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Composite Indicator for Regional Innovative Systems of the Countries with Developing and Transitional Economy

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Abstract

Present article introduces composite indicator for regional innovative systems of the countries with developing and transitional economy. Using the factor analysis technique it exposes four principal unobservable factors, which reflect basic aspects of regional innovative systems. Those factors are used as sub indicators to elaborate composite indicator of the regional innovative systems. This composite indicator may be used for measurement of the regions innovative level. Proposed composite indicator can be easily adapted for other countries with developing and transitional economy (e.g. for the post USSR space). By way of illustration here are provided calculations of sub indicators and the composite indicator for Georgian regions (GRIS-2010).

Key words

Regional innovation systems, Developing countries, Countries in transition, Composite indicator, Factor analysis

JEL Classification: *C43, C81, O18, O3*

1. Introduction

Regional innovative systems (RIS) are the base of national innovative system (NIS) and determine innovative potential of the country. In order to manage such a complicated multidimensional phenomenon as RIS along with following monitoring of the results obtained it is necessary to work out special quantitative instrument. From nowadays point of view such instruments are composite indicators, which make it possible to interpret multidimensional nature of RIS by means of integrated characteristic, estimate the changes which take place within regional innovation systems and positioning them.

In the recent years due to the efforts of numerous organizations and researchers huge experience is accumulated in the scope of development of the composite indicators¹. Composite indicators were successfully utilized for estimating of the EU Lisbon strategy progress at the regional level of European Union members. Owing to this experience we come to the conclusion that within the existing theoretical and methodological frames principal difficulties related to certain composite indicators establishment are connected with the availability of qualitative initial statistical data. For example, due to the statistical data availability problem earlier European regional innovation scoreboards (2002,2003 yy) assessed innovative potential of just EU15

¹ see <http://composite-indicators.jrc.ec.europa.eu/>

member countries regions. Only substantial renewal of the initial indicators composition in 2006 made possible to consider also EU new member countries regions (see Hollanders H. (2007)).

Statistical data availability problem is overall and is a burning issue especially for the countries with developing and transitional economy both at the regional and national level (see Tijssen R., Hollanders H.(2006); Bhutto, A., P.L. Rashdi, Abro, Q.M.(2012)). On the other hand, exactly in this case may turn out to be most useful to have composite indicators which reflect various features of innovative development. Lately increases interest to the issues related to the establishment of special indicators for countries with developing and transitional economy at the national level (see Archibugi D., Coco A.(2004); Chen D. H. C., Dahlman C. J. (2005)). However, we must notice that the modern literature insufficiently represents the problems concerning to the creating of new composite indicators related to the regional aspects of innovative development for the countries with developing and transitional economy.

In the present article we intend to show that for the countries with developing and transitional economy it is possible to elaborate composite indicator which may become an efficient tool to estimate current innovative processes at the regional level. Within our investigation we will be based on the Georgian example. The proposed composite indicator seems to be easily adapted to other countries (e.g. for the post USSR space) too because it use specially selected group of initial indicators which are quite available.

Article is arranged as follows: next paragraph contains some methodological issues and generation of GRIS-2010 indicator; the third paragraph is concerned to the capabilities of this indicator to estimate innovative level of Georgian regions and reveals its relationship with basic economic indicators of the regions; and finally we draw conclusions, submit citation and technical annexes which includes definitions of the initial indicators and results of certain calculations.

2. GRIS-2010 Indicator

2.1 Innovative System of the Region

Concept of RIS cleared up after the intensive scientific discussion, held over last twenty years, but still it has not obtained final shape. For example, Doloreux D., Parto S. (2004) claims: “The concept of RIS has no commonly accepted definitions but usually is understood as a set of interacting private and public interests, formal institutions and other organizations that function according to organizational and institutional arrangements and relationships conducive to the generation, use and dissemination of knowledge”.

To be clearer, let's discuss particular components of RIS concept. First of all, concept of RIS needs definitions of region and innovation. Following Cooke, P., Uranga, M. J., Etxebarria, G. (1997) region is: “...a territory less than its sovereign state, possessing distinctive supralocal administrative, cultural, political, or economic power and cohesiveness, differentiating it from its state and other regions”. On the other hand, OECD,EUROSTAT(2005) Oslo Manual suggests following definition of the concept of innovation: “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations”. As for the essence of “innovative system”, it is defined by Gregersen B., Johnson, B.(1997) in

the following way: “ The central idea of the concept of innovation systems is that the overall innovation performance of an economy depends not only on how specific organizations like firms and research institutes perform, but also on how they interact with each other and with the government sector in knowledge production and distribution. Innovating firms operate within a common institutional set-up and they jointly depend on, contribute to and utilize a common knowledge infrastructure. It can be thought of as a system which creates and distributes knowledge, utilizes this knowledge by introducing it into the economy in the form of innovations, diffuses it and transforms it into something valuable, for example, international competitiveness and economic growth”.

