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Unequal fortunes: a note on income convergence across Russian regions

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This article uses annual data for 1992–2005 to examine income dispersion and convergence across 76 Russian regions. Wide disparities in income levels have emerged during the transition period. Dispersion has increased most among the initially better-off regions, whereas for the initially poorer regions no clear trend of divergence or convergence could be established. Further, evidence was found of both unconditional and conditional convergence, especially among the initially richer regions. Finally, it is observed that there is much less evidence of convergence after the economic crisis of 1998.

During the 1990s and the early 2000s Russia experienced enormous regional differences in growth rates. For example, while on average real incomes grew by 9% in 2005, growth was by no means evenly distributed across regions. In eight regions incomes increased by more than 15% and in 10 regions real incomes actually decreased in comparison with 2004. Although these large differences are nowadays widely recognised, not much is known about what kinds of regions are growing fast and what may explain the strong divergence trends. This article describes trends in convergence and divergence across Russian regions using publicly available Rosstat data for 1992–2005.

There are a few recent papers that analyse growth and convergence across Russian regions. Berkowitz and DeJong (2003) look at the determinants of economic growth for a group of 48 of the 89 regions over the period 1993–97. Their interest is in determining whether regional policy reform matters for economic growth, and they do, indeed, find a positive correspondence between price liberalisation and growth in per capita incomes. Another study on regional growth by Ahrend (2005) uses a panel of 77 regions for a somewhat longer period. Ahrend finds that economic reform and general reform orientation explain little of the observed difference in regional growth rates. He concludes that a region's initial industrial structure and resource endowment seem to have a pronounced impact on its growth prospects. A somewhat similar conclusion is arrived at by Dolinskaya (2002) who 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. In a recent paper, Yemtsov (2003) analyses poverty and inequality across Russian regions over 1994–2000. His emphasis, however, is on the determinants of inequality as measured by the Gini index. Therefore, 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 short

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article shows that there should be no reason for such neglect, as there seem to be many interesting phenomena which even a fairly simple analysis can reveal.

The first section briefly discusses the data and their limitations. The next section focuses on general trends in income convergence in Russia and the following one presents the results from simple growth regressions. The next section assesses the robustness of the analysis via panel data techniques. The last section concludes.

Data description

While regional data tend to be problematic everywhere, Russian regional data are often regarded as dubious at best. In many instances it is, indeed, somewhat unclear exactly how regional data on production, incomes and prices are collected and what the precise relationship is between regional and national figures. These problems notwithstanding, the Russian Statistical Office, Rosstat, is the only feasible data source. Moreover, even if Rosstat data are not perfect, one can at least assume the same mistakes are made everywhere. The possible inaccuracies in Rosstat data should not make comparing Russian regions with each other impossible.

Ideally one would like to use gross regional product (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 or 1998–2004 as Rosstat changed the methodology of GRP calculations in the early 2000s. A further complication with GRP data is that Rosstat does not publish regional GRP deflators. Even if the deflators were available, the accuracy of GRP data is probably poorer than that of its components (Granberg and Zaitseva 2002).

The weaknesses of GRP data have forced researchers to rely on alternative data series. Both monetary incomes per capita and the value of industrial production have been used in earlier studies on regional growth in Russia. As one would suppose, both measures are closely correlated with GRP. Further, Rosstat reports regional consumer and producer price indices for 1992–2005, greatly facilitating the analysis. Yudaeva *et al.* (2001) and Ahrend (2005) use both indicators, whereas Berkowitz and DeJong (2003), Dolinskaya (2002), Yemtsov (2003) and Carlauer and Sharipova (2001) use monetary incomes.

In this article the real income per capita indicator is used, because relying on industrial production makes agricultural regions and the regions where the service sector has any significance look unfairly poor. The regional statistics on monetary income do indeed come close to describing regional national income. By definition, monetary income includes wages, social transfers, income from enterpreneurial activity and capital incomes of the household sector. Nominal monetary income per capita originates from Rosstat's *Regiony Rossii* publications and is available for 76 of 89 regions for the whole period 1992–2005.[1]

Nominal figures are deflated by regional consumer price indices to arrive at real incomes measured in 2000 rubles. This is done assuming that the price level in 2000 was roughly equal in all regions. In fact, Glushenko (2003) shows that the variation in price levels in Russia as a whole was smallest in 1992 and 2000. It would be tempting to use the monetary incomes adjusted by a price level indicator as the real income measure, but there is no consistent measure of regional price levels over the entire period.[2]

Table 1 gives the number of observations, standard deviation, median and mean of real per capita income for every year in the sample. Mean real income is considerably higher than median, confirming the generally held view that a handful of regions are extremely rich. High positive values of skewness further confirm that the distribution of incomes across regions is not symmetric. On the contrary, the tail of high values is longer than the tail of low values. The same picture is given by the kurtosis measure: the distribution of income across regions is characterised by long and thin tails.

Table 1. Summary statistics for monthly real income per capita (rubles).

