DOI: 10.1515/danb-2015-0001

Regional development in advanced countries: A within-country application of the Human Development Index for Austria

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Abstract

Since its implementation in 1990, the human development index (HDI), the flagship indicator of multidimensional development, has attracted a great deal of attention and critics in academic, political and media circles. It initiated a new stage in the discussion of appropriate indicators to measure socioeconomic development. Until now, the vast majority of empirical work using the HDI concept has taken a cross-country perspective. The main aim of this paper is the application of the HDI at the sub-country level in small, highly developed and socioeconomically homogenous countries. For this undertaking we use a slightly modified version of the HDI, called the regional development index (RDI). For the components of the RDI – life expectancy, education and standard of living – we use recent cross section information for Austria at the level of districts. There exists considerable heterogeneity across districts in the RDI and its components. Our Theil-decomposition reveals that the overwhelming part of the observed heterogeneity is based on differences within provinces (96 percent), although the differences in life expectancy between the provinces explain a substantial part of the overall heterogeneity in this indicator (54 percent).

Keywords

Human Development Index, Regional Development, Decomposition, Austria

I. Introduction

Capturing well-being, quality of life, human development, welfare and prosperity in appropriate indices is an important concern of economic reporting. Such an undertaking helps (i) to evaluate the present status of a society, (ii) to deduce targets and define measures

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to improve the status quo, (iii) to review policies and assess the effectiveness of specific strategies of intervention, and (iv) to compare the level/development between political units at different levels of spatial aggregation (regions, states, world regions).

GDP (and its regional counterparts) is still the most widely used index for measuring economic development and/or prosperity. However, a quick look at its basic construction principles reveals that GDP is an inappropriate indicator of economic welfare. Based on this insight, and parallel with the implementation of 'The System of National Accounts' (SNA) in the 1960s, a broad strand of research tried to develop more comprehensive economic reporting systems (e.g. the social indicator movement in the 1970s and the derivation of various SNA-satellite systems). More recently, the development of aggregated multidimensional measures of socio-economic development has been on both the scientific and political agenda, such as (i) the Life Product Index (LPI; Lind, 1993), which combines life expectancy and GDP, (ii) the Quality of Life index (QOL; Porter & Purser, 2008), which includes components measuring economic, political, environmental, health/educational and social parameters, (iii) the Happy Planet Index (HPI; nef, 2012), combining environmental impact with human well-being, (iv) the Multidimensional Poverty Index (MPI; UNDP, 2011a) identifying multiple deprivations at the individual level in education, health and standard of living, and (v) the Index of Sustainable Economic Welfare (ISEW; Daly & Cobb, 1989), which subtracts those expenditures which do not increase welfare from the regular GDP figure (see Ludwig, 1999). In a similar way, Stiglitz et al. (2009) suggest that well-being should be measured in a multidimensional way. They identify material living standards, health, education, personal activities including work, political voice and governance, social connections and relationships, environment and insecurity in an economic as well as a physical nature as the key elements of such an index. Recently, the OECD (2011) proposed a new measure of well-being and progress, including a comprehensive set of indicators covering material conditions (income and wealth, jobs and earnings, housing) and quality of life (health status, work and life, education and skills, social connections, civic engagements and governance, environmental quality, personal security, and subjective well-being).

The most widely used aggregated index, however, is the Human Development Index (HDI). It was developed by Haq & Sen on behalf of the United Nations and is the nucleus of the annually published Human Development Report (HDR; UNDP, 2011b). Since its first publication in 1990, the HDI has undergone several methodological changes, the most recent and quite far-reaching in 2010 (for an overview on these changes, see Kovacevic, 2010). For the application and assessment of the HDI, it is indispensable to bear in mind that the HDI is not just a tool to enlarge the existing concepts of economic welfare measurement or to diminish their shortcomings (e.g. GDP). The HDI is a multidimensional index that tries to inform about the "capabilities" open to the individuals in a society. Thus, the focus is on possibilities of economic activities and not on their results. The capability approach ultimately rests on Sen's critique of important building blocks of Utilitarism (these are: Act-Consequentialism, Welfarism, Sum Ranking; for details, see Sen, 1985; for comprehensive overviews, see Clark, 2005, and Wells, 2012). Central to the capability approach is the idea of functioning. "A functioning is an achievement of a person: what

DOI: 10.1515/danb-2015-0001

she manages to do or be (. . .). Thereby, the capability of a person is a derived notion and reflects the various combinations of functionings he or she can achieve" (Sen, 2003, p. 5). Ultimately, the capability set in the functioning space reflects the person's freedom to choose between possible ways of living. The HDI includes the following three individual abilities, which act as its sub-indicators: (i) to live a long and healthy life, measured by life expectancy at birth, (ii) to have access to knowledge, which is necessary to communicate and participate in the life of the community, measured by the adult literacy rate, and (iii) to have command over the resources necessary to participate in community life and to make the choices to live a full and meaningful life, measured by logarithm of GDP per capita (see Zambrano, 2011a).[4] The first two dimensions of the HDI are seen as elementary functionings with an intrinsic value of their own, while the third component ("access to resources") has only an instrumental value, since commodities (goods) are primarily means to other ends (see Zambrano, 2011a).

The implementation of the HDI was accompanied by an intensive discussion of its merits and shortcomings (for comprehensive discussions, see Kovacevic, 2010; Zambrano, 2011a; Zambrano, 2011b; Klugman et al., 2011, and Ravallion, 2010). This debate covers the theoretical background of the concept as well as methodological details of its construction and its political interpretation and significance. Kaplow (2007) fundamentally challenges the capability approach of Sen underlying the HDI from the perspective of traditional welfare economics (see also the discussions in Clark, 2005, and Wells, 2012). Many authors with different scientific background criticize the number and nature of the selected capabilities (sub-indicators). Ranis et al. (2006), for instance, suggests measuring human development in a more detailed manner, i.e. with more than three sub-indicators. Another point of criticism is that the HDI does not include environmental and distributive/inequality issues. Bagolin (2004) summarizes that the HDI is too restricted to the socioeconomic sphere of life and does not include the political and civil spheres (see also Dasgupta & Weale, 1992). Furthermore, she points out that both between gender (Hicks, 1997) and within-country inequality (Ram, 1992) are not considered. Chowdhury & Squire (2006) and Desai (1991) criticize the equal weighting of the three components and suggest a different weighting scheme to reflect the role of different capabilities more appropriately. Other authors (Ravallion, 2010, and Sagar & Najam, 1998) point to the tradeoffs between different components of the HDI captured in the aggregation rule and are critical on the policy relevance of the HDI.