Hence we can conclude that: 1. RIS is a social system which operates due to the interaction of its constituent actors (companies, research and academic organizations, regional administration, technical mediators and other formal and informal institutions); 2. In the course of functioning RIS exploits accessible resources (human, financial, infrastructural, institutional etc.) both local and national; 3. RIS ensures generation and dissemination of knowledge, as well as its utilization in innovations; 4. Results of RIS functioning call forth economic development of region.

2.2. Definition of the Region and Initial Indicators

With the practical view of composite indicators elaboration at the regional level, definition of a region is of crucial importance. Practical definition of regions, along with conceptual aspects, should consider availability of the statistical information for initial indicators set. Various possibilities of region practical definition may exist in different countries. For example, to produce RIS composite indicator for Georgia (GRIS-2010), in light of statistical information availability, it is considerable to define region, as a second level body of state administering (see Annex A, Table A.1.). Possibility to capture information at the lower levels of country administrative division is much more restricted.

On the base of the above-stated conceptual representation (see 2.1.) and of the multilateral testing of available data we singled out assortment of initial indicators given below.

In order to reflect resource capability of RIS we picked out following indicators:

Educational Level (EDL), - this indicator reflect to estimate professional skills of regional labor force.

Infrastructure (INF). - this indicator reflect regional infrastructure development level and represented by the share of households, equipped with personal computers.

Governmental Support (GSP) - this indicator reflect state support level and represents volume of transfers from state budget to the region.

In order to reflect of RIS social networks we have chosen following indicator:

Social Network (NET). - this indicator reflect existing social nets in the region. It points out the level of participation of citizens in various voluntary organization.

In order to reflect knowledge generation and utilization we have chosen following indicators:

Knowledge Generation (KNG) - this indicator reflect intellectual production in the region and represented by number of patent applications.

Knowledge Intensive Production (KIP) -this indicator characterizes employment in high and medium- high technology industries and knowledge- intensive services.

In order to reflect results of RIS functioning we have chosen indicator

Competitive Capacity (CMP)- this indicator reflect value added per capita in the region.

Annex A includes thorough definitions of above-mentioned seven indicators. Certainly, this assortment of indicators needs some efforts to be retrieved from existing sources, but they seem substantially accessible for numbers of countries with developing and transitional economy. It should be noted also, that **NET** is the sole indicator in present assortment which uses external source of information – it is obtained from the World Values Survey data. This fact cannot be considered as a serious restriction because the appropriate set of WVS's questions may be involved by the state statistic offices into the regularly held General Household Survey with no effort.

2.3. Normalization and Aggregation of the Initial Data

Let us introduce following designations: R is (finite) set of regions and its cardinality $|R| = M$; $x_i : R \rightarrow \mathbf{R}, 1 \leq i \leq N$, where \mathbf{R} is a set of real numbers designates set of initial indicators. Accordingly, $x_i(r)$ is a value of i -th ($1 \leq i \leq N$) indicator for region $r \in R$. Further we consider that indicators $x_i, 1 \leq i \leq N$, have "same direction". It means that the less value of indicator corresponds to the "worse" and greater- to the "better". Symbols

$$\bar{x}_i = \frac{1}{M} \sum_{r \in R} x_i(r), \quad \sigma_i = \left(\frac{1}{M-1} \sum_{r \in R} (x_i(r) - \bar{x}_i)^2 \right)^{1/2}$$

designate mean and standard deviation of the i -th indicator, $1 \leq i \leq N$, respectively.

As far as the initial indicators are represented in different scale units, it is reasonable to normalize them. With this view we use following standardization procedure (z-scores):

$$I_i(r) = \frac{x_i(r) - \bar{x}_i}{\sigma_i}, \quad r \in R$$

Functions, obtained as a result of the present procedure, we denominate normalized initial indicators.

Choice of aggregation procedure is a crucial moment within the process of composite indicator construction. As this problem cannot be solved unequivocally we shall use most simple and widely applied linear aggregation scheme:

$$I(r) = \sum_{1 \leq i \leq N} w_i I_i(r), \quad r \in R,$$

where $w_i \left(w_i \geq 0, 1 \leq i \leq N; \sum_{1 \leq i \leq N} w_i = 1 \right)$ are the weights of the i -th ($1 \leq i \leq N$) normalized initial indicator in the composite indicator. After the decision is made, problem of aggregation procedure choice comes to the problem of weights choice. It should be noted, that despite of this important simplification weights choice issue remains non-trivial and has not unequivocal solution. In order to choose weights we use factor analysis method as in Nicoletti G., Scarpetta S., Boylaud O.(2000) (details of realization see in the Annex B).

2.4. Construction of GRIS-2010 Indicators

In this paragraph we carry out constructing procedure of the composite indicator GRIS-2010, which reflects innovative systems' current condition in the Georgian regions by 2010 status. Initial indicators values underlying GRIS-2010 calculations are given in the Annex B (see Table B.1.). Values of normalized initial indicators presented in Table 2.1.

-----Table 2.1.-----

Using factor and cluster analysis techniques (see Annex B) we come to the conclusion: It is possible to arrange normalized initial indicators within the following sub indicators which allow quite simple interpretation: **Inner resources - INRS** (EDL, KGN, and INF), **Connection with NIS - NISC** (GSP, KIP), **Social network- NETW** (NET) and **Competitive capacity CMPT** (CMP). Values of GRIS-2010 composite indicator and corresponding sub indicators presented in Table 2.2.