	N	Median	Mean	SD	Skewness	Kurtosis
1992	76	881.2	1025.7	533.9	2.558	10.052
1993	79	1107.7	1303.1	904.0	4.664	29.656
1994	79	1472.2	1798.2	1264.5	4.199	22.467
1995	79	1470.5	1827.2	1188.8	3.897	21.886
1996	79	1759.9	2175.6	1456.1	4.496	28.637
1997	88	1976.1	2492.9	1787.6	3.603	18.922
1998	88	1174.1	1509.5	1059.4	3.030	14.161
1999	88	1358.5	1694.7	1173.8	3.271	16.422
2000	88	1472	1898.5	1372.9	3.202	15.169
2001	88	1785.7	2306.7	1635.5	2.767	11.430
2002	88	2090.2	2598.8	1656.0	2.741	11.658
2003	88	2434.4	3015.3	1884.3	2.286	8.459
2004	87	2624.8	3312.0	2039.2	2.349	8.855
2005	87	2931.1	3658.0	2078.5	2.205	8.360
1992–2005	1182	1738.1	2209.0	1669.6	2.89	13.69

Note: Real income is the personal monetary income in rubles divided by the regional CPI (2000 as base year).

The skewness and kurtosis of the income distribution increased up to 1996, but have subsequently decreased. These measures indicate that income distribution in the mid-2000s was as asymmetric as it was in 1992. Compared with the mid-1990s, the distribution's tails have shortened and especially the tail of high values has become shorter again. However, apart from 1998, the standard deviation of incomes has steadily increased, suggesting that the income distribution has become more dispersed over time.

Clearly the mean of regional real income figures, as reported in Table 1, seems to tell a brighter story of real income developments than the national figures. This is probably due to the fact that the national figures are reported using population weights. Indeed, most of the regions with high real incomes are small regions in the Russian North that are well known for rich natural resources and relatively high price and wage levels.[3] The regions with the highest incomes also account for much of the variation (standard deviation) in real incomes. Excluding Moscow City, Khanti-Mansi ao, Nenets ao, Yamalo-Nenets ao and Chukotka from the sample reduces the overall standard deviation of real incomes to 867.9 and the sample mean over the whole period to 1747.2 rubles. These five regions are clearly the potential outliers. As data for the autonomous *okruga* are available only from 1997 onwards, four of the outliers are automatically excluded when the basic sub-sample of 76 regions is analysed.

Two concepts of absolute convergence

A key property of the neoclassical growth models is conditional convergence. The models predict that per capita growth will be inversely related to the starting level of income or output per capita. Therefore, an economy starting out further below its steady state tends to grow faster. Assuming similar tastes and technologies, the economies' steady states are similar and consequently poor economies tend to grow faster than richer ones. This is referred to as absolute (i.e. unconditional) convergence. Many empirical studies have shown that absolute convergence does not apply for a broad selection of countries. For a relatively homogeneous group of countries or regions, like the OECD or the states of the US, absolute convergence has been established. Two concepts of absolute convergence appear in discussions of economic growth across countries or across regions within countries: sigma-convergence and beta-convergence.

Sigma-convergence

In one view, convergence occurs if the dispersion in per capita incomes or per capita output tends to decrease over time. Barro and Sala-i-Martin (2004) define sigma-convergence in terms of the level of income dispersion. Sigma-convergence occurs if the cross-sectional 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.

Figure 1 shows the standard deviation (i.e. sigma-convergence) of real incomes for three sub-sets of data. The solid line graphs the movement of sigma-convergence, including all available observations. The dashed line stands for the basic sub-set of 76 regions for which we have full data for the whole period and the last line describes sigma-convergence within the basic sub-set excluding Moscow City.

There are three immediate lessons to be learned from these data. First, there does not seem to be any evidence of sigma-convergence. On the contrary, even excluding Moscow City, the income dispersion has more than doubled between 1992 and 2005. The second observation is that the economic crisis in 1998 caused a sudden and remarkable decrease in income dispersion, but that proved to be only temporary. The variation in incomes started to grow immediately after the crisis, and in 2003 the level of dispersion exceeded the pre-crisis level. The third observation is that – as expected – removing the most obvious outlier significantly reduces the variance in real incomes but does not change the general trend of divergence.

Andrienko and Guriev (2004) suggest that the poorest third of Russian regions are poverty-trapped in the sense that many people would move out if 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 whether the growth experience of the poorest third differs from the majority of the regions, the sample was split into two using a dummy for the initially poorest regions. A region was classified as initially poor if its income per capita divided by the cost of a 19 good basket was less than one third of the national average in 1992.[4]

The variation in the real income levels of the initially poor group is significantly lower than in those of the remaining Russian regions. Figure 2 depicts sigma-convergence for the two groups separately. It suggests that up until 2000 one cannot detect any clear trend of either convergence

