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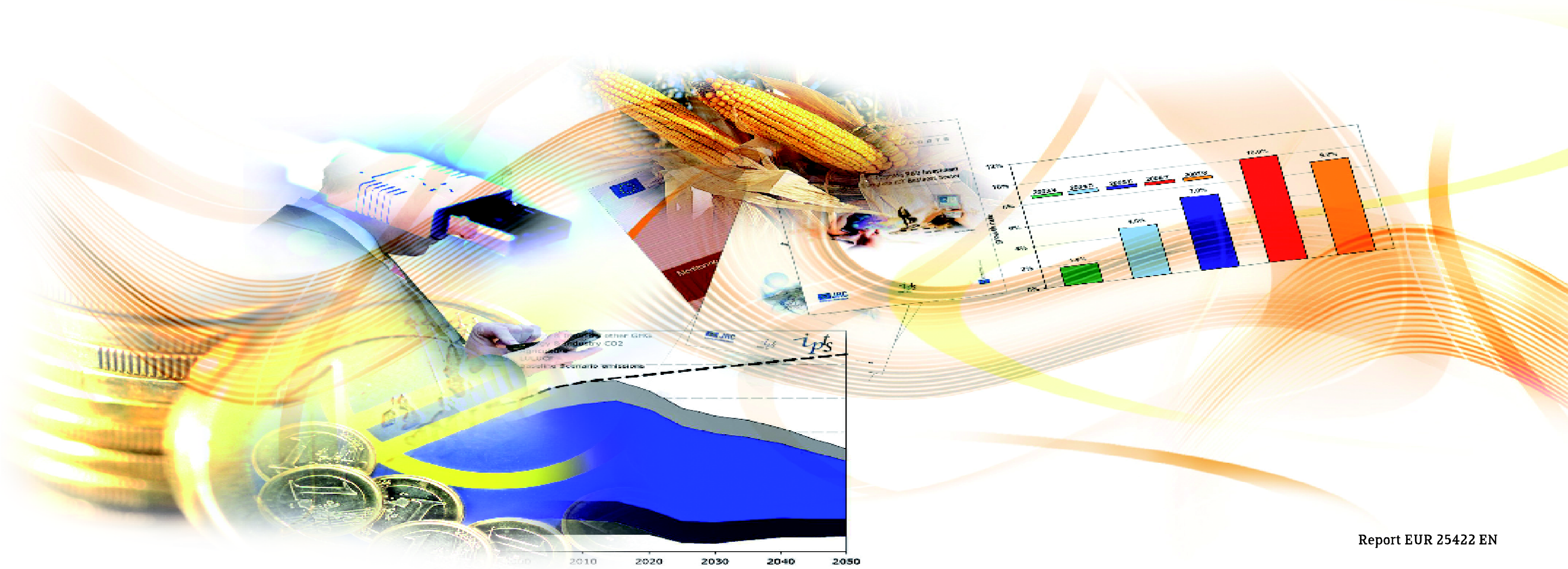

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1. Introduction

The main purpose of this research was to construct a multi-dimensional (composite) index measuring the overall level of regional development and quality of life in individual rural regions of a given EU country at NUTS-4 level. From a methodological point of view, the work on the RDI is rooted in the studies on development indices[1] (the latter *inter alia* resulted in the construction of the Human Development Index) as well as in research focusing on linking the measurement of a quality of life[2] with welfare- and rural indicators[3]. Given growing demand for composite development indicators in applied policy analysis (e.g. in evaluation of rural development/structural programmes) potential gains from having a multi-dimensional regional/ rural development index are straightforward. As a composite indicator, the proposed RDI can be applied to analysis of the main determinants of rural/regional development in individual rural areas as well as to the measurement of the impact of cohesion policy and RD/structural programmes at various regional levels (Michalek, 2007; 2009).

1 E.g. Nordhaus and Tobin, 1972; Amartya Sen, 1987
2 E.g. OECD, 2006; Douglas and Wall, 1999, 1997 and 2000; Deller et al. 2001; Rudzitis, 1999; Nord and Cromartie, 1997
3 E.g. Midgley, Hodge and Monk, 2003; Hagerty et al. 2001; Noll, 2002; Bryden, 2003

2. Application of an RDI to policy analysis of rural development

2.1. Understanding regional rural development

Fully understanding of the main determinants of economic and social growth of rural areas remains one of the chief policy issues (Bryden, 2003). Given the multiple dimensions (e.g. economic, social, environmental) of rural development, there is a huge interest among policy makers to learn more about the magnitude and trends in the *overall welfare* in rural regions. There is also the desire to learn about the importance of individual factors fostering the overall growth and convergence of individual regions. In last two decades numerous cross-country rural development studies have been carried out and/or sponsored by international and national organisations, with the objective to gain specific knowledge about the key constraints to rural growth (OECD, 1995; 2007-2009; EC, 2004, 2005; DORA, 2001; RAPIDO, 2009; IIASA, 2002; World Bank, 2000, 2009; FAO, 2003). While the main areas of policy concerns related to rural development have been relatively easily identified, i.e.: i) economic structure and performance, ii) social well-being and equity, iii) population and demographics, and iv) environment and sustainability, overcoming these constraints in *individual* rural areas through precise targeting of policy interventions has proven to be a complex policy task, mostly due to their *local/regional specificity* as well as complex links among individual growth components and their constraints.

Various rural development studies showed that in most EU rural regions the primary engines of local rural developments are activities of those economic units located in specific growth centres or rural poles (including small towns in rural areas) carried out in response to needs and changing demands of various groups of population and sectors not necessarily located in rural regions (Courtney and Errington, 2003; Peltre, 2007). Furthermore, the growth of rural economies in the EU depends to an increasing extent on national and supra-national rural development policies (e.g. rural development policies, structural and sectoral policies, etc.) implemented at various regional levels[4]. Although all these policies affect rural economies their exact impact on individual rural areas is largely unknown.

The main common objective of EU rural and regional policies is to encourage a balanced economic, social and environmental growth of regions and rural areas; this object is to be reached by overcoming their structural deficiencies and strengthening their competitiveness and employment. With its main goal to "reduce disparities between the levels of development of EU regions and countries" the general objective of EU cohesion policy is rather uncontroversial. Yet, *empirical verification* of the impact of cohesion policy on regions and rural areas (i.e. especially at NUTS-4, NUTS-5 or lower levels) can be problematic. Typically, GDP per capita (applied at highly aggregated NUTS-2 and NUTS-3 levels) is used as a basic criterion of policy effectiveness and as a standard measure of a regional welfare. This is despite numerous deficiencies of this specific indicator being well-known:

4 Typical rural development policies in the EU are implemented via RD programmes (with the Ministry of Agriculture as the main responsible institution). At the same time numerous other policy interventions (e.g. initiatives and programmes co-financed by the EU or covered from national sources only) are carried out *independently* (normally under the responsibility of other ministries) by focusing on specific sectors of rural economies, e.g. social welfare, employment, transport and infrastructure, environment, health and education, housing, trade, local government and so on.

i) GDP per capita as a measure of regional welfare largely ignores other important aspects of the regional quality of life, e.g. education, health, intra-regional income variation, environmental quality, etc.;

ii) GDP per capita does not take into account the price variation within a country,

iii) GDP per capita can be biased due to interregional imbalances in commuting and;

iv) GDP per capita is usually not available at lower regional levels (i.e. NUTS 4 and NUTS5 levels, etc.).

In the late 1960s dissatisfaction with an abundant usage of GDP, material well-being and a stringent definition of economic growth led to development of alternative approaches involving a further conceptualization of the *quality of life*. These trends were followed by numerous efforts aimed at developing a composite index that embraced various aspects/domains of a quality of life previously largely ignored in a standard GDP per capita measure (Kaufman, et al. 2007). Although a quality of life index reflecting various aspects of regional/rural development at regional levels is generally considered as superior, compared to GDP per capita, numerous methodological difficulties linked to construction of such an index have previously prohibited its wider usage.

Deficiencies of GDP measure (including its inapplicability at lower regional levels) and huge diversities in economic, social and environmental situation and performance of individual rural areas observed in EU countries at NUTS-4 and lower levels (using various partial indicators), stimulated public interest in learning more about the overall impact of policies on individual rural areas, and identifying the key factors responsible for high- or low performance of given rural economies (e.g. DEFRA, 2004)

Relevant policy questions in this context are:

- Can the *overall* development (beyond GDP) and performance of complex rural systems in specific areas, including their economic, social and environmental domains, be objectively measured and compared across individual regions at various disaggregated levels?

- If the answer to the first question is affirmative, how big are spatial disparities across individual rural regions in a given country? Can any particular spatial development/performance pattern (e.g. performance clusters) across rural regions be recognized? How has the overall performance of individual regions changed in recent years (divergence or convergence)? Which individual rural regions/areas are currently leading/lagging in terms of their overall (combined) economic, social and environmental development? What was the contribution of individual economic, social, infrastructural, and environmental components (development domains) to the overall development of individual rural areas (social value of individual growth components)? Which factors were the most advantageous and/or harming an overall development of individual rural areas?

Beyond a “standard” regional analysis, answers to above questions may also be used in evaluating EU policies and programmes targeting specific rural areas (e.g. learning about the net effect of RD/structural policies at various regional levels NUTS-4 or NUTS-5)[5].

5 Description of a methodology (e.g. combining propensity score matching techniques and a RDI as an outcome indicator) enabling policy evaluations in rural areas is provided in Michalek, 2012.

2.2. Possible use of partial indicators

Basic knowledge about various aspects of rural/regional development is typically obtained on the basis of numerous *partial* indicators helping an analyst to understand good or poor performance of individual rural regions. Compared with difficulties experienced by collectors of such indicators two or three decades ago, a huge regional statistical data base available for researchers and policy analysts today (applies especially to EU new member states) enables the analysis of the development of rural areas by means of hundreds/thousands of various partial indicators calculated at various regional levels, including NUTS-4 and NUTS-5. Increased data availability also fuels the interest of policy makers (including EC) to apply such data in evaluations of EU RD/structural programmes (EC, 2006).

Although widely recommended, the applicability of partial indicators as a basic source of knowledge about an overall level of development of individual rural regions is limited. Firstly, an increased richness and a great number of details available from regional databases (variables and indicators) showing various partial aspects of the overall regional/rural development makes it difficult to select the most representative indicators for a given rural development domain (e.g. selection of the best proxies for rural education, environmental situation or health). Secondly, the direct use of partial indicators in the analysis of an *overall* (economic, social and environmental) growth of rural areas is especially problematic if *weights* of individual partial indicators/components in such overall rural/regional development *are not known*. Thirdly, as shown in various studies concerned with the evaluation of programmes and policies affecting rural areas, the use of a large number of partial indicators can be highly misleading in the case of opposite or dissimilar trends observed in the same area[6].

Given the complexity of local interactions, the comparative analysis of the situation in rural regions, and the estimation of an overall effect of policies in a specific region that may simultaneously influence economic, social and environmental domains of rural development, requires using an evaluation methodology enabling a consistent aggregation of impacts.

2.3. A composite index approach

A possible solution to the above problems may offer a composite index approach measuring the overall level of rural/regional development at a given territorial/local base. The expected advantages from using a composite development index to policy analysis include: comprehensiveness, multi-dimensionality and an ability to reduce empirical sets of the hundreds/thousands of available indicators to a one synthetic measure (Saisana and Tarantola, 2002; OECD 2005).

Ideally, the composite RDI should measure multi-dimensional concepts that cannot be

6 Implemented RD programmes and policies may lead to simultaneously positive (usually expected by policy makers) and negative (e.g. unexpected general equilibrium) effects. For example, support of investments in rural infrastructure or in processing facilities, along with some positive effects, may bring about negative environmental impacts, including potential loss of land supporting biodiversity, protected habitats and/or species, deterioration of soil, water environment and air quality, etc. Similarly, support of local food processors may lead to negative effects in the form of strengthening local monopolies (e.g. large processors), causing breakdown of other local food processing businesses, and therefore a decrease of employment and income in non-supported local enterprises, an increase out-migration, etc.; some investments in irrigation may cause depletion of water resources in other areas, etc.; support provided to certain types of agricultural producers may have negative effects on on-supported population, etc. In all these cases an assessment of a **net-effect** (impact) of pursued policies may be rather unmanageable, because positive and negative outcomes (expressed in form of partial indicators) only hardly can be compared to each other (social weights of individual effects in various RD domains, e.g. economic, social and environmental are usually unknown).

captured by partial indicators alone, and should therefore embrace all the most important rural development domains, e.g. economic output (including agriculture, food industry, rural tourism, etc.), investment, employment, poverty, education, health, housing conditions, crime, environment, urbanization and land use, etc. (DEFRA, 2004).

A good RDI should be able to aggregate the above domains into a one dimensional indicator using objective and statistically verifiable weights. Furthermore, as a composite indicator (CI), the RDI should fulfil a number of general conditions (Hagerty, et al. 2001; OECD, 2005):

- The index should be based on a sound theoretical framework;
- Basic data used for its construction should be of highest quality. The selection of variables should be based on their relevance, analytical soundness, timeliness, accessibility, etc.;
- Construction of the index should follow an exploratory analysis investigating the overall structure of used indicators, e.g. by grouping available information along at least two dimensions of the dataset: sub-indicators and regional units;
- The index should be reported as a single number but can be broken down into components (domains);
- Each domain must encompass a substantial but discrete portion of the construct;
- Each domain must have the potential to be measured in both objective and subjective dimensions;
- Each domain must have a relevance for most people (not a few groups only);
- Particular attention should be given to weighting and aggregation;
- The index should be subject to checking for robustness and sensitivity;
- The index should maintain clear links to other variables and indicators (measures);
- The index should be transparent and be able to be decomposed into its underlying indicators or values;
- Its constructor should apply normalization of data to render their comparability;
- Its constructor should give adequate consideration to different approaches for inputing missing data;
- The index should be based on time series to allow periodic monitoring and aggregation;

The review of various empirical studies on the construction of a composite index to policy analysis shows that its constructors have to cope with numerous methodological issues; the most crucial of these were:

- Selection of appropriate variables/ coefficients and balancing between objective vs. subjective indicators;
- Weighting the variables/indicators according to their relative importance;
- Using unbiased aggregation techniques; and
- Making the index useful for policy purposes (i.e. in programme evaluation).

(Berger-Schmitt and Noll, 2000; Deutsch et al. 2001; Henderson, et al. 1999; Ontario Social Development Council, 2001; Rahman et al. 2003; Kaufmann, et al. 2007)

A comprehensive description of various methodologies and problems linked to a derivation of a meaningful QOL/RDI in policy analysis is provided in Kaufmann, et al. (2007). The authors showed that; in order to be relevant for an empirical policy analysis (e.g. policy evaluations), a composite index should meet a number of general and specific policy criteria:

General evaluation criteria	Policy specific criteria
Efficiency – Index has to be cost efficient in its construction then compared to the outcomes it gives	**Regionality** – it should be possible to calculate index at regional (NUTS 2 and/or NUTS 3) and local levels (at least NUTS 4 and/or NUTS 5)
Effectiveness – Index has to measure what is intended to be measured	**Rurality** – Index has to be applicable for rural areas
Relevance – Index has to be relevant for policy objectives (i.e. fulfil the policy specific criteria summarized in the next column)	**Frequency** – Index has to make it possible to calculate the frequency in line with the programmes requirements
Sustainability – Index has to be useful in both the short and long term	**Objectivity** – Index has to be derived with minimum subjectivity
Sufficiency – Index has to be sufficient to answer the question of Quality of Life in evaluating the policy	**Transparency** – the way of derivation of the Index has to be clear enough for other researchers to replicate
	Simplicity – Index has to be easily understood by policy makers and public
	Comparability – Index has to be comparable across regions and countries
	Dynamics – Since the Index has to measure changes over time it has to be dynamic

Given the above criteria Kaufmann, et al. (2007) suggest some practical consequences for the construction of a composite RD index at disaggregated level:

- The RDI should be either built on an indirect (i.e. using available secondary data) or a hybrid approach (i.e. combining secondary data with direct surveys on various aspects of quality of life in rural areas). A solely direct approach (i.e. by interviewing population living in this area) is not adequate due to high costs, low frequency of data collections and high level of subjectivity[7].

- The RDI should be based on a method that allows empirical derivation of the weights from an econometric model. It should use secondary data (indirect) or possibly some elements of surveys (hybrid), the latter if this is deemed necessary for theoretical and/or data availability reasons.

- The form of the Index should be as simple as possible (e.g. a one equation model) to be better understood by the broader public.

- Data for the index must be available cheaply or freely at the regional level over time with the possibility of rural-urban distinctions.

In the following chapters we show how an RDI can draw on these considerations and how it can be used for practical policy analysis.

7 Empirical studies show that in many cases a large increase in the population's standard of living has almost no detectable effects on life satisfaction or happiness pronounced in direct interviews, see: Easterlin, 1995, 2001; Burkholder, 2005; Kahneman and Krueger, 2006.

2.4. Overview of methodological approaches applied to construction of a Quality of Life index or a composite development index

Among many different methodological approaches currently applied to construction of an index measuring an overall development and/or a quality of life at regional level, the most well-known are:

- Direct or expert approach[8];
- Factor analysis[9];
- Structural equation modelling approach[10];
- Hedonic price approach[11];
- Structural models of growth[12]
- Efficiency transformation approach[13];
- Market/residence approach, spatial equilibrium approach and compensating differentials[14]

While an in-depth review of the above methodological approaches would go beyond the scope of this study, the main problems are linked to: i) selection (usually arbitrary) of a proxy serving as a natural identification of an amenity's capitalization, or a direct equivalence of a quality of life in a specific geographical area, e.g. wages/incomes, house prices, rents, land prices, net-migration, decision of business location, etc.; ii) the assumption that, within a given geographic area/region, the selected proxy representing the overall quality of life remains homogenous and the quality of life can be expressed in a one-dimensional space; iii) the use of socio-economic indicators and assigning them arbitrary weights. Regarding the latter, major problems associated with this approach can be summarized as follows: (i) in a majority of relevant studies the choice/selection of the most representative socio-economic indicators was *arbitrary*, *leaving other available indicators unused or downgraded* as "less representative"; (ii) experts' weights assigned to selected indicators appeared often as *subjective* and not directly transferable from one geographic area to another; (iii) different normalizations of variables could result in different weights; (iv) some weights would become inconsistent when a larger number of indicators/coefficients/variables had been analyzed; (v) weights that were based on pure statistical analysis of factors (e.g. factor loadings) appeared to miss an appropriate welfare (social utility) context; (vi) many assigned weights appeared as region specific, so they were not applicable to other regions in the same country.

In the following section, we directly address the above issues both from a methodological as well as a practitioner's perspectives.

8 Jones and Riseborough, 2002; OSDC (Ontario), 2000; Aivazian, 2005; Osberg and Sharpe, 2000, 2002; Anderson, 2004; Rosner, et al. 2002; Douglas and Wall, 1993.
9 Grasso and Canova, 2007; Rahman, et al, 2003; Sung-Bok Park, 2005.
10 Krishnakumar, 2007; Kuklys, 2005; Juanda and Wasrin, 2002.
11 Buettner and Ebertz, 2009;
12 Deller, et al., 2001.
13 Lovell et al., 1991; Zhu, 2001; Deutsch, et al, 2001.
14 Rosen, 1979; Roback, 1982; Gyourko and Tracy, 1989; Berger and Blomquist, 2003; Gabriel, et al, 2003; Wall, 1997; Douglas and Wall, 2000; Granger and Price, 2008.

3. Construction of the RDI

3.1. Empirical studies on quality of life and migration

Assuming equivalence between the level of rural development and rural quality of life at the same territorial unit, the proposed methodology used for derivation and construction of a composite RDI draws upon research from the past 50 years. This is focused on the main determinants of the quality of life and especially the relationship between the quality of life and migration.

The original foundation for analyzing the effect of regional performance and migration was provided by Tiebout (1956), who found out that, as long as consumers are fully mobile and informed, they convey their preferences through migration or "voting with their feet". Sjaastad (1962) modelled migration flows as a function of the present value of the differences in income streams between alternative locations, minus any initial or subsequent, financial or psychic (physical?) costs of moving. Following the work of Liu (1974) there was a vast sociologic and economic literature showing that people tend to move in order to improve the quality of their lives in a variety of specific respects, and they continue to move until they achieve goals for the majority of those respects (Fuguitt, 1985; Michalos, 2003; Berger, 2003; Douglas and Wall, 1993, 2000).

An approach incorporating *characteristics of origin and destination regions* affecting the decision to move (extension of the traditional migration approaches) was originally focused on the importance of income and the probability of employment (job opportunity) in different locations[15]. In migration studies incorporating characteristics of origin and destination regions, the most frequently reported motives for in-migration flows into destination areas (pull-factors) included factors such as higher probability of obtaining employment, better housing, nicer neighbourhood, more pleasant community, lower pollution, lower crime rates, better health service, better educational facilities, more favourable human-made and natural environments, etc. Under factors found to determine out-migration in origin areas (push-factor) the most important were: poor location amenities, poor public transportation, lack of good medical facilities, unemployment, economic and environmental distress, etc. (Williams and McMillen, 1980; Roseman, 1977; Michalos, 2003). Furthermore, various migrations studies showed empirically that people living in societies that have reached a certain stage of material wealth will also increasingly focus upon immaterial aspects of life, e.g. attractiveness of places that depends upon the needs, demands and preferences of the individual (Inglehart, 1997; Niedomysl, 2006).

The "pull-push" approach assumes that numerous objective indicators describing various regions (e.g. unemployment, crime rate, infant mortality, level of prices, etc.) can be transformed into a subjective judgement of the overall quality of life on which any migration decision is made. However in a *general theory of movement* (Alonso, 1978) it is argued that the migration flows between locality **i** and locality **j** depend not only

15 This model was extended by Todaro (1969) who proposed a modification of the neo-classical migration model by adding dynamics, i.e. individuals were assumed to migrate if their discounted future stream of urban-rural expected income differentials exceeded migration costs, which implied that urban jobs are more attractive than rural employment.

upon characteristics of the localities of origin and destination, but also upon the *ease of movement between them*. Migration also depends upon the alternative opportunities available from that origin and the degree of competition existing at that destination[16]. An extension of pure origin-destination migration models can be found in gravity, modified gravity or spatial interaction models (Tinbergen, 1962; Anderson 1979; Sen and Smith, 1995). Most gravity and modified gravity models forecasted migration flows between relevant origin and destination areas as a function of distance, size of population between respective areas and differences in characteristics of both areas, including income, unemployment rates, poverty level, crime level, degree of urbanisation, various measures of public goods and expenditures, natural amenities, etc. (Greenwood, 1997; Andrienko and Guriev, 2003). In the model of net-migration by Greenwood et al. (1991), the net migration into a certain area is a function of a net present value of potential earnings and the amenities in this area, compared with what is available in other areas[17].

From the perspective of this study, particularly interesting version of migration models are those models which forecast *probability* of migration by also incorporating information on the relative frequency of *non-migration* (e.g. probit or logit models); this provides a natural transition from the gravity model to the more *behavioural* grounded modified gravity models[18]. In an extension to this approach, i.e. the new economics of labour migration, (see, e.g. Stark (1991), Stark and Bloom (1985)), migration decision is not modelled as an individual choice but viewed in a larger context – typically the household, which usually consists of individuals with different preferences and different access to income and is influenced by its social milieu (Taylor and Martin, 2001)[19].

The modelling of migration decision naturally depends on the type of data available. For example, availability of individual data on different types of households encourages a researcher to use a micro-economic model of a decision to migrate utilizing probit or logit estimation techniques (Taylor, 1986; Emerson, 1984). In the structural models, in which only aggregated data is available (e.g. in form of a full origin-destination matrix migration flows), migration decision can be modelled by combining a micro-approach and e.g. spatial econometrics (Ibarra and Soloaga, 2005; Frazier and Kockelman, 2005; Ashby, 2007; Lundberg, 2002; Verkade and Vermeulen, 2004).

Irrespective of a selected object of such analysis (individual or household) important determinants of a migration decision appeared, those variables describing:

- Differences in factors determining the quality of life in origin and destination regions, as well as

16 An empirical estimation of the Alonso's simultaneous equation model with unobservables is provided in Vries, et al, 2000.

17 While the majority of these models forecast the probability of migration from area i to area j depending on the ratio of various destination-to-origin characteristics describing differentials in the quality of life between both areas, an individual migration decision itself can be modeled as a two-step decision process. First a decision maker decides whether to migrate, based on origin characteristics, and second, a choice of destination area is made based on destination characteristics and by taking into consideration other variables describing transaction costs of migration (e.g. distance between origin and destination areas) or as a joint decision (Linneman and Graves, 1983).

18 It has been argued that in the limit, as the unit of time diminishes over which migration is measured, differences between these two specification of migrations might be expected to diminish (Schultz, 1982). The reason is that the population at risk to migrate becomes a better measure of the non-migrating population when the migration interval is very short (Greenwood, 1997).

19 The overview of the respective literature shows that maximization of the well being of the other family members is crucial for such a decision (Mincer, 1978; De Jong, Warland, Root 1998; Konseiga, 2007). The general objective of a household's migration decision is usually modeled as those to maximize a von-Neuman type expected utility function with a vector of end-of-period discounted household wealth (benefits minus costs) and human capital characteristics of all family members as arguments (Agesa, Sunwoong, 2001; Greenwood, 1997).

- Transaction costs related to such a decision.

In the simplest form, the incorporation of transaction costs into modified gravity models involves *distance* as a proxy for costs of moving. The hypothesis that there is an inverse relationship between the distance between receiving and sending areas and the likelihood of moving was confirmed in number of empirical studies (Jones, 1976; Michalos, 2003). Arguments for using distance as a proxy for transaction costs of moving between origin and destination regions are as follows (Greenwood, 1997):

- Distance reflects costs of breaking important ties with relatives and friends as well as other forces;

- Longer distances between origin and destination areas also usually imply higher information costs to offset the greater uncertainty associated with longer distance locations;

- Usually longer distance require more time which in turn means more foregone earnings if the individual is not explicitly compensated for it, e.g. is not involved in a job transfer;

- Distance may also serve as a proxy for the psychic (physical?) costs of moving which could be offset by making more frequent or longer trips back to the origin, where each type of return trips raises the costs of moving as a positive function of distance

Although over time the importance of some direct costs related to distance may diminish, e.g. transportation and communication systems become relatively cheaper and more accessible, some other important costs remain high and directly proportional to distance, e.g. gasoline, direct costs of moving, some of search costs, etc.

3.2. Derivation of weights in the RDI

The methodological approach applied in our study draws strongly on the supposition that quality of life and migration are closely linked to each other (e.g. Greenwood, et al. 1991; Douglas and Wall, 1993; 2000). For example, Greenwood, et al. (1991) estimated compensating income differentials between the states in the US on the base of net-migration rates.[20] In Douglas and Wall (1993) the QOL index was derived directly as proportional to the positive scores computed for each province on the base of net-migration coefficients across all destination provinces. Douglas and Wall (2000) applied regression techniques to identify the portion of migration flows that was correlated with income opportunities to compute a measure of the relative levels of living standards in different regions. The modelling technique applied in Douglas and Wall (2000) allowed the ranking of provinces in terms of their non-pecuniary amenities and to calculate the value of those amenities in terms of their income value, or compensating differential.

The approach applied in our study to the derivation of weights in RDI builds upon Tiebout, 1956; Douglas and Wall, 1993; Douglas and Wall, 1997 and Douglas and Wall, 2000 who argue that cross-migration rates provide the richest and most reliable source of data on the relative attractiveness of different locations. Yet, contrary to previous studies, in our study the estimated quality of life or rural development index is *not* identical with migration. Although the weights showing "social importance" of various RD domains used in the calculation of the Rural Development Index are derived *directly* from an econometrically estimated intra- and inter-regional migration function in which the main arguments are: i) observed differences between a number of economic, social and

20 For each state Greenwood, et al. (1991) estimated the per capita income that would be necessary for there to be no net migration to the state from the rest of the country. If this estimated income was less than national average, the state was said to be amenity-rich.

environmental factors characterizing the origin and destination regions, and ii) transaction costs linked to a migration decision, in contrast to other studies (Douglas and Wall, 1993; Douglas and Wall, 2000), the approach used in our study neither assumes any unique equivalence between quality of life and migration, nor is the quality of life expressed as a parameter that is *independent of individual characteristics* of a given location [21]. In fact, as we show below, the method proposed in this study allows for the computation of the quality of life /rural development index even in regions exhibiting null in-or out-migration.

3.3. The model

Using the notation of Douglas and Wall, (1993) we assume that an individual perception of quality of life **(QL)** for each person **l** living in region **i** can be expressed as a real-valued function **q** that captures the common component of utility function across individuals with region specific characteristics **Zi** as arguments (eq. 1),

$$\mathbf{QL^l_i = q\,(Z_i) + \varepsilon^l_i} \qquad \textbf{(1)}$$

Where:

l = individual person
q = real valued function that captures the common component of utility function a cross individuals
$\mathbf{Z_i}$ = vector of characteristics in region **i**
$\boldsymbol{\varepsilon}^l_i$ = stochastic element capturing factors unique to individual **l**

In this approach QL^l_i, which is an individual l's perception of his/her own quality of life in region **i**, has to be distinguished from $\mathbf{q_i}$ in (2) that stands for the "objective" quality of life in region **i** and is expressed as a function of a vector of characteristics **Z** generally available in region **i**.

$$\mathbf{q_i = q\,(Z_i)} \qquad (2)$$

Where:

$\mathbf{q_i}$ = "objective" quality of life in region **i**

Following Douglas and Wall (1993), by defining a cost of moving from region **i** to **j** as $\mathbf{C_{ij}}$ and considering a decision of an individual regarding migration from region **i** to region **j** as $\mathbf{mig^l_{ij}}$

where:

$\mathbf{mig^l_{ij}}$ = is an individual decision of moving from region **i** to **j** such that:
$\mathbf{mig^l_{ij}}$ = {1} if individual **l** migrates from **i** to **j** or
$\mathbf{mig^l_{ij}}$ = {0}, otherwise

Douglas and Wall (1993) showed that in case an individual **l** decides to move from region **i** to region **j** the quality of life in region **j**, QL^l_i i.e. less the costs of moving from i to j must be higher than the quality of life in region i (QL^l_j).

