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Regional Disparities in the EU

Are They Robust to the Use of Different Measures and Indicators?

Sieps
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Preface

The aim of reducing regional disparities in the European Union is enshrined in the EU Treaty. The so-called EU cohesion policy rose to prominence in the late 1980s and early 1990s when the structural and cohesion funds were substantially increased. Today, cohesion policy consumes more than one-third of the EU budget.

An important aspect that takes centre stage in discussions on EU cohesion policy is the ranking of the Union's many regions in terms of their levels of prosperity in relation to the EU average. This ranking largely determines whether and by how much a region will be supported from the general budget. Crucially, regional prosperity and the ranking as such depend largely on how we measure disparities and development. However, the lack of clear and generally agreed definitions of the two concepts severely complicates such exercises.

The authors of the present report, Professors José Villaverde and Adolfo Maza, take a practical approach to the problem and employ a number of tests to ascertain whether different indicators such as GDP per capita, wages and employment and unemployment rates – as well as combinations of these indicators – yield similar results regardless of which indicator, set of indicators or methods are used.

By issuing this report, SIEPS hopes to contribute to the on-going debate on the future of EU cohesion policy and to bring insights into how we should measure regional disparities in the European Union.

Stockholm, June 2011
Anna Stellinger
Head of Agency, SIEPS

SIEPS carries out multidisciplinary research in current European affairs. As an independent governmental agency, we connect academic analysis and policy-making at Swedish and European levels.

About the authors

José Villaverde is Full Professor of Macroeconomics at University of Cantabria. He has been a consultant of the World Bank and the European Commission. His research focuses on international economics, open-economy macroeconomics, economic growth and regional economics and he has participated in numerous research projects. He has published more than 150 articles and several books dealing with these topics. Among his more recent articles are those published in journals such as The World Economy, European Urban and Regional Studies, Tijdschrift Voor Economische en Sociale Geografie, European Planning Studies, Annals of Regional Science, Journal of Policy Modeling, China and World Economy and Applied Economics.

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Executive summary

The reduction of EU regional disparities has been an important issue on the European Commission's policy agenda since at least the mid-1970s, which saw the launch and implementation of the European Regional Development Fund. Several articles in the Lisbon Treaty establish that the EU should deal directly with this issue, of which Article 174 is among the most specific as it states that "the Union shall aim at reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions."

Although the stated goal of this article is self-evident, there are at least two points that have captured the attention of academics and policy-makers: how to measure disparities between regions and the practical meaning of the word development. Bearing this in mind, the present report *Regional Disparities in the EU: Are They Robust to the Use of Different Measures and Indicators?* attempts to contribute to the debate by shedding some light on these two points. First, as different measures have been proposed to evaluate the evolution of (regional) disparities, the report attempts to verify whether all of them roughly convey similar information. Second, given that different (single and composite) indicators, other than the traditional per capita GDP, have also been proposed to represent the term development, the paper aims to investigate whether the conclusions drawn from these single and composite indicators are generally similar to those from the per capita GDP.

The report begins by reviewing the most conventional measures of disparity and, in particular, of inequality. The problem with these measures is that – because they employ different weighting schemes and some of them are based on social welfare judgements while others are not – they may offer different views of the extent and evolution of this inequality. The report holds that a practical way of dealing with this issue is to jointly consider a representative set of inequality measures. If all of them point in the same direction, we could be relatively sure about the robustness of the conclusions obtained. Following this rather convenient approach, the report reviews five of the most commonly used summary measures of inequality: σ-convergence, the Gini index, two versions of the Theil index (T(0) and T(1)) and the Atkinson index.

After reviewing these inequality measures, the report turns its attention to the meaning of the term development, as used in Article 174 of the Lisbon Treaty, because it could be interpreted as referring to the well-being or living conditions of European citizens, the actual economic performance of EU countries and regions and/or to the competitiveness of EU countries and regions.

Although researchers, policy-makers and international institutions have proposed different indicators to measure national or, as is the focus of this paper, regional development, it is typically measured by per capita GDP. However, even though it is evident that this indicator is a key component in measuring economic development, other dimensions of development should also be taken into consideration. In this report, we employ two different sets of development indicators. The first is made up of single indicators; to be precise, some highly significant individual socio-economic variables (apart from per capita GDP), such as productivity, wages, household expenditure, disposable income and unemployment and employment rates. The second set consists of various groups of composite indicators that include some and/or all of those individual variables. As both approaches have pros and cons, and there is no generally accepted rule for determining which is best, this report suggests a simple but logical idea: whether all (or most) of the development indicators studied point to conclusions somewhat similar to those obtained using per capita GDP, then we would ascertain a reasonable picture of the evolution of disparities in the development of EU27 regions and of the changes in the ranking of the regions. As a result, policy-makers would be in a better position to address the problems they seek to ameliorate.

Subsequently, and after a word of caution regarding the data used for computing the (single and composite) development indicators, the report applies the inequality measures mentioned above to all of these indicators to assess the evolution of European regional disparities. Regarding inequality measures, the results tend to show that all of them convey more or less the same information, namely a common time pattern leading to a significant reduction of regional disparities in EU27. With respect to the development indicators, the results give support to the conclusion that regional variations in development, whatever indicator is employed, are closely related to variations in per capita GDP. Does this mean we should pay attention to only this variable and ignore other single and/or composite indicators? The report considers that the most prudent answer to this question is that it depends. To be more specific, the report maintains that the answer should be NO if ideally we were able to fulfil these three conditions:

- Agreement regarding the real content of the term development;
- Agreement on the attributes or dimensions that best fit with this concept; and
- Establishment of a basic databank with reliable, consistent and far-reaching time series observations for all the underlying variables (single indicators) behind the previously agreed dimensions.

However, acknowledging the difficulty of achieving these three conditions, the report proposes a straightforward "rule of thumb": keep it simple. In other words, it seems to us that:

1. Per capita GDP is the best single indicator of the degree of development in the EU27 regions, as it is the most widely available and reliable of all indicators. Therefore, increasing efforts should be made by the European statistical offices and, in particular, by EUROSTAT to improve the way this variable is estimated.
2. If, as mentioned in the report, it is considered that the term development refers to a multifaceted concept that, to be properly measured, requires a composite indicator, then we believe that this should be constructed using as few single indicators as possible. In fact, the report considers that the greater the number of single indicators used in the construction of any composite indicator, the more assumptions regarding the data imputation will be required, and the resulting composite indicator will be more difficult to interpret and less reliable.

1 Introduction

The reduction of regional disparities in the European Union (EU) has been an important issue in the European Commission's policy agenda since at least the mid-1970s, which saw the launch and implementation of the European Regional Development Fund. This policy and, consequently, academic interest in the extent and scope of regional disparities in the EU[1] has been prompted by two main factors. From an analytical perspective, there exists a desire to test the validity of different and somewhat competing theories of economic growth, specifically the neoclassical and endogenous growth theories. From an empirical perspective, interest has been generated by successive EU enlargements and the economic changes related to the ongoing process of globalisation, which has greatly increased regional disparities within the area.

To address these regional disparities, the EU has implemented a regional policy (now essentially renamed "cohesion policy") that, under the pressure of mounting evidence, has experienced several reforms over time, some of them quite drastic. The official reasoning behind this policy is that "economic and social cohesion is one of the main operational priorities of the EU" (Monfort, 2008: 3). Several articles in the treaty establishing the EU deal directly with this issue. Of these, Article 174 is among the most specific as it states that "the Union shall aim at reducing disparities between the levels of development of the various regions and the backwardness of the least favoured regions."

Although the stated goal of this article is self-evident, there are at least two points that have captured the attention of academics and policy-makers: how to measure disparities between regions and the practical meaning of the word *development*. With respect to the first point, most empirical papers employ measures that attempt to summarise dispersion in a distribution. Meanwhile, to deal with the second issue, many employ per capita GDP as the variable that, in theory, better describes the degree of development a region enjoys.

Bearing this in mind, the current paper attempts to contribute to the empirical literature by shedding some light on these two points. Therefore the purpose of this work is two-fold, with both aspects being comparative in nature. First, as different measures have been proposed to evaluate the evolution of (regional) disparities, we want to verify whether all of them convey roughly similar information. Second, and in the same vein, given that different (single and composite) indicators other than per capita GDP have also been proposed

[1] For references about this issue see, for instance, Armstrong & Vickerman (1995), Fingleton (2003), Badinger *et al.* (2004), Meliciani (2006), Villaverde & Maza (2007) and Monfort (2008).

to represent the term *development*, we want to see if the conclusions drawn from the former (single and composite) are generally similar to those from the latter (per capita GDP).

The remainder of this paper is organised as follows. Section 2 reviews some of the most widely used measures of regional disparity, while Section 3 addresses the issue of which indicators are more suitable to represent what is encompassed within the term *development*.[2] With reference to the Nomenclature of Units for Territorial Statistics 2 (NUTS2) regions of the EU27,[3] Section 4 applies the measures mentioned in Section 2 to the indicators considered in Section 3 to test whether the use of one or other indicator and one or other disparity measure makes any noticeable difference either on the evolution of disparities or on the ranking of the regions. Finally, some concluding remarks are presented in Section 5.