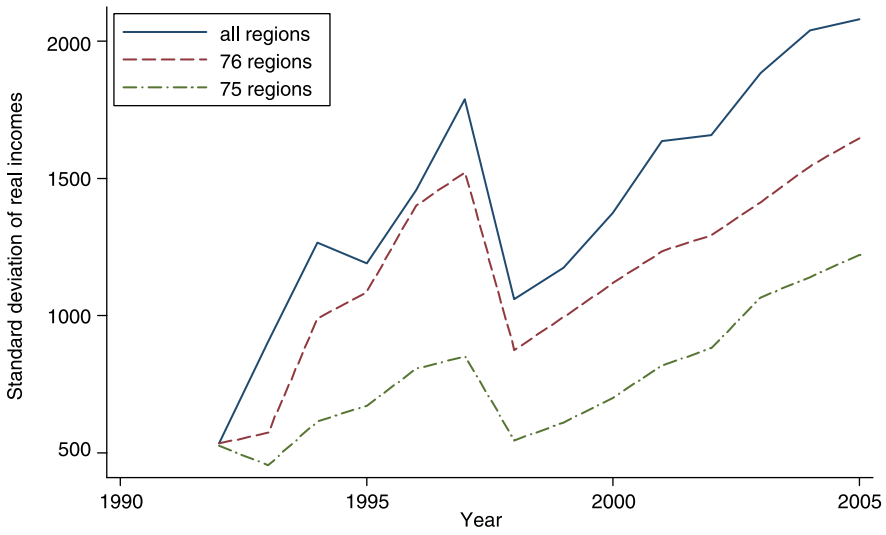

Figure 1. Sigma-convergence across Russian regions, 1992–2005.

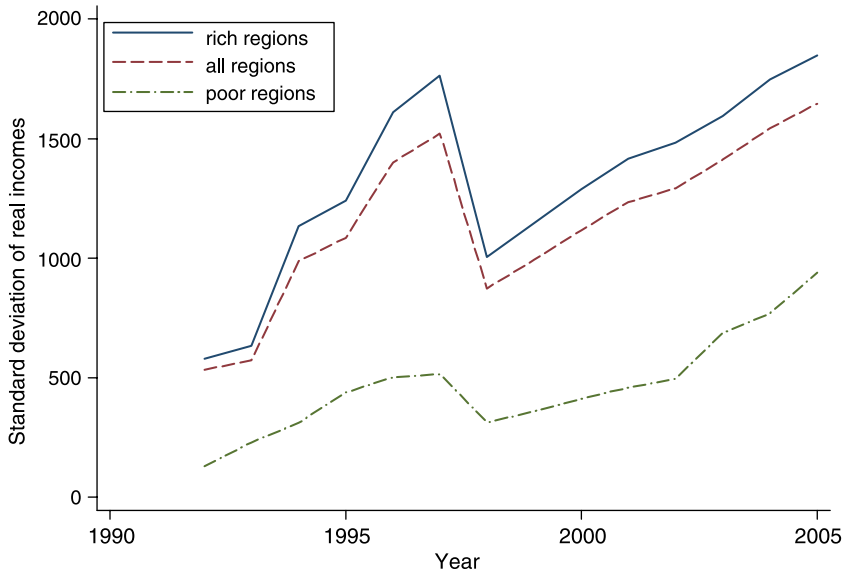

Figure 2. Sigma-convergence for initially poor and initially rich regions, 1992–2005.

or divergence for the initially poor regions, but over the last couple of years differences in income levels have increased markedly. The group of initially rich regions is considerably more heterogeneous and – apart from 1998 – income dispersion has continually increased.

Comparing the relative positions of Russian regions in annual rankings of income levels also reveals a high level of variation. Comparison between the rankings in 1992 and the rankings in 2005 indicates that the relative position of practically all regions has changed significantly. The rankings of 20 regions had changed (up or down) by more than 25 ranks. The regions whose relative position deteriorated most between 1992 and 2005 are a heterogeneous bunch, including Kalmykia, Kurgan, Mordva, Orenburg, Ryazan, Adygeya and Altai *krai*. The regions whose relative position increased most include Moscow *oblast'* (which has benefited from the growth in Moscow City), the independence-minded republics of Bashkortostan and Tatarstan, and a handful of 'traditional' regions of European Russia: Smolensk, Vologda, St Petersburg, Leningrad, Perm, Pskov and Voronezh. The tiny Buryat republic in the Siberian federal district also saw a tremendous increase in its relative position.

A standard rank correlation coefficient, Spearman's rho, gauges whether any two given rankings are independent of each other. The coefficient between a region's rank in 2005 and in any other year is very high, confirming that a region's position in the income ranking is dependent on its relative position in previous years. As Table A1 indicates, there is no clear difference between the two groups in how the income level rankings develop.

Unconditional beta-convergence

The second concept of convergence, usually labelled beta-convergence, focuses on the speed of convergence. Beta-convergence applies if a poor country or region tends to grow faster than a rich one. This implies that a poor region tends – over a long time period – to catch up with a rich region in terms of per capita income. Unconditional beta-convergence refers to countries or regions converging to a common steady state, whereas conditional beta-convergence implies convergence among regions with similar economic structures (Barro and Sala-i-Martin 2004).

There is no universal way of measuring beta-convergence, as the exact formulation depends on the assumptions of the underlying growth model. Loosely speaking, unconditional beta-convergence is said to exist if the income level in the base year is negatively correlated with the average annual growth rate over the observed period. In our case the simplest measure of unconditional beta-convergence is the simple correlation between the 1992 income level and the average annual income growth rate in 1992–2005. This simple measure of unconditional beta-convergence is −0.47 for the 76 regions for which there are data over the entire period 1992–2005. Excluding Moscow City from the sample increases the correlation to −0.57. This cross-sectional correlation indicates strong beta-convergence. Regions with initially low income levels appear, on average, to have had faster rates of income growth than regions which were better off initially.

