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SOCIAL CONVERGENCE IN NORDIC NUTS-3 REGIONS

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Abstract

Research background: Geographical proximity, common historical roots and collaboration within the Nordic Council make the Nordic countries, often wrongly treated as monoliths. However, in reality, Nordic regions differ in terms of broadly defined social and economic development. Issues concerning the standard of living are one of the priorities of the Helsinki Treaty signed by Nordic countries.

Purpose of the article: The main goal of this paper is to analyze the existence of the social convergence in the Nordic NUTS-3 regions over the 2000-2015 period. The social convergence refers to a reduction in the dispersion of the standard of living across regions. Result of this analysis may be helpful in evaluating the efficiency of the activities under third and fourth Nordic Strategy for Sustainable Development.

Methodology/methods: The spatial taxonomy measure of development proposed by Pietrzak was used as the standard of living approximation. Inclusion of spatial relationships in the construction of taxonomic measure of development is justified as regions are not isolated in space and can be affected by other units. The existence of beta-, sigma- and gamma convergence was tested for global spatial aggregate measure and as well for sub-groups of determinants forming the standard of living.

Findings & Value added: The analysis showed that the regions with the highest standard of living are those situated on the west coast of Norway. Regions with the lowest standard of living were regions located in central Finland. However the most important part of this research was to investigate the existence of beta-, sigma- and gamma- social convergence. The results show that there is no convergence for global standard of living measure. However the convergence occurs in groups of determinants of education and health care.

Introduction

The main goal of this research is to analyze the social convergence in the Nordic NUTS-3 regions over the 2000-2015. In this article social convergence refers to a reduction in the dispersion of the standard of living across regions. In this paper the definition proposed by Bywalec and Wydmus (1992, pp. 669-687) has been used. It refers to the level of wealth, comfort, material goods and necessities available to a certain socioeconomic class in a certain geographic area.

The subjects of interest in this article are Nordic NUTS-3 regions. Nordic regions were chosen for several reasons. Firstly, Nordic countries stand out against the background of today's developed countries, not only in terms of a higher standard of living (OECD Better Life Index 2013, pp. 1-2; Human Development Report 2015, pp. 20-22; World Happiness Report 2017, pp. 22-27) but also the relatively better conditions of their economies. Secondly, in 1952, Nordic Council was formed and in 1962 the Nordic countries signed the so-called 'Helsinki Treaty' which regulates cooperation between them. Nordic Council implemented the fourth strategy for the sustainable development of the Nordic region (A Good Life in a Sustainable Nordic Region. Nordic Strategy for Sustainable Development 2013, pp. 5-32). In this strategy, the emphasis is on cooperation leading to higher employment, green economic growth and increasing the competitiveness of the economies but also the safe, healthy and decent life of inhabitants. Thirdly, it should be remembered that the good of society is deeply rooted in the traditions of the Nordic countries. Starting from the beginning of the twentieth century when *folkhemmet* concept was launched in Sweden until nowadays. Folkehemmet can be translated as 'a home for society' where everybody contributes and everybody counts, and an emphasis is on equality and mutual understanding. Finally, due to their geographical proximity and common historical roots, the Nordic countries are often wrongly treated as unity. However, in reality, different regions of the Nordic countries are diverse in terms of socio-economic development.

Research Methodology

As it was mentioned in the introduction the social convergence in this article refers to the reduction of disparities in the standard of living among regions. To evaluate standard of living spatial taxonomy measure of development according Pietrzak (2014, pp. 181-201) was used as this approach allows the occurrence of different potential strength of interaction for each variable.. It is worth mentioning here that inclusion of spatial factor into socio-economic analysis getting popularity in contemporary researches (Antczak, 2013, pp. 37-53; Pietrzak, 2014, pp. 181-201; Pietrzak et al., 2014, pp.

135-144; Sobolewski et al., 2014, pp. 159-172; Vu et al, 2014, pp. 6400-6417; Pietrzak, 2016a, pp. 69-86; Pietrzak, 2016b, pp. 47-58).

