XXI. MEZINÁRODNÍ KOLOKVIUM O REGIONÁLNÍCH VĚDÁCH. SBORNÍK PŘÍSPĚVKŮ.

21ST INTERNATIONAL COLLOQUIUM ON REGIONAL SCIENCES. CONFERENCE PROCEEDINGS

Place: Kurdějov (Czech Republic)
June 13-15, 2018

Publisher: Masarykova univerzita, Brno

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Publikace neprošla jazykovou úpravou. / Publication is not a subject of language check.
Za správnost obsahu a originalitu výzkumu zodpovídají autoři. / Authors are fully responsible for the content and originality of the articles.

AN OVERVIEW AND EVALUATION OF METHODS FOR DERIVING COMPOSITE INDICES OF REGIONAL DEVELOPMENT IN SOCIO-ECONOMIC ISSUES

Přehled a hodnocení metod pro konstrukci kompozitních indexů regionálního rozvoje v socioekonomických otázkách

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Annotation

Economic growth has lifted hundreds of millions out of poverty and improved the lives of many more over the last half-century. Yet it is increasingly evident that a model of development based solely on economic progress is incomplete. We must widen our understanding of the success of societies beyond economic outcomes. Inclusive growth requires achieving both economic and social progress as stated in the Strategy Europe 2020. Advances in understanding, theory and measurement must necessarily proceed hand in hand. Right measurement is a powerful instrument for social progress; wrong or imprecise measurement a source of hazard and even havoc. Measurement of a region's progress plays a crucial role in improving the prosperity and quality of life of regional communities. This process has however proven difficult as contemporary views on measurement of regional development are presented as multi-dimensional concepts. Several methods of evaluating regional economies exist, most of methods have their own limitations in selection of relevant indicators and weighting scheme. Despite the limitations, several approaches in the form of composite indices have been proposed by the European Union and the other institutions. This paper discusses challenges faced in the design of composite indices of regional development in socio-economic issues.

Key words

composite index, indicators, literature review, regional development, socio-economic progress evaluation

Anotace

Hospodářský růst pozvedl z chudoby stovky milionů lidí a v posledním období zlepšil životy mnoha dalších. Je však stále více zřejmé, že model vývoje založený výhradně na ekonomickém pokroku je neúplný. Je potřeba rozšířit naše chápání úspěchu jednotlivých ekonomik či společností nad rámec čistě ekonomických výsledků. Inkluzivní růst vyžaduje dosažení hospodářského i společenského pokroku souběžně, jak je uvedeno i ve Strategii Evropa 2020. Pokrok v porozumění teorie, ale i způsobu měření a hodnocení musí nezbytně probíhat ruku v ruce. Správné měření je silným nástrojem pro následné hodnocení společenského pokroku; nesprávné nebo nepřesné měření je určitým nebezpečím a rovněž zdrojem určitých nepřesností. Měření a hodnocení socioekonomického pokroku regionu hraje zásadní roli při zlepšování prosperity a kvality života regionálních komunit. Tento proces se však ukázal obtížný, protože současné pohledy na měření regionálního rozvoje mají několik úhlů pohledu a jsou tak multidimenzionální. Existuje několik metod hodnocení regionálních ekonomik, avšak většina metod má svá vlastní omezení při výběru relevantních ukazatelů a schématu vážení. Navzdory existenci těchto omezení navrhla Evropská unie a další instituce několik přístupů k hodnocení regionálních ekonomik, a to ve formě kompozitních indexů. Tento příspěvek pojednává o výzvách při navrhování těchto indexů regionálního rozvoje v sociálně-ekonomických otázkách.

Klíčová slova

indikátory, kompozitní indexy, literární rešerše, regionální rozvoj, hodnocení socioekonomického pokroku

