INTERREGIONAL CONVERGENCE AND DIVERGENCE IN THE INNOVATION-DRIVEN ECONOMY: EVIDENCE FROM SOUTH KOREA

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Abstract. *This study examines interregional disparities in South Korea. The research methodology is based on neo-classical convergence analysis: 1) β-analysis implies examining the correlation between average yearly growth rate of a respective indicator and its initial level; 2) σ-analysis implies examining the indicator's variance during the analyzed period. Interregional disparities are analyzed with regard to gross regional product per capita, gross regional income per capita, individual income per capita, and private consumption per capita. The empirical evidence indicates a high correlation for β-convergence in individual income per capita. Variance analysis indicates that during 2005-2013 gross regional product per capita demonstrated σ-divergence while gross regional income per capita, individual income per capita and private consumption per capita demonstrated σ-convergence in South Korea. Overall the conclusions of this study support the idea that the innovation-driven economy is favorable for interregional convergence.*

Key words: *interregional disparities, β- and σ-analysis, neo-classical convergence model, innovation-driven economy, socio-economic development.*

1. Introduction

A summary review of the literature leads one to the general conclusion that a resource oriented national economic structure has a negative influence on its economic growth [1-9] whereas innovation-driven economies demonstrate positive dynamics in their growth [10-14]. Although there have been a number of studies on resource- and innovation-oriented economies, the issues surrounding the impact of a national economy's structure on interregional disparities in different countries have not been thoroughly covered in economic studies.

This study aims to examine interregional disparities in socio-economic development in South Korea. Within the framework of this study we seek to achieve the following research goals: 1) to choose appropriate research methodology along with socio-economic indicators to be analyzed; 2) to test an empirical model for adequacy and accuracy; 3) to draw conclusions on how the structure of a national economy influences the level of interregional disparities based on the case South Korea.

2. Methodology

The most widespread methodology of interregional analysis in use is the neo-classical one based on the Solow-Swan [15, 16] and Barro-Sala-i-Martin [17-19] models. For the purpose of this study we use the following analytical form of the neo-classical model of β-convergence [20]:

$$\ln(g_{yi}) = a_0 + a_1 \ln(y_{0i}) + \varepsilon,\ g_{yi} = \sqrt[n-1]{\frac{y_{ni}}{y_{oi}}} \quad (1)$$

where g_{yi} represents respective regional socio-economic indicator growth rate, calculated as a geometric average; y_{0i}, y_{ni} – socio-economic indicator of i-region in basic and current year respectively; a_0, a_1 – regression parameters, a_1 also represents convergence (divergence) speed; ε – average approximation error.

The β-convergence neo-classical model implies also analysis of σ-convergence: examining the indicator's variance (coefficient of variation) allows researching the depth of interregional

disparities in a respective socio-economic indicator. Conclusions regarding the presence of convergence or divergence within a neo-classical methodological framework are made based on two assumptions: 1) a negative or positive sign of the a_1 parameter indicates convergence or divergence respectively; 2) a decrease or increase in the variation coefficient of a given indicator means convergence or divergence respectively. In addition, we assume that if the variation coefficient exceeds its level of 0,33 one can conclude there is a high variance in the values of the respective indicator.

Available data on regional development in South Korea covers the years 2005-2013. In this study we use four important indicators of regional socio-economic development: real regional GDP per capita, real gross regional income per capita, real individual income per capita, and real private consumption per capita [21] (Hereafter, "real" will be omitted for stylistic purpose). These indicators do not portray the full picture of regional development and interregional disparities in the country analyzed; nevertheless, they can serve as a reliable measure of the regional differentiation in socio-economic development.

South Korea is divided into 16 administrative units, consisting of special city Seoul, 6 metropolitan cities, 8 provinces, and special self-governing province Jeju-do. Cross-regional analysis implies n=16 number of observations and m=2 number of regression parameters. Hence, we take the following critical values for correlation-regression coefficients: r=0,50; d=0,247; F=4,6; t=2,145; ε=15%.