Assuming for the moment that all Russian regions have a common steady state, beta-convergence may be estimated by a simple equation of the form:

$$(1/T)\ln(y_{it}/y_{i,t-T}) = a + b\ln y_{i,t-T} + \varepsilon_{it}, \quad (1)$$

where $y_{i,t\text{-}T}$ is per capita real income in region i in 1992, $y_{i,t}$ is the real income in 2005, T is the length of the interval (13 years) 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 yields the results in Table 2.

The coefficient of the initial level of per capita income ($\ln y_{92}$) has the expected negative sign and is statistically highly significant. In all specifications the estimated magnitude of beta-convergence is 0.03, indicating annual convergence at the rate of 3%. This is broadly in line with the magnitude of beta-convergence found in many regional studies.

Table 2. Unconditional beta-convergence.

	Spec (1)	Spec (2)	Spec (3)	Spec (4)
Initial income in 1992	−0.03	−0.03	−0.04	−0.03
	(−463)***	(−4.37)***	(−6.73)***	(−5.88)***
Constant	0.30	0.30	0.33	0.31
	(6.70)***	(6.44)***	(9.39)***	(8.33)***
Observations	76	76	75	76
R-squared	0.22	0.22	0.31	0.32

Note: *T*-statistics in parentheses, * significant at 10%, ** significant at 5%; *** significant at 1%. Spec 1: Standard OLS. Spec 2: OLS with Huber/White robust standard errors. Spec 3: Same as Spec 2, excluding Moscow City. Spec 4: Iteratively reweighted least squares calculated with STATAs rreg.

The first two columns of Table 3 report beta coefficients from regressions in the form of equation (1) for various periods. An extremely interesting finding is that the magnitude of income convergence was many times larger before the economic crisis of 1998 than afterwards. The rapid economic growth Russia has enjoyed after the crisis has decreased income convergence. The strength of this result does, however, depend on the period and the sub-set of regions studied. For the full sample, values of beta are always negative and significant, but removing Moscow City from the analysis makes the result much less robust.

Further, as reported in the last two columns of Table 3, the dynamics of the groups of initially poor and initially rich regions differ. No beta-convergence can be established for the initially poor group, whereas beta is negative and statistically different from zero for the rich group for most of the periods studied. This can be interpreted as evidence of club convergence. In the beta-sense the income levels among the initially rich regions are converging, while the incomes of the group of initially poor regions are neither converging nor diverging.

Table 3. Values of unconditional beta.

Growth period	Full sample	75 Obs (excluding Moscow City)	Initially poor regions	Initially rich regions
1992–2002	− 0.03***	− 0.04***	− 0.04	− 0.02**
1993–2003	− 0.02***	− 0.01	− 0.02	− 0.01
1994–2004	− 0.01**	− 0.01	− 0.02	− 0.01
1995–2005	− 0.02***	− 0.01**	− 0.03**	− 0.01***
1992–2005	− 0.03***	− 0.04***	− 0.03	− 0.02**
1992–1997	− 0.27**	− 0.36***	− 0.01	− 0.18
1999–2005	− 0.03***	− 0.02***	− 0.03	− 0.03***

Note: Table reports beta coefficients of the regressions by standard OLS, * significant at 10%, ** significant at 5%; *** significant at 1%, constant included but not reported.

These results clearly indicate that, even though on average the dispersion of incomes has increased, on average the growth of per capita real income is negatively related to the initial level of per capita income in Russian regions. Income convergence is stronger for the club of initially rich regions and during the period 1992–97. The income convergence may be partially caused by internal migration or it may reflect increasing income redistribution across regions.[5]

These results, however, require a number of caveats. The first is rather trivial: Russian regions are not likely to have a single steady state common to each and every one. Thus, the regression above is likely to be erroneous and it needs to be redefined before the results can be interpreted. It is also possible that simple OLS, being fairly sensitive to outlying observations, does not produce robust estimates. The results do not change, however, if the three regions with the highest leverage (Sakhalin, Kamchatka and Tyumen) as well as the two with especially poor fit (Moscow City and Kalmykia) are removed from the regression.

Conditional income convergence

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 last 10 years. The existence of unconditional beta-convergence seems to suggest that poorer regions have grown faster. Increasing sigma, together with beta-convergence, implies that the initial value of sigma is below its steady-state value. Taking into account Soviet history, this may indeed be the case. As already mentioned above, it is, however, questionable whether all of Russia's regions share a common steady state.

The common language, culture, values and socialist history notwithstanding, in their economic environment Russian regions differ considerably from each other. First, much of Russia's wealth is concentrated in natural resources, which are far from evenly distributed across the whole federation. Second, several of the smallest regions are wholly dependent on a handful of large enterprises. A dramatic change in the operations of one big plant may alter annual industrial production, income and tax revenue significantly.[6] This is indeed one of the reasons for the wide annual variations in regional growth rates. It would therefore be surprising to find that all Russian regions had a common steady state. Controlling for differences in steady states (i.e. structural differences) yields estimates of the so-called conditional beta-convergence.