2 Measures of regional disparities

As indicated in Villaverde & Maza (2009: 3) the term "disparity is a multifaceted concept encompassing dimensions such as convergence, inequality, polarisation and concentration". Of these four dimensions, the dimension of inequality probably offers the broadest perspective. Yet, inequality is far from an easy concept to capture; on the contrary, it can be said that "[i]nequality is like an elephant: You can't define it but you know it when you see it" (Fields, 2001: 14). However interesting the debate regarding the meaning of inequality, we will not delve into it deeply here; considered in its simplest sense, it implies that two or more quantities are not the same (Villaverde & Maza, 2009).

Although initially devised to address inequality issues between individuals, most conventional measures can easily be, and have been, adapted to address inequality between territories. The problem with these measures is that – because they employ different weighting schemes and some of them are based on social welfare judgements while others are not – they may offer different views of the extent and evolution of this inequality. Furthermore, none of them is universally accepted as being superior to the others. As this is a policy-oriented paper, we believe that a practical way of solving this issue is

2 A similar question ("Which indicators give the most accurate idea of prevailing disparities?") has been posed, among others, by Tarschys (2003) in his critical analysis of the EU cohesion policy.

3 For statistical reasons, all our indices have been calculated for 264 regions, although the official number is 271 regions.

to jointly consider a representative set of inequality measures. If all of them point in the same direction, we can be relatively sure about the robustness of the conclusions obtained. Following this rather convenient approach, we review in this section five of the most commonly used summary measures of inequality: σ-convergence, the Gini index, two versions of the Theil index and the Atkinson index. The first four are positive measures of inequality, while the fifth is a normative measure based on value judgments regarding welfare lost due to the existence of inequality.

The first of these measures, σ-convergence, is probably the most widely used in studies of regional disparities, at least in the past two decades. Put simply, it refers to the reduction of cross-sectional dispersion of the variable under analysis over time. Although it can be computed in different ways, σ-convergence is conventionally measured by the weighted coefficient of variation:

$$\sigma = s / \overline{y} \qquad (1)$$

where s stands for the weighted standard deviation of the distribution under consideration and $\overline{y}$ is its weighted mean.

The Gini index (G) is a descriptive inequality measure that is calculated as the ratio between the Lorenz curve[4] and the line of perfect equality over the area contained between the lines of perfect equality and complete inequality (Villaverde, 2006). Although several forms have been proposed to compute it, the Gini index's most general expression can be written as:

$$G = \frac{1}{2\overline{y}} \sum_{i=1}^{n} \sum_{j=1}^{n} p_i p_j \left| y_i - y_j \right| \qquad (2)$$

where n is the number of observations, p_i and p_j refer to the population shares of observations i and j and y_i and y_j to the values of the variables analysed for those observations. The value of the index is constrained to be between zero (complete equality) and one (complete inequality).

The Theil index, based on the concept of Shannon entropy[5] developed in

[4] A Lorenz curve plots the degree of inequality that exists in the distribution of two variables.

[5] This concept comes from the field of information theory and measures the degree of uncertainty that exists in a system.

information theory, is also a descriptive positive inequality measure. It takes one of these two expressions, T(0) or T(1),[6] the first given by:

$$T(0) = -\frac{1}{n}\sum_{i=1}^{n}\log\left(\frac{y_i}{\bar{y}}\right) \tag{3}$$

and the second by:

$$T(1) = \frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\bar{y}}\right)\log\left(\frac{y_i}{\bar{y}}\right) \tag{4}$$

In contrast to the Gini index, the Theil index does not have a constant defined upper limit and can range from zero to log(n), with higher values indicating a more unequal income distribution. Although some authors have judged this index to be somewhat arbitrary and lacking intuition as a measure of inequality, others consider it to be most interesting because it is additive and, as such, admits different types of decomposition.

Finally, the Atkinson index is an inequality measure that explicitly incorporates normative judgments about social welfare; in particular, this index is more "bottom-sensitive" – meaning that it is strongly correlated to the extent of poverty – than are other inequality indices. The Atkinson index can be expressed as:

$$A_{\varepsilon} = 1 - \left[\sum_{i=1}^{n} p_i \left(\frac{y_i}{\bar{y}}\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)} \tag{5}$$

where the parameter ε reflects the strength of society's preference for equality. It should be noted that when ε is positive, there is a social preference for equality (inequality aversion parameter) and, as ε rises, more (less) weight is attached to income transfers in the lower (top) end of the distribution. The value of the index lies between zero and one, such that the smaller the value of the index, the more equal income distribution is.

[6] These are two particular cases of the "entropy generalised inequality index", given by:

$$\mathrm{E}(\alpha) = \frac{1}{n(\alpha^2 - \alpha)}\sum_i \left[\left(\frac{y_i}{\bar{y}}\right) - 1\right]$$

When α = 0 we get T(0), whereas when α = 1 we get T(1), α being a parameter capturing the sensitivity of the index to a specific part of the distribution. The higher (lower) α, the more sensitive is the index to what happens in the upper (lower) tail of the distribution.

3 Which variables are most accurate as indicators of development: single or composite indicators?

The term *development* is widely used in the literature (as well as in ordinary conversation), and is similar to the word *inequality* in that people generally understand what one is talking about. However, since it is a broad concept, it is difficult to define and even more difficult to capture in an indicator. For instance, from the European Commission's point of view, the term *development* employed in Article 174 of the Lisbon Treaty could be interpreted as referring to the well-being or living conditions of European citizens, the actual economic performance of EU countries and regions and/or to the competitiveness of EU countries and regions.[7]

In an effort to create a working definition, researchers, policy-makers and international institutions have offered various proposals addressing how to measure country/regional development. One of the most interesting is that of the United Nations Development Programme (UNDP) with its yearly publication of the Human Development Report, in which the Human Development Index (HDI), inspired by Sen's development theory, is included (UNDP, 1990). More recently, the proposal of the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP) created by the President of the French Republic also generated much interest (Stiglitz *et al.*, 2009).

Typically, national or, as is the focus of this paper, regional development is measured by gross domestic product (GDP) per capita, mainly for the handy usability of this indicator. In fact, per capita GDP is the most frequently used indicator because, directly or indirectly, it is considered to reflect a region's production capacity, income and/or economic development level.[8] However, the premise of the HDI and the CMEPSP report, as well as that of many other critics of the *de facto* position of this variable as the primary (or sole) indicator of development,[9] is that although per capita income is a key component in measuring economic development, other relevant dimensions are closely linked to quality of life and the opportunities available to individuals. Among these, it is thought that non-income dimensions such as health, education,

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7 Recent examples of this flexible, interchangeable interpretation can be found in European Commission (2010).

8 See, for example, Khan (1991) and Mankiw *et al.* (1992) and, more recently, European Commission (2009: 2), which specifically states that "GDP has also come to be regarded as a proxy indicator for overall societal development and progress in general".

9 See, for instance, Davidson (2000), issue no. 2 of the *Review of Income and Wealth* or the conference "Beyond GDP" organized by the European Commission, European Parliament, Club de Rome, OECD and WWF and held in Brussels on 19-20 November 2007.

personal activities, political voice and governance, social connections, environmental conditions and personal and economic (in)security should also play a role.

Acknowledging the soundness of these, and other, proposals, but also considering the difficulty of their implementation (as indicated in the CMEPSP report), or lack of practical relevance to the EU case, here we adopt a simple yet rigorous approach. That is, to measure disparities in the degree of regional development in the EU27, we use two different sets of indicators. The first is made up of some highly significant individual socio-economic variables and the second consists of various groups of composite indicators. Both approaches have pros and cons, and there is no generally accepted rule for determining which is best.

Similar to what was said in Section 2 regarding inequality measures, our idea is simple but logical. If all these (single and composite) indicators point to conclusions somewhat similar to those obtained using per capita GDP, then we would gain a reasonable picture of the evolution of disparities in the development of EU27 regions and of the changes in the ranking of these regions. As a result, policy-makers would be in a better position to address the problems they seek to ameliorate.

Which are the original, key variables we have singled out for our analysis? Although we are well aware of the criticism directed at per capita GDP (e.g., it is not the best indicator of living conditions and/or potential development prospects), we have opted to use it as our benchmark in accordance with a long-standing tradition in economics. In its favour is the fact that it is an unambiguous indicator of the strength of regions relative to others. However, as mentioned previously, it has been argued that, with the word *development*, one is referring to a concept with multiple dimensions that, to be properly measured, would need other indicators besides per capita GDP. Following this line of reasoning, there are, in our opinion, two possible courses of action: the first and simplest consists of taking a group of single variables and analysing, separately, their evolution over time; the second possibility involves the construction of composite indicators based on these single variables. We propose to use both options and, taking into consideration data availability and our aim of measuring the evolution of disparities in economic development across EU27 regions, in addition to per capita GDP, we will employ the following single indicators: productivity (PR), compensation per employee (wages, W), household expenditure (HE), disposable income (DI) and unemployment (UR) and employment (ER) rates. Some of these indicators are, on an *a priori* basis, better suited for measuring what could be termed *economic development*, *economic performance* or *competitiveness* (e.g. per capita GDP, productivity), while others are better suited for measuring social aspects of development (e.g. disposable income, household expenditure and unemployment rate) and, finally, others (wages, activity and employment rates) could easily play both roles. These indicators are shown in Appendix 1.[10]

According to the opinions of the UNDP and the CMEPSP, the first option – using separately single indicators other than per capita GDP – adds little to the use of this variable alone as a proxy for development. Therefore, the construction of composite indices has been proposed. Although this type of indicator has its drawbacks, such as difficulty of interpretation, its construction has become popular in the past few years, to the point that the OECD has produced a handbook giving directions on how to proceed (Nardo *et al.*, 2005).

