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Laura Solanko

An empirical note on growth and convergence across Russian regions

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Laura Solanko*

An empirical note on growth and convergence across Russian regions

Abstract

This empirical note uses publicly available Goskomstat data to investigate income growth and convergence across Russian regions. Using data for 1992-2001, we find strong sigma divergence simultaneously with beta convergence. The results indicate that per capita income in Russian regions may be converging towards two separate steady states. The poorest regions seem to be converging among themselves, while growth experiences among other regions have been highly heterogeneous.

Keywords: convergence, divergence, Russia, regions, growth

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Laura Solanko

An empirical note on growth and convergence across Russian regions

Tiivistelmä

Tässä lyhyessä empiirisessä tutkimuksessa tarkastellaan väestön rahatulojen kasvua ja Venäjän alueiden välistä lähentymistä eli konvergenssia. Asukasta kohden lasketun tulotason hajonta on kasvanut selvästi samanaikaisesti vahvan beta-konvergenssin kanssa. Tulokset viittaavat siihen, että asukasta kohden laskettu tulotaso Venäjän alueilla olisi konvergoitumassa kahteen eri tasapainoon. Kaikkein köyhimmät alueet konvergoituvat keskenään, kun taas muiden alueiden kasvu on paikoin ollut hyvin ripeää. Analyysi pohjautuu julkisesti saatavilla oleviin Goskomstatin tilastoihin vuosilta 1992–2001.

Asiasanat: konvergenssi, divergenssi, Venäjä, alueet, kasvu

1 Introduction

Russia experienced enormous regional differences in growth rates during the 1990s. As an example, while the total gross regional product (GRP) grew 6 % in 2001, growth was by no means evenly distributed across regions. In 17 regions, GRP increased more than 10 %, while in eight regions GRP actually decreased. Although this phenomenon is nowadays widely recognised, surprisingly little is known about exactly what kind of regions are growing fast and what may explain the strong divergence trends. This paper describes some trends in convergence and divergence across Russian regions using publicly available Goskomstat data for 1992-2001.

There are a few recent papers analysing growth and convergence in Russian regions. Berkowitz and DeJong (2003) look at the determinants of economic growth for a sample of 48 out of the 89 regions over the period from 1993 to 1997. Their interest is in determining whether regional policy reform matters for economic growth, and indeed they find a positive correspondence between price liberalization and growth in per capita incomes. Ahrend (2002) studies regional growth for a panel of 77 regions for a somewhat longer period. He finds that economic reform and general reform orientation explain little of the observed differences in regional growth rates, and concludes that a region's initial industrial structure and resource endowment seem to have a large impact on its growth prospects. Dolinskaja (2002) derives a similar conclusion when she analyses regional convergence in real incomes using the transition matrix approach. Her findings confirm that initial industrial structure and natural resources are significant in explaining regional differences in growth rates.

None of these papers, however, covers the period after 1998. Further, to my knowledge there is no paper attempting to apply the very basic notions of neoclassical growth models, namely conditional and unconditional convergence, to Russian regional data. This paper contributes to the literature by extending the sample studied to 2001, i.e. covering the post-crisis period. Also, we apply some simple empirical tests of neoclassical growth models to Russian regional data. Results indicate that per capita income in Russian regions may be converging towards two separate steady states. The poorest regions appear to be converging among themselves, while other regions continue to grow fairly rapidly.

The following section briefly discusses the data and its limitations. Section three focuses on general trends in convergence and section four provides the results from simple growth regressions. The last section concludes the paper.

2 Data description

While regional data tends to be problematic everywhere, Russian regional data is regarded as dubious at best. In many instances it is even unclear exactly how regional data on production, incomes and prices is collected and what the precise relationship is between regional and national figures – which rarely ever add up to the same totals.[1] Data on nominal incomes is based on expenditure data derived from monthly household surveys supplemented with information on e.g. retail sales. As the validity of income data is

[1] Goskomstat reports that in 2001 national GDP grew 5 %. The average reported GRP was 6 %.

undermined by ad hoc estimations, figures on industrial production suffer from problems in registering the actual location of production.

These problems notwithstanding, Goskomstat is our only feasible data source here. In theory, the data collected and published by regional statistical offices (*komstats*) may more accurately reflect local conditions, but gathering the data from 89 different administrative subjects is clearly out of question. Moreover, even if Goskomstat data are imperfect, one can at least assume the same mistakes are made consistently. The possible inaccuracies in Goskomstat data thus do not preclude comparison of the Russian regions with each other.

Ideally, one would like to use GRP as the indicator of regional real income level in any analysis of regional income distribution dynamics. Unfortunately, consistent time series exist only for the periods 1995-2000 and 1998-2001. The latter dataset became available in late April 2003 after Goskomstat revised its GDP and GRP figures to make them more compatible with international standards. Consequently, relying on GRP figures would unnecessarily shorten the time period of the analyses. A further complication with the GRP data is that Goskomstat does not publish regional GRP deflators.[2]

Fortunately, it turns out that the indicators "monetary incomes per capita" and the "value of industrial production" both closely correlate with GRP, and both indicators are readily available from 1990 onwards. The average annual correlation coefficients with GRP for the full sample of 89 regions are reported in Table 1.

Table 1. Correlation between GRP and monetary incomes and industrial production

Year	Monetary income per capita	Industrial prod.
1995	0.749	0.880
1996	0.789	0.860
1997	0.833	0.843
1998	0.850	0.830
1999	0.832	0.838
2000	0.874	0.796
1995-2000	0.894	0.868

Regional consumer and producer price indices for 1992-2001 are also readily available, which greatly facilitates growth analysis. There is no self-evident decision rule for determining which of the two indicators is better in analysing convergence. Both have been used in earlier studies on regional growth. Yudaeva et al (2001) and Ahrend (2002) use both indicators, whereas e.g. Berkowitz and DeJong (2003), Dolinskaya (2002) and Carluer-Sharipova (2001) use monetary incomes. Here, we have chosen the "income per capita" indicator, mainly because relying on industrial production makes agricultural regions and the regions where service sector has any significance look unfairly poor.