-----Table 2.2.-----

3. Georgia's Regions Innovative Capacities Estimation by GRIS-2010

The ranking of Georgia's Regions by Indicator GRIS-2010 and its sub indicators is given in the Table 3.1. Composite Indicator GRIS-2010 also enables to classify regions by their innovative capacities (see the Annex B). For example, we can sort out following five clusters of the regions: CL1=(TB), CL2=(QQ), CL3=(AC), CL4=(IM, SQ, MM, SJ), CL5=(GU,SS,RL,KA).

-----Table 3.1.-----

GRIS-2010 and its sub indicators analysis shows that there is considerable difference between the RIS of the Georgia's regions by their innovative capacities (see Fig.3.1. Panels A,B). We should notice that inner resources of almost every region of Georgia except Tbilisi (TB) and Ajara (AC) are below the country average. We also should take notice of a fact that links to NIS of the regions, contained in the clusters CL4=(IM, SQ, MM, SJ), CL5=(GU,SS,RL,KA) are below the country average.

More detailed analysis shows (see Fig.3.1. Panels C,D) that differences between the regions RIS are deeply rooted in the inequalities by such the factors, as: education, infrastructure, governmental support, knowledge generation capacities etc. Problem of elimination of above-mentioned inequalities in the regions is one of the most serious challenges Georgia confronts.

----- Fig. 3.1.-----

In order to analyze interrelations between GRIS-2010 indicator values and main economic indexes of the regions let's introduce following denotations: Y – value added per capita, K – fixed capital per capita, E – employed per capita. We also denote by I a RIS composite indicator (GRIS-2010 indicator in our case) and define labor efficiency by the equation $A(I) = A_0 \exp(I)$. Suppose production process in the region is being described by Cobb-Douglas production function:

$$Y = K^\alpha (A(I)E)^{1-\alpha}$$

where $0 < \alpha < 1$. Hence, we obtain

$$\left(\frac{Y}{\exp(I)E} \right) = A_0^{1-\alpha} \left(\frac{K}{\exp(I)E} \right)^\alpha$$

Supposing now $A(I) = A_K K^{\gamma_K}$ (see Romer D.(1996)) and $A(I) = A_E E^{\gamma_E}$ we obtain following equations

$$K = \left(\frac{A_0}{A_K} \right)^{1/\gamma_K} e^{(1/\gamma_K)I}, \quad E = \left(\frac{A_0}{A_E} \right)^{1/\gamma_E} e^{(1/\gamma_E)I}$$

If we define parameters γ_Y, A_Y by the equations

$$\gamma_Y = \left[\alpha \frac{1}{\gamma_K} + (1-\alpha) \frac{1+\gamma_E}{\gamma_E} \right]^{-1}, \quad A_Y = A_K^{\frac{\gamma_Y-\alpha}{\gamma_K}} A_E^{\frac{\gamma_Y(1-\alpha)}{\gamma_E}}$$

Under these assumptions we get $A(I) = A_Y Y^{\gamma_Y}$ and accordingly

$$Y = \left(\frac{A_0}{A_Y} \right)^{1/\gamma_Y} e^{(1/\gamma_Y)I}$$

These equations allow us to make following estimation: $\alpha = 0.4837$, $A_0 = 5.0283$. (see Fig 3.2. Panel D); $\gamma_K \approx 1.1808$, $A_K \approx 3.9884$; $\gamma_E \approx 1.4937$, $A_E \approx 447.9457$ (see Fig.3.2. Panel B,C); $\gamma_Y \approx 0.9627$, $A_Y \approx 9.1574$ (see Fig. 3.2., Panel A)

----- **Fig. 3.2.** -----

Above-stated theoretical assumptions are in satisfactory agreement with empirical data and GRIS-2010 indicator has satisfactory explanatory power - R^2 index values make up for GRIS-2010 indicator's regression: relative to the Value added per capita – 0.9; relative to the Fixed capital per capita-0.6; relative to the Employed per capita – 0.9 and R^2 index values for production function estimation is 0.6.

4. Conclusion

Regional innovative systems (RIS), as the components of national innovative system, determine innovative potency of the country. This circumstance makes very important to work out specific quantitative instrument with a view of analysis and monitoring processes within the RIS-es of the countries with developing and transitional economy. Considerably RIS composite indicators should serve as such an instrument. Unfortunately the modern literature insufficiently represents the problems concerning to the creating of composite indicators related to the regional aspects of innovative development for the countries with developing and transitional economy.

The goal of present article is to make up for above-mentioned deficiency at least in part. On the basis of Georgian example we showed that for the countries with developing and transitional economy it is possible to elaborate composite indicator which may become an efficient tool to estimate current innovative processes at the regional level. For the construction of the composite indicator introduced here we used specially selected quite available set of initial indicators and applied widely practiced factor analysis technique. Testing of this composite indicator based

upon the Georgian regions' data, revealed its satisfactory capacity both for regions ranking, classification and regarding links with main economic indicators of the regions.

