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Dynamics of Russian Regional Clubs: The Time of Divergence

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CARLUER F. (2005) The dynamics of Russian regional clubs: the time of divergence. *Regional Studies* **39**, 713–726. This paper examines the evolution of Russian regional disparities in the light of the theory of convergence clubs. The first part presents the limits of the methodology traditionally used in most studies of the convergence process. For example, the choice of indicators (usually per-capita income or labour productivity) and the statistical test applied (beta- or sigma-convergence) strongly influence the results obtained, sometimes adversely. Then, following the works of Quah and Fingleton, the superiority of an analysis of distribution dynamics, especially one based on Markov chains, is explained. The second part presents the main results based on the per-capita regional income of the Russian database (88 regions) over a fairly long period (1985–99). The key conclusion is the strong diversity of regional evolutions, which are characterized by both inertia (rich regions remain rich, poor regions remain poor) and mobility (some rich regions become poor and vice versa). The value of an analysis of downward mobility relative to upward mobility (34 regions to 11), as well as of economic geography through specific spatial dynamics, are demonstrated. A clear bimodality (implosion of the two intermediate clubs) emerges, which confirms the present stratification process. In other words, Russia is emerging as a multipolarized economy.

Growth empirics Convergence clubs Regional disparities Stratification Bimodality

CARLUER F. (2005) La dynamique des clubs régionaux russes: le temps de la divergence. *Regional Studies* **39**, 713–726. Cet article examine l'évolution des disparités des régions russes à la lumière de la théorie des clubs de convergence. La première partie expose les limites de la méthodologie traditionnelle utilisée dans de nombreuses études pour expliciter le processus de convergence. Par exemple, le choix des indicateurs (généralement le revenu par tête ou la productivité du travail) et des tests statistiques appliqués (beta- ou sigma-convergence) influencent grandement les résultats obtenus, et parfois sont contradictoires. C'est pourquoi, en prolongeant les travaux de Quah et de Fingleton, nous démontrons la supériorité d'une analyse dynamique de la distribution, plus particulièrement au travers des chaînes de Markov. Dans la seconde partie, nous présentons nos principaux résultats basés sur les revenus par tête des régions russes (au nombre de 88) sur une période relativement longue (1985–99). La conclusion principale est la forte diversité des évolutions régionales qui sont caractérisées à la fois par l'inertie (les régions riches restent riches, les régions pauvres restent pauvres) et par la mobilité (plusieurs régions riches deviennent pauvres, et vice versa). Nous mettons en évidence l'importance de la 'mobilité descendante' comparativement à la 'mobilité ascendante' (34 régions contre 11), ainsi que la pertinence des thèses de l'économie géographique. Une évidente bimodalité apparaît donc (du fait de l'implosion des deux clubs intermédiaires), ce qui confirme l'ampleur du processus de stratification à l'œuvre. En d'autres termes, la Russie se transforme en une économie multipolaire.

Dynamique spatio-économique Clubs de convergence Disparités régionales Stratification Bimodalité

CARLUER F. (2005) Die Dynamik russischer Regionalklubs: die Zeit der Divergenz. *Regional Studies* **39**, 713–726. Dieser Aufsatz untersucht die Entwicklung russischer regionaler Ungleichartigkeiten im Lichte der Theorie der Konvergenzklubs. Der erste Teil behandelt die Grenzen der traditionell in den meisten Stadien des Konvergenzprozesses benutzten Methodik. Die Wahl der Indikatoren, z.B. (gewöhnlich pro-Kopf Einkommen oder Arbeitsleistung), und die Wahl der angewandten statistischen Überprüfung (beta-oder sigma-Konvergenz) beeinflußt die gewonnenen Resultate beträchtlich, manchmal nachteilig. In Weiterführung der Arbeiten von Quah und Fingleton wird sodann die Überlegenheit einer Analyse der Verteilungsdynamik erklärt, besonders wenn sie auf Markowschen Ketten beruht. Im zweiten Teil werden die Hauptergebnisse dargestellt, die sich auf die pro-Kopf Einkommen der russischen Datenbank (88 Regionen) eines ziemlich langen Zeitraums (1985–90) stützen. Die Hauptschlußfolgerung ist die ausgesprochene Unterschiedlichkeit regionaler Entwicklungen, die sowohl durch Trägheit (wohlhabende Regionen bleiben wohlhabend, arme bleiben arm) als auch Mobilität (manche wohlhabenden Gebiete werden arm, und umgekehrt) gekennzeichnet werden. Es wird sowohl der Wert einer Analyse absteigender im Verhältnis zu aufsteigender Mobilität (34 zu 11 Regionen) als auch der Wirtschaftsgeographie selbst durch spezifisch räumliche Dynamiken dargestellt. Es ergibt sich eine klare Doppelmodalität (Implosion der beiden Mittelklubs), die damit den gegenwärtig stattfindenden Vorgang der Schichtenbildung bestätigt. Anders ausgedrückt: Rußland erweist sich als mehrpolige Wirtschaft.

Wachstumsempirik Konvergenzklubs Regionale Ungleichheiten Stratifizierung Doppelmodalität

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CARLUER F. (2005) La dinámica de los clubes regionales rusos: tiempos de divergencia. *Regional Studies* **39**, 713–726. Este artículo examina la evolución de las disparidades regionales que existen en Rusia en base a la teoría de los clubes de convergencia. La primera parte expone las limitaciones de la metodología tradicionalmente utilizada en la mayoría de los estudios sobre el proceso de convergencia. Por ejemplo, la elección de indicadores (normalmente ingresos per cápita o productividad laboral) y el test estadístico que se ha aplicado (convergencia beta o sigma) ejercen una gran influencia sobre los resultados obtenidos, a veces de forma desfavorable. A continuación, basándonos en los trabajos de Quah y Fingleton, explicamos por qué resulta mejor utilizar un análisis de las dinámicas de la distribución, especialmente el que está basado en las cadenas de Markov. En la segunda parte, presentamos los principales resultados que están basados en ingresos regionales per cápita en cada una de las regiones que forman la base de datos rusa (88 regiones) a lo largo de un periodo bastante largo (1985–99). La conclusión clave que se extrae es que existe una gran diversidad en lo que respecta a la evolución de las distintas regiones, las cuales se caracterizan tanto por inercia (las regiones ricas permanecen siendo ricas, mientas que las regiones pobres continúan siendo pobres) y la movilidad (algunas de las regiones ricas se vuelven pobres y viceversa). Demostramos las ventajas que acarrea utilizar un análisis de movilidad descendente con relación a una movilidad ascendente (34 y 11 regiones relativamente), así como de la geografía económica a través de dinámicas espaciales específicas. Dicho análisis muestra la emergencia de una clara modalidad binaria (implosión de los dos clubes en posición intermedia), confirmando así el actual proceso de estratificación. En otras palabras, Rusia está emergiendo como una economía multipolarizada.

