was around 15%. During the 1990s, middle-high and high income states face a small increase in the probabilities of changing quartile, while the first two quartiles show a greater degree of persistence relative to the previous decade.

**Table 4.6. Transition matrix estimates**

1981-2004

| | I Quartile | II Quartile | III Quartile | IV Quartile | Total |
|---|---|---|---|---|---|
| **I Quartile** | 88.19 | 11.81 | 0.00 | 0.00 | 100.00 |
| **II Quartile** | 11.97 | 78.17 | 9.86 | 0.00 | 100.00 |
| **III Quartile** | 0.00 | 10.42 | 84.03 | 5.56 | 100.00 |
| **IV Quartile** | 0.00 | 0.00 | 6.29 | 93.71 | 100.00 |

1981-1990

| | I Quartile | II Quartile | III Quartile | IV Quartile | Total |
|---|---|---|---|---|---|
| **I Quartile** | 84.85 | 15.15 | 0.00 | 0.00 | 100.00 |
| **II Quartile** | 15.15 | 74.24 | 10.61 | 0.00 | 100.00 |
| **III Quartile** | 0.00 | 10.61 | 84.85 | 4.55 | 100.00 |
| **IV Quartile** | 0.00 | 0.00 | 4.55 | 95.45 | 100.00 |

1991-2004

| | I Quartile | II Quartile | III Quartile | IV Quartile | Total |
|---|---|---|---|---|---|
| **I Quartile** | 91.03 | 8.97 | 0.00 | 0.00 | 100.00 |
| **II Quartile** | 9.21 | 81.58 | 9.21 | 0.00 | 100.00 |
| **III Quartile** | 0.00 | 10.26 | 83.33 | 6.41 | 100.00 |
| **IV Quartile** | 0.00 | 0.00 | 7.79 | 92.21 | 100.00 |

Source: see Table 2

[6] See Quah (1993, 1996, 1997).

The following sections will seek to explore the main determinants of the stylised facts presented in this section. Our main emphasis will be on the spatial pattern of growth across Indian states, and on the importance of neighbouring states in influencing the performance of individual states.

### 4.3. Convergence and divergence across Indian States

We make use of a number of empirical methodologies to analyse the pattern of growth of the Indian states and to explore the determinants of their different performance. The literature on convergence or divergence across states or regions evolved considerably since Baumol (1986) and Barro and Sala-i-Martin (1991). The two concepts of absolute and conditional $\beta$-convergence, directly derived from the dynamic implications of the Solow model (1956), seek to establish whether rates of growth in a cross-section of countries or regions are negatively related to initial levels of GDP per capita. It is well known that cross-sectional regressions could present problems of both omitted variables bias and endogeneity. The conditional convergence approach could itself be considered as one possible way to address the omitted variable bias, but the introduction of additional explanatory variables could raise a further problem of endogeneity, since the rate of growth could in turn influence some of the conditioning variables. In order to alleviate this potential difficulty, control variables are usually introduced in a predetermined form.

An effective strategy to deal with the issue of omitted variables bias in cross-sectional regressions is to reformulate the neoclassical convergence equation in a panel data format (Knight Loayza and Villanueva, 1993, and Islam, 1995). The dynamic specification makes it possible to relax the identical technology assumption and to control for unobservable country- or state-specific effects. Persistent disparities in technology development and in the quality of institutions have been found to play an important role in explaining cross-country economic performance.

This panel data approach is however not sufficient to deal with time-varying country-specific effects nor with endogeneity. Caselli, Esquivel and Leffort (1996) suggest using the Arellano-Bond (1991) GMM efficient estimator for dynamic panel data. However, this *First-Differenced GMM* approach has been found to suffer from serious bias when the time series are persistent and the number of time series observations is small. These issues could be potentially serious in the empirical analysis of growth and even more when it comes to studies of convergence, which is known to be a long run phenomenon. By exploiting an additional assumption that imposes

a stationarity restriction on the initial conditions for GDP per capita, Blundell and Bond (1998) are able to obtain moment conditions that remain informative even for persistent series. This *System GMM* uses the lagged first-differences as instruments not only for the standard set of equations in first differences (as in the Arellano-Bond procedure), but also for a supplementary set of equations in levels (see also Bond, Hoeffler and Temple., 2001).

We use data for a subset of 24 Indian states for the period 1980-2004, made available by the Indian Central Statistical Organization (CSO). The Data Appendix describes the data set. We first analyse $\beta$-convergence by estimating a log-linearised dynamic version of the Solow model:

$$(1) \qquad \ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = -(1-e^{-\beta\tau})\ln(Y_{i,t-\tau}) + (1-e^{-\beta\tau})\frac{\alpha}{1-\alpha}\left[\ln(s) - \ln(n+g+d)\right] + \eta_i + \varepsilon_{i,t}$$

where $Y_{i,t}$ denotes the level of GDP per capita of state *i* at time *t*, $s$ the saving rate, *n* the population growth rate, *g* the rate of labour-augmenting technological progress, *d* the depreciation of physical capital, $\alpha$ the share of capital in total output and $\beta$ the convergence rate measuring the speed at which a given economy converges to its steady state output level. In empirical applications of the Solow model the investment rate or the capital expenditure are used as alternative proxies of the saving rate *s*. The sum of the common exogenous rate of technical change and the common depreciation rate is assumed to be 0.05.

Table 4.7 reports estimates for the textbook Solow model in both its unrestricted and restricted versions. The latter is obtained by imposing that saving and population growth enter in a difference format, to test whether in steady state they exhibit the same rate of growth. The results on convergence appear to be different depending on the estimation method. Both the OLS and the System GMM findings are in favour of divergence among the states, whereas the within-group (Fixed-Effect) and the Differenced GMM estimators imply a relatively high rate of convergence. The differences among the estimators are in line with the results of empirical analysis over cross-sections of countries. OLS have been shown to yield estimated convergence coefficients that are lower than those obtained after controlling for regional specific effects. Differenced GMM tends to provide even higher estimates of the convergence rate. However, Bond, Hoeffler and Temple (2001) use System GMM estimators and obtain results strikingly similar to the simple OLS regressions.

In our estimates, we obtain positive values for the $\beta$ coefficients (implying convergence) when we use the Fixed-Effect and the Difference GMM estimators. According to the analysis in Bond, Hoeffler and Temple (2001), however, these estimates could be affected by a positive bias.

When using a regional dataset, there could be an additional source of positive bias in the estimation of the convergence coefficient due to spatial interactions across the observations, which can be attributed to the presence of knowledge spillovers, trade, and migration among neighbouring regions. The issue of possible spatial interactions across the observations deserves particular attention and we will discuss it in detail in the next section. At this stage, it would appear that the most plausible estimates of the regional growth pattern are obtained with the System GMM specification. It should indeed be noted that all the variables have the expected signs, positive and significant for the investment ratio (which turns out to be insignificant both according to the fixed effect and the Differenced GMM) and negative and significant for the population growth rate corrected by 0.05 (completely insignificant in the case of the Differenced GMM).