JEL classification: B41, O10, O21, R11, R58

1. Introduction

The essential purpose of economic activity is the promotion of human development, welfare and well-being in a sustainable manner, and not growth for growth's sake, yet we lack effective measures to monitor progress toward these objectives. A society which fails to address basic human needs, equip citizens to improve their quality of life, protect the environment, and provide an opportunity for its citizens is not succeeding. It is only human to try to find easy and straightforward answers to vital questions in an increasingly complex world. Evaluation of socioeconomic progress is a measure of the economic and social status of an individual or group of individuals based on education, income, occupation, and other relevant indicators, relative to other members of the population. It is often used to refer to a geographic region's combined economic and social position relative to other areas. The development of the modern economy has been made possible by continuous development and refinement of tools and measures. Right measurement is a powerful instrument for socio-economic progress, which is why efforts are constantly being made to improve their power and precision; wrong or imprecise measurement a source of hazard and even havoc. The essential purpose of economic activity is the promotion of human development, welfare and well-being in a sustainable manner, and not growth for growth's sake, yet we lack effective measures to monitor progress toward these objectives. Advances in understanding, theory and measurement must necessarily proceed hand in hand. Measuring multiple dimensions of socioeconomic progress is indispensable to understanding its components, benchmarking success, and catalysing improvement. What level have we reached in comparison to others? Are we doing well? Are we going in the right direction? Are we catching-up or lagging behind? Are we meeting benchmarks or are we missing them? Are we using our fair and sustainable share of resources or too much? Is a group of economies converging or not? Just to list a few. At the same time, we are surrounded by an abundance of indicators trying to provide answers to these questions, at different levels of sophistication, in many cases serving as a basis for evidence-based policy decisions. Such indicators often seek to measure much aggregated but also diffuse concepts, rich in value judgements but not always grounded in hard science. The most prominent examples we see are indicators of "economic development and performance" and "environmental and sustainable development". In recent years these have been complemented by alternative "progress" and "well-being" measurements. These indicators are frequently presented in dashboards and scoreboards, as well as aggregated or model-based composite indicators or indices (CIs). In recent years, international organizations, think-tanks, and the social sciences have contributed to a dramatic expansion in the range of CIs indices measuring concepts such as human development, governance, or social capital. Therefore, a large number of composite indexes of economic and social well-being have been developed. Unfortunately, the methodological issues associated with CI construction have often been neglected or inadequately treated by index developers. The objective of this paper is to provide a comprehensive review of the methodological choices involved in the construction of Cis of economic and social well-being and the implications of the choices for the properties of the index. This paper discusses challenges faced in the design of CIs, and suggests the process of CI construction using the conventional methods.

2. Approaches to the construction of composite indices

Attempts at measuring the development process have made use of CIs. In recent years, international organizations, think-tanks, and the social sciences have contributed to a dramatic expansion in the range of CIs measuring concepts such as human development, governance, or social capital. CI is the mathematical combination of individual indicators that represent different dimensions of a concept whose description is the objective of the analysis (Saisana, Tarantola, 2002). CIs comparing territorial (e.g. country, region, city or local municipality) performance are increasingly recognised as a useful tool in policy analysis and public communication and very common for benchmarking the mutual and relative progress of territories in a variety of policy domains. CIs as a tool for a ranking become more and more popular because they illustrate a comprehensive view of a phenomenon that cannot be captured by only one single indicator. CIs provide simple comparisons of territories that can be used to illustrate complex and elusive issues in wide-ranging fields. It often seems easier for the general public to interpret CIs than to identify common trends across many separate indicators and CIs have also proven useful in benchmarking territorial performance. This reflects a growing recognition of the important role that CIs can play as a tool for evaluating trends in the level of territorial development and for assessing the impact of policy on well-being. However, CIs can send misleading policy messages if they are poorly constructed or misinterpreted. It would point that CIs should never be seen as a goal per se. They should be seen, instead, as a starting point for initiating discussion and attracting public interest and concern. In fact, CIs must be seen as a means of initiating discussion and stimulating public interest. Many scientists dispute the use of CIs that lead to the determination of a single value for each geographic area, preferring the so-called dashboard. In the case of the dashboard, it is possible to identify various dimensions of the phenomenon, all relevant, without that they are further aggregated. From the statistical point of view, it is an incontrovertible choice but from the standpoint of political and media is a heavy limitation.

In general terms, an indicator is a quantitative or a qualitative measure derived from a series of observed facts that can reveal relative positions in a given area (OECD, 2008, p. 13). When evaluated at regular intervals, an indicator can point out the direction of change across different units and through time. In the context of policy analysis, indicators are useful in identifying trends and drawing attention to particular issues. They can also be helpful in setting policy priorities and in benchmarking or monitoring performance. CIs have thus received substantial attention in recent years and various methodologies have been developed to handle different aspects of the issue. Indicators are pieces of information that summarize the characteristics of a system or highlight what is happening in a system. CIs are useful in their ability to integrate large amounts of information into easily understood formats and are valued as a communication and political tool. They are often a compromise between scientific accuracy and the information available at a reasonable cost. However, CI construction suffers from many methodological difficulties, with the result that they can be misleading and easily manipulated. The main pros and cons of using CIs provide Saisana and Tarantola (2002).