While the majority of previous empirical studies focuses on the comparison between states in a cross-country perspective, a corresponding index at the regional level offers the possibility of monitoring heterogeneous developments within countries. Porter & Purser (2008) argue that an understanding of human development on international, national and regional levels is essential for a proper understanding of the capabilities of the population, and thus, for appropriate strategies of political intervention. They calculate a sub-national HDI to assess the development of US states and find high heterogeneity across regions and states. Moreover, while US metropolitan areas are highly developed, they are also far from

[4] The logarithmic transformation of the component income captures the idea that income increases capabilities at a decreasing rate.

homogeneous at a sub-national scale. Similar studies for various countries emphasize the considerable heterogeneity across regions within countries, which cannot be captured by regular cross-country comparisons.[5] Lower welfare of a certain region might cause higher social costs and negative external effects. Moreover, within-country divergence might lead to the depopulation of economically disadvantaged areas, increasing the economic vulnerability of small and medium-sized cities and economic disengagement between metropolitan and surrounding areas (see Dubois et al., 2007).

The main aim of this paper is the application of the HDI at the sub-country level for highly developed and socioeconomically homogenous countries. We offer a modified approach to measure within-country heterogeneity in capabilities at the regional level based on the HDI concept. Thereby, we use slightly modified sub-indicators and a different method of standardization (ensuring that each sub-indicator is equally weighted) to capture capabilities in industrialized countries more appropriately. Thus, our regional development index (RDI) could easily be applied to any developed (OECD) country in the world. In a second step, we offer an application of this index to the case of Austria. Thereby, we are able to measure and compare human development on the regional (province and district) level in Austria. Furthermore, we decompose the within-country heterogeneity in the RDI into a between- and within-province variation. Thus, we are able to assess whether the heterogeneity of the index is actually driven by inequality within (i.e. across districts) or between provinces. The results are relevant for policy makers both (i) to monitor the current state of development across provinces and districts, and (ii) to assess whether and how policy interventions supported regional development. Thus, our results could also figure as a partial answer to the question as to whether the efforts to guarantee minimum standards of living (capabilities) irrespective of individual spatial location were successful. This was a widely agreed principle of regional policy in Austria in the 1970s, and is still highly relevant in the EU's regional policy. Similar to Porter & Purser (2008), we show descriptive statistics and GIS analysis to show the geographical distribution of development at a decentralized level in Austria.

The structure of the paper is as follows. Section two presents the methodological framework, indicators and data used in the paper. Section three presents the empirical results. Finally, section four discusses its policy implications, draws some conclusions and offers possible directions for future research.

II. Methodology and Data

Methodology

Our definition of the Regional Development Index (RDI) and its application to the Austrian case is based on the methodological approach of the HDI used in the Human Development Report 2010. Following the HDI formula, the RDI is the geometric mean of three dimensions: (i) long and healthy life, (ii) knowledge and (iii) standard of living. These

[5] For further studies, albeit with partly different methodologies, see Liu (1973, 1976), Harttgen & Klasen (2010), Alkire & Santos (2010), Silva et al. (2012). All authors emphasize the importance of within-country differences even in countries with similar levels of development according to the corresponding index.

DOI: 10.1515/danb-2015-0001

three dimensions are measured by (i) life expectancy at birth, (ii) level of education and (iii) net income per capita. This results in the following RDI-formula:[6]

$$RDI = I_{Life_Expectancy}{}^{(1/3)} * I_{Education}{}^{(1/3)} * I_{Net_Income}{}^{(1/3)} \quad (1)$$

Due to differences in the scales of the variables (e.g. income vs. life expectancy), it is necessary to standardize each sub-indicator. We standardize each of the sub-indices by a z-transformation to the mean of 100 and a standard deviation of 10 (see equation (2)). Thereby, it is ascertained that all three variables contribute evenly to the overall RDI, i.e. each variable is equally weighted in the overall index.[7] This modification of the original HDI seems particularly important for advanced countries, where certain variables are more homogeneous across regions than others.[8]

$$X_j = \frac{X_i - \overline{X}}{\sigma(X)} * 10 + 100 \quad (2)$$

Our second modification of the original HDI concerns the choice of sub-indicators. Due to data availability, we are able to use more sophisticated measures for the sub-indicators knowledge and standard of living. As the school system in advanced countries is typically institutionalized as a hierarchy of education, a simple measure ‘years of schooling’ does not seem to be appropriate for such countries. On the contrary, the school leaving certificate is based on comparable standards and can be used to measure education more adequately. For the sub-indicator standard of living (command over resources), we use the annual average net income of all employees, self-employed and pensioners according to their political district as proxy variable because there is no regional GDI or GDP available. The detailed calculations of the sub-indicators are described below.

[6] Thus, the HDI embodies imperfect substitutability across the HDI dimensions. This element of the HDI-revision in 2010 addresses one of the most serious criticisms of the HDI used previously, namely the linear aggregation formula of its single sub-indicators. The linear aggregation formula of equally weighted sub-indicators was used until 2009 and means perfect substitution, which does not seem to be appropriate (see Zambrano, 2011a). Some substitutability, however, is inherent in the definition of any index that increases with the values of its components (see Klugman et al., 2010). For critical views on this change, see Ravallion (2010). For a modification of the old HDI, which allows imperfect substitutability, see Chakravarty (2003). The multiplicative structure of the HDI-index 2010 fulfills important assumptions/principles of the construction of such an index. These principles are monotonicity, subsistence, and independence; for details, see Zambrano, 2011a and 2011b.

[7] Without any standardization, variables with higher standard deviations would have a higher impact on the overall index (e.g. income is less homogeneously distributed than, for instance, life expectancy).

[8] In the original form of the HDI, the indicators are normalized. Thereby, it is necessary to create minimum and maximum values (so called ‘goalposts’) to transform the indicators into indices between 0 and 1 (where a score of one reflects a high/the highest ranking). Because the geometric mean is used for aggregation, the maximum value does not affect the relative comparison (in percentage terms) between any two districts or periods of time. The goalposts used in the HDI are at least to some extent the results of normative considerations. In our calculations of the RDI we take the maximum and minimum values observed in the districts as goalposts for the different sub-indicators.

Table 1: U.N.'s HDI and the RDI (Regional Development Index)

Dimension	U.N.'s HDI 2010	RDI
Long and healthy life	Life expectancy at birth	Life expectancy at birth
Knowledge	Average years of schooling and expected years of schooling	Level of education
Decent standard of living	Real GDI per capita PPP (natural logarithmic)	Net income per capita (natural logarithmic)

- ***Life expectancy at birth:*** This indicator represents the dimension "a long and healthy life". Similar to the definition in the HDI, we include overall life expectancy at birth into our Regional Development Index (RDI). We do not differentiate between men or women, because gender-specific data are only available for two sub-indicators of the RDI. Life expectancy measures the number of years a newborn could expect to live if the prevailing patterns of age-specific mortality rates at the time of birth were to stay the same throughout the infant's life.