In our case, we have opted initially for computing a simple yet consistent composite index echoing the HDI, but, to be more representative of the EU case, using different single indicators. Therefore, we proceed in four steps. First, we choose the variables, X_{ij}, as our single indicators. In practice, these are the seven variables previously mentioned, making $i = 1, 2, \dots 7$.[11] Second, we rescale them so that they take on values between zero and one.[12]

Third, an intermediate indicator I_j is defined for each region j as the average of the single indicators X_{ij}, and fourth, we rescale the composite indicator by making the average of I_j equal to 100. The average for different *ad hoc* weightings is computed both in arithmetic and in geometric terms, the first under the assumption of perfect substitutability across all single indicators considered, and the second under the assumption of imperfect substitutability among them.

In total, we have computed five rounds of four indicators with three variables. Thus, in total, we have 20 versions of the index, as shown in Table 1 on the next page. For the first round of four indicators, we gave the same weight to each variable, and for the other four rounds, we began by assuming that the first two variables (those not related to the labour market) have the same weights and, in total, this equals 50%, 60%, 70% and 80%, respectively. The results obtained for these indicators (both for arithmetic and for geometric means) are shown in Appendix 2.

10 Appendices 1-8 can be downloaded from the SIEPS homepage at www.sieps.se/en.

11 Actually, instead of UR we have used the variable "1/UR", meaning that larger values represent better situations for the region considered.

12 For this we use the expression:

$$I_{ij} = \frac{Actual\ value\ X_{ij} - Minimum\ value\ X_{ij}}{Maximum\ value\ X_{ij} - Minimum\ value\ X_{ij}}$$

The main drawback is that the distribution of normalised values is heavily influenced by outlier observations.

Table 1 Weights for HDI

	GDP	PR	W	HE	DI	1/UR
I11	33.3	33.3				33.3
I12	25.0	25.0				50.0
I13	30.0	30.0				40.0
I14	35.0	35.0				30.0
I15	40.0	40.0				20.0
I21		33.3	33.3			33.3
I22		25.0	25.0			50.0
I23		30.0	30.0			40.0
I24		35.0	35.0			30.0
I25		40.0	40.0			20.0
I31		33.3		33.3		33.3
I32		25.0		25.0		50.0
I33		30.0		30.0		40.0
I34		35.0		35.0		30.0
I35		40.0		40.0		20.0
I41		33.3			33.3	33.3
I42		25.0			25.0	50.0
I43		30.0			30.0	40.0
I44		35.0			35.0	30.0
I45		40.0			40.0	20.0

A composite indicator such as the previous one can be criticised on at least two counts: the *ad hoc* weights chosen for its computation and the small number of variables used.[13] To address the first of these issues, the *ad hoc* weighting employed in the construction of the index, we opted to compute a new composite indicator. Specifically, we used all our seven single indicators and applied a principal components analysis (PCA), so that the weightings are determined within the model (endogenously).[14] Following standard practice, we proceed in four steps:

- First, we analyse the correlation structure of the variables. For this, we rely on the KMO measure of sampling adequacy and Bartlett's test of

[13] However, it must be recognised that, as it is in this paper, the index is widely used in research and policy work (McGillivray & Shorrocks, 2005).

[14] This, however, does not preclude some "subjectivity" in the weightings because, as stressed by Nardo *et al.* (2005: 43), "different extraction methods supply different values for the factors thus for the weights, influencing the score of the composite and the corresponding country ranking".

Table 2 KMO and Bartlett's test

KMO measure of sampling adequacy		0.725
Bartlett's test of sphericity	Approximate χ^2	28709.202
	Degrees of freedom	21
	Significance (p-value)	0.000

sphericity.[15] As it happens (see Table 2), this KMO statistic is greater than 0.5 and Bartlett's measure on the correlation matrix passes at the 0.05 significance level, indicating that our sample is adequate to conduct a PCA.

- Second, we proceed to the factor extraction step and observe that, as expected, the PCA extracts two factors (Table 3). These two factors, with eigenvalues greater than 1, explain more than 84% of the total variance of the original indicators.

Table 3 Total variance explained

	Initial eigenvalues			Extraction sums of square loadings			Rotation sums of square loadings		
Component	Total	% variance	Cumulative %	Total	% variance	Cumulative %	Total	% variance	Cumulative %
1	4.571	65.293	65.293	4.571	65.293	65.293	4.041	57.727	57.727
2	1.315	18.787	84.080	1.315	18.787	84.080	1.845	26.353	84.080
3	0.423	6.036	90.116						
4	0.395	5.638	95.754						
5	0.165	2.354	98.108						
6	0.121	1.727	99.835						
7	0.012	0.165	100.000						

- Then, we calculate factor loadings, for which we first have the component matrix, indicating the loading (correlation) of each variable with each factor and, subsequently, the communalities or proportion of the variance explained by the two factors. Afterwards, although it is not essential in our case, we compute the rotated component matrix, with the results shown in Table 4 on the next page. The rotated component matrix results lead

[15] KMO is an index used to examine the appropriateness of a PCA. Bartlett's test is a statistic used to examine the hypothesis that the variables are uncorrelated in the population.

Table 4 Rotated component matrix and communalities

	Factors		
Variables	F1 (Income)	F2 (Labour market)	Communalities
GDP	0.873	0.369	0.899
PR	0.942	0.013	0.888
W	0.925	0.136	0.875
HE	0.812	0.241	0.717
DI	0.902	0.267	0.884
1/UR	0.205	0.862	0.786
ER	0.142	0.904	0.837

us to conclude that the variables that correlate highly with factor 1 are all related to economic activity. Therefore, we label this factor *income*, while factor 2 is highly correlated with the employment and unemployment rates, so an appropriate label is *labour market*.

This two-factor solution has three primary advantages. First, all the original variables are highly correlated with one factor and weakly with the other. Second, all variables have at least one factor loading with a magnitude greater than 0.5, which experts consider to be very significant. Third, the reliability of the extracted factor structure is clear since it explains between 72% and 90% of the variance of each original variable.

- The fourth and final step involves a weighting and aggregation procedure to obtain the summary indicators. To construct the weights from the rotated component matrix, we follow the approach described by Nicoletti *et al*. (2000: 22), in which the weights for each factor "are obtained by squaring and normalising the estimated factor loadings". Weights thus obtained are then applied to the original variables and the products are summed to give two intermediate composite indicators. Finally, we aggregate the intermediate indicators "by weighting each composite using the proportion of the explained variance in the dataset" (Nardo *et al.*, 2005: 65). The weights obtained for both the intermediate and summary indicators are shown in Table 5. Finally, the summary composite indicators for every sample year and region are reported in Appendix 3.

Lastly, to address the relatively small number of variables used in our analysis, we also took a cursory look at the EU Regional Competitiveness Index (RCI), a regional composite index developed by Annoni & Kozovka (2010)

Table 5 PCA weights

Variables	Factor loadings F1	Factor loadings F2	Weights of variables in factor F1	Weights of variables in factor F2
GDP	0.76	0.14	0.19	0.07
PR	0.89	0.00	0.22	0.00
W	0.86	0.02	0.21	0.01
HE	0.66	0.06	0.16	0.03
DI	0.81	0.07	0.20	0.04
1/UR	0.04	0.74	0.01	0.40
ER	0.02	0.82	0.00	0.44
Total	4.04	1.84	1.00	1.00
Weight of factors in summary indicator			0.69	0.31

for the European Commission.[16] The main goal of the RCI is "to map economic performance and competitiveness at the NUTS2 regional level for all EU Member States" (p. 28), for which the authors use a framework that includes what they refer to as 11 major pillars (institutions, macroeconomic stability, infrastructure, health, quality of primary and secondary education, higher education/training and lifelong learning, labour market efficiency, market size, technological readiness, business sophistication and innovation), each of which is the result of employing various single indicators (in total some 79 single indicators are used). Although interesting, this index suffers from the drawback mentioned in the first Human Development Report (UNDP, 1990: 13), namely "having too many indicators in the index would blur its focus and make it difficult to interpret and use".[17] In any case, the RCI scores are shown in Appendix 4.

[16] A similar composite indicator, but computed with significantly fewer variables than has the EURCI index, is provided by Campo *et al.* (2008). A similar and interesting approach, using more variables but fewer regions, is provided by Huggins & Davies (2006) on the European competitiveness index. Some country-specific regional indices have also been computed, among which clearly stand out those for the UK, as they have been consistently published since 2000 (Huggins & Thompson, 2010). Also of interest are those for Croatia (UNDP, 2008), Finland (Huovari *et al.*, 2001) and Spain (Villaverde, 2007).

[17] Khan (1991) also argued that using a composite index for comparing the level of development across countries (regions) has some major disadvantages. For a summary of the pros and cons of using composite indicators, see Nardo *et al.* (2005).

4 Regional disparities in the EU

4.1 Data collection, missing data and imputation methods

In this section, we present the results obtained on the evolution of regional disparities in the EU27 over the sample period for all our (single and composite) indicators. However, a word of caution is warranted regarding the data used for computing these indicators. Given the limitations of regional data availability, working with regional data at the EU27 level, other than for the most common variables, is difficult because of two factors. First, because there are so many omitted data points in so many indicators in the official (EUROSTAT) and some private but widely used (Cambridge Econometrics) statistical databases, it is absolutely necessary to make assumptions, including some which are very crude, on how to deal with missing information. Second, in some cases original and/or imputed data are totally inconsistent and thereby unreliable.