For what concerns the estimates relating the restricted Solow model (right part of Table 4.7), the more reliable results appear again to be those obtained through the System GMM. The OLS predicts a share of capital in the order of 79%, which is too far from the value of around 10% computed as a simple average of the ratio between capital expenditure and the NSDP on our data. The fixed effect rejects the hypothesis that the saving rate in the steady state completely offsets the sum of the population growth rate, the rate of technical change and the common depreciation rate. The Differenced GMM provides an incredibly high annual rate of convergence in the order of 30%. Finally, from a purely econometric viewpoint the lagged dependent variable is strongly significant indicating a strong persistence of the annual growth rate of the NSDP per capita and, hence, limiting the choice between the two GMM specifications.

Summarizing, the comparison of alternative econometric methods has led us to choose the System GMM as the most appropriate estimator. This yields a divergence rate of 1.3% for the unrestricted version of the Solow model and 1.7% for the restricted version. These results are consistent with other existing empirical findings, which also find evidence of increasing gaps between Indian regions (see Bandyopadhyay, 2006, for an accurate analysis of the issues).

**Table 4.7. Unrestricted and restricted Solow model for 24 Indian states (1980-2004)**

| | Unrestricted Solow Model | | | | Restricted Solow Model | | | |
|---|---|---|---|---|---|---|---|---|
| | OLS | Fixed Effect | Differenced-GMM | System-GMM | OLS | Fixed Effect | Differenced-GMM | System-GMM |
| Lag Annual Growth | - | - | -0.348 (0.066)*** | -0.399 (0.063)*** | | | -0.332 (0.078)** | -0.445 (0.066)*** |
| lag_log_NSDP | 0.011 (0.006)* | -0.022 (0.015) | -0.349 (0.084)*** | 0.018 (0.007)*** | 0.008 (0.006) | -0.033 (0.014)** | -0.343 (0.097)** | 0.026 (0.011)** |
| ln(s) | 0.009 (0.005)** | 0.01 (0.01) | 0.004 (0.016) | 0.01 (0.006)* | | | | |
| n+ 0.05 | -0.07 (0.024)*** | -0.127 (0.036)*** | -0.021 (0.056) | -0.082 (0.036)** | | | | |
| ln(s)—(n + 0.05) | | | | | -0.003 (0.005) | -0.02 (0.009)** | -0.021 (0.018) | 0.005 (0.006) |
| Constant | -0.215 (0.075)*** | -0.108 (0.113) | | -0.27 (0.097)*** | -0.029 (0.049) | 0.283 (0.105)*** | | -0.149 (0.083)* |
| Implied $\beta$ | **-0.011** | **0.022** | **0.299** | **-0.013** | **-0.008** | **0.033**[10] | **0.297** | **-0.017** |
| Prob > chi2 | (0.000)*** | (0.0721)* | (0.000)*** | (0.000)*** | (0.0131)** | (0.000)*** | (0.000)** | (0.000)*** |
| Implied $\alpha$ | - | - | - | - | **0.789** | **0.373**[11] | **0.313** | **0.17** |
| Prob > chi2 | | | | | (0.0000)*** | (0.0000)*** | (0.0000)*** | (0.0000)*** |
| Number of ID | 24 | 24 | 24 | 24 | 24 | 24 | 24 | 24 |
| Observations | 546 | 546 | 499 | 525 | 527 | 527 | 480 | 506 |
| R-squared | 0.0215 | 0.11 | - | - | 0.0044 | 0.01 | - | - |
| Number of instruments | | - | 252 | 328 | | - | 180 | 184 |
| Hausman Test | - | 11.81 (0.0081) | - | - | | 11.71 (0.0029) | - | |
| Arellano-Bond test for AR(1) in first differences: | - | - | -3.64 (0.000) | -3.80 (0.000) | | - | -3.75 (0.000) | -3.89 (0.000) |
| Arellano-Bond test for AR(2) in first differences: | - | - | -0.68 (0.498) | 1.30 (0.193) | | - | -0.29 (0.773) | -0.37 (0.710) |
| Hansen test of overid. restrictions | - | - | 0.000 (1.000) | 0.000 (1.000) | | - | 0.000 (1.000) | 0.000 (1.000) |

Robust standard errors in parentheses * significant at 10%; ** significant at 5%; *** significant at 1%

## 4. The spatial pattern of growth

[10] Computation method: (-(1-exp(-b))+0.165)
[11] Computation method: ((1-exp(-.180))*(a/(1-a))-0.051)

In a regional dataset the spatial interactions across observations can seriously affect the estimates of convergence patterns, whose magnitude could be overestimated. In our case this would imply an underestimation of the divergence rate. We therefore relax the assumption that observations are represented by states with arbitrarily drawn boundaries and implement a model, which allows for a degree of dependence across locations sharing a common border. Specifically, we make use of the so-called Spatial Lag System GMM Model, which introduces a spatial lag of the dependent variable among the explanatory variables and controls jointly for both time and spatial interaction across observations (Anselin, 1988 and Arbia, 2006). In order to explore the robustness of these effects, rather than considering interaction only across contiguous states sharing common borders (neighbourhood effect), we also take into account a more general specification in which the strength of the spatial interactions is inversely related to the distance among regions. In our application, we consider the distances in highway kilometres separating the main urban centres of each state.

The spatial dimension has been only marginally considered in recent studies concerning convergence across Indian states. However, a simple visual analysis of the patterns of growth relating to the Indian Union map would suggest that the group of best performers countries concentrates in the South, while the poorer countries concentrate in the north-eastern landlocked part of the Union. For panel dataset with a time series dimension the most common way to address this issue is the use of the so called *Spatial Lag Model,* which takes the following form:

$$(2)\qquad \ln(Y_{i,t}) - \ln(Y_{i,t-\tau}) = \alpha + \rho W[\ln(Y_{i,t}) - \ln(Y_{i,t-\tau})] + \beta \ln(Y_{i,t-\tau}) + \gamma X'_{i,t} + \varepsilon_{i,t},$$
$$\varepsilon_{i,t} \sim \text{i.i.d.}(0, \sigma^2 I_n)$$

where $W$ is a binary contiguity matrix expressing neighbouring regions by 0-1 values. The value 1 is assigned when two regions have a common border of non-zero length, *i.e.* they are considered first-order contiguous. We also consider a second spatial specification in which the elements of the matrix $W$ are the inverse of the distances among capital cities of each of the 24 states measured in highways kilometres. In equation (2), $\rho$ denotes the coefficient associated to the spatial lag of the dependent variable and $\varepsilon$ is a vector of independently and identically distributed error terms. The matrix $X$ contains additional explanatory steady-state variables and $\gamma$ is its respective vector of coefficients.