Nominal monetary income per capita is taken from Goskomstat's *Regiony Rossii* publications. Figures are available for most regions (excluding Chechnya) for 1990 – 2001. Data for autonomous okrugs (AOs) is reported only from 1997 onwards.[3] The nominal figures are deflated by regional consumer price index to arrive at real incomes measured in 2000 roubles. We start with the assumption that the price level in 1992 was equal in all

[2] Even if the deflators were available, the accuracy of GRP data is probably weaker than that of its components (Granberg-Zaitseva 2002).

[3] Chukotka (Chukchi) AO and Jewish (Yevreyskaya) AO are reported starting from 1993. The Adygeya Republic, Karachai-Cherkessia Republic, Altai Republic and Khakassia Republic are reported from 1991.

regions as there is no consistent way to control for differences in overall price levels. Later, we relax this assumption.

As Goskomstat reports regional CPI only from 1992 onwards, real monetary income for 1990-1991 becomes unavailable. This certainly is not a dramatic loss of data as the reliability of the data on very early 1990's is extremely unreliable due to the enormous economic changes. CPI is missing for Ingushetia in 1992 and for Komi-Permyak AO for the entire period (i.e. for 1997-2000). The table below shows number of observations, standard deviation, median and mean of real per capita income measured in 2000 roubles for each year in the sample. The mean real income per capita is 1821.8 and the standard deviation is 1357.6 over the whole period.

Table 2. Real monetary incomes per capita, per month, in 2000 roubles

Year	N	Median	Mean	Standard deviation	Skewness	Kurtosis	Real national income[4]
1992	76	881.1765	1025.738	533.9026	2.6	10.1	
1993	79	1107.692	1303.127	904.0181	4.7	29.7	
1994	79	1472.254	1798.161	1264.457	4.2	22.5	
1995	79	1470.478	1827.166	1188.835	3.9	21.9	100
1996	79	1759.946	2175.561	1456.075	4.5	28.6	101.3
1997	87	1986.383	2509.799	1790.905	3.6	18.9	108.2
1998	87	1176.371	1519.937	1060.938	3.0	14.1	91.8
1999	87	1365.438	1707.152	1174.743	3.3	16.4	79.9
2000	87	1478	1911.195	1375.722	3.2	15.1	91.1
2001	87	1787.752	2322.852	1637.874	2.8	11.4	100.7
1992-2001	828	1455	1821.8	1357.6	3.7	21.6	

Mean real income is considerably higher than median, confirming the general view that a handful of regions are very rich. High positive values of skewness further confirm that the distribution of incomes across regions is asymmetric. The tail of high values is longer than the tail of low values. The same picture is given by the kurtosis measure: long, thin tails characterise the distribution of income across regions.

Interestingly, the skewness and kurtosis of the income distribution increase up to 1996 then decrease gradually thereafter. The available data suggest that the distribution in 2001 was as asymmetric as it was in 1992. Compared to the mid-1990s, the distribution's tails have shortened; in particular, the tail of high values has become shorter again. The crisis year 1998 seems to cause no significant impact on these indicators. However, apart from 1998, the standard deviation (sd) of incomes increases constantly, suggesting that the distribution has become more dispersed.

Table 2 readily suggests that the mean of regional real income figures tell a brighter story of real income developments than the national figures. This is probably due to the fact that the national figures use population weights. This should mean that several of the high-income regions have small populations. Apart from the capital city, this seems indeed to be the case. There are five regions with mean real incomes for 1992-2000 above 4000 roubles (The City of Moscow, Tyumen, Khanty-Mansi AO, Yamalo-Nenets AO and Chukotka). High (above 3000 roubles) mean real incomes are also reported for Nenets AO, Murmansk, Taymyr AO, Kamchatka, Koryak AO, Magadan and Sakha (Yakutia). Of all

[4] Goskomstat, 1995=100.

the above-mentioned regions, only The City of Moscow and Tyumen have populations over 1.5 million. All the others are small regions in the Russian North, which is well known for natural resource wealth and relatively high price and wage levels.

Not surprisingly, The City of Moscow, Khanty-Mansi AO, Yamalo-Nenet AO and Chukotka also account for much of the variation (standard deviation) in real incomes. Excluding these regions from the sample reduces the overall standard deviation of real incomes to 801 and the sample mean over the whole period to 1631.5 roubles. These four regions clearly are the potential outliers in the analyses. As the Tyumen region includes both AO's, it may be wise to include the parent region into the list of potential outliers at some point.

These four regions are also jurisdictions with relatively high price levels, making it tempting to use the monetary incomes adjusted by a price level indicator as the income measure. Unfortunately, data limitations prohibit us from doing this, because Goskomstat offers no consistent measure of regional price level over the entire period. The price of a basket of 19 basic goods is reported for 1992-1994, the price of a 24-goods basket for 1994-1997, the regional minimum subsistence level for 1996-1999 and finally the price for a minimum food basket from 2000 onwards.