What then are the likely determinants of regional steady states? If possible shocks always affect different parts of the country differently, adding geographical 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 to explain some of the variation in incomes. Further, depending on whether one has a neoclassical or endogenous growth model in mind, proxies for investment in physical and human capital should turn out to have statistically significant coefficients. And finally, regional economic policy could matter for income growth and convergence.

Geography has indeed been a significant regressor in several cross-sectional growth studies, but whether geography matters is probably more of an open question in Russia than in many other countries. The 11 federal districts imposed by President Putin in 2001 have nothing to do with economic logic and so are not likely to be helpful in economic analysis. Taking into account the highly centralised nature of the Soviet economy, with all roads leading to Moscow, distance from the capital may turn out to be interesting. The distance variable measures the distance in kilometres from regional capital to Moscow City.

There are strong reasons to assume that a region's initial economic structure also strongly influences income growth. The initial economic structure 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 rendered them extremely vulnerable to the dramatic price changes of the early transition. And regions with notable natural resources in oil, natural gas or metals gained a huge comparative advantage immediately foreign trade was liberalised. A region's initial economic structure is proxied by the share of extractive industries in industrial output in 1995 and by the number of people employed in agriculture in 1995 relative to the total regional population.

Extractive industries consist of metals and energy and fuel (oil, gas, coal) production. This is roughly the same classification as the one used by Dolinskaya (2002). The share of extractive industries is the closest available proxy for valuable natural resources. *A priori*, one would thus assume that regions with relatively higher shares of manufacturing fared worse during the 1990s than regions in which the share of extractive industries was higher. Even though the data are for 1995, we can fairly safely take that year 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 changes in regional composition of output have been remarkably slow. The share of agriculture in total regional employment probably changed much more during the early 1990s, but we feel that data for 1995 are a good proxy for the initial levels.

Regional figures for fixed investment in Russia are extremely volatile and unreliable. And as most fixed investment is in any case concentrated in the oil and gas sectors, even accurate figures might fail to produce an especially good explanatory variable. On the other hand, the data on human capital, i.e. education, are fairly accurate, and several possible explanatory variables are available. As regional differences in primary and secondary schooling in Russia are extremely small, the average number of students graduating from higher education establishments per capita in 1993–2003 will be used in the analysis.

Whether economic policies of Russian regions have actually affected regional growth dynamics is a highly debated issue. During the 1990s Russian regions had a relatively high degree of freedom in deciding on their economic policies, including taxation and investment promotion. But the turbulent macroeconomic environment was not especially conducive to regional fine-tuning. The recent macroeconomic stability would certainly have improved the possibilities for regional economic policy making, but currently regions have virtually no independent policy-making power. Owing to the lack of consistent data on regional economic policies or business climate in Russia, this issue will remain unsettled for the time being. I will, however, make an attempt to proxy regional policies. A possible proxy is the number of small and medium-sized enterprises (employing less than 250 persons). The number of small and medium-sized enterprises is roughly equivalent to the number of new businesses. New business formation can be taken as an important outcome

of market-friendly or growth-promoting policies. Thus, the average number of registered small and medium-sized enterprises per capita for 1993–2003 will be used to proxy regional policies and business environment. The inherent problem with this variable is that it is bound to be endogenous, as shown by Berkowitz and DeJong (2003). Growth in income spurs emergence of small and medium-sized enterprises, which typically operate in the service and retail sectors. Therefore the results will be presented both with the regional policy proxy and without it.

The Russian regions differ considerably with regard to all these variables, as shown in Table 4.

Table 4. Descriptive statistics for regional cross-section, 1992–2005.

Variable	Obs	Mean	Std. Dev.	Min	Max
Average annual income growth	76	0.09	0.02	−0.003	0.16
Log of real initial income in 1992, 000 rubles	76	6.8	0.39	6.16	8.09
Distance to Moscow, km	76	2211.9	2612.5	0	11,876
Share of extractive industries, %	76	20.8	20.9	0.20	80.4
Share of workforce employed in agriculture, %	76	6.0	2.71	0.14	13.31
University graduates per 1000 inhabitants	76	2.07	1.03	0.035	7.80
SMEs per capita	76	0.005	0.003	0.002	0.021

Results on conditional convergence of income

Equation (1) from the previous section is augmented by the proxies for a region's economic structure (i.e. steady state). The model to be estimated is therefore:

$$(1/T)\ln(y_{it}/y_{i,t-T}) = a + b\ln y_{i,t-T} + \sum c_{i,j}X_i + \varepsilon_{it}, \tag{2}$$

where $y_{i,t-T}$ is per capita real income in region i in 1992, $y_{i,t}$ is real income in 2005, T is the length of the interval (13 years), a is a constant, $\sum_{j=1}^{6} X_{i,j}$ is the vector of steady state proxies and ε is the error term. If b is negative and significantly different from zero, unconditional convergence is said to hold.

The model is estimated by a simple cross-sectional OLS on the full sample of 76 regions. The results are reported in Table 5. The immediate finding is that, when supplemented with the other variables, the absolute value of the coefficient on initial income becomes larger, thus explaining a greater part of growth. Moreover, the explanatory power of the regression is very high. The variables characterising the economic structure of a region (share of extractive industries and agriculture) are significant and have the expected signs. A larger share of extractive industries causes higher average growth whereas a larger share of agriculture leads to lower growth rates. The distance and education variables are not significant. The fact that education is not significant may reflect the fact that the quality of university education varies a lot across regions. The variable on small and medium-sized enterprises is significant and has the expected sign but, as discussed earlier, it is possibly endogenous.