The literature on CIs is vast and almost every month new proposals are published on specific methodological aspects potentially relevant for the development of CIs. CIs are much like mathematical or computational models and, as such, their construction owes more to the craftsmanship of the modeller than to universally accept scientific rules for encoding. With regard to models, the justification for a CI lies in its fitness for the intended purpose and in peer acceptance. The quality of CI, as well as the soundness of the messages it conveys, depend not only on the methodology used in its construction but primarily on the quality of the framework and the data used. A composite based on a weak theoretical background or on soft data containing large measurement errors can lead to disputable policy messages, in spite of the use of the state-of-the-art methodology in its construction. CI construction is a complex task whose phases involve several alternatives and possibilities that affect the quality and the reliability of results. The main problems, in this approach, concern the choice of theoretical framework, the data availability, the selection of the more representative indicators and their treatment in order to compare and aggregate them. It is possible, shortly, to individuate the following steps to tackle (OECD, 2008), see Table 1.

Tab. 1: Steps to tackle within CI construction

| Defining the phenomenon to be measured |
|---|
| The definition of the concept should give a clear sense of what is being measured by the composite index. It should refer to a theoretical framework, linking various sub-groups and underlying indicators. |
| **Selecting a group of individual indicators** |
| Ideally, indicators should be selected according to their relevance, analytical soundness, timeliness, accessibility, etc. The selection step is the result of a trade-off between possible redundancies caused by overlapping information and the risk of losing information. A statistical approach to indicators choice involves calculating the correlation between potential indicators and then including the ones that are less correlated in order to minimize the redundancy. |
| **Normalizing the individual indicators** |
| This step aims to make the indicators comparable. Normalization is required prior to any data aggregation as the indicators in a data set often have different measurement units. Therefore, it is necessary to bring the indicators to the same standard, by transforming them into pure, dimensionless, numbers. Another motivation for the normalization is the fact that some indicators may be positively correlated with the phenomenon to be measured (positive 'polarity'), whereas others may be negatively correlated with it (negative 'polarity'). We want to normalize the indicators so that an increase in the normalized indicators corresponds to increase in the composite index. There are various methods of normalization, such as ranking, re-scaling (or min-max transformation), standardization (or z-scores) and indication (index number transformation or 'distance' to a reference). |
| **Aggregating the normalized indicators** |
| It is the combination of all the components to form one or more composite indices (mathematical functions). Different aggregation methods are possible. The most used are additive methods that range from summing up unit ranking in each indicator to aggregating weighted transformations of the original indicators. Multivariate techniques as Principal Component Analysis are also often used. |

Source: Mazziotta and Pareto (2013)

It is important to emphasize that the theoretical part (definition of the phenomenon and selection of the indicators) is not separate from the statistical-methodological part: so, the choice of the individual indicators is not independent of the choice of the aggregation method. No universal method exists for composite indices construction. In each case, their construction is much determined by the particular application, including both formal and heuristic elements, and incorporate some expert knowledge on the phenomenon. Nevertheless, the advantages of composite indices are clear, and they can be summarized in the unidimensional measurement of the phenomenon, an easy interpretation with respect to a battery of many individual indicators and simplification of the data analysis (e.g., ranking units and comparing their performance over time). The main factors to take into account in the choice of the method to be adopted for summarizing individual indicators are as follows (Mazziotta, Pareto, 2013):

- type of indicators (substitutable/non-substitutable),
- type of aggregation (simple/complex),

- ▪ type of comparisons (absolute/relative),
     type of weights (objective/subjective).

There is not always a 'well-established' solution, and sometimes it may be necessary to renounce to some requirements, to satisfy others. Following Figure 1 shows the flowchart for the choice of the 'best' method in constructing a CI, with the main possible solutions (normalization, weighting and aggregation) for each 'path' followed (assumptions and requirements). CI construction is not straightforward and the methodological challenges raise a series of technical issues that, if not addressed adequately, can lead to CIs being misinterpreted or manipulated. Therefore, careful attention needs to be given to their construction and subsequent use. CI developers have to face a justifiable degree of scepticism from statisticians, economists and other groups of users. This scepticism is partially due to the lack of transparency of some existing indicators, especially as far as methodologies and basic data are concerned.