Present composite indicator seems to be easily adapted in the case of other countries. However, we apprehend its narrowness we consider it necessary further detailed investigations to elaborate composite indicators which will serve as an index of innovative processes regional aspects for the countries with developing and transitional economy.

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Annex A

GRIS-2010 Initial Indicators and their Multivariant Analysis

1. Regions

With the view of research goals Georgian regions are represented by the second level administration units (see Table A.1).

-----Table A.1-----

2. Initial Indicators

EDL – Educational Level:

Indicator defined as a share 25 – 64 age population having tertiary education in the region.

Demension: percent

Information source: Households general survey (Geostat)

INF - Infrastructure:

Indicator defined as a share of households equipped by PC in the region.

Demension: percent

Information source: Households general survey (Geostat)

GSP –Governmental Support

Indicator defined as per capita transfers from state budget to the region.

Demension: GEL per capita

Information source: State budget (Ministry of Finance of Georgia) and Demographic statistics (Geostat)

NET – Social Nets

Indicator defined as share of region residents which have stated that they are active members of at least one voluntary organization contained in the following list: sports and fitness, religious, arts and education, labor union, political parties, environmental, charity-humanitarian, any other. Information is captured through the answers on questions V24-V33 of World Values Survey ().

Demension: percent

Information source: World Values Survey

KNG - Knowledge Generation

Indicator is defined as a number of patent applications per 1000 labor force representatives. In case of co-authors application the index is to be divided proportionally co-author's regions number.

Demension: Number of patents per 1000 labor force representatives

Information source: Patent applications (SAKPATENTI) and Labor statistics (Geostat)

KIP – Knowledge-intensive Production and Services

Indicator is defined as share of employed in High- and Medium-high technology Industries and Knowledge-intensive Services in the region. High- and Medium-high technology Industries and Knowledge-intensive Services are to be determined according to standart classification (see Table A.2).

Demension: percent

Information source: Business register (Geostat).

-----Table A.2.-----

CMP – Competitive Capacity

Indicator represents ratio of extra costs throughout the region to the total number of employed.

Dimension: 1000 GEL per employee.

Information source: Production statistics (Geostat).

Initial statistical data available by special request or directly from internet sites:

Geostat - <http://www.geostat.ge>

Ministry of Finance of Georgia - <http://www.mof.ge>

National Intellectual Property Centr SAKPATENTI - <http://www.sakpatenti.org.ge>

World Values Survey - <http://www.worldvaluessurvey.org>

Annex B

Multivariate Analysis of Initial Indicators

On the basis of the normalized initial indicators (see Table 3.1) correlation matrix's eigenvalues (see Fig. B.1.) and rotated loading factor's weights analysis (see Table B.2.), we consider to be reasonable retaining four leading factors for the further analysis. These four factors explain about 99% of data variation. In order to arrange initial indicators within sub indicators and to specify their weights we use Nicoletti G., Scarpetta S., Boylaud O. (2000) approach² (see Tables B.3., B.4).

-----Table B.1.-----

-----Table B.2.-----

-----Table B.3.-----

-----Table B.4.-----

----- Fig. B.1.-----

----- Fig. B.2.-----

²In slightly different way, we use also additional information obtained from the normalized initial indicators cluster analysis (see Fig.B.2. Panel B) which makes practically unequivocal procedure of initial indicators arrangement within sub indicators (see Table B.3.)

Tables

Table 2.1 Values of Normalized Initial Indicators for GRIS-2010

REGION		EDL	NET	GSP	INF	KNG	KIP	CMP
TB	Tbilisi	2.96	-0.24	2.36	2.87	3.00	1.80	1.81
AC	Ajara	0.05	-0.95	1.52	0.50	-0.32	1.45	-0.16
GU	Guria	-0.27	-1.31	-0.51	-0.45	-0.12	-0.64	-0.73
IM	Imereti	-0.27	-0.22	-0.44	-0.30	-0.12	-0.30	-0.42
KA	Kakheti	-0.35	-0.68	-0.55	-0.46	-0.32	-0.57	-0.87
MM	Mtskheta-Mtianeti	-0.24	0.77	-0.43	-0.45	-0.33	-0.70	-0.37
RL	Racha-Lechkhumi-Qvemo Svaneti	-0.27	-0.22	0.19	-0.45	-0.40	-0.80	-1.22
SS	Samegrelo-Zemo Svaneti	-0.26	-0.46	-0.52	-0.45	-0.39	-0.67	0.33
SJ	Samtskhe-Javaxeti	-0.75	0.90	-0.53	-0.45	-0.41	-0.13	0.36
QQ	Qvemo Qartli	-0.47	2.26	-0.56	0.12	-0.33	1.30	1.77
SQ	Shida Qartli	-0.14	0.14	-0.53	-0.45	-0.26	-0.74	-0.49