The procedure of calculating spatial taxonomy measure of development (sTMD) according to Pietrzak is as follows:

1. Testing the presence of spatial autocorrelation using Moran's I statistics:

$$I = \frac{n}{\sum_i \sum_j w_{ij}} \cdot \frac{\sum_{i=1}^{n} \sum_{j=1}^{n} w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^{n} (x_i - \bar{x})^2} \quad (i = 1,..,n;\ j = 1,...,n) \quad (1)$$

where:
I - the value of Moran's I statistics;
n - number of observations;
w_{ij} - spatial weight matrix;
x_i, x_j - the value of analysed variable in *i* and *j* objects;
$\bar{x}$ - the mean average of analysed variable.

The variables for which the value of Moran's I statistic are statistically significant are included in the group of 'spatial' variables and otherwise - in the group of variables having no spatial character. In this research, spatial contiguity weight matrix was used, since it is the most frequently used in the studies, taking into account the spatial relationship. These weights indicate whether regions share a common boundary or not.

$$w_{ij} = \begin{cases} 1, & bnd(i) \cap bnd(j) \neq \varnothing \\ 0, & bnd(i) \cap bnd(j) = \varnothing \\ 0, & i = j \end{cases} \quad (2)$$

Spatial weight matrix was row standardised.

2. Estimating the SAR model for each variable from 'spatial' group of variables (LeSage, 1999):

$$\mathrm{X}_{\mathrm{j}} = \rho \mathrm{W} \mathrm{X}_{\mathrm{j}} + \varepsilon \quad (3)$$

where:
X_{j} - the vector of analysed *j* variable;
ρ - the spatial autoregression parameter;
W - the spatial weight matrix;
ε - the spatially correlated residuals.

3. Preparing the set of diagnostic variables:

3.1. Adjusting the values of variables from 'spatial' group according to formula:

$$S_j = (I - \rho W)^{-1} X_j \qquad (4)$$

where:

S_j - the vector of spatially adjusted *j* variable;

I - identity matrix;

ρ - the spatial autoregression parameter,

W - the spatial weight matrix.

3.2. Remaining unchained the values of variables from 'non-spatial' group.

4. Changing destimulants for stimulants and standardise variables according to Hellwig's formula:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j} \quad (i = 1,\ldots,n;\ j = 1,\ldots,m) \qquad (5)$$

where:

z_{ij} - standardised value of *j* variable in *i* object;

x_{ij} - the value of *j* variable in *i* object;

$\bar{x}_j$ - the mean average of *j* variable;

s_j - the standard deviation of *j* variable.

5. Calculating the distance between the i object and 'ideal' object:

$$d_i = \sqrt{\sum_{j=1}^{m} \left(z_{ij} - \varphi_j\right)^2} \quad (i = 1,\ldots,n;\ j = 1,\ldots,m) \qquad (6)$$

where:

z_{ij} - standardised value of *j* variable in *i* object;

φ_j - value of *j* variable in the 'ideal' object.

6. Calculating the spatial taxonomy measure of development (sTMD) according to formula:

$$sTMD_i = 1 - \frac{d_i}{d_{i-}} \quad (i = 1,\ldots,n) \qquad (7)$$

where:

$$d_{i-} = \bar{d} + 2s_d \quad (i = 1,\ldots,n) \qquad (8)$$

$sTMD_i$ - the taxonomy spatial measure of development for the county *i*;

d_i - the distance between object *i* and 'ideal' object;

$\bar{d}$ - the average value of *d* vector ($d = d_1,\ldots,d_n$);

s_d - the standard deviation of *d* vector.

The higher the value of $sTMD_i$ the better from the point of view of analysed phenomena.

Values of sTMD were the basis for the beta-, sigma- and gamma-convergence analysis. Firstly the beta-convergence was tested, as the existence of beta-convergence is a necessary, but not sufficient, condition for existence of sigma- and gamma-convergence (Sala-i-Matin, 1996, pp. 1019-1036). In this research a growth equation model was used to examine the existence of beta-convergence:

$$g_i = \alpha + \beta sTMD_{i,0} + \varepsilon_t \tag{9}$$

where:

$sTMD_{i,0}$ - the value of spatial taxonomy measure of development in region *i* at the first year of analysis,

g_i - the average change of the value of spatial taxonomy measure of development over time, calculated as:

$$g_i = \frac{1}{T}\log\frac{sTMD_{i,T}}{sTMD_{i,0}} \tag{10}$$

where:

T - number of analyzed periods,

$sTMD_{i,T}$ - the value of spatial taxonomy measure of development in region *i* at the last year of analysis.