Formally,

$$mig^l_{ij} = \{1\} \text{ if } QL^l_j - \mathbf{C_{ij}} > QL^l_i \qquad (3)$$

Given (3), a decision of an individual l to move to a region j depends on the relative quality of life in all possible destination regions n less costs of moving to regions n compared with the quality of life in the origin region i.

Thus,

$$QL^l_j - \mathbf{C_{jj}} > QL^l_i \textbf{ and } -QL^l_j\, \mathbf{C_{ji}} > QL^l_n - \mathbf{C_{in}} \quad (4)$$

In terms of utility maximization, all else being equal, it is expected that individuals will move to a new location **j** if the perceived utility (corrected for respective transaction costs/moving

21 In Douglas and Wall (1993) data on net migration flows between states was directly used for calculation of a Quality of Life. Construction of QOL ranking was performed by making pair-wise comparisons of migration rates. In Douglas and Wall (2000) the quality of life was estimated as a constant from a net-migration rate function with intercepts (QOL) and income ratio as the main arguments.

costs) from doing so is greater than the utility of moving to any other location (corrected for respective transaction costs/moving costs) or not moving at all.

While "real" QOL in a possible destination relative to an individual's current residence is the prime determinant of the probability that the individual will move[22] to that location, in this sense, *migration is a better measurement of* ***utility improvement*** *than any other measurement of well-being* (the preferences are manifested through revealed action, Ashby, 2007).

Defining migration rate as

$$\mathbf{MR}_{ij} = \mathbf{\Sigma}\ mig^{l}_{ij}\ \mathbf{/\ (P_i * P_j)} \qquad (5)$$

Where:

$\mathbf{MR}_{ij}$ **=** rate of migration between regions i and j

mig^{l}_{ij} **=** inflows of those who migrate from region **i** to region **j**

$\mathbf{P}_i$**,** $\mathbf{P}_j$ **=** population **P** of those willing to migrate in regions **i** and **j** (only those who are at risk of migration)

Douglas and Wall (1993) show that $\mathbf{MR}_{ij}$ is an asymptotically normally distributed variable with mean that depends on the differences: qj – qi - Cij between i and all other possible locations n.

$$E\ (MR_{ij}) = f\ (q_j – q_i - C_{ij}\ ,\ q_j – q_1 - C_{1j}\ ,\ q_j – q_2 - C_{2j}\ ,\ ....) \qquad (6)$$

Where:

$E\ (MR_{ij})$ = expected value of a migration rate between regions i and j, and

f = includes all possible alternative destinations **(n)** for moving of individual **l** living in region **i**

Following Douglas and Wall (1993) and assuming that the effect on **f** of transaction costs Cij of moving from **i** to ***j*** are the same as from **j** to **i**, the M_{ij} can be treated as a net-migration flow function or inflow from region **i** to **j** that are both monotonically increasing in (q_i – q_j), i.e. differences in **q** between regions **i** and **j**. It is therefore expected that the probability that the event $\mathbf{M}_{ij}$ will occur decreases, as the population **P** in **i** and **j** of those willing to migrate increase. It can also be shown that in large samples the probability of migrating from region **i** to **j** and from region **j** to region **i** will be independent of individual stochastic elements $\boldsymbol{\varepsilon}^{l}_{i}$ (eq 8).

Formally, given (eq. 3-6) an econometrically estimable form of **E** $(\mathbf{MR}_{ij})$ can be expressed in terms of function **f,** with $\mathbf{Z}_{ki}$ and $\mathbf{C}_{ij}$ as the main arguments. In our study various forms of **f** are discussed and separately estimated using appropriate econometric methods[23].

In contrast to previous studies (e.g. Douglas and Walls, 1993; 2000) a synthetic index of the rural development **(RDI)** is calculated in our study according to eq. (7) on the base of regional characteristics $\mathbf{Z}_i$ and individual weights $\boldsymbol{\beta}_k$ that are derived from the estimated migration function (with $\mathbf{M}_{ij}$ or a $\mathbf{MR}_{ij}$ as dependent variable)[24]. In such a model, the *estimated weights* $\boldsymbol{\beta}_k$ *represent the relative "importance" or a "social value" assigned by a society (composed of those who migrated and those who stayed) to each of characteristics* $\mathbf{Z}_{ki}$ *representing various aspects of the quality of life in all origin and destination regions i.*

22 In Douglas and Wall (2000) the authors distinguish between the concept of the standard of living (SOL) and the quality of life (QOL); for the former includes both QOL and the differences in income. In our concept the differences in income are already included into the overall measure of the quality of life.

23 Selection of the most suitable model is described in section "econometric models used for estimation of weights" (Models 1-4 below).

24 While in our study RDIs are computed directly using all i-region specific Z_{ki} and β, this approach to the construction of a QOL Index differs from one described in Douglas and Wall (1993, 2000) for its explicit estimation of covariates (quality of life determinants and the magnitude of the estimated transaction costs C_{ij}, see: Models 1- 4).

Formally the **RDI** in region **i** can be therefore expressed as a linear function of **i**-region specific characteristics $\mathbf{Z}_{ki}$ and their weights $\boldsymbol{\beta}_k$ (see: eq7):

$$\mathbf{RDI_i} = h(\boldsymbol{\beta}_k, Z_{ki}) = \Sigma_k \boldsymbol{\beta}_k * Z_k^i \qquad (7)$$

Where:

$\mathbf{RDI}_i$ = Rural development index (an equivalent of the quality of life index) in region **i**

$\mathbf{Z_k^i}$ = Measurable characteristics **k** in a region **i**

$\boldsymbol{\beta}_k$ = Weights for each characteristic **k** derived from the estimated migration function that can be both **i**-region and time **t** specific

In empirical work, due to the multidimensionality of relevant data, a particular importance is to be assigned to an appropriate selection (or estimation) of $\mathbf{Z}_k^i$ describing major attributes of the overall development and the quality of life in individual rural areas.

In our study $\mathbf{Z_k^i}$ are constructed empirically using the factorization method applied to all relevant coefficients and variables $\mathbf{V}^i$ available in a given country at regional level. The latter are nested in $\mathbf{Z_k^i}$ (i.e. RD domains) and describe in detail various specific aspects of rural development in each individual region **i** (e.g. a number of enterprises, employment coefficients, water/air pollution coefficients, schools, health facilities, etc., available from regional secondary statistics). While the basic objective of this intermediate analysis is to reduce dimensionality of performed analysis, $\mathbf{Z_k^i}$ are empirically estimated using the principle-component factor method. This factorization method treats communalities as all **1** meaning that there are no unique factors (extraction of principal components amounts to a variance maximizing rotation of the original variable space, whereby each consecutive factor is defined to maximize the variability that is not captured by the preceding factor)[25]. The general form of the factor analysis model applied in our study is shown in eq (7a)

Defining common factors $\mathbf{Z_{mn} = f\,(V_{mn})}$

such as: $V^i_{ma} = Z^i_{m1}b_{1a} + Z^i_{m2}b_{2a} + \dots Z^i_{mq}b_{qa} + e_{ma}$ (7a)

Where:

$\mathbf{V^i_{ma}}$ = value of the **m-** observation on the **a-variable** describing a given attribute of RD in region **i**

$\mathbf{Z^i_{ma}}$ = **m-** observation on **a-** common factor

$\mathbf{b_{ma}}$ = the set of linear coefficients (factor loadings)

$\mathbf{e_{ma}}$ = **a-** unique factor

$\mathbf{Z_{ma}}$ can be estimated empirically using available regional secondary statistics (see: Results).

While the number (**k**) of extracted factors $\mathbf{Z_k}$ to be used in the construction of the **RDI** is usually unknown, various criteria are commonly applied in empirical studies to determine **k**, e.g. eigenvalues larger than 1 (Kaiser criterion); fixed number of factors, etc.

In our study the optimal **k** is determined using methodology that ensures that derived factors $\mathbf{Z}_k$ (both the number and values) at the same time guarantee the best fit of the estimated migration model. Given that both the **RDI** and the estimated migration function share several common arguments ($\mathbf{Z_k}$) the "optimal" number of factors $\mathbf{Z_k}$ is empirically derived using an *iterative procedure,* i.e. by i) starting from an arbitrary **k,** performing factorization, deriving $\mathbf{Z_k}$ and carrying out an estimation of respective migration function; ii) iterate on **k** and perform all

25 This leads to consecutive factors being uncorrelated or *orthogonal* to each other.

steps as in i; iii) selecting optimal **k** (result of factor analysis and estimation of a migration model) and vector of $\mathbf{Z_k}$ that guarantee a *maximization* of the likelihood function or (depending on the model) any other relevant maximization criterion applied in an econometric estimation of the respective migration model.

Given estimates of $\boldsymbol{\beta}_k$ (<social> weights) for all individual factors $\mathbf{Z_k^i}$ and the knowledge of particular factor loadings of each observable individual rural development attribute (coefficient/variable) $\mathbf{V_a^i}$ in all $\mathbf{Z_k}$ (factorization using principal component method) desirable information on the relative importance (at the country level) of all individual attributes ($\mathbf{V_a^i}$) can be obtained using function $\mathbf{R_a}$, defined as in eq (7b).

$$\mathbf{R_a = \Sigma_k\, \beta_k * LV_a^k} \qquad (7b)$$

Where:

$\mathbf{R_a}$ **=** relative importance of an individual regional attribute ($\mathbf{V_a}$) in the overall rural development (at the country level)

$\boldsymbol{\beta}_k$ **=** <social> weight of a given factor (component) $\mathbf{Z_k}$ obtained from a relevant migration model

$\mathbf{LV_a^k}$ **=** factor loading of an individual attribute/variable/coefficient ($\mathbf{V_a}$) in factor (component) $\mathbf{Z_k}$

k = number of selected factors

By applying the above methodology, the social value (relative importance) of each partial rural development attribute $\mathbf{V_a}$ (i.e. contribution of individual V_a to the overall quality of life and development level) can be measured (at the country level), and is equal to the weighted sum (= k) ($\boldsymbol{\beta}_k$ as weights) of each attribute's respective factor loadings **($\mathbf{LV_a^k}$)** in all selected factors $\mathbf{Z_k}$**.** Obviously, the magnitudes of the *highest* factor loadings and a social weight (estimated coefficient in migration function) of a relevant factor is decisive for the rank of a given variable $\mathbf{V_a}$.

4. Econometric models used for estimation of weights in RDI

Depending on availability of data and research hypothesis, an econometric estimation of weights in the RDI can be carried out on the basis of various models (Models 1-4), whereby the selection of the most appropriate model specification followed criteria is discussed below.

Notation:

M = Migration Matrix
D = Distance Matrix
F = Factor Matrix
n = number of regions
k = number of factors
T = number of years
a = index for individual rural development attributes => a = 1…m
i, j = index for regions => i, j = 1 …n
p, q = index for factors => p , q = 1…k
ID = index for region pairs => ID = 1… $A^n{}_i$(= n (n – 1))
t = index for years => t = 1…T

4.1. Model 1

The basic form of a migration model can be estimated using panel data on **i** regions over **t** years applied for an estimation of weights of $\mathbf{F_k}$ in an **RDI** as shown in eq. 8.

$$mpit = \alpha 0 + \mathbf{F}_{iKt} * \boldsymbol{\beta}_K + V_i + \varepsilon it \quad (8)$$

where:

α_0, $\boldsymbol{\beta}_k$ = parameters

mp_{it} = net-migration flows into region i divided by population (p) of region i in period t

$\mathbf{F}_{iKt}$ = factor k´s value in region i in period t

V_i = region i specific residual which differs between regions i but for any specific region its value is constant over time

ε_{it} = the residual with `` usual ´´ properties (mean 0, uncorrelated with itself, uncorrelated with F, uncorrelated with V, and homoscedastic)

α0 is the intercept parameter, and βK is the constant slope coefficient (factor – k related parameter) that reflects the change in net-migration to region i determined by a change in the value of factor k. The parameter βK can be used as a specific weight assigned to factor k that directly enters the calculation of the RDI in region i[26]. Model 1 assumes a single set of slope coefficients for all the observations i and t.

Given the availability of panel data the random-effects estimator of (8) is a matrix weighted average of the estimates produced by the 'between' and 'within' estimators and is equivalent to an estimation of

$$(mp_{it} - \theta\ mp_{i.}) = (1 - \theta\ )\ \alpha_0 + (\ mp_{it} - \theta\ IF_{i.}\ )^* I\beta + \{\ (1- \theta)\ V_i + (\varepsilon_{it} - \theta\ \varepsilon_{i.})\} \quad (8a)$$

where:

$E\ [\varepsilon_{it}\ I\ F_{it=1} \ldots F_{it=T}\ ] = 0$

$var\ [\varepsilon_{it}\ I\ F_{it=1} \ldots F_{it=T}] = \sigma^2$

26 Note that in the current version of the model, weights $\boldsymbol{\beta}_k$ are kept constant across all regions **i,** i.e**.** they do not take into account possible different preferences for the regional endowment with **Z** of people moving to various regions.

and:

$$mp_{i.} = \frac{\Sigma^T_{t-1}\, mp_{it}}{T_i}$$

$$F_{i.} = \frac{\Sigma^T_{t-1}\, F_{it}}{T_i}$$

$$\varepsilon_{i.} = \frac{\Sigma^T_{t-1}\, \varepsilon_{it}}{T_i}$$

Whereby:

θ is a function of σ^2_v and σ^2_ε

Estimated as a random effect model, the repeated observations per region **i** are assumed to be not independent and the individual regional differences are modelled as a random disturbance drawn from some specific distribution.

A major disadvantage of this approach is the assumption of an *unique equivalence* between quality of life and migration. Other pros and cons of selecting Model 1 as a base for the derivation of weights to be used in calculation of RDI are specified below:

Table 1. Pros and Cons in applying Model 1 to derivation of weights in the RDI

Pros	Cons
1. Data on net-migration flows for specific region is usually robust and well documented.	1. Number of observations is restricted to the number of regions i over years T. More abundant data, i.e. pair-wise observations on migration flows between individual regions are not used.
2. Interpretation of model parameters and their application to RDI (Index) is straightforward	2. Possible spatial dependence between individual regions is not accounted for.
3. Panel estimation of fixed and random effects allows the selection of an appropriate econometric model	3. Due to a possible negativity of dependent variable (i.e. net migration) an estimation of a usually better fitted logistic function, i.e. log (migr rate / (1- migr rate) is not possible.
	4. Possible various sizes of regions from which migration flows originated is not taken into consideration.
	5. Other important determinants of migration, i.e. transaction costs involved in an individuals decision of moving from one region to another, e.g. in the form of a distance variable cannot be accounted for (average net-migration flows are dependent variables).
	6. Model 1 is not derived from a utility function of individuals willing to migrate, i.e. does not take into account a background for such a migration decision that may be linked to observable differences between factors in both regions as well as transaction costs (linked to the distance between regions).
	7. Estimated quality of life in Model 1 is not separated from migration

4.2. Model 2

Model 2 is an extension of Model 1 as it accounts for the possibility of a spatial dependence between individual regions.

Spatial dependence in a sample of data observations refers to the fact that a given observation at location i may also depend on other observations at location j ≠i, i.e. net-migration to a specific region may also depend on net-migration flows of neighbouring regions. By the same token, observations on various indicators of performance (positive or negative) linked to the value of factors k in region i can be spatially correlated with other factors in neighbouring regions j. If there is a spatial dependence among regions, some part of the total variation in the dependent variable mp across the spatial sample would be explained by each observation's dependence on its neighbouring regions.

Formally:

$mp_{it} = f(mp_{jt})$,

where

$j = 1 \ldots n$ and $j \neq i$.

A possibility of spatial dependence arising from various regional interactions suggests an explicit quantification and modelling of those interactions.

Given the above, Model 1 can be extended to Model 2 (eq 9) as follows:

$$\mathrm{mp}_{it} = \hat{\alpha}_0 + \hat{\rho} \cdot W_1 \cdot mp_{it} + F_{iKt} \cdot \hat{\beta}_K + v_i + u_{it}$$
$$u_{it} = \lambda \cdot W_2 \cdot u_{it} + \varepsilon_{it} \qquad (9)$$

where :

$$\varepsilon \sim N(0, \sigma_\varepsilon^2 \cdot I_n)$$

W_1 and W_2[27] = spatial weight matrices containing first-order contiguity relations among all regions i.

A general version of the spatial model 2 (eq 9) includes both the spatial lagged term that includes ρ (rho) as well as a spatially correlated error structure containing λ (lambda).

Setting $W_2 = 0$ produces a mixed regressive - spatial autoregressive or a spatial lag model shown in (9a).

$$\mathrm{mp}_{it} = \hat{\alpha}_0 + \hat{\rho} \cdot W_1 \cdot mp_{it} + F_{iKt} \cdot \hat{\beta}_K + v_i + \varepsilon_{it} \qquad (9a)$$

where

$$\varepsilon \sim N(0, \sigma_\varepsilon^2, I_n)$$

W_1 = first order contiguity relations matrix among all regions i.

ρ = is a coefficient on the spatially lagged dependent variable

β = slope coefficient that enters a RDI as in Model 1

Letting $W_1 = 0$ results in a regression model with spatial autocorrelation in the disturbance, i.e. spatial error model as shown in (9b).

$$\mathrm{mp}_{it} = \hat{\alpha}_0 + F_{iKt} \cdot \hat{\beta}_K + v_i + u_{it} \qquad (9b)$$

$$u_{it} = \hat{\lambda} \cdot W_2 \cdot u_{it} + \varepsilon_{it}$$

where

$$\varepsilon \sim N(0, \sigma_\varepsilon^2, I_n)$$

$F_{iKt}, v_i, \varepsilon_{it}$ = are the same as in (1)

W_2 = specific contiguity relations matrix among all regions i

λ = is a coefficient on the spatially correlated errors

β = slope coefficients that enter a RDI as in Model 1

In Model 2 (eq 9) the spatial contiguity relationships are quantified in the form of a W_1 spatial weight matrix with elements $W_{1\,(ij)} = W_{2\,(ij)} = 1$ for regions that share a common edge with the region of interest.

27 Matrix W_2 can, for example, be a diagonal matrix measuring the distance from the central city (LeSage, 1998).

All versions of Model 2, i.e. the general spatial model (eq 9), the spatial lag model (9a) and the spatial error regression model (9b) can be estimated by using the maximum likelihood method.

The most important pros and cons of selecting Model 2 as a base for derivation of weights to be used in calculation of RDI are as follows:

Table 2. Pros and Cons in applying Model 2 to derivation of weights in the RDI

Pros	Cons
1. Data on net-migration flows for a specific region is usually robust and well documented.	1. Number of observations is limited to the number of regions i over years T. More abundant data, i.e. **pair-wise** observations on all migration flows between individual regions are not accounted for.
2. Interpretation of model parameters and their application to RDI (Index) is straightforward	2. Due to the possible negativity of dependent variable (net migration) an estimation of a usually better fitted logistic function, i.e. log (migr rate / (1- migr rate) is not possible
3. Model 2 explicitly takes into account possible spatial dependencies and interactions between individual regions bordered to each other.	3. Model 2 does not take into consideration the possibility of various sizes of other regions from which migration flows originated.
4. Various model specifications regarding the importance of specific spatial effects can be econometrically tested and verified.	4. Other important determinant of migration, i.e. transaction costs involved in individuals moving from one region to another, e.g. in the form of a distance variable cannot be accounted for if average net-migration flows are modelled as a dependent variable.
	5. Model 2 is not derived from a utility function of individuals willing to migrate, i.e. it does not take into account a background for such a migration decision that should be linked to observable differences between factors in both regions as well as transaction costs linked to the distance between regions.
	6. Quality of life estimated on the basis of Model 2 is not separated from migration

4.3. Model 3

The basic difference between Model 1 and Model 3 is the introduction of variables representing transaction costs (a distance is used as a proxy reflecting transaction costs in a migration decision of moving between regions i and j) as well as a better approximation of the micro-foundation of a migration decision. *Introduction of transaction costs into the migration model brings about a formal separation of the RDI (consisting of individual factors and related estimated coefficients) from migration.* This is because transaction costs do not enter the index itself, but are used to explain a part of the overall variance in a migration model. In a current version of Model 3, transaction costs are modelled as a time-invariant variable consisting of two elements, i.e. distance matrix D and squared distance matrix D^2 reflecting curvature properties of transaction costs (a quadratic function). Model 3 allows for pair-wise data observations on net migration flows between each region i and j, and postulates that net migration flows between each pair of regions depend both on observable by individual migrants differences between factor k in region i and respective factor k in region j () as well as transaction costs of moving from region i to j.

Model 3 (eq 10a) is estimated as a multi–level mixed effect or nested error component regression model, which can be decomposed as follows:

$$mpp_{IDt} = \hat{\alpha}_0 + D_{ID} \cdot \hat{\delta}_1 + D^2_{ID} \cdot \hat{\delta}_2 + \Delta F_{K,ID,t} \cdot \hat{\beta}_K + v^{(1)}_i + v^{(2)}_{ID,t} + \varepsilon_{ID,t}$$

(10a)

where:

mpp_{ID} = net-migration flows between regions i, j (pair-wise ID)

D_{ID} = matrix of distances between regions i, j

D^2_{ID} = matrix of squared distances between regions i, j

$\Delta F_{ID,k}$ = matrix of the differences in factors k between regions i j

v^1_i = random intercept at region (i) level

v^2_{ID} = random intercept at the pair wise ID level

$\varepsilon \sim N(0, \sigma^2_\varepsilon)$ the residual with "usual" properties (i.e. mean zero, uncorrelated with itself, uncorrelated with D and F, uncorrelated with v and homoscedastic)

In Model 3 pair-wise data on net-migration flows between regions ID is set to be a panel (observable in t years). Since ID can be specific within regions, Model 3 assumes region's nested structure, i.e. accounting for the similarity of net-flows (ID)-within-a given region (i).

In Model (10a) mpp is multivariate normal with mean

$$D_{ID} \cdot \delta_1 + D^2_{ID} \cdot \delta_2 + \Delta F_{IDK} \beta_K \qquad \text{and}$$

variance - covariance matrix

$$v = Z\sigma Z' + \sigma^2_\varepsilon \cdot I_{T(n(n-1))} \qquad (10b)$$

Given the above, and defining θ as the vector of unique elements of σ results in log likelihood:

$$L(\delta,\beta,\theta,\sigma^2_\varepsilon) = -\frac{1}{2}\{T(n(n-1)) \cdot \log(2\pi) + \log|v| + (mpp - D_{ID} \cdot \delta_1 - D^2_{ID} \cdot \delta_2 - \Delta F_{IDK} \cdot \beta_K)' \cdot V^{-1} \cdot (mpp - D_{ID} \cdot \delta_1 - D^2_{ID} \cdot \delta_2 - \Delta F_{IDK} \cdot \beta_K)\} \qquad (10c)$$

which is maximized as a function of δ, β, θ and δ^2_t.

Model 3 has two random effect equations. The first is a random intercept (constant only) at the regional level, and the second is a random intercept at the ID level. Model 3 can be estimated using a restricted maximum likelihood (REML) estimator.

The most important pros and cons of selecting Model 3 as a base for derivation of weights to be used in calculation of RDI are as follows:

Table 3. Pros and Cons in applying Model 3 to derivation of weights in RDI

Pros	Cons
1. Model 3 takes into account available data on pair-wise migration flows between all regions over a number of years, which significantly increases the number of observations and degree of freedom.	1. Spatial aspects of interregional dependence in Model 3 are not accounted for.
2. Panel estimation of fixed or random effects allows for selection of appropriate model specification.	2. Due to a possible negativity of dependent variable, an estimation of migration flows in the form of a logistic function, i.e. log (migr.rate / (1- migr.rate) is not possible.
3. Other important explanatory variables describing the impact of transaction costs (e.g. distance variable as proxy) on a decision to migrate can be easily incorporated into the model.	
4. Estimation of model 3 as multilevel mixed-effect linear regression models allows for more precise specification of the correlation of migration flows and explanatory variables in dependence on specific location (region i).	
5. Model 3 accounts for different sizes of population in all region pairs where migration flows are observed.	
6. Model 3 is indirectly derived from an individual utility function of migrants. It takes into account a background for such a decision by relating it to observable ***differences*** between factors describing economic, social and environmental situation in rural regions as well as transaction costs of moving to another place.	
7. Model 3 allows for a formal separation of the RDI from migration (due to the introduction of transaction costs)	

4.4. Model 4

Model 4 differs from Model 3 as it replaces net-migration flows between regions i j with gross migration inflows. As all observable migration inflows between regions are either zero or positive, Model 4 can be estimated as a logistic function (comp. Schulz, 1982; Ashby, 2007), whereby a dependent variable reflects the probability distribution of migration from one region to another. Thus Model 4 is closely related to the modelling of a microeconomic behaviour of an individual willing to migrate. Similar to Model 3, the weights used later to construct the RDI are only a *subset* of all coefficients estimated within this specification. *This brings about a desirable separation of the RDI from migration* (due to transaction costs). Model 4 can be estimated in two alternative forms: a) as a panel regression that allows the choice between fixed or random effect models (specification 11a); or b) as a multi-level mixed-effect regression model (11b).

$$\log(m)_{ID,t} = \alpha_0 + D_{ID} \cdot \delta_1 + D_{ID}^2 \cdot \delta_2 + \Delta F_{IDKt} \cdot \beta_K + v_{ID} + \varepsilon_{IDt}$$

(11a)

Where:

$$\log(m) = \log\left(\frac{\text{mrate}}{1\text{-mrate}}\right)$$

mrate = inflows from region i to j divided by (population in i multiplied by population in j)

D_{ID} = distance between region i and j

D^2_{ID} = squared distance between i and j

ΔF_{IDKt} = differences in factors k between regions i j

v_{ID} = random intercept at the pair wise ID level

ε_{IDt} = residual with "usual" properties (mean zero, uncorrelated with itself, uncorrelated with D and F, uncorrelated with v and homoscedastic).

$$\varepsilon \approx N(0, \sigma^1_\varepsilon)$$

As a random effect model, Model 4a (eq 11a) assumes that the random effects occur at the level of the pair-wise migration flows between all regions i j (region as a group variable). Model 4a is thus estimated as a random effect linear regression model with a group variable at the level of i j (ID) by using the GLS random effects estimator (a matrix-weighted average of the between and within estimators)[28].

Version 4b of Model 4 (eq 11b) controls for the possibility of the nested error structure within a region i.

$$\log(m)_{IDt} = \hat{\alpha}_0 + D_{ID} \cdot \hat{\delta}_1 + D^2_{ID} \cdot \hat{\delta}_2 + \Delta F_{K,ID,t} \cdot \hat{\beta}_K + v^{(1)}_i + v^{(2)}_{ID,t} + \varepsilon_{ID,t}$$

(11b)

Where:

$$\log(m) = \log\left(\frac{\text{mrate}}{\text{1-mrate}}\right)$$

mrate = inflows from region i to j divided by (population in i multiplied with population in j)

D_{ij} = matrix of distances between regions i. j

D^2_{ij} = matrix of squared distances between regions i, j

$\Delta F_{ij,k}$ = matrix of the differences in factors k between regions i j

$v^{(1)}_i$ = random intercept at the region i level

$v^{(2)}_{ID}$ = random intercept at the gross migration flows <pair wise level> nested within the region i level

$\varepsilon \sim N(0, \sigma^2_\varepsilon)$ the residual with "usual" properties (mean zero, uncorrelated with itself, uncorrelated with D and F, uncorrelated with v and homoscedastic).

28 The random effect estimator produces more efficient results than between estimator, albeit with unknown small sample properties. The between estimator is less efficient because it discards the over time information in data in favour of simple means; the random-effects estimator uses both the within and the between information (STATA, ver.10; Kennedy, 2003).

Model 4b has two random effect equations. The first is a random intercept at the regional level, and the second is a random intercept at the ID level. Model 4 can be estimated using a restricted maximum likelihood (REML) estimator.

The most important pros and cons of selecting Model 4 as a base for derivation of weights to be used in the calculation of the RDI are as follows:

Table 4. Pros and Cons in applying Model 4 to policy analysis

Pros	Cons
1. Model 4 takes into account available data on pair-wise migration flows between all regions over a number of years, which significantly increases the number of observations and degrees of freedom. 2. Panel estimation (balanced panel) of fixed or random effects allows the selection of appropriate model specification. 3. Other important explanatory variables describing the impact of transaction costs (e.g. distance variable as proxy) on a decision to migrate can be easily incorporated into the model. 4. Estimation of model 4b as multilevel mixed –effect linear regression models allows for a more precise specification of the correlation of migration flows and explanatory variables in dependence on specific location (region i). 5. Model 4 accounts for different sizes of population in all region pairs where migration flows are observed. 6. Due to non-negativity of dependent variable (mrate), an estimation can be carried out in the form of a logistic function, i.e. log (migr.rate/(1-migr.rate)) representing the probability of migration from region i to j. This model specification is better suited to a micro founded analysis of migration decision. 7. Model 4 (similar to Model 3) allows for a formal separation of the RDI from migration (due to the introduction of transaction costs)	1. Spatial aspects of interregional dependence are not accounted for.