- ***Level of education:*** Education is a good proxy for acquired knowledge, skills and the possibility of participation in public and political life. Due to the more sophisticated data available in industrialized countries, we are able to use a more detailed indicator than in the case of the 'original' HDI[9] as a sub-indicator for the dimension knowledge. More precisely, level of education refers to the highest educational attainment a person has achieved. For this purpose, we consider five educational levels (based on the ISCED classification)[10] and multiply the number of persons in each group with the corresponding level of education. Subsequently, we divide the sum of the subgroups by the population between 25–64 years, as indicated in equation (3),

$$Edu = \frac{\sum_{E=2}^{5} POP_E * E}{POP_{25-64}} \quad (3)$$

where E corresponds to the level of education, POP_E is the population in each subgroup and POP_{25-64} is the overall population between 25 and 64 years. The factors used for the educational level E were (2) compulsory school (ISCED 2), (3) apprenticeship, secondary education or higher school certificate (general qualification for university entrance) (ISCED 3), (4) an additional education after this school-leaving certificate (e.g. general qualification for university entrance and vocational education or a college) (ISCED 4), and finally (5) a university degree (including PhD) or equivalent (ISCED 5/6).[11] Thus, we obtain an index measuring the average

[9] The HDI simply uses average schooling years due to data availability and for simplicity reasons. For advanced countries, a multi-stage index according to the highest graduation level seems more appropriate.

[10] For a similar, albeit slightly different approach, see Gächter & Theurl (2011).

[11] As a certain number of schooling years (i.e. 9 years in Austria) are compulsory in (most) advanced countries, our lowest category represents the ISCED 2 level (compulsory school), entering with the index number of 2 into

DOI: 10.1515/danb-2015-0001

educational level within regions where increasing values indicate a higher level of education, and vice versa (see Gächter & Theurl, 2011).

- ***Income per capita:*** Income is a proxy for the possibility to satisfy material as well as immaterial needs, and thus, measures the ability to enjoy a comfortable standard of living (see Porter & Purser, 2008). Our measure consists of annual average net income at the district level. Income tax statistics from the tax administration includes workers/employees, self-employed and pensioners based on the residence principle. Moreover, transfer payments (such as unemployment benefits, social benefits, assistance, nursing allowance, family allowance, etc.) are also included. It contains all those persons who were recorded by the tax office through a pay slip, an income tax assessment or as pensioners. Similar to the calculation of the HDI, the natural logarithmic income (without a cap) is used, which implicitly means that income enters in a non linear version in the RDI. We prefer net income to gross income as an indicator for the command over resources on the district level. In general, one could argue that gross income (market income supplemented by old age transfers) is a better indicator for the command over public and private resources. But this is only the case when the regional gross income is a good approximation for the capability of financing regional public goods. However, due to the existing system of intergovernmental fiscal relations in Austria, this is not the case.[12]

Furthermore, we want to analyze whether the observed heterogeneity of the RDI and its three sub-components (life expectancy, education and income) is indeed a phenomenon between districts or is caused by differences between provinces. This is important information for policy interventions, especially on its optimal spatial level (see Kanbur, 2006). To gain insight into this question, we decompose the inequality into two components. The two components are predefined by the territorial division of Austria (provinces and districts). Following this division we decompose the inequality of the RDI and its sub-components in (i) variations between districts (within provinces), and (ii) variations between provinces.

Theil (1967) and Cowell (1985) derive the characteristics of a multilevel decomposition based on the Theil index. Bahattacharya & Mahalanobis (1967) and Rao (1969) decompose the inequality in a two-stage setting using the Gini coefficient.[13] The following

the equation above. As the Austrian education system differs quite strongly from other countries, we included the various levels of education as follows. Compulsory school (ISCED 2) includes *Allgemeinbildende Pflichtschule* (index value 2); apprenticeship, secondary education or higher school certificate (ISCED 3) include *Lehre, Berufsbildende mittlere Schule, Allgemeinbildende höhere Schule* (3); an additional education after this school-leaving certificate (ISCED 4) includes *Berufsbildende höhere Schule* (4); and finally, a university degree or equivalent (ISCED 5/6) comprises of *Hochschulverwandte Lehranstalt, Universität, Fachhochschule* (5).

[12] Our indicator excludes minor groups of the population. Thus, we do not exactly measure per-capita income of the population of the districts. We expect that there could be a slight bias in our indicator income per capita depending on differences in the employment and family structure between the districts.

[13] Kakamu & Fukushige (2009) offer a broader discussion of the decomposition of different inequality concepts in a multilevel setting. They demonstrate that each of the suggested inequality concepts can be decomposed into multilevels if and only if each lower subgroup belongs to only one particular higher level group, in a so-called “nested structure”.

decomposition is based on the Theil index. This allows a complete decomposition of the overall inequality between provinces and districts.

In the case of Austria, the state is divided into districts and provinces. The subdivision of the state is exhaustive and non-overlapping. This means that every district is assigned to only one province. Therefore, we use the following notations for our multilevel decomposition procedure. The state consists of K provinces. μ_k is the population weighted average of the RDI over all provinces. μ is the population weighted average of the RDI over all districts. N_k is the number of districts in a province. x_i is the RDI of a single district. The population share with respect to the population of the state is p_k and p_{ik} is the population share of a single district on the population of the province. This allows a decomposition of the Theil index (T) in a between-province component *TBP* and a within-province component *TWP*, which is calculated in the following way:

$$T = \sum_{1}^{K}(p_k)(\frac{\mu_k}{\mu}) * ln(\frac{\mu_k}{\mu}) + \sum_{1}^{K}(p_k)(\frac{\mu_k}{\mu}) * \sum_{1}^{N_k}(p_{ik}) * (\frac{x_i}{\mu_k}) * ln(\frac{x_i}{\mu_k}) \quad (4)$$

The first part of equation (4) is the *TBP*-component, the second part represents the *TWP*-component. T is zero, if there is total equality in the RDI. T increases, if inequality increases. The calculation of T, *TBP* and *TWP* for the sub-indicators (life expectancy, education and income) is done in the same way as for the RDI, while the population weighted averages are adjusted.

For robustness purposes, we also estimate the RDI dispersion (i) between provinces, and (ii) between districts by calculating the coefficient of variation (CV). The CV is defined by the ratio of the RDI's standard deviation σ and its mean $\overline{X}$ (5).

$$CV = \frac{\sigma}{\overline{X}} \quad (5)$$

Data

To calculate the RDI for the districts and provinces in Austria[14] we use various data sources from *Statistik Austria*. Period-based life expectancy at birth for the province and district level are available for the time period 2005–2010.[15] To calculate the level of education, we use data from the educational attainment register in 2008. This dataset includes the highest educational attainment a person (aged 25–64) has achieved. Our income data are based on the annual report on labor income tax and the general income tax (*Integrierte Statistik der Lohn- und Einkommensteuer 2008*). This report includes individual annual taxable incomes and transfer payments averaged at the district level.[16] Our population data source

[14] Following the NUTS-classification, the province level is NUTS 2. Thereby, Austria is divided into 9 provinces. Furthermore, each province is divided into districts. In sum, Austria consists of 121 districts (98 political districts and the 23 municipal districts of Vienna). Austria has a decentralized political system with a strong central state. Number and size of the provinces and districts are based on historical contingencies and only partially on criteria of an optimal spatial organization of public policy (Gächter & Theurl, 2011).