A negative relationship between the growth rate and the initial level of the standard of living (β must be negative and statistically significant) is evidence that the followers are catching up with the leaders (Barro & Sala-i-Matin, 1992, pp. 223-251).

For areas in which beta convergence occurs, the presence of sigma and gamma convergence was also tested. Sigma-convergence refers to a reduction of disparities among regions. In this research, the standard deviation of a log-transformed spatial taxonomy measure of development (sTMD) was used as a measure of sigma-convergence. To test if the sigma-convergence exists, a linear trend model was estimated:

$$S_{sTMD} = \alpha_0 + \alpha_1 t + \varepsilon_t \tag{11}$$

where:

S_{sTMD} - standard devotion of log-transformed sTMD.

Sigma convergence occurs when α_1 is negative and statistically significant.

At the last stage of analysis, gamma convergence was investigated. It is a concept proposed by Boyle and McCarthy (1999, pp. 343-347). Gamma convergence usually is based on comparison of linear ordering of analyzed regions. Simple measure that captures the change in rankings is Kendall's index of rank concordance calculated as:

$$\tau = \frac{C - D}{n(n-1)} \qquad (12)$$

where:
C - the number of concordant pairs,
D - the number of discordant pairs,
n - the number of observations.

Empirical analysis

The main goal of this paper is to analyze the existence of the social convergence in the Nordic NUTS-3 regions over the 2000-2015 period. The subject of analysis are 67 NUTS-3 regions of Nordic countries in 2000-2015 period. The standard of living was calculated based on a set of 18 diagnostic variables, divided into 9 groups (Table 1).

Table 1. The set of diagnostic variables.

Domain	Variables
Population	x_1 - the net migration rate (S),
Labour market	x_2 - the unemployment rate (D), x_3 - the average income of household in euro (current prices) (S),
Health care	x_4 - the number of deaths due to tuberculosis per 100 000 inhabitants (D), x_5 - the number of deaths due to malignant neoplasm per 100 000 inhabitants (D), x_6 - the number of deaths due to heart diseases per 100 000 inhabitants (D), x_7 - the number of new AIDS cases per 100 000 inhabitants (D), x_8 - the number of physician per 100 000 inhabitants (S),
Education	x_9 - the number of students in tertiary education per 1000 inhabitants (S),
Leisure time	x_{10} - the number of hotels per 1000 inhabitants (S), x_{11} - the number of museums per 100 000 inhabitants (S),
Living conditions	x_{12} - the number of new dwellings completed per 1000 inhabitants (S),
Transport and communication	x_{13} - transport infrastructure in km per km2 of land area (S), x_{14} - the number of cars per 1000 inhabitants (S),
Social security	x_{15} - the number of suicides per 100 000 inhabitants (D), x_{16} - the number of divorces per 1000 marriages (D),
Natural environment	x_{17} - protected area as % of land area (S), x_{18} - the CO_2 emission in kg per capita per year (D).

Source: Author's own investigation. (S) – for stimulants, (D) – for destimulants.

At the first step of analysis the presence of spatial autocorrelation was tested using Moran's I statistics (1). Half of the used variables revealed spatial autocorrelation (x_1, x_2, x_3, x_4, x_7, x_9, x_{13}, x_{14}, x_{18}). Therefore, the inclusion of spatial factor in the construction of synthetic measure seems reasonable. For each variable that belongs to 'spatial' group in each period a SAR model (3) was estimated. Then sTMD was calculated according to (4)-(8). Obtained sTMD values for 2000 and 20015 are presented in Table 2.

