

VISUAL EVALUATION OF CHANGES IN REGIONAL GROWTH AND DISPARITIES: USAGE OF A PARETO CHART

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Abstract: *This paper shows how to evaluate a development of regional disparities with the Pareto chart. Explanation of chart principles is followed by its application to the regions of Visegrad Group countries. To present the usability of Pareto chart, we applied it on three different situations – involving both convergence and divergence. In addition, to confirm the estimates resulted from charts, we used the σ -convergence approach as a benchmark. Our results found that the chart has very good predicative ability, since virtually all conclusions of its application have been confirmed by σ -convergence analysis. The benefit of Pareto chart is involvement of extra information about changes in some sample sections, growth and order. Based on this information one can find more comprehensive conclusions about changes in disparities over time. Besides, the Pareto chart has a very easy interpretation which calls for no special knowledge in methods for disparity measurement. This is a great advantage for other fields' researchers, political-bureaucratic apparatus and both expert and inexpert public. That is why we believe the Pareto chart is a very interesting tool to evaluate development of regional disparities, which can be used solely or in combination (complementary) with other approaches of disparity measurement.*

Keywords: *Pareto chart, Visegrad Group, disparity measurement, evaluation of regional policy, development.*

JEL Classification: *R12, Y10, O47.*

Introduction

The long-term existence of significant socio-economic disparities across societies led towards quite logical attempts of analytical quantification during the development of economically oriented disciplines, while the quantification is a prerequisite for disciplines' effective directing (Capello, Nijkamp, 2009). The reason for the interest in the issue of disparities is obvious, since economic systems burdened by high inequality are seriously limited by this handicap, and cannot fully realize their growth potential, thus effectively facing a significant obstacle to their own development (Alesina, Rodrik, 1994; Temple, 1999; Stiglitz, 2012). Restrictions on economic performance is then also, of course, reflected in other related, and for society, highly sensitive areas, one of which the level of living standards of the population may be mentioned in particular (Zdražil, 2016). In this context, however, we cannot completely forget some positive effects generated by disparities - but just because of the existence of certain, however "reasonable" differences, can be regarded as a stimulus and factual condition for progress (Hirschman, 1958; Myrdal, 1957). In other words, socio-economic disparities should only be regulated, not entirely eliminated in order to the growth and development of any territorial unit burdened with them. Knowledge of the extent and development of disparities can literally be described in the best way as a cardinal prerequisite for development, as the realization of any activity with the aim of their

influencing may not be desirable for growth and development, and moreover these activities are usually associated with spending a considerable amount of economic resources, whose economic efficiency and effectiveness is necessary to systematically evaluate (König, 2009; Applová, 2015).

1 Statement of a problem

Since regional disparities refer to spatial variability in economic performance and welfare, they are manifested in unequal distribution of both potential of development and the level of population's standards of living. Although the issue of disparities is a long-term and global problem at the general level, an important impulse, which in the development of their studies in the last decades has significantly been contributing, is the effort to achieve solidarity across EU countries and regions (Kraftová, Matěja, 2015). The availability of a sophisticated analytical apparatus for estimating regional disparities is an essential prerequisite for the formulation of successful regional policy, as well as an evaluation of its application capabilities, and necessary continuous correction. Within the theoretical and practical applications, and over time, some basic directions came into existence, through which we can approach regional disparities for evaluation. The methods used under these directions share a single goal (i.e. to quantify the disparities development) and neoclassical postulates (i.e. particularly the natural tendency of economies to a state of their long-term equilibrium), as well as they often agree in results; however, the ways of their implementation substantially differ. In terms of the most common approaches to economic disparities evaluation it would probably be possible to indicate the following directions:

- β -convergence, which is based on the assumption of the inverse relationship between the level of production and long-term growth, while generally using estimations through various forms of linear, or linearized, regression models (Mankiw et al, 1992; Baumol, 1986; Barro, Sala-i-Martin, 2004)
- σ -convergence, which is also based on the assumption of the neoclassical natural tendency of economies to a common long-term equilibrium, while generally lying in the evaluation of dispersion or variability across a reference sample (Barro, Sala-i-Martin, 2004; Baumol, 1986);
- data distribution analysis by means of using non-parametric estimations of the shape of density function, usually based on the description of Markov chains, or transition probability matrix (Quah, 1996; Ezcurra et al, 2005);
- econometric approaches based on the analysis of deterministic and stochastic trends' components of time series through cointegration analysis (Bernard, Durlauf, 1995; Pesaran, 2007)

