ORIGINAL PAPER

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Social convergence in Nordic countries at regional level

Abstract

Research background: Geographical proximity, common historical roots and collaboration within the Nordic Council cause the Nordic countries to be 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. The results of this analysis may be helpful in evaluating the efficiency of the activities under third and fourth Nordic Strategy for Sustainable Development.

Methods: The spatial taxonomic 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 the ones 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 period. 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 Wydymus (1992, pp. 669–687) has been used. It refers to the level of wealth, comfort, material goods and necessities available to a certain socio-economic class in a certain geographic area. A good approximation of such a comprehensive phenomenon can be a synthetic variable which is a combination of several other variables. Measures based on GDP were rejected, as many authors claim that GDP per capita cannot be used alone as the standard of living measurement (Daly & Cobb, 1990, pp. 62–82; Khan, 1991, pp. 153–175; Clarke, 2005, pp. 3; Stiglitz *et al*., 2009, pp. 21–40).

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 (The lottery of life 2012, pp. 1–2; OECD Better Life Index 2013, pp. 1–2; Global Peace Index 2015, pp. 6–8; Human Development Report 2015, pp. 20–22; The Legatum Prosperity Index Ranking 2015, pp. 3–4; World Happiness Report 2016, pp. 20–22; World Happiness Report 2017, pp. 22–27), quality of human capital (Balcerzak, 2016, pp. 17–20; Balcerzak & Pietrzak, 2016b, pp. 9–10), but also the relatively better conditions of their economies (The Global Competitiveness Report 2015, pp. 15–16). Therefore, those countries have high positions in different rankings on happiness and quality of life, as well as the competitiveness of their economies. Secondly, in 1952, Denmark, Iceland, Norway and Sweden the Nordic Council was formed, which was later joined by Finland, and also by the autonomous territories: Greenland, Åland and the Faroe Islands. In 1962, the Nordic countries signed the so-called 'Helsinki Treaty' (The Helsinki Treaty 1962), which regulates cooperation between them. The Nordic Council and cooperating Nordic Council of Ministers are responsible for the agreements within the Nordic countries and the pursuit of the sustainable development of associated regions. Currently, the fourth strategy for the sustainable development of the Nordic region is implemented (A Good Life in a Sustainable Nordic Region. Nordic Strategy for Sustainable Development 2013, pp. 5–32). The time frame of this strategy covers the period up to 2025. 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. It seems that the issues concerning the standard of living comprise one of the priorities of the Helsinki Treaty. Thirdly, one should remember that emphasis on the good of the 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. Folkehemmet sometimes is understood as a third way, next to socialism and pure capitalism. In fact, this concept was implemented in all Nordic countries, not only Sweden, and it is commonly known as the Nordic Model of Welfare. It should be noted here that even thought the Nordic Model of development is commonly used term, we actually have five different models — different for each country (Hilson, 2008, pp. 99–106; Anioł, 2013, pp. 36–42). However, the common feature of those models is highlighting the quality of life and the standard of living of its inhabitants. Finally, due to their geographical proximity and common historical roots, the Nordic countries are often wrongly treated as a unity. However, in reality, different regions of the Nordic countries are diverse in terms of socio-economic development.

The analysis was conducted for 67 NUTS-3 regions of Nordic countries (excluding: Höfuðborgarsvæði, Landsbyggð, Grønland, Føroyar, Åland, Gotland and Bornholm) in 2000–2015 period. Empirical material was taken from the national statistical offices of analysed countries.

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 the standard of living, spatial taxonomic measure of development according to Pietrzak (2014, pp. 181–201) was used. It is worth mentioning here that inclusion of spatial factor into socio-economic analysis getting popularity in contemporary researches. Spatial taxonomic measure of development was used for example in analysis of:

− sustainable development of Polish voivodship (Antczak, 2013, pp. 37–53);
− economic development level of Polish subregions (Pietrzak, 2014, pp. 181–201);

− standard of living in Polish counties (Sobolewski *et al*., 2014, pp. 159–172);
− social convergence in the European Union (Kuc, 2014, pp. 123–136);
− standard of living in the European Union (Kuc, 2015, pp. 163–170);
− regional sustainable development in China (Vu *et al*, 2014, pp. 6400–6417);
− labour market in Poland (Pietrzak, 2016a, pp. 69–86; Pietrzak, 2016b, pp. 47–58).