In any event, following the suggestion made by Annoni & Kozovska (2010), we have considered a limit of 10-15% missing data to be the threshold for including a single indicator in our computations. As a result, some variables that, in our opinion, should have been included in the analysis[18] were completely discarded, as it makes no sense to use a different set of original variables for (nearly) every year of the sample. Depending on the number of missing observations for each indicator, we proceeded as follows:

1. If NUTS1 values are available, we assign these values to NUTS2 regions.
2. If data are available at country and NUTS2 levels, but only for some years, and only country data for others, we impute values to NUTS2 regions by taking the average of the "region/country" ratios.
3. If data are available at country and NUTS2 levels for some years but there is no information at all (neither for the country nor for the regions) for others, we extract a quadratic trend.
4. If, for a specific indicator and specific country, data are unavailable for all years, we proceed in three steps. First, we identify countries with a similar per capita GDP; second, for these countries, we calculate the "indicator/GDP" ratio and then their average; and third, we impute to this country a value equal to the product of its GDP multiplied by the aforementioned ratio.

As a result of these data issues, one should be aware that, except for per capita GDP and possibly productivity, when using the data sets mentioned above, the validity of the conclusions drawn from the analysis may, in some cases, be affected by these interpolation methods.

18 These variables are mainly related to public capital, human capital and technological capital endowments.

4.2 The evolution of regional disparities in the EU27: The results

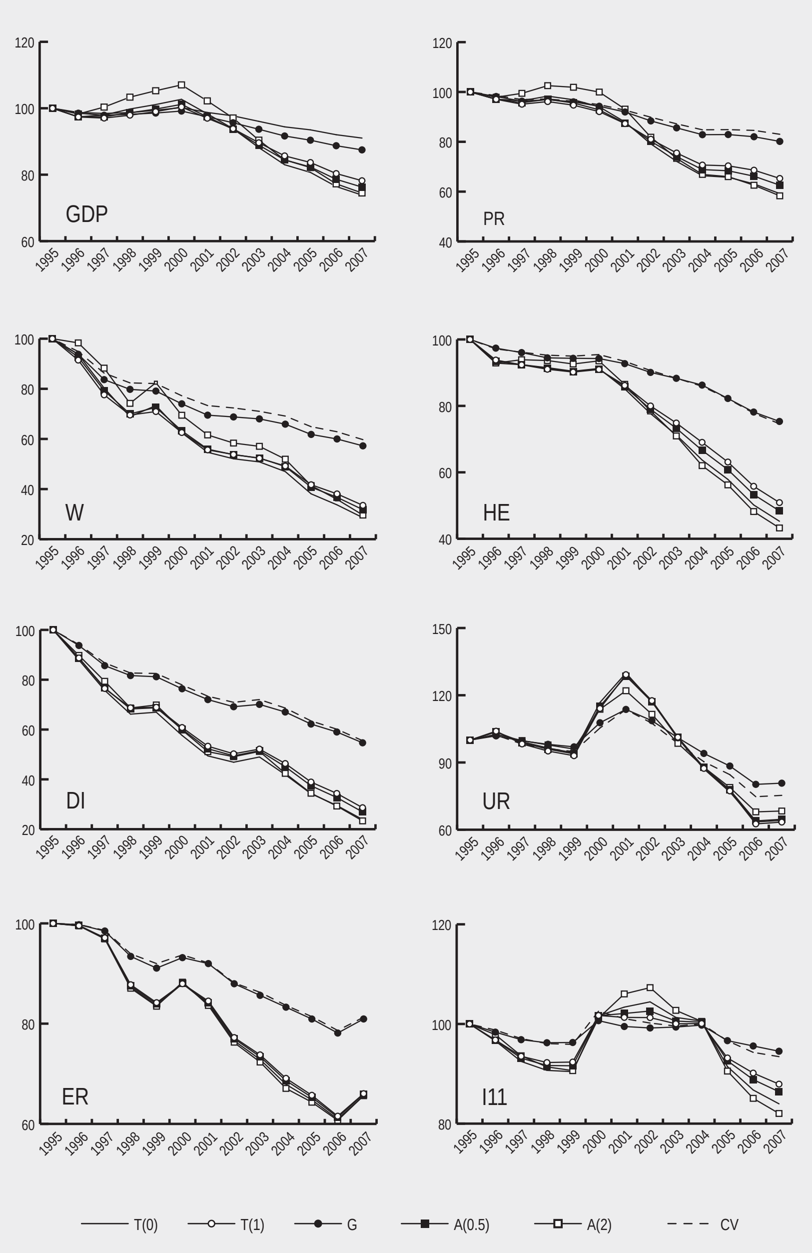
With the aforementioned precautions in mind, we apply the inequality measures summarised in Section 2 to the (single and composite) indicators mentioned in Section 3. After normalising our results relative to those of the first year (1995 = 100), Figure 1 on the next page offers a clear idea of how regional development disparities have evolved over time for each of the single and composite indicators computed.[19] Three main conclusions can be drawn:

- The foremost conclusion is that it matters little which indicator (single or composite) and inequality measure is considered, since the evolution of regional disparities nearly always follows the same time pattern. There are, however, two main differences between single and composite indicators: a) the time patterns of single indices tend to be more linear (less variable) than are those of composite indicators and b) the period between 2000 and 2004 tends to systematically show higher values with composite (excluding these computed using factor analysis) than it does with single indicators. These results seem to be mainly related to the fact that unemployment rate – a highly volatile variable with no apparent trend – is included in the calculus of all composite indices.
- The second conclusion is that, depending on the indicator considered, the decline in regional disparities varies substantially. This decline is much larger when wages and/or disposable income are involved in the computation.
- The third conclusion is that the observed decrease in the level of inequality shows large discrepancies depending on the measure considered; the degree of variability is the lowest with the Gini coefficient and the coefficient of variation. This is quite a common result as each measure emphasises a slightly different aspect of inequality.

These conclusions are strengthened when we compute the Pearson correlation coefficient – measuring the strength of the linear correlation – between our (single and composite) indicators. The results shown in Table 6 (which run through to 2007 and use arithmetic mean indices; see Appendix 6 for the rest of the years and geometric average indices) on pages 26-27 indicate that per capita GDP and productivity are the indicators that best correlate with the others. In particular, the per capita GDP correlations are strong (always >70%

[19] As the results obtained for composite indicators based on the HDI methodology are similar to both arithmetic and geometric averages, the second are presented in Appendix 5. As with geometric averages, there are zero values, and thereby we add a small constant so they could be included in a logarithmic scale. Additionally, Blackorby *et al.* (1981) indicated that, with zero values, the parameter ε of the Atkinson index must be between 0 and 1; thus, we compute the A(1) instead of the A(2) index.

Figure 1 Evolution of disparities (1995-2007)