Datos empíricos sobre el crecimiento Clubes de convergencia Disparidades regionales Estratificación Modalidad binaria

JEL classifications: F14, L6, O30

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INTRODUCTION

The regional level constitutes an appropriate framework for the study of convergence, from both the empirical and theoretical points of view. Empirically, it is easier to compare data derived from the same sources than to undertake international comparisons. Theoretically, the assumptions made, such as those regarding the unicity of structures and infrastructures as well as the institutional framework, preferences and available technologies, are directly relevant since impediments to exchanges do not exist (except for natural barriers).

It is especially interesting to examine the convergence of Russian regions since Russia has the secular feature of a centre, the Moscow region, that is clearly defined by its size, location and above all its widely accepted leadership in technologies and industry. This being so, there is every incentive to analyse polarization phenomena and, more generally, spatial-economic asymmetries, particularly since Russia stretches across 11 time zones.

In the light of the difficulties encountered in ensuring harmonious development within the European Union (DUNFORD, 1994; VERSPAGEN, 1997; FINGLETON, 2003), despite the use of structural funds and a decade of continuous growth (ARMSTRONG and VICKERMAN, 1995; BACHTLER and TUROK, 1997; EUROPEAN COMMISSION, 1999; TUMPEL-GUGERELL and MOOSLECHNER, 2003), it is not surprizing that Russian regional disparities have been accentuated by the opening of markets (STEHRER and WÖRZ, 2003). Indeed, only a small number of the Russian regions have benefited from 'cumulative growth', with the majority threatened rather by the 'poverty trap' (AZARIADIS and DRAZEN, 1990; AMABLE, 1993, DEN HAAN, 1995; FIASCHI and LAVEZZI, 2003).

In order to characterize the divergent trajectories of these economic spaces, an analysis of the convergence clubs between 1985 and 1999 is undertaken. Adopting the Markov chains approach enables one to highlight the overall evolution and relative performance of each region, as well as the nature of its mobility (up- or downward). The results are without ambiguity: the gap between the richest and the poorest regions has grown sharply and the intermediate clubs have nearly disappeared. Such bimodality, where the follower regions do not exist, heralds a long period of divergence (PRITCHETT, 1997; QUAH, 1997; BOUBA-OLGA and CARLUER, 2001; KOZUL-WRIGHT and ROWTHORN, 2002).

Our approach has two stages. First, some methodological elements of certain convergence analyses are discussed, especially the fact that the standard regression analysis lacks the richness and flexibility of the Markov approach (the first section). Second, a descriptive analysis of Russian regional disparities is undertaken from the standard convergence perspective (beta- and sigma-convergence are then tested; the second section). Lastly, the emphasis is on the estimation of the Markov transition probabilities matrix, which points to a tendency towards two permanent income levels (the third section). By adopting this growth empirics perspective, which links in with some recent theoretical conclusions, this paper can offer evidence of the unbalanced regional dynamics in Russia, especially since the transition (STEHRER *et al.*, 2000; SVEJNAR, 2002).

METHODOLOGICAL ELEMENTS

The notion of convergence may have several meanings. This is mainly due to empirical findings that have shown the weakness of the standard hypothesis of a catching-up process between nations, thereby compelling theoreticians to modify their definitions. For

example, BAUMOL *et al.* (1994) highlight seven different conceptions. The following observations address the issue of conditional convergence, i.e. relative to economic structures, to a short period or to a small number of countries or regions, and to the development of new statistical tests and econometrical applications, and even new theoretical models (TEMPLE, 1999; GALOR and WEIL, 2000; DURLAUF *et al.*, 2001; CANIELS and VERSPAGEN, 2003).

Limits of absolute and conditional convergence

The study of absolute convergence (the existence of a negative relationship between the initial level of a variable and its further growth) does not reveal the main determinants of regional specificities (BARRO, 1997). Such a study must be supplemented by a multivariate analysis using a large set of variables so as to explain regional performances and disparities (conditional convergence).

Two different sets of elements missing from this analysis can be identified. First, the weakness of what is called 'auto-convergence' is obvious:

- The unique steady-state underlined by the neo-classical model (monotonic decrease or increase in the growth rate, until all regions grow at the common exogenous growth rate) and the test of beta-convergence (LICHTENBERG, 1994; CHESHIRE and CARBONARO, 1995) is over simplistic, because the possibility of multiple equilibria or divergent paths is excluded (the steady-state levels of income may be different across regions because of cross-region heterogeneity in the determinants of the steady-state). Our results stand in contrast to this predicted unicity.
- The stability of the equilibrium obtained is not ensured, and the wealth differences could not disappear over time (QUAH, 1993a, b; BERNARD and DURLAUF, 1996).
- Beta-convergence is a necessary but not a sufficient condition for the sigma-convergence (variance reduction of the variable in cross-section between two dates) to be verified. However, in the event of strong asymmetrical regional shocks, income or productivities dispersion may not diminish, even in the presence of beta-convergence.
- The existence of shocks such as harvest failures, oil shocks or purely random events (Barro and SALA-I-MARTIN, 1999) can deeply and durably modify regional dynamics. The individual steady-state is then questioned. Income distribution evolves differently and there is convergence to a new steady-state. In this sense, the assumption of transition probabilities that remain constant over time is unrealistic. Thus, 'an uneven stream of shocks at the micro-level creates the potential for regions to leapfrog each other on a more or less continuous basis, but with movement constrained by a tendency towards permanent income disparities' (FINGLETON, 1997, p. 389).
- No interpretation of regional mobility can be made. The dynamic behaviour of an economy must include not only initial conditions and the shocks occurring at the beginning of the period (hysteresys effect), but also the set of all occurrences during the period (QUAH, 1996a). This is why the use of a tool such as the Markov chain is relevant as it takes into account ongoing turbulence as well as different forms of equilibrium.

Second, the selection criteria are often biased. It is particularly the case for the following:

- Added effects, which encapsulate all the variables taken into account in the models of conditional convergence, especially institutional and socio-political structures, even if they do not affect the per-capita growth rate in the neo-classical approach (ELMSLIE and MILBERG, 1996; GALOR, 1996; BLISS, 1999). DURLAUF and QUAH (1999) record more than 80 variables in the early literature that were often highly auto-correlated. Moreover, it is possible to control the effects causing divergence statistically or merely to compare countries or regions that are sufficiently similar in order to show conditional convergence.
- The forming of groups encounters a problem when a simple *ex-post* definition is applied. One may merely retain the regions that have obviously converged during the period (i.e. reduce the size of the sample) in order to validate for good the convergence hypothesis. This 'experimental design' shows that convergence is absolute and not conditional (DELONG, 1988). The only way of avoiding this bias is to detect the groups *ex-ante*. If the better method, or rather the less worse one, seems to be the endogenous detection of thresholds, the forming of homogenous groups (for instance, with the quartiles) is relatively satisfying for intra-countries studies for which the assumption of a common steady-state is reasonable (SALA-I-MARTIN, 1996). It is not the case when countries are markedly different, e.g. developed and underdeveloped countries (LEE *et al.*, 1997) or North and South Europe (NEVEN and GOUYETTE, 1994; FINGLETON and MCCOMBIE, 1998; CAPPELEN *et al.*, 1999) and even OECD countries (DOWRICK and NGUYEN, 1989; BEELEN and VERSPAGEN, 1994). So what are the best selection criteria? The main objective is the decomposition by quartiles (homogenous groups), but also the economic 'distance' or human development indicators. The first is applicable to a great number of indicators (given that there is no theoretical relevance in starting with quartiles or whatever former methods), but its technical aspect may be criticized in the sense that the quartiles are of unequal size in terms of per-capita income ranges. However, it remains a good measure

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for showing migrations between the initial fixed thresholds.