The positive sign of the a_1 parameter (see table 1) indicates an overall interregional divergence in the level of regional GDP per capita in South Korea during the years 2005-2013. However, analysis of the model's statistical characteristics leads us to conclude the model is inadequate for the analyzed period. Among the analyzed sub-periods only the empirical results for the years 2009-2010 and 2012-2013 support β-divergence and β-convergence. The empirical value of the approximation error for the overall period as well as for the sub-periods exceeds its critical level of 15%, therefore, we conclude the model is inaccurate.

Table 1

Analysis of β-convergence in real regional GDP per capita in South Korea, 2005-2013 роки

[calculated by author]

Years	a_0, a_1	r	d	F	t	ε
2005-2013	a_0=0,0143 a_1=0,0029	0,13	0,017	0,2	t_0 = 1,1 t_{a1} = 0,4	24,6%
2005-2006	a_0=0,1058 a_1=-0,0264	-0,48	0,23	4,18	t_0 = 39,1 t_{a1} = 2,9	104,4%
2006-2007	a_0=-0,0090 a_1=0,0189	0,32	0,102	1,6	t_0 = 3,3 t_{a1} = 2,097	33,9%
2007-2008	a_0=-0,1096 a_1=0,0350	0,36	0,13	2,1	t_0 = 13,5 t_{a1} = 1,3	90,2%
2008-2009	a_0=0,1930 a_1=-0,0559	-0,50	0,25	4,67	t_0 = 17,9 t_{a1} = 1,6	95,2%
2009-2010	a_0=-0,2817 a_1=0,1071	0,73	0,533	16,0	t_0 = 34,7 t_{a1} = 3,96	84,6%
2010-2011	a_0=-0,0147 a_1=0,0081	0,11	0,012	0,2	t_0 = 1,8 t_{a1} = 0,3	84,6%
2011-2012	a_0=0,0399 a_1=-0,0094	-0,21	0,044	0,6	t_0 = 14,8 t_{a1} = 1,0	91,4%
2012-2013	a_0=0,1885 a_1=-0,0536	-0,58	0,336	7,1	t_0 = 23,3 t_{a1} = 2,181	108,1%

The analysis of regional GDP per capita variance (see fig. 1) illustrates the changing dynamics of the analyzed indicator during 2005-2013 years. Overall, the trend indicates slight σ-divergence in the gross regional product per capita dynamics during the analyzed period (variation coefficient increased from 0,36 in 2005 to 0,37 in 2013).

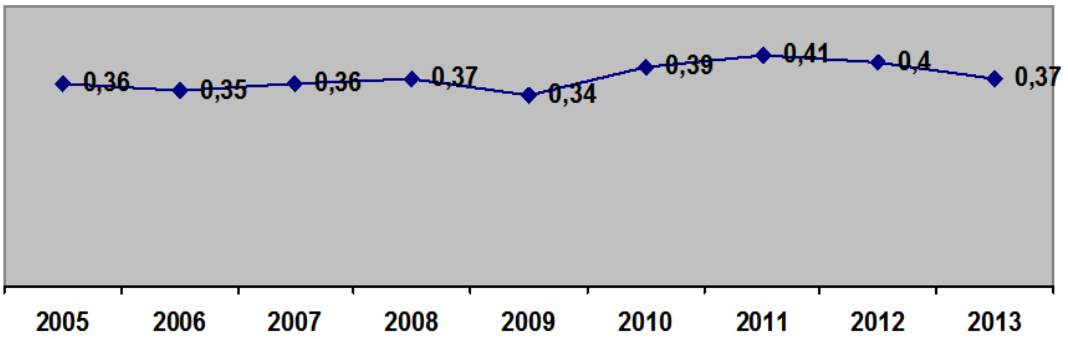

Figure 1. Real regional GDP per capita variance in South Korea, 2005-2013 [calculated by author]

The negative sign of the a_1 parameter indicates a convergence tendency in the gross regional income per capita dynamics in South Korea during 2005-2013 (see table 2). Statistical characteristics of the model point to its inadequacy for the overall analyzed period and for most sub-periods, except for 2008-2009, 2009-2010, and 2012-2013: the years 2008-2009 and 2012-2013 can be characterized as convergence periods, and 2009-2010 – as a divergence one. The approximation error exceeds its critical level; therefore, we conclude that the model is inaccurate.