[15] The districts *Eisenstadt (Stadt), Rust (Stadt)* and *Eisenstadt-Umgebung* are combined to one unit. Similarly, the districts *Waidhofen an der Ybbs* and *Amstetten* are merged.

[16] From 8,355,260 registered inhabitants in the end of the year 2008 in Austria, 6,552,826 persons were reported in the income and taxation report 2008.

DOI: 10.1515/danb-2015-0001

from *Statistik Austria* and the population office of Vienna (magistrate No. 5) includes all inhabitants by their main residence district for the year 2008.

Table 2: Summary statistics for the sub-indicators at the district level

Index	Mean	Std. Dev.	Min.	Max.
Life expectancy	80.15	0.84	78.29	82.40
Level of education	3.16	0.17	2.93	3.81
Net income in EUR	19,943.72	1,996.67	16,700	37,000

Notes: Means are weighted by population. The average values differ slightly from the published values by the primary datasets because we used a slightly adopted population dataset.

As shown in table 2, the average life expectancy in Austria is 80.15 years, whereas the average level of education is 3.16. The average level of (net) income is 19,944 euro per year. Proportionately, life expectancy at birth has the lowest standard deviation, followed by the level of education, while income exhibits the largest heterogeneity of the three included indicators.

III. Main Results

The RDI at the regional level and its sub-indicators

Figure 1 presents the distribution of both the overall RDI and its sub-indicators. While life expectancy at birth is almost normally distributed, the level of education as well as income per capita (even in its logarithmic form) are clearly right skewed, resulting in a slightly right-skewed overall RDI across all districts.

Figure 1: Distribution of the RDI and its sub-indicators

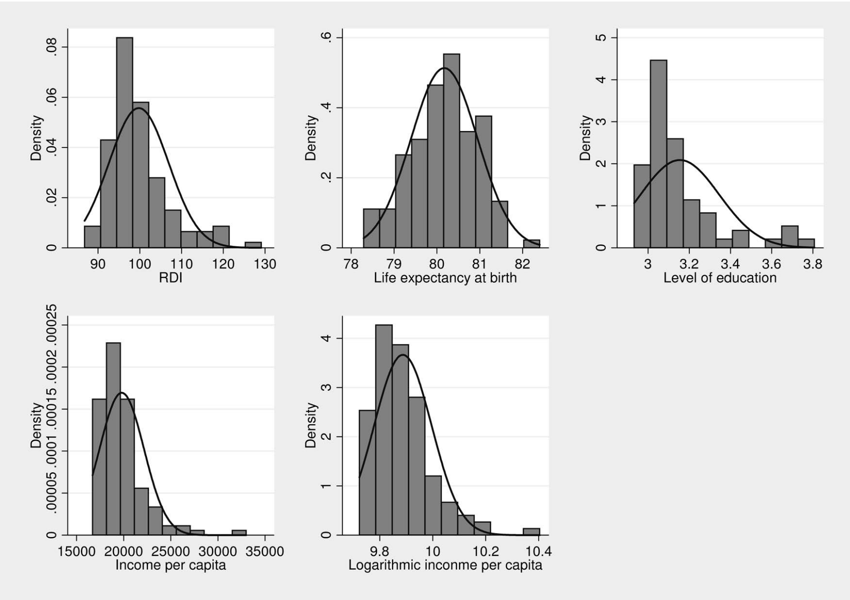
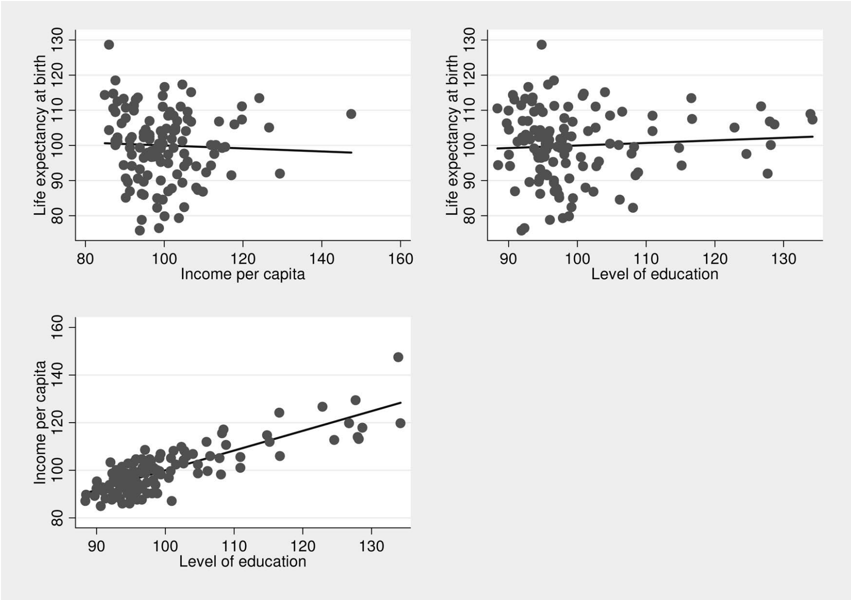


Figure 2 shows (bivariate) scatter plots for the corresponding sub-indicators on the district level. While the sub-indices education and income are clearly positively correlated, the relationship between the remaining two pairs of variables seems less pronounced. Clearly, these low correlations confirm the necessity to measure welfare from a broader perspective, as suggested by the HDI.

Figure 2: Correlation diagram for the sub-indicators



For clustering the Austrian provinces and districts into three categories, *sub-average*, *average* and *above average*, we calculated three corresponding quantiles at the district level (of 40 districts each). For the province level we use the same classification, i.e. we apply the same absolute benchmarks to the corresponding RDI at the province level. Therefore, contrary to the district level, provinces are not necessarily equally distributed across the three categories or quantiles. Figure 3 (figure 4) presents the corresponding GIS results of those clusters for the province (district) level, while table 3 and table 4 report the actual values of the RDI and its sub-indicators.[17] At the province level, we find a quite pronounced West-East incline with the highest RDI in Salzburg, followed by Vorarlberg, Tyrol and Carinthia. Interestingly, both the top three as well as the bottom three districts are located in Vienna, indicating quite strong heterogeneity within this province. Similarly, considerable within-province differences across districts (figure 4) are also visible in the provinces outside Vienna. Unsurprisingly, the RDI seems to be particularly high in districts around the corresponding province capital (*Landeshauptstadt*) while rural

[17] For the sub-indices, actual (absolute) values are reported. The complete list/ranking of the districts is available in the appendix.

regions seem to suffer from structural weaknesses. A more detailed look at the distribution of the sub-indicators on the district level reveals additional interesting patterns. In the case of life expectancy, a quite pronounced West-East incline seems to prevail, whereas the educational level and per capita income are particularly high around the corresponding province capitals (GIS results for the sub-indicators at the province- and district level are available in the appendix). The main exception is the province of Vorarlberg (at the western top end of Austria), where income per capita in all four districts is average or above. This phenomenon might be explained by a considerable share of commuters to Switzerland, and thus, higher average incomes.