Table 2.2 Values of GRIS-2010 Composite Indicator and its Sub indicators

REGION		INRS	NISC	NETW	CMPT	GRIS-2010
TB	Tbilisi	1.68	0.42	-0.05	0.05	2.11
AC	Ajara	0.02	0.32	-0.18	0	0.16
GU	Guria	-0.15	-0.13	-0.25	-0.02	-0.56
IM	Imereti	-0.13	-0.07	-0.04	-0.01	-0.25
KA	Kakheti	-0.21	-0.12	-0.13	-0.02	-0.49
MM	Mtskheta-Mtianeti	-0.19	-0.14	0.15	-0.01	-0.20
RL	Racha-Lechkhumi-Qvemo Svaneti	-0.21	-0.13	-0.04	-0.04	-0.41
SS	Samegrelo-Zemo Svaneti	-0.21	-0.14	-0.09	0.01	-0.42
SJ	Samtskhe-Javaxeti	-0.31	-0.05	0.17	0.01	-0.18
QQ	Qvemo Qartli	-0.14	0.19	0.43	0.05	0.53
SQ	Shida Qartli	-0.16	-0.15	0.03	-0.01	-0.29

**Table 3.1. Ranking of Georgia's Regions
by Composite Indicator GRIS-2010 and its sub Indicators**

REGION		INRS	NISC	NETW	CMPT	GRIS-2010
TB	Tbilisi	1	1	7	1	1
AC	Ajara	2	2	10	5	3
GU	Guria	5	7	11	9	11
IM	Imereti	3	5	5	6	6
KA	Kakheti	8	6	9	9	10
MM	Mtskheta-Mtianeti	7	9	3	6	5
RL	Racha-Lechkhumi-Qvemo Svaneti	8	7	5	11	8
SS	Samegrelo-Zemo Svaneti	8	9	8	3	9
SJ	Samtskhe-Javaxeti	11	4	2	3	4
QQ	Qvemo Qartli	4	3	1	1	2
SQ	Shida Qartli	6	11	4	6	7

Table A.1. Georgian Regions

N-Code	A-Code	REGION
11	TB	Tbilisi
15	AC	Ajara
23	GU	Guria
26	IM	Imereti
29	KA	Kakheti
32	MM	Mtskheta-Mtianeti
35	RL	Racha-Lechkhumi-Qvemo Svaneti
38	SS	Samegrelo-Zemo Svaneti
41	SJ	Samtskhe-Javaxeti
44	QQ	Qvemo Qartli
47	SQ	Shida Qartli
Remark: This list does not include regions occupied by Russian Federation		

Table A.2. High- and Medium-high technology Industries and Knowledge-intensive Services

	ISIC Rev. 3
High-technology industries	
Aircraft and spacecraft	353
Pharmaceuticals	2423
Office, accounting and computing machinery	30
Radio, television and communication equipment	32
Medical, precision and optical instruments	33
Medium-high-technology industries	
Electrical machinery and apparatus, n.e.c.	31
Motor vehicles, trailers and semi-trailers	34
Chemicals excluding pharmaceuticals	24 excl. 2423
Railroad equipment and transport equipment, n.e.c.	352 + 359
Machinery and equipment, n.e.c.	29

Knowledge-intensive services (KIS)	
Water transport	61
Air transport	62
Post and telecommunications	64
Financial intermediation, except insurance and pension funding	65
Insurance and pension funding, except compulsory social security	66
Activities auxiliary to financial intermediation	67
Real estate activities	70
Renting of machinery and equipment without operator and of personal and household goods	71
Computer and related activities	72
Research and development	73
Other business activities	74
Education	80
Health and social work	85
Recreational, cultural and sporting activities	92
Sorse: OECD	

Table B.1. GRIS-2010 Initial Indicators

REGION		EDL	NET	GSP	INF	KNG	KIP	CMP
TB	Tbilisi	58.2%	4.8%	448	44.4%	0.405	4.4%	19.99
AC	Ajara	27.7%	1.6%	335	16.9%	0.014	3.8%	10.83
GU	Guria	24.4%	0.0%	58	5.9%	0.038	0.3%	8.19
IM	Imereti	24.4%	4.9%	69	7.7%	0.038	0.9%	9.62
KA	Kakheti	23.5%	2.8%	54	5.8%	0.014	0.4%	7.57
MM	Mtskheta-Mtianeti	24.7%	9.3%	70	5.9%	0.013	0.2%	9.85
RL	Racha-Lechkhumi-Qvemo Svaneti	24.4%	4.9%	155	5.9%	0.004	0.1%	5.92
SS	Samegrelo-Zemo Svaneti	24.5%	3.8%	58	5.9%	0.006	0.3%	13.11
SJ	Samtskhe-Javaxeti	19.3%	9.9%	56	5.9%	0.004	1.2%	13.24
QQ	Qvemo Qartli	22.3%	16.0%	52	12.5%	0.013	3.6%	19.81
SQ	Shida Qartli	25.7%	6.5%	56	5.9%	0.021	0.2%	9.30
MEAN		27.2%	5.9%	128	11.2%	0.05	1.4%	11.58
STDEV		10.5%	4.5%	136	11.6%	0.12	1.7%	4.65
MEDIAN		24.4%	4.9%	58	5.9%	0.01	0.4%	9.85
MAX		58.2%	16.0%	448	44.4%	0.41	4.4%	19.99
MIN		19.3%	0.0%	52	5.8%	0.00	0.1%	5.92