In literature one can find several reasons to include spatial factors into socio-economic analysis. Firstly, according to Tobler, 'Everything is related to everything else, but near things are more related than distant things' (Tobler, 1970, pp. 234–240). Secondly, the use of a regional dataset implies consideration of the possibility that observations may not be independent, as a result of the inter-connections between neighbouring regions (Buccellato, 2007, p. 1). Thirdly, it is better to use the simplest weight matrix than assume the independence in advance (Griffith, 1996, pp. 351–367). Fourthly, the diversification of economic phenomena in an established group of regions is highly affected by the spatial conditions (Pietrzak *et al*., 2014a, pp. 203–220; Pietrzak *et al*., 2014b, pp. 135–144). Fifthly, empirical analyses that have ignored the influence of spatial location may have produced biased results (Fingleton & Lopez-Bazo, 2006, p. 178). Finally, the convergence analysis based on spatial synthetic measure gives models that fit more closely to the data and indicate a faster rate of convergence (Kuc, 2014, pp. 11–12). It seems that the inclusion of spatial relationships is justified because nowadays no region develops in isolation. Therefore, the situation in each region is influenced by neighbourhood.

In this research, the method proposed by Pietrzak (2014, pp. 181–201) was used, as this approach allows the occurrence of different potential strength of interaction for each variable. The procedure of calculating spatial taxonomic measure of development (sTMD), according to Pietrzak, is as follows:

1. Testing the presence of spatial autocorrelation using Moran's I statistics. 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 ('non-spatial' variables).
2. Estimating the SAR model for each variable from 'spatial' group of variables (LeSage, 1999):

$$X_j = \rho W X_j + \varepsilon \tag{3}$$

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:

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

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

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

where:

z_{ij} – standardised value of j variable in i object; φ_j – value of j variable in the 'ideal' object.

It is worth mentioning here that constant pattern (the maximum value for 2000) for the entire analyzed period was used. That procedure is a condition for dynamic analysis that ensures comparability of results (Balcerzak, 2015, p. 194; Balcerzak & Pietrzak, 2016a, p. 85; Pietrzak & Balcerzak, 2016a, p. 125).

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

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

where:

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

$sTMD_i$ – the spatial taxonomic 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 ($d = d_1,...,d_n$); s_d – the standard deviation of d vector.

The values of sTMD were the basis for the beta-, sigma- and gamma-convergence analysis. Research conducted by Hobijn & Franses (2001, pp. 171–200), Neumayer (2003, pp. 275–296), Puss *et al.* (2003, pp. 1–24), Berbeka (2006, pp. 267–280), Molina & Purser (2010, pp. 1–53) show that the methods previously used for economic convergence analysis can be adapted to evaluate the existence of social convergence. Convergence analysis at the regional level are extremely important as sometimes a given country may converge to other countries, but at the same time diverge at the regional level (Pietrzak & Balcerzak, 2016b, p. 1705).

Firstly, the beta-convergence was tested, as the existence of beta-convergence is a necessary, but not sufficient, condition for the existence of sigma- and gamma-convergence. It is a necessary condition, because without the catching up the spread between regions cannot shrink. It is not a sufficient condition, because it is possible (at least theoretically) that those regions with lower standard of living can overtake those with higher standard of living, so this may increase the disproportion (Sala-i-Matin, 1996, pp. 1019–1036). Social beta-convergence is a process in which regions with lower standard of living are developing faster than regions with higher standard of living. In this research a growth equation model was used to examine the existence of beta-convergence:

$$\frac{1}{T} \log \frac{sTMD_{i,T}}{sTMD_{i,0}} = \alpha + \beta \log sTMD_{i,0} + \varepsilon_t \tag{9}$$

where:
$sTMD_{i,0}$ – the value of spatial taxonomic measure of development in region i at the first year of analysis, $sTMD_{i,T}$ – the value of spatial taxonomy measure of development in region i at the last year of analysis, T – number of analyzed periods.

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 taxonomic 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:

$$S_{sTMD} = \alpha_0 + \alpha_1 t + \varepsilon_t \tag{10}$$

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 is usually based on comparison of linear ordering of analyzed regions. A simple measure that captures the change in rankings is Kendall's index of rank concordance calculated as:

$$\tau = \frac{C - D}{n(n-1)} \tag{11}$$

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 (excluding: Höfuðborgarsvæði, Landsbyggð, Grønland, Føroyar, Åland, Gotland and Bornholm) in 2000–2015 period. The standard of living was calculated based on a set of 18 diagnostic variables, divided into 9 groups (Table 1).