Figure 3: The RDI at the province level

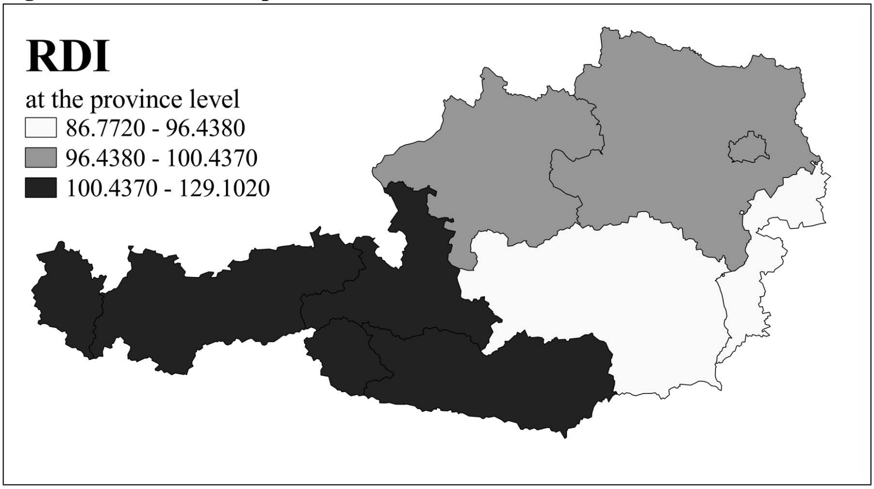


Figure 4: The RDI at the district level

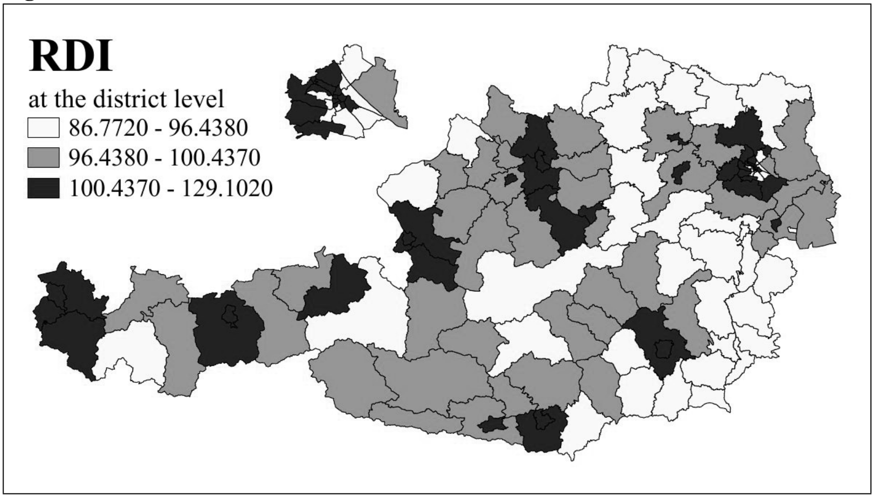


Table 3: The ranking of the provinces by the RDI

Position and province	RDI	Life expectancy	Level of education	Net income in EUR
1 Salzburg	102.565	80.96	3.16	19,400
2 Vorarlberg	102.560	81.12	3.04	20,200
3 Tyrol	101.479	81.29	3.11	18,500
4 Carinthia	100.467	80.43	3.19	19,100
5 Upper Austria	100.096	80.37	3.09	19.900
6 Vienna	99.034	79.31	3.28	21,300
7 Lower Austria	96.875	79.76	3.15	20,600
8 Burgenland	96.297	79.84	3.07	19,200
9 Styria	87.409	80.30	3.15	19,000

Notes: The values are weighted by population.

Table 4: The top and bottom five districts

Position and district	RDI	Life expectancy	Level of education	Net income in EUR
Top five:				
1 1st Vienna-City	129.10	80.87	3.80	33,000
2 8th Vienna-Josefstadt	119.95	80.75	3.81	24,400
3 18th Vienna-Währing	119.03	81.04	3.67	24,400
4 Mödling	117.99	81.22	3.47	25,600
5 19th Vienna-Döbling	117.81	80.57	3.59	26,300
Bottom five:				
117 15th Vienna-Rudolfsheim-Fünfhaus	90.78	79.01	3,10	17,700
118 Leibnitz	89.71	79.16	2.98	17,900
119 20th Vienna-Brigittenau	89.38	78.53	3.08	18,500
120 11th Vienna-Simmering	88.65	78.34	3.01	19,400
121 10th Vienna-Favoriten	86.77	78.29	3.00	18,400

Notes: The complete list/ranking of the districts is available in the appendix.

According to the RDI, the most advanced regional development is observed in the 1st district of Vienna (*Vienna-Innere Stadt*), which is also the leading district in per capita income. The leading districts in the remaining two sub-indices are Kitzbühel (life expectancy) and the 8th district of Vienna (*Vienna-Josefstadt*, level of education). The Feldbach district in Styria features the lowest level of education. The lowest income per capita is found in Landeck, while the lowest life expectancy is reported for the 10th district of Vienna (*Vienna-Favoriten*).

Results on decomposition

The considerable heterogeneity even in such a small country like Austria makes the subsequent analysis of a decomposition into a within- and between-province variation both of the RDI and its sub-indicators particularly interesting. More precisely, we want to examine whether the heterogeneity of welfare (according to the RDI), life expectancy, education and income is either a phenomenon within or between provinces.