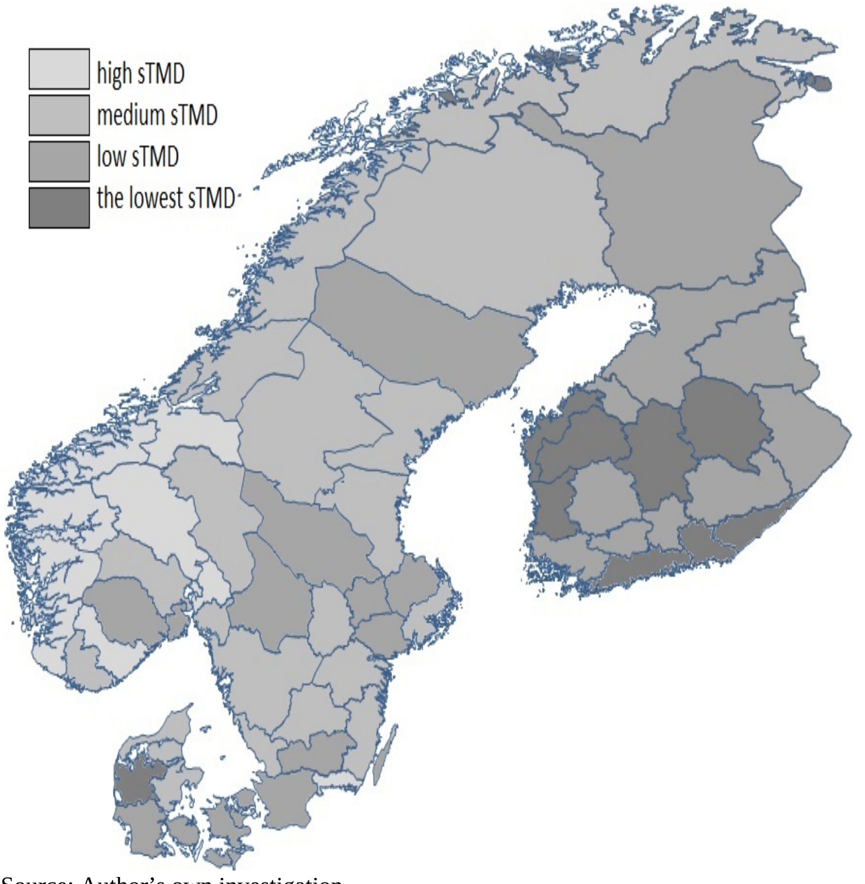
Table 2. Values of sTMD in year 2000 and 2015

Region	sTMD		Region	sTMD		Region	sTMD	
	2000	2015		2000	2015		2000	2015
Byen København	0,436	0,494	Hordaland	0,497	0,582	Jämtland	0,415	0,402
Københavns omegn	0,382	0,403	Sogn og Fjordane	0,512	0,531	Västerbotten	0,347	0,385
Nordsjælland	0,371	0,366	Møre og Romsdal	0,542	0,652	Norrbotten	0,431	0,437
Østsjælland	0,315	0,358	Nordland	0,444	0,459	Pohjois-Savo	0,281	0,324
Vest- og Sydsjælland	0,362	0,370	Troms	0,424	0,461	Pohjois-Karjala	0,330	0,327
Fyn	0,352	0,354	Finnmark	0,403	0,453	Kainuu	0,324	0,319
Sydjylland	0,369	0,361	Stockholm	0,410	0,442	Uusimaa	0,304	0,373
Vestjylland	0,302	0,359	Uppsala	0,385	0,400	Itä-Uusimaa	0,375	0,398
Østjylland	0,421	0,422	Södermanland	0,343	0,382	Varsinais-Suomi	0,354	0,355
Nordjylland	0,405	0,408	Östergötland	0,329	0,381	Kanta-Häme	0,352	0,356
Oslo	0,757	0,693	Örebro	0,443	0,454	Päijät-Häme	0,332	0,350
Akershus	0,511	0,532	Västmanland	0,460	0,476	Kymenlaakso	0,283	0,253
Hedmark	0,428	0,435	Jönköping	0,407	0,440	Etelä-Karjala	0,299	0,322
Oppland	0,514	0,516	Kronoberg	0,357	0,385	Satakunta	0,241	0,219
Østfold	0,404	0,409	Kalmar	0,362	0,403	Pirkanmaa	0,352	0,341
Buskerud	0,457	0,490	Blekinge	0,529	0,554	Keski-Suomi	0,286	0,290
Vestfold	0,385	0,405	Skåne	0,432	0,457	Etelä-Pohjanmaa	0,239	0,296
Telemark	0,355	0,383	Halland	0,424	0,425	Pohjanmaa	0,301	0,284
Aust-Agder	0,507	0,550	Västra Göta-land	0,420	0,451	Keski-Pohjanmaa	0,312	0,313
Vest-Agder	0,488	0,510	Värmland	0,390	0,388	Pohjois-Pohjanmaa	0,325	0,332
Rogaland	0,599	0,707	Dalarna	0,385	0,429	Lappi	0,339	0,340
Sør-Trøndelag	0,730	0,799	Gävleborg	0,416	0,427			
Nord-Trøndelag	0,453	0,493	Västernorrland	0,429	0,448			

