REGIONAL INEQUALITIES IN GREECE A PROPOSITION FOR THEIR DEPICTION

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Abstract
Regional inequalities are a topic which has timely occupied both the academic society as well as the directorate authorities. The different methodology approaches in solving the problem are offered for critical analysis and possible alterations. In this article, a composite weighted indicator of growth is proposed, which will be used to portray regional inequalities. Moreover, the methodology for the choice of a number of variables as part of the composite indicator will also be put forward. The depiction of the inequalities regards those between the country's regions (NUTS 2) as well as those between ex-prefectures (NUTS 3).
Key words: regional inequalities, composite indicators
JEL classification R10, R40, R30

1. Introduction

The objective portrayal of regional inequalities in Greece is a topic that is maintained seasonable and is often presented in a charged manner. Despite the critics, the depiction of inequalities is approached by calculations of the per capita gross domestic income (Ward 1963, Glitsos 1988, Barro 1991,Petrakos 2003). Another approach is the use of calculations of more than one of the variables (Glitsos, 1998, Polyzos 2008). The calculations are combined to compose a composite indicator in order to calculate quality of life (Liargovas, 2003) or regional inequalities (Petrakos 2004), in the latter instance through a composite indicator of growth (CIG). Beginning with the construction of CIG (Petrakos 2004) - on the basic hypothesis that the weighting of each variable that comprises CIG is proportionate to the contribution of the variable to the fluctuation of the sum of the variables – we propose, on the one hand, a means of weighting the variables that comprise the indicator, and on the other hand a means of choice of variables that contribute to the indicator. Lastly, we use the indicator as a variable, weighting it against the population in order to calculate the variability coefficient and to illustrate regional inequalities.

2. Composite Weighted Indicator of Growth (CWIG)

If X_{ri} the variables for the depiction of regional inequalities, and x_{ri} their arithmetic values in the region of *r*, where *r=1,2,3,4,...,m* and *i=1,2,3,..,n*. The transformation $\frac{x_{ri} - \min(x_{ri})}{\max(x_{ri}) - \min(x_{ri})}$ (OECD 2008) standardizes the values of the initial variables. For the numeral y_{ri} of the standardized variable Y_i , $0 \le y_{ri} \le 1$. If higher or lower values are an indication of a better or worse level of development in a region, then the sum: $s_r = \sum_{r=1}^{m}(y_{r1} + y_{r2} + y_{r3} + ... + y_{rn})$ comprises a composite indicator of growth (CIG) for the region *r*. Using the numerical value of the sum for each region, it is possible to classify the regions according to their development. A possible objection to the theory regarding the CID could be the fact that in the equation of the sum, each variable has an equal weighting. Different methods have been proposed for the weighting of the variables (OECD, 2008). One such approach could be to calculate the contribution of each variable to the variance $\mathrm{var}(S)$, where: $\mathrm{var}(S) = \mathrm{var}(\sum_{i=1}^{n} Y_i)$. The contribution of the variables could be calculated as follows. The variance var(*S*) is equal to:

$$\mathrm{var}(S) = \sum_{i}^{n} \mathrm{var}(Y_i) + 2\sum_{i}^{n} \sum_{j>i} \mathrm{cov}(Y_j Y_i) \;\mathbf{(1)}$$

What is valid for the covariance $\mathrm{cov}(Y_j Y_i)$ is: $\mathrm{cov}(Y_j Y_i) = b_{ji} Var(Y_j)$ with $b_{ji} = 1$ if $j = i$ therefore, (1) is equivalent to:

$$\mathrm{var}(S) = \sum_{i}^{n} [b_{1i}\,\mathrm{var}(Y_1) + b_{2i}\,\mathrm{var}(Y_2) + \ldots + b_{ni}\,\mathrm{var}(Y_n)] \quad \mathbf{(2)}$$

The weighting coefficient w_i for the variable Y_i, $i = 1,2,3,..,,n$ as results from (2) equals to:

$$w_i = \frac{\mathrm{var}(Y_i)}{\mathrm{var}(S\;)} (b_{1i} + b_{2i} + .. + b_{ni}) \;\mathbf{(3)}$$