- Lastly, the question of the relevance of regional statistics, and more generally of databases, has not been resolved. Even the Eurostat REGIO database only partially tackles the problem (Dunford, 1993; Casellas and Galley, 1999), which applies a fortiori to the Russian regions. Given the lack of regional data, such statistics are often derived from national deflators (however, with regard to sectoral specializations and the transaction costs bound to distance, regional prices can differ considerably; this is obviously the case for Russia). Such approximations become even more questionable when several countries are studied, particularly when groups of regions (poor, below average, above average, rich) are not pre-formed.

Convergence clubs theory

Given the diversity of definitions and above all the inconsistency of results (the impossibility of proving the existence of a global convergence process so as to resolve for good the issue of convergence or divergence), the idea of multi-speed economies leads to a tuning decomposition of countries or regions into clubs. Thus:

> the club convergence hypothesis (polarization, persistent poverty, and clustering) is appeared: per-capita incomes of regions that are identical in their structural characteristics converge to one another in the long run provided their initial conditions are similar as well.
>
> (Galor, 1996, p. 1056)

Some of these clubs are said to benefit from a cumulative dynamic, while others have weak growth or may even be locked in a poverty trap. Such growth models shed light on the global divergence process between clubs and the convergence within each club, as well as highlighting regional or national structural changes. Last but not least, punctuated growth processes (phases of convergence or divergence, mobility from one club to another, emergence of a leader) can account for income level transitions by regions over time (Ben-David, 1994).

Contrary to the beta- and sigma-convergence tests, convergence club theory focuses on analysis of an indicator distribution (more generally of per-capita income, and sometimes of productivity). This approach confines the analysis to certain subsets of regions and tests the convergence assumption for predefined and homogenous clubs. In this sense, it seeks to validate absolute but not conditional convergence, since the structural effects are supposed to be neutralized before the tests.

Finally, in order to highlight the dynamics of transition within and among clubs, i.e. the trajectory shifts (cumulative growth, inertia or reversal), a tuning analysis must be realized. To this end, several sophisticated non-parametric methods have been developed that attempt to describe this diversity of evolutions (Blanchard and Katz, 1992; Pehkonen and Tervo, 1996). Of these tools, the Markov chain approach is one of the more realistic since it always takes into account the possibility of change and partly solves the indetermination of regression-based cross-sectional analyses.

Virtues of 'distributional' convergence

Some authors such as Quah (1996b, c), Jones (1997) or Lopez-Bazo *et al.* (1999) have attempted to estimate the probability density of an indicator distribution at different dates t using non-parametric statistics. The objective is to sum the different Gauss functions in order to obtain continuous density function (Silverman, 1986).[1] The various graphs give some crucial information about the form of the whole distribution (Bianchi, 1997; Canova, 2004) and confirm the presence of an unimodal distribution (the economies under consideration are relatively similar except if the densities are estimated with regard to the leader economy and if the mode is to the left of the graph) or of multimodality (the existence of several groups of regions).

The Markov chains approach (Spilerman, 1972; Isaacson and Madsen, 1976; Norris, 1997) is helpful in any attempt to highlight the distribution mobility (and the convergence of a region to a specific club over time), since it characterizes the transition process towards a finite set of states over time (Magrini, 1995, 1999; Fingleton, 1997) with or without taking into account the spatial autocorrelation (Rey, 2001; Le Gallo, 2004).

If a set of economies is considered on the basis of a performance indicator between two dates (t and $t+n$), it is possible to define I intervals of values corresponding to I income level states (from the poorest region to the richest), and to build a transition matrix on the basis of the observations depending on the number of economies being in state $i=1$ to I at the beginning of the period (t) and $j=1$ to I at the end of the period ($t+n$):

$$M=\begin{bmatrix} m_{11}=\frac{n_{11}}{n_{1.}} & \cdots & \cdots & \cdots & m_{1I}=\frac{n_{1I}}{n_{1.}} \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdots & m_{ij}=\frac{n_{ij}}{n_{i.}} & \cdots & \cdot \\ \cdot & \cdot & \cdot & \cdot & \cdot \\ m_{I1}=\frac{n_{I1}}{n_{I.}} & \cdots & \cdots & \cdots & m_{II}=\frac{n_{II}}{n_{I.}} \end{bmatrix}$$

where n_{ij} is the number of economies in state i at time t and in state j at time $t+n$, and m_{ij} is the proportion of these economies relative to the whole set being in state i at time t.

The diagonal elements represent the proportion of economies that stayed in the same state. The formal nature of the matrix implies that the elements of M are

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non-negative and the sum of each line is equal to one. Consequently, this matrix underlines the importance of inertia and mobility forces:

- High values on the diagonal indicate considerable inertia of evolution.
- High values to the right of the diagonal imply that upward mobility took place during the period, with a majority of economies now belonging to an upper group.
- High values to the left of the diagonal show the presence of downward mobility, i.e. a retrogression (on average) in the scale of the clubs.

Within this theoretical framework, the Markov chain approach proves very useful, especially in order to show that each region has a probability $p_i(t)$ of being in state i at time t and a transition probability $m_{ij}(t)$ of being in state j at time $t+1$. Following the assumption that transition probabilities are unchanging over time, i.e. $m_{ij}(t)=m_{ij}$ for all t, one can determine the average number of time periods it takes for a region in state i to reach state j and the limiting probabilities in an ergodic probability vector.[2] Ordering these stationary probabilities as the $I \times I$ transition matrix M, and $p_i(t)$ as the time-dependent elements of the $1^{\star}I$ row vector $p(t)$, then:

$$p(t+1)=p(t)M=p(0)M^t \qquad (1)$$

where M^t is the product of t identical M matrices. There exists a $1^{\star}I$ row vector s, which is such that $s=sM$. This vector s is the ergodic probability vector to which each of the rows of M^t tends as t tends to infinity. Economically, the vector comprises states that are exhaustive and mutually exclusive per-capita income categories. Thus, the steady distribution for the Markov chain is attained when the proportion of the four clubs (i.e. the poor, below average, above average and rich economies) remains constant over time. It then becomes possible to scan the modalities of the distribution.