Table 2

Analysis of β-convergence in real gross regional income per capita in South Korea, 2005-2013

[calculated by author]

Years	a_0, a_1	r	d	F	t	ε
2005-2013	a_0=0,0513 a_1=-0,0090	-0,32	0,102	1,6	t_0 = 21,1 t_{a1} = 0,9	28,9%
2005-2006	a_0=0,1364 a_1=-0,0357	-0,42	0,176	3,0	t_0 = 6,6 t_{a1} = 2,0	69,1%
2006-2007	a_0=-0,0964 a_1=0,0483	0,48	0,23	4,18	t_0 = 17,8 t_{a1} = 2,06	51,8%
2007-2008	a_0=-0,1091 a_1=0,0365	0,39	0,152	2,51	t_0 = 20,2 t_{a1} = 1,6	93,6%
2008-2009	a_0=0,2951 a_1=-0,0874	-0,58	0,336	7,1	t_0 = 27,3 t_{a1} = 2,4	190,1%
2009-2010	a_0=-0,2568 a_1=0,0953	0,61	0,372	8,3	t_0 = 31,7 t_{a1} = 2,7	109,6%
2010-2011	a_0=0,0762 a_1=-0,0179	-0,17	0,029	0,4	t_0 = 9,4 t_{a1} = 0,6	94,1%
2011-2012	a_0=0,1236 a_1=-0,0352	-0,40	0,16	2,7	t_0 = 22,9 t_{a1} = 1,6	106,1%
2012-2013	a_0=0,2706 a_1=-0,0809	-0,59	0,348	7,5	t_0 = 33,4 t_{a1} = 2,4	145,3%

Analysis of the gross regional income variance (see fig. 2) indicates both interregional convergence and divergence trends in this indicator's dynamics. Overall the 2005-2013 period can be characterized as a period of convergence with the variation coefficient decreasing from 0,28 in 2005 to 0,26 in 2013.

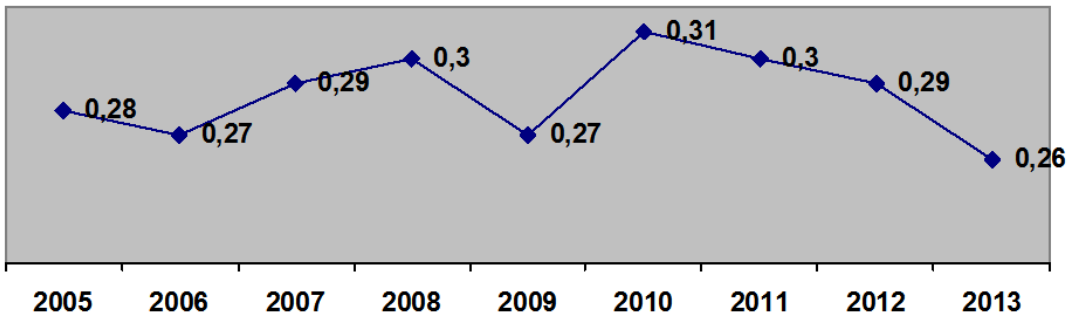

Figure 2. Real gross regional income per capita variance in South Korea, 2005-2013
[calculated by author]

The negative sign of the a_1 parameter indicates an interregional convergence trend in the individual income per capita dynamics for the 2005-2013 period (see table 3). Statistical characteristics of the model for the overall analyzed period lead us to guardedly conclude there is interregional convergence regarding the individual level of income per capita in South Korea during 2005-2013 years with a yearly average convergence speed of 1,6%. The approximation error proves the high accuracy of the model for the overall analyzed period while none of sub-periods has statistically significant characteristics pointing either convergence or divergence.