5. Synthesis of the methodological approach

Given the pros and cons of all four alternative models it appears that Model 4b is most appropriate (especially in terms of data efficiency) to an empirical construction of a region specific RDI.[29]

Consequently, the estimation of the RDI was carried out on the basis of Model 4b taking the following steps:

1. Defining relevant rural development domains to be taken into consideration prior to the assessment of the overall impact of the RD programme;

2. Defining variables describing each rural development domain in all regions I;

3. Translating the above variables into meaningful coefficients (e.g. per capita, per km^2, etc.) in all regions **i**;

4. Converting those coefficients into region specific factors $\mathbf{f_i}$ (principal component method) in order to reduce the dimension of the analysis (factor analysis);

5. Deriving weights for each individual factor f (embracing variables in each rural development domain) to be applied in the construction of the RDI from econometrically estimated migration functions using Model 4b (see above).

6. Computing for each rural **region i** a synthetic index $\mathbf{RDI_i}$**.** The latter is defined as a weighted sum of factors (variables, domains) with $\boldsymbol{\beta}$k derived from a selected inter- and intra-regional migration function according to eq. 7 (the optimal number of factors **k** selected to the construction of an RDI was derived from the maximization of the restricted likelihood function used in the estimation of the intra-regional migration model).

In practice, steps 4 and 5 were performed jointly using an iterative procedure (i.e. starting from the minimal number of factors and increasing this number until achieving a convergence), whereby the maximization of a restricted likelihood function of a migration model was applied as the main criterion.

29 Further extension of Models 4a and 4b through inclusion of spatial regional interdependencies is theoretically possible but it was dropped due to computational problems involving processing of the huge amount of spatial data for a large number of regions.

6. Domains of an RDI

Generally speaking, existing literature does not provide a definite answer to the question: which domains and what relevant variables/proxies should be selected into a synthetic/composite index measuring the overall level of economic and social development/quality of life (FAO, 2005; Jones and Riseborough, 2002; Kazana and Kazaklis, 2008; Erikson, 1993; Johansson, 2002; Grasso and Canova, 2007). In international comparison studies some consensus was achieved concerning the inclusion of specific domains into such an index (the list of an index's components includes various important quality of life aspects linked to, e.g., democracy, health conditions, etc.). This suggests a high degree of universalism across different countries in what are considered as social concerns (Johansson, 2002); a similar consensus regarding the appropriate list of welfare components (quality of life domains) to be used in the analysis of regional economics appeared as problematic and difficult[30].

In order to meet relevant policy criteria (e.g. objectivity, transparency and simplicity) and ensure full data comparability across all regions in a given country (EU), we applied a direct approach in our study. This used a country's available secondary regional statistics and objectively verifiable indicators representing various aspects of quality of life rather than subjective indicators derived on the base of sporadic interviews with individuals in selected regions. The list of domains linked to various important aspects of rural development in individual regions, together with examples of indicators[31] used in our study, is shown below (see Table 5).

While all the above domains (and relevant socio-economic indicators) show different aspects of rural development and some of them are typically more crucial than others, it can be expected that any change in variables/coefficients representing these domains *ceteris paribus* will have a positive, neutral or negative impact on the overall level of rural development measured in a specific locality[32].

Following this approach, the rural development domains discussed above are represented in our study by hundreds of partial socio-economic indicators/variables (e.g. 991 variables/indicators describing various aspects of rural development at NUTS-4 level in Poland; 340 variables/indicators at NUTS-4 level in Slovakia; see: Section 7. Data). For this the constructed RDI combines all selected economic, environmental and social indicators and links them within a theoretically consistent framework.

30 In some quality of life studies representatives of individual regions had chosen indicators that were not necessarily comparable across regions but seemed most appropriate to them in the light of their own circumstances and priorities (DEFRA, 2004b).

31 The list of available regional indicators in Poland can be found under: http://www.stat.gov.pl/bdren_n/app/strona.indeks

32 Statistical verification of the magnitude and scope of contribution of individual variables/coefficients to the overall rural development (RDI) is one of the outcomes of this study.

Table 5. Overview of domains and examples of indicators/coefficients used in empirical construction of the RDI index (Poland)

Specific domains	Indicators/coefficients (examples)
Economic	Employed , by sector, per employment total; Average incomes and income distribution; entities in public and private sectors; newly registered entities; entities crossed off the register; Gross-value of fixed assets, average monthly gross wages and salaries; Sold production by sectors; Gmina's budget, own revenue total per 1000 population;
Social	Dwelling stock by type of ownership, average usable floor space per 1 person (m2); Social assistance, libraries, cinemas, museums; care homes, per 1000 population; physicians - total per 1000 population; Library collection in volumes per 1000 population; Schools (primary, lower secondary, etc.); hazards related to work; registered unemployed by age per total unemployed; Registered unemployed per total population;
Environment	Nature monuments (environmental objects) per km²; legally protected areas in ha of which: nature reserves; parks, green belts; waste management, disposal sites; sludge produced in tonnes dry mass per km²; Sewage discharged directly to waters and soil; Sewage management and water protection, Air and climate protection, particulate pollution
Demographics	Population by actual place of residence, as on 31 XII, males per population tot ; Married couples per 1000 population; Actually living population – of pre-working age total per population total ; Actually living population – of post-working age, females; Deaths by age and gender total;
Administration	Local administration units; Rural settlements per km²; Entities newly registered in section L (public administration); Expenditures for public security and fire protection from rural powiats' budgets ; Village councils; Gmina councillors by occupational status: parliamentarians, higher-ranking officials; Members of powiat boards other members per member of powiat boards total by age and education; local self-government units
Infrastructure	Electricity supply system; Gas supply system; Heat supply; Urban transport, transport lines, bus lines in km per km²; household consumption of low-voltage electricity; Roads owned by the powiats; hard surfaced roads of which improved-surface roads; Municipal infrastructure, Sale of heating energy during the year by destination

7. Data

The multi-dimensional character of the quality of life/level of development of rural areas in various countries calls for the use of objective statistical secondary data on variables/indicators reflecting various important aspects of rural development (e.g. economic, social, environmental, etc.). These should be calculated either directly for rural regions (at NUTS-4 level) or collected at NUTS-5 level and aggregated to a higher NUTS-4 level. The approach used in our study in the territorial delimitation of rural areas excludes from available data for large cities but acknowledges the importance of small towns located in rural areas as being a significant component of rural economy in most parts of Europe ("sub-poles" in rural economic and social development).

Poland: The data used for the calculation of the RDI for Poland originates from the Regional Data Bank of the Polish Statistical Office at (NUTS-4), as well as data obtained from the Ministry of Finance (e.g. distribution of personal income) and the Ministry of Interior (e.g. crimes) collected at NUTS-4 levels for the years 2002 to 2005. Of 379 NUTS-4 regions in Poland 314 rural Powiats (NUTS-4) are included in the analysis (84.2% of all NUTS4-regions), which excludes 65 big cities. The data basis for Poland covers all relevant rural development dimensions available in regional statistics at NUTS-4 level and consists of 991 coefficients/indicators collected/calculated either directly at NUTS-4 level or aggregated from NUTS-5 (approximately 2500 Polish gminas) levels into NUTS-4 level.

Slovakia: The database for Slovakia originates from the Slovak Statistical Office whereby 337 indicators/variables collected at 72 regions (NUTS-4) are used for the construction of the RDI.

In both countries data cleaning was performed using linear interpolation if less than 10% data were missing, whereas the expectation-maximization method (EM) was applied if data for one whole year was missing. EM estimates the means, the covariance matrix, and the correlation of quantitative variables with missing values, using an iterative process. Overall, imputations were done for approximately 2-3% of variables.

8. Results

8.1. Factor Analyses

In both Poland and Slovakia the number of variables characterizing individual rural regions was large and various regional indicators/coefficients were expected to be linearly dependent. Therefor at the first stage the factor analyses (principles components) was carried out with the main objectives of:

- Reducing the database necessary for computation of the RDI (explaining variability among observed random variables describing various aspects of rural development in terms of fewer unobserved random variables called factors), and

- Detecting data structure that would allow a clear interpretation of obtained results.

The application of a principle component method was favoured because in addition to data reduction it provides a unique solution, so that the original data can be reconstructed from the results[33]. The principal components are normalized linear functions of the indicator variables and they are mutually orthogonal. The first principal component accounts for the largest proportion of the total variation of all indicator variables. The second principal component accounts for the second largest and so on. To obtain interpretable results the solution was rotated using the Varimax technique (the method minimizes the number of variables with high factor loading values). The resulting structure of factor-loadings comprises information about the impact of single variables on each extracted factor. While both the size as well as the quantity are of importance, rotated loadings were sorted by size. In this way patterns of similarity between individual items (coefficients/variables/indicators) that load on a given factor became straightforward.

The number of retained factors in Slovakia was determined using Kaiser criterion (only factors with eigenvalues greater than 1 were retained). In contrast to this procedure, the final number of selected factors in Poland was determined in an iterative procedure by selecting the number of factors that maximized the restricted likelihood function used in Model 4b as the convergence criterion. As an outcome of factor analysis (2002-2005) 337 original variables/indicators in 72 Slovak NUTS-4 regions were converted into 21 factors characterising various aspects (domains) of rural/regional development in Slovakia, and 991 variables/coefficients in 314 rural NUTS-4 regions were converted into 17 factors in Poland. Estimated factor values in both countries are region and time specific. For each region and year, estimated factor values were z-normalized thus indicating a relative position of a given region (in their respective country) in comparison to a country's average (years 2002-2005). Positive factor values reflect a positive deviation from a country's average (for a given domain); negative values mean the opposite. Tables 1a (Poland) and 1b (Slovakia) (Annex) show the respective labelling patterns of factor domains drawing on the major loading components (irrespective of the size of individual loadings).

8.2. Estimated migration functions and model selection

An econometric estimation of weights in the RDI was carried out separately in both countries on the basis of eq. 7. In the case of Slovakia, migration Models 1-4 were estimated using data on 72 individual NUTS-4 regions

33 This has important empirical implications, if an RDI is used in the evaluation of RD policies (Michalek, 2007).

over years 2002-2005. Starting from the simplest specification, i.e. Model 1, a net-migration pooled average data model was estimated in two versions: Version (a) as a random effect model using 288 (72 groups x 4 years) observations and applying a maximum likelihood estimator (random effects ML regression); and Version (b) as a panel random effect model applying a GLS estimator (random effects GLS regression). Results of the Model 1 estimation (Versions a and b) are provided in Table 2 (Annex).

In order to learn about spatial features of data, estimated Model 1 was tested for possible spatial dependencies (using Friedman, Pesaran and Free's statistical tests of cross sectional independences). Testing global spatial autocorrelation of regional characteristics (i.e. net migration rates and factors) was carried out using a) Moran's, b) Geary's, and c) Getis and Ord's statistical criteria after the construction of appropriate contiguity matrices (converting non-standardized into standardized ones). In the next step a net-migration pooled average data spatial dependence model (Model 2) was estimated applying a spatial econometrics approach in three versions: Version 2a (i.e. SAR (Spatial Autoregressive Model); Version 2b SEM (Spatial Error Model); and Version 2c GSAR (General Spatial Model). This accounts for the possibility of a spatial dependence between individual regions (with a net-migration vector as a dependent variable, extracted factors representing explanatory variables matrix and a standardized contiguity matrix). The results of the Model 2 estimations are provided in Tab 2 (Annex).

Model 3 assumes that net-migration flows between each pair of regions depend both on regional differences between respective characteristics Z observable by individual migrants as well as transaction costs (D) of moving from one region to another. Econometric estimation of a migration model (Model 3) was carried out on the basis of pair-wise observations on net-migration flows between each region i and j over the years 2002-2005 (with 71 x 72 x 4/2 = 10224 data observations). Model 3 was estimated as a multi-level mixed effect or nested error component regression model using a restricted maximum likelihood (REML) estimator. Results of Model 3 estimations are provided in Table 2 (Annex).

Model 4 differs from Model 3 as it replaces net-migration flows between regions ij with gross migration inflows. As all observable migration inflows between regions are either zero or positive, Model 4 was estimated as a logistic function[34] reflecting a probability distribution of migration from one region to another (71 x 72 x 4 = 20.448 data observations in Slovakia, and 313 x 314 x 4 = 393.128 data observations in Poland). Model 4 was estimated in two versions: Version 4a as a panel regression that allows between, fixed or random effect model specification (estimated as a random effects linear regression model with a group variable at the level of ID [GLS regression estimate]), and version 4b as a multi-level mixed-effect regression model (mixed-effects REML regression) that also allows for the possibility of the nested error structure within a region i. The results of an econometric estimation of both versions of Model 4 are shown in Table 2 (Annex).

A comparison of the RDIs calculated for Slovakia on the basis of the above models (1-4) shows that, depending on the model's structure and specification of the error term, the results (e.g. ranking of the regions) may differ considerably[35] (the latter especially apply to the ranking of regions included in 2nd and 3rd quartiles). Though each of the models (1-4) was estimated using similar data (consistent database) only few versions of the above models were nested in each other. For the same reason standard selection techniques based on a max likelihood ratio test statistics or other statistical

34 In order to ensure positivity of the log function, values of migration equal to 0 was replaced with the value 0.00000001.

35 This does not apply to Models 4a and 4b which, in their final version show similar results (due to the reduction of nesting terms to only one level (ID).

selection procedures were not applied here. Instead, the "best" model was chosen on the basis of qualitative assessments of pros and cons linked to each of the models. Given the advantages of Model 4 this approach[36] was selected as a basis for the derivation of weights and applied to the construction of the RDI in both countries.

8.3. Estimation results of the selected model (Model 4)

The estimation results of Model 4b for Slovakia and Poland are presented in Table 2 (Annex 1). In Slovakia approximately 67% and in Poland approximately 75% of estimated coefficients are significant at the 0.01-0.05 level. In both Slovakia and Poland approximately half the extracted factors were found to contribute positively to in-migration and thus to the RDI.

Concerning the sign and magnitude of coefficients representing the contribution of individual rural development domains (factors) to the overall RDI, the respective values in Slovakia ranged from the highest +0.121 (factor f4, i.e. agriculture and natural endowment) to the lowest -0.107 (factor f2, i.e. availability of social services and technical infrastructure, per capita). In Poland the respective values ranged from the highest +0.086 (factor 4, i.e. high income groups and availability of dwellings) to the lowest -0.015 (factor 11, i.e. energy sector and specific deaths structure)[37]. Obviously, due to the "artificiality" of estimated factors and problems with their exact interpretation, one has to be cautious when applying these measures to the analysis of rural development of individual areas[38]. Nevertheless, signs and magnitude of coefficients assigned to individual factors can provide some valuable insights regarding the identification of basic trends and showing contributions of broadly-defined rural development domains to the overall development and quality of life in analysed regions.

Among factors (RD domains) found to positively affect the quality of life in rural areas in Slovakia, the most important appeared to be: agriculture and natural endowment (f4), availability of public facilities (f13), and social and living environment (f3). Among those found to contribute negatively to the overall quality of life in rural regions of Slovakia, the most important were: low spatial availability of social and technical infrastructure (high value of coefficients calculated on per capita basis (f2); high endowments with special schools (f10); and high endowment with vocational secondary schools (f8) (see Table 5a).

In Poland, among the factors positively influencing the overall quality of life the most important were: the percentage share of high income population and availability of dwellings (f4); structure of population (f6); and natural population growth (f12). Factors exhibiting particular negative impacts on the quality of life index were: heating energy sectors and structure of deaths (f11), structure of employment and work hazard (f10); and subsidies and social expenditures (f5) (see Table 5b).

Concerning the impact of transaction costs on migration, both coefficients (dist and dist2) included in the estimated migration models (Model 4b) in Slovakia and Poland have expected signs and are highly significant (at 0.01 level). This empirical outcome confirms a general opinion that the probability of migration between regions decreases along with an increase of a distance between regions (albeit at a diminishing rate).

An overview of the estimated coefficients and their values in both countries is presented in Figure 2 (Annex) (sorted by size and a significance level).

36 Further methodological improvements, e.g. linking of Model 4 with spatial econometrics may, due to a large number of regions, led to problems with data processing (e.g. estimation of W-matrix under a General Spatial Model).

37 We note however, that contextual interpretation of individual factors in both countries differs.

38 Factorization is used as an important vehicle enabling derivation of social weights for individual attributes Vi characterizing various aspects of rural development.

Table 5a. Slovakia: Social weights of individual rural development components (2002-2005)

Factor	Rural development component	Estimated social weight
f4	Agriculture and natural endowment	0.121
f13	Public facilities	0.114
f3	Social conditions and living environment (incl. availability of dwelling)	0.096
f14	Availability of retail infrastructure (per capita)	0.076
f1	Spatial density of social and retail infrastructure (per km²)	0.048
f6	Spatial density of public utilities and social infrastructure: gas pipelines, water-supply-system (per km²)	0.044
f21	Policlinics, grammar schools, sport grounds	0.038
f12	Accommodation endowment	0.036
f16	Primary schools	0.031
f15	Social facilities	0.031
f17	Houses of social services	0.028
f5	Availability of young people's infrastructure (per capita)	0.015
f9	Recreation facilities	0.014
f18	Basic schools of art, etc.	0.003
f11	Availability of social facilities (per capita)	-0.0002
f20	High-standard tourist accommodations <negative loadings!>	-0.009
f7	Density and structure of enterprises	-0.009
f19	Density of specialized state secondary schools	-0.016
f8	Density of vocational secondary schools	-0.053
f10	Endowment with special schools	-0.081
f2	Availability of social services and technical infrastructure (per capita)	-0.107

Table 5b. Poland: Social weights of individual rural development components (2002-2005)

Factors	Rural development component	Estimated social weights
F4	Highest income groups and housing availability	0.0865912
F6	Population structure	0.0386539
F12	Natural population growth	0.0212287
F1	Employment by sectors	0.0153122
F16	Structure of local budgets	0.0069754
F15	Social sector and its financing	0.0053761
F8	Gas supply system	0.0038934
F9	Tourist sector, newly registered companies	0.0033851
F13	Public administration and social infrastructure	0.0007278
F14	Unemployment structure and dwelling equipment	-0.000968
F7	Industrialization, investments and fixed assets	-0.0045909
F3	Population density and urbanisation	-0.0057717
F17	Environmental pollution and infrastructure	-0.0061922
F2	Lowest income groups and structure of own budgetary resources	-0.0063749
F5	Subsidies and social expenditures	-0.0072237
F10	Employment conditions and work hazard	-0.007454
F11	Heating energy sector <pollution> and deaths	-0.0147941

8.4. Individual components of the RDI

8.4.1. Ranking the importance of regional variables

Information about the relative importance of partial coefficients/variables describing various aspects of rural development in a given country was obtained on the basis of eq. 7b, i.e. by merging results of factor analysis (factor loadings of each of variable/coefficient in a respective factor) with model estimation results (estimated RDI weights for each factor). The weighted average calculated for each regional variable (the specific attribute of rural development) was used to rank all 991 individual coefficients in Poland and 337 regional coefficients in Slovakia with regard to their relative contribution to quality of life and rural development in both countries. Results of this ranking are shown in Table 1c and Table 1d (Annex).

Among the **top 10** groups of variables/ coefficients **positively** contributing to quality of life in rural regions in Poland the most important were those associated with:

- Personal income (highest income group; social weight = 0.07);
- Availability and quality of new residential buildings (social weight = 0.06/0.07);
- Access to selected technical infrastructure, e.g. gas consumption from gas-line system per capita (social weight = 0.05/0.06);
- The share (high) of the private sector in the service sector (social weight = 0.05/0.06);
- Spatial accessibility of rural population to rural enterprises (social weight = 0.05)

In Slovakia, the most important variables/ coefficients **positively** contributing to local rural development were those associated with:

- Population structure (e.g. high share of population at a productive age within the total population) (social weight = 0.17/0.18)
- The share (high) of private enterprises and natural persons in total legal units (social weight = 0.17)
- Level of consumption (high), e.g. municipal waste disposal per capita (social weight = 0.16)
- Spatial access of rural population to social infrastructure, e.g. swimming pools, sport stadia, telephone lines, post offices, local communication, etc., per km² (social weight = 0.1/0.12)
- The structure of local business; share (high) of enterprises in areas: financial mediation, real estate, rental and business activities in total enterprises (social weight = 0.12)
- Variables/coefficients associated with favourable climate and nature, e.g. high share of vineyard in agricultural land (social weight = 0.10)

Among the 10 variables/coefficients that had a particularly **negative** impact on the quality of life and rural development, the most important in Poland were those associated with:

- Low personal income (low income groups; social weight = - 0.07)
- The high ratio of the public sector in the service sector (social weight = - 0.06)
- Disproportion in the gender structure of the rural population, e.g. over-proportional share of male of working age (=> low share of females of working age) (social weight = - 0.04)
- The share (high) of legal units in the public administration and security sectors (social weight = - 0.04)

- The share (high) of young unemployed (25-34 years) of the total registered unemployed (social weight = - 0.04)

- Level of subsidies received at gmina level (NUTS-5) (social weight = - 0.03). Yet, the latter may also merely represent society's response to a low development level in the regions.

Respective variables/coefficients that were particularly **negatively** associated with the quality of life and the level of rural development in Slovakia were those associated with:

- The over-proportional share of NGOs, contributory organisations, other non-profit organisations in the structure of legal units registered in a given region (weight = - 0.17). Yet, this variable (along with a number of other response variables, e.g. a high percentage of social expenditures) may merely represent the policy**'s response** to a low local development level.

- The share (high) of women among unemployed persons (weight = - 0.16)

- The share (high) of urban territory in the total area of municipality (weight = - 0.13)

- The share (high) agricultural units in total number of legal subjects registered on a given territory (weight = - 0.12)

- The share (high) of cooperatives in total enterprises (weight = - 0.12)

Beyond these two extreme groups a third group of variables/coefficients was found to have a **neutral** impact on rural development (weight equal to approximately zero). In Poland these were, for example: variables showing a high share of commercial companies in the public sector; coefficients showing a high share of overnight stays of foreign tourists in total overnights; variables showing a high share of publicly-owned entities in sectors: G (trade and retail) I (transport and communication) and H (hotels and restaurants). Among the respective "neutral" variables in Slovakia there were: the number of tax offices per capita; number of secondary school-children per school; number of cable TV per capita, etc.

While the above results seem plausible they show also that an assessment of the level of rural development using partial *per capita* indicators only (used as a measure of the level of regions development) may be highly misleading. Indeed, the results of this study prove that many *per capita* indicators (theoretically, they show a high availability of social and infrastructural goods/services) may merely reflect a low density of rural population in those regions thus ignoring the important aspect of *spatial accessibility* to these goods/services.

8.4.2. Ranking importance of RD domains

In order to assess the relative importance of various rural development domains, all partial coefficients/variables describing various aspects of rural development were subdivided[39] into six main groupings/domains:

- Economic (292 variables in Poland; 102 variables in Slovakia)

- Social (337 variables in Poland; 187 variables in Slovakia)

- Environmental (199 variables in Poland; 20 variables in Slovakia)

- Demographic (70 variables in Poland; 13 variables in Slovakia)

- Administrative (122 variables in Poland; 13 variables in Slovakia)

39 In a few cases individual partial coefficients were allocated to more than one RD domain (e.g. expenditures for public utilities and environment were allocated to both environmental as well as infrastructural domains).

- Infrastructural (69 variables in Poland; 19 variables in Slovakia)

Given information on number and an individual importance (social weight) of variables entering a particular RD domain, the social weight of each RD domain was calculated as a sum of all weights (for variables included into specific RD domain) divided by the number of variables in each entry. Naturally, the more variables are included into specific RD domains the more objective (and comparable) is the weight for this specific domain. Obtained valuations of RD domains are presented in Table 5c (Poland) and 5d (Slovakia).

The results of the above rankings show that the social valuation of various RD domains generally depends on a specific society's preferences (which may be unique for a given country and period). Interesting is the high value assigned to demographic and social characteristics (Poland) and environmental and infrastructural variables (in Slovakia), and a relatively low value assigned to administrative variables characterising rural regions in both countries. Yet, as the above ranking system depends exclusively on availability of individual partial variables describing various aspects of RD, the exclusion of important individual variables (with high social weight) from an analysis may considerably bias obtained results.

Tab 5c. Poland: Significance of individual RD domains

RD domain	Relative weight	Partial variables	
		Highest weight (+)	Lowest weight (-)
Demographic	1	% of females of age 30-39 in total population; actually living population in age 30-39 in total population;	% males in population of working age; % of post-working age in total population;
Social	0.56	New residential buildings (usable floor space of dwelling units per km²); new single family residential buildings;	Library collection in volumes per 1000 population; registered unemployed by age (25-34 years) per total unemployed; Registered unemployed per total population;
Infrastructural	0.55	Gas consumption from gas-line system; electricity consumption per capita; % of local (gmina) expenditures for public utilities and environment in total expenditures;	% of wages in local (gmina) expenditures; % public entities in expenditures for public utilities; length of water supply system per capita;
Economic	0.53	% of taxpayers group 3 (the highest income group) in taxpayers total; % of private sector in service sector;	% of taxpayers group 1 (the lowest income group) in taxpayers total; % of public sector in service sector;
Environmental	0.28	Nature monuments (environmental spectaculars) per km²; sludge produced in tonnes dry mass per km²;	% of biological treatment plants per municipal facilities total; total number of treatment plants per 1000 population;
Administrative	0.07	% of councillors with tertiary education level; % councillors of age 25-29 in total councillors;	Local self-government units per 1000 population; organisational entities controlled by powiat government;

Tab 5d. Slovakia: Significance of individual RD domains

RD domain	Relative weight	Partial variables	
		Highest weight (+)	Lowest weight (-)
Environmental	1	Municipal waste in tonnes per capita; % of households in consumption of drinking water; % parks in communal verdure	% of permanent pastures in agricultural land; presence of public sewage system;
Infrastructural	0.88	% of residential telephone lines; local communication lines per km²	Telephone lines per capita; cable TV per capita
Economic	0.83	% enterprises in total legal units; % of real estates, rental and business activities in total number of economic subjects	% of non-profit organisations in total legal units; % of agriculture, hunting and fishery in total legal units; % fo cooperatives in total legal units
Demographic	0.49	% population in productive age; population growth;	Deaths till 1 year per 1000 life-births; deaths till 28 days per 1000 life-births
Social	0.31	Sport stadiums per km²; swimming pools per km²;	% of unemployed women in total unemployed persons; primary schools per capita
Administrative	-0.39	Post offices per km²; central bodies of state administration per capita	% urban territory in municipality area; % of public administration, defence, etc. in total subjects

8.4.3. Fractions

The main individual components of an estimated RDI (eq. 7) are the so-called "fractions" calculated (for each country, regional unit, and year) as a product of z-standardized factor's value and its respective weight (from Model 4). Obviously, positive fractions (i.e. positive contribution of a given factor to the overall level of regional development) are obtained for all regions over-proportionally endowed with factors that display positive weights. In case a factor displays a negative weight (i.e. an increase of this factor leads to diminution of the quality of life) an under-proportional endowment of a given region with this particular factor (negative standardized factor's value) results also in a positive term (positive contribution to the RDI). On the other hand, under-proportional factor endowment with factors with positive weights results in negative fractions (negative contribution to rural development). The same applies to an over-proportional endowment of a region with factors exhibiting negative weights (i.e. negative term).

Among the most important "fractions" improving the quality of life in rural regions in Slovakia (country average) in year 2002 were: T4 (more intensive agriculture compared with a country's average) and T12 (higher than average density of accommodation facilities). On the other hand, domains that to a large extent negatively affected the quality of life in rural regions in Slovakia were: T7 (high share of public enterprises), T14 (low availability of retail infrastructure) and T8 (over-endowment with vocational secondary schools). The importance of particular fractions regarding their impact on the rural development changed slightly between the years 2002 and 2005. In 2005 the most important fractions which positively contributed to quality of life in rural regions in Slovakia (country average) appeared to be: T16 (over-proportional endowment with primary schools), T8 (under-proportional endowment with vocational secondary schools) and T7 (improved structure of private and public sectors). The negative ones included: T4 (less developed agriculture), T15 (underdeveloped social facilities) and T12 (e.g. underdeveloped accommodation endowment).

In Poland, the most important fractions positively contributing to the local development level (country average) in 2005 were: T12 (natural population growth, high share of population of pre-working age); T4 (highest income groups and housing availability); T6 (Population's structure, high percentage of population in productive age). Among the most disadvantageous ones (country average) in 2005 were: T11 (energy sectors and deaths, an over-proportionally high share of male deaths; extensive agriculture with a high share of pasture land; high exposure to industry, e.g. heat supply, energy sales, etc.), T16 (structure of local budget, lower than average expenditures from rural poviats' budget on investment, properties, communication and transport; lower than average share of newly registered entities in total public sector), and T2 (lowest income groups and own budgetary resources, high share of local budget revenues from personal income tax in total local budget revenues; high share of local budget expenditures on health care; high level of appropriated budget allocations from the national budget[40]).

The distribution of fractions calculated in both countries at regional level (i.e. major contributors to the overall quality of life and rural development in individual rural areas) is shown in Figures 2a and 2b (Annex).