In order to estimate equation (2) one has to take into due account the source of endogeneity induced by the spatial lag of the dependent variable. To overcome the problem, we only present

estimates of model (2) obtained through the System GMM estimator[7], which allows us to treat the spatial lag as endogenous and, hence, estimate consistent coefficients[8].

Table 8 reports estimates obtained through System GMM, considering both the whole sample period 1980-2002 and the two sub-periods 1980-1990 and 1991-2002. In the left half of the table we display results obtained considering distances in highway kilometres across capitals of the 24 states for both the unrestricted and the restricted versions of the Solow model. The spatial coefficient appears to be significant for the series considered as a whole and over the period 1980-1990, for both the versions of the Solow model. Our results are reinforced when considering a spatial model with neighbourhood effect. The spatial lag turns out to be always significant in the unrestricted version of the Solow model, and significant for the whole series and for the second sub-period 1991-2002 when estimating the restricted version of the model. In line with the literature concerning regional studies, we provide evidence that the inclusion of the spatial lag induces an increase of the divergence rate. This result becomes more evident when controlling for the neighbourhood effect with a divergence rate of around 5% against the 1.3% displayed in Table 7. Our results provide also evidence of an exacerbation of the pace of divergence in the 1990s with respect to the 1980s[9].

[7] However, in addition to the System GMM, we implemented also the maximum likelihood estimator for the cross section counterparts of both the spatial lag and spatial error model. In particular, we tested the two specifications for the whole period 1980-2003, for the decade 1980-1990 and for the post-crisis period 1993-2003. For all the cross sectional specifications of absolute convergence, the spatial coefficients are found to be not significant. These results are also confirmed through the implementation of Moran I and Geary's tests for the detection of spatial correlation.

[8] For a comprehensive survey on the panel data techniques that can be implemented allowing for the presence of spatial autocorrelation see Mutl (2006).

[9] During the 1980s we lose the observation of Delhi due to a lack of data for the capital expenditure. However, we decided to use all the data when possible. In order to check the robustness and comparability of the results relating to the 1980s and 1990s we also omitted Delhi from the 1990s. The main findings discussed in the paper are not affected.

**Table 4.8. Convergence across 24 Indian states (1980-2002): Spatial System GMM estimates with robust standard errors.**

| | Spatial analysis considering km distance (Highways) | | | | | | Spatial analysis considering neighbourhood effects (common borders) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Unrestricted Solow Model | | | Restricted Solow Model | | | Unrestricted Solow Model | | | Restricted Solow Model | | |
| | **1980-2004** | **1980-1990** | **1991-2002** | **1980-2004** | **1980-1990** | **1991-2002** | **1980-2004** | **1980-1990** | **1991-2002** | **1980-2004** | **1980-1990** | **1991-2002** |
| Lag Annual Growth | -0.407 | -0.399 | -0.413 | -0.403 | -0.394 | -0.41 | -0.403 | -0.383 | -0.417 | -0.392 | -0.361 | -0.415 |
| | (0.062)*** | (0.076)*** | (0.072)*** | (0.063)*** | (0.071)*** | (0.073)*** | (0.062)*** | (0.069)*** | (0.075)*** | (0.060)*** | (0.068)*** | (0.071)*** |
| Spatial Lag Annual Growth | 0.373 | 0.539 | 0.135 | 0.51 | 0.621 | 0.32 | 0.284 | 0.272 | 0.257 | 0.248 | 0.168 | 0.273 |
| | (0.200)* | (0.279)* | (0.272) | (0.227)** | (0.329)* | (0.27) | (0.117)** | (0.148)* | (0.133)* | (0.129)* | (0.158) | (0.132)** |
| lag_log_NSDP | 0.025 | 0.023 | 0.028 | 0.026 | 0.024 | 0.027 | 0.022 | 0.014 | 0.025 | 0.018 | -0.005 | 0.026 |
| | (0.008)*** | (0.016) | (0.007)*** | (0.008)*** | (0.016) | (0.008)*** | (0.008)*** | (0.016) | (0.008)*** | (0.009)** | (0.023) | (0.008)*** |
| ln(s) | 0.01 | 0.013 | 0.009 | | | | 0.011 | 0.013 | 0.01 | | | |
| | (0.005)** | (0.009) | (0.005)* | | | | (0.005)** | (0.009) | (0.006) | | | |
| n+ 0.05 | -0.071 | -0.09 | -0.058 | | | | -0.065 | -0.102 | -0.053 | | | |
| | (0.025)*** | (0.038)** | (0.028)** | | | | (0.021)*** | (0.040)** | (0.026)** | | | |
| ln(s)—(n + 0.05) | | | | 0.004 | 0.001 | 0.005 | | | | 0.004 | 0.002 | 0.006 |
| | | | | (0.004) | (0.006) | (0.005) | | | | (0.005) | (0.009) | (0.005) |
| Constant | -0.327 | -0.346 | -0.314 | -0.181 | -0.16 | -0.185 | -0.287 | -0.304 | -0.278 | -0.111 | 0.08 | -0.171 |
| | (0.091)*** | (0.164)** | (0.093)*** | (0.067)*** | (0.124) | (0.067)*** | (0.078)*** | (0.171)* | (0.089)*** | (0.072) | (0.176) | (0.066)*** |
| **Implied $\beta$** | **-0.018** | **-0.016** | **-0.02** | **-0.018** | **-0.017** | **-0.019** | **-0.053** | **-0.036** | **-0.058** | **-0.045** | **-0.014** | **-0.061** |
| Prob > chi2 | (0.000)*** | (0.018)** | (0.000)*** | (0.000)*** | (0.008)*** | (0.000)*** | (0.000)*** | (0.001)** | (0.000)*** | (0.000)*** | (0.704) | (0.000)*** |
| **Implied $\alpha$** | | | | **0.133** | **0.04** | **0.156** | | | | **0.059** | **0.096** | **0.063** |
| Prob > chi2 | | | | (0.000)*** | (0.000)*** | (0.000)*** | | | | (0.000)*** | (0.000)*** | (0.000)*** |
| Observations | 480 | 197 | 283 | 480 | 197 | 284 | 480 | 197 | 283 | 480 | 197 | 283 |
| Number of ID | 24 | 23 | 24 | 24 | 23 | 24 | 24 | 23 | 24 | 24 | 23 | 24 |
| Number of instruments | 373 | z141 | 235 | 296 | 112 | 187 | 373 | 141 | 235 | 296 | 112 | 187 |
| Arellano-Bond test for AR(1) in first differences: | | | | | | | | | | | | |
| z = | -4.03 | -3.58 | -3.64 | -4.06 | -3.61 | -3.71 | -4.08 | -3.70 | -3.68 | -4.08 | -3.77 | -3.72 |
| Pr > z = | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Arellano-Bond test for AR(2) in first differences: | | | | | | | | | | | | |
| z = | 0.34 | -0.18 | 0.54 | 0.36 | -0.10 | 0.61 | 0.38 | -0.15 | 0.67 | 0.46 | -0.08 | 0.73 |
| Pr > z = | (0.731) | (0.859) | (0.589) | (0.720) | (0.917) | (0.544) | (0.707) | (0.880) | (0.503) | (0.649) | (0.934) | (0.468) |
| Hansen test of overid. restrictions: | | | | | | | | | | | | |
| | 0.00 | 10.23 | 4.46 | 0.00 | 8.76 | 5.01 | 0.00 | 7.75 | 5.41 | 0.00 | 8.85 | 7.78 |
| | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) |