3 Concepts of convergence

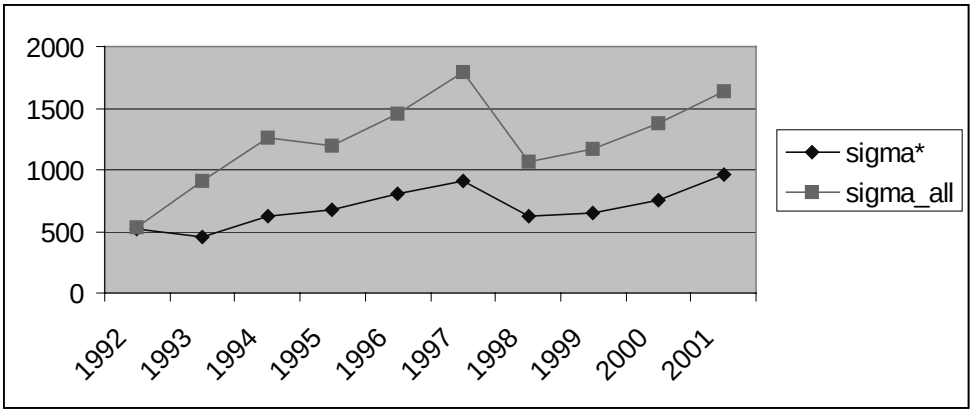
A key property of the neoclassical growth models is convergence. Most models predict that the further below its steady state an economy starts out, the faster it tends to grow. Assuming similar tastes and technologies, economies' steady states are similar, i.e. poor economies tend to grow faster than rich ones. This is referred to as absolute, or unconditional, convergence. Many empirical studies have proved that absolute convergence does not apply for a broad cross-selection of countries. For a relatively homogenous group of countries or regions, like the OECD or the states of the US, absolute convergence has been established.[5]

3.1 Sigma convergence

Barro and Sala-i-Martin (1995) define sigma (σ) convergence as a measure of the level of income dispersion. Sigma convergence occurs if the dispersion in income declines over time. This dispersion can, for example, be measured by the standard deviation – hence the name – of per capita income across regions or countries. The figure below shows the standard deviation (i.e. sigma convergence) of real incomes from 1992 to 2001 for the full sample of 79/87 regions (sigma_all) and for the sample excluding The City of Moscow, Khanty-Mansi AO, Yamalo-Nenets AO and Chukotka (sigma*).

[5] For more discussion on growth and convergence see Barro and Sala-i-Martin (1995) or de la Fuente (2000).

Figure 1. Sigma convergence across Russian regions 1992-2001



There are three immediate lessons to be derived from the data. First, there does not seem to be any evidence of sigma convergence. On the contrary, income dispersion increased by more than three times between 1992 and 2001. Second, the crisis of 1998 caused only a temporary decrease in income dispersion. The variation in incomes started to grow immediately after the crisis. By 2001, the level of dispersion was about the same as in 1997. The third observation is that – as expected – removing the four richest regions from the sample significantly reduces the variance in real incomes but does not change the general trend of divergence.

3.2 Unconditional beta convergence

Beta (β) convergence measures the speed of convergence. Beta convergence applies if a poor country or region tends to grow faster than a rich one. Beta convergence implies that, over a long time period, the per capita income level of a poor region will tend to catch up with the level of a rich region. Unconditional beta convergence refers to countries or regions converging to a common steady state, whereas conditional beta convergence implies conditional convergence. There is no universal way of measuring beta convergence as the exact formulation depends on the assumptions of the underlying growth model used. Loosely speaking, however, unconditional beta convergence is said to exist if the income level in the base year is negatively correlated with annual average growth rate over the observed period.

In our case, the simplest measure of unconditional beta convergence is the simple correlation between 1992 income level and the average annual income growth rate in 1993-2001. Defined this way, the simple measure of unconditional beta convergence is –0.2 for the 76 regions for which there is data over the entire period 1992-2001. Excluding The City of Moscow from the sample increases the absolute value of correlation to –0.4. This cross-sectional correlation would seem to indicate that beta convergence exists. Regions with initially low-income levels appear, on average, to have had faster growth rates than regions that were better off initially.

Assuming for the moment that all Russian regions have a common steady state[6], beta convergence may be estimated by a simple regression $lngrowth = a + b\ lny92 + \varepsilon$, where lngrowth is average annual growth rate over the entire period, lny92 is the initial level of income and ε is the error term. If *b* is negative and significantly different from zero, absolute convergence is said to hold. Estimating the simple log-linear model by OLS gives the results in Table 3 below.

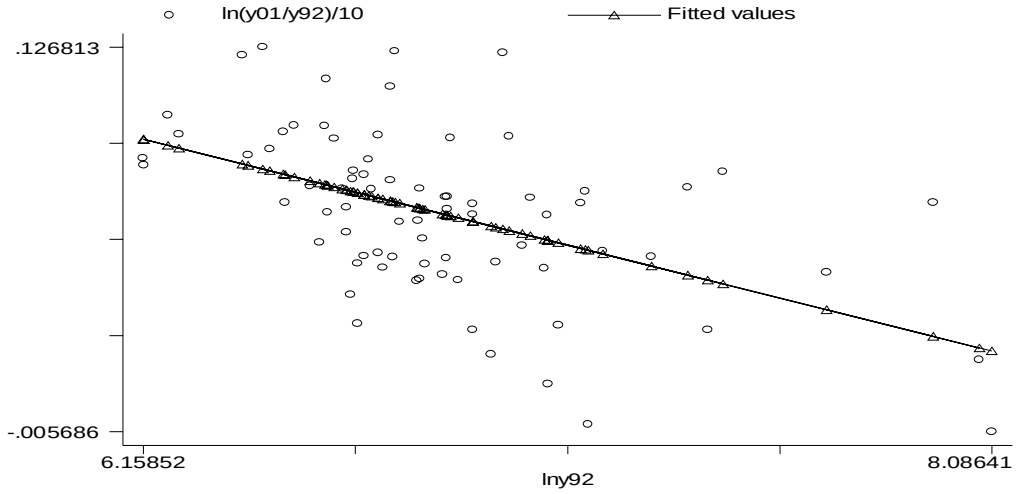
Table 3. Unconditional beta convergence

regress lngrowth lny92

lngrowth	Coef.	Std. Err.	t	
				Number of obs = 76
lny92	-.029933	.0081619	-3.67	
_cons	.275564	.0559493	4.93	Adj R-squared = 0.1424

The coefficient for initial level of per capita income (lny92) has the expected sign and is statistically highly significant. The estimated magnitude of beta convergence is 0.03, which indicates annual convergence at the rate of 3 %.[7] This is broadly in line with the magnitude of beta convergence found in many cross-country and regional studies.