Fig. 1 Flowchart for the choice of the 'best' method for construction of a composite index
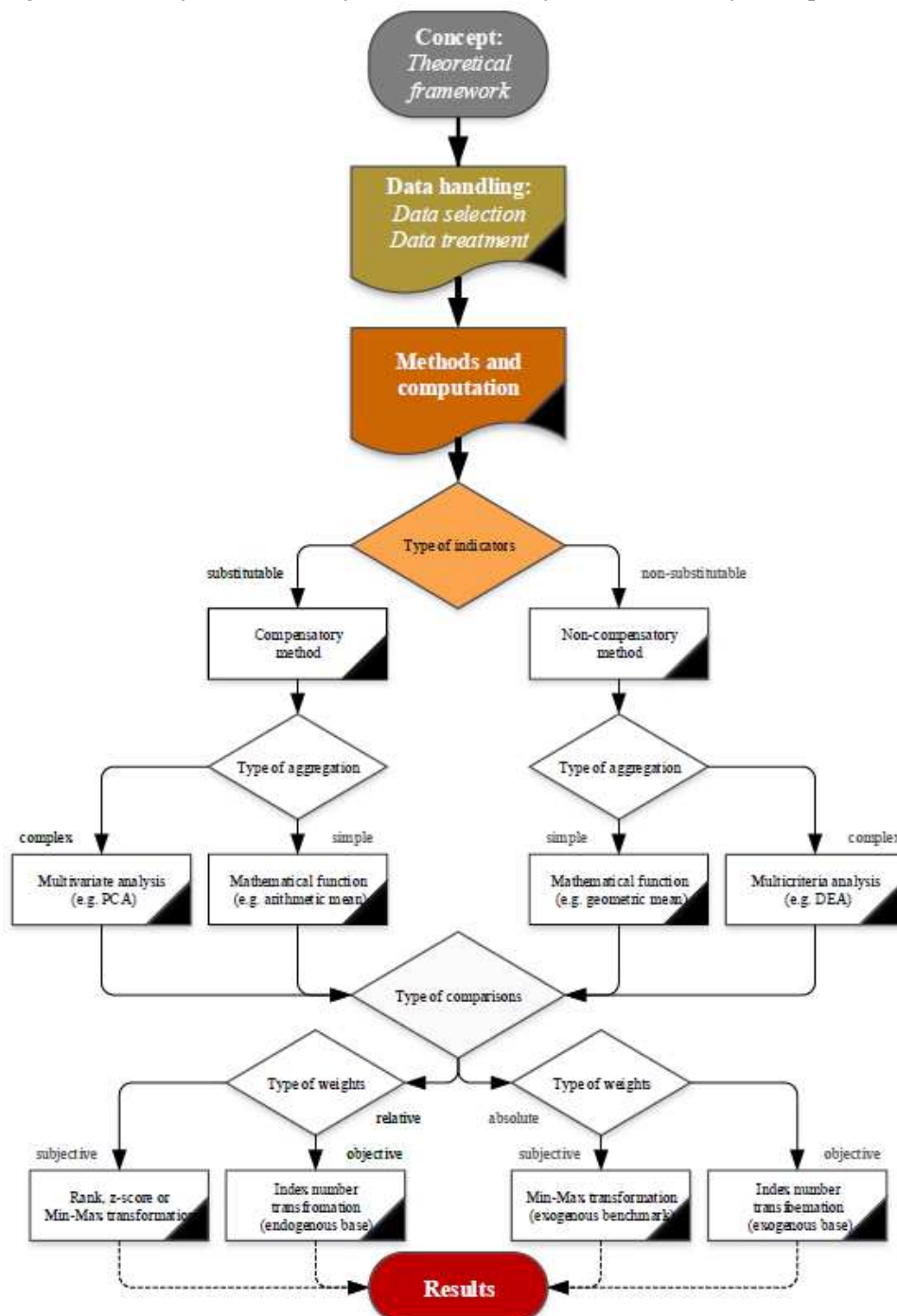
Source: Mazziotta, Pareto (2013, p. 74); own elaboration (2018)

As is known, the implementation of a CI is a complex process that involves stages of work well defined, where the arbitrary choices of the researcher have a significant effect on the final results. The heated debate within the scientific community, over the years, seems to converge towards the idea that there is not a composite index universally valid for all areas of application, and, therefore, its validity depends on the strategic objectives of the research. Beyond the procedure of CI construction, CIs provide an irreplaceable contribution to simplification; however, they are based on methods that flatten the basic information and they can lead to a myopic reading of reality, especially if not sustained, upstream, from an adequate step of selection and interpretation of the individual indicators. Thus, it is considered absolutely essential, in order to obtain valid and reliable results, to support the process of choosing the set of the individual indicators with a theoretical framework that defines the social reality in each of its dimensions (Mazziotta, Pareto, 2013; Delvecchio, 1995). The biggest challenges of CIs appear to be the translation of a possible generalised or vague information requirement into a measurable concept, the technical complexity of the model, the selection of assumptions that hold, the appropriate presentation to users, and the facilitation of the correct use of the indicator by users.