Table 3

Analysis of β-convergence in real individual income per capita in South Korea, 2005-2013
[calculated by author]

Years	a_0, a_1	r	d	F	t	ε
2005-2013	a_0=0,0584 a_1=-0,0164	-0,51	0,26	4,9	t_0 = 72,0 t_{a1} = 2,09	13,4%
2005-2006	a_0=0,1403 a_1=-0,0480	-0,43	0,185	3,2	t_0 = 52,5 t_{a1} = 1,8	50,8%
2006-2007	a_0=-0,1134 a_1=0,0598	0,43	0,185	3,2	t_0 = 42,4 t_{a1} = 2,24	34,9%
2007-2008	a_0=0,0973 a_1=-0,0391	-0,41	0,168	2,8	t_0 = 40,4 t_{a1} = 1,6	97,3%
2008-2009	a_0=0,4053 a_1=-0,1520	-0,47	0,221	4,0	t_0 = 50,5 t_{a1} = 1,9	127,8%
2009-2010	a_0=0,0816 a_1=0,0200	-0,08	0,01	0,1	t_0 = 15,3 t_{a1} = 0,3	63,1%
2010-2011	a_0=-0,2398 a_1=0,0928	0,44	0,194	3,4	t_0 = 89,7 t_{a1} = 3,1	90,2%
2011-2012	a_0=0,1630 a_1=-0,0564	-0,39	0,152	2,5	t_0 = 61,0 t_{a1} = 2,11	84,8%
2012-2013	a_0=0,1677 a_1=-0,0558	-0,40	0,16	2,7	t_0 = 62,7 t_{a1} = 1,9	65,9%

The analysis of the individual income per capita variance (see fig. 3) indicates interregional σ-convergence for the overall analyzed period (variation coefficient decreased form 0,108 in 2005 to 0,095 in 2013).

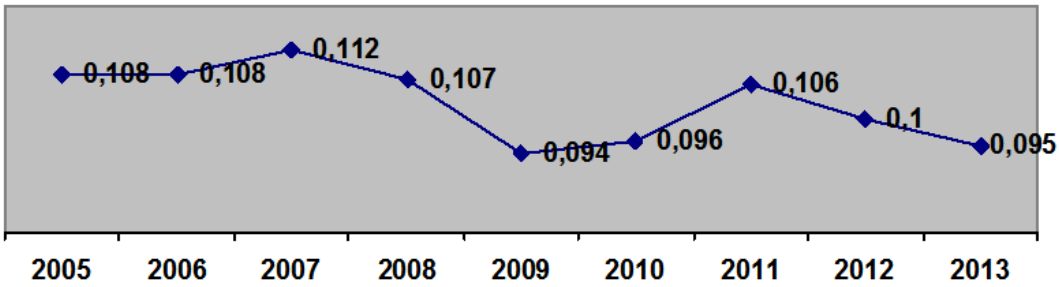

Figure 3. Real individual income per capita variance in South Korea, 2005-2013 [calculated by author]

The negative sign of the a_1 parameter (see table 4) indicates a tendency toward interregional convergence in the private consumption per capita dynamics in South Korea during 2005-2013. However, statistical characteristics of the model point to its inadequacy for both the overall period analyzed and the sub-periods.

Table 4

Analysis of β-convergence in private consumption per capita in South Korea, 2005-2013
[calculated by author]