Figure 2. Unconditional beta convergence across Russian regions



These results would seem to indicate that, even though dispersion of incomes has increased on average, the incomes in the initially richer regions have not grown as fast (or contracted as much) as in the poorer regions. This somewhat surprising result comes with a number of caveats. The major one is rather trivial: Russian regions are unlikely to have one steady

[6] Studies focusing on regional convergence in e.g. the US, Spain, Japan and EU usually assume that all regions within the same country have a common steady state. This certainly is a more realistic assumption than expecting all countries in the world to have a common steady state; regions often share similar culture, central administration, law enforcement, language etc. Homogeneity of Russian regions, of course, remains an open issue.

[7] Dropping Moscow City from the regression slightly improves the fit. With 75 observations OLS gives a = 0.33, b = -0.38 and R-squared = 0.26. The b-coefficient remains statistically highly significant.

state common to all. Thus, the regression above is likely to be erroneous due to misspecification and thus needs to be redefined before the results can be interpreted. It is also possible that simple OLS, which is fairly sensitive to outlying observations, does not provide robust estimates. The second caveat is more fundamental and potentially tantalising. As already discussed, all of the above analyses assume that the initial price level was identical in all regions at the beginning of the period (i.e. 1992). However, it is well known that prices and wages were significantly higher in the North even in the Soviet era and that price liberalization further increased the relative living costs in very remote areas. If we use the number of 19-goods baskets an average monthly income could buy in 1992 (yreal92) as the explanatory variable, the simple correlation and regression analysis gives a completely different picture.

The table below describes the simple correlation between the variables: y is the real income level, avegrowth is average annual growth rate of y and yreal92 is the income level in 1992 divided by the price of the 19- basic goods basket. The prefix ln indicates the same variables in logarithmic form.

Table 4. Simple correlation

(obs=74[8])

	avegrowth	lngrowth	y92	lny92	yreal92
avegrowth	1.0000				
lngrowth	0.9693	1.0000			
y92	-0.2922	-0.3411	1.0000		
lny92	-0.3336	-0.3711	0.9574	1.0000	
yreal92	0.0464	0.0581	0.4744	0.5123	1.0000
lnyreal92	0.0299	0.0433	0.4676	0.5334	0.9660

On average, it appears growth of per capita real incomes is significantly and negatively related to initial level of monetary income, but positively, if not strongly, related to the measure of initial real monetary income level. Any OLS regressing growth on y92 is likely to produce a negative coefficient, while regressing growth on yreal92 is likely to produce a positive coefficient pointing towards divergence. This suggests that regions with initially high price levels grew slower than other regions. While this issue requires more careful analyses, it raises the possibility that at least two groups of regions exist, i.e. a poor group and another "rich" group.

In a recent paper, Andrienko and Guriev (2003) suggest that the poorest third of the Russian regions are trapped in poverty in the sense that people would move away if only they could afford it. Elsewhere in the Russian Federation, the well-known Tiebout hypothesis of people voting with their feet seems to have some validity. To test if the growth experience of the poorest third differs from the majority of the regions, the sample was split in two using a dummy for the poorest regions. Dummy poor92 = 1 if yreal92 was less than the 30th percentile.

The table below seems to suggest that the two groups differ. For the poor regions, average income growth is negatively related to both the income level in 1992 and the income level adjusted by the price level indicator in 1992. For the other regions, y92 is

[8] Leningrad region is excluded due to missing data on the price of the 19-goods basket.

negatively, and yreal92 positively, correlated with average annual growth. Thus, it could well be that the poorer regions are converging among themselves, while the rest are not.

Table 5. Correlation for poor group

poor92 = 0 (obs = 53)

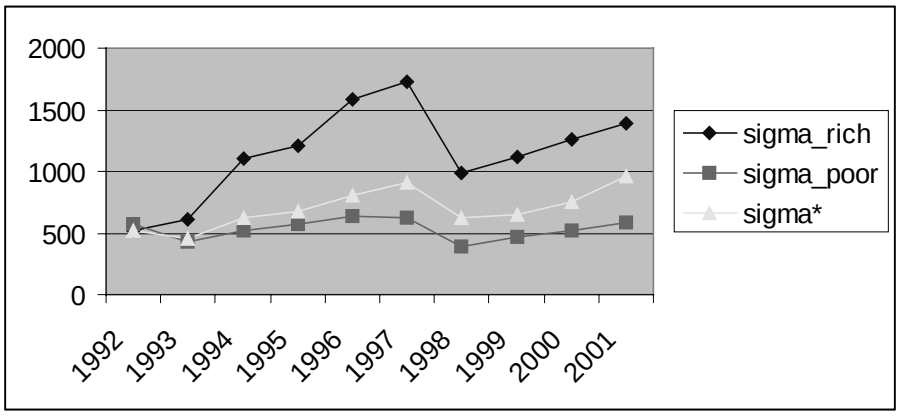
	avegrowth	y92	yreal92
avegrowth	1.0000		
y92	-0.1185	1.0000	
yreal92	0.1410	0.5317	1.0000

poor92 = 1 (obs = 21)

	avegrowth	y92	yreal92
avegrowth	1.0000		
y92	-0.6153	1.0000	
yreal92	-0.0819	0.2526	1.0000

The average annual growth in the poor group has indeed been higher than in the rest of the sample. The difference is confirmed by a basic t-test, which rejects the null hypothesis on the equality of the means. The standard deviations of annual real income levels (rmipc) the poor group are significantly lower than those of the rest of the Russian regions. Figure 3 depicts sigma convergence for the two groups separately. For the sake of comparison, the sigma convergence of the full sample excluding the four outliers (sigma*) is included.