Thus, the basic Markov chain approach avoids the need to reduce a priori the diversity of possible evolutions and makes it possible to capture the plurality of regional trajectories and highlight the convergence or divergence process itself, and even to explain structural change (Chatterji and Dewhurst, 1996; Beine *et al.*, 1999; Rey and Montouri, 1999; Verspagen, 1999). This approach is therefore particularly valuable in analysing a country such as Russia, which has experienced a difficult transition period, characterized by an increase in regional disparities. While numerous empirical studies show that many transition economies have experienced regional divergence in the first phase after the opening of markets (Stehrer *et al.*, 2000; Dana, 2002; Young *et al.*, 2002; Dyker, 2004), the phenomenon seems to have been strengthened for Russia, where the 'conversion' from 'autocratic real socialism' to the capitalist system has been hard and radical, the immensity of the country (in spite of its tremendous centralism), and the strong sectoral specialization of regions (comparing mineral resources and heavy industry, for example) accentuated the differences in the ability of the regions to integrate into the world economy (Carluer and Gaulier, 2005).

RUSSIAN REGIONAL DISPARITIES: WHAT LEVEL OF CONVERGENCE?

Descriptive analysis

This study draws on data on regional per-capita income (which corresponds to personal income and differs considerably from per capita Gross Domestic Product) for the 88 Russian regions (there are no data for the 89th regional unit of Tchechenia) available to the Ministry of Economic and Finance and obtained by the Russian European Center for Economic Policy (RECEP), Moscow, since 1985. Here the data in our possession are the real income deflated by a national price indicator. Thus, one can study, for example, the variance ratio that corresponds to a measure of standard deviation, so higher regional dispersions will only be due to real growth. In order to avoid certain problems related to changes in measurements or even in particular definitions, especially given the substantial political and economic changes in the country between the Soviet and post-Soviet systems, a statistical attempt at harmonization has been made by smoothing data using the moving average method for 3 years, using weightings of 0.25, 0.5 and 0.25, respectively, for the dates $t-1$, t and $t+1$, and different sub-periods will be considered. The initial (1985) and final (1999) levels are not modified, so the procedure does not change the regressions and calculus carried out in cross-section, but the results are considerably modified when the Markov chain approach is applied in a dynamic perspective, i.e. when transition probabilities are changing over time, year by year ($t-t+1$). However, in the light of the immense size of the country and the cultural diversity of its regions, as well as of the fragility of the sources, especially the differences in the degree of monetization of the economy and the absence of regional price deflators (even if the Markov chain approach neutralizes the influence of inflation on the inferences about convergence), the results should be interpreted with caution.

An initial analysis of Russian regional disparities reveals that the gap between the groups of regions remains substantial: the ten richest regions have, on average, a per-capita income four times higher than the ten poorest regions in 1985, and the trend is upward (more than six times higher in 1999). This is confirmed for the 20 richest and poorest regions, but the gap increased at a slower rate during the period, from 2.5 to 3.8. Nevertheless, the difference between the richest (Moscow) and the poorest (Ingushetia) regions reached an incredible level in 1999. (The downward direction

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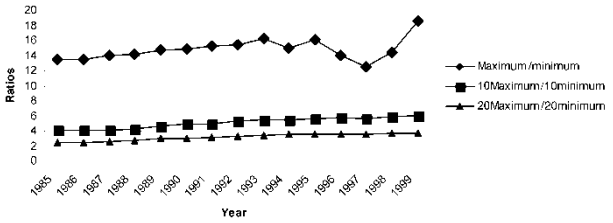

Fig. 1. *Gaps between the richest and the poorest regions: per-capita income*

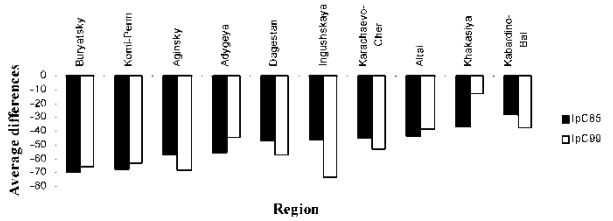

Fig. 2. *Per-capita income deviations for the ten worst performing regions*

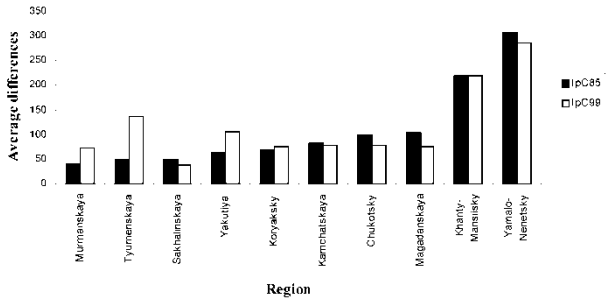

Fig. 3. *Per-capita income deviations for the ten richest regions*

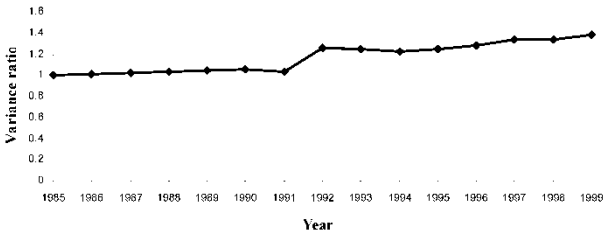

Fig. 4. *Sigma-convergence of per-capita regional income*

of the trend at the end of the period is due to slower growth and the emergence of a contest for the national leadership between Yamalia, a central northern region, and Moscow.)

From a geographical perspective, the ten worst performing regions in terms of per-capita income are mainly located in the Caucasus (South-West) and near the Mongolian frontier (South). Moreover, their position and performance remained stable between 1985 and 1999, with six of the ten poorly performing regions always in the bottom ten (Fig. 2). Only one region, Khakasiya, really soared up the table, leaping nearly 50 places. Except for this one spectacular case of leapfrogging, no process of convergence is revealed.

The performance of the top ten regions is also characterized by considerable stability: eight of the ten richest regions maintained their superiority and five increased their lead. It was mainly the Eastern and the Northern regions that out performed the rest. Particular mention should be made of the regions east of the Urals 'frontier': Tyumenskaya, Khanty-Mansiiky and Yamalo-Nenetsky. Thus, the richest regions are located close to the poorest such as Komi-Permyatsky. The presence or absence of raw materials for which world demand is high plays a major role in regional growth (catching up or forging ahead), especially the discovery of precious metals in Kalmikya, for example, and obviously oil, mainly in the North-East. Lastly, the spectacular progress of the Moscow region should be noted since it occupies no fewer than ten of the top 11 places (and therefore does not feature in Fig. 3). Clearly, there is now a genuine capital effect in Russia.