3. A literature review of composite indices in a regional context

Quantifying systems is a complex process, and scales for measuring regional development, at any level, do not currently exist. In last years, the debate on the measurement of multidimensional phenomena has renewed interest. Measurement the progress that societies have made in their developmental efforts has proven to be difficult but also very popular. It is a common awareness that a number of socioeconomic phenomena cannot be measured by a single descriptive indicator and that, instead, they should be represented with multiple dimensions. Phenomena such as development, progress, poverty, social inequality, well-being, quality of life, provision of infrastructures, etc., require, to be measured, the 'combination' of different dimensions, to be considered together as the proxy of the phenomenon. This combination can be obtained by applying methodologies known as CIs. Our society is changing so fast we need to know as soon as possible when things go wrong. Measurement the progress that societies have made in their developmental efforts has proven to be difficult but also very popular, see e.g. Minarčíková (2016). CIs which compare territorial (e.g. country, region, city or local municipality) performance is increasingly recognised as a useful tool in policy analysis and public communication and very common for benchmarking the mutual and relative progress of territories in a variety of policy domains. CIs as a tool for a ranking become more and more popular because they illustrate a comprehensive view of a phenomenon that cannot be captured by only one single indicator. CIs provide simple comparisons of territories that can be used to illustrate complex and elusive issues in wide-ranging fields. It often seems easier for the general public to interpret CIs than to identify common trends across many separate indicators and CIs have also proven useful in benchmarking territorial performance. This reflects a growing recognition of the important role that CIs can play as a tool for evaluating trends in the level of territorial development and for assessing the impact of policy on well-being. However, CIs can send misleading policy messages if they are poorly constructed or misinterpreted. In fact, CIs must be seen as a means of initiating discussion and stimulating public interest.

Number of CIs in existence around the world is growing year after year. Literally, hundreds of sets of CIs on economic and social well-being have been developed throughout the world. CIs are very common in the field of economics and are used in a variety of policy domains such as national or regional competitiveness, sustainable development, quality of life assessment, globalisation and innovation (Huggins, 2003; Saisana, Tarantola, 2002). The proliferation of these indicators is a clear symptom of their political importance and operational relevance in decision-making processes. CIs are valued for their ability to integrate large amounts of information into easily understood formats for a general audience. Over the course of the last years, more and more researchers have looked at the benchmarking of places. The paper examines a number of published studies on this topic corresponds to well-being concept. There are three kinds of publications to be distinguished, some studies looking at the constructing of indices (Bowen, Moesen, 2010; Saisana, Tarantola, 2002), others focusing on the indices applied (Bandura, 2005; Booysen, 2002) and – only a few – incorporating both approaches. Berger and Bristow (2009) analysed four national indices in more detail, looking at index construction and their use as a predictor of future economic performance. Several well-established studies measure competitiveness at the country level and present mainstream approach. At the country level, Global Competitiveness Index (GCI), prepared by the World Economic Forum (WEF), and World Competitiveness Yearbook (WCY) by the Institute for Management Development (IMD) is by far the most influential and best known indices. GCI is indeed the most internationally recognised index covering a fairly comprehensive set of aspects relevant to competitiveness.

All of these indices analysed indices benchmarking nations, not regions. Studies on the regional level are harder to find (Berger, 2011). Rogerson (1999) seems to be the first to look at such indices in more detail, although he does it with a strict quality of life focus, comparing such rankings on the city level. He finds striking similarities

in the dimensions included and concludes that such indices seem to follow – the view that quality of life evaluation should focus on the extent to which the necessary conditions for personal satisfaction and happiness are achieved. Greene et al. (2007) in a study comparing 22 composite indices benchmarking cities and city-regions, also found many inconsistencies in theorising and measuring spatial competitiveness. They go on to doubt whether such rankings are really of value to the public. As important as this study may be, it lacks a more profound analysis of issues around the construction of such indices. This is what Fisher (2005), analysing eight US composite indices, did, combining the analysis of dimensions with the analysis of construction. He also looked at the predictive quality of the indices and found that they do a poor job of predicting state economic growth.