Figure 3. Sigma convergence of poor and rich groups



The figure confirms that the poor regions have neither diverged nor converged (at least, in a sigma-convergence sense). The differences in the income levels between the regions that were the poorest in 1992 have not changed markedly over the ten-year period. The rich group, on the other hand, seems to be considerably more heterogeneous. Among the initially rich regions income dispersion has increased dramatically.

What characterises a poor region? Have the initially poor regions really improved their relative position vis-à-vis the initially richer regions? These questions are examined in the following section.

4 Conditional convergence and growth

4.1 Ranking regions by per capita income

We begin our analysis by ranking all regions by their incomes per capita in 1992-2001. The first observation from comparing the rankings in 1992 with the rankings in 2001 is that the relative position of practically taken all regions has changed remarkably. The position of 54 regions (out of the 76 in the sample) had changed more than 5 ranks (i.e. dropped or increased more than 5 ranks). The regions whose relative position between 1992 and 2001 has deteriorated most are a heterogeneous group including Kalmykia, Chita, Kurgan, Mordva and Orenburg. The regions whose relative position has increased most include Moscow oblast (which has largely benefited from the growth in The City of Moscow), the independence-minded republics of Bashkortostan and Tatarstan and a handful of "traditional" regions of European Russia: Smolensk, Vologda, St. Petersburg, Astrakhan, Perm and Voronezh.

A standard rank correlation coefficient, Spearman's rho, measures if any two given rankings are independent of another. The correlation coefficient between a region's rank in 2001 and a region's rank in any other year is very high leading to rejection of the null hypothesis that the rankings are random and independent of each other. A region's position in the income ranking in 2001 is dependent on its relative position in previous years. However, the rank correlation between years 1992 and 2001 is significantly lower than between any year after 1992 and 2001.

As the table below shows, there is a clear difference between the two groups in how the income level rankings develop. For the poor regions (which had real incomes in the lowest third in 1992), rank correlation with the income ranking in 2001 is close to one from 1993 onwards. For other regions, the value of Spearman's rho increases, as one would expect, each year. This observation suggests that the relative position of those initially poor has not changed significantly since 1993. It is thus possible that choosing the first reform year 1992 as the base year gives an incorrect picture of actual changes.

Table 6. The values of Spearman's rho

	rank_y2001 full sample	rank_y2001 for poor regions	rank_y2002 for rich regions	1 % critical value in two-tailed test
rank_y92	0.5588	0.5935	0.5346	0.405
rank_y93	0.7776	0.9104	0.6903	0.405
rank_y94	0.8230	0.9026	0.7587	0.405
rank_y95	0.8811	0.9299	0.8558	0.405
rank_y96	0.9066	0.9169	0.8895	0.405
rank_y97	0.9545	0.9377	0.9319	0.405
rank_y98	0.9701	0.9805	0.9532	0.405
rank_y99	0.9748	0.9636	0.9668	0.405
rank_y00	0.9723	0.9558	0.9652	0.405

4.2 Possible determinants of conditional convergence

The examination of sigma convergence in the previous section confirms that, apart from 1998, differences in income levels between Russian regions have grown during the past ten years. The existence of beta convergence seems to suggest that poorer regions have grown faster. Increasing dispersion of incomes together with beta convergence implies that the initial value of σ is below its steady-state value. As mentioned above, it is, however, questionable if all of Russia's 89 regions share a common steady-state level of per capita income.

Common language, culture, values and socialist history notwithstanding, the economic environments in Russian regions differ significantly from each other. First, the tinier regions are often wholly dependent on a handful of large enterprises. Thus, a major change at a large plant can alter annual industrial production, incomes and tax revenues significantly. Indeed, this is one of the reasons for large annual variation in regional growth rates. Second, much of Russia's wealth is concentrated in natural resources, which are unevenly distributed across the federation. Therefore, it would be rather surprising to find that all Russian regions would have a common steady state.

If regions do not converge to a common steady state, then the estimations on absolute convergence are misspecified. If the real steady state is correlated with the initial income level, then the error term is, in fact, correlated with the explanatory variable. This leads to downward-biased estimates. One widely used remedy is to use a multivariate regression, including some constant proxies for the steady states such as geography and sectoral composition of output. Further, the cross-sectional dispersion of incomes is naturally sensitive to aggregate shocks that affect certain regional subgroups. To the extent these shocks tend to affect poor and rich regions differently (i.e. shocks correlate with the explanatory variable), their omission from a regression usually leads to biased estimates of beta. Controlling for possible aggregate shocks and differences in steady states (i.e. differences in the economy's production function) gives estimates of "conditional" beta-convergence.

What are the likely determinants of regional steady states? A first guess might be that geography matters for the steady state. If possible shocks always affect different parts of the country differently, adding regional dummies to the regression should improve the fit. Shocks that affect different sectors of the economy differently may also cause divergence across regions. A measure of the economic structure of each region may thus help explain some of the variation in incomes. Further, depending on whether one has a neoclassical or endogenous growth model in mind, proxies on investment in physical and human capital may be significant. Finally, regional economic policy may matter for growth and convergence.