Sigma- and beta-convergence

To evaluate more precisely the convergence of per-capita income, one could apply the two concepts of beta- and sigma-convergence. The former refers to the existence of a negative relationship between the initial level of income and the further growth. Beta-convergence is a necessary but not sufficient condition for sigma-convergence to be verified. The latter merely shows the variance reduction of income or of productivities in cross-section between two dates. In the case of strong asymmetrical regional shocks, the per-capita income dispersion could not diminish even in the presence of the beta-convergence. The results of a standard empirical analysis of regional disparities using the hypothesis of sigma- and beta-convergence corroborate this trend.

First, the study of sigma-convergence confirms this preliminary diagnosis: the variance ratio (which corresponds to the variance of the logarithms of the deflated regional per-capita real income) increases by nearly 40% during the 1990s (Fig. 4), and there is no reversal of the trend. The intensity of the uneven process is reinforced by the fact that the ten leading regions (in particular the last ones) and the ten lagging regions (especially the middle ones) swap positions (Figs 2 and 3) inside these two specific groups.

As is apparent from Fig. 4, there is a clear breakdown during the transition process (1991–93) at the point where regional divergence begins to emerge. The breakdown of growth after the initial transition and the subsequent resumption of growth reflect the stability of regional disparities before the sigma-divergence increases again.

Second, the estimation of beta-convergence (performed in cross-section with 88 regions) clearly shows there is no absolute convergence between 1985 and 1999 for regional per-capita income (Table 1). A

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Table 1. *Beta-convergence of per-capita income*

88 regions	Period	Beta	Constant	Heteroskedasticity test: ML	R^2
Per-capita income	1985–99	0.78% (0.161)	0.66 (0.000)	2.05 (0.123)	0.151
Per-capita income	1993–99	−1.00% (0.215)	0.59 (0.000)	0.97 (0.294)	0.215
Per-capita income	1991–93	4.44% (0.227)	2.29 (0.000)	1.99 (0.144)	0.227
Per-capita income	1985–91	−0.56% (0.158)	0.18 (0.000)	1.07 (0.238)	0.158

Note: Values in parentheses are *p* values.

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divergence process is almost revealed (about 0.8%/year), but its robustness is weak. With regard to the heterogeneity of the period, the sample must be split into three sub-periods to isolate the transition process and to test the validity of the results obtained for these three sub-samples.

Thus, three distinct phases can be identified for the 'convergence' process, corresponding to the best decomposition of the sample (according to the robustness of the regressions). In the first Soviet phase (i.e. before the transition 1985–91), there was a slight beta-convergence (around 0.5%), even if the robustness of the equation is weak. The second phase represents the transition itself (1991–93) and validates the hypothesis of beta-divergence: relatively strong (more than 4%) but not very significant. The last phase includes the last years of the century (1993–99) and is characterized by slow convergence (about 1%/year). The impact of the transition process on (beta-)convergence seems to be slightly positive, even if the sigma-divergence does not disappear during the period. (One reason for this difference is that the intensity of the uneven process is reinforced by the fact that the ten leading regions, in particular those at the bottom of the top ranking, and the ten worst-performing regions, especially the middle ones, swapped positions, as shown by Figs 2 and 3, inside these two specific groups.) Thus, this period has two major crisis at either end of it: the breakdown of growth during the transition and the financial turbulence of the late 1990s. However, the slow catch-up that took place was probably cancelled in the years that followed (1999–2002) because of the Asian financial crisis and its consequences.

A complementary study confirms this beta-divergence in respect of industrial output during the last years of the century (about 8%/year for 1994–99) but highlights a strong beta-convergence with regard to gross regional product (nearly 13%) for 1995–2000. Moreover, other authors (Kocenda, 2001; Carluer and Sharipova, 2004) show the crucial role played by macroeconomic determinants such as investments, public expenditures (what might be called 'structural funds') and especially foreign direct investments in creating conditional convergence, as well as the importance of geographical determinants, particularly the favourable positions of northern and, more generally, frontier regions. However, if a clear process of convergence appears for regional industrial output, it remains insignificant for per-capita income.

The increase of the disparities between the richest and the poorest regions and the double existence of a sigma-divergence (the variance ratio increased by nearly 40% during the 1990s) and a beta-divergence (about 0.8%/year) highlight a real divergence process over the whole period and especially during the transition process (Babetski and Maurel, 2002). It could be clarified by the detection of different group dynamics, showing that not all the regions 'converge' to the same equilibrium. The analysis of the 'convergence' clubs makes it possible to identify such specific regional paths.

A BIPOLARIZED ECONOMY: EVIDENCE FROM REGIONAL CLUBS?

What clubs?

A second, more relevant analysis of Russian regional disparities can be undertaken by constructing regional clubs (based on a decomposition by quartiles). The results are shown in Tables 2 and 3. They provide information on the number, percentage and name of the regions belonging to each club and on the evolution of their positions (mobility to another club) or otherwise (inertia) during the period. (The matrix diagonal is in **bold**.) The results show that the first club (leading regions) and the last club (lagging regions) maintained their position because more than 80% of the regions were in the same club at the end of the 1990s. On the other hand, the two intermediate clubs experienced a genuine implosion. Indeed, in the second and third clubs, only two and four regions respectively of the initial 20 remain, i.e. fewer than 20%!

This striking fact is accentuated by the strong downward mobility of the second club: the performances of the 'followers' regions deteriorated considerably, since a majority (59%) ended up in the last club in 1999, with only three moving to the first club. The same phenomenon characterizes the third club, even though upward mobility was slightly greater here. This depressive tendency contrasts with the inertia of the clubs at either end of the range, in which mobility was marginal.

Consequently, it is hardly surprizing that the values of the ergodic vector (which reflects the long-run

Table 2. Position and evolution of the 88 Russian regions (per-capita income) between 1985 and 1999

	[0–83.2[	[83.3–89.5[	[89.6–98.1[	[98.2–408.3]	SUM
[0–83.2[	**18 (82%)**	2 (9%)	2 (9%)	0 (0%)	22
[83.3–89.5[	16 (73%)	**2 (9%)**	1 (4%)	3 (14%)	22
[89.6–98.1[	13 (59%)	2 (9%)	**4 (18%)**	3 (14%)	22
[98.2–408.3]	0 (0%)	1 (5%)	2 (9%)	**19 (86%)**	22
SUM	47	7	9	25	88
Initial proportion	0.25	0.25	0.25	0.25	1
Ergodic limit	0.65	0.08	0.09	0.18	1

*Table 3. Club membership and mobility of the 88 Russian regions (*oblast*), 1985–99*