The popularity of CIs nowadays is also evident in the EU that is confirmed by the establishment of the Composite Indicators Research Group (COIN) under the Joint Research Centre (JRC) of the European Commission (European Commission, 2016). The EU and its institutions intend to support and improve participation of local and regional authorities in the planning and implementation of the EU policies and activities on the ground also by contributing to improving sound statistics and data by exploring possible new ways of measuring and presenting regional performance. Importance of CIs approach for the EU research is confirmed by the number of studies evaluated the level of development in specific thematic topic across the EU territory. In the paper, for each type of CI, reviewed general information on the number and type of indicators are offered, for more information see Melecký (2017) or Staníčková (2017). Many more approaches evaluating the EU in terms of CIs exist, but they are not included in evaluated sample with regard to their progress in terms of theory and empiricism, timeliness and validity, e.g. An Indicator for Measuring Regional Progress towards the Europe 2020 Targets (European Commission, 2014), The Regional Lisbon Index (European Commission, 2010), Synthetic index: Regional perspective on the Lisbon Agenda (European Commission, 2007). Attempts to extend the analysis at the regional level have been carried out in more recent years also in the EU. The European Competitiveness Index (ECI), computed by the University of Wales Institute, focuses on European regions at the EU NUTS 1 level (Huggins, Davies, 2006), which did not include Romania and Bulgaria at the time. A simpler but more detailed geographical description of competitiveness is presented in Atlas of Regional Competitiveness (Eurochambers, 2007), reflecting the international recognition of the importance of the regional NUTS 2 level, but the approach falls short of aggregating the variables to a single composite index. Some European countries have dedicated efforts to construct national measures of regional competitiveness, such as in the UK (Huggins, Izushi, 2008), Croatia (UNDP, 2008), Lithuania (Snieška, Bruneckiené, 2009) and Finland (Huovari et al., 2001), in the Visegrad Four countries (Melecký and Skokan, 2011) or in their NUTS 2 regions (Melecký, 2015) and also in the Czech Republic (Žižka, 2013; Žítek, Klímová, 2015) The literature's most widely acclaimed index is seemingly the Regional Competitiveness Index constructed for the EU by Annoni and Kozovska in 2010 (Annoni, Kozovska, 2010), and enhanced and enlarged in 2013 by Annoni and Dijkstra (Annoni, Dijkstra, 2013) and subsequently in 2017 updated by Annoni, Dijkstra and Gargano (Annoni, Dijkstra, Gargano, 2017) to include the EU regions. These studies were commissioned by the European Commission as a part of preparatory work for the EU' fifth, sixth and seventh Report on economic and social cohesion. Its methodological soundness, vast territorial extent, as well as the fact that it is the support document to the European Commission's policies, makes the three publications of this index highly recommendable for further improvements.

The proliferation of all these CIs is a clear symptom of their political importance and operational relevance in decision-making processes. CIs are valued for their ability to integrate large amounts of information into easily understood formats for a general audience. In addition to CIs, there are other approaches because regional development and its evaluation are issues constantly in the forefront of economic sciences, which lacks a mainstream method of regional competitiveness monitoring and evaluation. Decomposition of aggregate macroeconomic indicators of international organizations (WEF, IMD) is most commonly used approach at the regional level, as well as comprehensive (mostly descriptive) analysis aimed at identifying the key factors of regional development, productivity and economic growth (Viturka, 2016). Another approach is an evaluation by structural indicators of the EU, which is used for the assessment and the attainment of the objectives of the EU growth strategies (such as Lisbon strategy or Strategy Europe 2020) or by multicriteria decision-making methods (Hančlová, Melecký, 2016).

As is obvious, different types of CIs can be used for univariate, bivariate or multivariate analyses of data in any territorial level (country, region, district, municipality, etc.) as Al Sharmin (2011) illustrates in his case study. On the other hand, CIs can send misleading messages to policymakers if they are poorly constructed or interpreted as evidenced by Nardo, Saisana, Saltelli and Tarantola (2005). CIs construction owes to universally accepted scientific rules for encoding. The definition type of CI used in this book is adopted by the EC, i.e. composite indicators are based on sub-indicators that have no common meaningful unit of measurement and there is no obvious way of weighting these sub-indicators (Saisana and Tarantola, 2002, p. 5). Among the reasons that CIs have found such favour among development organizations and researchers in recent years, Foa and Tanner (2012)

suggest four. First, a composite measure has the ability to summarize complex or multi-dimensional issues in a simple manner, making it possible for policymakers to get a tractable and representative sense of the situation in a given country as it stands in comparison with others. A measure such as GDP per capita, for example, provides a more intuitive understanding of the state of an economy, than a table of the output of different industries and sectors. Second, because they provide a single estimate, CIs have substantial ease of interpretation over the use of multiple benchmarks, while quantification of a concept makes it possible to assess progress over time and to highlight cases where intervention may be needed. Third, the commitment to regularly produce and update quantitative ratings facilitates communication with ordinary citizens, including stakeholders in developing countries, showing both the commitment of an organization to a particular set of development challenges. Finally, CIs are an important starting point for public debate.

Conclusion

The 21st century sees changes in modern society, social structure, territorial policy, public administration and other fields, generated by the EU, which have a significant impact on the functioning and efficiency of the whole society. For real competences to find their appropriate places and levels, a mature society is required as well as the investigation and improvement of the maturity of regional levels prior to implementing any measures. The practice of spatial planning pointed to the need to create a CI with which you can get a broader perspective on the territory. CIs are pieces of information that summarize the characteristics of a system or highlight what is happening in a system, i.e. aggregate multidimensional processes into simplified concepts. They are often a compromise between scientific accuracy and the information available at reasonable cost. CIs have received substantial attention in recent years and various methodologies have been developed to handle different aspects of the issues. CIs which compare territorial performance is increasingly recognised as a useful tool in policy analysis and public communication. It often seems easier for the general public to interpret CIs than to identify common trends across many separate indicators, and they have also proven useful in benchmarking territorial performance (Saltelli, 2007). The quality of CI, as well as the soundness of the messages it conveys, depend not only on the methodology used in its construction but primarily on the quality of the framework and the data used. A composite based on a weak theoretical background or on soft data containing large measurement errors can lead to disputable policy messages, in spite of the use of the state-of-the-art methodology in its construction.