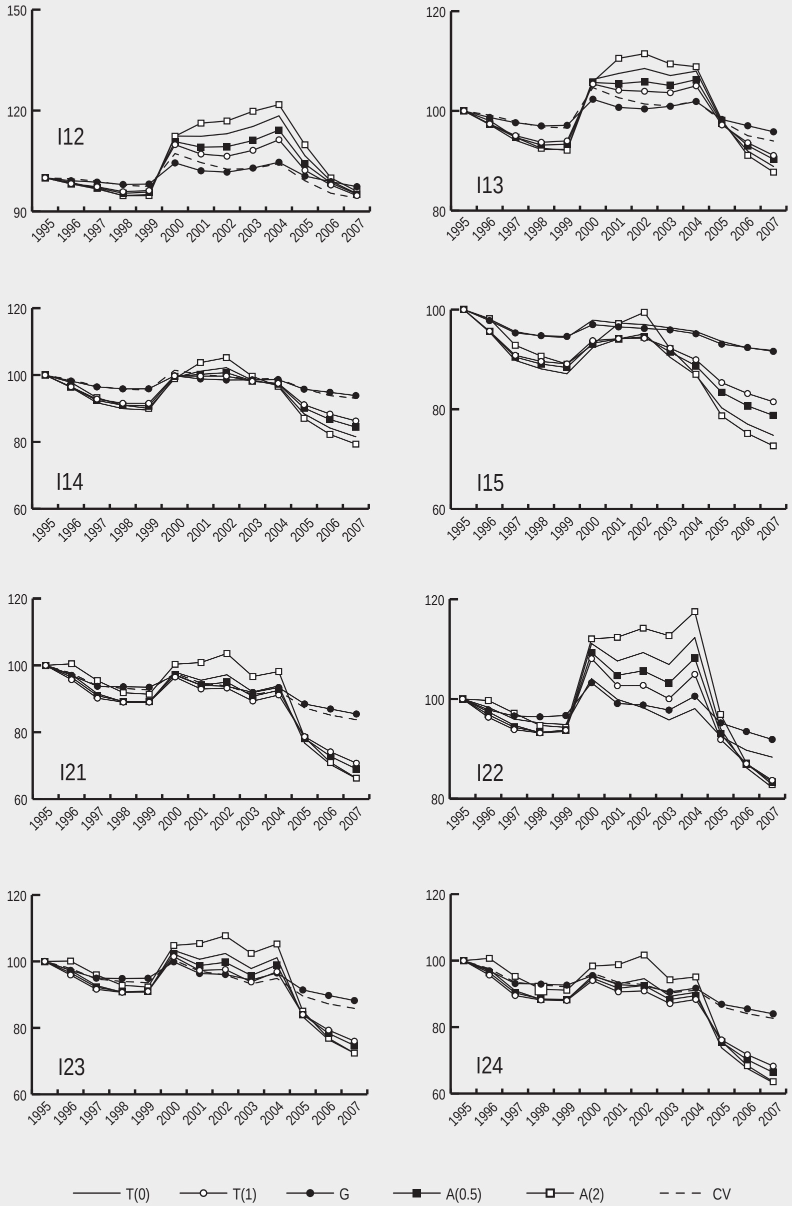
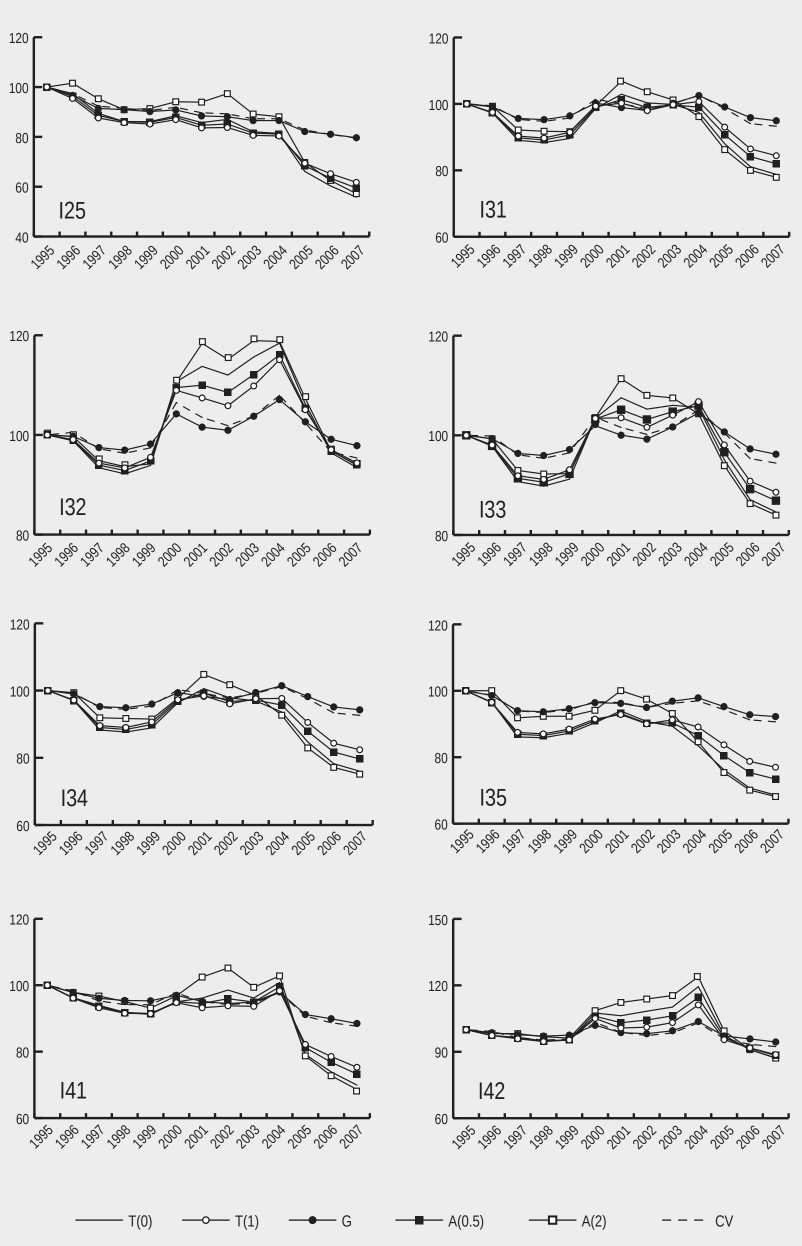
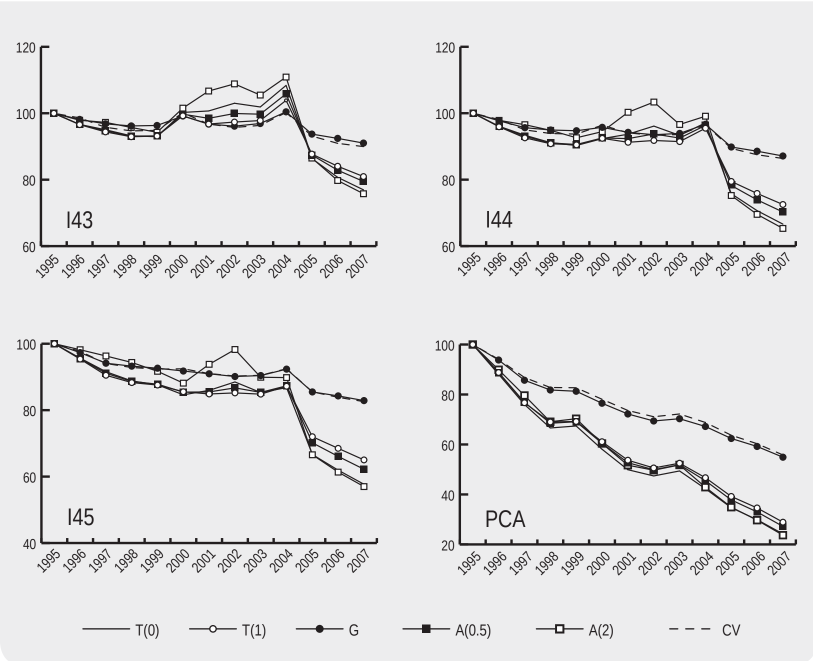

I12
I13
I14
I15
I21
I22
I23
I24
T(0)
T(1)
G
A(0.5)
A(2)
CV

Figure 1 Evolution of disparities (cont.)





and in most cases > 80%) with all composite indicators. By contrast, household expenditure and unemployment and employment rates tend to correlate much more poorly with the other indicators.

Although the two previous conclusions offer interesting insights into the evolution of regional disparities in the EU, it would be enlightening to see whether regions tend to be situated in roughly the same positions whatever indicator is used, as this can be considered a key element in the design of regional policy. This evaluation can be accomplished by computing the Spearman rank correlation coefficient, which measures the statistical dependence between two variables (Table 7 on pages 28-29 and Appendix 7). However, we believe that we can ascertain more information by using the approach proposed herein. Our approach is based on a reinterpretation of the so-called transition matrix approach (Maza *et al.*, 2010) in that instead of measuring the mobility degree in a distribution between two years, it measures, for a specific year, the "mobility" degree between any two of our distributions,[20]

[20] As is evident, we have a distribution for each of our (single and composite) indicators.

Table 6 Correlation matrix (Pearson coefficient) 2007

	GDP	PR	W	HE	DI	1/UR	ER	I11	I12	I13	I14	I15	I21	I22
GDP	1.00													
PR	0.92	1.00												
W	0.81	0.83	1.00											
HE	0.61	0.57	0.60	1.00										
DI	0.79	0.76	0.79	0.68	1.00									
1/UR	0.44	0.26	0.29	0.29	0.39	1.00								
ER	0.56	0.20	0.31	0.37	0.39	0.59	1.00							
I11	0.88	0.78	0.71	0.55	0.73	0.80	0.59	1.00						
I12	0.76	0.62	0.59	0.48	0.64	0.91	0.62	0.97	1.00					
I13	0.84	0.71	0.66	0.52	0.70	0.85	0.61	1.00	0.99	1.00				
I14	0.91	0.81	0.73	0.56	0.75	0.76	0.58	1.00	0.96	0.99	1.00			
I15	0.96	0.89	0.79	0.59	0.78	0.65	0.54	0.98	0.90	0.95	0.99	1.00		
I21	0.86	0.79	0.83	0.58	0.78	0.75	0.52	0.97	0.94	0.96	0.97	0.96	1.00	
I22	0.75	0.64	0.68	0.51	0.68	0.89	0.58	0.96	0.99	0.98	0.95	0.90	0.97	1.00
I23	0.82	0.73	0.77	0.55	0.74	0.82	0.55	0.98	0.97	0.98	0.97	0.94	0.99	0.99
I24	0.88	0.82	0.86	0.59	0.79	0.72	0.50	0.96	0.92	0.95	0.97	0.96	1.00	0.95
I25	0.91	0.88	0.92	0.62	0.82	0.59	0.44	0.92	0.84	0.89	0.93	0.95	0.97	0.89
I31	0.80	0.70	0.69	0.81	0.77	0.75	0.56	0.92	0.90	0.92	0.92	0.89	0.92	0.91
I32	0.72	0.58	0.59	0.67	0.68	0.89	0.61	0.93	0.96	0.95	0.92	0.86	0.91	0.96
I33	0.77	0.66	0.66	0.76	0.73	0.81	0.58	0.93	0.93	0.94	0.92	0.89	0.92	0.94
I34	0.81	0.72	0.71	0.83	0.78	0.71	0.54	0.91	0.88	0.90	0.91	0.89	0.91	0.89
I35	0.83	0.78	0.75	0.89	0.81	0.59	0.49	0.86	0.80	0.84	0.87	0.88	0.87	0.82
I41	0.83	0.74	0.72	0.59	0.83	0.81	0.55	0.97	0.96	0.97	0.97	0.94	0.97	0.97
I42	0.72	0.59	0.59	0.50	0.70	0.92	0.59	0.95	0.99	0.97	0.94	0.87	0.93	0.99
I43	0.79	0.68	0.67	0.56	0.78	0.86	0.57	0.97	0.98	0.98	0.96	0.92	0.96	0.98
I44	0.85	0.77	0.74	0.61	0.85	0.77	0.54	0.97	0.95	0.97	0.97	0.95	0.97	0.95
I45	0.89	0.85	0.81	0.65	0.91	0.66	0.48	0.95	0.88	0.92	0.95	0.96	0.95	0.90
PCA	0.79	0.77	0.79	0.69	1.00	0.39	0.39	0.74	0.64	0.70	0.75	0.79	0.78	0.68
RCI	0.71	0.55	0.62	0.47	0.50	0.44	0.65	0.67	0.62	0.65	0.68	0.69	0.67	0.62