Robust standard errors in parentheses significant at 10%; ** significant at 5%; *** significant at 1%

Hence, taking into account spatial interactions across observations does not contradict our previous finding of a significant rate of divergence across Indian States in terms of NSDP per capita. However, such a result could reflect large geographical disparities in the sector distribution of economic activity. As argued by Purfield (2006), approximately half of the total agricultural value added in India is produced in the northern and central states, whereas 40 percent of industrial and service sector output is produced in the coastal states of Maharashtra, Gujarat and Tamil Nadu. In order to check the robustness of our results to the possible interference of sector effects we also test three conditional convergence specifications using the share of production sectors to NSDP as added explanatory variables. In Table 9 are displayed results of regressions considering only the sector share and omitting the spatial effects. Among sectors agriculture appears to have constantly acted as a restraint to growth, mirroring the stylized fact discussed in the literature about the backwardness of rural areas. During the 1990s, it also emerges the positive impact of the service sector. Table 10 and Table 11 report results for the two different spatial specifications considering respectively distance and neighbourhood effects. The spatial effects are substantially reduced when considering distances (they remain significant only when considering service sector as a control variable during the whole period and in the 1980s), whereas they are still present and highly significant when measured in terms of the neighbourhood effects. These results tend to suggest that spatial interactions are stronger across very close states, and tend to disappear rapidly for longer distances. Furthermore, under both spatial specifications it appear that the fastest growing regions in the 1980s were those more specialized in manufacturing, whereas during the 1990s the fastest growing economies were those specialized in service activities.

**Table 4.9. Convergence across 24 Indian states over the period 1980-2002, 1980-1990 and 1991-2002. System GMM estimates controlling for sector shares in total production.**

| | 1980-2002 | | | 1980-1990 | | | 1991-2002 | | |
|---|---|---|---|---|---|---|---|---|---|
| Lag Annual Growth | -0.393 | -0.402 | -0.400 | -0.408 | -0.410 | -0.413 | -0.394 | -0.405 | -0.408 |
| | (0.059)*** | (0.061)*** | (0.063)*** | (0.063)*** | (0.064)*** | (0.073)*** | (0.070)*** | (0.073)*** | (0.075)*** |
| lag_log_NSDP | 0.007 | 0.019 | 0.017 | 0.027 | 0.023 | 0.029 | 0.004 | 0.022 | 0.023 |
| | (0.009) | (0.008)** | (0.006)*** | (0.022) | (0.026) | (0.02) | (0.01) | (0.009)** | (0.010)** |
| ln(s) | 0.01 | 0.007 | 0.003 | 0.005 | 0.004 | 0 | 0.011 | 0.007 | 0.005 |
| | (0.005)** | (0.006) | (0.005) | (0.009) | (0.012) | (0.01) | (0.005)** | (0.007) | (0.005) |
| n+ 0.05 | -0.068 | -0.077 | -0.075 | -0.061 | -0.061 | -0.1 | -0.071 | -0.071 | -0.05 |
| | (0.026)*** | (0.030)*** | (0.033)** | (0.051) | (0.051) | (0.043)** | (0.031)** | (0.035)** | (0.034) |
| lag_AGR | -0.11 | | | -0.116 | | | -0.102 | | |
| | (0.025)*** | | | (0.032)*** | | | (0.037)*** | | |
| lag_MAN | | 0.024 | | | 0.088 | | | -0.016 | |
| | | (0.041) | | | (0.074) | | | (0.043) | |
| lag_SERV | | | 0.067 | | | 0.091 | | | 0.063 |
| | | | (0.032)** | | | (0.078) | | | (0.035)* |
| Constant | -0.119 | -0.278 | -0.298 | -0.263 | -0.293 | -0.472 | -0.097 | -0.279 | -0.265 |
| | (0.066)* | (0.083)*** | (0.107)*** | (0.154)* | (0.233) | (0.222)** | (0.084) | (0.104)*** | (0.101)*** |
| **Implied $\beta$** | **-0.005** | **-0.014** | **-0.012** | **-0.019** | **-0.016** | **-0.021** | **-0.003** | **-0.016** | **-0.016** |
| Prob > chi2 | (0.161) | (0.000)*** | (0.000)*** | (0.037)** | (0.142) | (0.011)** | (0.465) | (0.000)*** | (0.000)*** |
| Observations | 525 | 525 | 525 | 197 | 197 | 197 | 328 | 328 | 328 |
| Number of ID | 24 | 24 | 24 | 23 | 23 | 23 | 24 | 24 | 24 |
| Number of instruments | 334 | 334 | 334 | 118 | 118 | 118 | 219 | 219 | 219 |
| Arellano-Bond test for AR(1) in first differences: | | | | | | | | | |
| z = | -3.80 | -3.79 | -4.01 | -3.60 | -3.60 | -3.55 | -3.33 | -3.37 | -3.34 |
| Pr > z = | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.001) | (0.001) | (0.001) |
| Arellano-Bond test for AR(2) in first differences: | | | | | | | | | |
| z = | 1.05 | 1.18 | 1.20 | -0.68 | -0.57 | -0.54 | 1.57 | 1.65 | 1.52 |
| Pr > z = | (0.295) | (0.238) | (0.231) | (0.497) | (0.571) | (0.592) | (0.117) | (0.098) | (0.129) |
| Hansen test of overid. restrictions: | | | | | | | | | |
| chi2= | 0.000 | 0.000 | 0.000 | 4.12 | 9.50 | 7.04 | 2.01 | 2.39 | 6.02 |
| Prob > chi2 | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) |

Robust standard errors in parentheses *significant at 10%; ** significant at 5%; *** significant at 1%