Methodological variability, on the one hand, allows selection procedures due to a different extent of the accentuation of relevant variables more suitable to the specific objective evaluation; on the other hand, this freedom attributes a certain degree of entropy to the results of the evaluation, because the choice of specific methods is subjective to a large extent, while the analogy of their results is not universal. Concerning the abovementioned theoretical measurement directions of disparities development, it can be generally stated that, in principle, it is not about the approaches that would have mutually substituted, but it is rather about the complements, since the advantages of one group of methods can be generally considered as the disadvantages

of another one, and vice versa. For example, in β -convergence and σ -convergence concepts, we may mark as crucial advantages the lower knowledge requirements of mathematical and statistical apparatus, the calculation (un)demanding and easy interpretation of results. On the other hand, the results of these methods are basically just summary characteristics describing a given territorial unit, which completely abandons the provision of detailed information about their own composition, and thus about causes of the development in terms of changes within the sample regions. Analogously opposite conclusions can then be developed towards methods for disparities evaluation by means of analyzing the data distribution and econometric models, which usually provide “complete” information that is possible to de-compose to the level of individual regions, or pairs, and therefore identify the partial causes of development tendencies. These methods are then logically more demanding, particularly when their interpretation requires a deeper methodological knowledge of both the presenter and the recipient’s side.

Given approaches may also be considered in certain exaggeration as opposite poles however, lacking the “middle way” between them, which would offer simplicity and easy interpretation, yet maintain sufficient information for a basic partial analysis. The method, which would have offered the usability potential not only in the context of empirical studies, but the results would have been, without necessity of more detailed study of partial steps, clear enough also for inexpert audiences from other fields, like the political-bureaucratic apparatus, but also the wider public. The authors of this paper assume that the so-called “Pareto analysis” or “the Pareto chart” could be an instrument suitable for the number of the abovementioned points, as well as serving as a suitable form of evaluation of the development of regional disparities.

Considering the abovementioned, the aim of this paper is to demonstrate the usability of an alternative approach to the evaluation of the development of regional disparities, specifically of the application of the Pareto chart, and assess its usefulness as a tool which through graphic expression to some extent is able to combine the advantages of the undemanding and simple interpretability, as well as preserving information useful for a more detailed evaluation of specific causes of development for the disparities of the whole unit.

2 Methods

As already indicated, this paper orients its focus on the evaluation of the advantages of regional disparities by using the Pareto chart, so it is certainly quite appropriate to specify this tool. Generally, the Pareto chart is designed as one of the seven basic tools of quality improvement defined by Kaoru Ishikawa (1985). In the Juran defined concepts (Juran, Godfrey, 1999) Ishikawa used, a diagram is essentially an application of the famous Pareto 80/20 rule, which has been interpreted by using a combination of column and line graphs simultaneously capturing the sequence, frequency and cumulative relative frequency within a given sample. In the field of quality management, this diagram is often used as a tool for simple error analysis. Its application, however, downright offers itself in the regional disparities evaluation since the used cumulative relative frequency (line graph) is nothing else than the inverse expression of the notoriously known Lorenz curve (1905), commonly used in economics to demonstrate wealth distribution in society. In combination with a (column) graph of aligned absolute frequencies, or when applying weighted values in

the field of regional development (e.g. per capita), it can then be easily read from the graph how individual parts of the sample, or even specific regions, diverge from one another.

The disparities development evaluation through the Pareto chart then lies in the visual comparison of two or more periods. This crucial advantage of the approach is, however, its most significant drawback to some extent. Although the Pareto chart can be described as clear for comparing a single, two perhaps even three periods, its clarity undoubtedly decreases with a growing number of the compared periods within a single field of the graph. Other apparent disadvantages arising from the principle of visual comparison is a limited ability to estimate the extent of disparities, as well as the evaluation of their development in the case that in terms of the partial convergence and divergence tendencies, the individual parts of the sample are fundamentally differentiated. In addition, one may find limitation in selection process of periods for comparison or evaluation based on selected reference points of time which are up to the researcher to choose. Of course, selection of periods that are burden for specific deviations can significantly bias the conclusions about development of regional disparities. However, such a limitation is common also for many other methods of disparities measurement - the β -convergence approach in particular. On the contrary, a great advantage of diagram application while comparing can undoubtedly mark the information content not only concerning the changes in disparities, but also the values of the monitored indicator and their changes, or extreme values, growth, etc., which other methods of disparities evaluation usually do not provide directly.