Geography has been a significant regressor in several cross-sectional growth studies. In the case of the US, main state census regions have been used as the geography proxy. In China's case, it has become almost standard to impose a dummy for coastal regions.[9] Whether geography matters is probably more of an open question in Russia than in many countries. At least two groupings could be used: administrative division into the federal districts and distance from Moscow. Distance from the capital may sound like a strange explanatory variable in a growth regression, but if we take into account the overly centralized nature of Soviet economy with all roads leading to Moscow, it could well yield interesting results. The variable dist measures the distance in kilometres from regional capital to the City of Moscow.

[9] See Demurger et al (2002) for China and Barro and Sala-i-Martin (1995) for the US and Japan.

In the case of Russian regions, there are strong reasons to suppose that a region's initial economic structure matters considerably for growth. Economic structures inherited from Soviet times did not necessarily have much to do with economic efficiency or productivity. Regions typically specialised in production within a few industrial branches, which made them extremely vulnerable to the dramatic price changes in early transition. As noted above, regions with substantial natural resources in oil, natural gas or metals received huge comparative advantage immediately when foreign trade was liberalised. As no satisfactory federation-wide measure of natural resource endowments is available, one needs to find some indirect proxy for it.

All in all, when it comes to the economic structure of a region, we must work with extremely incomplete data. In the ideal case, we would have the relative shares of all basic economic sectors in average regional per capita income over the whole period. The best available proxies are the relative shares of manufacturing and extracting industries in region's industrial output in 1995 (man95 and ext95) as well as the number of people employed in agriculture in 1995 (agri95).

Manufacturing industries here include machinery, light industries and construction of building materials. Extractive industries are composed of ferrous and nonferrous metallurgy and energy & fuel (oil, gas, coal) production. This is roughly the same classification as the one used by Dolinskaya (2002). The share of processing industries is the closest available proxy for the valuable natural resources. Intuitively, one would expect that regions with relatively higher shares of manufacturing fared worse during the 1990s compared with regions where the share of processing industries is higher. Although the data are for 1995, we can fairly safely take them to represent the inherited industrial structure at the outset of transition. The level and value of industrial production may have changed dramatically in the early 1990s, but regional economic structures have been remarkably stable.

Regional figures on investments in Russia are generally considered highly unreliable. Yet even accurate figures would not produce an especially good explanatory variable as most fixed investments go to the oil and gas sectors. There is also some uncertainty as to whether investments drive economic growth or vice versa.[10] The same considerations also apply to foreign direct investment. On the other hand, the data on education is supposedly fairly accurate and several possible explanatory variables are available. We use the number of students graduating from higher education establishments (aveedu) to proxy investment in human capital.

Whether economic policies of Russian regions have, in fact, affected regional growth dynamics is hotly debated. On the one hand, the period we focus on is rather short for any impacts from economic policy to show up. The 1990s were generally turbulent time and hardly amenable to long-term planning. On the other hand, regional policies and practices differ considerably across Russian regions. One of the generally accepted results of the voluminous literature that emerged in the 1990s on determinants of cross-country growth is that institutions matter. Corruption and good governance, as well as measures of good economic policies, have proven to be significant not just in transition countries, but across a wide selection of countries.[11]

Due to the lack of any consistent data on regional economic policies or business climate in Russia, this issue must remain open for the time being. We, however, attempt to proxy regional policies. One readily available proxy on region's general reform orientation

[10] Barro (1997), for example, finds that growth spurs investments.
[11] See e.g. Havrylyshyn and van Rooden (2000) on transition countries.

is provided by population's voting behaviour in federal elections. Unfortunately, the share of votes given for reform-minded parties or candidates has proven to be completely insignificant in almost all existing studies on Russian regions. There exist various rankings of the regions that could probably be used in proxying regional policies and attitudes. None of them, however, has the advantage of covering all regions. To cite an example, Transparency International published in conjunction with Russian IMDEP a corruption ranking of Russian regions in 2002. Unfortunately, this ranking covers only a small part of the regions.

Consequently, one is tempted to stick to Goskomstat data in the search for a measure of regional economic policies. The one most often used is the number of small and medium-sized enterprises (i.e. firms employing fewer than 250 persons). The number of SMEs is roughly equivalent to number of new businesses. New business formation can be taken as an important outcome of market-friendly or growth-promoting policies. Thus, we use the number of registered SMEs (avesme) to proxy regional policies and business environments.

4.3 Simple growth regressions

Following the tradition in growth literature, the dependent variable is average annual growth in income. To measure beta convergence, the initial level of income (lny92) is included as the first explanatory variable and followed by the proxies for different steady states. The regions differ considerably (for example, with regard to per capita incomes and the share of agriculture), as is apparent in Table 7.

Table 7. Descriptive statistics for the regional cross-section

Variable	Obs	Mean	Std. Dev.	Min	Max
lngrowth	76	.0707083	.02999	-.0056863	.1617462
ext95	76	20.83553	20.89522	.2	80.4
dist89	76	2211.895	2612.468	0	11876
lny92	76	6.8438	.3929209	6.158518	8.086411
aveedu	76	6047.304	10717.56	100.75	87064.55
avesme	76	833.7487	2110.282	17.9	18138.6
agri95	76	103.3408	82.95736	7.3	456.7

We first run a simple OLS on the full sample. The immediate finding is that, when supplemented with other variables, initial income becomes more significant in explaining growth. Also, its absolute size increases.