DOI: 10.1515/danb-2015-0001

Figure 5: Theil's decomposition of the RDI and the sub-indices

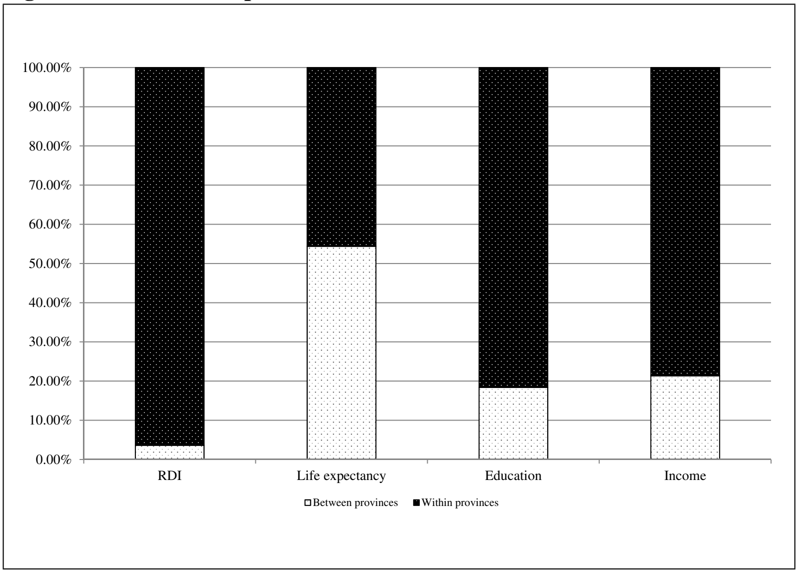


Figure 5 shows the decomposition of the Theil's index for the RDI and the corresponding sub-indices. Thereby, we are able to (i) decompose the total inequality into a within- and between-province component, and therefore (ii) we are able to assess whether structural regional weaknesses are the result of failures in regional policies at the federal (if the between-province component is particularly high) or rather at the province level (if the within-province component is particularly high).

Overall, 96.40% of the inequality in the RDI is explained by the within-province component. Thus, the inequality in welfare seems to be a particular challenge for regional policy at the province level (for the corresponding *Landesregierung*). This pattern is also confirmed by the coefficient of variation (CV), which amounts to 40% at the provincial level and to 60% at the district level. Similar results are observed for the level of education (81.59% explained by the within-province component) and income per capita (78.66%). Life expectancy is the exception, where the majority (54.4%) of the variation is explained by the between-provinces component. As the heterogeneity between the provinces is higher in each sub-indicator compared to the whole index, the RDI seems to contain more information than the three sub-indicators. Simultaneously, this confirms the necessity and the benefits to measure welfare from a broader perspective, as is done by the RDI.

Overall, it seems a particular challenge for regional policy at the province level to reduce structural weaknesses across districts in the corresponding region. This result applies especially to the sub-indices income per capita and education, whereas for health (life expectancy) policies towards more equality across provinces (introduced by certain regional policies at the federal level), such as equal access to health care, also seem to be appropriate.

IV. Discussion

The following discussion focuses on several points, which either back our approach, but also might be seen as limitations to our findings. Firstly, it was not our intention to contribute to the methodological discussion of the HDI (see the broad literature mentioned in the introduction). Therefore, our adaptations of the HDI are only minor. Primarily, we wanted to learn from the application of the HDI in within-country comparisons. Compared to other indices of regional development – for example the recently developed very broad OECD-Index (OECD 2011) – the RDI is very simple and includes only three dimensions. We are convinced that life expectancy, education and "command over resources" are the essential dimensions which also characterize the regional capability set in highly developed countries. Various extensions of the index – e.g. the inclusion of the political sphere or political rights – do not really make sense in our context, as there is no variation in these sub-indicators in a within-state perspective. Other proposed extensions do not really measure capabilities but rather results (outcomes). On the other hand, we agree with the large group of critiques, which are concerned with the fact that the RDI presents averages concealing wide disparities in the distribution of capabilities in the overall population. However, such an extension would require a different (individual) data set, which is currently not available for Austria.

In contrast to various suggestions to include additional dimensions in the index, several other critiques pointed out the redundancy in the information provided by the HDI and its components due to their high correlation. They argue that the aggregated index is yet another redundant composite development index. However, while our analysis for Austria indeed shows a high correlation between education and income, it also reveals low correlations of life expectancy with income and education. Therefore, the requirement that a good composite index should have components which are themselves insignificantly correlated, is not completely fulfilled in the Austrian case. This conclusion is also confirmed by a principle component analysis. The first two components explain 94.50 percent of the observed variance. The first component (61.07 percent, eigenvalue = 1.832) is characterized by a strong correlation of the component with income and education (both roughly 0.70). The second component (33.44 percent, eigenvalue = 1.003) reveals a high correlation with life expectancy (0.99) and very low negative/positive correlations with income (-0.08) and education (0.02). Following this result, we also calculated a slightly adapted RDI for robustness purposes, which only included the two components "command over resources" and "life expectancy" (the correlation diagram is shown in figure 2).[18] We take a multiplicative formulation (as in the HDI 2010) with equal weights for the two components. The results show only minor impact on the ranking of the districts. Thereby, Spearman's rank correlation between the original and the adapted RDI is 0.9536, while Kendall's coefficient amounts to 0.8209.

[18] There exists a strong movement in the inequality literature to incorporate life expectancy in an overall assessment of the evolution of cross-country economic inequality. The empirical results of this literature show that this extension is important, because income inequality trends are substantially different from inequality trends in life expectancy (Becker et al., 2005).

DOI: 10.1515/danb-2015-0001

Even if the three dimensions of the RDI are accepted, the question remains whether we use the best indicators for the three dimensions. As far as life expectancy is concerned, one could argue a separation between life expectancy at birth and life expectancy at the age of 15. This would give additional insights on mortality in the period of childhood. More importantly, the indicator life expectancy primarily includes the length but not the quality of life. There exists a broad literature on indicators of health quality (e.g. disability adjusted life years (DALY), quality adjusted life years (QALY), healthy adjusted life expectancy (HALE)). Unfortunately, a serious statistical basis on quality adjusted measures of health for Austria on the district level is not available. As far as education is concerned, we checked an alternative measure of the education variable. Thereby, we used the percentage of the population reaching more than educational level 3 as an indicator. Once again, our empirical results show that the ranking of the districts does not change substantially (with Spearman's rank correlation coefficient amounting to 0.990, Kendall's rank correlation to 0.9256). For robustness purposes, we also applied alternative methods of aggregation of the sub-components. Following the critique of Chakravarty (2003) and Ravallion (2010), we use a generalized version of the method of arithmetic aggregation using equal weights for the sub-indicators, while we allow for different weights of the single components (Chakravarty, 2003). A weight of one means perfect substitutability (constant marginal rate of substitution) between the three sub-components, while weights lower than one indicate imperfect substitutability. Once again, by taking the weights 1, 0.9, 0.5 and 0.1 for our calculations, the ranking of the districts does not change substantially when using this modified version of the RDI.[19] On the other hand, we should not overstress the similarity in rankings, because in several other respects (e.g. the implicit trade-offs between the components) the interpretation of the results of the two RDI versions are quite different.