	Club 4	Club 3	Club 2	Club 1
Club 4	**Aga; Adygea; Birobijan; Chuvashia; Dagestan; Gorno-Altay; Ingushetia; Kabardino-Balkaria; Karachay-Cherkessia; Krasnodar; Mari-El; Mordvinia; Permyakia; Stavropol; Tuva; Ust-Orda; Volgograd; Voronezh.**	North-Ossetia; Khakassia.	Bashkor-tostan; Tatarstan.	
Club 3	Astrakhan; Belgorod; Bryansk; Buryatia; Chita; Ivanovo; Karelia; Kirov; Kurgan; Kursk; Leningrad-skaya; Orel; Tambov; Tver; Udmurtia; Ulyanovsk.	**Lipetsk; Smolensk.**	Novgorod.	Moskovskaya; Perm; Samara.
Club 2	Amur; Kaliningrad; Kaluga; Kostroma; Nizhegorod; Omsk; Orenburg; Penza; Pskov; Ryazan; Saratov; Tula; Vladimir.	Novosi-birsk; Rostov.	**Chelia-binsk; Vologda; Sverd-lovsk; Yaroslav.**	Irkutsk; Kemerovo; Evenkia.
Club 1		Arkhan-gelsk.	Altay; Primorskiy	**Chukotka; Kalmykia; Kamchatka; Khabarovsk; Khantia-Mansia; Komi; Koryakia; Krasnoyarsk; Magadan; Moscow; Murmansk; Nenetsia; Saint-Petersburg; Sakhalin; Taymyria; Tomsk; Tyumen; Yakutia; Yamalia.**

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distribution of the regions) are so unbalanced. The weight of the last club will be not far from two-thirds, the intermediate clubs will fall to one-tenth and the first one will account for 18% of the regions. To make a sociological parallel, the Russian regional productive system will not have a 'middle class' in the near future.

Who are they?

A nominal roll allows us the diagnosis to be completed. Geographical position and proximity would seem to play a key role in determining economic performances and hence membership of the four clubs.

When the results shown in Table 3 are drawn on a map (see Appendix 2), the homogeneity of the four 'colours' (representing the four clubs: the leading, the following, the uncoupling and the laggard regions, respectively) is amazing, making it pointless to calculate the correlation between the performance of a region and the wealth and growth of its neighbours. Spatial externalities are one of the main sources of growth in Russia. Indeed, there are very few regions that have recorded strong growth and growing incomes during the last decade without benefiting from a dynamic environment. Except for the two great Russian metropolises (Moscow and Saint-Petersburg), there are only two cases of such growth, i.e. Samara and Kalmykia, where the main development factors are the quality of the automobile production factories compared with the decay of the military–industrial complex of the neighbouring Nizhegorod region, and the presence of diamonds, respectively.

The most significant geo-economic fracture is the Urals (more than three-quarters of the regions in the leaders' club, 19–25, are located to the East of this natural barrier), to which must be add the Trans-Siberian railroads (from the city of Perm to Vladivostok), which separates the wealthy northern regions from the southern ones. (The presence of precious metals, energy resources or a high level of industrial specialization are key elements in understanding such a domination.) Thus, Siberia emerges as Russia's dynamic growth pole. Several studies confirm its prominent role (Show, 1987; Portnov, 1994), even though this finding must be qualified in the light of the high cost of living in such remote regions (given that transaction costs are very considerable).

The south-west border regions, as well as those on

Table 4. *'Taking over' versus 'falling behind' (per-capita income, 1985–99)*

Falling behind	Taking over
Amur; Vladimir; Kaliningrad; Kaluga; Kostrom; Nizhegorod; Omsk; Orenburg; Penza; Pskov; Ryazan; Saratov; Tula; Arkhangelsk.	Bashkortostan; Tatarstan; Moskovskaya; Permyakia; Samara.

Russia's western border, seem to have experienced the same difficulties as those on the southern border (where the low level of monetization is also an indicator of the black market dynamics). The calculation shows that ten to 16 of the southern border regions were in the last club in 1999, ten to 12 of the south-western ones, and eight to 12 of the western ones. The last result is the most surprizing; after all, the proximity of Western Europe might have been expected to create some forward linkages. Only one region (Voronezhskaya) belonged to the last club in 1985, while the emblematic case of this backward movement is the 'European' enclave of Kaliningrad, together with Pskov, Karelia and Leningrad Oblast. It should be added that Arkhangelskaya is the only northern border region that belonged to the 'uncoupling regions club' (club 3) in 1999.

The last salient result is that the periphery of the Moscow region (beyond Moskovskaya) seems to have suffered more than the rest of Russia because the regions located far from Moscow have experienced stronger growth (which corroborates what has been called elsewhere the 'vampire effect of the Russian capital', Carluer and Sharipova, 2004; or of regional capitals, Carluer *et al.*, 2004). In the beginning of the period there was no region located within 500 km of Moscow that was seriously lagging behind, whereas in 1999, five to seven regions of the first circle (except Yaroslav and Smolensk) and nine to 12 regions of the second circle (except Novgorod, Vologda and Lipetsk) were in the last club.

What kind of mobility?

The spectacular shifts in the regional ranks (or 'overtaking' in Abramovitz's, 1996, terminology; 'leapfrogging' for Brezis *et al.*, 1993, and Motta *et al.*, 1997; or 'jumping approach' for Stehrer and Wörz, 2003) must be emphasized and they are entered in the accounts if, and only if, they correspond to a leap of two clubs. If this 'double' leap is in an upward direction, it is called a 'taking over'; if it is in a downward direction, it is called 'falling behind'. Table 4 sums up these movements.

Three times more negative 'double' leaps than positive ones (14 to five; the proportion is the same, six to 19, if only 'single' leaps are taken into account) have been identified. Besides the poor performance of numerous regions on the periphery of the Moscow region and on the western border, mention must also be made of the difficulties of the regions located on the Kazakhstan border, i.e. Saratov, Orenburg and Omsk, especially when they are compared with some of their immediate neighbours such as Bashkortostan, Tatarstan and Samara. It must be emphasized that those regions that did forge ahead performed very spectacularly indeed, particularly since the decade was particularly turbulent. The two other great winners are the Moscow region and Perm, although the evolution in central Siberia was also positive (Portnov, 1998).

Dynamic analysis

Finally, to clarify further regional trajectories and particularly their dynamics, account could be taken of the annual evolution by considering pairs of years and regions rather than just the start and end dates (that corresponds to better information). The dynamics could be non-linear because of regional specificities (e.g. favourable or unfavourable specialization), their resistance to crisis and their reactivity to shocks. As Table 5 shows, the results are less clear-cut than in the first computation.