Therefore, the composite weighting indicator of growth (CWIG) for each region $r = 1,2,3,4,..,m$ is:

$$s_{wr} = \sum_{r=1}^{m} (w_1 y_{r1} + w_2 y_{r2} + w_3 y_{r3} + \ldots + w_n y_{rn}) \;\mathbf{(4)}$$

3. Applications of the depiction of regional inequalities

In order to depict regional inequalities in Greece, for the years 2003 and 2008, we used 23 of the following variables. [1]: Per Capita gross Domestic Product, [2]:Per Capita Declared Income, [3]:Per Capita Savings, [4]: Per Capita time Savings, [5]: Per Capita of Gross value added by Agriculture/forestry/fishing, [6]: Per Capita of Gross value added by Industry including energy, [7]: Per Capita of Gross value added by Construction, [8]: Per Capita of Gross value added by Wholesale and retail trade-vehicle repairs and household items- Hotels and restaurants-Transportation and communication, [9]: Per Capita of Gross value added by Financial intermediation-Real estate renting and Business activities, [10]: Per Capita of Gross value added by Other services, [11]: New Dwelling by number/1000 residences, [12]: Volume of New Construction Activities/1000 residences, [13]: New Passenger Cars/1000 residences,[14]:New Passenger Trucks/1000 residences,[15]: In service Passenger Cars (private and public)/1000 residences, [16]: In Service Passenger Trucks (private and public)/1000 residences,[17]: Beds in Hotel Accommodation/1000 residences,[18]: Overnight stays of nationals/1000 residences,[19]: Overnight stays of foreigners/1000 residences, [20]:Doctors/1000 residences,[21]:Dentists/1000 residences,[22]: Infirmary rooms/1000 residences, [23]: Per Capita Electrical Power Consumption.

Subsequently, the initial variable values were standardized. The values of the composite weighting indicator of growth (s_{wr}) were calculated from (4). The range of variables that comprise the indicator affect its values, because variance $\mathrm{var}(S)$ -which is necessary to calculate the weightings of each variable- is affected. It's important therefore to examine whether the presence or not of variables with small weightings will affect the regional rankings, as will result from the indicator (s_{wr}). In order to provide an answer, we conducted a statistical test in order to test the hypothesis $H_0 : \sigma_n^2 = \sigma_k^2$ with the alternative of $H_1 : \sigma_n^2 \neq \sigma_k^2$ where $n \neq k$ is the different number of variables. For the regions NUTS2 we used the rank sum dispersion test by Siegel-Tukey (Gopal, 2006) – a non parametric test. For the regions NUTS3, the statistical test γF was used which regards to variables that are correlated (Gopal, 2006). We expect that in the instance that the hypothesis H_0 is accepted, the rankings from the range of variables to be correlated. Using the Kendall indicator (Siegel, 1956) the intensity of correlation was calculated. If the correlation is strong, the hypothesis which states that the addition of variables doesn't affect the variance var(S) is reinforced, and consequently the regional rankings are not affected. Furthermore, we do not expect the ranking of a region to be affected with regards to the Median value and the Quartile values of the indicator (s_{wr}).Cohen's Kappa indicator (Cohen, 1960) was used to examine the degree of concordance with regard to the ranking of the regions (above or below or in between), in relation to the indicator's (s_{wr}) Median and Quartile values, as results from the different number of variables. A high K indicator value confirms that the addition of variables - which from the point of statistical importance do not affect the variance var(S) - also do not affect the ranking of the region in relation to the positioning standards aforementioned. Lastly, after being weighed up against each regions population, the new variable (s_{wr}) was used to calculate the coefficient of variation to portray the regional disparities.

4. Results and Conclusions

From (3) the weightings for each of the 23 variables arose. Three variables have the lowest weighting values both for NUTS2 level and NUTS3, for both the two years. The variables are: Per Capita Electrical Power Consumption, in service trucks/1000 residences and the share of the gross added value within the branches of agriculture, forestry and fishery. The three variables were subtracted and the variance var(S) was re-calculated with 20 variables. The statistical test value γF and z, the degree of freedom df and the level of significance α are presented in table 1. In table 2 the results regarding Kendall's correlation coefficient r_K are presented. Table 3 depicts the results regarding the values of Cohen's *Kappa* indicator, the Quartile Q_1, Q_3 values, and the median M as well as the mean $\bar{s}$ for 23 and 20 variables respectively.