Removing the insignificant variables does not alter the magnitude or significance of the other variables. The result on strong income convergence is also fairly robust to the exclusion of Moscow City, as seen from Spec (3) in Table 5. As the endogeneity of the SME variable cannot be easily treated with instrumental variables, the preferred model is the one presented in the last column of Table 5.

As noted in the previous section, we should be careful not to overvalue the results based on the 1992–2005 period. To address this problem we once again run cross-sectional regressions for several growth periods ending with the most recent year of our data. Table 6 reports the beta

Table 5. OLS on average annual growth rate, 1992–2005.

	Spec (1)	Spec (2)	Spec (3)	Spec (4)
Initial income level in 1992	−0.058	−0.055	−0.055	−0.049
	(8.06)***	(9.57)***	(9.54)***	(6.93)***
Share of extractive industries	0.000	0.000	0.000	0.000
	(4.19)***	(6.00)***	(4.10)***	(2.12)**
Distance to Moscow	0.000			
	(1.33)			
Number of SMEs	4.073	4.069	3.349	
	(4.96)**	(4.11)***	(6.14)***	
University graduates per capita	0.000			
	(0.22)			
Share of agricultural workers	−0.003	−0.003	−0.003	−0.005
	(2.57)**	(2.53)**	(2.64)**	(4.11)***
Constant	0.479	0.457	0.465	0.451
	(8.98)***	(10.18)***	(10.16)***	(9.07)***
Observations	76	76	75	76
R-squared	0.66	0.65	0.64	0.50

Note: Model estimated with OLS. Significance levels calculated using robust standard errors, *significant at 10%, **significant at 5%, ***significant at 1%. Robust *t* statistics in parentheses.

coefficients from OLS regressions of the form of Spec (4) in Table 5. These results strongly suggest that, when controlling for initial economic structure, incomes in a region with a lower initial income level will have grown faster in every period. Similarly to the results of the previous section, conditional convergence was stronger in 1992–97 than in the post-crisis period 1999–2005. Further, after 1998 the proxy for the initial share of agriculture in a region's economy ceases to be significant.

How do the initially poor compare with the rest of the regions? As one would expect, the share of extractive industries in total industrial production is much lower in the initially poor regions. The last two columns of Table 6 report the values of beta for these two groups separately. While the simple growth model performs fairly well in explaining income growth of the initially rich regions, it largely fails to explain the growth experience of the initially poor regions.

Purely as a robustness check similar regressions were run with gross regional product per capita in 1995–2003 as the dependent variable, even though the data for the first years are hardly comparable with those for the later ones. The beta coefficients are always negative and statistically significant in specifications corresponding to columns 1, 2 and 3 of Table 5. The results are available from the author upon request.

Table 6. Values of conditional betas.

Growth period	Full sample	75 regions	Initially poor regions	Initially rich regions
1992–2005	−0.05***	−0.05***	−0.05*	−0.05***
1992–1997	−0.09***	−0.11***	−0.01	−0.09***
1999–2005	−0.04**	−0.03	0.002	−0.05**
1992–2002	−0.06***	−0.06***	−0.06**	−0.05***
1993–2003	−0.03**	−0.03***	−0.02	−0.03*
1994–2004	−0.03**	−0.03***	−0.03	−0.02
1995–2005	−0.02**	−0.03**	−0.03	−0.02***

Note: Model estimated with standard OLS. Significance levels calculated using robust standard errors, *significant at 10%, **significant at 5%, ***significant at 1%.

A robustness check using panel analysis

The preceding analysis suggests that during the period 1992–2005 Russian regions have converged in the beta sense. The result is especially strong when we control for structural differences in regions. Since some of the data are available for the whole period, or at least for a large part of it, the panel feature of the data is used to see whether the main results change. Owing to the short time series in this article, one can only use annual changes in real per capita income as the dependent variable. This certainly risks being far too short a period since normal business cycle movements are likely to drive the results. Being fully aware of the limitations of using such a short period, the following exercise is to be taken only as a robustness check for the previous results.

We first run a panel fixed-effects model[7] and then an Arellano and Bond (1991) dynamic panel model to see whether the results on unconditional convergence in the previous section change. The equations to be estimated are:

$$Yit = (1/T)\ln(y_{it}/y_{i,t-T}) = a + b\ln y_{i,t-T} + u_i + \varepsilon_{it}, \quad T = 1(\text{fixed-effects model}) \text{ and} \tag{3}$$

$$\Delta Yit = a + b\,\Delta Y_{it-1} + c\Delta \ln y_{i,t-T} + \Delta\varepsilon_{it}, \quad T = 1(\text{first-difference form}) \tag{4}$$

A regression allowing for fixed effects, which captures unobserved region-specific factors, confirms that regional growth is significantly correlated with the level of initial income and has the expected sign. The result is confirmed by the Arellano and Bond methodology, which allows for dynamic effects by introducing lagged dependent variables. The coefficients on the initial income are much higher than in the cross-section analysis and they are indeed suspiciously high. Therefore we suggest reading the results only as a confirmation of the signs on initial income level. Table 7 reports only results using an unbalanced panel of 88 regions. The results remain quantitatively the same when a balanced panel of 76 regions and only 834 observations is used.