I23	I24	I25	I31	I32	I33	I34	I35	I41	I42	I43	I44	I45	PCA	RCI
1.00														
0.99	1.00													
0.95	0.99	1.00												
0.92	0.91	0.87	1.00											
0.94	0.89	0.82	0.97	1.00										
0.93	0.91	0.86	0.99	0.99	1.00									
0.91	0.90	0.88	1.00	0.96	0.99	1.00								
0.86	0.88	0.87	0.98	0.89	0.95	0.99	1.00							
0.97	0.96	0.92	0.93	0.95	0.95	0.92	0.88	1.00						
0.96	0.91	0.83	0.91	0.97	0.94	0.89	0.81	0.97	1.00					
0.98	0.95	0.89	0.93	0.96	0.95	0.91	0.85	1.00	0.99	1.00				
0.97	0.96	0.93	0.93	0.93	0.94	0.93	0.89	1.00	0.96	0.99	1.00			
0.94	0.96	0.95	0.91	0.87	0.90	0.91	0.90	0.98	0.90	0.95	0.99	1.00		
0.74	0.79	0.83	0.77	0.68	0.74	0.78	0.81	0.83	0.70	0.78	0.85	0.91	1.00	
0.65	0.67	0.67	0.63	0.60	0.62	0.63	0.62	0.61	0.57	0.60	0.61	0.61	0.50	1.00

Table 7 Correlation matrix (Spearman coefficient) 2007

	GDP	PR	W	HE	DI	1/UR	ER	I11	I12	I13	I14	I15	I21	I22
GDP	1.00													
PR	0.87	1.00												
W	0.77	0.81	1.00											
HE	0.50	0.43	0.45	1.00										
DI	0.75	0.76	0.70	0.55	1.00									
1/UR	0.57	0.34	0.31	0.30	0.41	1.00								
ER	0.65	0.26	0.32	0.32	0.36	0.66	1.00							
I11	0.90	0.75	0.66	0.49	0.70	0.83	0.66	1.00						
I12	0.82	0.64	0.57	0.44	0.62	0.91	0.68	0.98	1.00					
I13	0.87	0.71	0.62	0.47	0.66	0.86	0.67	1.00	0.99	1.00				
I14	0.92	0.77	0.67	0.50	0.71	0.81	0.65	1.00	0.97	0.99	1.00			
I15	0.96	0.84	0.72	0.51	0.74	0.73	0.62	0.98	0.93	0.97	0.99	1.00		
I21	0.88	0.78	0.78	0.50	0.72	0.78	0.57	0.97	0.94	0.96	0.97	0.96	1.00	
I22	0.82	0.66	0.65	0.46	0.65	0.89	0.63	0.98	0.99	0.98	0.97	0.93	0.98	1.00
I23	0.85	0.73	0.72	0.49	0.69	0.83	0.60	0.98	0.97	0.98	0.98	0.96	0.99	0.99
I24	0.89	0.80	0.80	0.50	0.74	0.75	0.55	0.96	0.93	0.95	0.97	0.96	1.00	0.96
I25	0.90	0.87	0.89	0.49	0.76	0.63	0.48	0.91	0.85	0.89	0.92	0.94	0.97	0.90
I31	0.81	0.68	0.61	0.72	0.69	0.78	0.57	0.93	0.91	0.92	0.93	0.91	0.91	0.92
I32	0.78	0.62	0.56	0.62	0.65	0.88	0.63	0.95	0.96	0.96	0.94	0.90	0.93	0.96
I33	0.80	0.66	0.59	0.68	0.68	0.82	0.60	0.94	0.94	0.94	0.94	0.91	0.92	0.94
I34	0.81	0.69	0.62	0.74	0.70	0.75	0.56	0.92	0.90	0.91	0.92	0.90	0.90	0.90
I35	0.81	0.71	0.63	0.80	0.71	0.66	0.51	0.87	0.84	0.86	0.88	0.88	0.87	0.85
I41	0.86	0.74	0.66	0.52	0.79	0.82	0.61	0.98	0.96	0.98	0.98	0.96	0.97	0.97
I42	0.79	0.62	0.57	0.47	0.68	0.92	0.65	0.97	0.99	0.98	0.96	0.92	0.94	0.98
I43	0.84	0.69	0.63	0.50	0.75	0.86	0.63	0.98	0.98	0.98	0.97	0.95	0.96	0.98
I44	0.87	0.76	0.68	0.53	0.81	0.80	0.60	0.97	0.95	0.97	0.97	0.96	0.97	0.96
I45	0.90	0.83	0.74	0.53	0.87	0.70	0.54	0.94	0.90	0.93	0.95	0.96	0.95	0.91
PCA	0.75	0.77	0.71	0.55	1.00	0.41	0.36	0.70	0.62	0.67	0.71	0.74	0.73	0.65
RCI	0.77	0.56	0.59	0.44	0.44	0.47	0.67	0.71	0.66	0.69	0.72	0.73	0.67	0.65

I23	I24	I25	I31	I32	I33	I34	I35	I41	I42	I43	I44	I45	PCA	RCI
1.00														
0.99	1.00													
0.94	0.98	1.00												
0.92	0.90	0.85	1.00											
0.95	0.91	0.83	0.98	1.00										
0.94	0.91	0.85	1.00	0.99	1.00									
0.91	0.90	0.85	1.00	0.97	0.99	1.00								
0.86	0.86	0.83	0.98	0.92	0.96	0.99	1.00							
0.97	0.96	0.91	0.93	0.95	0.94	0.92	0.88	1.00						
0.97	0.93	0.85	0.92	0.97	0.94	0.90	0.84	0.98	1.00					
0.98	0.95	0.89	0.93	0.96	0.95	0.92	0.87	1.00	0.99	1.00				
0.97	0.96	0.92	0.93	0.94	0.94	0.92	0.88	1.00	0.97	0.99	1.00			
0.94	0.95	0.93	0.90	0.89	0.90	0.90	0.87	0.98	0.92	0.96	0.99	1.00		
0.70	0.74	0.77	0.69	0.65	0.68	0.70	0.71	0.79	0.68	0.75	0.81	0.88	1.00	
0.67	0.67	0.66	0.63	0.62	0.63	0.63	0.63	0.64	0.62	0.64	0.64	0.63	0.45	1.00

one of which is always the per capita GDP distribution. To compute our transition matrix, we defined, for each distribution, a set of five non-overlapping states, each containing 20% of the regions. In other words, we composed regional groups according to quintiles (the lowest 20%, the second 20% and so forth).[21] The information contained in the transition matrix was also summarized by applying the Shorrocks Mobility Index (SMI).[22] The results obtained for 2007 for all our single and composite indicators (Table 8 on pages 31-34, with geometric averages shown in Appendix 8) indicate that:

- The values of the elements along the main diagonal are, in general, the highest of each row, meaning that in most cases the region's positions are roughly the same regardless of the indicator considered.
- As expected, owing to the presence of strong inertia factors, this consistency is most pronounced among the very well-positioned (top quintile) and very poorly positioned (bottom quintile) regions, as the diagonal values are much greater in those cases than they are for the other quintiles.
- As seems to be obvious, "mobility" from one quintile to adjacent quintiles is greater than to more distant quintiles. This implies that, when discrepancies between per capita GDP and the other indicators emerge, they are not overly large.
- According to the SMI, the "mobility" degree is, in most cases, around 0.5, although it varies from a minimum of 0.29 to a maximum of 0.66. Although this finding could imply that, in most cases, the mobility degree between any two indicators is "medium", the truth is that, considering the small range of the second, third and fourth quintiles, this mobility should be termed as "low".[23]

21 The criterion on which this division is based is arbitrary, as there is no theoretical method to achieve an appropriate partition of the distribution. For references, see Magrini (1999) and Bulli (2001).