Table 1. Statistical Test of the Hypothesis $H_0 : \sigma_{23}^2 = \sigma_{20}^2$

Nuts 3 (Year 2008)	Statistical Test Value $\gamma F = 0.069$, $df = 49$, $a = 0.01$ and $a = 0.05$
Nuts 3 (Year 2003)	Statistical Test Value $\gamma F = 0.034$, $df = 49$, $a = 0.01$ and $a = 0.05$
Nuts 2 (Year 2008)	Statistical Test Value $z = -0.718$ $a = 0.01$ and $a = 0.05$
Nuts 2 (Year 2003)	Statistical Test Value $z = -0.718$ $a = 0.01$ and $a = 0.05$

Table 2. Correlation of rankings of 23 and 20 variables

Nuts 3 (Year 2008)	$r_K = 0.962$	Nuts 2 (Year 2008)	$r_K = 0.949$
Nuts 3 (Year 2003)	$r_K = 0.965$	Nuts 2 (Year 2003)	$r_K = 0.949$

Table 3. Cohen's Kappa, Median, Quartile and Arithmetic Mean values

	Number of Variables 23	Number of Variables 20	Cohen's-Kappa
Nuts 3 (Year 2008)	$Q_1 = 0.167$ $M = 0.243$ $Q_3 = 0.297$ $\bar{s} = 0.255$	$Q_1 = 0.166$ $M = 0.240$ $Q_3 = 0.306$ $\bar{s} = 0.257$	$Kappa = 0.895$
Nuts 3 (Year 2003)	$Q_1 = 0.167$ $M = 0.227$ $Q_3 = 0.290$ $\bar{s} = 0.242$	$Q_1 = 0.169$ $M = 0.230$ $Q_3 = 0.299$ $\bar{s} = 0.247$	$Kappa = 0.843$
Nuts 2 (Year 2008)	$Q_1 = 0.181$ $M = 0.194$ $Q_3 = 0.323$ $\bar{s} = 0.268$	$Q_1 = 0.191$ $M = 0.203$ $Q_3 = 0.327$ $\bar{s} = 0.275$	$Kappa = 1.00$
Nuts 2 (Year 2003)	$Q_1 = 0.143$ $M = 0.190$ $Q_3 = 0.322$ $\bar{s} = 0.266$	$Q_1 = 0.171$ $M = 0.207$ $Q_3 = 0.343$ $\bar{s} = 0.277$	$Kappa = 0.794$

The statistical test of the hypothesis $H_0 : \sigma_{23}^2 = \sigma_{20}^2$ (table 1) showed that H_0 was accepted. Furthermore, the high correlation values for the Kendall indicator (table 2) based on the results for the indicator (s_{wr}), leads us to the conclusion that the regional rankings are highly in accordance when using 23 variables, to the regional rankings when 20 variables are used for the indicator (s_{wr}) values. On the basis of the indicator (s_{wr}) results, when 23 or 20 variables are used and by applying the Median and Quartile parameters Q_1, M, Q_3, we limit the regions to more or less developed. The high Kappa values (table 3) signifies a high degree of accordance for the ranking of regions with regards to the ranking parameter Q_1, M, Q_3. Therefore, acceptance of the hypothesis $H_0 : \sigma_{23}^2 = \sigma_{20}^2$ is greatly amplified, meaning that the subtraction of three variables does not affect the ranking and positioning of the regions. In the following tables 4 and 5 the regional rankings are exemplified for 20 and 23 variables as result from the values of the indicator (s_{wr}).