8.5. Rural Development Index

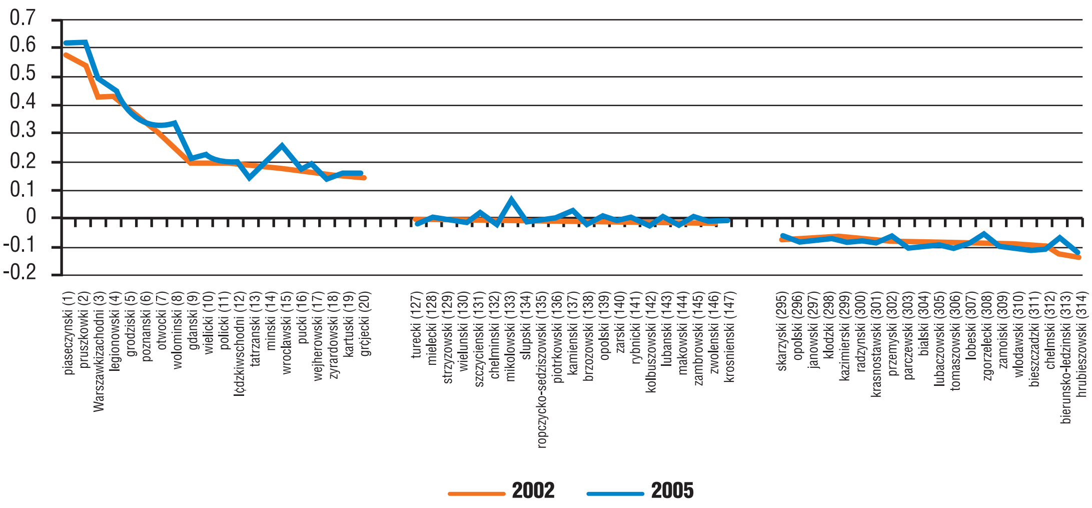
8.5.1. Poland

8.5.1.1. Ranking of regions

The RDI in Poland involving 991 regional indicators was calculated according to eq. 7 as the sum of 17 fractions (i.e. term = product of a given factor's value and respective coefficient from the estimated migration function using Model 4). The distribution of the RDI by NUTS-4 regions in years 2002-2005 is shown in Figure 1 (below).

During the years 2002-2005 the estimated value of the RDI in Poland ranged between -0.13 and 0.57 (in 2002) and from -0.11 to 0.62 (in 2005), i.e. regional disparity *between*

Figure 1. Poland: Ranking of regions. RDI Index by regions (NUTS-4, 314 regions)



40 These may have occurred as a policy response to a low local development level.

extreme regions **increased** (the RDI range increased by 0.03 points). In the majority of regions (46.5%) the level of rural development between 2002-2005 was similar to a country's average (RDI varied between -0.03 and 0.03). Although 31.5% of all rural regions can be characterised as better or well developed (RDI was higher than 0.03) 22.6% of all rural regions in Poland can be qualified as less or least developed (RDI lower than -0.03). As expected, the highest values of an RDI (higher than 0.18) were found in the rural suburb areas of big cities Warsaw, Poznan, and Gdansk. This confirms a thesis of a strong positive influence of economically and socially most developed urban regions (cities) on the development of neighbouring rural areas. On the other hand the lowest RDIs (lower than – 0.08) were found in remote regions situated in south-eastern Poland, i.e. hrubieszowski (border with Ukraine), bierunsko-ledzinski (post heavy industrial complex in south Poland), chelmski (border with Ukraine), bieszczadzki (remote region bordered to Ukraine and Slovakia) for details see Table 1 in the Annex).

8.5.1.2. Statistical distribution of RDI

The geographical distribution of the RDI in Poland (average of 2002 and 2005) is shown in Figure 2 (below). Our results confirm a clear typological division of Poland based on the performance of individual regions into a good performing western and central part, and a badly performing eastern part (north-eastern and south-eastern), and back up a general opinion that the suburbs of biggest cities (e.g. Warsaw, Poznan, Gdansk, Wroclaw, Lodz, Krakow) exhibit the highest quality of life (see Figure 2).

The statistical distribution of the average RDI in Poland is shown in Figure 3 (histogram).

The statistical analysis of the RDI (Figure 3) shows that 314 rural regions in Poland were **not** normally distributed regarding their development level. The tails of the distribution were non-symmetrical (i.e. gamma distributed), with a higher number of very **well** performing regions (31 regions with RDI>0.1 in 2002) compared with only few extreme *badly* performing regions

Figure 2. Poland: Average RDI (by regions and years 2002-2005)

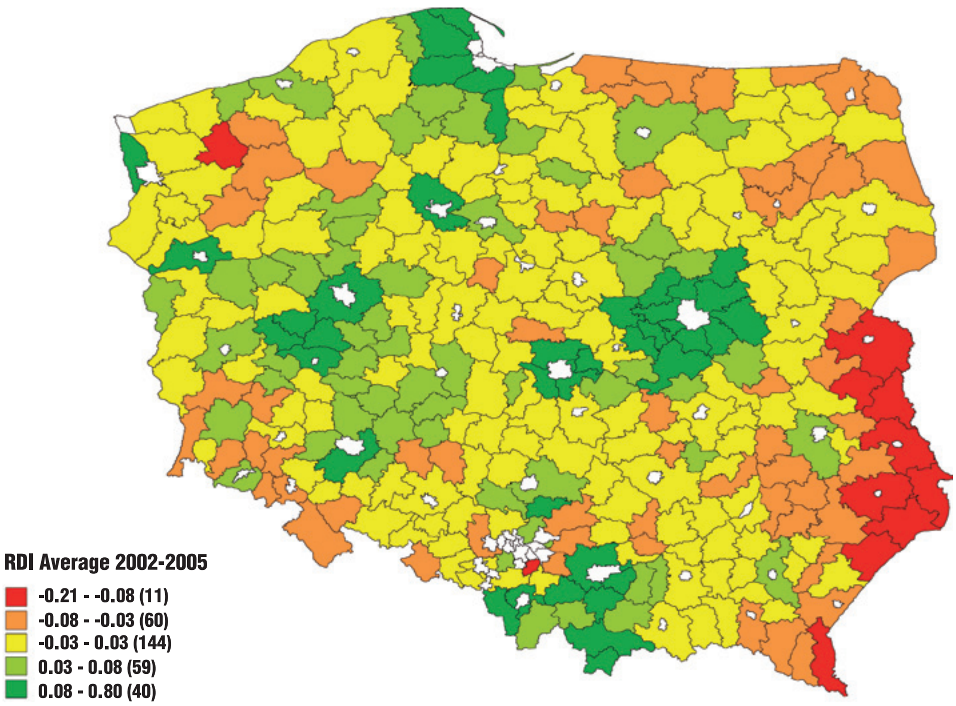


Figure 3. Poland: Distribution of the average RDI: 2002-2005 (Histogram)

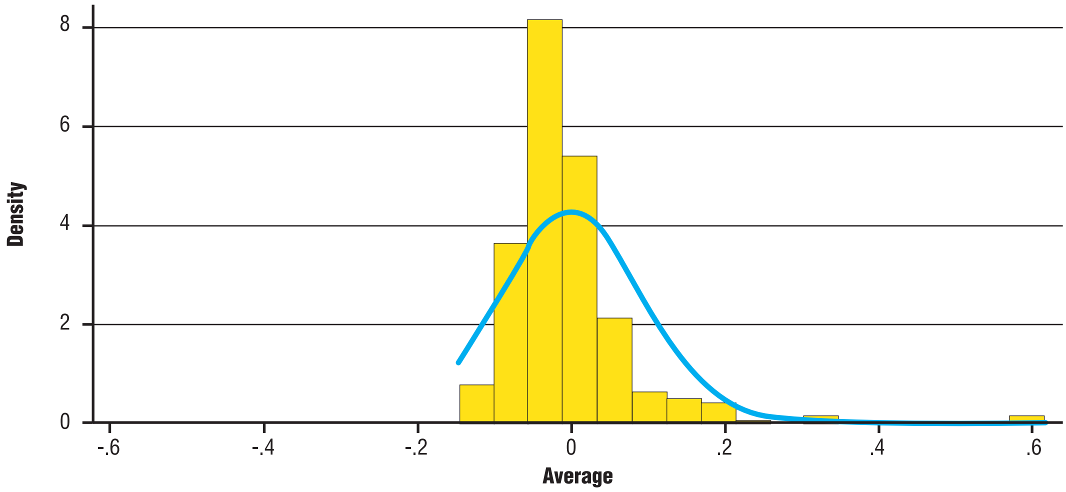
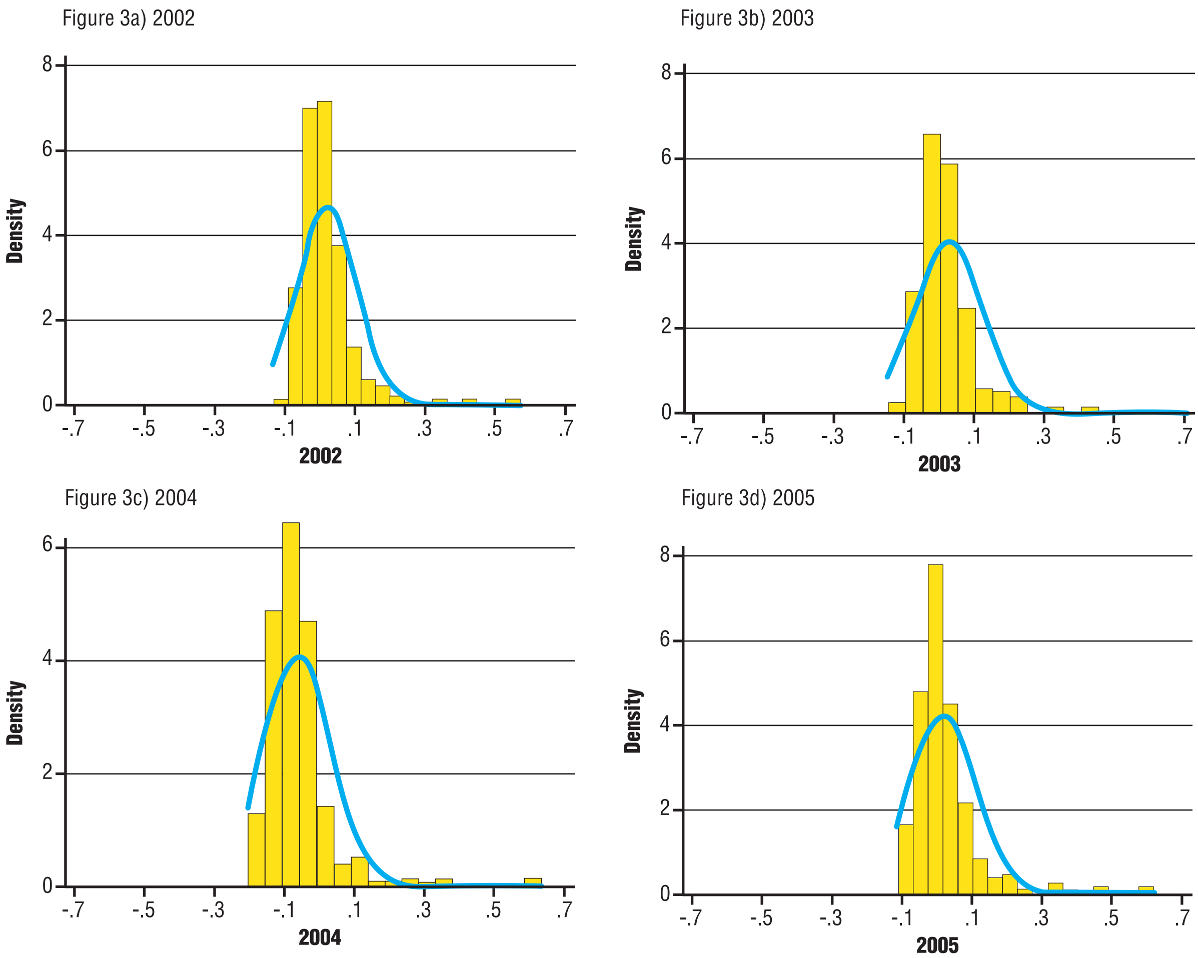


Figure 3a-3d. Poland: RDI-Value-Distribution: Histograms of 2002-2005

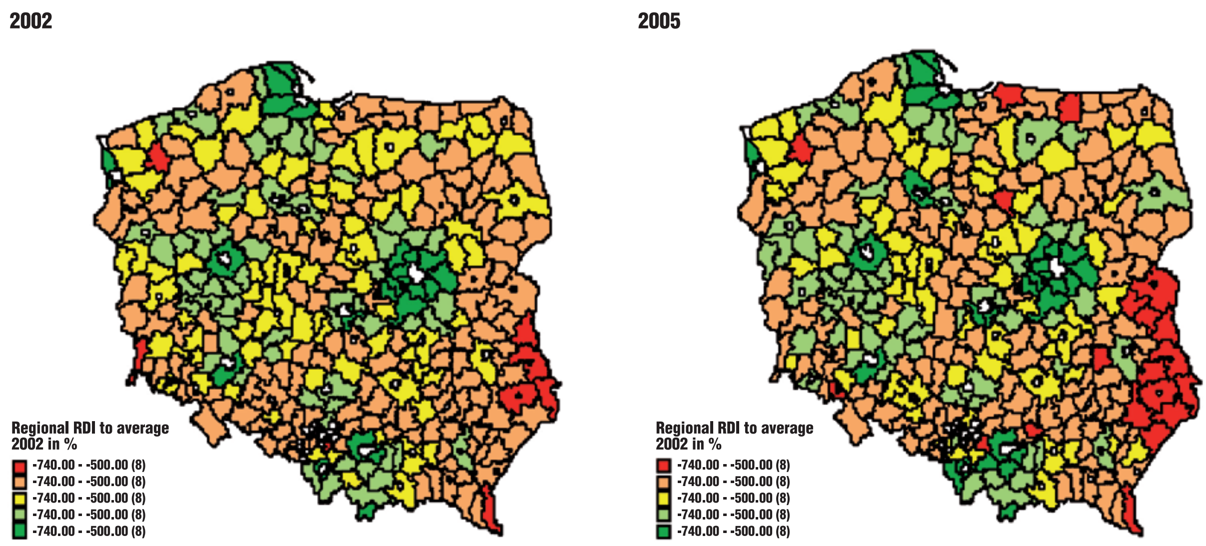


(2 regions with RDI< - 0.1 in 2002). During 2002-2005 this trend weakened somewhat (i.e. 32 regions exhibited RDI>0.1 in 2005 compared with 4 regions with RDI < - 0.1). Changes in distribution of the RDI over the years 2002-2005 are shown in Figures 3a-3d.

8.5.1.3. Regional disparities

With regard to the level of regional disparities our analysis shows that in Poland, these are extremely large and especially concern the best developed regions. Indeed, the estimated level of quality of life in the best developed regions in Poland (i.e. suburbs of the biggest cities) measured in terms of the RDI was in 2005, approximately 17-34 times higher than the country average. The quality of life index in the less-developed regions (i.e. South-east Poland) was "only" 6-7 times lower compared to the country average (see Table 5 and Figure 4).

Figure 4. Poland: Ratios of region specific RDI to an average RDI (years 2002 and 2005) in %



8.5.1.4. Dynamics in spatial inequalities

During the years 2002-2005 the estimated mean value of the RDI in Poland for 314 rural regions dropped slightly from 0.020 (2002) to 0.018 (2005) showing some fluctuation over the years. During the same period, the number of powiats with negative RDIs (i.e. those below the average level of development) increased from 154 (2002) to 160 (2005) and those with a positive RDI (above the country average) decreased respectively. In the same period the overall level of rural development in 135 regions improved, but it deteriorated in another 179 regions (Figure 5). The majority of regions which improved their absolute level of RDI were located in west- and south-western Poland; those where the quality of life deteriorated were in north-east and eastern Poland.

The regional inequality pattern observed in 2002 strengthened over the next years. The quality of life in the best developed regions of rural Poland further improved (absolutely and relatively compared to the country average) whereby in less developed regions the quality of life deteriorated (both in absolute and relative terms).

The analysis of dynamics in spatial inequality of rural regions in Poland shows that the level of regional disparities increased strongly between 2002 and 2003 (i.e. the RDI range grew from 0.703 to 0.851; variance increased from 0.007 to 0.010), and then dropped in years 2004 and 2005 (see Table 6). Over the whole period 2002-2005 regional disparities measured in terms of the RDI increased slightly (i.e. RDI range grew from 0.703 to 0.734; variance of the RDI increased from 0.007 to 0.009). Yet, the progressive regional divergence that occurred between 2002 and 2003 stopped in 2004 (i.e.

Figure 5. Change of RDI in 2005 in comparison to 2002 (absolute values)

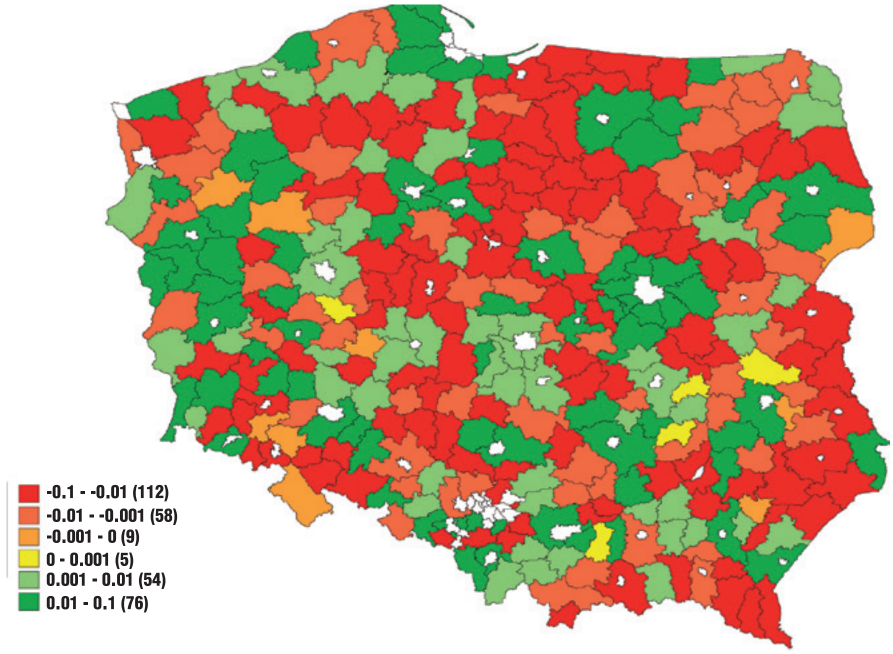
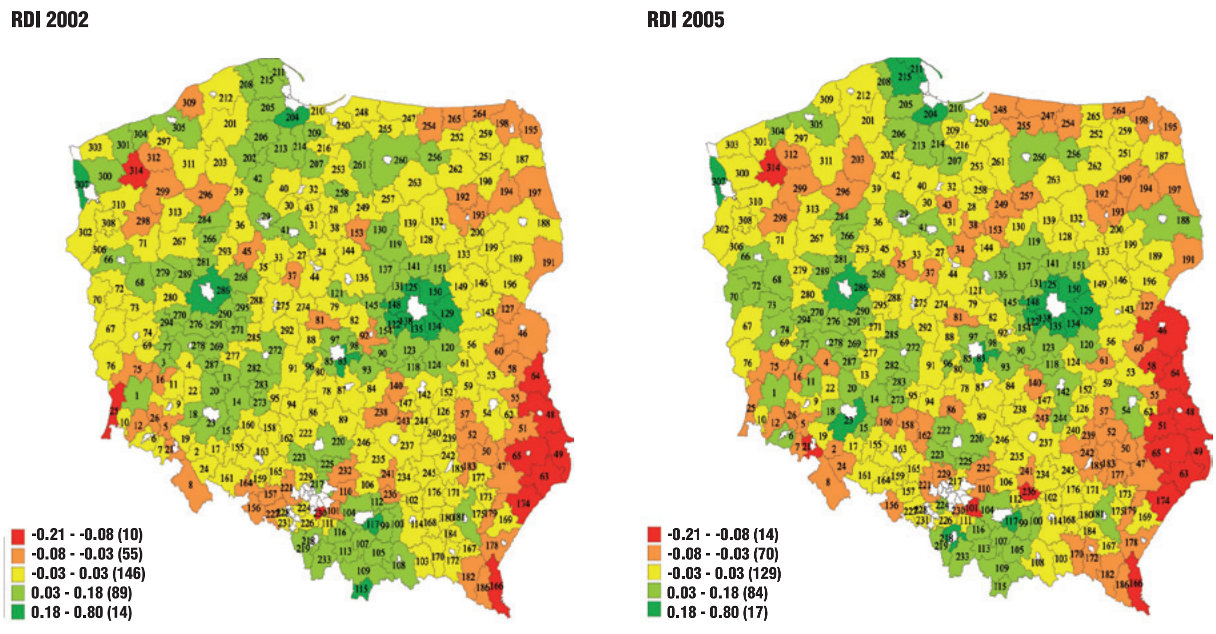


Figure 6. Poland: Distribution of the RDI by NUTS-4 (2002-2005)



during 2004 and 2005 the absolute value of the RDI increased from -0.065 to 0.018, while variance remained unchanged), *inter alia* due to effect of EU accession. The above figures support

Table 6. Poland: RDI Index (2002-2005), Descriptive Statistics

Year	Min	Max	Range	Mean	Median	Variance	Skewness	Kurtosis	Shapiro-Wilk* Prob>z
2002	-0.131	0.572	0.703	0.020	0.002	0.007	2.945	16.090	0
2003	-0.147	0.704	0.851	0.026	0.005	0.010	3.092	17.269	0
2004	-0.207	0.627	0.834	-0.065	-0.083	0.009	3.314	19.935	0
2005	-0.114	0.620	0.734	0.018	-0.001	0.009	3.025	16.472	0
Average	-0.146	0.615	0.761	0.000	-0.019	0.009	3.149	17.679	0

* *Shapiro-Wilk W test performs a test for normality; the hypothesis that RDI in the years 2002-2005 is normally distributed can be rejected.*

an opinion about the positive effect of Poland's EU accession on the level of rural development.

8.5.1.5. Stability of rural development

The stability of rural development over time was measured using the Pearson-Correlation coefficient matrix (higher values stand for higher stability), the Euclidean-Distance matrix (lower values stand for a higher stability over time) and quartile stability matrices.

8.5.1.5.1. Similarity-/ dissimilarity matrices

The similarity-/ dissimilarity matrices (Tables 7 and 8) show that the highest level of stability in rural development occurred between the years 2004 and 2005, while the highest instability (here: growth)

Table 7. Poland: Similarity-Matrix: RDIs 2002-2005

	Pearson-Correlation of RDI-values			
	2002	2003	2004	2005
2002	1			
2003	0.977	1		
2004	0.974	0.973	1	
2005	0.974	0.978	0.980	1

Table 8. Poland: Dissimilarity-Matrix: RDIs 2002-2005

	Euclidian-Distance of RDI-values			
	2002	2003	2004	2005
2002	0			
2003	0.430	0		
2004	1.569	1.661	0	
2005	0.397	0.391	1.509	0

took place shortly *before* Poland's accession to the EU, i.e. between the years 2003 and 2004.

8.5.1.5.2. Quartile-Stability

More detailed information about the scale of instability can be obtained on the basis of regions' quartile stability matrices. In this approach 314 regions in Poland were subdivided into four equal groups – quartiles, comprising of 78 (79) regions in each case and year, whereby in each year the 1st quartile consisted of the most developed regions (highest RDI) and the 4th quartile included the least developed regions (lowest RDI), see Figure 7a-7d. The stability of each grouping was analysed in two steps: firstly by counting the number of regions changing their position between groups over time (2002-2005) with reference to origin and destination quartile; secondly by investigation of the number of regions changing the group in each observed year.

The quartiles development matrix (Table 9) shows that in the period 2002-2005 as many as 96 (31% of all) regions changed their group-membership (in both directions, i.e. positive and negative). The highest number of changes took place in the 3rd quartile (second worst regions in

Figure 7a-d. Poland: RDI-Quartiles 2002-2005

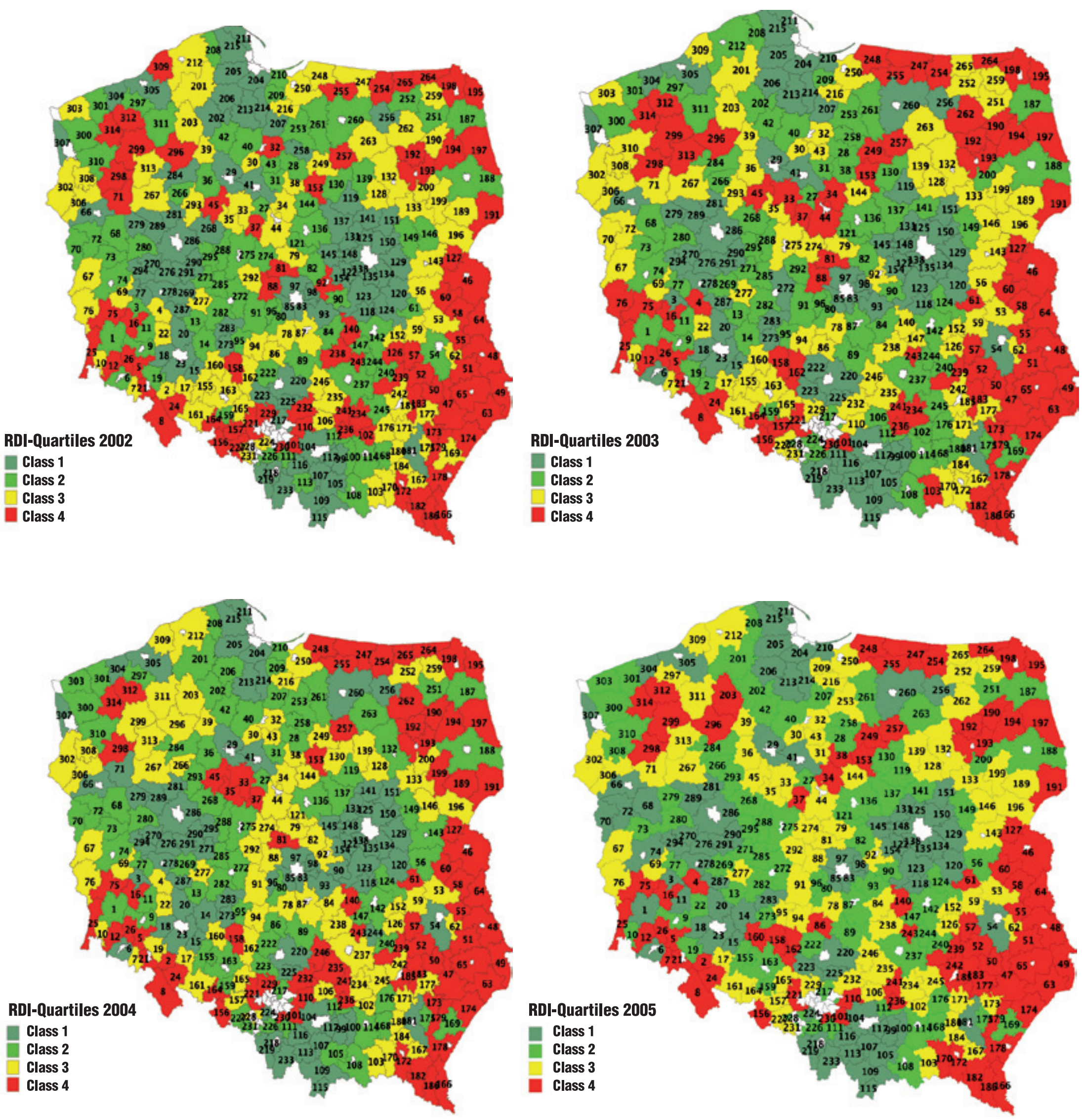
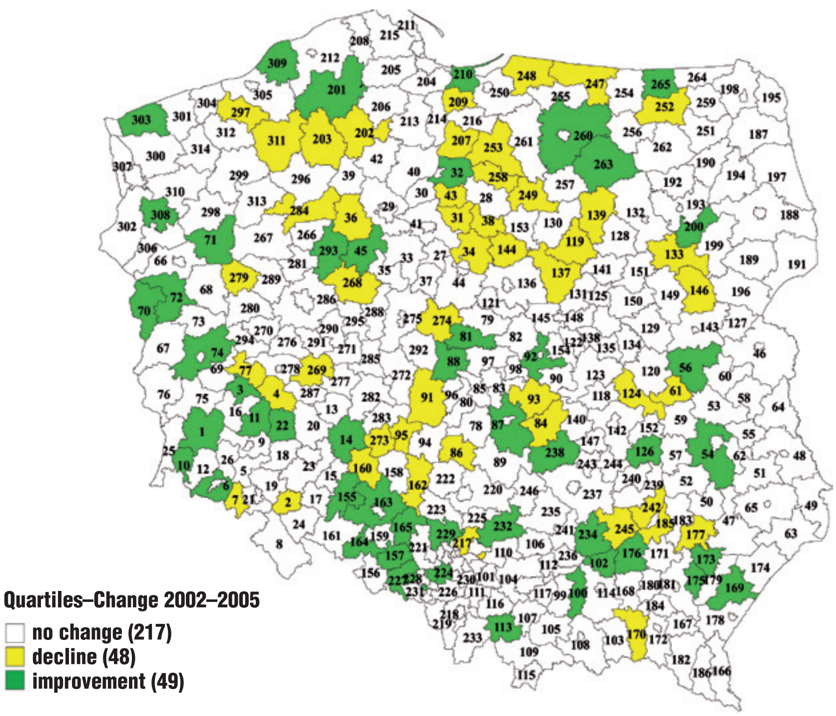


Table 9. Poland: Development-Matrix of Quartiles: 2002-2005

		Origin			
		Quartile 1	Quartile 2	Quartile 3	Quartile 4
Destination	Quartile 1	0	14	0	0
	Quartile 2	15	0	17	0
	Quartile 3	0	16	0	18
	Quartile 4	0	1	16	0

Figure 8. Poland Quartiles-Change 2002-2005



terms of RDI) followed by the 2nd (second best). In the 4th quartile group (the worst regions) 18 regions (23%) improved their position. At the same time 15 regions (19%) from the 1st quartile (the best developed group) dropped to the lower group. The most stable were regions included in quartiles 1 and 4 (i.e. the group of the highest and the less developed regions).