Table B.2. Factors Rotated by Varimax Method

	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Communality
EDL	0.947872	0.295748	-0.05802	0.05436	0.050935	0.062794	-0.00385	0.99853832
NET	-0.14458	0.023746	0.916703	-0.02669	-0.01083	-0.0016	0.000252	0.85377343
GSP	0.660431	0.663272	-0.21777	-0.10139	0.248984	0.004645	0.000345	0.99472553
INF	0.841299	0.529316	0.073563	0.074863	0.022984	-5.61E-05	0.019266	0.99983521
PAT	0.963392	0.239593	0.023381	0.086999	-0.04549	-0.05752	-0.0054	0.99879669
HTM+KIS	0.372003	0.878302	0.274883	0.102731	-0.04784	-0.00028	-0.00141	0.9977181
VAD/EMP	0.438849	0.442922	0.668616	0.36863	-0.03652	-0.00045	0.0003	0.96959161
Proportion	0.486627	0.268495	0.207941	0.025421	0.010388	0.001066	6.11E-05	
Cum	0.486627	0.755123	0.963064	0.988485	0.998873	0.999939	1	

Table B.3. Formation of sub indicators

	Squared factors				Scaled to unity sum squared factors			
	Factor1	Factor2	Factor3	Factor4	Factor1	Factor2	Factor3	Factor4
EDL	0.898461	0.087467	0.003366	0.002955	0.27	0.05	0.00	0.02
NET	0.020904	0.000564	0.840344	0.000712	0.01	0.00	0.59	0.00
GSP	0.436169	0.43993	0.047425	0.010279	0.13	0.24	0.03	0.06
INF	0.707784	0.280175	0.005412	0.005604	0.21	0.15	0.00	0.03
PAT	0.928124	0.057405	0.000547	0.007569	0.28	0.03	0.00	0.04
KIP	0.138386	0.771415	0.075561	0.010554	0.04	0.42	0.05	0.06
CMP	0.192588	0.19618	0.447048	0.135888	0.06	0.11	0.31	0.78
Sum	3.322417	1.833135	1.419702	0.173561	1	1	1	1
Proportion	0.492296	0.271623	0.210363	0.025717				

**Table B.4. Weights of initial indicators and sub indicators
in GRIS-2010 indicator**

Sub Indicator	Initial Indicator	Initial Indicator's Weight in Sub Indikator	Sub Indicator's Weight	Initial Indicator's Weight
INRS	KNG	0.37	0.57	0.21
	EDL	0.35		0.20
	INF	0.28		0.16
NISC	KIP	0.77	0.22	0.17
	GSP	0.23		0.05
NETW	NET	1.00	0.19	0.19
CMPT	CMP	1.00	0.03	0.03