At the first step of analysis the presence of spatial autocorrelation was tested using Moran's I statistics (1). The results of this analysis for year 2000 are presented in Table 2.

As can be seen in Table 2, in 2000 half of the used variables reveal spatial autocorrelation (x_1, x_2, x_3, x_4, x_7, x_9, x_{13}, x_{14}, x_{18}). The same tendency has been maintained throughout the whole analyzed period. 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 (Formula 3) was estimated. Then, the estimated parameter was used to adjust 'spatial' variables according to the formula. Variables from 'non-spatial' group were not modified. All destimulants have been transformed into stimulants and then standardised using Formula 5. Afterwards, the spatial taxonomy measure of development was calculated according to formulas 6–8. Obtained sTMD values for 2000 and 2015 are presented in Table 3.

Analysing data presented in the Table 3, one can see that the 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 higheststandard of living was observed mostly on 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 Figure 2).

The main part of this research is to analyze the existence of beta-, sigma- and gamma- convergence among Nordic NUTS-3 regions. The analysis is based on sTMD values. However, it should be noted here that the analysis was conducted not only for the standard of living measure, but also for synthetic variables describing each domain of the 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. It is also possible that regions may converge in some areas, but in others divergence may be observed.

Firstly, the existence of beta-convergence was tested, according to the methodology outlined in second paragraph of this study. The results of this analysis are presented in Table 4.

As can be seen from Table 4, the conditions for the existence of beta convergence (negative and statistically significant β parameter) are fulfilled only for two standard of living dimensions, i.e. health care and education. It can be therefore stated that regions with initially lower standard of living (see Table 3 or Figure 1) are not developing fast enough to catch up with the regions with initially higher standard of living. The same situation is taking place in most of the standard of living domains. Looking for positives, it can be noticed that at least there is no evidence of divergence processes (positive and statistically significant β), so the differences among analyzed regions are not growing.

The analysis of sigma and gamma convergence is only possible for two standard of living dimensions, i.e. health care and education. As it was mentioned before, 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 5.

Analysing the data presented in the Table 5, it can be seen that sigma convergence occurs in the health care domain (α_1 is negative and statistically significant). It means that disproportions among regions in terms of health care are decreasing from year to year. In the education area, sigma convergence does not occur, so even though that the weaker regions are developing faster than the stronger ones, the differences between them are still quite high and are not shrinking over time.

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.

As can be seen in Table 6, 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 occurs neither in health care nor the education domain.

Conclusions

The main goal of this paper was to analyze the existence of social convergence in the Nordic regions in the 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 exceptions 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 a monolith, it has been shown that the regions differ strongly among each other. It should not be surprising that Nordic Council and Nordic Council of Ministers are implementing another strategy for sustainable development. The fourth sustainable development strategy is orientated i.a. towards higher employment and green economic growth. The orientation of sustainability policy seems reasonable, as the results of this study indicate that the strongest variation between regions is in the labor market and natural environment sectors.

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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Annex

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 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	x_{13} - transport infrastructure in km per km2 of land area (S),
communication	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	x_{17} - protected area as % of land area (S),
environment	x_{18} - the CO_2 emission in kg per capita per year (D).

(S) – for stimulants, (D) – for dis-stimulants.

Table 2. Moran's I statistics and corresponding p-values in year 2000

Variable's number	Moran's I	p-value	Variable's number	Moran's I	p-value	Variable's number	Moran's I	p-value
x_1	0,489	0,003	x_7	0,021	0,028	x_{13}	0,472	0,001
x_2	0,332	0,016	x_8	-0,114	0,349	x_{14}	0,619	0,000
x_3	0,521	0,002	x_9	0,284	0,046	x_{15}	0,058	0,252
x_4	0,517	0,002	x_{10}	0,150	0,104	x_{16}	0,021	0,357
x_5	-0,122	0,355	x_{11}	0,136	0,127	x_{17}	0,124	0,166
x_6	0,004	0,405	x_{12}	-0,001	0,400	x_{18}	0,361	0,017

Table 3. 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
København omegn	0,382	0,403	Sogn og Fjordane	0,512	0,531	Västerboten	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