Detailed information about the geographical distribution of regions that changed their position (i.e. group membership) in the years 2002-2005 is shown in Figure 8 (a change from lower RDI to higher RDI groupings are marked in green, while negative developments, i.e. a drop from higher to lower RDI groupings, are in yellow). The above graph confirms that most of the changes (positive and negative) concerned regions located in Central- and South-West Poland, leaving Eastern Poland (the worst regions) relatively unaffected.

8.5.1.6. General characteristics of high/ low RDI-regions in Poland

As mentioned above, all the best performing rural regions in Poland were found to be located close to big cities (e.g. Warsaw, Poznan, Gdansk, Krakow). On the other hand the least developed

Table 10. Poland: Highest developed rural regions: 2002-2005

2002			2005		
Region	**ID**	**RDI**	**Region**	**ID**	**RDI**
piaseczynski	135	0.5715176	pruszkowski	138	0.6195706
pruszkowski	138	0.5439028	piaseczynski	135	0.617891
warszawski zach.	148	0.4278901	warszawski zach.	148	0.4900318
legionowski	125	0.4258461	legionowski	125	0.4500781
grodziski	122	0.3647016	grodziski	122	0.3755801
poznanski	286	0.3312572	poznanski	286	0.3342962
otwocki	134	0.2995462	wolominski	150	0.3337665
wolominski	150	0.2485645	otwocki	134	0.324424
gdanski	204	0.2018781	wroclawski	23	0.2576797
wielicki	117	0.20132	wielicki	117	0.23112
Sample average		0.361642			0.4034438

Table 11. Poland: Lowest developed rural regions: 2002-2005

2002			2005		
Region	**ID**	**RDI Index**	**Region**	**ID**	**RDI Index**
lubaczowski	174	-0.0785554	lubaczowski	174	-0.0897232
tomaszowski	63	-0.0818053	bialski	46	-0.0919815
lobeski	314	-0.0828834	zamojski	65	-0.09563
zgorzelecki	25	-0.0829488	wlodawski	64	-0.0962988
zamojski	65	-0.0839498	parczewski	58	-0.0994447
wlodawski	64	-0.0846719	tomaszowski	63	-0.099909
bieszczadzki	166	-0.0853664	chelmski	48	-0.1018753
chelmski	48	-0.0894798	bieszczadzki	166	-0.1042763
bierunsko-ledzinski	230	-0.1194016	hrubieszowski	49	-0.1117482
hrubieszowski	49	-0.1309348	walbrzyski	21	-0.1141421
Sample average		-0.0919997			-0.10050291

rural regions were found in remote areas in Eastern Poland (e.g. close to the Belarusian or Ukrainian border) or in post heavy industrial zones (e.g. poviat walbrzyski bordered with the Czech Republic). An analysis of the RDI in the selected 10 best and 10 least developed regions reveals that the discrepancy between the best developed group of regions and the country average was much higher compared with the country average and least developed regions. Moreover, discrepancies in the development of the above two extreme groups of regions increased over time suggesting growing disparities (the RDI in the 10 best developed regions increased over the period 2002-2005 from 0.36 to 0.40, whereas in the 10 least developed the RDI dropped from -0.09 to -0.10).

Both groups of regions differed significantly concerning their endowments with factors (F) determining, to a large extent the overall quality of life (see Annex 2). The most significant differences concerned endowments with factors: F1 (employment by sectors), F4 (Highest income groups and housing availability), F6 (structure of population), F11 (primarily sector – energy, structure of deaths), F12 (population natural growth), and F16 (structure of expenditures in local budgets).

8.5.1.7. Robustness of obtained results

An additional verification of the accuracy and robustness of the obtained results (e.g.

identification of the most-developed and the less-developed rural areas in Poland on the basis of the RDI) was carried out by comparing available secondary statistics on individual aspects of quality of life and the overall level of rural development in both groups of regions, (i.e. the most developed regions (group1) and the less developed regions (group 2).

Generally, identification of the most and the less developed regions in Poland by means of the RDI proved very robust. Comparison of both groups of regions using partial indicators shows numerous differences in various important attributes and domains of rural development. The largest differences between both groups were found in:

- Natural population increase (high rate in grouping 1 vs. negative rate in grouping 2);
- Share of state-owned and public-owned enterprises in total enterprises;(=> very low shares in grouping 1 vs. high shares in grouping 2);
- Availability of housing and living space ("New two-dwelling and multi-dwelling buildings, number of buildings per km²; usable floor space of dwellings; number of building permits per km², number of dwellings per km²) => high shares in grouping 1 vs. low in grouping 2.
- Environmental pollution ("Air protection, capacity of the installed facilities to arrest pollutants; particulate pollutants in t/year per 1000 population"; "Area of waste management total, disposal sites, per total land"; "particulate pollutants per km²"; "gaseous pollutants per km²"); => low values in grouping 1 vs. very high values in grouping 2;
- Protected landscape areas ("Legally protected areas in ha of which: protected landscape areas of which those established under gmina council resolutions per protected landscape areas") => high values in grouping 1 vs. very low values in grouping 2);

Additionally, both groups of regions were found to differ considerably in a number of other important coefficients: e.g. region (gmina) own revenues per capita (high value in grouping 1 vs. low value in grouping 2); share of population with high income (high share in grouping 1 and low share in grouping 2); share of enterprises in sectors: public administration, national defence and social security to total enterprises (low share in grouping 1 vs. high in grouping 2); infant deaths per 1000 live births (low share in grouping 1 vs. higher share in grouping 2); rate of unemployment (lower rate in grouping 1 vs. higher in grouping 2); number of job offers per total unemployed (higher value in grouping 1 vs. low in grouping 2), etc.

Although the economic, social and environmental performance of the best and the worst developed regions can generally be analysed using various partial indicators, ranking of regions using partial indicators may differ from the ranking of regions obtained on the basis of the synthetic RDI (the latter combines **all** relevant partial indicators using a consistent system of objectively derived social weights).

8.5.2. Slovakia

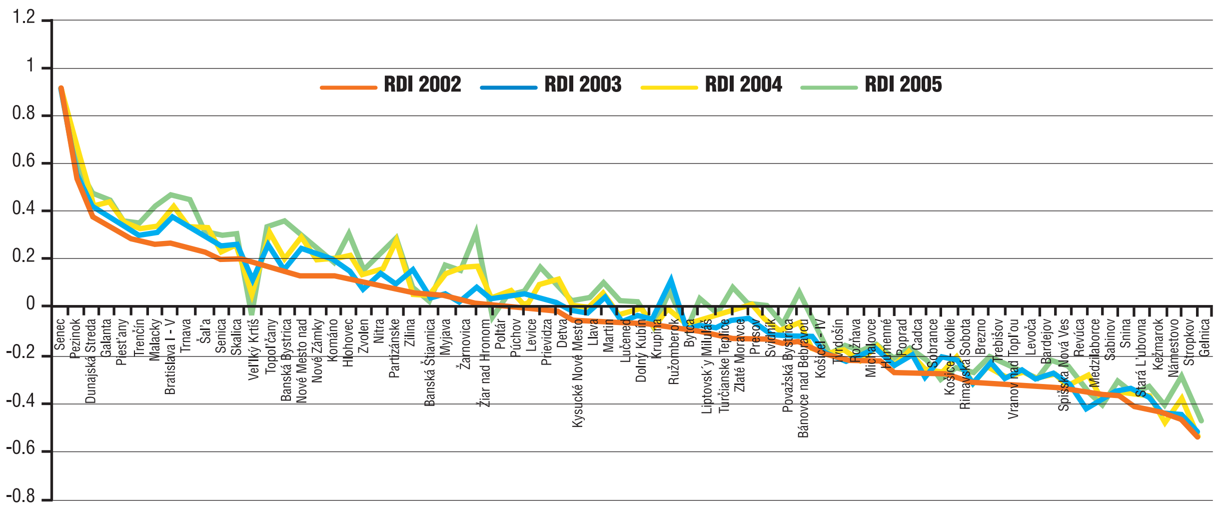
8.5.2.1. Ranking of regions

The RDI constructed for Slovakia consists of 21 fractions and involves 337 regional indicators calculated and weighted according to eq 7.

The territorial distribution of the RDI in Slovakia (by NUTS-4 regions) in years 2002-2005 is shown in Figure 9 (below).

During the years 2002-2005 the estimated value of the RDI ranged from -0.51 to +0.91 (regional discrepancies are therefore higher than in Poland). As expected, the highest values of RDI were found in regions located in West

Figure 9. Distribution of RDI (by NUTS-4 regions) in years 2002-2005



Namestovo, Kezmarok, Stara Lubovna) exhibit the lowest RDI values. The statistical distribution of the average RDI is shown in Figure 10 (histogram). Geographical distribution of RDI is presented in Figure 11.

8.5.2.2. Statistical distribution of RDI Index

In contrast to Poland, the results of analysis show that the statistical distribution of 72 rural regions in Slovakia with regard to their development level was close to normal (approximately the same number of rural regions belonged to high and low performing groups). The results also confirm a clear typographic division of Slovakia into western-, central and eastern sub-areas based on performance of individual regions, and back-up a general opinion that the level of rural development decreases from West to East.

Figure 10. Distribution of an average RDI: 2002-2005 (Histogram)

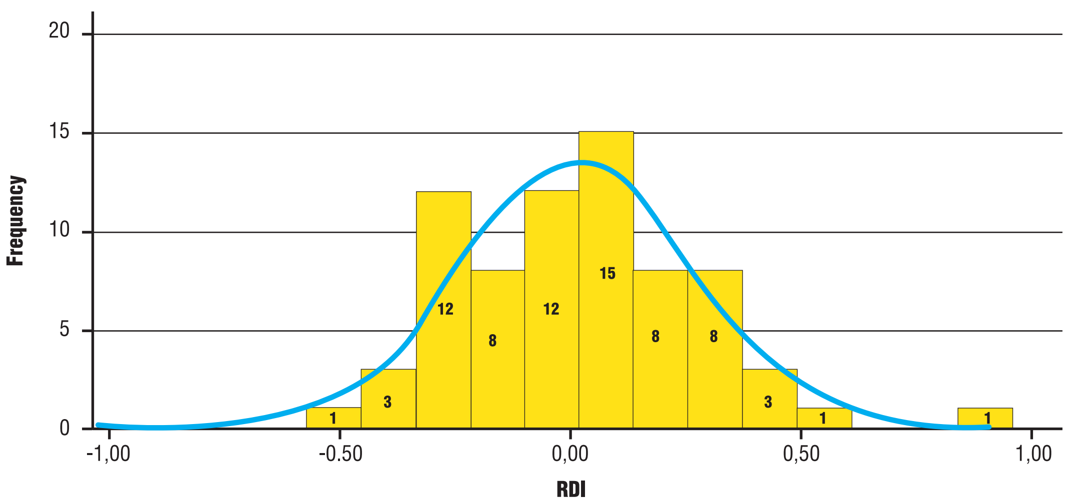
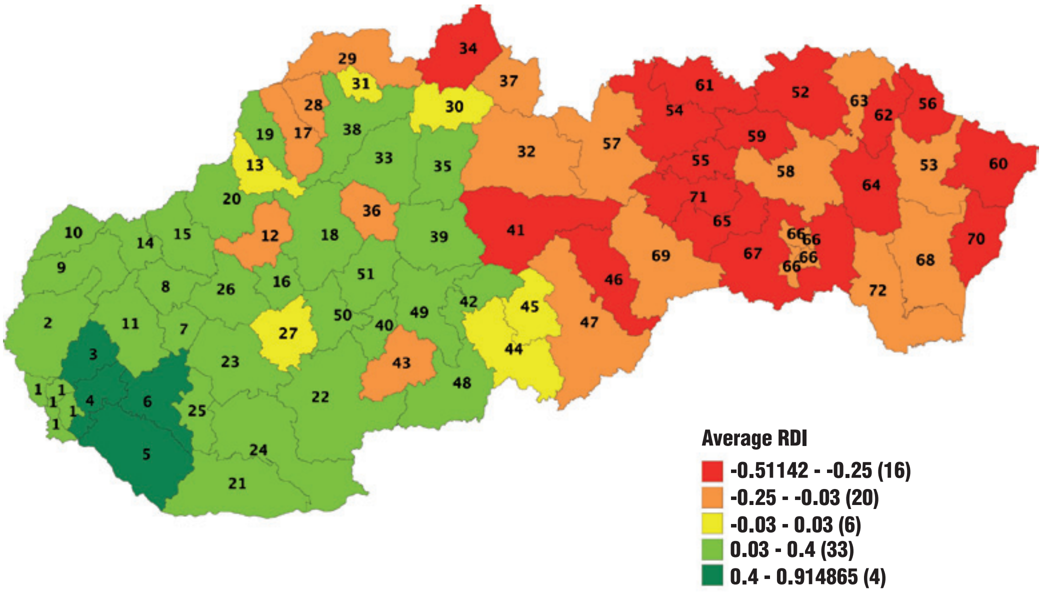


Figure 11. Distribution of RDI (average 2002-2005)



8.5.2.3. *Regional disparities and Development Dynamics*

The change in the RDI across Slovak regions over the years 2002-2005 is illustrated in Figures 12 and 13. The figures show that a general pattern of development (i.e. western regions have higher RDI values compared with east-Slovak regions) persisted throughout the years 2002-2005. Yet, particularly interesting was an improvement of the RDI in regions located in West and Central Slovakia, which can be interpreted as a considerable spill-over effect transmitting economic and social development from better developed western regions (okres) to less developed regions (Central Slovakia).

The analysis also shows that, during the years 2002-2005, the range of RDI values in Slovak regions shrank from -0.53 to -0.46 (min) and from +0.93 to +0.92 (max), i.e. the absolute difference between **two** extreme regions decreased over this

Figure 12. Slovakia RDI 2002

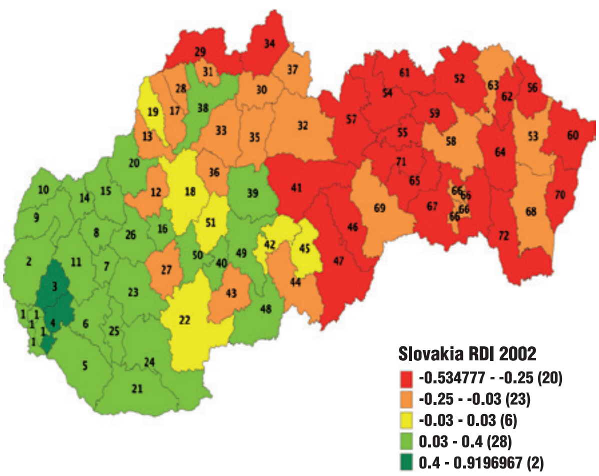


Figure 13. Slovakia RDI 2005

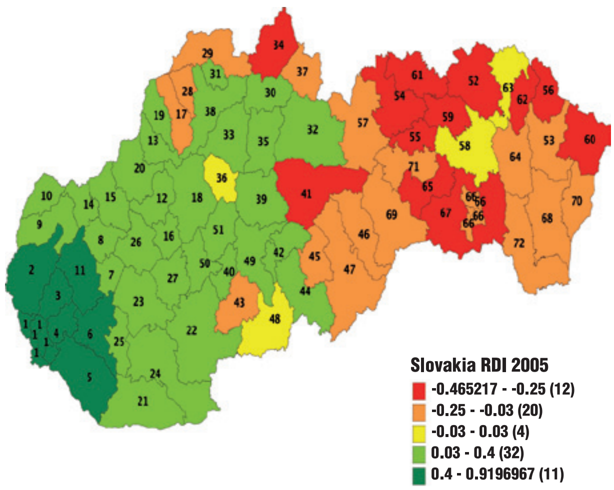
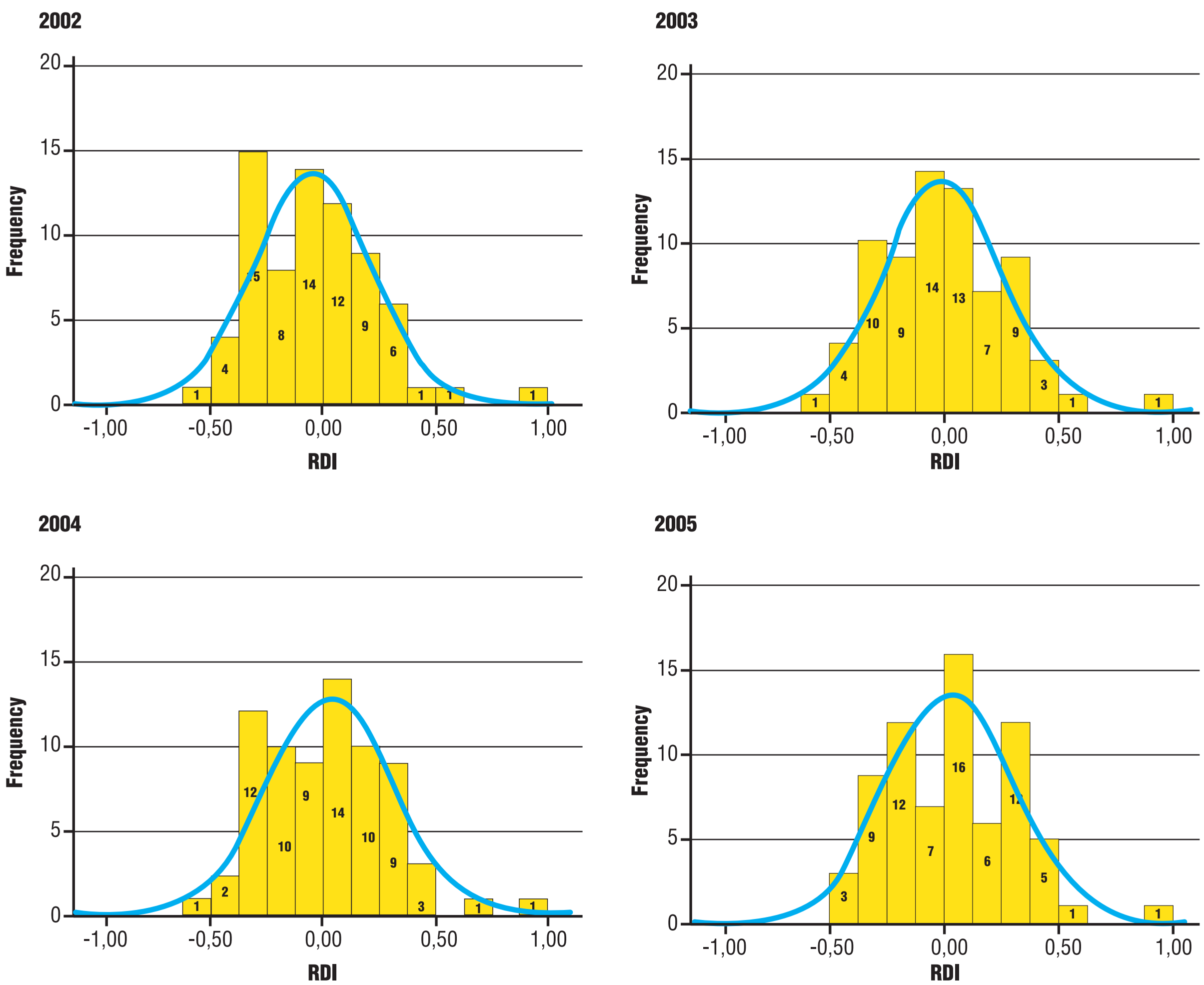


Table 12. Positive/ Negative RDI Index: Number of okres

RDI	Number of okres			
Year	2002	2003	2004	2005
Positive	30	34	38	41
Negative	42	38	34	31

Figure 14. RDI-Value-Distribution: Histograms of 2002-2005



period. At the same time a general improvement of a development level across all rural regions took place (i.e. the number of regions with negative values decreased from 42 (2002) to 31 (2005), and those with a positive RDI increased from 30 (2002) to 41 (2005); see Table 12).

Yet, this encouraging development (combined with the change of yearly average mean- and median-values from negative to positive) was simultaneously accompanied by an increasing variance in RDI values in the years 2002-2005 (see Tab 13). While the change of a mean of RDI from a negative value (2002) to a positive value in 2005 suggests a general improvement of the level in the quality of life across the regions, the latter trend (i.e. increase of variance in RDI) indicates a progressive regional divergence.

Table 13. Slovakia: RDI 2002-2005 Descriptive-Statistics

Year	Min	Max	Range	Mean	Median	Variance
2002	-0.535	0.92	1.45	-0.048	-0.057	0.068
2003	-0.51	0.931	1.44	-0.008	-0.022	0.072
2004	-0.536	0.886	1.42	0.011	0.009	0.076
2005	-0.465	0.923	1.39	0.045	0.038	0.078

Figure 14a. Slovakia: Difference between an average- and a region specific RDI (2002)

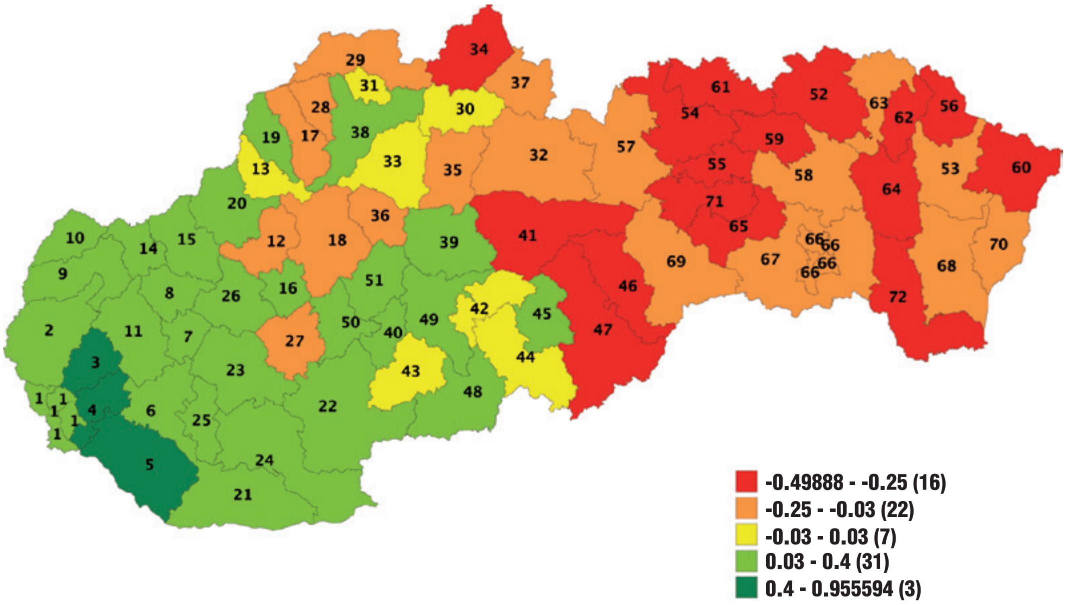


Figure 14b. Slovakia: Difference between an average- and region specific-RDI (2005)

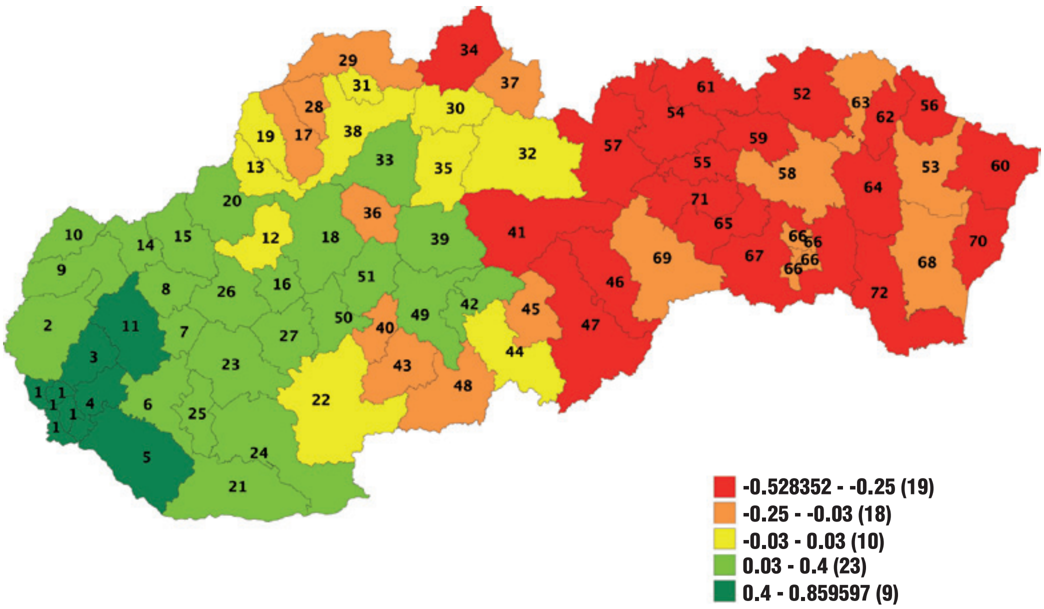
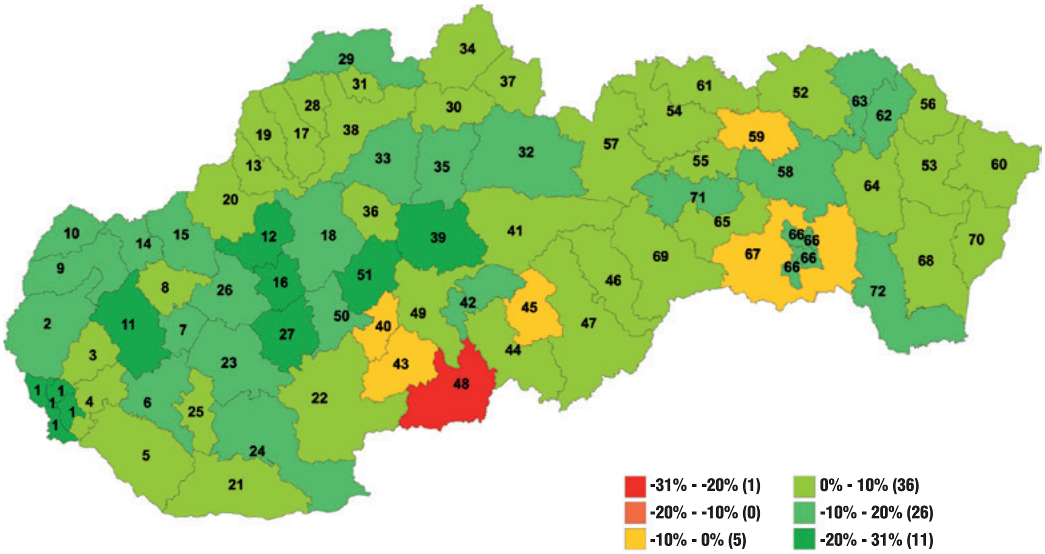


Figure 14c. Slovakia: Change of an value of RDI by region (2002-2005)



Confirmation of above trend (i.e. progressing divergence) can be found in Figures 14a-14b.

Progressive regional divergence in Slovakia becomes even more apparent by analysing changes of individual RDI by regions (see Figure 14c). Figure 14c shows that most regions with an improved RDI were located in Western Slovakia and the northern part of Central Slovakia. At the same time, the level of development deteriorated in regions located in the southern part of Central Slovakia and Eastern Slovakia. Especially problematic is an apparent continuous deterioration of rural development level observed in some Slovak regions (e.g. region Nr. 48; Okres Vielki Krtis, see Figure 14c).

An analysis of the geographical distribution of RDI values confirms a dichotomy in the development of Slovak regions (i.e. a clear pattern with the higher-than-average rural development in West-Slovakia and lower-than-average development pattern of regions located in Eastern-Slovakia). Yet, in contrast to declared policy and efforts towards a greater regional convergence (one of the main important objectives of EU regional and rural policies) our analysis shows that discrepancies in the level of rural development between Western and Eastern Slovakia was reinforced over the years 2002-2005, i.e. in Western Slovakia an average increase of the RDI was approximately 50% higher compared with Eastern Slovakia. This shows a progressive divergence of West and East regions despite an absolute improvement in the overall average level of rural development.

8.5.2.4. Stability

More accurate information regarding the stability of the calculated RDIs over time can be obtained on the basis of similarity matrices using distance measures as well as group-comparisons measures.

8.5.2.4.1. Similarity-/ dissimilarity matrices

Similar to Poland, the stability of rural development over time was measured using the Pearson-Correlation coefficient matrix, the Euclidean-Distance matrix and quartile change matrices.