Figures

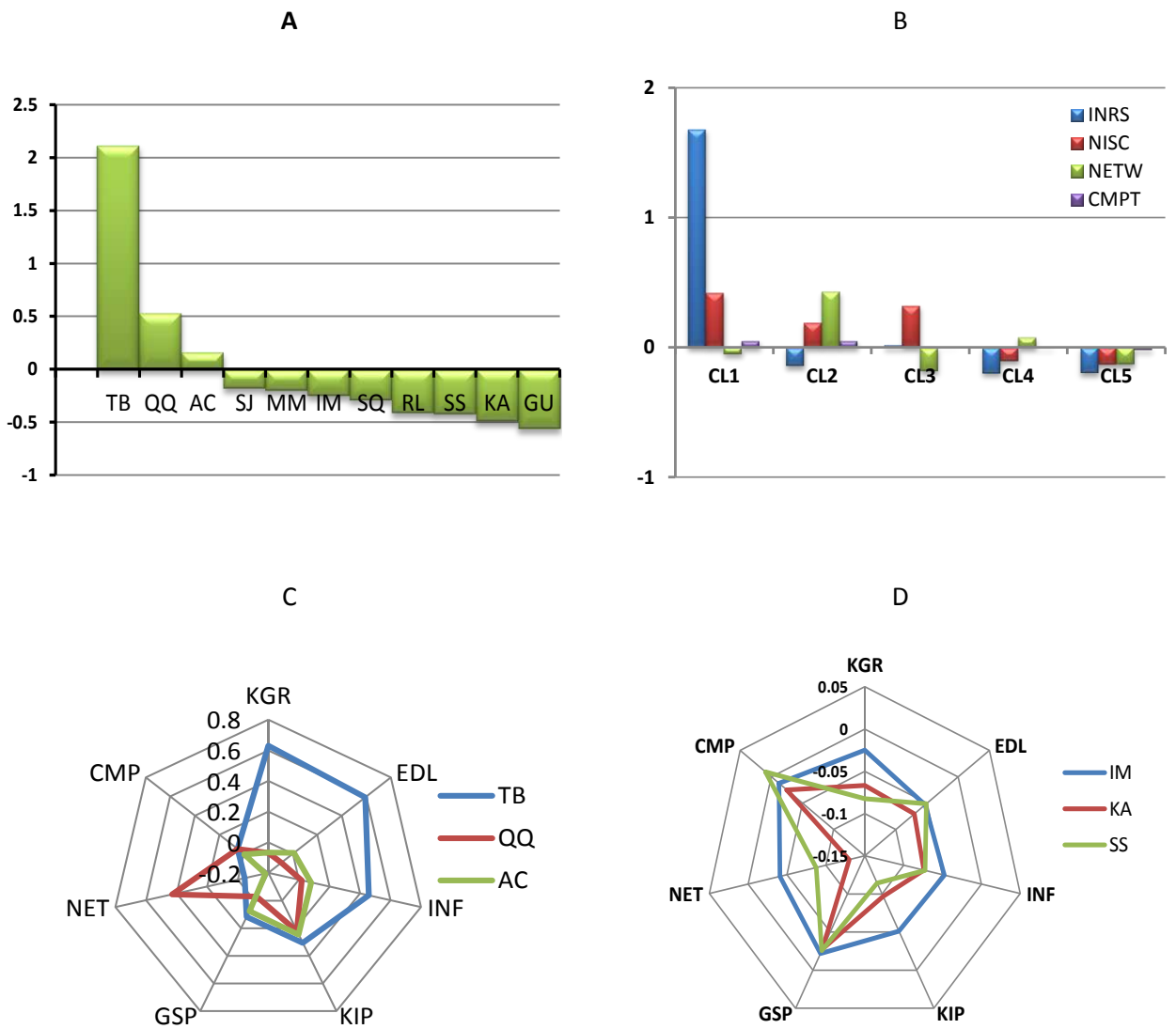


Fig. 3.1. Heterogeneity of Georgia's Regions RIS

Panel A – Distribution of indicator GRIS-2010 by Georgia's regions; **Panel B** – Distribution of the average values of GRIS-2010 sub indicators by regional clusters; **Panel C** – Comparison of the regions TB, QQ, AC; **Panel D** – Comparison of the regions IM, KA, SS.