The inertia of regional positions is clearly greater for the two intermediate clubs than when only the initial and final dates are considered, while downward mobility is clearly reduced and is nearly equal to movement in the opposite direction.[3] However, the values of the ergodic vector are less optimistic, as the last club is likely to account for more than 50% of the regional population in the long run at the expense of the

Table 5. *Position and percentage evolution of the 88 Russian regions* (t − t + 1)

	[0–83.2[	[83.3–89.5[	[89.6–98.1[	[98.2–408.3]
[0–83.2[	**0.95**	0.03	0.02	0.00
[83.3–89.5[	0.16	**0.74**	0.07	0.02
[89.6–98.1[	0.07	0.14	**0.65**	0.14
[98.2–408.3]	0.01	0.02	0.03	**0.93**
Initial proportion	0.42	0.18	0.11	0.29
Ergodic limit	0.57	0.13	0.07	0.22

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followers' clubs. As for the leaders' club, it would go beyond the 20% and draw close to the quartile. Thus, it is difficult to talk about an average growth rate due to the existence of divergent forces that polarize the Russian regions along two different trajectories. This appears to be a stratification process (Quah, 1996c, 1997; Giovanetti, 1999), the main characteristic of which is the bimodality of the population. (For a similar result on the world scale, see Fiaschi and Lavezzi, 2003.) This will undoubtedly have considerable implications for the nature and intensity of the transition process (Svejnar, 2002; Dyker, 2004).

CONCLUSION

The results confirm that convergence club theory is one of the more interesting developments in the standard analysis of convergence. Applied to the Russian productive system and its 88 regions over more a decade, it underlines the relevance of the evolutionary approach and of the New Economic Geography (Boschma and Lambooy, 1999; Fujita *et al.*, 1999; Baldwin *et al.*, 2005).

When convergence in Russia during the last decade is discussed, there is no doubt about the meaning of the indicators as a whole: the sigma-convergence, the beta-convergence, the gaps between the poorest and the richest regions, and above all the convergence clubs and their dynamics (Markov transitory matrix) all combine to indicate that the regional productive system is characterized by a real process of divergence, even though some indicators show a slight convergence process during the period immediately following the transition.

The main result of the paper is the detection of convergence clubs in the growth process. In particular, the findings suggest a range of incomes characterized by an accelerating growth rate, which eventually decelerates once a region catches up the wealthier regions. However, this only holds for a subset of regions, because evidence is found of poverty traps in the sense that cross-regional distribution persistently displays a considerable proportion of regions lagging at low income levels. Although some regions, especially the metropolitan, eastern and northern ones, have succeeded in extracting themselves from a difficult situation, the challenge is to fill the huge gap between these leaders and the great majority of the others, so as to recreate the two intermediate clubs in order to give a new cohesion to the country. When the number of laggard regions has doubled during a decade, the very real threat of an irreversible lock-in needs to be considered. The danger of such a bimodality is that the polarization process will further reinforce itself in the future, producing a predatory rather than a diffusive effect. In the absence of a counter-evolution, the two Russias, highlighted by this strong statistical binodality, might never meet again.

APPENDIX 1: LIST OF REGIONS (GEOGRAPHICAL DUMMIES AND DISTANCE FROM MOSCOW)

	Regions	East	West	Border	South	North	Distance
1	Aginsky-Buryatsky okrug	0	0	0	0	0	15.1
2	Altaisky krai	0	0	1	1	0	9.4
3	Amurskaya oblast	0	0	1	1	0	17.4
4	Arkhangelskaya oblast	0	0	0	0	1	3.2
5	Astrakhanskaya oblast	0	0	1	1	0	4.1
6	Belgorodskaya oblast	0	1	1	0	0	1.7
7	Bryansk oblast	0	1	1	0	0	1.2
8	Vladimirskaya oblast	0	0	0	0	0	0.6
9	Volgogradskaya oblast	0	0	1	1	0	2.9
10	Vologodskaya oblast	0	0	0	0	0	1.4
11	Voronezhskaya oblast	0	1	1	0	0	1.6
12	Evreiskaya avtonomnaya oblast	0	0	1	1	0	18.5
13	Ivanovskaya oblast	0	0	0	0	0	0.9
14	Republic of Ingushetiya	0	0	1	1	0	4.9
15	Irkutskaya oblast	0	0	0	0	0	13.0
16	Kabardino-Balkarskaya Republic	0	0	1	1	0	4.7
17	Kaliningrad economic region	0	1	1	0	0	3.4
18	Kaluzhskaya oblast	0	0	0	0	0	0.4
19	Kamchatskaya oblast	1	0	1	0	0	21.4
20	Karachaevo-Cherkesskaya Republic	0	0	1	1	0	4.4
21	Kemerovskaya oblast	0	0	0	0	0	9.4
22	Kirovskaya oblast	0	0	0	0	0	2.5
23	Komi-Permyatsky okrug	0	0	0	0	0	3.5
24	Koryaksky avtonomny okrug	1	0	1	0	0	20.0
25	Kostromskaya oblast	0	0	0	0	0	1.0