The similarity-/ dissimilarity matrices (see Tables 14 and 15) show that the highest development stability was recorded between the years 2002 and 2003, while strong instability

Table 14. Slovakia: Similarity-Matrix: RDIs 2002-2005

	Pearson-Correlation of RDI-values			
	2002	**2003**	**2004**	**2005**
2002	1			
2003	.987	1		
2004	.982	.984	1	
2005	.961	.971	.985	1

Table 15. Dissimilarity-Matrix: RDIs 2002-2005 (Canberra distance)

	Euclidean-Distance of RDI-values			
	2002	**2003**	**2004**	**2005**
2002	0			
2003	16.21	0		
2004	21.89	15.11	0	
2005	29.14	22.04	16.41	0

(here growth) occurred between the years 2002 and 2005. A positive development of the RDI between years 2002 and 2005 and a rapid growth of the RDI between 2004 and 2005 indicates a strong effect of Slovakia's EU accession (2004) on rural development.

8.5.2.4.2. Quartile-Stability

The values in the quartiles development matrix show that in the period 2002-2005 only 12-15% of all regions in Slovakia changed their group-membership (in both directions, i.e. positive and negative). Similar to Poland, the highest number of changes took place in the 2nd quartile (second best regions in terms of the RDI), followed by the 3rd and 1st quartile and at the end quartile 4 (the worst regions). Yet, in contrast to Poland, the most stable were regions included in quartile 4 (i.e. the group of the least developed regions[41]) where during the period 2002-2005 only three regions managed to improve their relative position vs. other regions (see Table 16).

More detailed information about the change of a relative position (i.e. group membership) of individual regions in the years 2002-2005 is provided in Figure 15 (a change from lower RDI to higher RDI groupings are marked in green, while negative developments, i.e. a change from higher RDI to lower RDI groupings are in yellow).

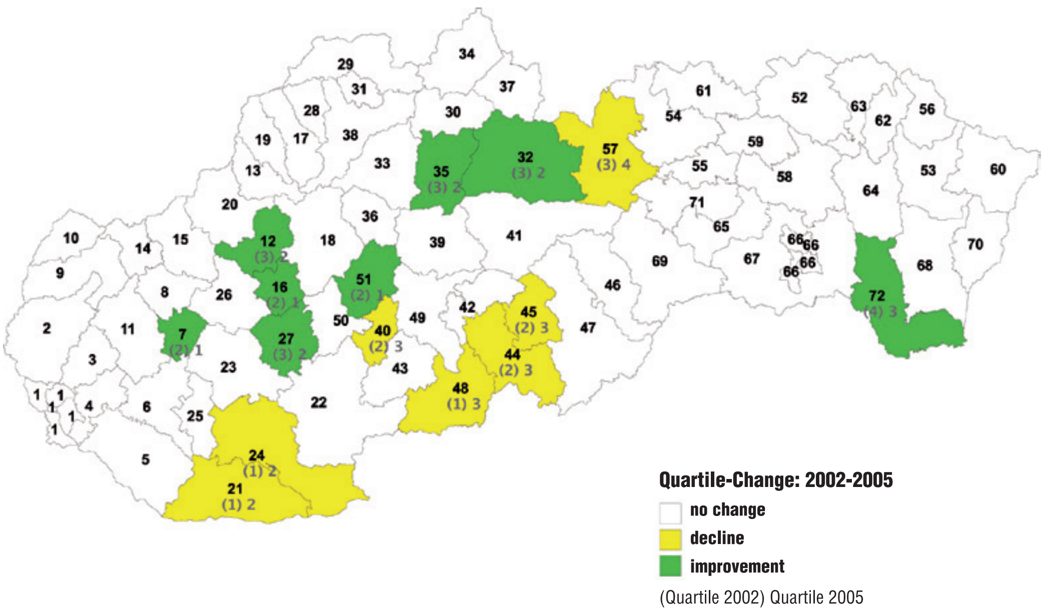
The above graphs confirm that most of the observed changes (positive as well as negative) concerned regions located in Central Slovakia. Yet, the picture illustrates also some negative developments. For example, region Veľký Krtíš (Reg: 48; in the south of Central Slovakia) dropped from quartile 1 (in 2002) to quartile 3 (in 2005), i.e. in comparison to all other regions its development clearly lagged.

41 In Poland the most stable were regions in quartile 1, i.e. the best developed regions (see above).

Table 16. Development-Matrix of Quartiles: all years

		Origin			
		Quartile 1	**Quartile 2**	**Quartile 3**	**Quartile 4**
Destination	**Quartile 1**	0	5	0	0
	Quartile 2	5	0	6	0
	Quartile 3	0	6	0	3
	Quartile 4	0	0	3	0

Figure 15. Quartile change during years 2002 – 2005



8.5.2.5. General characteristics of high/ low RDI-regions in Slovakia

In Slovakia, the most significant differences between good and bad performing regions concerned endowments with factors F2 (availability of social services and technical infrastructure per capita), F3 (social and living environment including availability of housing), F10 (special schools), F4 (agriculture), F13 (public facilities) and F14 (availability of retail infrastructure). Interestingly, a high endowment with social and technical infrastructure calculated per capita (F2) was not found to contribute to the high quality of life in individual rural regions (high values of regional coefficients computed per capita level may reflect a region's low population density, and therefore usually do not provide reliable information about the spatial availability of a given service). Good performing regions were found to be endowed with a higher than the country average with factors: F3 (Social and living environment, incl. availability of housing), F4 (Agriculture), F13 (Public facilities) and F14 (Availability of retail infrastructure).

The analysis of regions with the highest and lowest RDI (2002-2005) also shows that both the five most developed regions (i.e. Senec, Pezinok, Dunajska Streda, Galanta and Piestany) and the five less developed regions (Stara Lubovna, Kezmarok, Namestovo, Stropkov and Gelnica) maintained

Table 17. Highest RDI-Regions: 2002-2005

2002		2003		2004		2005	
Region	**RDI**	**Region**	**RDI**	**Region**	**RDI**	**Region**	**RDI**
Senec	0.920	Senec	0.931	Senec	0.886	Senec	0.923
Pezinok	0.552	Pezinok	0.567	Pezinok	0.654	Pezinok	0.612
Dunajská Streda	0.385	Dunajská Streda	0.431	Galanta	0.448	Dunajská Streda	0.482
Galanta	0.343	Bratislava I - V	0.388	Dunajská Streda	0.439	Galanta	0.460
Piešťany	0.309	Galanta	0.384	Bratislava I - V	0.428	Piešťany	0.369
Total	**2.509**		**2.701**		**2.855**		**2.847**

Table 18. Lowest RDI-Regions: 2002-2005

2002		2003		2004		2005	
Region	**RDI**	**Region**	**RDI**	**Region**	**RDI**	**Region**	**RDI**
Stará Ľubovňa	-0.411	Sabinov	-0.384	Stará Ľubovňa	-0.366	Stará Ľubovňa	-0.346
Kežmarok	-0.419	Medzilaborce	-0.414	Sabinov	-0.368	Kežmarok	-0.321
Námestovo	-0.434	Stropkov	-0.438	Stropkov	-0.378	Námestovo	-0.405
Stropkov	-0.468	Námestovo	-0.441	Námestovo	-0.473	Stropkov	-0.279
Gelnica	-0.535	Gelnica	-0.510	Gelnica	-0.536	Gelnica	-0.465
Total	**-2.267**		**-2.187**		**-2.120**		**-1.816**

their rank over time (i.e. high stability). While both groupings of regions experienced a positive trend in their development (the sum of RDI values calculated for the five highest and five lowest RDI regions increased over time), in the case of the five best regions this trend stopped in 2004, i.e. the level of development in the great majority of the best regions deteriorated in 2005, compared with 2004 (except for the leading region: i.e. Senec). The highest improvement of RDI among the five less developed regions occurred in eastern Slovakia: Stropkov (40%) and Kezmarok (23%).

In the five most developed regions, i.e. regions with the RDI higher than 0.3 (5 regions in 2002; 10 regions in 2003; 11 regions in 2004; 17 regions in 2005) components with the most positive impact on rural development were: T4 (agriculture), T2 (availability of social and technical infrastructure per capita), and T14 (availability of retail infrastructure per capita). In all these cases the shares of the above components in an overall index's value were among the highest and estimated coefficients were statistically significant at the 1% level.

On the other hand, i.e. in the case of the five least developed regions, i.e. regions with an RDI lower than -0.3 (15 regions in 2002; 10 regions in 2003; 9 regions in 2004; 7 regions in 2005) components which contributed to the highest extent to the low value of the RDI were: T13 (inadequate public facilities), T4 (less intensive agriculture) and T2 (social and technical infrastructure per capita).

9. Conclusions

An empirical analysis of the overall development and performance of rural regions (NUTS-4 level) using an RDI in Slovakia and Poland shows a number of important common trends: i) huge differences in the level of regional/rural development among rural regions in both countries; ii) a clear deterioration in the level of rural development from West to East both in Poland and in Slovakia;, iii) positive spill-overs of development from better developed to the neighbouring less developed regions; iv) progressing regional **disparities** between the highest and the lowest developed regions over time; v) particular importance of specific economic, social and environmental indicators (e.g. high income, availability of housing, lack of pollution, high share of private sector, high share of population in working age and women in population's structure, etc.) contributing to the high overall level of development in rural areas.

Comparing the ranking of regions in Poland and Slovakia established on the basis of the RDI with alternative rankings based on other selected socio-economic indicators, e.g. populations' income, unemployment rate, density of enterprises, etc., showed clear dissimilarity in the results obtained (depending on which partial indicator was selected). This confirms the full applicability of an approach based on the RDI to the measurement of an *overall* (synthetic) level of rural development across regions.

The main methodological conclusions are:

- An RDI allows for a comprehensive analysis of various rural development domains (economic, social, environmental, etc.) and their impact on the overall quality of life in rural regions and is powerful at NUTS 2-5 or even village levels;

- The index is not constant over time, easily adjustable and allows for an easy inclusion of additional relevant variables/coefficients representing various aspects of the overall quality of life/rural development;

- The weights applied into the construction of the RDI represent society's valuation of endowments and socio-economic trends observable at local/regional levels. They are also representative for society as whole (reflects both the decision of the migrating population and of the population that stays in the region). The weights are empirically derived and statistically verified (in the actual version the estimated weights are kept constant in time);

- The approach used in our study allows for a technical separation of quality of life from migration;

- Data: an RDI is data hungry.

The main policy conclusion of this study is that, due to its comprehensiveness and reliability, the RDI is suitable both to an analysis of the overall level of development of rural areas and to an evaluation (impact indicator) of the impacts of RD and structural programmes at regional levels (Michalek, 2007; 2012).

10. Summary and conclusions

The main purpose of this research was to construct a multi-dimensional (composite) index measuring the *overall* level of rural development and quality of life in individual rural regions of a given EU country. Given economic, social and environmental dimensions of rural development, an important objective of this study was to use an RD Index approach to learn more about the magnitude and major trends in the overall welfare of individual rural areas. It was also used to identify key factors fostering growth (economic, social and environmental) and convergence of rural regions in a given EU country.

Typically, basic knowledge about the overall level of rural/regional development is obtained on the basis of the GDP (per capita) or various *partial* indicators. The applicability of these indicators to policy analysis of rural areas at lower regional levels (e.g. NUTS-4 and NUTS-5 levels) is, however strongly limited. Firstly, GDP per capita is normally not available at NUTS 4-5 levels. Secondly, GDP as a basic criterion of policy effectiveness (e.g. impact of a cohesion policy), and as a standard measure of a regional development, shows numerous deficiencies. For example, it largely ignores important aspects of the regional quality of life, e.g. education, health, intra-regional income variation, environmental quality, etc.; it does not take into account the price variation within a country; and it can be biased due to interregional imbalances in commuting. While deficiencies of GDP indicators encouraged making intensive use of various partial indicators, applicability of the latter to assessment of an overall welfare of individual rural areas is questionable. Firstly, an increased richness of regional databases at NUTS-4 or NUTS-5 levels makes it difficult to find out an appropriate proxy representing a situation objectively within a given RD domain (e.g. economic development, rural education, environmental or health situation). Secondly, the direct use of partial indicators to the analysis of an *overall* growth of rural areas (economic, social and environmental) is especially problematic if weights of selected partial indicators/components in the overall rural/regional development are not known. Thirdly, the use of a large number of partial indicators in the evaluation of programmes and policies affecting rural areas can be highly misleading in the case of opposite or dissimilar trends observed for the same area.

A possible solution to the above problems offers a composite index approach measuring the overall level of rural/regional development at any relevant territorial/local base. The proposal in this study of a composite RDI embraces all important rural development domains, e.g. economic output (including agriculture, food industry, rural tourism, etc.), investment, employment, poverty, education, health, housing conditions, crime, environment, urbanization and land use, structure of civil society, etc.), and aggregates them into a one dimensional indicator using objective and statistically verifiable weights. The RDI measures multi-dimensional development concepts which cannot be captured by partial indicators alone and simultaneously overcomes most of the deficiencies of previous studies[42] .

42 Some major problems associated with the construction of an composite index of development can be summarized as follows: (i) in the majority of relevant studies the choice/selection of the most representative socio-economic indicators was *arbitrary*, *leaving other available indicators unused or downgraded* as "less representative"; (ii) experts' weights assigned to selected indicators appeared often as *subjective* and not directly transferable from one geographic area to another; (iii) different normalizations of variables could result in different weights; (iv) some weights would become inconsistent when a larger number of indicators/coefficients/variables had been analyzed; (v) weights that were based on pure statistical analysis of factors (e.g. factor loadings) appeared to miss an appropriate welfare (social utility) context; (vi) many assigned weights appeared as region specific, so they were not applicable to other regions in the same country.

The basic methodological concept applied to the construction of the RDI draws on the linkage between the quality of life and migration. The weights representing "social importance" of various RD domains used in the calculation of the RDI are derived from an econometrically estimated intra- and inter-regional migration function in which the main arguments are: i) observed *differences* between a number of economic, social and environmental factors characterizing the origin and destination regions, and, ii) transaction costs linked to a migration decision. While the RDI is calculated as a weighted sum of regional *individual characteristics* of a given location, the major components of the overall development in individual rural areas are constructed using a factorization method (principal components) applied to all relevant variables describing various aspects of rural development at regional level. In contrast to other studies, the proposed approach neither assumes any unique equivalence between quality of life and migration[43] nor applies subjective and non-verifiable weights to individual rural development domains.

From a policy analyst's perspective the reliability and robustness of a composite index can be assessed using various criteria. In this respect the RDI fulfils a number of important requirements:

- The index is based on a sound theoretical framework;
- Basic data used for its construction is of a high quality (the data originate from secondary statistics and is comparable across all regions within a given country, it enables comparisons of regions over years);
- Construction of the index follows an exploratory analysis investigating the overall structure of used indicators, e.g. by grouping available information along at least two dimensions of the dataset: sub-indicators and regional units;
- The index is reported as a single number but can be broken down into components (domains);
- Each domain encompasses a substantial but discrete portion of the construct;
- Each domain has a potential to be measured in both objective and subjective dimensions;
- Each domain of the index has a relevance for most people (not a few groups only);
- Particular attention is given to weighting and aggregation (weights are statistically verifiable);
- The index is checked for robustness and sensitivity;
- The index maintains clear links to other variables and indicators;
- The index is transparent and can be decomposed into its underlying indicators or values;
- The index is based on time series and allows periodic monitoring and aggregation;

43 In fact, the proposed approach allows for computation of the quality of life /rural development index even in regions exhibiting null in- or out-migration.

Additionally, as a potential instrument (i.e. impact indicator) to be applied to evaluation of specific EU RD and structural programmes, the RDI meets all important general evaluation criteria[44] (i.e. efficiency, effectiveness, relevance, sustainability and sufficiency), as well as policy specific criteria (e.g. regionality, rurality, frequency, objectivity, transparency, simplicity and comparability).

The proposed RD Index has been empirically applied to an analysis of the overall welfare and the quality of life in rural areas of Poland and Slovakia. The data used for calculation of the RDI in Poland consist of 991 partial coefficients/indicators showing various aspects of rural development collected/calculated for 314 rural regions (NUTS-4 level). The database for Slovakia embraces 337 similar partial indicators/variables collected for 72 regions (NUTS-4).

In both countries regional data covers the four year period (2002-2005). Depending on the availability of data and research hypothesis regarding distribution of the error term, the estimation of weights for RD domains in the RDI can be carried out on the basis of various econometric models (yet, depending on the

44

General evaluation criteria	Policy specific criteria
Efficiency – Index has to be cost efficient in its construction compared to the outcomes it gives	**Regionality** – it should be possible to calculate the index at regional (NUTS 2 and/or NUTS 3) and local levels (NUTS 4 and/or NUTS 5)
Effectiveness – Index has to measure what it is intended to be measured	**Rurality** – Index has to be applicable for rural areas
Relevance – Index has to be relevant for policy objectives (i.e. fulfil the policy specific criteria summarized in the next column)	**Frequency** – Index has to be possible to calculate with the frequency in line with the programmes requirements
Sustainability – Index has to be useful in the short and long run	**Objectivity** – Index has to be derived with minimum subjectivity
Sufficiency – Index has to be sufficient to answer the question of Quality of Life in evaluating the policy	**Transparency** – the way of derivation of the Index has to be clear enough to anable to replicate by other researchers
	Simplicity – Index has to be easily understood by policy makers and the public
	Comparability – Index has to be comparable across regions and countries
	Dynamics – Since the Index has to measure changes over time it has to be dynamic

Source, Kaufmann, et al. (2007).

model's structure and specification of the error term the results, e.g. ranking of the regions may differ considerably). The best econometric model applied to estimation of weights in RDI in this study was selected on the basis of its attractive properties and clear comparative advantages in comparison with other approaches[45].

Empirical analysis of the overall development and performance of rural regions (NUTS-4 level) using the RDI in Slovakia and Poland shows a number of important common trends: i) huge differences in the level of regional/rural development among rural regions in both countries; ii) a clear deterioration in the level of rural development from West to East both in Poland as well as in Slovakia; iii) positive spill-overs of development from better developed to the neighbouring less developed regions; iv) progressing regional *disparities* between the highest and the lowest developed regions over time; v) particular importance of specific economic, social and environmental indicators (e.g. high income, availability of housing, lack of pollution, high share of private sector, high share of population in working age and women in population's structure, etc.), contributing to the high overall level of development in rural areas.

A comparison of the ranking of regions in Poland and Slovakia established on the basis of the RDI with alternative rankings based on other selected socio-economic indicators, e.g. populations' income, unemployment rate, density of enterprises, etc., showed clear dissimilarity in obtained results (depending on which partial indicator was selected) thus confirming the full applicability of an approach based on the RDI to the measurement of an *overall* (synthetic) level of rural development across regions.

The main methodological conclusions are:

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- The index is not constant over time, easily adjustable and allows for an easy inclusion of additional relevant variables/coefficients representing various aspects of the overall quality of life/rural development;

- The weights applied into the construction of the RDI represent society's valuation of endowments and socio-economic trends observable at local/regional levels, and are representative for society as a whole (reflects both the decision of migrating population as well as the population which stays in the region). The weights are empirically derived and statistically verified (in the actual version the estimated weights are kept constant in time);

- The approach used in our study allows for a technical separation of quality of life from migration;

- Data: an RDI is data hungry;

The main conclusion of this study is that due to its comprehensiveness the RDI Index is suitable both to analysis of the overall level of development of rural areas and to an evaluation of the impacts (impact indicator) of RD and structural programmes at regional levels (Michalek, 2007; 2009, 2012).

45 The most important characteristics of the selected model are as follows:

1 The model (i.e. panel regression or multi-level mixed-effect regression model), estimated as a balanced panel with random effects, uses statistical data on pair-wise migration flows between all regions in a given country (full regional migration matrix) over a number of years, which significantly increases the number of observations and statistical degree of freedom;

2 The model allows for the incorporation of both the differences in economic, social and environmental characteristics of respective regions and transaction costs as explanatory variables determining a migration decision of an individual moving from one region to another;

3 As a multi-level mixed–effect linear regression model it allows for a more precise specification of correlation between dependent and explanatory variables;

4 The model takes into account different sizes of population in all region pairs where migration flows are observed;

5 Due to non-negativity of dependent variable, the model can be estimated in the form of a logistic function representing a probability of migration from region i to j. This model specification fits better a micro founded analysis of a migration decision;

6 The selected model (due to incorporation of transaction costs) allows for a formal split of the RDI from migration.

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12. Annex

Table 1a: Poland: Extracted Factors (17) and major factor loadings

Factor	Factor-Domain	Examples of major loadings[1]	Explained total variance (%)
f1	**Employment by sectors**	Employed in agricultural sector (sections: A+B) total per employed total **(neg)**; Registered unemployed by length of unemployment, 20 - 30 years per unemployed total; Sewage system, population served by the sewage system per 1000 population; Deaths by age and gender total, 65 years and over per deaths total **(neg)**; Registered unemployed by age, 45 - 54 years per unemployed total; Employed in service sector - total per employed total	8.87
f2	**Lowest income groups and own budgetary resources**	Budget Revenue of the powiat, Own revenue, personal income tax per own revenue; Taxpayers_1 per 1000 pop **(neg)**; Budget Revenue of the powiat, Own revenue total per 1000 population; Expenditure for health care from rural powiats' budgets in pLN, current expendit; Budget Revenue of the powiat,Budget revenue in pLN total per 1000 population **(neg)**; post-primary secondary vocational schools for youth excluding special schools, **(neg)**	4.13
f3	**Population density and urbanization**	Population by actual place of residence, as on 31 XII, total per km²; Pharmacies - total per km²; places in nursery schools (excluding special schools) , total number of places; Library establishments , libraries and branches per km²; Nursery schools (excluding special schools), Urban transport, transport lines in km per km².	3.89
f4	**Highest income groups and housing availability**	Taxpayers_3 per taxpayers_total; New residential buildings B-05, B05C99, number of dwelling units, usable floor s; New residential buildings B-05, B05C99, number of dwelling units per km²; New residential buildings B-05, B05C99, number of buildings per km²; New single-family (single-dwelling) residential buildings, number of dwelling un; New single-family (single-dwelling) residential buildings, number of buildings per	2.47
f5	**Subsidies and social expenditures**	Expenditure for public security and fire protection from rural powiats' budgets; Expenditure for education from rural powiats' budgets in pLN total per 1000 popu; Budget Revenue of the powiat, General subsidies total per 1000 population; Expenditures from powiat budgets, wages due under employment contracts and for o; Expenditures from powiat budgets, current expenditure of budgetary entities of w; Budget Revenue of the powiat, General subsidies of which component for education	2.24
f6	**Population structure**	Actually living population aged 20 and more - males, 20-29 per population total; Actually living population aged 20 and more - males, 50-59 per population total; Actually living population aged 20 and more - total. As on 31XII, 20-29 per capita; Actually living population aged, 50-59 per population total; Actually living population aged 20 and more - males, 30-39 per population total; Actually living population aged 30-39 per population total	1.86
f7	**Industrialization, investments and fixed assets**	Investments and fixed assets, gross value of fixed assets in industry and constr; Gas pollutant emissions in t/year, (excluding carbon dioxide) Total per 1000 pop; Investments and fixed assets, gross value of fixed assets per capita; Investments and fixed assets, Outlays on fixed assets expenditures on environment; Water consumption for the needs of the national economy and households in dam3/y; Gas pollutant emissions in t/year, (excluding carbon dioxide) Total per km²	1.77
f8	**Gas supply system and deaths**	Gas supply system (ZpG-7), active distribution gas mains in km per 1000 populati; Gas supply system (ZpG-7), total length of active gas pipelines in km per 1000 p; Gas supply system (ZpG-7), number of active connections to residential buildings; Deaths due to neoplasms, total (boesartige Geschwuelste), total per 1000 pop **(neg)**; Settlements (including cities) per km² **(neg)**; Premature deaths: 0 - 64 yrs per 1000 population **(neg)**	1.52
f9	**Tourist sector, newly registered companies**	bed spaces I - IX, bed spaces VII per km²; Overnight stays per 1000 capita; Enterprise_sec_ h per enterprise_total (hotels and restaurants); Enteties of the national economy, In section H (Hotels and restaurants) total pe; Number of tourist beds per 1000 capita; Entities newly registered in section H (hotels and restaurants) per 1000 population	1.41

f10	**Employment conditions and work hazard**	Employed,*) – the data includes legal persons and organisational entities without **(neg)**; Persons injured in accidents at work per 1000 pop at working age; Employed, females per employed total **(neg)**; Days of incapacity for work per 1000 pop at working age; Hazards related to work environment total per 1000 employed total; Employed in hazardous conditions by hazard type and intensity (a) total - number	1.08
f11	**Heating energy sector <pollution> and deaths**	Total deaths by gender, females per deaths total **(neg)**; Total deaths by gender, males per deaths total; in farms operated by private individuals, pastures total per agricultural land; Heat supply, thermal energy sales over the year, total per 1000 population; Municipal infrastructure, Sale of heating energy during the year by destination; Municipal infrastructure, Sale of heating energy during the year by destination	1.05
f12	**Natural population growth**	Natural population increase by gender (difference between the total number of li; Live births (by the mother's place of residence and gender) total per 1000 popu; Post-working-age population per 100 population of pre-working age **(neg)**; Actually living population – of pre-working age total per population total; population by actual place of residence, as on 31 XII, males per population tot; entities of the national economy, private sector of which: businesses natural pe	1.02
f13	**Public administration and social infrastructure**	Powiat Councillors total per 1000 population **(neg)**; Members of powiat boards total per 1000 population **(neg)**; Expenditure for public administration from rural powiats' budgets in pLN total **(neg)**; General hospitals per 100000 population **(neg)**; Accidents at work in percent of total accidents; Expenditure for physical culture and sport from rural powiats' budgets in pLN of	0.91
f14	**Unemployment and dwelling equipment**	Registered unemployed - females, unemployed with previous work experience per Re **(neg)**; Dwellings provided with utilities and sanitary amenities (all dwellings), water; Dwellings provided with utilities and sanitary amenities (all dwellings), centra; Dwellings provided with utilities and sanitary amenities (all dwellings), bathro; Expenditures from powiat budgets, remunerations tied to wages per current expend; Dwellings provided with utilities and sanitary amenities (all dwellings), inside	0.89
f15	**Social sector and its financing**	Care homes total (gmina+powiat+voivodship), residents (including branches) per 1; Expenditure on social welfare (2002/2003) by Powiats, renamed as social care and; Care homes total (gmina+powiat+voivodship) per 1000 population; Budget Revenue of the powiat, Appropriated allocations from the national budget; Budget Revenue of the powiat, Appropriated allocations from the national budget **(neg)**; social assistance establishments, residents – total (including branches) per 1000 population	0.87
f16	**Structure of expenditures in local budgets**	Expenditures from powiat budgets, Budget expenditure in pLN of which property ex; Expenditures from powiat budgets, Budget expenditure in pLN of which investment; Expenditure for transport and communications from rural powiats' budgets in pLN,; Expenditure for transport and communications from rural powiats' budgets in pLN,; Expenditure for transport and communications from rural powiats' budgets in pLN **(neg)**; new-registered entities of the national economy, total public sector per total	0.80
f17	**Environmental pollution and infrastructure**	Sewage management and water protection, of which municipal treatment plants: nu; Sewage management and water protection, biological plants (excluding digestive; Sewage management and water protection, of which municipal treatment plants: th; Sewage management and water protection, biological plants (excluding digestive; Forests and wooded land total per Gmina surface area in ha; Sewage management and water protection, biological plants	0.75

Table 1b: Slovakia: Extracted Factors (21) and major factor loadings

Factor	Factor-Domain	Examples of major loadings*	Explained total variance (%)
f1	**Spatial density of social and retail infrastructure (per km)**	Schools, medical centres, physicians, shops (food, non-food), pharmacies, sport facilities, banks, higher quality tourist accommodations, population density, etc. **per km**	24.4
f2	**Availability of social services and technical infrastructure (per capita)**	Social services and technical infrastructure, e.g. public libraries, cultural centres, football grounds (except school); public water-supply system; gas distribution - gas pipelines : **per capita**	6.3
f3	**Social conditions and living environment (incl. availability of dwelling)**	Pop. post-productive age (55, 60+) in total; Number of dwellings per capita; Number of divorces: per capita, etc.	4.8
f4	**Agriculture and natural endowment**	Share of agricultural land; share of water in non-agric; share of arable land in agric. land;	4.4
f5	**Availability of young people's infrastructure (per capita)**	Specialized secondary schools in total - number: per capita; Youth hostels total - number of beds - total: per capita	4.1
f6	**Spatial density of public utilities and social infrastructure: gas pipelines, water-supply-system (per km)**	Gas distribution - gas pipelines : per km²; Cultural centres number: per km²; football grounds (except school) - number: per km²; Public water-supply system - : per km²; Primary schools - state (1. - 4. year) - number: per km²	3.2
f7	**Density and structure of enterprises**	Number of enterprises in public sector: per capita; number of enterprises in private sector per capita; number of individual enterprises in private sector (**Neg.);** Number of enterprises in private sector total of which in co-operative ownership (**Neg).**	2.7
f8	**Density of vocational secondary schools**	Vocational secondary schools endowment	2.5
f9	**Hotels and recreation facilities**	Natural curative Spa and hotels endowment	2.3
f10	**Endowment with special schools**	Special schools in total - number of children of school age: per capita; Special schools - state - number: per capita;	2.0
f11	**Availability of social facilities (per capita)**	Other social services facilities - number of places: per capita; Children houses - number of places: per capita; Other social service facilities - number: per capita	1.7
f12	**Accommodation endowment**	Seniors homes - number: per capita (**Neg); Accomodation facilities in total: per km²; special therapeutic institutes; Other collective accomodations : per km²	1.6
f13	**Public facilities**	Sports stadiums open - number: per capita; public sewage system - : per km²; Public sewage system - (yes - no): per capita; Special schools - state - number of teachers: per special schools – state; Stations of the fire and life-saving brigade (including factory) : per km²	1.5
f14	**Availability of retail infrastructure (per capita)**	Services for maintenance and repair of motor vehicles - number of services: per capita; Commercial insurance companies - number: per capita; Shops of motor vehicles - number: per capita; Supermarkets and shopping centres - number: per capita	1.4
f15	**Social facilities**	Boarding houses for seniors - number of positions: per km²; Dwellings in houses with nursing services - number: per km² (**Neg);** Houses with nursing services - number: per km²	1.3
f16	**Primary schools**	Primary schools - state (1. - 9. year) - number of teachers: p Primary schools; Primary schools - state (1. - 9. year) - number of classes: p Primary schools; Primary (basic) schools (1. - 9. year) in total - number: per capita	1.2
f17	**Houses of social services**	Houses of social services for adults - number of places: per capita; Houses of social services for adults - number of places: per km²; Houses of social services for adults - number: per capita; Houses of social services for adults - number: per km²	1.2
f18	**Basic schools of art, etc.**	Basic schools of art - state - number of school children: per capita; Basic schools of art - state - number: per capita;	1.1

f19	**Density of specialized state secondary schools**	Specialized secondary schools in total - number of students of the full-time students; Specialized secondary schools - state - number of classes: per school; Specialized secondary schools - state – share of the full-time students	1.0
f20	**High standard tourist accommodations**	Beds in Inns with accommodation services *** up to *: p Beds in accommodation facilities (**Neg**); Beds in cottage colonies *** up to *: p Beds in accomodation facilities in total (**Neg**); Children houses - number: per capita (**Neg)**	1.0
f21	**Policlinics, grammar schools, sport grounds**	Independent policlinics (regional and factory) - number: per capita; Grammar secondary schools - state - number of teachers: per school; Swimming pools - open (except school) - number: per capita; Other sports grounds - number: per capita	1.0