Table 3. Continued

Region	sTMD		Region	sTMD		Region	sTMD	
	2000	2015		2000	2015		2000	2015
Vest- og Sydsjællan d	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	Södermanla nd	0,343	0,382	Varsinais-Suomi	0,354	0,355
Nordjylland	0,405	0,408	Östergötlan d	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	Västmanlan d	0,460	0,476	Kymenlaak so	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 Götaland	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	Västernorrl and	0,429	0,448			

Table 4. Absolute beta-convergence in the standard of living domains

Domain	α	p-value	β	p-value	R^2
Standard of living	0,0012	0,2295	0,0003	0,8711	0,0004
Population	0,0074	0,4491	-0,0246	0,4890	0,0098
Labour market	0,0080	0,2005	-0,0083	0,7160	0,0027
Health care	0,6181	0,0000	-1,4585	0,0000	0,2673
Education	0,0650	0,0000	-0,1087	0,0062	0,1429
Leisure time	0,0190	0,0003	-0,0282	0,1252	0,0473
Living conditions	0,0135	0,0047	-0,0238	0,1628	0,0393
Transport and communication	0,0296	0,0000	-0,0461	0,1655	0,0855
Social security	0,0059	0,1351	0,0047	0,2351	0,0548
Natural environment	0,0120	0,1131	-0,0018	0,1340	0,2153

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

Domain	α	p-value	α_1	p-value	R^2
Health care	0,0875	0,0000	-0,0023	0,0030	0,8526
Education	0,1030	0,1259	0,0009	0,5247	0,0951

Table 6. Gamma-convergence in the standard of living domains

Domain	τ	p-value
Health care	0,8436	0,0042
Education	0,7349	0,0126

Figure 1. Similar group of Nordic NUTS-3 regions in terms spatial taxonomy measure o development value in 2000.
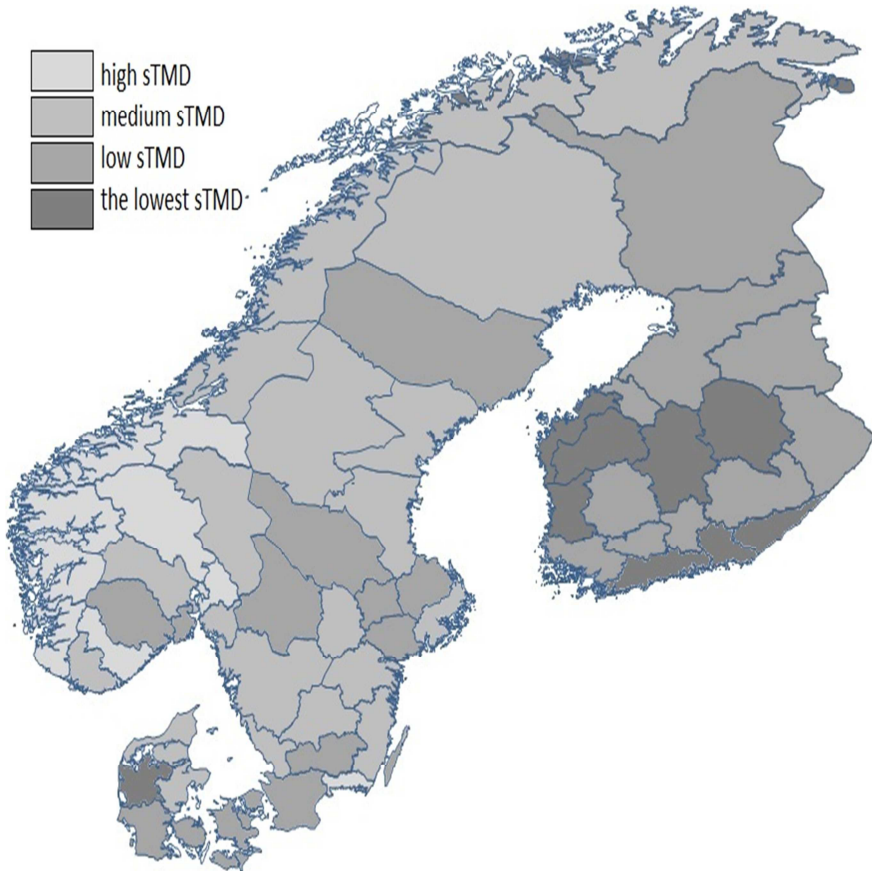
Figure 2. Similar group of Nordic NUTS-3 regions in terms spatial taxonomy measure o development value in 2015