22 This index, *SMI* for a transition matrix T is given by:

$$SMI(T) = \frac{n - tr(T)}{n - 1}$$

where *tr* denotes the trace of the matrix and *n* is the number of states (five in this case). The index – a measure of the mobility degree in a distribution – is normalised to take values between 0 and 1 by dividing it by: $n/_{n-1}$

23 The results obtained for the Spearman correlation coefficient (Table 7) support this statement.

Table 8 Transition matrices (GDP vs. other indicators). 2007

PR

GDP	Q1	Q2	Q3	Q4	Q5
Q1	86.8	7.5	5.7	0.0	0.0
Q2	13.2	56.6	20.8	9.4	0.0
Q3	0.0	25.0	30.8	36.5	7.7
Q4	0.0	9.4	37.7	35.8	17.0
Q5	0.0	1.9	3.8	18.9	75.5
SMI			0.43		

W

GDP	Q1	Q2	Q3	Q4	Q5
Q1	83.0	15.1	1.9	0.0	0.0
Q2	17.0	49.1	11.3	11.3	11.3
Q3	0.0	25.0	25.0	26.9	23.1
Q4	0.0	7.5	43.4	32.1	17.0
Q5	0.0	3.8	17.0	30.2	49.1
SMI			0.52		

HE

GDP	Q1	Q2	Q3	Q4	Q5
Q1	77.4	15.1	7.5	0.0	0.0
Q2	11.3	20.8	22.6	26.4	18.9
Q3	3.8	21.2	25.0	23.1	26.9
Q4	5.7	26.4	17.0	26.4	24.5
Q5	1.9	17.0	26.4	24.5	30.2
SMI			0.64		

DI

GDP	Q1	Q2	Q3	Q4	Q5
Q1	86.8	7.5	5.7	0.0	0.0
Q2	11.3	43.4	32.1	11.3	1.9
Q3	1.9	15.4	25.0	42.3	15.4
Q4	0.0	22.6	22.6	28.3	26.4
Q5	0.0	11.3	13.2	18.9	56.6
SMI			0.52		

1/UR

GDP	Q1	Q2	Q3	Q4	Q5
Q1	50.9	22.6	13.2	13.2	0.0
Q2	35.8	22.6	18.9	17.0	5.7
Q3	9.6	32.7	21.2	25.0	11.5
Q4	1.9	15.1	17.0	28.3	37.7
Q5	1.9	7.5	28.3	17.0	45.3
SMI			0.66		

ER

GDP	Q1	Q2	Q3	Q4	Q5
Q1	50.9	22.6	17.0	7.5	1.9
Q2	35.8	30.2	15.1	18.9	0.0
Q3	7.7	38.5	25.0	25.0	3.8
Q4	1.9	3.8	26.4	32.1	35.8
Q5	3.8	5.7	15.1	17.0	58.5
SMI			0.61		

I11

GDP	Q1	Q2	Q3	Q4	Q5
Q1	81.1	18.9	0.0	0.0	0.0
Q2	18.9	52.8	24.5	3.8	0.0
Q3	0.0	26.9	40.4	32.7	0.0
Q4	0.0	1.9	28.3	39.6	30.2
Q5	0.0	0.0	5.7	24.5	69.8
SMI			0.43		

I12

GDP	Q1	Q2	Q3	Q4	Q5
Q1	75.5	15.1	9.4	0.0	0.0
Q2	22.6	43.4	20.8	11.3	1.9
Q3	1.9	34.6	30.8	26.9	5.8
Q4	0.0	7.5	26.4	34.0	32.1
Q5	0.0	0.0	11.3	28.3	60.4
SMI			0.51		

Table 8 Transition matrices (cont.)

I13

GDP	Q1	Q2	Q3	Q4	Q5
Q1	79.2	18.9	1.9	0.0	0.0
Q2	18.9	49.1	22.6	9.4	0.0
Q3	1.9	26.9	38.5	30.8	1.9
Q4	0.0	5.7	30.2	34.0	30.2
Q5	0.0	0.0	5.7	26.4	67.9
SMI			0.46		

I14

GDP	Q1	Q2	Q3	Q4	Q5
Q1	81.1	18.9	0.0	0.0	0.0
Q2	18.9	54.7	22.6	3.8	0.0
Q3	0.0	26.9	42.3	30.8	0.0
Q4	0.0	0.0	30.2	41.5	28.3
Q5	0.0	0.0	3.8	24.5	71.7
SMI			0.42		

I15

GDP	Q1	Q2	Q3	Q4	Q5
Q1	84.9	15.1	0.0	0.0	0.0
Q2	15.1	71.7	13.2	0.0	0.0
Q3	0.0	13.5	63.5	21.2	1.9
Q4	0.0	0.0	22.6	56.6	20.8
Q5	0.0	0.0	0.0	22.6	77.4
SMI			0.29		

I21

GDP	Q1	Q2	Q3	Q4	Q5
Q1	79.2	18.9	1.9	0.0	0.0
Q2	20.8	45.3	28.3	5.7	0.0
Q3	0.0	25.0	40.4	28.8	5.8
Q4	0.0	9.4	22.6	39.6	28.3
Q5	0.0	1.9	5.7	26.4	66.0
SMI			0.46		

I22

GDP	Q1	Q2	Q3	Q4	Q5
Q1	73.6	20.8	5.7	0.0	0.0
Q2	24.5	41.5	20.8	13.2	0.0
Q3	1.9	28.8	36.5	25.0	7.7
Q4	0.0	7.5	24.5	32.1	35.8
Q5	0.0	1.9	11.3	30.2	56.6
SMI			0.52		

I23

GDP	Q1	Q2	Q3	Q4	Q5
Q1	75.5	22.6	1.9	0.0	0.0
Q2	22.6	43.4	24.5	9.4	0.0
Q3	1.9	23.1	42.3	25.0	7.7
Q4	0.0	9.4	22.6	37.7	30.2
Q5	0.0	1.9	7.5	28.3	62.3
SMI			0.48		

I24

GDP	Q1	Q2	Q3	Q4	Q5
Q1	81.1	18.9	0.0	0.0	0.0
Q2	18.9	49.1	28.3	3.8	0.0
Q3	0.0	23.1	40.4	30.8	5.8
Q4	0.0	9.4	22.6	41.5	26.4
Q5	0.0	0.0	7.5	24.5	67.9
SMI			0.44		

I25

GDP	Q1	Q2	Q3	Q4	Q5
Q1	83.0	17.0	0.0	0.0	0.0
Q2	17.0	54.7	20.8	7.5	0.0
Q3	0.0	23.1	38.5	30.8	7.7
Q4	0.0	5.7	30.2	35.8	28.3
Q5	0.0	0.0	9.4	26.4	64.2
SMI			0.45		

I31

GDP	Q1	Q2	Q3	Q4	Q5
Q1	84.9	15.1	0.0	0.0	0.0
Q2	9.4	49.1	28.3	11.3	1.9
Q3	3.8	23.1	32.7	28.8	11.5
Q4	1.9	11.3	22.6	32.1	32.1
Q5	0.0	1.9	15.1	28.3	54.7
SMI			0.49		

I32

GDP	Q1	Q2	Q3	Q4	Q5
Q1	77.4	18.9	3.8	0.0	0.0
Q2	20.8	39.6	22.6	15.1	1.9
Q3	1.9	25.0	38.5	23.1	11.5
Q4	0.0	11.3	22.6	32.1	34.0
Q5	0.0	5.7	11.3	30.2	52.8
SMI			0.52		

I33

GDP	Q1	Q2	Q3	Q4	Q5
Q1	83.0	15.1	1.9	0.0	0.0
Q2	15.1	45.3	26.4	11.3	1.9
Q3	1.9	23.1	36.5	28.8	9.6
Q4	0.0	11.3	22.6	28.3	37.7
Q5	0.0	5.7	11.3	32.1	50.9
SMI			0.51		

I34

GDP	Q1	Q2	Q3	Q4	Q5
Q1	86.8	13.2	0.0	0.0	0.0
Q2	7.5	54.7	24.5	11.3	1.9
Q3	3.8	21.2	34.6	26.9	13.5
Q4	1.9	9.4	24.5	35.8	28.3
Q5	0.0	1.9	15.1	26.4	56.6
SMI			0.46		

I35

GDP	Q1	Q2	Q3	Q4	Q5
Q1	83.0	17.0	0.0	0.0	0.0
Q2	11.3	47.2	26.4	13.2	1.9
Q3	5.8	21.2	30.8	26.9	15.4
Q4	0.0	13.2	24.5	39.6	22.6
Q5	0.0	1.9	17.0	20.8	60.4
SMI			0.48		

I41

GDP	Q1	Q2	Q3	Q4	Q5
Q1	77.4	22.6	0.0	0.0	0.0
Q2	20.8	45.3	24.5	9.4	0.0
Q3	1.9	19.2	44.2	26.9	7.7
Q4	0.0	11.3	20.8	41.5	26.4
Q5	0.0	1.9	9.4	22.6	66.0
SMI			0.45		

I42

GDP	Q1	Q2	Q3	Q4	Q5
Q1	69.8	20.8	9.4	0.0	0.0
Q2	28.3	35.8	22.6	9.4	3.8
Q3	1.9	30.8	34.6	25.0	7.7
Q4	0.0	11.3	18.9	35.8	34.0
Q5	0.0	1.9	13.2	30.2	54.7
SMI			0.54		

I43

GDP	Q1	Q2	Q3	Q4	Q5
Q1	75.5	24.5	0.0	0.0	0.0
Q2	22.6	43.4	24.5	9.4	0.0
Q3	1.9	19.2	44.2	26.9	7.7
Q4	0.0	11.3	18.9	39.6	30.2
Q5	0.0	1.9	11.3	24.5	62.3
SMI			0.47		

Table 8 Transition matrices (cont.)