**Table 4.10. Convergence across 24 Indian states over the period 1980-2002 1980-1990, 1991-2002. Spatial System GMM estimates controlling for sector shares in total production. Spatial analysis considering km distance (highways).**

| | **1980-2002** | | | **1980-1990** | | | **1991-2002** | | |
|---|---|---|---|---|---|---|---|---|---|
| Lag Annual Growth | -0.399 | -0.406 | -0.402 | -0.395 | -0.396 | -0.4 | -0.41 | -0.411 | -0.41 |
| | (0.059)*** | (0.060)*** | (0.061)*** | (0.067)*** | (0.069)*** | (0.074)*** | (0.072)*** | (0.072)*** | (0.073)*** |
| Spatial Lag Annual Growth | 0.298 | 0.228 | 0.385 | 0.447 | 0.397 | 0.613 | 0.157 | 0.067 | 0.142 |
| | (0.219) | (0.211) | (0.225)* | (0.302) | (0.296) | (0.298)** | (0.29) | (0.264) | (0.286) |
| lag_log_NSDP | 0.011 | 0.021 | 0.019 | 0.019 | 0.017 | 0.02 | 0.016 | 0.025 | 0.022 |
| | (0.007) | (0.008)** | (0.008)** | (0.016) | (0.018) | (0.018) | (0.007)** | (0.008)*** | (0.007)*** |
| ln(s) | 0.01 | 0.013 | 0.006 | 0.007 | 0.015 | -0.001 | 0.012 | 0.013 | 0.008 |
| | (0.004)** | (0.005)*** | (0.004) | (0.008) | (0.008)* | (0.008) | (0.005)** | (0.006)** | (0.005)* |
| n + 0.05 | -0.056 | -0.078 | -0.059 | -0.046 | -0.059 | -0.068 | -0.066 | -0.076 | -0.05 |
| | (0.020)*** | (0.020)*** | (0.023)** | (0.05) | (0.047) | (0.043) | (0.026)** | (0.027)*** | (0.029)* |
| lag_AGR | -0.109 | | | -0.11 | | | -0.079 | | |
| | (0.024)*** | | | (0.036)*** | | | (0.034)** | | |
| lag_MAN | | 0.058 | | | 0.125 | | | 0.023 | |
| | | (0.039) | | | (0.054)** | | | -0.04 | |
| lag_SERV | | | 0.071 | | | 0.071 | | | 0.072 |
| | | | (0.028)** | | | (0.062) | | | (0.031)** |
| Constant | -0.147 | -0.314 | -0.303 | -0.172 | -0.237 | -0.336 | -0.209 | -0.331 | -0.283 |
| | (0.059)** | (0.069)*** | (0.095)*** | (0.134) | (0.167) | (0.219) | (0.070)*** | (0.083)*** | (0.093)*** |
| **Implied $\beta$** | **-0.008** | **-0.015** | **-0.014** | **-0.013** | **-0.012** | **-0.014** | **-0.011** | **-0.018** | **-0.015** |
| Prob > chi2 | (0.009)** | (0.000)*** | (0.000)*** | (0.049)** | (0.118) | (0.061)* | (0.002)*** | (0.000)*** | (0.000)*** |
| Observations | 480 | 480 | 480 | 197 | 197 | 197 | 283 | 283 | 283 |
| Number of ID | 24 | 24 | 24 | 23 | 23 | 23 | 24 | 24 | 24 |
| Number of instruments | 361 | 361 | 361 | 141 | 141 | 141 | 223 | 223 | 223 |
| Arellano-Bond test for AR(1) in first differences: | | | | | | | | | |
| z = | -4.02 | -4.02 | -4.01 | -3.52 | -3.53 | -3.49 | -3.53 | -3.64 | -3.60 |
| Pr > z = | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Arellano-Bond test for AR(2) in first differences: | | | | | | | | | |
| z = | 0.08 | 0.19 | 0.33 | -0.32 | -0.32 | -0.14 | 0.44 | 0.54 | 0.52 |
| Pr > z = | (0.939) | (0.850) | (0.740) | (0.749) | (0.747) | (0.849) | (0.659) | (0.589) | (0.605) |
| Hansen test of overid. restrictions: | | | | | | | | | |
| chi2= | 0.000 | 0.000 | 0.000 | 5.48 | 5.52 | 7.85 | 7.60 | 7.52 | 2.3 |
| Prob > chi2 | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1000) |

**Table 4.11. Convergence across 24 Indian states over the period 1980-2002 1980-1990, 1991-2002. Spatial** System **GMM estimates controlling for sector shares in total production. Spatial analysis considering neighbourhood effects (common borders).**

| | **1980-2002** | | | **1980-1990** | | | **1991-2002** | | |
|---|---|---|---|---|---|---|---|---|---|
| Lag Annual Growth | -0.395 | -0.405 | -0.402 | -0.376 | -0.387 | -0.387 | -0.416 | -0.42 | -0.427 |
| | (0.059)*** | (0.061)*** | (0.062)*** | (0.064)*** | (0.068)*** | (0.068)*** | (0.072)*** | (0.074)*** | (0.076)*** |
| Spatial Lag Annual Growth | 0.279 | 0.272 | 0.301 | 0.262 | 0.242 | 0.279 | 0.257 | 0.258 | 0.285 |
| | (0.130)** | (0.131)** | (0.132)** | (0.146)* | (0.143)* | (0.145)* | (0.150)* | (0.146)* | (0.151)* |
| lag_log_NSDP | 0.009 | 0.022 | 0.02 | 0.006 | 0.014 | 0.016 | 0.012 | 0.027 | 0.027 |
| | (0.006) | (0.009)** | (0.008)** | (0.014) | (0.019) | (0.018) | (0.008) | (0.009)*** | (0.009)*** |
| ln(s) | 0.011 | 0.012 | 0.006 | 0.008 | 0.013 | 0.001 | 0.014 | 0.013 | 0.009 |
| | (0.005)** | (0.005)** | (0.005) | (0.009) | (0.009) | (0.01) | (0.005)*** | (0.007)* | (0.006)* |
| n + 0.05 | -0.059 | -0.066 | -0.057 | -0.082 | -0.088 | -0.08 | -0.059 | -0.057 | -0.035 |
| | (0.021)*** | (0.019)*** | (0.024)** | (0.042)* | (0.042)** | (0.044)* | (0.026)** | (0.026)** | (0.028) |
| lag_AGR | -0.105 | | | -0.108 | | | -0.097 | | |
| | (0.020)*** | | | (0.035)*** | | | (0.035)*** | | |
| lag_MAN | | 0.042 | | | 0.097 | | | -0.008 | |
| | | (0.041) | | | (0.058)* | | | (0.044) | |
| lag_SERV | | | 0.067 | | | 0.082 | | | 0.072 |
| | | | (0.030)** | | | (0.064) | | | (0.038)* |
| Constant | -0.131 | -0.29 | -0.296 | -0.163 | -0.281 | -0.325 | -0.154 | -0.296 | -0.288 |
| | (0.053)** | (0.070)*** | (0.096)*** | (0.127) | (0.174) | (0.221) | (0.075)** | (0.085)*** | (0.090)*** |
| **Implied $\beta$** | **-0.006** | **-0.016** | **-0.014** | **-0.004** | **-0.01** | **-0.011** | **-0.008** | **-0.019** | **-0.019** |
| Prob > chi2 | (0.023)** | (0.000)*** | (0.000)*** | (0.470) | (0.878) | (0.144) | (0.008)*** | (0.000)*** | (0.000)*** |
| Observations | 480 | 480 | 480 | 197 | 197 | 197 | 283 | 283 | 283 |
| Number of ID | 24 | 24 | 24 | 23 | 23 | 23 | 24 | 24 | 24 |
| Number of instruments | 361 | 361 | 361 | 141 | 141 | 141 | 223 | 223 | 223 |
| Arellano-Bond test for AR(1) in first differences: | | | | | | | | | |
| z = | -4.07 | -4.07 | -4.05 | -3.67 | -3.7 | -3.65 | -3.56 | -3.68 | -3.59 |
| Pr > z = | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Arellano-Bond test for AR(2) in first differences: | | | | | | | | | |
| z = | 0.18 | 0.22 | 0.30 | -0.23 | -0.180 | -0.17 | 0.48 | 0.65 | 0.50 |
| Pr > z = | (0.880) | (0.828) | (0.762) | (0.816) | (0.857) | (0.867) | (0.631) | (0.517) | (0.619) |
| Hansen test of overid. restrictions: | | | | | | | | | |
| chi2= | 0.000 | 0.000 | 0.000 | 4.84 | 10.550 | 6.62 | 8.92 | 8.67 | 2.15 |
| Prob > chi2 | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) |