Table 1c. Poland: Ranking of individual rural development variables (years 2002-2005)

Variable	Variable Name	Social weight	Rank
kv5650_	Taxpayers_3 (highest income group) per taxpayers _total	0.076738027	1
kv860_	New residential buildings B-05, B05C99, dwelling units, usable floor	0.076155578	2
kv858_	New residential buildings B-05, B05C99, number of dwelling units per km²	0.076065601	3
kv5620_income	Average yearly income per taxpayer (Income _total per taxpayers _total)	0.059595662	4
kv_Gas _capita	Gas consumption from gas-line system per capita (m3)	0.058656313	5
kv5649_	Taxpayers_2 (middle income group) per taxpayers _total	0.057875378	6
kv449_	Service sector, private sector (according to REGON - SEK=2)	0.057504415	7
kv902_	New non-residential buildings and civil engineering facilities, number of permits	0.055772816	8
kv5622_	Income_2 (middle income group) per taxpayers_2	0.054922672	9
kv533_	Registered unemployed by length of unemployment, over 30 years per unemployed total	0.05356685	10
kv5628_	Enterprise _total per 1000 pop	0.052725651	11
kv4928_	Entities of the national economy, private sector of which: commercial companies	0.05173477	12
kv906_	New non-residential buildings and civil engineering facilities, number of permits	0.051418325	13
kv5652_	Income_2 per income _total (middle tertile by total)	0.050772029	14
kv4920_	Entities of the national economy total per 1000 population	0.048479134	15
kv_New_entities	New-registered entities of the national economy recorded in the REGON register	0.047992625	16
kv4767_	Social assistance establishments - total per km²	0.047840491	17
kv_Invest_a~_ms	Investments and fixed assets, gross value of fixed assets in market services per	0.047710739	18
……..	…………………….	…….	……
kv_unemploy~464	Registered unemployed - total: Mp1C99 total per population total	-0.032016035	978
kv5124_	Revenues in gmina budgets, Own revenue of which agricultural tax per own revenues	-0.034085973	979
kv19_	Gmina councillors total per 1000 population	-0.034432776	980
kv5148_	Budget Revenue of the powiat, General subsidies total per 1000 population	-0.034571398	981
kv_District_u~t	Local self-government units - district local self-government organizational unit	-0.03512848	982
kv5135_	Revenues in gmina budgets, General subsidies, total	-0.035280421	983
kv493_	Registered unemployed by age, 25 - 34 years, per unemployed total	-0.036891031	984
kv4783_	Library establishments , library collection in volumes per 1000 population	-0.036967977	985
kv453_	Service sector - market services (sections: G + H + I + J + K + O + p + Q), public sector	-0.038546122	986
kv5640_	Enterprise_ sector_ I (public administration, social security) per enterprise_total	-0.039408563	987
kv354_	Actually living population – of working age, males per actually living population	-0.043682531	988
kv448_	Service sector, public sector (according to REGON - SEK=1) per employed service	-0.057504415	989
kv5651_income~e	Income_1 per income_total (lowest income tertile by total)	-0.061541154	990
kv5648_	Taxpayers_1 (lowest income tertile) per taxpayers_total	-0.065576668	991

Table 1d. Slovakia: Ranking of individual rural development variables (years 2002-2005)

Variable	Variable Name	Social weight	Rank
U04128pU04120	"% of population in productive age	0.17556071	1
U16020pU16010	"Legal units in total of which enterprises per Legal units in total - number"	0.17181794	2
U23041pp	"Amount of municipal waste in t: per capita"	0.16719127	3
U23044pp	"Foiled municipal waste in t: per capita"	0.15792791	4
U16040pp	"Legal units in total of which natural persons - number: per capita"	0.14568167	5
U06040pqkm	"Sports stadiums opened - number: per km²"	0.13643376	6
U06010pqkm	"Swimming pools unnatural and natural - number: per km²"	0.13630294	7
U02320pqkm	"Built up pathways in km (d. m.): per km²"	0.13319589	8
U03021pU03020	"Number of the main telephone stations/lines - in total	0.12445546	9
U17126pU17100	"Total number of subjects (Financial mediations, real estates, rental and business activities) per total subjects,	0.12410529	10
U03085pU03084	"Consumption of drinking water (thousand m3) in households per Consumption of drinking water total	0.12110497	11
U05080pU05090	"Decreases of dwellings (including territorial changes) to total dwellings"	0.11705852	12
U10130pp	"Automatic teller machines - number (bankomaty): per capita"	0.11422651	13
U14130pqm	"Built up area and courtyard in m2: per km²"	0.11376102	14
U03010pqkm	"Number of post offices: per km²"	0.11287077	15
U02291pqkm	"Local communications in km in total on 1 d. m. – dust-free: per km²	0.11186641	16
U16052pU16050	"Number of enterprises in private sector total of which individuals: p Number of enterprises in private sector total	0.10862346	17
U17104pU17100	"Total number of subjects Trade (Shops), hotels and restaurants, per total number of subjects for territory"	0.1074418	18
U08110pp	"Gas-stations - number: per capita"	0.1074259	19
U08040pp	"Outlet centers of catering - number: per capita"	0.1071612	20
U06013pqkm	"Swimming pools - opened (except school) - number: per km²"	0.10712198	21
U08050pp	"Non-food shops - number: per capita"	0.10622093	22
......	....	....	.....
U04180pU04220p100	"Number of deaths till 1.year: p Live-births per 1000 inhabitants p1000p"	-0.10386244	329
U11031pp	"Primary schools - state (1. - 4. year) - number of schoolchildren: per capita"	-0.10414145	330
U11005pp	"Primary (basic) schools (1. - 9. year) in total - number: per capita"	-0.10441468	331
U09040pqkm	"Tourist hostels **, * (lowest catergory) : per km²"	-0.10846773	332
U16024pU16020	"Trading companies of which co-operatives: per Legal units in total of which enterprises - number"	-0.12140335	333
U17101pU17100	"Total number of subjects in agriculture, hunting, forestry, fishing and fish breeding per total number of subjects	-0.12255664	334
U14010pp	"Total area of the municipality - urban territory in m2: per capita"	-0.12560015	335
U15062pU15061	"Number of registered unemployed women: per Number of registered unemployed total"	-0.15885093	336
U16030pU16010	"Legal units in total of which non-profit oriented organizations - number: per Legal units in total - number"	-0.17181794	337

Table 2. Estimated coefficients (Models 1-4)

	SLOVAKIA								POLAND
Variable	Model 1a	Model 1b	Model 2a	Model 2b	Model 2c	Model 3	Model 4a	Model 4b	Model 4b
	Coef	Coef	Coef	Coef	Coef	Coef	Coef	Coef	Coef.
	P>|z|	P>|z|	P>|z|	P>|z|	P>|z|	P>|z|	P>|z|	P>|z|	(P>|z|)
dist	---	---	---	---	---	-0.00647	-0.0328827	-0.0328827	-0.0155487
	---	---	---	---	---	(0.000)	(0.000)	(0.000)	(0.000)
dist2	---	---	---	---	---	0.000011	0.0000528	0.0000528	0.0000176
	---	---	---	---	---	(0.000)	(0.000)	(0.000)	(0.000)
f1	-0.0337742	-0.0340015	-0.00454	0.0372758	-0.043813	-0.1318864	0.0479373	0.0479373	0.0153122
	(0.030)	(0.047)	(0.719)	(0.000)	(0.000022)	(0.000)	(0.000)	(0.000)	(0.000)
f2	-0.0334016	-0.0333746	-0.0450834	-0.034605	-0.028248	0.0072217	-0.1067878	-0.1067878	-0.0063749
	(0.029)	(0.047)	(0.000)	(0.000)	(0.005894)	(0.887)	(0.000)	(0.000)	(0.395)
f3	0.0038537	0.0026703	0.0208847	0.0178619	0.006146	-0.0370857	0.0958631	0.0958632	-0.0057717
	(0.800)	(0.871)	(0.028)	(0.001)	(0.547775)	(0.312)	(0.000)	(0.000)	(0.004)
f4	0.1753705	0.1753534	0.1963562	0.148703	0.173265	0.1200129	0.1214241	0.1214241	0.0865912
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
f5	-0.004202	-0.0042433	-0.005898	0.0004893	-0.002824	0.0149093	0.0146118	0.0146117	-0.0072237
	(0.777)	(0.793)	(0.505)	(0.955)	(0.758259)	(0.641)	(0.268)	(0.268)	(0.000)
f6	0.0374212	0.0370587	0.0335045	0.0228773	0.044477	0.1123199	0.0444111	0.0444111	0.0386539
	(0.013)	(0.023)	(0.000)	(0.000)	(0.000006)	(0.001)	(0.001)	(0.001)	(0.000)
f7	0.0139125	0.013468	0.02507	0.0232218	0.023304	0.0434883	-0.0094112	-0.0094108	-0.0045909
	(0.036)	(0.048)	(0.005)	(0.004)	(0.011334)	(0.584)	(0.829)	(0.829)	(0.023)
f8	-0.0757978	-0.0727633	-0.1128318	-0.1091545	-0.107991	-0.0465272	-0.0533764	-0.0533767	0.0038934
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.068)	(0.000)	(0.000)	(0.055)
f9	0.0014124	0.0016751	-0.0007914	-0.0033756	0.000365	0.0437019	0.0142794	0.0142794	0.0033851
	(0.925)	(0.918)	(0.929)	(0.689)	(0.968152)	(0.153)	(0.278)	(0.278)	(0.096)
f10	-0.0266282	-0.026443	-0.0340546	-0.0370684	-0.023008	0.0406337	-0.0806422	-0.0806422	-0.007454
	(0.071)	(0.099)	(0.000)	(0.000)	(0.020841)	(0.331)	(0.000)	(0.000)	(0.000)
f11	-0.0222995	-0.0211326	-0.0368123	-0.0385469	-0.028202	-0.0010215	-0.0002728	-0.0002729	-0.0147941
	(0.130)	(0.183)	(0.000)	(0.000)	(0.002619)	(0.978)	(0.984)	(0.984)	(0.000)
f12	0.0816846	0.0818779	0.0853884	0.0735055	0.077629	0.0844089	0.0355725	0.0355726	0.0212287
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)	(0.006)	(0.006)	(0.000)
f13	0.0779869	0.0769469	0.0978029	0.0896888	0.080242	0.0785445	0.114079	0.1140789	0.0007278
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.025)	(0.000)	(0.000)	(0.718)
f14	0.0430394	0.0431098	0.051214	0.0303169	0.043942	0.0629831	0.0763757	0.0763757	-0.000968
	(0.001)	(0.003)	(0.000)	(0.001)	(0.000003)	(0.047)	(0.000)	(0.000)	(0.758)
f15	0.0221035	0.0213133	0.0406672	0.0338524	0.028227	0.1170819	0.0310431	0.0310431	0.0053761
	(0.076)	(0.109)	(0.000)	(0.000)	(0.002602)	(0.001)	(0.01)	(0.010)	(0.007)
f16	0.0044563	0.0041234	0.0145181	0.0031777	0.005283	-0.0114958	0.0307629	0.0307631	0.0069754
	(0.714)	(0.750)	(0.118)	(0.642)	(0.5945)	(0.735)	(0.028)	(0.028)	(0.000)
f17	0.0099371	0.0109983	0.0104826	0.0085012	0.003952	0.0583137	0.0283804	0.0283806	-0.0061922
	(0.443)	(0.426)	(0.245)	(0.302)	(0.673743)	(0.085)	(0.032)	(0.032)	(0.002)

f18	0.0104811	0.0121476	-0.0024144	-0.0084437	-0.002542	-0.0635076	0.0033573	0.0033574	---
	(0.437)	(0.392)	(0.785)	(0.281)	(0.78153)	(0.029)	(0.788)	(0.788)	---
f19	0.0249889	0.0252933	0.0222327	0.0119356	0.019115	0.0059925	-0.015526	-0.0155261	---
	(0.046)	(0.058)	(0.012)	(0.099)	(0.042315)	(0.818)	(0.215)	(0.215)	---
f20	-0.0019147	-0.0012118	-0.003337	-0.0184813	-0.005192	0.0926176	-0.0087221	-0.0087222	---
	(0.892)	(0.936)	(0.707)	(0.032)	(0.569148)	(0.018)	(0.498)	(0.498)	---
f21	0.0710278	0.0680539	0.0957856	0.0899684	0.090675	0.0175004	0.0384665	0.0384665	---
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.536)	(0.003)	(0.003)	---
_cons	0.0035566	0.0035566	0.0017254	0.0021761	0.004	0.8518292	-1.189695	-11.89695	-14.95615
	(0.820)	(0.835)	(0.845)	(0.564)	(0.348825)	(0.000)	(0.000)	(0.000)	(0.000)
rho	0.590255	0.62824263	-0.24176	---	0.007004	---	0.30284976	---	---
	---	---	(0.002)	---	(0.475574)	---	---	---	---
lambda	---	---	---	-1.221217	---	---	---	---	---
	---	---	---	(0.000)	---	---	---	---	---
sigma_u	0.1223119	0.12654284	---	---	---	---	1.0781443	---	---
	---	---	---	---	---	---	---	---	---
sigma_e	0.1019074	0.09734276	---	---	---	---	1.635786	---	---
	---	---	---	---	---	---	---	---	---

Figure 2a. Poland: Migration-Function (Model 4): Estimation results (coefficients sorted by size)

	Coefficient	Standard Error	P > |z|	95% Confidence Interval	
factord1	.0153122	.0020459	0.000	.0113023	.019322
factord2	-.0063749	.0074876	0.395	-.0210504	.0083006
factord3	-.0057717	.0020299	0.004	-.0097502	-.0017932
factord4	.0865912	.0020237	0.000	.0826248	.0905577
factord5	-.0072237	.0020193	0.000	-.0111815	-.0032659
factord6	.0386539	.0110061	0.000	.0170824	.0602255
factord7	-.0045909	.0020238	0.023	-.0085575	-.0006244
factord8	.0038934	.0020259	0.055	-.0000772	.007864
factord9	.0033851	.0020341	0.096	-.0006017	.0073718
factord10	-.007454	.0019941	0.000	-.0113623	-.0035457
factord 11	-.0147941	.0020124	0.000	-.0187384	-.0108498
factord12	.0212287	.002028	0.000	.0172538	.0252035
factord13	.0007278	.0020154	0.718	-.0032222	.0046779
factord14	-.000968	.0031414	0.758	-.0071251	.005189
factord15	.0053761	.00198	0.007	.0014954	.0092567
factord16	.0069754	.0018237	0.000	.003401	.0105498
factord17	-.0061922	.0019569	0.002	-.0100276	-.0023569
_cons	-14.95615	.0119866	0.000	-14.97964	-14.93265

*Level of significance: *0.1; ** 0.05; ***0.01.*

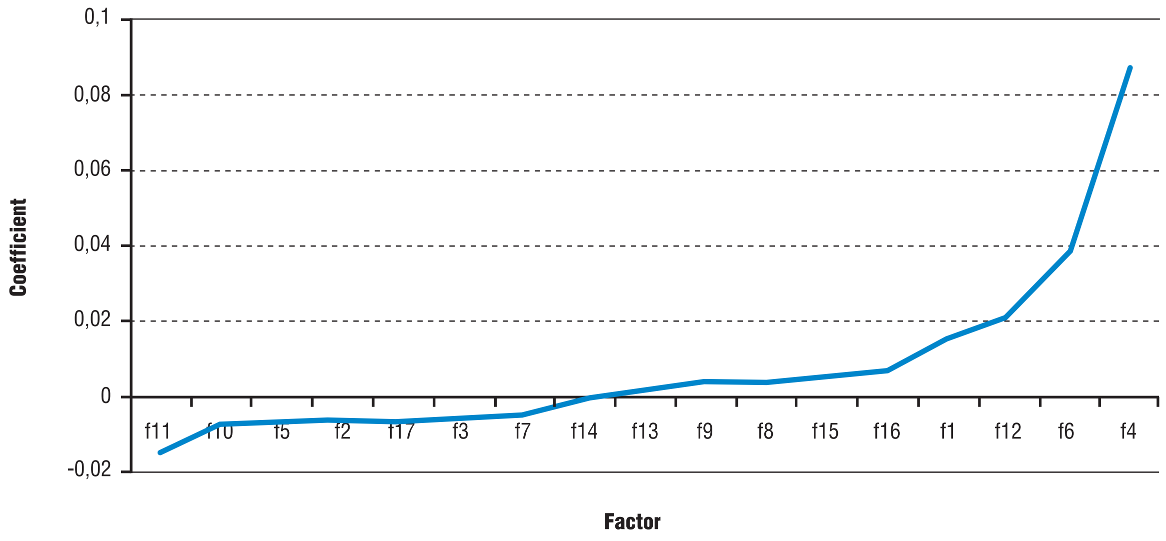
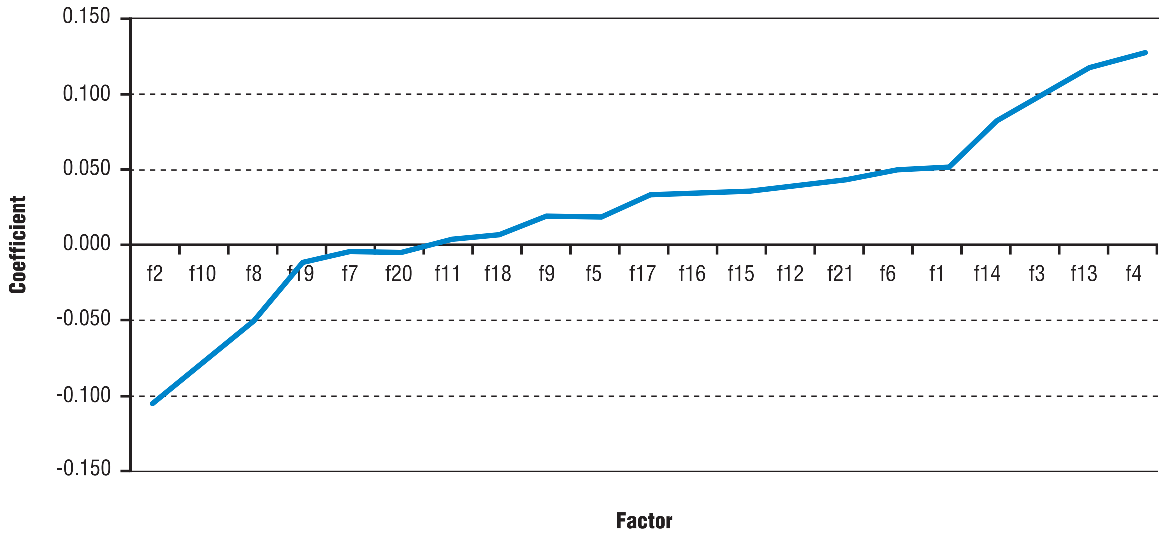


Figure 2b. Slovakia: Migration-Function (Model 4): Estimation results, coefficients sorted by size

	Coefficient	Standard Error	P > |z|	95% Confidence Interval	
f2***	-0,107	0,013	0	-0,133	-0,081
f10***	-0,081	0,013	0	-0,106	-0,055
f8***	-0,053	0,013	0	-0,078	-0,028
f19	-0,016	0,013	0,215	-0,04	0,009
f7	-0,009	0,044	0,829	-0,095	0,076
f20	-0,009	0,013	0,498	-0,034	0,017
f11	-0,0002	0,013	0,984	-0,026	0,026
f18	0,003	0,013	0,788	-0,021	0,028
f9	0,014	0,013	0,278	-0,012	0,04
f5	0,015	0,013	0,268	-0,011	0,04
f17**	0,028	0,013	0,032	0,002	0,054
f15**	0,031	0,012	0,01	0,007	0,055
f16**	0,031	0,014	0,028	0,003	0,058
f12***	0,036	0,013	0,006	0,01	0,061
f21***	0,038	0,013	0,003	0,013	0,064
f6***	0,044	0,013	0,001	0,019	0,07
f1***	0,048	0,013	0	0,022	0,074
f14***	0,076	0,013	0	0,05	0,103
f3***	0,096	0,013	0	0,07	0,122
f13***	0,114	0,013	0	0,089	0,139
f4***	0,121	0,013	0	0,096	0,147

*Level of significance: *0.1; ** 0.05; ***0.01.*



ANNEX 2. Poland: Ranking NUTS-4 regions in year 2005

Year	NUTS1	NUTS2	NUTS3	id	NUTS-4 regions	RDI 2005	Rank
2005	CENTRALNY	Mazowiecki	Warszawski	138	pruszkowski	0.6195706	1
2005	CENTRALNY	Mazowiecki	Warszawski	135	piaseczynski	0.617891	2
2005	CENTRALNY	Mazowiecki	Warszawski	148	warszawski zachodni	0.4900318	3
2005	CENTRALNY	Mazowiecki	Warszawski	125	legionowski	0.4500781	4
2005	CENTRALNY	Mazowiecki	Warszawski	122	grodziski	0.3755801	5
2005	POLNOCNO-Z	Wielkopols	Poznanski	286	poznanski	0.3342962	6
2005	CENTRALNY	Mazowiecki	Warszawski	150	wolominski	0.3337665	7
2005	CENTRALNY	Mazowiecki	Warszawski	134	otwocki	0.324424	8
2005	POLUDNIOWO	Dolnoslask	Wroclawski	23	wroclawski	0.2576797	9
2005	POLUDNIOWY	Malopolski	Krakowsko-	117	wielicki	0.23112	10
2005	POLNOCNY (	Pomorskie	Gdanski	204	gdanski	0.2191464	11
2005	CENTRALNY	Lodzkie	Lodzki	83	l¢dzki wschodni	0.2052962	12
2005	CENTRALNY	Mazowiecki	Warszawski	129	minski	0.1996907	13
2005	POLNOCNY (	Pomorskie	Gdanski	211	pucki	0.1982272	14
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	307	policki	0.1928254	15
2005	POLNOCNY (	Pomorskie	Gdanski	215	wejherowski	0.1830711	16
2005	POLUDNIOWY	Slaskie	Bielsko-bi	218	bielski	0.1820663	17
2005	POLNOCNY (	Pomorskie	Gdanski	205	kartuski	0.1640045	18
2005	CENTRALNY	Mazowiecki	Warszawski	123	gr¢jecki	0.1596713	19
2005	POLUDNIOWY	Malopolski	Krakowsko-	104	krakowski	0.1595205	20
2005	POLNOCNY (	Kujawsko-p	Bydgoski	29	bydgoski	0.1451555	21
2005	POLUDNIOWY	Malopolski	Nowosadeck	115	tatrzanski	0.1400122	22
2005	CENTRALNY	Mazowiecki	Warszawski	154	zyrardowski	0.1382332	23
2005	CENTRALNY	Mazowiecki	Warszawski	131	nowodworski	0.1367839	24
2005	POLUDNIOWY	Slaskie	Bielsko-bi	219	cieszynski	0.1360218	25
2005	CENTRALNY	Lodzkie	Lodzki	85	pabianicki	0.1223748	26
2005	POLUDNIOWY	Malopolski	Nowosadeck	116	wadowicki	0.1115575	27
2005	POLUDNIOWY	Malopolski	Nowosadeck	107	myslenicki	0.1114839	28
2005	POLNOCNO-Z	Wielkopols	Poznanski	270	grodziski	0.1031719	29
2005	POLNOCNO-Z	Lubuskie	Gorzowski	66	gorzowski	0.1019654	30
2005	POLNOCNO-Z	Wielkopols	Poznanski	278	leszczynski	0.1015964	31

2005	CENTRALNY	Lodzkie	Lodzki	97	zgierski	0.1004772	32
2005	POLNOCNO-Z	Wielkopols	Poznanski	294	wolsztynski	0.0905396	33
2005	POLNOCNY (	Pomorskie	Gdanski	214	tczewski	0.0887358	34
2005	POLNOCNO-Z	Wielkopols	Poznanski	276	koscianski	0.0869583	35
2005	CENTRALNY	Lodzkie	Lodzki	98	brzezinski	0.0854063	36
2005	CENTRALNY	Mazowiecki	Warszawski	145	sochaczewski	0.0834921	37
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	304	kolobrzeski	0.083386	38
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	41	torunski	0.0829176	39
2005	POLUDNIOWY	Malopolski	Nowosadeck	109	nowotarski	0.0813008	40
2005	CENTRALNY	Mazowiecki	Radomski	118	bialobrzeski	0.0763893	41
2005	POLNOCNO-Z	Lubuskie	Gorzowski	68	miedzyrzecki	0.075992	42
2005	CENTRALNY	Mazowiecki	Ostrolecko	151	wyszkowski	0.0733527	43
2005	POLUDNIOWY	Slaskie	Czestochow	220	czestochowski	0.072773	44
2005	POLUDNIOWO	Dolnoslask	Wroclawski	20	trzebnicki	0.0708755	45
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	6	jeleniog¢rski	0.06987	46
2005	POLUDNIOWO	Dolnoslask	Wroclawski	15	olawski	0.0670964	47
2005	WSCHODNI (	Podkarpack	Rzeszowsko	181	rzeszowski	0.0646662	48
2005	POLUDNIOWY	Slaskie	Centralny	224	mikolowski	0.0645031	49
2005	POLUDNIOWY	Slaskie	Bielsko-bi	233	zywiecki	0.0638041	50
2005	POLUDNIOWY	Slaskie	Czestochow	225	myszkowski	0.0622822	51
2005	POLUDNIOWO	Dolnoslask	Legnicki	3	glogowski	0.0622354	52
2005	POLNOCNO-Z	Wielkopols	Kaliski	283	ostrzeszowski	0.0613119	53
2005	POLNOCNO-Z	Wielkopols	Poznanski	281	obornicki	0.0607545	54
2005	POLNOCNY (	Warminsko-	Olsztynski	256	mragowski	0.0606613	55
2005	POLNOCNY (	Pomorskie	Gdanski	213	starogardzki	0.0598931	56
2005	POLNOCNY (	Pomorskie	Gdanski	206	koscierski	0.0597803	57
2005	POLNOCNY (	Warminsko-	Olsztynski	260	olsztynski	0.0596683	58
2005	POLNOCNO-Z	Wielkopols	Poznanski	289	szamotulski	0.0590489	59
2005	POLNOCNO-Z	Lubuskie	Zielonogor	74	zielonog¢rski	0.0586986	60
2005	POLUDNIOWO	Dolnoslask	Wroclawski	18	sredzki	0.057002	61
2005	POLNOCNO-Z	Wielkopols	Poznanski	290	sredzki	0.0537591	62
2005	POLNOCNO-Z	Wielkopols	Kaliski	287	rawicki	0.0533927	63
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	305	koszalinski	0.0531477	64
2005	POLUDNIOWO	Dolnoslask	Legnicki	11	lubinski	0.0519333	65
2005	POLNOCNO-Z	Lubuskie	Gorzowski	72	sulecinski	0.051168	66
2005	POLNOCNO-Z	Wielkopols	Poznanski	291	sremski	0.0498846	67
2005	POLUDNIOWY	Slaskie	Centralny	223	lubliniecki	0.0467664	68
2005	POLNOCNY (	Pomorskie	Gdanski	210	nowodworski	0.0467328	69
2005	POLUDNIOWY	Malopolski	Krakowsko-	99	bochenski	0.046079	70
2005	WSCHODNI (	Lubelskie	Lubelski	54	lubelski	0.0459807	71
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	1	boleslawiecki	0.0459494	72
2005	POLUDNIOWO	Dolnoslask	Wroclawski	14	olesnicki	0.0457812	73
2005	POLUDNIOWY	Malopolski	Nowosadeck	105	limanowski	0.045439	74
2005	POLUDNIOWY	Malopolski	Nowosadeck	113	suski	0.0454345	75
2005	POLUDNIOWY	Malopolski	Krakowsko-	100	brzeski	0.0446998	76
2005	POLNOCNO-Z	Lubuskie	Gorzowski	70	slubicki	0.0441287	77
2005	CENTRALNY	Mazowiecki	Radomski	120	garwolinski	0.0435753	78
2005	CENTRALNY	Mazowiecki	Ostrolecko	141	pultuski	0.0426853	79
2005	POLNOCNO-Z	Wielkopols	Kaliski	282	ostrowski	0.0417481	80
2005	CENTRALNY	Lodzkie	Lodzki	96	zdunskowolski	0.0416551	81
2005	POLNOCNO-Z	Wielkopols	Kaliski	269	gostynski	0.0406597	82
2005	CENTRALNY	Mazowiecki	Ciechanows	119	ciechanowski	0.0403694	83
2005	POLNOCNY (	Pomorskie	Gdanski	207	kwidzynski	0.0385107	84
2005	POLNOCNO-Z	Wielkopols	Kaliski	273	kepinski	0.0383711	85
2005	WSCHODNI (	Swietokrzy	Swietokrzy	244	starachowicki	0.0379123	86