Years	a_0, a_1	r	d	F	t	ε
2005-2013	a_0=0,0635 a_1=-0,0283	-0,42	0,176	3,0	t_0 = 26,4 t_{a1} = 1,1	72,6%
2005-2006	a_0=0,2006 a_1=-0,1574	-0,28	0,078	1,2	t_0 = 15,0 t_{a1} = 1,1	19,4%
2006-2007	a_0=-0,0050 a_1=0,0120	0,15	0,023	0,3	t_0 = 2,1 t_{a1} = 0,5	21,5%
2007-2008	a_0=-0,0071 a_1=0,0053	0,06	0,004	0,006	t_0 = 2,7 t_{a1} = 0,2	59,9%
2008-2009	a_0=0,1524 a_1=-0,0621	-0,48	0,23	4,2	t_0 = 5,7 t_{a1} = 2,3	87,1%
2009-2010	a_0=0,0142 a_1=0,0080	0,09	0,008	0,1	t_0 = 5,9 t_{a1} = 0,3	21,1%
2010-2011	a_0=-0,0108 a_1=0,0100	0,15	0,023	0,3	t_0 = 4,5 t_{a1} = 0,4	44,4%
2011-2012	a_0=0,1170 a_1=-0,0377	-0,38	0,144	4,6	t_0 = 43,8 t_{a1} = 1,4	33,9%
2012-2013	a_0=0,1505 a_1=-0,0531	-0,40	0,16	2,7	t_0 = 56,3 t_{a1} = 1,8	66,5%

An analysis of the private consumption per capita variance (see fig. 4) proves σ-convergence in the interregional level of private consumption per capita during the period analyzed (variation coefficient decreased from 0,102 in 2005 to 0,093 in 2013).

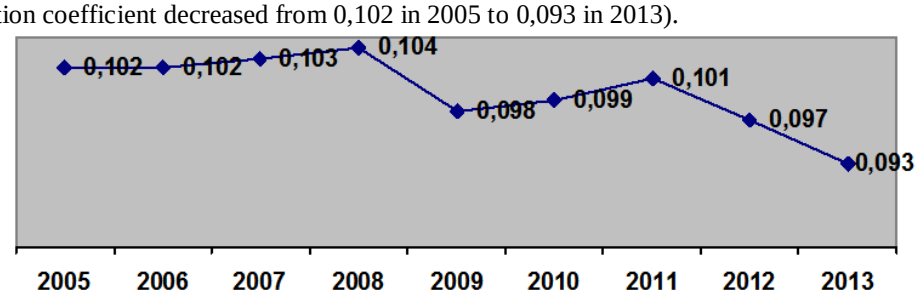

Figure 4. Real private consumption per capita variance in South Korea, 2005-2013 [calculated by author]

The empirical evidence provides support for a conclusion that overall there is interregional convergence in the level of socio-economic development in South Korea during the years 2005-2013. Among the indicators analyzed only one of the latter, namely regional GDP per capita, had a tendency towards interregional divergence. Gross regional income per capita, individual income per capita and private consumption per capita showed a tendency towards interregional β- and σ-divergence during the analyzed period.

The outcome of the neo-classical model testing shows β-convergence in the level of individual income per capita for the analyzed period overall with a guarded assumption of an average yearly convergence speed of 1,6% (the empirical t_{a1}-value of 2,09 approaches but does not reach its sufficient value of 2,145). Gross regional income per capita, individual income per capita and private consumption per capita all proved to demonstrate σ-divergence during the analyzed period as a whole.

3. Limitations of this study

An important note should be made in regard to the very high values of the average approximation error in the interregional convergence analysis of South Korea data. One should note the relatively small number of statistical data points for the interregional convergence analysis of Korea (n=16). This methodical aspect cannot serve as a full explanation for high values of the approximation errors; however, it must be taken into consideration. Another factor influencing the high values of approximation error is the necessity of examining non-linear forms of correlation for convergence analysis within the neo-classical framework

4. Conclusion

Empirical evidence from this study indicates both interregional divergence and convergence in socio-economic development in South Korea. Gross regional product per capita demonstrated interregional σ-divergence dynamics, whiles other three analyzed indicators, gross regional income per capita, individual income per capita, and private consumption per capita, demonstrated interregional σ-convergence during 2005-2013 years. Evidence from β-analysis leads one to conclude the model shows the highest adequacy with individual income per capita as the examined indicator; however, high values of approximation error indicate inaccuracy of β-convergence model for analysis of interregional disparities in South Korea. This can be explained by a relatively small number of statistical observations (n=16). Another way to lower values of approximation error is to examine non-linear forms of correlation in the β-convergence model which could be the subject of a separate study. Overall, the conclusions of this research support the idea that the innovation-driven economy is favorable for interregional convergence.

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