Table 8. First OLS on average annual growth rate

lngrowth	Coef.	Std. Err.	t	P>t	Number of obs = 76
lny92	-.0515132	.0085302	-6.04	0.000	R-squared = 0.5642
ext95	.0005084	.0001259	4.04	0.000	F(6, 69) = 14.89
dist89	5.04e-07	1.17e-06	0.43	0.668	
aveedu	1.37e-06	8.57e-07	1.59	0.115	
avesme	1.98e-06	4.40e-06	0.45	0.655	
agri95	-.0000369	.0000305	-1.21	0.230	
_cons	.4054532	.056556	7.17	0.000	

The second surprising observation is that variables on education and new business formation are strongly positively correlated. Jointly, they are statistically insignificant; once one is dropped from the regression, the other immediately becomes significant. Although they are positively correlated, we dare not argue that a higher level of education causes new business formation or the converse. The close correlation is probably due to the fact that the majority of universities are concentrated in rich regions with big regional capitals (e.g. the City of Moscow, St. Petersburg, Sverdlovsk) where there is a sufficient demand base for services. Most new enterprises operate in the service sector.

Several of the explanatory variables in the initial model turned out to be insignificant, and thus dropping the insignificant ones could actually improve the fit. I dropped one explanatory variable at the time starting from the education variable. Once *aveedu* was removed, new business formation (*avesme*) became highly significant. Other explanatory variables that were initially insignificant stayed so. Dropping *dist*, *poor92* and *agri95* one at the time from the regression produces the results reported in Table 9.

Table 9. Second OLS

lngrowth	Coef.	Std. Error	t-stat	Signif	Number of obs = 76
lny92	-.0481504	.0067224	-7.16	0.000	
ext95	.0004948	.0001242	3.98	0.000	
avesme	8.40e-06	1.17e-06	7.18	0.000	
_cons	.3829269	.0449398	8.52	0.000	Adj R-squared = 0.5205

The coefficient on initial income (*lny92*) remains significant and negative suggesting surprisingly strong beta convergence at the rate of 5 %. The coefficients on the share of extractive industries and the number of SMEs remain highly significant and have the expected signs. The values of these coefficients, however, are extremely small. All other potential explanatory variables turn out to be insignificant.

What about initially poor regions vis-à-vis all other regions? As expected, the share of extractive industries in total industrial production (*ext95*) is much lower and the number of people employed in agriculture (*agri95*) is much higher in the initially poor regions. Apart from the increased significance of *lny92* for the poor, the regression results change little much even when the sample is split in two (see Appendix A). Also as expected, when using the level of income adjusted by the price level indicator in 1992 (*yreal92*) as the initial level of income, the results change. The explanatory variables that turn out to

significant in this regression are the share of extractive industries and the number of SMEs together with distance from Moscow (see Appendix B).

What happens if we drop the City of Moscow? The other potential outliers identified in the section 2 (Khanty-Mansi AO, Yamalo-Nenets AO and Chukotka) are not included in the regressions due to missing data for 1992. Without the City of Moscow the variable measuring the share of agriculture becomes significant. The negative coefficient on the variable *agri95* indicates that agricultural regions have experienced slower growth (see Appendix C). The fact that the results change substantially when only one potential outlier is removed from the sample should not come as a surprise. OLS is extremely sensitive for outlier observations.

A far more robust estimation technique is provided by least trimmed squares (LTS) estimator of Rousseeuw and Leroy (1987). LTS defines outliers as those with standardised LTS residuals exceeding 2.5. The results from the initial LTS regression appear in Appendix D. Dropping the insignificant variables one at the time results in the robust estimators below. Altogether four regions had standardised residuals exceeding 2.5: The City of Moscow (-21.15821), Komi (3.13878), Tyumen (2.73797) and Magadan (2.64999), and consequently those observations are excluded from the regression reported in Table 10.

Table 10. Linear regression based on LTS

Linear Regression - Estimation by Least Squares
Dependent Variable lngrowth

Usable Observations	72	Degrees of Freedom	67
Total Observations	76	Skipped/Missing	4
Centered R**2	0.600186	R Bar **2	0.576316
Uncentered R**2	0.944197	T x R**2	67.982
Mean of Dependent Variable	0.0689516472		
Std Error of Dependent Variable	0.0279655987		
Standard Error of Estimate	0.0182030851		
Sum of Squared Residuals	0.0222006045		
Regression F(4,67)	25.1445		
Significance Level of F	0.00000000		
Durbin-Watson Statistic	1.838688		

Variable	Coeff	Std Error	T-Stat	Signif
1. Constant	0.4435	0.0459	9.65916	0.00000000
2. lny92	-0.0571	6.7502e-03	-8.45175	0.00000000
3. agri95	-7.3417e-05	3.1018e-05	-2.36692	0.02083376
4. avesme	2.0063e-05	3.8412e-06	5.22308	0.00000187
5. ext95	4.5569e-04	1.1726e-04	3.88620	0.00023604

The results do not differ dramatically from the ones derived from standard OLS imposed on the sample excluding the City of Moscow alone. All significant explanatory variables have the expected signs. The coefficient on initial income is negative, pointing towards fairly strong beta convergence. The share of workers employed in agriculture has a clear negative effect on average growth rate, whereas the education variable and the measure of the share of extracting industries have a significant positive effect on growth. The most widely used goodness-of-fit measure, R squared, is 0.58 indicating that close to 60 % of the variation in growth can is explained by the estimated model. Given the data limitations, this can be considered to be a satisfactory level of explanatory power.

5 Conclusions and directions for further research

This paper used publicly available Goskomstat data on Russian regions to analyse regional growth and convergence between 1992–2001. A number of interesting phenomena were identified. First, as expected, income dispersion across Russian regions constantly increased over the observed period. This general picture, of course, does not tell the entire truth. When the sample was split into two, based on the level of real monetary income in 1992, it was found that among the poorest one-third of the regions income dispersion has not increased nor decreased. Differences in incomes widened first and foremost among the rest of the regions, i.e. among the group that were initially better off. Thus, we found evidence of club convergence.