Source: Author’s own investigation.

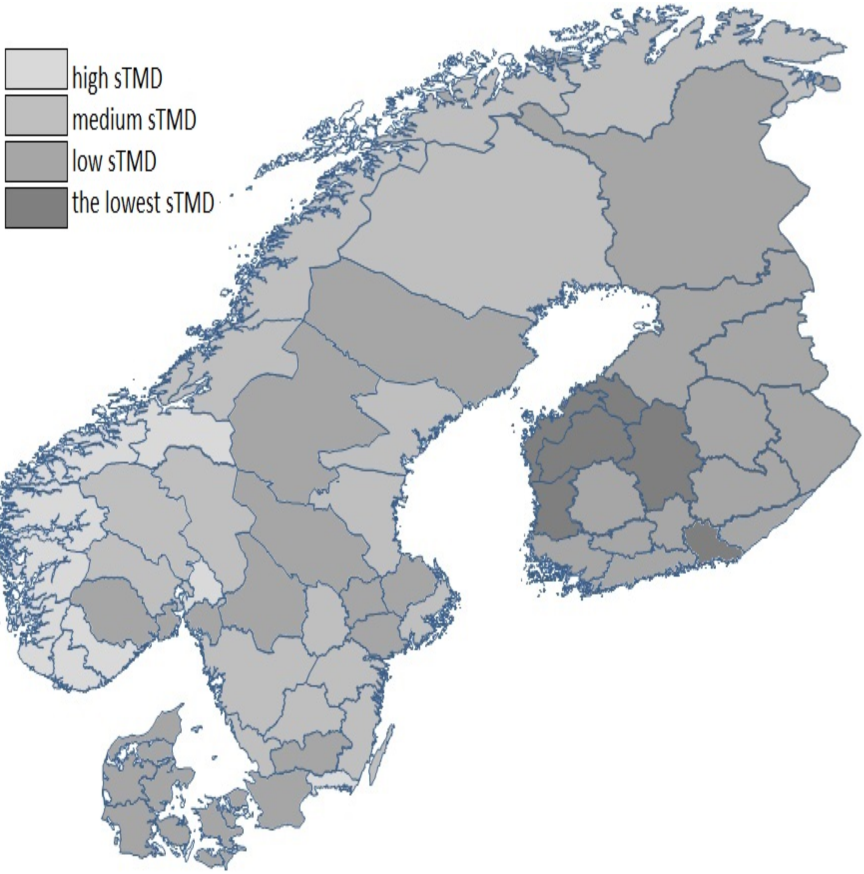
Analysing data presented in the table 2, one can see that regions with the highest standard of living in 2000 were: Oslo, Sør-Trøndelag, Rogaland, Møre og Romsdal and Blekinge. In 2015 the top 5 regions were: Sør-Trøndelag, Rogaland, Oslo, Møre og Romsdal and Hordaland. The highest standard of living was observed mostly at the west-coast of Norway, which is connected with well development industry, especially oil and petrochemical industry, affording high employment and relatively higher earnings, which have an impact on the material aspect of the inhabitants' standard of living. On the other hand, the lowest standard of living in 2000 was observed in following regions: Etelä-Pohjanmaa, Satakunta, Pohjois-Savo, Kymenlaakso and Keski-Suomi. In 2015 the bottom 5 regions were: Satakunta, Kymenlaakso, Pohjanmaa, Keski-Suomi and Etelä-Pohjanmaa. The regions with the lowest standard of living are forested regions of central Finland, with poorly developed industry, communications infrastructure and high unemployment. (see Figure 1 and 2).