V. Conclusion

The main aim of our paper is the adjustment/application of the HDI 2010 for sub-country comparisons in small, highly developed and socio-economically homogenous countries. For this undertaking, we propose a slightly modified version of the HDI, called RDI. The main adjustments are the definitions of the sub-indicators education and "command over resources" and the fixing of the goalposts for maximum and minimum values of the sub-indicators. Simultaneously, we decompose the heterogeneity of the RDI in a within- and between-province component. An application of the proposed index to the case of Austria reveals considerable heterogeneity across regions in terms of education, income and life expectancy. Unsurprisingly, the RDI seems to be particularly high in districts around the corresponding province capital while rural regions seem to suffer from structural weaknesses. We find a pronounced West-East incline, which is mainly driven by the sub-indicator life expectancy, whereas educational level and per capita income are particularly high around the corresponding province capitals. As the overwhelming part of inequality not only in the overall RDI, but also in income per capita and the level of education

[19] Kendalls's rank correlation coefficient takes a value of 0.9758 for our multiplicative RDI and the arithmetic RDI with the weight 1, while the coefficients for lower weights are even higher.

is explained by the within-province component, it is a particular challenge for regional policy at the province level to reduce structural weaknesses across districts within the corresponding provinces. In the case of life expectancy, the almost equal share of variation that can be explained by the corresponding within- and between-province components suggests efforts both at the federal as well as the province level to reduce the underlying inequality.

While the focus of this paper was to give a 'snapshot' of current within-country differences in socio-economic development across districts and provinces at one point in time, we expect valuable additional insights when studying the development of the RDI in a long time perspective (1970–2010) in the next step of research. In particular, such an approach allows conclusions about whether the capabilities across regions in Austria have converged or diverged over time.

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DOI: 10.1515/danb-2015-0001

Appendix

Table 5: The ranking of the districts in Austria

Position and province	RDI	LE*	EDU**	EUR***
1 1st Vienna-City	129.10	80.87	3.80	33,000
2 8th Vienna-Josefstadt	119.95	80.75	3.81	24,400
3 18th Vienna-Währing	119.03	81.04	3.67	24,400
4 Mödling	117.99	81.22	3.47	25,600
5 19th Vienna-Döbling	117.81	80.57	3.59	26,300
6 4th Vienna-Wieden	117.13	80.64	3.70	23,900
7 9th Vienna-Alsergrund	115.92	80.70	3.69	22,900
8 13th Vienna Hietzing	114.96	79.55	3.68	27,100
9 7th Vienna-Neubau	113.22	80.18	3.70	22,700
10 6th Vienna-Mariahilf	111.06	79.98	3.62	22,600
11 Graz (city)	109.97	80.76	3.47	21,000
12 Eisenstadt (city)	109.36	80.12	3.44	23,100
13 Urfahr-Umgebung	108.57	81.35	3.23	21,200
14 23th Vienna-Liesing	107.59	80.14	3.31	23,300
15 Salzburg (city)	107.35	80.92	3.28	21,000
16 Klagenfurt (city)	106.81	80.49	3.36	20,900
17 Innsbruck (city)	106.72	80.83	3.36	19,900
18 3rd Vienna-Landstraße	106.71	80.49	3.36	22,400
19 Salzburg-Umgebung	105.91	81.03	3.21	20,600
20 Korneuburg	105.90	80.18	3.27	22,400
21 Feldkirch	105.54	81.52	3.07	20,700
22 Villach (city)	105.19	80.83	3.25	20,200
23 Vienna-Umgebung	105.14	79.51	3.32	23,700
24 Innsbruck-Land	104.64	81.27	3.17	19,600
25 Linz-Land	104.24	80.70	3.14	21,200
26 14th Vienna-Penzing	103.61	79.58	3.32	22,100
27 Graz-Umgebung	103.51	80.56	3.21	20,300
28 17th Vienna-Hernals	103.47	79.99	3.31	20,800
29 Hallein	102.96	81.03	3.13	19,600
30 Bludenz	102.74	81.47	3.02	19,700
31 Waidhofen an der Ybbs (city)	102.68	80.49	3.18	20,200
32 Kitzbühel	101.62	82.40	3.06	16,900
33 Linz (city)	101.49	79.71	3.21	21,500
34 Krems an der Donau (city)	101.41	79.82	3.21	21,000
35 Bregenz	101.40	80.92	3.03	20,000
36 Klagenfurt-Land	101.28	80.21	3.25	19,400
37 Sankt Pölten (city)	101.18	80.27	3.11	20,700
38 Steyr-Land	101.10	80.54	3.12	19,800
39 Dornbirn	100.57	80.72	3.00	20,400
40 Wels (city)	100.52	80.51	3.05	20,300
41 Gmunden	100.44	80.37	3.14	19,600
42 Wels-Land	100.42	80.32	3.11	20,100
43 Hermagor	100.29	81.32	3.17	17,100
44 Lienz	100.10	81.61	3.09	17,200
45 Tulln	99.91	79.71	3,17	20,800
46 Spittal an der Drau	99.76	81.05	3.09	18,100
47 Eisenstadt-Umgebung	99.72	80.12	3.11	20,200
48 Kufstein	99.71	81.23	3.03	18,300
49 Amstetten	99.68	80.49	3.08	19,500
50 22th Vienna-Donaustadt	99.20	79.15	3.20	21,900