Robust standard errors in parentheses *significant at 10%; ** significant at 5%; *** significant at 1%

When considering spatial effects for the Indian Union one has to take into account the possibility of a bias due to the presence of coastal states. Many of the largest urban centres tend to be located on the coast. In general, landlocked states have usually experienced slower paces of growth because of the difficulties in accessing the advantages of international trade (Sachs and Warner, 1997). For instance, given the high cost of domestic transport, it is often relatively easier and cheaper for coastal states to satisfy their food demand through imports rather than from purchases from the hinterland (Pingali and Khwaja, 2004). After the process of liberalization and openness to international markets started with the 1990s reforms, the gap between coastal and landlocked states could have further widened. Our spatial estimates would then capture this effect. This hypothesis is confirmed in Figure 4.2, which suggests an association between coastline length and economic growth during the post-reform period. Table 4.12 includes as a control variable the length of the coast of each state in order to check the robustness of the spatial effects. The spatial lag appears to be still present but rescaled in significance (the neighbourhood effect becomes completely insignificant during the 1990s). In accordance with what illustrated in Figure 2, our results suggest that the larger exposition to the sea has become a key factor enhancing regional growth after the reforms implemented in the 1990s.

**Figure 4.2. Length of the coastline and growth in the pre- and post-reform period.**

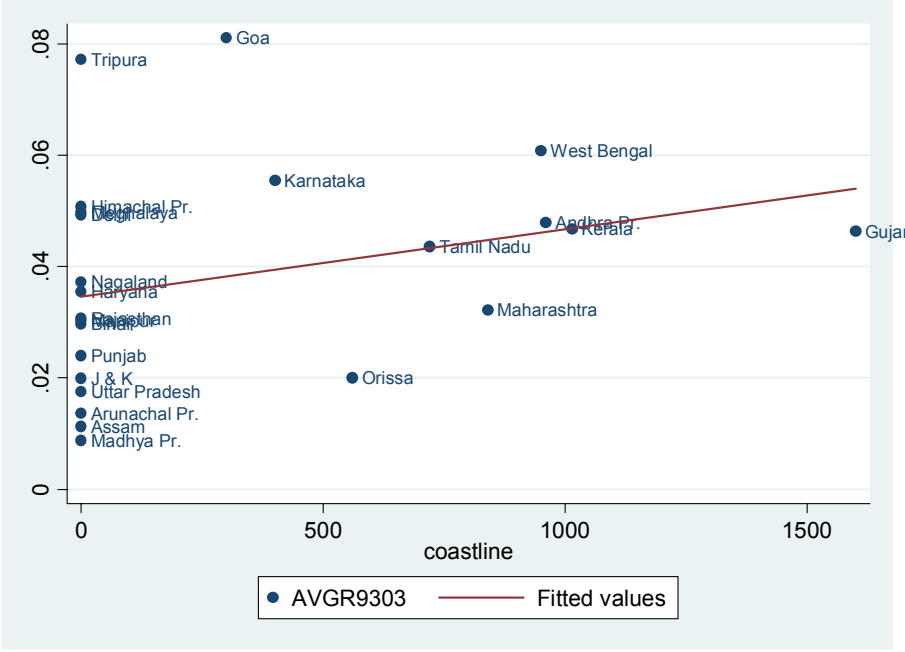



**Table 4.12. Testing the robustness of the spatial lag making use of the regional coastline length as a control variable**