The 1998 financial crisis clearly blurs the picture in the panel analysis. Introducing a dummy for the crisis year immediately reduces the beta coefficient to about −0.2 in the fixed-effects model.

Table 7. Unconditional beta-convergence with panel data, 1992–2005.

	Fixed-effects model		GMM	
	Growth (Yit)	Growth (Yit)	Growth (ΔYit)	Growth (ΔYit)
Initial income level	−0.26	−0.219		
	(13.31)***	(14.80)***		
Dummy98		−0.592		
		(42.51)***		
Δ(growth)			0.263	0.096
			(9.39)***	(5.59)***
Δ(initial income)			−0.722	−0.326
			(22.72)***	(15.49)***
ΔDummy98				−0.568
				(41.46)***
Constant	1.998	1.757	0.043	0.014
	(13.92)***	(16.17)***	(17.25)***	(8.55)***
Observations	1094	920	918	918
Number of regions	88	88	88	88
R-squared	0.15	0.77		

Note: First two columns estimated with panel fixed-effects model as in Table 5.1, the GMM model estimated with Arellano and Bond (1991) GMM estimator as in Table 5.2. Absolute value of *t* (and *z*) statistics in parentheses, *significant at 10%, **significant at 5%, ***significant at 1%.

The coefficient on difference in initial income in the dynamic panel model decreases by more than a half, to −0.4. Therefore it is worthwhile to include a dummy in the model for the crisis year 1998.

Next, conditional convergence was analysed. Here the data limitations are even more severe. We have the data for industrial structure for 1995 and 1997–2003. The missing year, 1996, was approximated by the average of the preceding and following observations. As the variable characterising the industrial structure of a region (Extract) is only available from 1995 onwards, the panel analysis covers only the period 1995–2003. As there is no knowledge of the appropriateness of the estimate for the value of Extract in 1996, a dummy for that year is included. The data for the number of small and medium-sized enterprises and for the education proxy are available for 1995–2003, but unfortunately we could not obtain values for the share of agriculture.

The main results of the previous section seem robust. Growth depends negatively on the level of initial income and positively on the share of extractive industries in regional industrial output. The results reported in Table 8 show that the coefficient of the lagged value of income is more reasonable, some 17%. Rates of convergence in the range of 12–20 are not uncommon in the literature of panel analysis on regional data.

The small and medium-sized enterprises variable is not significant in the panel model but, as before, removing it does not change the results reported. The coefficients of education have unexpected signs. This may be a result of the current value of the education proxy being in fact more of a burden for current growth. A one-period lagged value of the education proxy remains negative and significant but much smaller in value. The results from the dynamic panel regression largely confirm these results.

Table 8. Conditional beta-convergence with panel data 1995–2003.

	Fixed-effects model	Fixed-effects model	First-differences GMM model	First-differences GMM model
Initial income level	−0.117	−0.252	−0.493	−0.493
	(6.31)***	(17.89)***	(20.87)***	(20.87)***
Share of extractive industries	0.002	0.002	−0.001	−0.001
	(4.16)***	(2.66)***	(0.93)	(0.92)
Number of SMEs	−7.565		−3.132	
	(2.71)***		(0.71)	
University graduates per capita	−0.010	−0.020	−0.035	−0.034
	(3.78)***	(6.93)***	(11.40)***	(11.38)***
Dummy98	−0.595	−0.569	−0.480	−0.479
	(52.59)***	(42.38)***	(36.34)***	(36.38)***
Dummy96	0.071	0.054	0.091	0.092
	(6.91)***	(4.30)***	(7.68)***	(7.90)***
Constant	0.989	2.002	0.008	0.008
	(6.85)***	(18.77)***	(3.75)***	(3.88)***
Observations	786	937	702	702
Number of regions	82	82	81	81
R-squared	0.86	0.79		

Note: First two columns estimated with panel fixed effects model as in Table 5.1, the GMM model estimated with Arellano and Bond (1991) GMM estimator as in Table 5.2. Absolute value of t (and z) statistics in parentheses, *significant at 10%, **significant at 5%, ***significant at 1%.

Conclusions

This article used publicly available Rosstat data on Russian regions to analyse income convergence or divergence and regional income growth between 1992 and 2005. The apparent

data problems notwithstanding, a number of interesting phenomena were found. First, as expected, income dispersion across Russian regions has increased dramatically over the period studied. The economic crisis in 1998 caused a sudden and large drop in the level of dispersion, but the drop turned out to be only a temporary phenomenon. Dispersion, or sigma-divergence as Barro and Sala-i-Martin call it, began to increase immediately after the crisis and reached the pre-crisis level in a few years. This general picture, however, does not quite tell the whole truth. Differences in incomes have widened first and foremost among the group of regions that was initially better off. Among the initially poor regions a clear trend of divergence was detected only in recent years. This is considered as weak evidence of possible club convergence among the regions.