Literature

[1] AL SHARMIN, A., (2011). *A Composite Index to Assess the Regional Development*. A District-Level analysis. Saarbrücken: VDM. ISBN 978-3639360301.

[2] ANNONI P., DIJKSTRA, L., (2013). *EU Regional Competitiveness Index 2013*. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-32370-6.

[3] ANNONI P., DIJKSTRA, L., GARGANO, N., (2017). EU Regional Competitiveness Index 2016. *Working Paper WP 02/2017*. European Commission: Directorate-General for Regional and Urban Policy.

[4] ANNONI, P., KOZOVSKA, K., (2010). *EU Regional Competitiveness Index 2010*. Luxembourg: Publications Office of the European Union. ISBN 978-92-79-15693-9.

[5] BANDURA, R., (2005). *Measuring country performance and state behaviour: a survey of composite indices*. New York: United Nations, Office of Development Studies.

[6] BERGER, T., (2011). An Overview and Analysis on Indices of Regional Competitiveness. *Review of Economics & Finance,* vol. 1, pp. 17-33. ISSN 1923-7529.

[7] BERGER, T., BRISTOW, G., (2009). Competitiveness and the benchmarking of nations – A critical reflection. *International Advances in Economic Research*, vol. 15, no. 4, pp. 378-392. ISSN 1083-0898.

[8] BOOYSEN, F., (2002). An overview and evaluation of composite indicators of development. *Social Indicators Research,* vol. 59, no. 2, pp. 115-151. ISSN 0303-8300.

[9] BOWEN, H., MOESEN, W., (2010). Benchmarking the competitiveness of nations: benevolence versus equal treatment? In De Grauwe, P. (ed). *Dimensions of Competitiveness*. Massachusetts: MIT Press, pp. 181-206. ISBN 9780262013963.

[10] DELVECCHIO F., (1995). *Scale di misura e indicatori sociali*. Bari: Cacucci. ISBN 8899804203.

[11] EUROCHAMBERS., (2007). *Regional Competitiveness Atlas*. Brussels: Eurochambers.

[12] EUROPEAN COMMISSION., (2007). Growing Regions, Growing Europe. *Forth Report on Economic and Social Cohesion*. Luxembourg: Office for Official Publications of the European Communities. ISBN 92-79-05704-5.

[13] EUROPEAN COMMISSION., (2010). *Regional Focus – the Regional Lisbon index* [online]. [cit. 2018-03-03]. Available at www: http://ec.europa.eu/regional_policy/sources/docgener/focus/2010_03_lisbon_index.pdf.

[14] EUROPEAN COMMISSION., (2014). *An Indicator for Measuring Regional Progress towards the Europe 2020 Targets*. Brussel: EC, Committee of the Regions. ISBN 978-92-895-0783-7.

[15] EUROPEAN COMMISSION., (2016). *Composite Indicators Research Group* [online]. [cit. 2018-03-03]. Available at www: https://composite-indicators.jrc.ec.europa.eu/.

[16] FISHER, P., (2005). *Grading places: what do business climate rankings really tell us?* Washington DC: Economic Policy Institute. ISBN 9781932066210.

[17] FOA, R., TANNER, J.C. (2012). *Methodology of the Indices of Social Development.* Working Paper No. 2012-4. Hague: Institute of Social Studies.

[18] GREENE, F., TRACEY, P., COWLING, M., (2007). Recasting the city into city-regions: place promotion, competitiveness benchmarking and the quest for urban supremacy. *Growth and Change*, vol. 38, no. 1, pp. 1-22. ISSN 1468-2257.

[19] HANČLOVÁ, J., MELECKÝ. L., (2016). Application of the Nonparametric DEA Meta-frontier Approach with Undesirable Outputs in the Case of EU Regions. *Business Systems Research Journal,* vol. 7, no. 2, pp. 65-77. ISSN 1847-8344.

[20] HUGGINS, R., (2003). Creating a UK competitiveness index: Regional and local benchmarking. *Regional Studies,* vol. 37, no. 1, pp. 89-96. ISSN 0034-3404.