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APPENDIX 1: *Continued*

	Regions	East	West	Border	South	North	Distance
26	Krasnodarsky krai	0	1	1	0	0	3.6
27	Krasnoyarsky krai	0	0	0	0	0	10.8
28	Kurganskaya oblast	0	0	1	1	0	5.4
29	Kurskaya oblast	0	1	1	0	0	1.4
30	Leningradskaya oblast	0	1	1	0	0	2.5
31	Lipetskaya oblast	0	0	0	0	0	1.2
32	Magadanskaya oblast	1	0	1	0	0	18.8
33	Moskva	0	0	0	0	0	0.01
34	Moskovskaya oblast	0	0	0	0	0	0.1
35	Murmanskaya oblast	0	1	1	0	1	4.8
36	Nenetsky avtonomny okrug	0	0	0	0	1	5.0
37	Nizhegorodskaya oblast	0	0	0	0	0	1.2
38	Novgorodskaya oblast	0	0	0	0	0	1.4
39	Novosibirskaya oblast	0	0	1	1	0	9.0
40	Omskaya oblast	0	0	1	1	0	7.0
41	Orenburgskaya oblast	0	0	1	1	0	3.8
42	Orlovskaya oblast	0	0	0	0	0	1.1
43	Penzenskaya oblast	0	0	0	0	0	1.9
44	Permskaya oblast	0	0	0	0	0	3.6
45	Primorsky krai	1	0	1	1	0	20.0
46	Pskovskaya oblast	0	1	1	0	0	1.8
47	Republic of Adygeya	0	1	1	1	0	4.2
48	Republic Altai	0	0	1	1	0	10.3
49	Republic of Bashkortastan	0	0	1	1	0	4.6
50	Republic Buryatiya	0	0	1	1	0	13.9
51	Republic of Dagestan	0	0	0	1	0	5.0
52	Republic of Kalmykiya	0	0	1	1	0	3.8
53	Republic of Kareliya	0	1	1	0	1	3.1
54	Republic of Komi	0	0	0	0	0	3.5
55	Republic of Mariy-El	0	0	0	0	0	2.2
56	Republic of Mordoviya	0	0	0	0	0	1.7
57	Republic of Sakha (Yakutiya)	0	0	0	0	1	15.2
58	Republic of Severnaya Osetiya	0	0	1	1	0	4.8
59	Republic of Tatarstan	0	0	0	0	0	2.7
60	Republic Tyva	0	0	1	1	0	11.2
61	Republic Khakasiya	0	0	0	0	0	10.5
62	Rostovskaya oblast	0	1	1	0	0	3.0
63	Ryazanskaya oblast	0	0	0	0	0	0.7
64	Samarskaya oblast	0	0	1	1	0	2.7
65	Saint-Petersburg	0	1	1	0	0	2.1
66	Saratovskaya oblast	0	0	1	1	0	2.4
67	Sakhalinskaya oblast	1	0	1	0	0	20.8
68	Sverdlovskaya oblast	0	0	0	0	0	4.5
69	Smolenskaya oblast	0	1	1	0	0	1.1
70	Stavropolsky krai	0	0	0	0	0	4.1
71	Taimyrsky avtonomny okrug	0	0	0	0	1	8.7
72	Tambobskaya oblast	0	0	0	0	0	1.4
73	Tverskaya oblast	0	0	0	0	0	0.6
74	Tomskaya oblast	0	0	0	0	0	8.9
75	Tulskaya oblast	0	0	0	0	0	0.6
76	Tyumenskaya oblast	0	0	1	1	0	5.5
77	Udmurtskaya Republic	0	0	0	0	0	3.0
78	Ulyanovskaya oblast	0	0	0	0	0	2.2
79	Ust-Ordynsky Buryatsky okrug	0	0	0	0	0	13.0
80	Khabarovsky krai	1	0	1	1	0	18.9
81	Khanty-Mansiisky okrug	0	0	0	0	0	6.9
82	Chelyabinkskaya oblast	0	0	0	0	0	3.6
83	Chitinskaya oblast	0	0	1	1	0	14.9
84	Chuvashskaya Republic	0	0	0	0	0	1.8
85	Chukotsky avtonomny okrug	1	0	1	0	1	18.1
86	Evenkiisky avtonomny okrug	0	0	0	0	0	10.6
87	Yamalo-Nenetsky okrug	0	0	0	0	1	7.4
88	Yaroslavskaya oblast	0	0	0	0	0	0.8

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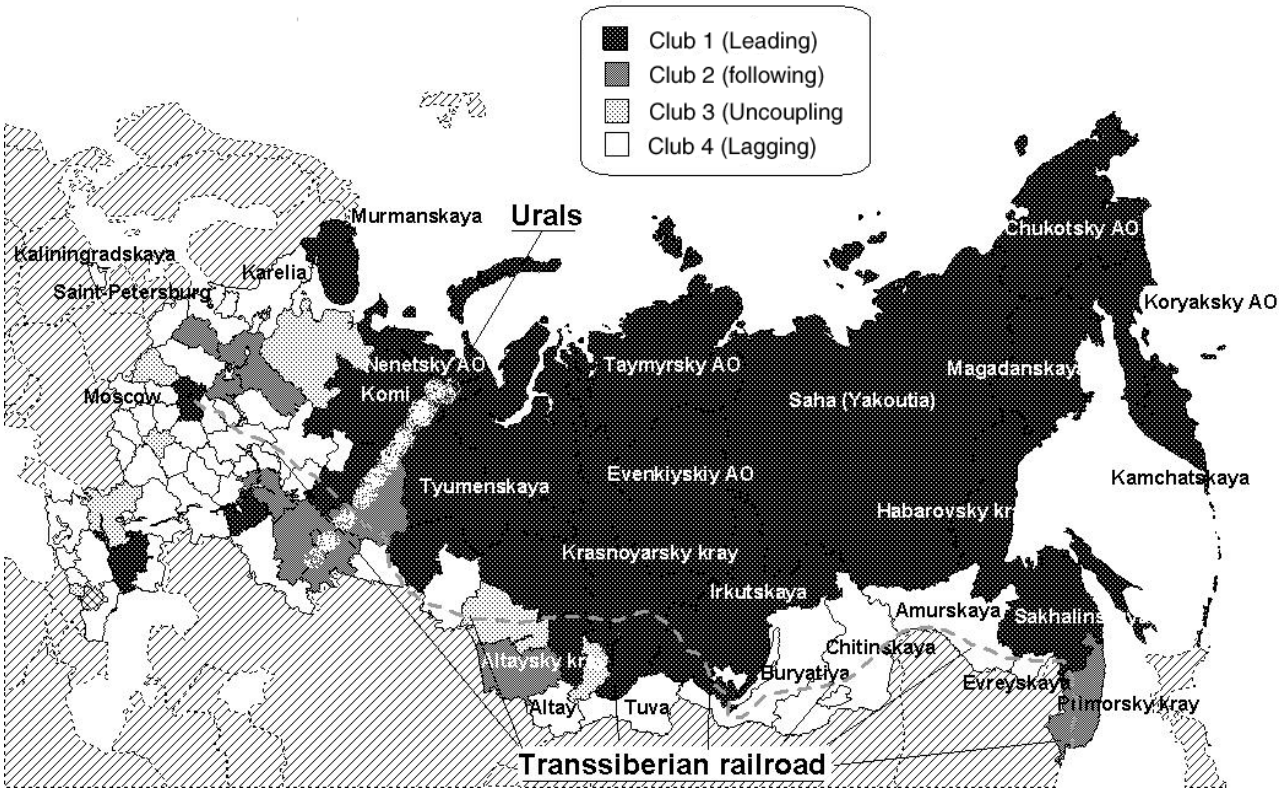
APPENDIX 2: RUSSIAN INCOMES PER-CAPITA INCOME, 1999



NOTES

1. On the contrary, the parametric statistics suppose that the data are issued from a standard parametric distribution (e.g. the normal distribution) and estimate the density function by computing, from the observations, some estimators of μ and σ^2, and then supersede them in the formula of the normal density.
2. Ergodicity is a property of a Markov chain in which there is a finite mean recurrence time for each state, where the recurrence time is that required for a first return to a state, and return is possible at any time. The implicit assumption here is that every state is ultimately reachable from every other state.
3. Examination of the individual trajectories during the period shows that not all the regions followed a linear trajectory or even a 'linear' mobility. The case of the Novgorod region is particularly interesting because its numerous changes of club have been followed over time. At the beginning of the period, this north-western region belonged to club 3 and maintained its position until 1991, before regressing to the last club for 2 years. It then took off dramatically and joined the leaders' club in 1996. It subsequently lost ground and slipped down to club 2 and then club 3, before clawing its way back into club 2 in 1999. The opening of markets has considerably modified regional dynamics, especially because the degree of absorption of foreign direct investment and government priorities have differed considerably from region to region.

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