I44

GDP	Q1	Q2	Q3	Q4	Q5
Q1	77.4	22.6	0.0	0.0	0.0
Q2	20.8	50.9	20.8	7.5	0.0
Q3	1.9	13.5	50.0	26.9	7.7
Q4	0.0	11.3	20.8	43.4	24.5
Q5	0.0	1.9	7.5	22.6	67.9
SMI			0.42		

I45

GDP	Q1	Q2	Q3	Q4	Q5
Q1	81.1	18.9	0.0	0.0	0.0
Q2	18.9	54.7	20.8	5.7	0.0
Q3	0.0	13.5	50.0	30.8	5.8
Q4	0.0	11.3	22.6	43.4	22.6
Q5	0.0	1.9	5.7	20.8	71.7
SMI			0.40		

PCA

GDP	Q1	Q2	Q3	Q4	Q5
Q1	86.8	7.5	5.7	0.0	0.0
Q2	11.3	43.4	32.1	11.3	1.9
Q3	1.9	15.4	26.9	40.4	15.4
Q4	0.0	22.6	22.6	28.3	26.4
Q5	0.0	11.3	11.3	20.8	56.6
SMI			0.52		

RCI

GDP	Q1	Q2	Q3	Q4	Q5
Q1	62.3	37.7	0.0	0.0	0.0
Q2	28.3	24.5	35.8	11.3	0.0
Q3	7.7	25.0	25.0	34.6	7.7
Q4	1.9	11.3	18.9	37.7	30.2
Q5	0.0	1.9	18.9	17.0	62.3
SMI			0.58		

5 Concluding remarks

This paper has tried to shed some light on the evolution of disparities in the degree of the development of European regions at the NUTS2 level. As there is ongoing debate on which measure(s) and indicator(s) are best suited to evaluate this evolution, we have examined both issues. We started by considering that the analysis of development disparities can be best looked at from the point of view of inequality, for which we proposed using five of the most conventional inequality measures (σ, Atkinson, Gini and Theil 0 and 1). We then discussed which indicator should be used to describe the degree and evolution of regional development disparities. We used a battery of both single and composite indicators and compared their results with those obtained with per capita GDP.

Regarding inequality measures, the results tended to show that all of them convey more or less the same information, namely, a common time pattern leading to a significant reduction of regional disparities in EU27,[24] although

[24] Although it is not the aim of this report, it must be stressed that this convergence process hides little or none intra-national regional convergence in new member states.

the Gini index and the coefficient of variation (σ) consistently displayed a lower degree of variability and change than did the others.

With respect to the development indicator, our results tend to support the conclusion that regional variations in development, whatever indicator is employed, are closely related to variations in per capita GDP. Whether we should pay attention to only this variable and ignore other single and/or composite indicators, however, is unclear. The plain answer is ”IT DEPENDS”.

In fact, the answer would be NO if ideally we were able to fulfil these three conditions:

- Agreement regarding the real content of the term *development*;[25]
- Agreement on the attributes or dimensions that best fit with this agreed concept; and
- Establishment of a basic databank with reliable, consistent and far-reaching time series observations for all the underlying variables (single indicators) behind the previously agreed dimensions.

However, acknowledging the difficulty in achieving these three conditions, we propose a straightforward “rule of thumb”: keep it simple. In other words, it seems to us that:

1. Per capita GDP is the best single indicator of the degree of development in the EU27 regions, as it is the most widely available and reliable of all indicators. Therefore, increasing efforts should be made by the European statistical offices and, in particular, by EUROSTAT to improve, as much as possible, the way this variable is estimated.
2. If, as mentioned in Section 3, it is considered that development is a multifaceted concept that, to be properly measured, requires a composite indicator, then we believe that this should be constructed using as few single indicators as possible. In fact, the greater the number of single indicators used in the construction of any composite indicator, the more assumptions regarding data imputation will be required, and the resulting composite indicator will be more difficult to interpret and less reliable. Finally, the decision to use simple or more complex composite indicators does not seem to be a substantial matter.

[25] As noted by Nardo *et al.* (2005: 12) “what is badly defined is likely to be badly measured”.

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Sammanfattning på svenska

Att minska de regionala skillnaderna i EU har varit en prioritering för Europeiska kommissionen sedan åtminstone mitten av 1970-talet, då den Europeiska regionalfonden lanserades. Flera artiklar i fördraget om Europeiska unionens funktionssätt behandlar denna fråga. Enligt Artikel 174 ska ”[u]nionen […] särskilt sträva efter att minska skillnaderna mellan de olika regionernas utvecklingsnivåer och eftersläpningen i de minst gynnade regionerna.”

Även om det uttalade syftet i denna artikel är uppenbart, har två aspekter fångat såväl akademikers som politikers intresse: hur regionala skillnader ska mätas och vad som är den praktiska betydelsen av ordet utveckling. Författarna till rapporten *Regional Disparities in the EU: Are They Robust to the Use of Different Measures and Indicators?* vill bidra till den diskussionen genom att belysa båda frågorna. För det första strävar man i rapporten efter att bekräfta att de olika mått som har föreslagits för att mäta regionala skillnader, överlag innehåller jämförbar information. För det andra undersöks om olika individuella och sammansatta indikatorer – vilka används för att fånga begreppet utveckling – leder till liknande slutsatser som när vi mäter utvecklingsgraden med BNP per capita som indikator.

Rapporten går inledningsvis igenom några av de oftast använda måtten på såväl regionala skillnader som ojämlikheter (i betydelsen snedfördelning av resurser). Ett vanligt problem med dessa mått är att de kan leda till olika slutsatser vad gäller såväl den regionala utvecklingen som storleken på de regionala skillnaderna, beroende på om man tar hänsyn till önskvärda välfärdsnivåer eller om man använder olika viktningsmetoder. I rapporten anläggs ett praktisk angreppssätt för att granska ett representativt urval av mått på ojämlikhet. Om samtliga av dessa mått pekar i samma riktning, finns det goda skäl att anta att de slutsatser som dras i rapporten är hållbara. De fem mått som har valts är sigma-konvergens (vilken räknas ut genom den så kallade variationskoefficienten), Gini-indexet, två versioner av Theil-indexet och Atkinson-indexet.

Efter att ha undersökt dessa ojämlikhetsmått koncentrerar sig författarna på innebörden av begreppet utveckling, som det används i EU:s fördrag. Fördraget tycks i vissa fall referera till de europeiska medborgarnas välbefinnande och i andra fall till hur väl EU:s länder och regioner presterar ekonomiskt; men även till regionernas konkurrenskraft.

Även om olika indikatorer för att mäta nationell och regional utveckling har föreslagits av forskare, politiker och internationella institutioner, är det vanligast att man använder BNP per capita. Samtidigt som det är uppenbart att

BNP per capita är viktigt när man mäter ekonomisk utveckling, bör även andra dimensioner av utveckling övervägas. Eftersom BNP per capita inte är heltäckande används i denna rapport två olika grupper av utvecklingsindikatorer.

Den första gruppen består av enskilda indikatorer, vilka samtliga är relevanta socio-ekonomiska variabler (förutom BNP per capita använder vi produktivitet, löner, hushållsutgifter, disponibel inkomst samt arbetslöshets- och sysselsättningsgrad). Den andra gruppen består av olika sammansatta indikatorer som inkluderar vissa eller samtliga enskilda indikatorer. Eftersom det finns för- och nackdelar med båda grupperna – och då det saknas en generellt accepterad regel för att bestämma vilken av dem som är bäst – föreslår vi en enkel men logisk metod: om alla (eller det stora flertalet) utvecklingsindikatorer ger liknande resultat som när vi använder BNP per capita, får vi en rimlig bild av hur de regionala skillnaderna och det inbördes förhållandet regionerna emellan har utvecklats i EU. Detta borde också leda till att aktörerna i beslutsprocessen får bättre möjligheter att ta itu med de regionalpolitiska problemen.

Efter en inledande varning när det gäller vissa brister i tillgängliga data, används de ovan nämnda metoderna för att utvärdera hur regionala skillnader i EU har förändrats. Slutsatsen är att samtliga mått på ojämlikhet leder till mer eller mindre samma resultat: det finns ett gemensamt mönster som visar att de regionala skillnaderna minskar i betydande utsträckning över tid. När det gäller utvecklingsindikatorerna stödjer resultaten slutsatsen att regionala skillnader i utvecklingsnivå, oavsett vilken indikator som används, har ett starkt samband med BNP per capita. Betyder då detta att vi endast bör fokusera på BNP per capita och ignorera övriga indikatorer? Svaret är att "det beror på". I rapporten hävdas att svaret är nej, givet att följande tre villkor är uppfyllda:

1. att det råder enighet om vad som ingår i begreppet utveckling;
2. att det råder enighet om de egenskaper som bäst överensstämmer med detta begrepp; samt
3. att det upprättas en databank med tillförlitliga, konsekventa och långtgående tidsserieobservationer för samtliga enskilda indikatorer som innefattas i de två föregående punkterna.

Med tanke på svårigheten att uppnå dessa tre villkor, föreslås i rapporten följande tumregel: gör det så enkelt som möjligt, det vill säga:

1. BNP per capita är den bästa enskilda indikatorn för att mäta graden av utveckling i EU:s regioner, eftersom den är den mest tillgängliga och tillförlitliga av samtliga relevanta indikatorer. Av den anledningen bör de europeiska myndigheter som ansvarar för EU:s statistik – i synnerhet Eu-

rostat – lägga mer resurser på att förbättra det sätt på vilket denna variabel uppmäts;

2. om man anser att utveckling är ett mångfacetterat begrepp som kräver en sammansatt indikator, bör den utformas med så få enskilda indikatorer som möjligt. Av rapporten framgår att ju fler enskilda indikatorer som används i en sammansatt indikator, desto fler antaganden tvingas man göra under dataimputationen (det vill säga när man ersätter saknade värden i datasetet), vilket i sin tur leder till att den sammansatta indikatorn blir både mindre tillförlitlig och svårare att tolka.

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