[21] HUGGINS, R., DAVIES, W., (2006) *European Competitiveness Index 2006-2007.* Cardiff: University of Wales Institute.

[22] HUGGINS, R., IZUSHI, H., (2008). *UK Competitiveness Index 2008*. Cardiff: University of Wales Institute.

[23] HUOVARI, J., KANGASHARJU, A., ALANEN, A., (2001). Constructing an index for regional competitiveness. *Working Paper,* no. 44. Helsinki: Pellervo Economic Research Institute.

[24] MAZZIOTTA, M., PARETO, A., (2013). Methods For Constructing Composite Indices: One For All Or All For One? Rivista Italiana di Economia, Demografia e Statistica - Italian Review of Economics, *Demography and Statistics*, vol. 67, no. 2, pp. 67-80. ISSN 0035-6832.

[25] MELECKÝ, L., (2015). Assessment of Socioeconomic Development of Visegrad Four NUTS 2 Regions Using Composite Indices. In *Proceedings of 12th International Conference Economic Policy in the European Union Member Countries*. Karviná: Silesian University, pp. 561-571. ISBN 978-80-248-3796-3.

[26] MELECKÝ, L., (2017). Meta-analyses of composite indices in the evaluation of European Union territory. In *XX. mezinárodní kolokvium o regionálních vědách. Sborník příspěvků*. Brno: Masarykova univerzita, pp. 43-51. ISBN 978-80-210-8587-9. DOI: 10.5817/CZ.MUNI.P210-8587-2017-4.

[27] MELECKÝ, L., SKOKAN, K., (2011). EU Cohesion and Its Evaluation in the Case of Visegrad Four Countries. In *Liberec Economic Forum 2011. Proceedings of the 10th International Conference*. Liberec: Technical University of Liberec, pp. 314-326. ISBN 978-80-7372-755-0.

[28] MINARČÍKOVÁ, E., (2016). Application of Selected Weighting Methods and Topsis Method in Regional Disparities Analysis. In *Proceedings of 10th International Days of Statistics and Economics*. Prague: University of Economics, pp. 1240-1249. ISBN 978-80-87990-10-0.

[29] NARDO, M., SAISANA, M., SALTELLI, A., TARANTOLA, S., (2005). *Tools for Composite Indicator Building*. Ispra: Institute for the Protection and Security of the Citizen, European Commission. EUR 21682 EN.

[30] ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT., (2008). *Handbook on Construction Composite Indicators*. Methodology and User Guide. Paris: OECD Publications. ISBN 978-92-64-04345-9.

[31] ROGERSON, R., (1999). Quality of life and city competitiveness. *Urban Studies*, vol. 36, no. 5, pp. 969-985. ISSN 0042-0980.

[32] SAISANA, M., TARANTOLA, S., (2002). *State-of-the-Art Report on Current Methodologies and Practices for Composite Indicator Development.* European Commission: Joint Research Centre. EUR 20498 EN.

[33] SALTELLI, A., (2007). Composite indicators between analysis and advocacy. *Social Indicators Research,* vol. 81, pp. 65-77. ISSN 0303-8300.

[34] SNIEŠKA, V., BRUNECKIENÉ, J., (2009). Measurement of Lithuanian Regions by Regional Competitiveness Index. *Engineering Economics*, vol. 61, no. 1, pp. 45-57. ISSN 1392-2785.

[35] STANÍČKOVÁ, M., (2017). Creation of Composite Index of the EU Regional Resilience: Analysis and Selection of Indicators. In *Proceedings of the 13th International Conference*. Liberec Economic Forum 2017. Liberec: Technical University of Liberec, pp. 136-144. ISBN 978-80-7494-349-2.

[36] SUCHACEK, J., (2015). Large Enterprise Branches: The Case of the Czech Republic. *Economics & Sociology*, vol. 8, no. 4, pp. 82-93. ISSN 2071-789X.

[37] VITURKA, M., (2016). Teoretická východiska a zobecnění výsledků modelování regionálního rozvoje České republiky. In *XIX. mezinárodní kolokvium o regionálních vědách. Sborník příspěvků*. Brno: Masarykova univerzita, pp. 22–27. ISBN 9788021082724. DOI: 10.5817/CZ.MUNI.P210-8273-2016-1.

[38] ŽÍTEK, V., KLÍMOVÁ, V., (2015). The Competitiveness Index of Czech Regions. *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis,* vol. 63, no. 2, pp. 693-701. ISSN 1211-8516.

[39] ŽIŽKA, M., (2013). Construction of composite indicator based on factor analysis. In *Proceedings of 31st International Conference Mathematical Methods in Economics 2013. Part II.* Jihlava: The College of Polytechnics Jihlava, pp. 1093-1098. ISBN 978-80-87035-76-4.