For the purposes of achieving the defined targets, the usability of the Pareto chart will be demonstrated on the disparities development indicator of GDP per capita (in purchasing power parity) between the NUTS II regions of the Visegrad Group countries, a total of 35 regions, of which 8 are Czech, 7 Hungarian, 16 Polish and 4 Slovak. The development was evaluated between 2000 and 2014, using source data from the Eurostat database (2016). Since we want to show that our results are not random but instead the Pareto chart is truly applicable tool to evaluate development of regional disparities, we extend the analysis beyond the period of 2000-2014 and provide two particular periods as well: 2000-2007 and 2007-2014. The fracture year 2007 not only splits the period of 2000-2014 to two symmetric sub-periods, but also is a year where the largest range of disparities among the Visegrad Group regions has been measured (the coefficient of variation at 49.94%) between 2000 and 2014, see Tab. 1. Moreover, as Tab. 1 shows, 2007 is a peak, which is followed by a downturn; hence, one can interpret the disparity process during sub-period of 2000-2007 as a divergence while the sub-period of 2007-2014 as a convergence. Well, we will be able to check whether the diagram is usable for examination of both regional convergence and divergence.

Tab. 1: Disparities in GDP of the Visegrad Group regions based on σ -convergence

	2000	2001	2002	2003	2004	2005	2006	2007
CV	41.42%	43.93%	44.62%	45.94%	45.86%	48.37%	48.66%	49.94%
	2008	2009	2010	2011	2012	2013	2014	
CV	48.70%	48.09%	47.12%	45.87%	44.80%	45.36%	44.36%	

Source: own calculations based on Eurostat (2016)

In order to evaluate the usability of the Pareto chart method for evaluating the development of regional disparities, the findings will be confronted with the results of

the disparities measurement through σ -convergence, namely by monitoring the development of the coefficient of variation. For the purposes of this paper there appears from the four abovementioned directions, the use of σ -convergence, as the “benchmark” method, seeming the most suitable because β -convergence is a formally necessary, but not sufficient, condition for σ -convergence (Monfort, 2008; Islam, 2003), while in comparison to the analysis of the distribution by using non-parametric estimates and econometric methods, it is a very simple and easily interpretable method, not necessary to extensively delimit now. The coefficient of variation is then chosen because of its good information value, comparability and customary use in solving disparities development by using the variability in many relevant studies (Zdražil, Applová, 2016; Monastiriotis, 2013; Marzinotto, 2012; Monfort, 2008).

In addition, we have to point out that since the evaluation of regional disparity based on Pareto chart is new and not yet known idea, no other similar studies of regional disparities were found in the literature. Hence, we are not able to provide any broader discussion of alternative methodological approaches and results gained by other Pareto chart applications.