2005	WSCHODNI (	Podlaskie	Bialostock	188	bialostocki	0.0371517	87
2005	CENTRALNY	Lodzkie	Piotrkowsk	93	tomaszowski	0.0369563	88
2005	POLNOCNY (	Pomorskie	Slupski	208	leborski	0.0369078	89
2005	POLNOCNO-Z	Lubuskie	Zielonogor	77	wschowski	0.036651	90
2005	POLNOCNO-Z	Wielkopols	Pilski	284	pilski	0.0364835	91
2005	CENTRALNY	Mazowiecki	Ciechanows	136	plocki	0.0354652	92
2005	POLNOCNO-Z	Wielkopols	Kaliski	272	kaliski	0.0353748	93
2005	CENTRALNY	Lodzkie	Piotrkowsk	90	rawski	0.0340216	94
2005	CENTRALNY	Mazowiecki	Ciechanows	137	plonski	0.0340138	95
2005	POLNOCNO-Z	Wielkopols	Pilski	266	chodzieski	0.0329877	96
2005	POLUDNIOWY	Slaskie	Czestochow	222	klobucki	0.0315885	97
2005	CENTRALNY	Mazowiecki	Radomski	142	radomski	0.03069	98
2005	POLNOCNO-Z	Wielkopols	Poznanski	268	gnieznienski	0.0306815	99
2005	POLNOCNO-Z	Wielkopols	Kaliski	285	pleszewski	0.0306166	100
2005	POLNOCNO-Z	Lubuskie	Zielonogor	73	swiebodzinski	0.0302278	101
2005	POLNOCNY (	Kujawsko-p	Bydgoski	40	swiecki	0.0263113	102
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	303	kamienski	0.0262272	103
2005	WSCHODNI (	Swietokrzy	Swietokrzy	240	ostrowiecki	0.0258888	104
2005	POLNOCNO-Z	Wielkopols	Poznanski	280	nowotomyski	0.0251827	105
2005	POLUDNIOWO	Dolnoslask	Wroclawski	13	milicki	0.0228478	106
2005	CENTRALNY	Mazowiecki	Ciechanows	130	mlawski	0.0217656	107
2005	POLNOCNO-Z	Wielkopols	Kaliski	271	jarocinski	0.0217001	108
2005	POLUDNIOWY	Malopolski	Krakowsko-	114	tarnowski	0.0214709	109
2005	POLUDNIOWO	Dolnoslask	Legnicki	22	wolowski	0.0212965	110
2005	WSCHODNI (	Swietokrzy	Swietokrzy	237	kielecki	0.0209293	111
2005	POLNOCNY (	Warminsko-	Elblaski	258	nowomiejski	0.0206727	112
2005	POLNOCNO-Z	Wielkopols	Poznanski	279	miedzychodzki	0.0201064	113
2005	POLUDNIOWY	Slaskie	Centralny	217	bedzinski	0.0200166	114
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	27	aleksandrowski	0.0192078	115
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	300	goleniowski	0.0185683	116
2005	CENTRALNY	Lodzkie	Lodzki	80	laski	0.0183024	117
2005	POLNOCNO-Z	Wielkopols	Poznanski	295	wrzesinski	0.0182111	118
2005	POLNOCNY (	Kujawsko-p	Bydgoski	42	tucholski	0.0177406	119
2005	POLNOCNY (	Warminsko-	Olsztynski	263	szczycienski	0.0169831	120
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	301	gryficki	0.0156206	121
2005	CENTRALNY	Mazowiecki	Ciechanows	121	gostyninski	0.0141688	122
2005	WSCHODNI (	Podkarpack	Rzeszowsko	168	debicki	0.0135536	123
2005	CENTRALNY	Mazowiecki	Radomski	124	kozienicki	0.0126938	124
2005	POLUDNIOWY	Malopolski	Krakowsko-	111	oswiecimski	0.0125664	125
2005	POLNOCNY (	Pomorskie	Slupski	202	chojnicki	0.0123978	126
2005	CENTRALNY	Mazowiecki	Ostrolecko	149	wegrowski	0.0123281	127
2005	POLUDNIOWY	Malopolski	Nowosadeck	108	nowosadecki	0.0112798	128
2005	CENTRALNY	Lodzkie	Piotrkowsk	89	radomszczanski	0.0106041	129
2005	POLUDNIOWO	Opolskie	Opolski	159	krapkowicki	0.0104969	130
2005	POLNOCNY (	Warminsko-	Elblaski	261	ostr¢dzki	0.0094971	131
2005	WSCHODNI (	Podlaskie	Bialostock	187	augustowski	0.0086615	132
2005	POLUDNIOWO	Opolskie	Opolski	163	opolski	0.0084746	133
2005	POLUDNIOWY	Slaskie	Centralny	226	pszczynski	0.0083704	134
2005	POLNOCNO-Z	Wielkopols	Koninski	288	slupecki	0.0073277	135
2005	WSCHODNI (	Podlaskie	Lomzynski	200	zambrowski	0.007004	136
2005	POLNOCNY (	Warminsko-	Elcki	251	elcki	0.0069708	137
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	308	pyrzycki	0.005486	138
2005	POLUDNIOWY	Slaskie	Rybnicko-j	228	rybnicki	0.0052993	139
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	28	brodnicki	0.0051811	140
2005	WSCHODNI (	Podkarpack	Krosniensk	169	jaroslawski	0.0047557	141

2005	POLUDNIOWO	Dolnoslask	Jeleniogor	10	lubanski	0.0040644	142
2005	CENTRALNY	Lodzkie	Piotrkowsk	82	lowicki	0.0029925	143
2005	CENTRALNY	Mazowiecki	Radomski	147	szydlowiecki	0.002616	144
2005	POLNOCNY (	Pomorskie	Slupski	201	bytowski	0.0023324	145
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	19	swidnicki	0.0020936	146
2005	WSCHODNI (	Lubelskie	Lubelski	56	lukowski	0.001446	147
2005	CENTRALNY	Lodzkie	Piotrkowsk	87	piotrkowski	0.00134	148
2005	POLNOCNO-Z	Wielkopols	Pilski	293	wagrowiecki	0.0011758	149
2005	POLUDNIOWO	Opolskie	Opolski	155	brzeski	0.0009449	150
2005	POLNOCNO-Z	Wielkopols	Koninski	275	koninski	0.000536	151
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	310	stargardzki	0.0004903	152
2005	WSCHODNI (	Podkarpack	Rzeszowsko	175	lancucki	0.0002592	153
2005	WSCHODNI (	Podkarpack	Rzeszowsko	176	mielecki	-0.0005548	154
2005	POLUDNIOWO	Dolnoslask	Legnicki	9	legnicki	-0.0007693	155
2005	POLUDNIOWY	Malopolski	Krakowsko-	112	proszowicki	-0.0008741	156
2005	POLUDNIOWO	Opolskie	Opolski	164	prudnicki	-0.0009249	157
2005	POLUDNIOWO	Opolskie	Opolski	165	strzelecki	-0.0010107	158
2005	WSCHODNI (	Podkarpack	Rzeszowsko	180	ropczycko-sedziszowski	-0.0012517	159
2005	CENTRALNY	Lodzkie	Piotrkowsk	78	belchatowski	-0.0023446	160
2005	POLNOCNY (	Warminsko-	Elcki	252	gizycki	-0.0026599	161
2005	CENTRALNY	Mazowiecki	Ciechanows	144	sierpecki	-0.0027007	162
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	302	gryfinski	-0.0030122	163
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	313	walecki	-0.0033607	164
2005	POLNOCNO-Z	Lubuskie	Zielonogor	76	zarski	-0.0033737	165
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	311	szczecinecki	-0.0040833	166
2005	POLNOCNO-Z	Wielkopols	Koninski	274	kolski	-0.0053177	167
2005	POLNOCNY (	Warminsko-	Elcki	259	olecki	-0.0054822	168
2005	POLNOCNY (	Pomorskie	Gdanski	209	malborski	-0.0055614	169
2005	CENTRALNY	Mazowiecki	Radomski	152	zwolenski	-0.0060917	170
2005	POLNOCNO-Z	Lubuskie	Zielonogor	67	krosnienski	-0.0068495	171
2005	CENTRALNY	Mazowiecki	Ostrolecko	146	sokolowski	-0.0071355	172
2005	WSCHODNI (	Podkarpack	Krosniensk	184	strzyzowski	-0.0079708	173
2005	CENTRALNY	Lodzkie	Lodzki	94	wielunski	-0.0081272	174
2005	CENTRALNY	Lodzkie	Lodzki	91	sieradzki	-0.0082563	175
2005	CENTRALNY	Lodzkie	Lodzki	95	wieruszowski	-0.0085808	176
2005	POLUDNIOWY	Slaskie	Rybnicko-j	227	raciborski	-0.0089668	177
2005	POLNOCNO-Z	Lubuskie	Zielonogor	69	nowosolski	-0.0092881	178
2005	POLNOCNY (	Kujawsko-p	Bydgoski	36	nakielski	-0.0095436	179
2005	CENTRALNY	Mazowiecki	Ostrolecko	132	ostrolecki	-0.009774	180
2005	CENTRALNY	Mazowiecki	Ostrolecko	139	przasnyski	-0.0099161	181
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	17	strzelinski	-0.0101202	182
2005	WSCHODNI (	Podlaskie	Bialostock	189	bielski	-0.0105099	183
2005	POLUDNIOWY	Malopolski	Krakowsko-	106	miechowski	-0.0106737	184
2005	WSCHODNI (	Swietokrzy	Swietokrzy	245	staszowski	-0.0107256	185
2005	POLNOCNO-Z	Wielkopols	Kaliski	277	krotoszynski	-0.0107405	186
2005	WSCHODNI (	Lubelskie	Lubelski	62	swidnicki	-0.0113942	187
2005	POLNOCNY (	Warminsko-	Elblaski	253	ilawski	-0.0115316	188
2005	POLNOCNY (	Pomorskie	Slupski	212	slupski	-0.0118063	189
2005	POLNOCNO-Z	Wielkopols	Koninski	292	turecki	-0.0121282	190
2005	POLNOCNY (	Warminsko-	Elcki	265	wegorzewski	-0.0122678	191
2005	CENTRALNY	Mazowiecki	Ostrolecko	133	ostrowski	-0.0123766	192
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	297	bialogardzki	-0.0124437	193
2005	WSCHODNI (	Lubelskie	Lubelski	59	pulawski	-0.012514	194
2005	WSCHODNI (	Swietokrzy	Swietokrzy	238	konecki	-0.012579	195

2005	WSCHODNI (	Swietokrzy	Swietokrzy	234	buski	-0.0125824	196
2005	POLNOCNY (	Warminsko-	Elblaski	250	elblaski	-0.012616	197
2005	POLNOCNY (	Kujawsko-p	Bydgoski	45	zninski	-0.0136964	198
2005	CENTRALNY	Lodzkie	Lodzki	79	kutnowski	-0.01437	199
2005	POLNOCNY (	Kujawsko-p	Bydgoski	39	sepolenski	-0.0145101	200
2005	CENTRALNY	Lodzkie	Piotrkowsk	92	skierniewicki	-0.0145444	201
2005	POLNOCNO-Z	Lubuskie	Gorzowski	71	strzelecko-drezdenecki	-0.0145907	202
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	31	golubsko-dobrzynski	-0.0148339	203
2005	POLUDNIOWY	Malopolski	Nowosadeck	103	gorlicki	-0.0163842	204
2005	CENTRALNY	Mazowiecki	Ostrolecko	143	siedlecki	-0.0172678	205
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	32	grudziadzki	-0.0172983	206
2005	POLNOCNY (	Kujawsko-p	Bydgoski	33	inowroclawski	-0.0180512	207
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	30	chelminski	-0.0182462	208
2005	WSCHODNI (	Podkarpack	Krosniensk	167	brzozowski	-0.0194324	209
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	306	mysliborski	-0.0197581	210
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	309	slawienski	-0.0200265	211
2005	WSCHODNI (	Lubelskie	Lubelski	53	lubartowski	-0.0201542	212
2005	POLNOCNO-Z	Wielkopols	Pilski	267	czarnkowsko-trzcianecki	-0.0201815	213
2005	CENTRALNY	Lodzkie	Piotrkowsk	84	opoczynski	-0.0202573	214
2005	CENTRALNY	Lodzkie	Lodzki	88	poddebicki	-0.0205785	215
2005	WSCHODNI (	Podlaskie	Bialostock	196	siemiatycki	-0.0216503	216
2005	WSCHODNI (	Swietokrzy	Swietokrzy	235	jedrzejowski	-0.0223204	217
2005	POLNOCNY (	Pomorskie	Gdanski	216	sztumski	-0.0223973	218
2005	CENTRALNY	Mazowiecki	Ostrolecko	128	makowski	-0.023281	219
2005	POLUDNIOWY	Slaskie	Rybnicko-j	231	wodzislawski	-0.0237396	220
2005	POLUDNIOWY	Malopolski	Krakowsko-	102	dabrowski	-0.0240966	221
2005	WSCHODNI (	Podkarpack	Rzeszowsko	171	kolbuszowski	-0.0242592	222
2005	CENTRALNY	Mazowiecki	Radomski	126	lipski	-0.0244142	223
2005	POLNOCNY (	Warminsko-	Elcki	262	piski	-0.0246611	224
2005	POLUDNIOWO	Opolskie	Opolski	161	nyski	-0.0254867	225
2005	POLUDNIOWO	Opolskie	Opolski	157	kedzierzynsko-kozielski	-0.0258666	226
2005	WSCHODNI (	Podlaskie	Lomzynski	199	wysokomazowiecki	-0.0270014	227
2005	WSCHODNI (	Swietokrzy	Swietokrzy	246	wloszczowski	-0.0278985	228
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	44	wloclawski	-0.0281137	229
2005	WSCHODNI (	Podkarpack	Rzeszowsko	173	lezajski	-0.0299211	230
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	43	wabrzeski	-0.0303616	231
2005	POLNOCNY (	Kujawsko-p	Bydgoski	35	mogilenski	-0.0307449	232
2005	POLUDNIOWY	Slaskie	Centralny	229	tarnog¢rski	-0.0312317	233
2005	POLUDNIOWY	Slaskie	Centralny	232	zawiercianski	-0.0314538	234
2005	CENTRALNY	Lodzkie	Lodzki	81	leczycki	-0.0327588	235
2005	WSCHODNI (	Podlaskie	Bialostock	191	hajnowski	-0.033241	236
2005	POLUDNIOWO	Dolnoslask	Legnicki	4	g¢rowski	-0.0337007	237
2005	WSCHODNI (	Swietokrzy	Swietokrzy	239	opatowski	-0.0341143	238
2005	CENTRALNY	Lodzkie	Piotrkowsk	86	pajeczanski	-0.0341649	239
2005	WSCHODNI (	Podkarpack	Rzeszowsko	185	tarnobrzeski	-0.0349477	240
2005	WSCHODNI (	Podlaskie	Bialostock	195	sejnenski	-0.0353643	241
2005	WSCHODNI (	Podkarpack	Krosniensk	170	jasielski	-0.0354567	242
2005	POLNOCNO-Z	Wielkopols	Pilski	296	zlotowski	-0.0360495	243
2005	POLUDNIOWY	Malopolski	Krakowsko-	110	olkuski	-0.0360742	244
2005	POLNOCNY (	Warminsko-	Elcki	264	goldapski	-0.0362679	245
2005	WSCHODNI (	Podkarpack	Krosniensk	172	krosnienski	-0.0378772	246
2005	WSCHODNI (	Swietokrzy	Swietokrzy	242	sandomierski	-0.0387405	247
2005	POLNOCNY (	Pomorskie	Slupski	203	czluchowski	-0.0394222	248

2005	POLNOCNY (	Kujawsko-p	Torunsko-w	34	lipnowski	-0.0396411	249
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	2	dzierzoniowski	-0.0397387	250
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	37	radziejowski	-0.0405111	251
2005	WSCHODNI (	Podkarpack	Rzeszowsko	183	stalowowolski	-0.0427012	252
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	299	drawski	-0.0428222	253
2005	POLNOCNY (	Warminsko-	Olsztynski	247	bartoszycki	-0.0429866	254
2005	POLUDNIOWO	Opolskie	Opolski	162	oleski	-0.0434428	255
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	5	jaworski	-0.0435491	256
2005	POLUDNIOWO	Opolskie	Opolski	160	namyslowski	-0.0438259	257
2005	POLNOCNY (	Warminsko-	Elblaski	249	dzialdowski	-0.0453102	258
2005	WSCHODNI (	Podlaskie	Bialostock	198	suwalski	-0.0462444	259
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	25	zgorzelecki	-0.0462996	260
2005	POLUDNIOWO	Opolskie	Opolski	158	kluczborski	-0.0470573	261
2005	CENTRALNY	Mazowiecki	Ostrolecko	127	losicki	-0.0473924	262
2005	POLNOCNY (	Warminsko-	Olsztynski	257	nidzicki	-0.0486257	263
2005	POLNOCNY (	Kujawsko-p	Torunsko-w	38	rypinski	-0.0491212	264
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	12	lw¢wecki	-0.0500909	265
2005	CENTRALNY	Mazowiecki	Radomski	140	przysuski	-0.0502719	266
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	24	zabkowicki	-0.0505324	267
2005	WSCHODNI (	Lubelskie	Lubelski	52	krasnicki	-0.0507762	268
2005	POLNOCNO-Z	Zachodniop	Szczecinsk	298	choszczenski	-0.0511864	269
2005	POLUDNIOWO	Opolskie	Opolski	156	glubczycki	-0.0517662	270
2005	WSCHODNI (	Podlaskie	Bialostock	194	moniecki	-0.0534603	271
2005	WSCHODNI (	Podkarpack	Rzeszowsko	177	nizanski	-0.0535586	272
2005	WSCHODNI (	Podlaskie	Lomzynski	190	grajewski	-0.0541181	273
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	7	kamiennog¢rski	-0.0546508	274
2005	POLNOCNO-Z	Zachodniop	Koszalinsk	312	swidwinski	-0.0582957	275
2005	WSCHODNI (	Swietokrzy	Swietokrzy	243	skarzyski	-0.06034	276
2005	WSCHODNI (	Podkarpack	Krosniensk	178	przemyski	-0.0603865	277
2005	WSCHODNI (	Podlaskie	Lomzynski	193	lomzynski	-0.0614623	278
2005	POLNOCNY (	Warminsko-	Olsztynski	255	lidzbarski	-0.0615006	279
2005	WSCHODNI (	Podlaskie	Bialostock	197	sok¢lski	-0.0616603	280
2005	WSCHODNI (	Podkarpack	Krosniensk	182	sanocki	-0.062557	281
2005	POLUDNIOWY	Slaskie	Centralny	221	gliwicki	-0.0634501	282
2005	WSCHODNI (	Podkarpack	Krosniensk	186	leski	-0.0640493	283
2005	POLUDNIOWY	Slaskie	Centralny	230	bierunsko-ledzinski	-0.0651434	284
2005	WSCHODNI (	Lubelskie	Lubelski	55	leczynski	-0.0663502	285
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	8	klodzki	-0.0663746	286
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	26	zlotoryjski	-0.06646	287
2005	POLUDNIOWO	Dolnoslask	Legnicki	16	polkowicki	-0.0669256	288
2005	WSCHODNI (	Lubelskie	Lubelski	61	rycki	-0.0698768	289
2005	WSCHODNI (	Swietokrzy	Swietokrzy	241	pinczowski	-0.0699466	290
2005	WSCHODNI (	Podkarpack	Krosniensk	179	przeworski	-0.0700971	291
2005	WSCHODNI (	Podlaskie	Lomzynski	192	kolnenski	-0.0703548	292
2005	POLNOCNO-Z	Lubuskie	Zielonogor	75	zaganski	-0.0706732	293
2005	WSCHODNI (	Lubelskie	Lubelski	50	janowski	-0.0711596	294
2005	CENTRALNY	Mazowiecki	Ciechanows	153	zurominski	-0.0731917	295
2005	WSCHODNI (	Lubelskie	Lubelski	57	opolski	-0.0738975	296
2005	POLNOCNY (	Warminsko-	Olsztynski	254	ketrzynski	-0.0747297	297
2005	WSCHODNI (	Lubelskie	Bialskopod	60	radzynski	-0.074765	298
2005	POLNOCNY (	Warminsko-	Elblaski	248	braniewski	-0.0754311	299
2005	WSCHODNI (	Lubelskie	Chelmsko-z	47	bilgorajski	-0.0760268	300
2005	WSCHODNI (	Swietokrzy	Swietokrzy	236	kazimierski	-0.0788447	301
2005	POLUDNIOWY	Malopolski	Krakowsko-	101	chrzanowski	-0.0789298	302
2005	WSCHODNI (	Lubelskie	Chelmsko-z	51	krasnostawski	-0.0811324	303

2005	POLNOCNO-Z	Zachodniop	Szczecinsk	314	lobeski	-0.0859722	304
2005	WSCHODNI (	Podkarpack	Krosniensk	174	lubaczowski	-0.0897232	305
2005	WSCHODNI (	Lubelskie	Bialskopod	46	bialski	-0.0919815	306
2005	WSCHODNI (	Lubelskie	Chelmsko-z	65	zamojski	-0.09563	307
2005	WSCHODNI (	Lubelskie	Bialskopod	64	wlodawski	-0.0962988	308
2005	WSCHODNI (	Lubelskie	Bialskopod	58	parczewski	-0.0994447	309
2005	WSCHODNI (	Lubelskie	Chelmsko-z	63	tomaszowski	-0.099909	310
2005	WSCHODNI (	Lubelskie	Chelmsko-z	48	chelmski	-0.1018753	311
2005	WSCHODNI (	Podkarpack	Krosniensk	166	bieszczadzki	-0.1042763	312
2005	WSCHODNI (	Lubelskie	Chelmsko-z	49	hrubieszowski	-0.1117482	313
2005	POLUDNIOWO	Dolnoslask	Jeleniogor	21	walbrzyski	-0.1141421	314

ANNEX 3. Slovakia: Ranking NUTS-4 regions in year 2005

Year	Oks	Disdrict	id	NUTS-4 regions	RDI	Rank
2005	108	Bratislava	4	Okres Senec	0.9227322	1
2005	107	Bratislava	3	Okres Pezinok	0.6123669	2
2005	201	Trnava	5	Okres Dunajská Streda	0.4818281	3
2005	100	Bratislava	1	Okres Bratislava I - V	0.4756532	4
2005	207	Trnava	11	Okres Trnava	0.4653926	5
2005	202	Trnava	6	Okres Galanta	0.4604303	6
2005	106	Bratislava	2	Okres Malacky	0.4396038	7
2005	204	Trnava	8	Okres Piešťany	0.3691574	8
2005	601	Banská Bystrica	39	Okres Banská Bystrica	0.3675302	9
2005	309	Trenčín	20	Okres Trenčín	0.3608834	10
2005	406	Nitra	26	Okres Topoľčany	0.350884	11
2005	613	Banská Bystrica	51	Okres Žiar nad Hronom	0.3251369	12
2005	206	Trnava	10	Okres Skalica	0.3183658	13
2005	405	Nitra	25	Okres Šaľa	0.3176727	14
2005	304	Trenčín	15	Okres Nové Mesto nad Váhom	0.3154868	15
2005	205	Trnava	9	Okres Senica	0.3123532	16
2005	203	Trnava	7	Okres Hlohovec	0.3120994	17
2005	305	Trenčín	16	Okres Partizánske	0.2993233	18
2005	404	Nitra	24	Okres Nové Zámky	0.2503592	19
2005	403	Nitra	23	Okres Nitra	0.2326357	20
2005	401	Nitra	21	Okres Komárno	0.1975368	21
2005	303	Trenčín	14	Okres Myjava	0.1863857	22
2005	307	Trenčín	18	Okres Prievidza	0.1807685	23
2005	611	Banská Bystrica	49	Okres Zvolen	0.1619759	24
2005	612	Banská Bystrica	50	Okres Žarnovica	0.1594588	25
2005	604	Banská Bystrica	42	Okres Detva	0.1115753	26
2005	506	Žilina	33	Okres Martin	0.1104098	27
2005	407	Nitra	27	Okres Zlaté Moravce	0.0970659	28
2005	511	Žilina	38	Okres Žilina	0.0930566	29
2005	508	Žilina	35	Okres Ružomberok	0.083531	30
2005	402	Nitra	22	Okres Levice	0.0786872	31
2005	301	Trenčín	12	Okres Bánovce nad Bebravou	0.0721815	32
2005	308	Trenčín	19	Okres Púchov	0.062122	33
2005	302	Trenčín	13	Okres Ilava	0.0504809	34
2005	505	Žilina	32	Okres Liptovský Mikuláš	0.0442787	35

2005	504	Žilina	31	Okres Kysucké Nové Mesto	0.0381189	36
2005	503	Žilina	30	Okres Dolný Kubín	0.0377225	37
2005	606	Banská Bystrica	44	Okres Lučenec	0.0363054	38
2005	602	Banská Bystrica	40	Okres Banská Štiavnica	0.0304395	39
2005	707	Prešov	58	Okres Prešov	0.0210179	40
2005	712	Prešov	63	Okres Svidník	0.0167922	41
2005	509	Žilina	36	Okres Turčianske Teplice	-0.0207629	42
2005	610	Banská Bystrica	48	Okres Veľký Krtíš	-0.0250817	43
2005	607	Banská Bystrica	45	Okres Poltár	-0.0333252	44
2005	800	Košice	66	Okres Košice I - IV	-0.0443389	45
2005	306	Trenčín	17	Okres Považská Bystrica	-0.0539491	46
2005	501	Žilina	28	Okres Bytča	-0.0806572	47
2005	605	Banská Bystrica	43	Okres Krupina	-0.0843034	48
2005	702	Prešov	53	Okres Humenné	-0.1373634	49
2005	808	Košice	69	Okres Rožňava	-0.1535023	50
2005	502	Žilina	29	Okres Čadca	-0.1589183	51
2005	807	Košice	68	Okres Michalovce	-0.1743169	52
2005	510	Žilina	37	Okres Tvrdošín	-0.1768976	53
2005	811	Košice	72	Okres Trebišov	-0.1905856	54
2005	809	Košice	70	Okres Sobrance	-0.2043191	55
2005	706	Prešov	57	Okres Poprad	-0.2064975	56
2005	810	Košice	71	Okres Spišská Nová Ves	-0.2068398	57
2005	608	Banská Bystrica	46	Okres Revúca	-0.2397224	58
2005	713	Prešov	64	Okres Vranov nad Topľou	-0.2417956	59
2005	609	Banská Bystrica	47	Okres Rimavská Sobota	-0.2464215	60
2005	603	Banská Bystrica	41	Okres Brezno	-0.2654727	61
2005	704	Prešov	55	Okres Levoča	-0.2694739	62
2005	711	Prešov	62	Okres Stropkov	-0.2786032	63
2005	806	Košice	67	Okres Košice - okolie	-0.291334	64
2005	701	Prešov	52	Okres Bardejov	-0.2927702	65
2005	709	Prešov	60	Okres Snina	-0.3008904	66
2005	703	Prešov	54	Okres Kežmarok	-0.3210428	67
2005	705	Prešov	56	Okres Medzilaborce	-0.330751	68
2005	710	Prešov	61	Okres Stará Ľubovňa	-0.3464734	69
2005	708	Prešov	59	Okres Sabinov	-0.3955054	70
2005	507	Žilina	34	Okres Námestovo	-0.4045707	71
2005	801	Košice	65	Okres Gelnica	-0.4652162	72

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Abstract

The main purpose of this research was to construct a multi-dimensional (composite) index measuring the overall level of rural development and quality of life in individual rural regions of a given EU country. In the Rural Development Index (RDI) the rural development domains are represented by hundreds of partial socio-economic, environmental, infrastructural and administrative indicators/variables at NUTS-4 level (e.g. 991 variables/indicators describing various aspects of rural development in Poland; 340 variables/indicators in Slovakia). The weights of economic, social and environmental domains entering the RDI index are derived empirically from the econometrically estimated intra- and inter-regional migration function after selecting the "best" model from various alternative model specifications (e.g. panel estimate logistic regression nested error structure model, spatial effect models, etc). The RDI is empirically applied to analysis of the main determinants of rural/regional development in individual rural areas in years 2002-2005 in Poland and Slovakia at NUTS-4 level. Due to its comprehensiveness the RDI Index is suitable both to analysis of the overall level of development of rural areas and to an evaluation of the impacts (impact indicator) of RD and structural programmes at regional levels (NUTS 2-5).

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