Continued on next page

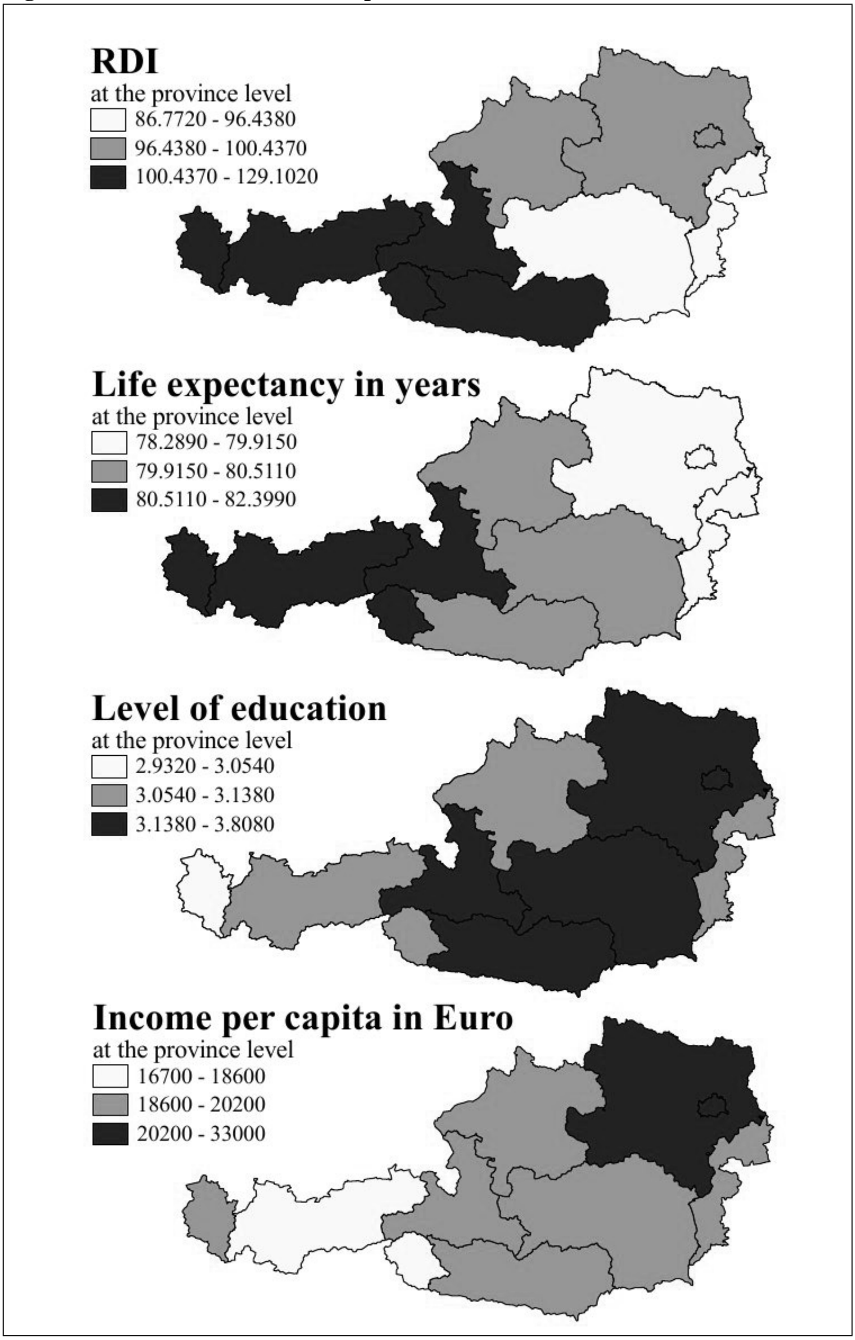
Position and province	RDI	LE*	EDU**	EUR***
51 Krems-Land	98.91	80.39	3.12	18,800
52 Mattersburg	98.84	79.97	3.12	19,900
53 Baden	98.74	79.24	3.18	21,500
54 Grieskirchen	98.51	80.71	3.02	18,900
55 Bruck an der Mur	98.48	80.14	3.10	19,400
56 Vöcklabruck	98.47	80.21	3.07	19,600
57 Feldkirchen	98.46	80.78	3.12	17,700
58 Rohrbach	98.42	81.19	2.98	18,200
59 Weiz	98.13	81.01	3.05	17,700
60 Reutte	98.12	81.06	3.00	18,100
61 Sankt Pölten-Land	98.06	79.78	3.12	19,900
62 Wolfsberg	98.00	80.45	3.08	18,600
63 Villach-Land	97.98	79.92	3.16	19,000
64 Imst	97.94	81.21	3.01	17,600
65 Eferding	97.74	80.36	3.05	18,900
66 Sankt Johann im Pongau	97.49	81.15	3.03	17,300
67 Knittelfeld	97.34	80.08	3.07	19,200
68 Perg	97.31	80.11	3.03	19,500
69 Bruck an der Leitha	97.27	79.19	3.10	21,600
70 Sankt Veit an der Glan	97.23	80.12	3.13	18,400
71 Freistadt	97.19	80.41	3.01	18,900
72 Schwaz	97.02	80.94	2.96	18,100
73 Ried im Innkreis	96.99	80.31	3.02	18,900
74 Leoben	96.97	79.81	3.09	19,500
75 Tamsweg	96.96	80.91	3.06	17,200
76 Judenburg	96.75	80.05	3.06	19,000
77 Steyr (city)	96.73	79.53	3.07	20,400
78 Gänserndorf	96.67	79.35	3.09	20,700
79 Kirchdorf an der Krems	96.60	80.35	3.02	18,600
80 Neusiedl am See	96.49	79.90	3.05	19,400
81 Braunau am Inn	96.44	80.52	2.96	18,700
82 Mürzzuschlag	96.42	79.92	3.06	19,100
83 2nd Vienna-Leopoldstadt	96.36	78.97	3.27	19,600
84 Liezen	96.17	80.29	3.08	17,900
85 Fürstenfeld	96.10	80.36	3.05	18,000
86 Lilienfeld	95.96	80.01	3.04	18,800
87 Landeck	98.84	81.29	2.98	16,700
88 Oberpullendorf	95.71	79.95	3.05	18,700
89 5th Vienna-Margareten	95.58	78.79	3.31	19,300
90 Wiener Neustadt-Land	95.38	79.22	3.10	20,100
91 Scheibbs	95.34	79.90	3.05	18,600
92 Rust (city)	95.25	80.12	3.07	17,900
93 Neunkirchen	95.19	79.40	3.09	19,500
94 Wiener Neustadt (city)	95.06	78.81	3.14	20,800
95 Jennersdorf	94.76	80.66	2.96	17,500
96 Feldbach	94.75	80.99	2.93	17,100
97 Mistelbach	94.71	79.16	3.09	19,900
98 Zell am See	94.42	80.51	3.04	16,900
99 Murau	94.40	80.18	3.08	17,200
100 Hollabrunn	94.29	79.51	3.07	18,800
101 Radkersburg	93.96	80.35	3.00	17,300
102 16th Vienna-Ottakring	93.95	79.00	3.14	19,300

Continued on next page

Position and province	RDI	LE*	EDU**	EUR***
103 Deutschlandsberg	93.89	79.65	3.05	18,400
104 Zewttl	93.57	80.28	3.01	17,200
105 Hartberg	93.36	80.26	2.99	17,300
106 Völkermarkt	93.15	79.44	3.13	17,700
107 21th Vienna-Floridsdorf	93.06	78.57	3.11	20,500
108 Gmünd	93.02	79.97	2.96	18,000
109 Melk	92.93	79.37	3.05	18,600
110 Voitsberg	92.79	79.44	3.05	18,300
111 Horn	92.56	79.08	3.10	18,600
112 12th Vienna-Meidling	92.43	78.61	3.13	19,700
113 Güssing	92.05	79.72	2.97	18,000
114 Oberwart	91.64	79.10	3.05	18,500
115 Waidhofen an der Thaya	91.12	79.36	3.02	17,800
116 Schärding	90.84	79.74	2.93	17,600
117 15th Vienna-Rudolfsheim-Fünfhaus	90.78	79.01	3.10	17,700
118 Leibnitz	89.71	79.16	2.98	17,900
119 20th Vienna-Brigittenau	89.38	78.53	3.08	18,500
120 11th Vienna-Simmering	88.65	78.34	3.01	19,400
121 10th Vienna-Favoriten	86.77	78.29	3.00	18,400

*Notes: *) Life expectancy at birth in years, **) Level of education (index), ***) Net income in euro*

Figure 6: The sub-indicators at the province level



DOI: 10.1515/danb-2015-0001

Figure 7: The sub-indicators at the district level