Table 4. Regional rankings (NUTS2)

NUTS2	2008 (23M)	2008 (20M)	2003 (23M)	2003 (20M)
Attiki	1	1	1	1
Notio Aigaio	2	2	2	2
Kriti	3	3	4	3
Kentriki Makedonia	4	4	3	4
Ionia Nisia	5	5	5	5
Sterea Ellada	6	7	9	9
Peloponnisos	7	6	11	10
Ipeiros	8	8	6	6
Thessalia	9	10	8	8
Voreio Aigaio	10	9	7	7
Dytiki Makedonia	11	11	10	11
Anatoliki Makedonia & Thraki	12	12	12	12
Dytiki Ellada	13	13	13	13

Table 5. Regional rankings (NUTS3)

NUTS3	2008 (23M)	2008 (20M)	2003 (23M)	2003 (20M)	NUTS3	2008 (23M)	2008 (20M)	2003 (23M)	2003 (20M)
Attica	1	1	1	1	Kozani	27	25	18	18
Dodecanese	2	2	2	2	Fthiotida	28	29	37	37
Kiklades	3	3	5	5	Messinia	29	28	33	33
Lefkada	4	6	15	15	Preveza	30	32	31	32
Zakinthos	5	4	4	4	Kastoria	31	31	27	25
Kefallonia	6	8	10	9	Evros	32	30	22	22
Iraklio	7	7	6	7	Pieria	33	33	36	36
Thessaloniki	8	5	3	3	Trikala	34	34	35	34
Chania	9	9	7	6	Lesvos	35	35	29	28
Lasithi	10	10	11	11	Lakonia	36	36	32	31
Chalkidiki	11	11	25	24	Drama	37	37	34	35
Rethimno	12	12	13	14	Imathia	38	38	39	39
Chios	13	13	12	12	Arta	39	39	38	38
Samos	14	15	14	13	Grevena	40	40	42	42
Ioannina	15	14	9	10	Kilkis	41	42	41	41
Arkadia	16	16	19	17	Xanthi	42	41	40	40
Korinthia	17	17	28	26	Fokida	43	45	45	43
Evoia	18	21	26	27	Karditsa	44	43	44	45
Argolida	19	20	30	30	Aitolokarnania	45	44	49	47
Magnisia	20	19	16	16	Pella	46	46	50	50
Larissa	21	18	17	19	Evritania	47	47	47	46
Kavala	22	22	21	20	Florina	48	49	48	49
Thesprotia	23	23	24	23	Serres	49	48	43	44
Viotia	24	27	23	29	Rodopi	50	50	46	48
Achaia	25	24	20	21	Ilia	51	51	51	51
Kerkira	26	26	8	8					

Having taken the performance of the indicator (s_{wr}) into consideration, from table 4 the regions which hold the top five positions during the years 2003 and 2008 arise. These are: Attiki, Notio Aigaio, Kriti, Kentriki Makedonia and the Ionia Nisia . During the same years the regions of Anatoliki Makedonia & Thraki and Dytiki Ellada rank in the last two positions. Also, on the basis of regional performance, from table 5 what transpires is Attiki's dominance on the one hand, and on the other hand, the decline of Thessaloniki's position in 2008 compared to 2005. As for the last 12 positions (40 up to and including position 51), the same NUTS3 regions occupy them with only slight reclassifications. Lastly, table 6 regards the weighting coefficient of variation (wCV) for the levels NUTS 2&3 and for 20 and 23 variables

Table 6. Weighting Coefficient of Variability

		Number of variables: 23	Number of variables: 20
Year 2008	Nuts 3	wCV=102.0%	wCV=103.2%
Year 2003	Nuts 3	wCV=122,2%	wCV=118,2%
Year 2008	Nuts 2	wCV=143,2%	wCV=134,7%
Year 2003	Nuts 2	wCV=144,5%	wCV=127,4%

The variability coefficient's high values show inequalities for both years on both NUTS levels. It should be noted that, when using NUTS3 level a tendency of reduction of inequalities within the two years emerges, whereas on NUTS2 level the inequalities seem invariable. In conclusion, with the method described we suggest a way in which to weigh the variables that comprise a growth indicator of a region which could subsequently be used to depict regional inequalities. Furthermore, with the proposed statistical test there's the possibility to evaluate whether the portrayal of regional inequalities is affected by the number of variables that comprise the indicator - with the presence of variables with a marked linear correlation not causing a methodological or theoretical problem (OECD, 2008).

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