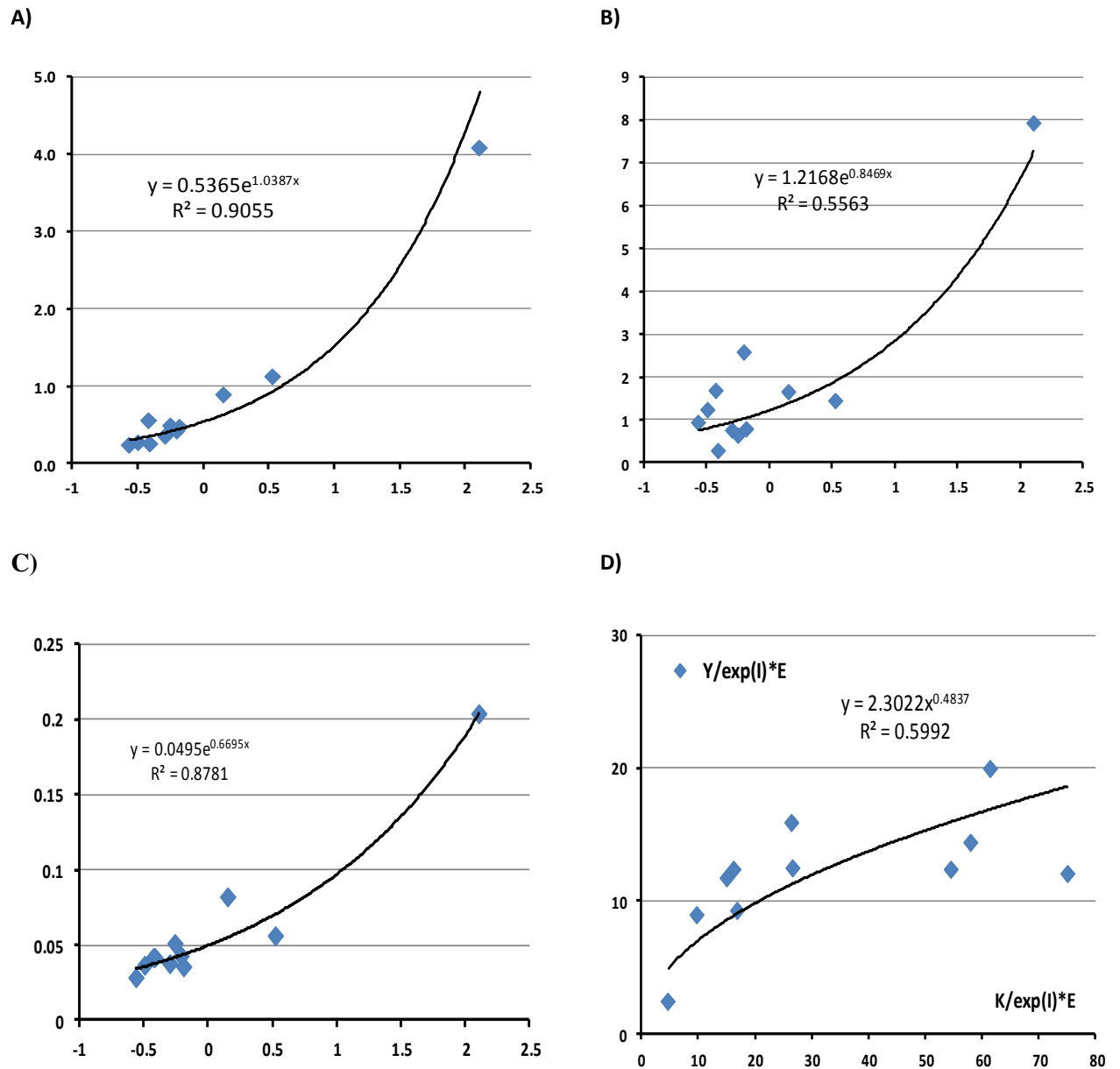


Fig. 3.2. GRIS-2010- Relations to the Main Economic Indexes of the Regions

Axis of abscisses: Values of GRIS-2010; **Axis of ordinates:** **Panel A** – Value added per capita; **Panel B** – Fixed assets per capita; **Panel C** – Employed per capita; **Panel D** – Assessment of regional production function (see text for the elucidations).

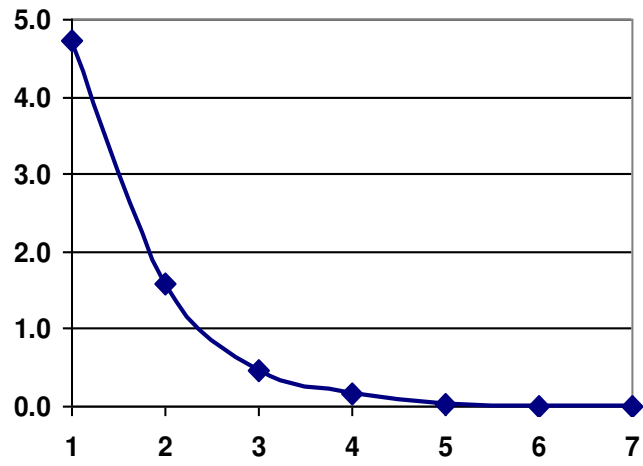


Fig. B.1 Normalized Initial indicators' Correlation Matrix Eigenvalues

Horizontal axis – serial number of eigenvalues; **Vertical axis** – values of eigenvalues

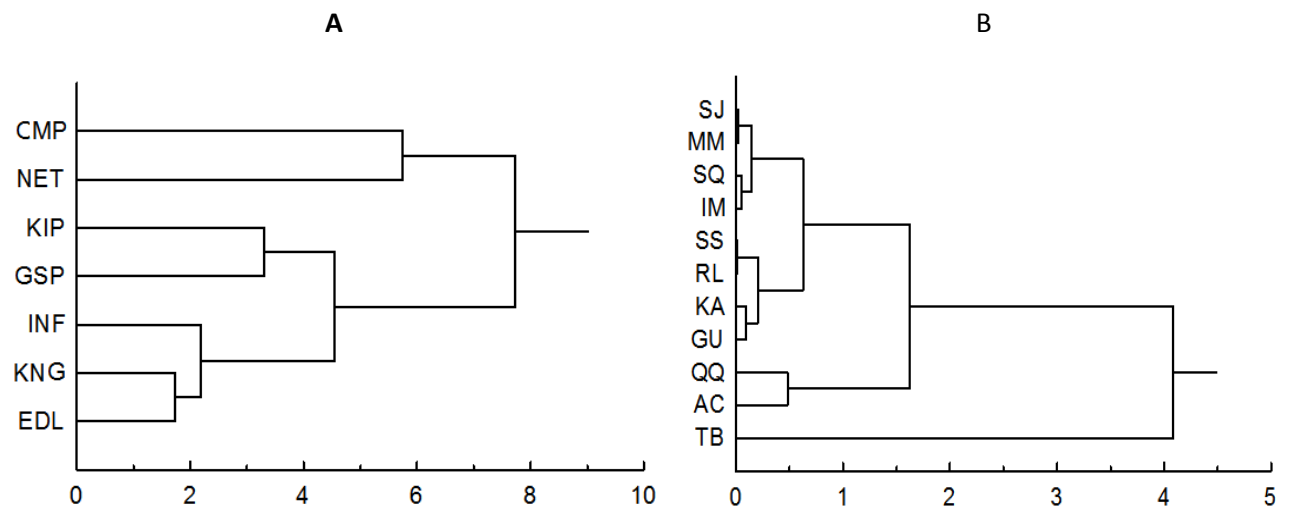


Fig.B.2 Cluster Analysis Results

Hierarchical Cluster Analysis-Ward's Method, Euclidian Distance.

Horizontal axis – distance, **Vertical axis** – objects.

Panel A – normalized initial indicators clustering.

Panel B – Regions' clustering by GRIS-2010 indicator.