The measure of the speed of convergence, i.e. beta convergence, points towards surprisingly strong convergence across regions. Estimated magnitudes of unconditional and conditional beta convergence were 3 % and 6 %, respectively. In addition to the initial income level, a number of other explanatory variables were found significant in explaining cross-sectional growth. In conformity with the empirical growth literature, levels of education and the share of agriculture were found significant with the expected signs in explaining growth across Russian regions. As expected, the share of extractive industries in total industrial production of a region was found to have a strong positive effect on growth rates. This is clearly in line with much of the transition literature arguing that the initial conditions, especially the initial industrial structure, matters for growth. In circumstances of Russia the share of extracting industries can also be interpreted as a proxy for natural resources as most of what was classified as extracting industries is mining together with oil, gas and fuel production. Finally, new business formation, proxied by the number of small and medium-sized businesses, had a robust, positive effect on growth.

Most studies of growth and convergence rely on much longer time-series than transition countries presently offer. Consequently, it has become standard in the literature to report not only estimates over the whole sample but also pooled data over shorter sub-periods, imposing a constant value of b while allowing for fixed time effects. As the 1998 crisis caused a clear break in growth and convergence in Russia, a follow-up paper might find it advantageous to split the data into the sub-periods 1992-1998 and 1999-2001.

Differences in real income levels widened during the 1990s, but the crisis years 1998-1999 narrowed the gap between rich and poor regions. Further research might also consider the following questions. Was this narrowing related to e.g. exporting regions facing temporary downturns? Have rural regions fared any better after the crisis? Was the convergence only a temporary phenomenon or did the August 1998 crisis result in some kind of a structural break?

Panel data approach has not been very widely used in growth analyses. However, results from such analyses have been radically different from the classical ones using single cross-section regressions. Those results have provoked many debates questioning both the validity of classical growth theories and the statistical methods used. Some researchers argue that the higher convergence rates found in panel data studies are at least partially explained by the fact that some estimates fail to separate between short-term fluctuations around a time trend and long-term growth (de la Fuente 2000). In the follow-up paper, we definitely plan to complement the cross-sectional regressions with basic panel data analyses.

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Appendices

Appendix A

. by poor, sort: regress lngrowth lny92 ext95 avesme

poor92 = 0

Source	SS	df	MS	Number of obs =	54
Total	.048095238	53	.000907457	Adj R-squared =	0.4841

lngrowth	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
lny92	-.0415839	.0087663	-4.74	0.000	-.0591915	-.0239763
ext95	.0004792	.0001384	3.46	0.001	.0002011	.0007572
avesme	7.89e-06	1.25e-06	6.31	0.000	5.38e-06	.0000104
_cons	.3373265	.0592774	5.69	0.000	.2182644	.4563886

poor92 = 1

Source	SS	df	MS	Number of obs =	21
Total	.018692313	20	.000934616	Adj R-squared =	0.6956

lngrowth	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
lny92	-.0654595	.0103475	-6.33	0.000	-.0872907	-.0436282
ext95	.0011791	.0004902	2.41	0.028	.0001449	.0022133
avesme	.0000225	.43e-06	4.15	0.001	.0000111	.000034
_cons	.4869207	.06651	7.32	0.000	.3465969	.6272445

Appendix B

regress lngrowth lnyreal92 ext95 avesme dist89

lngrowth	Coef.	Std. Err.	t	Number of obs =	74
lnyreal92	-.0042772	.0126561	-0.34		
ext95	.0002729	.0001638	1.67		
avesme	5.70e-06	1.43e-06	3.98		
dist89	-3.42e-06	1.17e-06	-2.92		
_cons	.0661094	.0069437	9.52	Adj R-squared =	0.2554

Appendix C

. drop if region=="MOS"

(14 observations deleted)

regress lngrowth lny92 ext95 agri95 avesme

Number of obs = 75 Adj R-squared = 0.5066

lngrowth	Coef.	Std. Err.	t	P>t
lny92	-.0501778	.0067385	-7.45	0.000
ext95	.0005036	.0001207	4.17	0.000
agri95	-.0000787	.0000335	-2.35	0.022
avesme	.0000197	4.19e-06	4.70	0.000
_cons	.398175	.0459726	8.66	0.000

Appendix D

In this estimation, three outliers are skipped: The City of Moscow (-9.59129), Tyumen (2.75431) and Komi republic (2.94355). LTS residuals are in parenthesis.

Linear Regression - Estimation by Least Squares
Dependent Variable lngrowth

Usable Observations	73	Degrees of Freedom	66
Total Observations	76	Skipped/Missing	3
Centered R**2	0.588645	R Bar **2	0.551249
Uncentered R**2	0.942537	T x R**2	68.805
Mean of Dependent Variable		0.0686809466	
Std Error of Dependent Variable		0.0278668606	
Standard Error of Estimate		0.0186676965	
Sum of Squared Residuals		0.0229998710	
Regression F(6,66)		15.7409	
Significance Level of F		0.00000000	
Durbin-Watson Statistic		1.801555	

Variable	Coeff	Std Error	T-Stat	Signif
1. Constant	0.4540	0.0551	8.24457	0.00000000
2. lny92	-0.0589	8.2872e-03	-7.11064	0.00000000
3. agri95	-7.1141e-05	3.2423e-05	-2.19415	0.03175025
4. aveedu	3.4076e-07	9.0731e-07	0.37557	0.70844046
5. avesme	1.7926e-05	7.8519e-06	2.28299	0.02565898
6. dist	1.4630e-06	1.1037e-06	1.32547	0.18958411
7. ext95	4.0102e-04	1.1801e-04	3.39823	0.00115392

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