Next, unconditional and conditional convergence were analysed. The measure of the speed of convergence obtained, beta-convergence, points towards surprisingly strong income convergence across regions. One of the reasons may be interregional migration. During the 1990s internal migration towards wealthier and climatically more favourable locations was observed. Migration may therefore have strengthened convergence considerably. Income redistribution in the form of federally mandated social benefits may also have contributed towards significant beta-convergence in income levels. These results, however, come with several caveats. First, it was shown that it is first and foremost the initially rich regions which exhibit convergence. The regions with income levels below the 30th percentile in 1992 have neither converged nor diverged over the period examined. Second, even for the initially rich regions beta-convergence depends on the choice of growth period. This result highlights the fact that when one must rely on very short time-series in convergence analysis, the choice of the starting point is crucial for the results.

In addition to the initial income level, a number of other explanatory variables were found to be significant in explaining regional income growth. In conformity with the earlier literature on Russian economic growth, a region's industrial structure was found to significantly affect income growth across Russian regions. As expected, the share of extractive industries in total industrial production of a region turned out to have a strong positive effect on the growth rate. The result was confirmed also with panel analysis. This is clearly in line with much of the transition literature arguing that initial conditions and especially the initial industrial structure matter for growth (see e.g. DeMelo *et al.* 1997). In the Russian circumstances, the share of extractive industries can also be interpreted as a proxy for natural resources, as most of what is classified as extractive industries is mining, along with oil, gas and fuel production.

The existence of some club convergence was further confirmed by the finding that we could not establish conditional convergence for the initially poor regions separately. The regions initially better-off, however, showed strong conditional convergence. This seems to suggest polarisation among Russian regions. One of the underlying reasons for this development could be that the poor regions are locked in poverty traps, as suggested by Andrienko and Guriev (2004). They show that in the poorest regions an increase in income spurs (instead of reducing) out-migration. These phenomena, if continued, could lead to a federation consisting of two kinds of regions. The majority of regions would be relatively well-off, converging towards their respective steady states. The minority, however, might be doomed to permanent poverty. The federal government's policy challenges arising from this kind of projection are considerable, but beyond the scope of this brief study.

Differences in real income levels across Russian regions widened during the 1990s, but in the crisis years 1998–99 the gap between rich and poor regions was temporarily narrowed. Therefore a frequently posed question is whether the 1998 crisis resulted in some kind of structural break in income dynamics across the regions. The results of this study suggest that this may indeed have been the case. Both conditional and unconditional convergence were stronger before 1998 than after it. A set of possible explanations is that the sharp devaluation of the ruble

and dramatic increases in world market prices of raw materials, together with changes in overall macroeconomic policies after 1999, may have caused a permanent change in income dynamics across the Russian regions. But this issue also clearly merits a study of its own.

Notes

1. Chukotka, Ingushetia and the Jewish ao are reported starting from 1993. Data for the nine autonomous *okruga* (ao) are reported from 1997 onwards, increasing the sample size to 88 for 1997–2003. Owing to the merger of Komi Permyak ao and Perm region, the sample size is reduced to 87 from 2004 onwards. No data are available for the Republic of Chechnya.
2. The price of a 19 basic-goods basket is reported for 1992–94, the price of a 24 goods basket for 1994–97, the regional minimum subsistence level for 1996–99, and finally the price for a minimum food basket from 2000 onwards. A further complication is that the baskets are not uniform across regions. Their composition varies (supposedly) according to local climatic conditions and tastes.
3. There are five regions with mean real incomes for 1992–2005 above 5200 rubles (Moscow City, Yamalo-Nenets ao, Khanti-Mansi ao, Chukotka and Nenets ao). Very high mean real incomes are reported also for Tyumen, Taimir ao, Kamchatka, Koryak ao, Magadan and Sakha (Yakutia). Of all the above mentioned regions only Moscow City and Tyumen have populations over 1.5 million.
4. Note, however, that the group of 21 initially poor regions is an extremely heterogeneous composite that includes such prominent regions as St Petersburg and Novosibirsk.
5. Using the data for per capita GRP in 1995–2003, no statistically significant convergence is found. The beta coefficients are usually negative but not significant and therefore not reported.
6. As illustrated by the Far Eastern region of Chukotka, in-migration of a single individual (Roman Abramovich in this case) may cause a dramatic increase in income and tax revenue.
7. The Hausman test is rejected at the 1% level in all specifications, so that the random effect model is not valid.

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Appendix

Table A1. Values of Spearman's rho.

	Rank_y2005 full sample	Rank_y2005 poor regions	Rank_y2005 rich regions
Rank_y92	0.54	0.53	0.56
Rank_y93	0.74	0.82	0.63
Rank_y94	0.78	0.78	0.71
Rank_y95	0.85	0.80	0.83
Rank_y96	0.85	0.81	0.81
Rank_y97	0.89	0.84	0.85
Rank_y98	0.89	0.88	0.86
Rank_y99	0.91	0.88	0.87
Rank_y00	0.91	0.87	0.87
Rank_y01	0.93	0.90	0.91
Rank_y02	0.95	0.86	0.95
Rank_y03	0.97	0.88	0.97
Rank_y04	0.99	0.97	0.98