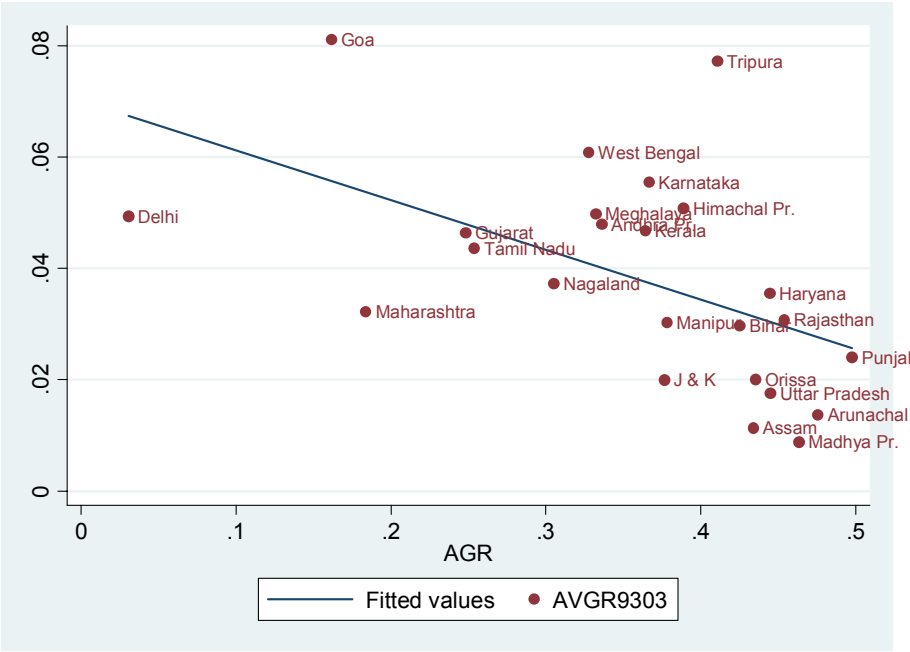
| | Spatial analysis considering distance (highways kilometres) | | | Spatial analysis considering neighbourhood (common borders) | | |
|---|---|---|---|---|---|---|
| | **1980-2004** | **1980-1990** | **1991-2002** | **1980-2004** | **1980-1990** | **1991-2002** |
| Lag Annual Growth | -0.405 | -0.381 | -0.422 | -0.41 | -0.395 | -0.419 |
| | (0.060)*** | (0.067)*** | (0.074)*** | (0.060)*** | (0.074)*** | (0.071)*** |
| Spatial Lag Annual Growth | 0.274 | 0.275 | 0.233 | 0.353 | 0.533 | 0.083 |
| | (0.120)** | (0.147)* | (0.136)* | (0.200)* | (0.284)* | -0.269 |
| lag_log_NSDP | 0.017 | 0.012 | 0.019 | 0.021 | 0.018 | 0.022 |
| | (0.008)** | (0.015) | (0.009)** | (0.008)*** | (0.016) | (0.008)*** |
| ln(s) | 0.016 | 0.015 | 0.015 | 0.015 | 0.016 | 0.014 |
| | (0.005)*** | (0.009) | (0.006)*** | (0.005)*** | (0.010)* | (0.005)*** |
| n + 0.05 | -0.045 | -0.097 | -0.029 | -0.05 | -0.085 | -0.034 |
| | (0.023)* | (0.040)** | (0.032) | (0.027)* | (0.038)** | -0.032 |
| log(coastline_length) | 0.002 | 0.001 | 0.003 | 0.002 | 0.001 | 0.003 |
| | (0.001)*** | (0.001) | (0.001)** | (0.001)*** | (0.001) | (0.001)** |
| Constant | -0.184 | -0.271 | -0.159 | -0.229 | -0.291 | -0.193 |
| | (0.078)** | (0.162)* | (0.114) | (0.093)** | (0.157)* | (0.112)* |
| Observations | 480 | 197 | 283 | 480 | 197 | 283 |
| Number of ID | 24 | 23 | 24 | 24 | 23 | 24 |
| Number of instruments | 374 | 142 | 236 | 374 | 142 | 236 |
| Arellano-Bond test for AR(1) in first differences: | | | | | | |
| z = | -4.00 | -3.67 | -3.56 | -3.95 | -3.55 | -3.52 |
| Pr > z = | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Arellano-Bond test for AR(2) in first differences: | | | | | | |
| z = | 0.25 | -0.15 | 0.46 | 0.18 | -0.17 | 0.34 |
| Pr > z = | (0.805) | (0.882) | (0.645) | (0.857) | (0.867) | (0.731) |
| Hansen test of overid. restrictions: | | | | | | |
| chi2= | 0.000 | 0.000 | 3.21 | 0.18 | 5.53 | 4.36 |
| Prob > chi2 | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) | (1.000) |

Robust standard errors in parentheses *significant at 10%; ** significant at 5%; *** significant at 1%

These findings indicate that the last two decades have witnessed a constant increase in the level of divergence of income per capita among the states of the Indian Union. Moreover, the dimension of the gap separating poorer and richer areas has increased especially during the 1990s. The acceleration in the divergence rate could be attributed to the heterogeneous response of states, in terms of growth performance, to the reforms implemented since the early 1990s. In general, the strategy that followed the crisis in 1991 has been aimed at achieving a broad liberalization of the economy and an increasing degree of openness to international markets through a gradual but steady cut in tariffs. Our econometric analysis indicates that the advantage acquired by those states with a larger exposition to the sea becomes crucial under this set of policies.

Particular attention deserves to be paid to the agricultural sector, which is found to play a significantly negative role over all the time spans considered. Rural areas have constantly lagged behind in terms of performance with respect to the rest of the Indian states during both decades considered in the analysis. However, within the group of rural states remarkable differences in terms of economic performance are present. In particular, those states with a large share of agriculture, together with a high percentage of arable land and an efficient system of irrigation, have generally outperformed other rural areas. Figure 3 illustrates empirically how the relationship between agricultural share and growth changes when the whole sample or, alternatively, the sub-sample including only states with a share of agriculture sector over the average is considered. States like Haryana and Punjab performed relatively well, despite their prevalent rural component in NSDP. This stylized fact is in line with the general finding that rural areas tend to be a reservoir of inefficient labour with low marginal productivity: such a context tends to be alleviated when labour can be reallocated in a newly established industrial sector or when productivity is enhanced through innovation and increased arable land. Furthermore, rural states starting with better infrastructure and human resources saw also significantly higher long-term rates of poverty reduction (Datt and Ravaillon, 1997). Punjab and Haryana have been among the most successful ones to implement innovative rural reforms through a continued expansion of farming and irrigated areas, double cropping existing farmland and use of seeds with improved genetics. The case of Uttar Pradesh is striking in this sense. This state, together with Haryana and Punjab, leads in terms of arable and irrigated land. Nonetheless, it has experienced poor performance in terms of economic growth. This could be partially explained through the fact that Uttar Pradesh, one of the states with the highest rate of poverty, also has the highest population density. The relative improvement in rural techniques may have been insufficient to offset a Malthusian dynamics, with population growing faster than food resources.

**Figure 3. Agriculture and growth across 24 Indian States in the 1990s. The role of irrigation and arable land.**





**Legenda**: the upper graph represents the fit computed over the whole sample of 24 Indian states. The lower graph represents the subsample the top nine states ranked by agriculture share. In the lower part of the graph we correct the share of the agriculture sector by the share of arable land and the share of irrigated land in order to capture the effect of reform and innovation in the sector. Source : CSO and indiastat.com

## 5. Conclusions

During the last two decades the states of the Indian Union experienced a continuous divergence in terms of their NSDP per capita. The main novel aspects of the analysis in this paper are the attention to the spatial aspects of the performance of Indian states and the attempt to capture the role played by the economic performance of the neighbouring states.

Based on a rigorous econometric and economic analysis we showed that the System GMM is the most appropriate estimator to conduct a study on the determinants of convergence/divergence across Indian states. The System GMM is also suitable for the inclusion of a spatial lag and Table 13 directly allows comparing the results with the case in which the spatial effects are instead omitted. Our findings are in line with the statistical evidence for an overestimation of the convergence rate when omitting the spatial lag. In our case, this implies an increase in the annual average divergence rate, which goes up from 1.3% in the traditional absolute convergence analysis without spatial lag to 1.8% when considering distance effects and to 5.3% when considering neighbourhood effects.