Figure 1. Similar group of Nordic NUTS-3 regions in terms spatial taxonomy measure o development value in 2000.



Source: Author's own investigation.

Figure 2. Similar group of Nordic NUTS-3 regions in terms spatial taxonomy measure o development value in 2015.



Source: Author's own investigation.

The main part of this research is to analyze the existence of beta-, sigma- and gamma- convergence among Nordic NUTS-3 regions. Analysis was conducted not only for standard of living measure but also for synthetic variables describing each domain of standard of living. The study was conducted this way because the occurrence (or absence) of convergence for the standard of living as a whole does not necessarily imply the existence (or absence) of convergence in its particular domain.

Firstly, the existence of beta-convergence was tested, according formula (9). Results of this analysis are presented in Table 3.

Table 3. Absolute beta-convergence in the standard of living domains.

Domain	α	β	R^2
Standard of living	0,0012	0,0003	0,0004
Population	0,0074	-0,0246	0,0098
Labour market	0,0080	-0,0083	0,0027
Health care	0,6181 ***	-1,4585 ***	0,2673
Education	0,0650 ***	-0,1087 ***	0,1429
Leisure time	0,0190 ***	-0,0282	0,0473
Living conditions	0,0135 ***	-0,0238	0,0393
Transport and communication	0,0296 ***	-0,0461	0,0855
Social security	0,0059	0,0047	0,0548
Natural environment	0,0120	-0,0018	0,2153

*** p<0,01; ** p<0,05; * p<0,01
Source: Author's own investigation.

As can be seen in Table 3, conditions for the existence of beta convergence are fulfilled only for two dimensions, i.e. health care and education. It can be therefore stated that regions with initially lower standard of living are not developing fast enough to catch up regions with initially higher standard of living. The same situation is taking place in most of the standard of living domains.

The analysis of sigma and gamma convergence is only possible for two standard of living dimensions, i.e. health care and education. As the occurrence of beta convergence is a necessary, but not sufficient condition for existence of sigma- and gamma-convergence. So in the next step of analysis the social sigma convergence was examined using formula (11). Results are presented in Table 4.

Table 4. Sigma-convergence in the standard of living domains.

Domain	α	α_1	R^2
Health care	0,0875 ***	-0,0023 ***	0,8526
Education	0,1030	0,0009	0,0951

*** p<0,01; ** p<0,05; * p<0,01
Source: Author's own investigation.

Analysing Table 4, it can be seen that sigma convergence occurs it the health care domain. It means that disproportions among regions in terms of health care are decreasing. In education area sigma convergence does not occur, so even though that weaker regions are developing faster than stronger one, the differences between them are still quite high.

At the last step of analysis the existence of gamma convergence was tested using formula 12. Once again only for domains in which beta-convergence occurred. Results are presented in table 5.

Table 5. Gamma-convergence in the standard of living domains.

Domain	τ	p-value
Health care	0,8436	<0,0500
Education	0,7349	<0,0500

*** p<0,01; ** p<0,05; * p<0,01
Source: Author's own investigation.

As can be seen in table 5, τ takes high, statistically significant values so there is a high rank concordance between 2000 and 2015. This is why it can be claimed that gamma-convergence does not occur neither in health care nor education domain.

Conclusions

Main goal of this paper was to analysis the existence of social convergence in the Nordic regions in period 2000-2015. Pietrzak's spatial taxonomy measure of development was used to determine inhabitants' standard of living in each region. The results of the analysis indicate that there is no social convergence in the standard of living and in most of its domain. The exception are the education sector for which beta convergence occurs, and the health care sector, where beta and sigma convergence have emerged.

Although the Nordic countries appear to be one strong monolith, it has been shown that the regions differ strongly among themselves. It should be not surprising that Nordic Council and Nordic Council of Ministers are implementing another strategy for sustainable development, as there is still much to do in terms of sustainability of Nordic region.

Future research will focus on the impact of immigration on the standard of living and social convergence in the Nordic regions.

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