We have than moved to the close examination of the presence of the positive and significant spatial connotation in the growth pattern of Indian states. We have shown that sectoral specialization is partly responsible for the spatial effects, which are indeed rescaled in magnitude and significance. The divergence has mainly been driven by the economic backwardness of rural areas, with the exception of those states which have performed relatively better due to more in-depth innovation during the Green Revolution and to the wider availability of arable land.

When controlling both for spatial effects and sector shares (see the lower part of Table 13), we show how the pace of divergence has on average experienced an acceleration during the 1990s, after the process of reform started with the 1991 economic recession. The process of liberalization and increased openness to international markets has imparted a further geographical connotation to the process of convergence/divergence across Indian states. Clear disparities emerge between landlocked states and states having access to the sea, possibly due to a comparative advantage of the latter in increasing their volume of trade in the post-reform period. This hypothesis has been directly tested and confirmed econometrically by including the state length of the coast.

Summarizing, the last two decades have seen winners and losers among the states of the Union. Winners were those states that benefited the most from the recent process of reform and liberalization, thanks also to their geographical advantage and to the presence of a developed service sector. Losers were instead the landlocked and highly populated states with a predominant agricultural sector and a low level of innovation. In some of these rural states where these problems

assume a heavier dimension (like Uttar Pradesh), the pressure on resources culminates in high rates of poverty.

Historically, the growth pattern in India has been very uneven. In the more recent period, the imbalances in the growth process have become more severe. It would appear that there has been no trickle-down of economic growth from the fastest growing states to the poorer states. At a time when India is poised to become a leading economic superpower, it is crucial that these imbalances are corrected, so that there are no losers from India's success story.

**Table 13 (continues): Summarizing results concerning the coefficients implied by the Solow Model.**

**Coefficients computed through the restricted and unrestricted Solow Model making use of different econometric methodologies (1980-2004) - Results extracted from Table 7**

*Unrestricted*

| | OLS | Fixed Effect | Differenced GMM | System GMM |
|---|---|---|---|---|
| **Implied Beta** | **-0.011*** ** | **0.022*** | **0.299*** ** | **-0.013*** ** |

*Restricted*

| | OLS | Fixed Effect | Differenced GMM | System GMM |
|---|---|---|---|---|
| **Implied Beta** | **-0.008**** | **0.033*** ** | **0.297*** ** | **-0.017*** ** |
| **Implied Alpha** | **0.789*** ** | **0.373*** ** | **0.313*** ** | **0.17*** ** |

**Coefficients computed through the restricted and unrestricted Solow Model making use of a Spatial System GMM over different periods - Results extracted from Table 8.**

Spatial analysis considering km distance (highways)

| | *Unrestricted* | | | *Restricted* | | |
|---|---|---|---|---|---|---|
| | 1980-2002 | 1980-1990 | 1991-2002 | 1980-2002 | 1980-1990 | 1991-2002 |
| **Implied Beta** | **-0.018*** ** | **-0.016**** | **-0.02*** ** | **-0.018*** ** | **-0.017*** ** | **-0.019*** ** |
| **Implied Alpha** | | | | **0.133*** ** | **0.04*** ** | **0.156*** ** |

Spatial analysis considering neighbourhood effects (common borders)

| | *Unrestricted* | | | *Restricted* | | |
|---|---|---|---|---|---|---|
| | 1980-2002 | 1980-1990 | 1991-2002 | 1980-2002 | 1980-1990 | 1991-2002 |
| **Implied Beta** | **-0.053*** ** | **-0.036**** | **-0.058*** ** | **-0.045*** ** | **-0.014** | **-0.061*** ** |
| **Implied Alpha** | | | | **0.059*** ** | **0.096*** ** | **0.063*** ** |

**Table 13 (end): Summarizing results concerning the coefficients implied by the Solow Model.**

**Coefficients computed through the unrestricted Solow Model making use of a Spatial System GMM over different periods and controlling for sectors - Results extracted from Table 9**

Analysis considering sector impact without spatial effects – Table 9

| | **1980-2002** | | | **1980-1990** | | | **1991-2002** | |
|---|---|---|---|---|---|---|---|---|
| **Controlling for:** | Agricolture | Manufacturing | Services | Agricolture | Manufacturing | Services | Agricolture | Manufacturing |
| **Implied Beta** | **-0.005** | **-0.014*** ** | **-0.012*** ** | **-0.019**** | **-0.016** | **-0.021**** | **-0.003** | **-0.016*** ** |

Spatial analysis considering distance effects (km-Highways)– Table 10

| | **1980-2002** | | | **1980-1990** | | | **1991-2002** | |
|---|---|---|---|---|---|---|---|---|

| **Controlling for:** | Agricolture | Manufacturing | Services | Agricolture | Manufacturing | Services | Agricolture | Manufacturing | |
|---|---|---|---|---|---|---|---|---|---|
| **Implied Beta** | **-0.008*** ** | **-0.015*** ** | **-0.014*** ** | **-0.013** ** | **-0.012** | **-0.014* ** | **-0.011*** ** | **-0.018*** ** | - |
| Spatial analysis considering neighbourhood effects (common borders) – Table 11 | | | | | | | | | |
| | | **1980-2002** | | | **1980-1990** | | | **1991-2002** | |
| **Controlling for:** | Agricolture | Manufacturing | Services | Agricolture | Manufacturing | Services | Agricolture | Manufacturing | |
| **Implied Beta** | **-0.006** ** | **-0.016*** ** | **-0.014*** ** | **-0.004** | **-0.01** | **-0.011** | **-0.008*** ** | **-0.019*** ** | - |

**Data Appendix**

This paper considers 24 States of the Indian Union: Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Nagaland, Orissa, Punjab, Rajasthan, Tamil Nadu, Tritura, Uttar Pradesh, West Bengal and the Union Territory of Delhi. The inclusion in the analysis of small and north-eastern States like Goa or Manipur and the Union Territory of Delhi, generally not considered in convergence studies, is mainly justified by the use of the Spatial Model. Mizoram and Sikkim are excluded from the sample due the lack of data, while Jharkhand, Chhattisgarh and Uttaranchal, created out respectively of Bihar, Madhya Pradesh and Uttar Pradesh, are considered parts of the original states for the years after the separation in 2000.

The source of the data is the Central Statistical Organisation (CSO) for income and sectors while the Reserve Bank of India (RBI) provides data on capital expenditure. Net State Domestic Product (NSDP) series is at factor cost and is based on 1980 constant prices. According to CSO, NSDP is divided into: Agriculture, which includes Forestry and logging, Fishing and Mining and quarrying; Manufacturing, subdivided into Registered, Unregistered, Construction and Electricity, gas and water supply; Services, ramified into Transport, storage and communication, Trade, hotels and restaurants, Banking and insurance, Real estate, ownership of dwelling and business services, Public administration and Other services. Capital expenditure is weighted by the NSDP and deflated by the state's inflation rate.

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