3 Results and discussion

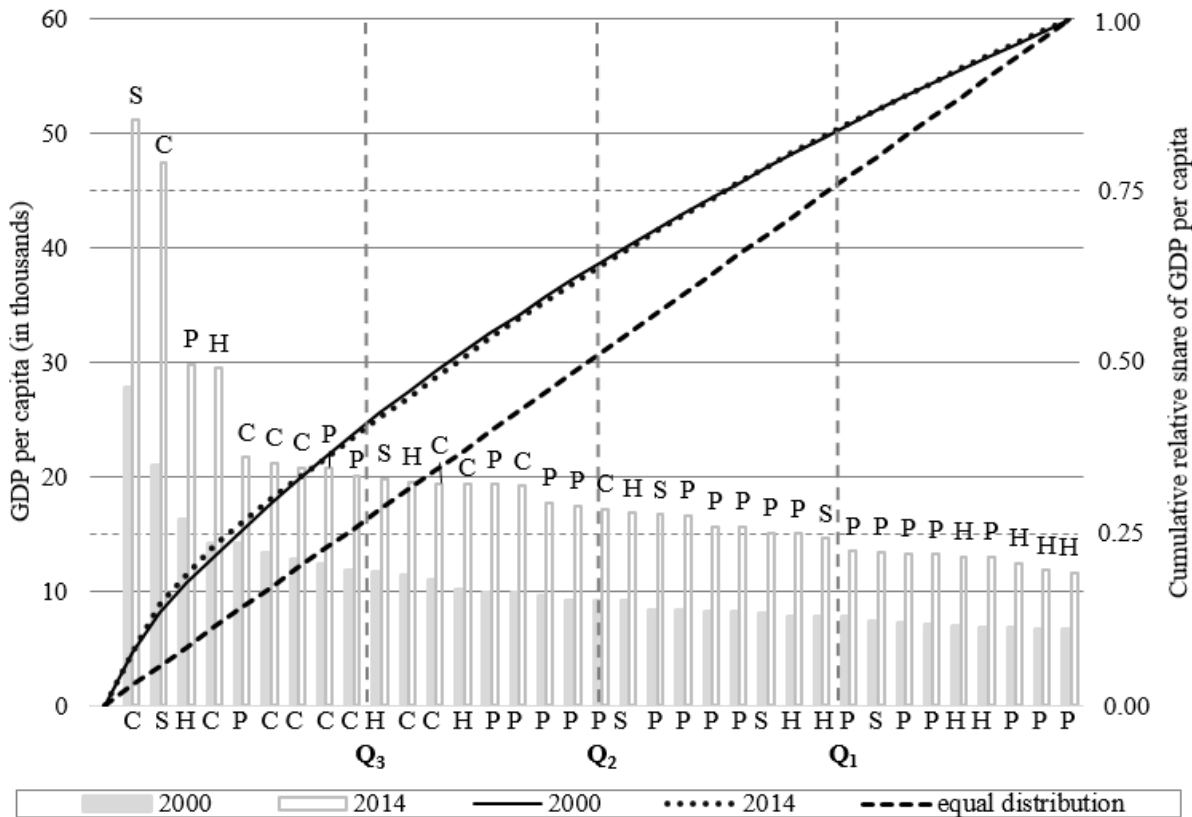
Disparities development in GDP per capita of regions in the Visegrad Group (V4) countries in the period 2000-2014 is shown in Fig. 1. Already at first sight it is clear, that thanks to the lines expressing distribution through the cumulative relative GDP per capita, the extent of regional disparities when comparing the years 2000 and 2014 has not change so much, when their deviation from the line of equal (uniform) distribution (black dashed) remained approximately at the same level. The area between the lines of equal distribution and real distribution can be marked as the range of disparities, or it is equal to the Gini coefficient, which can also be used as one of the methods of evaluating disparities in terms of σ -convergence approaches. The differences in regions disparities located between individual quartiles (Q) can be easily read from the curves and these differences are mostly very similar in both years being compared. There is a higher deflection of the curves between the most developed region and Q₃, as well as clear evidence of a relatively higher range of disparities among the regions with higher GDP per capita between Q₃ and Q₂. Furthermore, there is a convergence of both lines to the line of equal distribution in the Q₂ and Q₁ range, as well as in the lower quartile (between Q₁ and the least developed region) which is the sign of a relatively lower range of disparities between the less developed regions.

From the comparison of lines in the real distribution of GDP per capita, it can then be easily deduced that while the disparities ranging in the lower half of the sample remains unchanged because of the practically identical shape of the curves in both reference years, there were some changes in half of the developed regions (between the most developed region and Q₂) that are rather obvious even though they are based on visual inspection. Specifically, due to higher deflection (black dotted) line, which expresses disparity in 2014, it being clear that the disparities range between the most developed regions is higher in comparison with 2000 (full black line). Likewise, it is obvious that this trend is then reversed when the curve of the year 2014 converges to the curve of the equal distribution and is closer than the curve of the year 2000, while this reduction in the range of disparities is most noticeable between Q₃ and Q₂. In addition, we can even think about another reversion in this trend since it seems that the

2014 line crossed (slightly) the 2000 line for the bottom of our sample which indicates (very low) increase in the range of disparities among the least developed regions.

The absolute values of regional GDP per capita, shown in the diagram in columns, confirm these findings. The differences between the values of (colorless) columns that represent 2014 as compared to the (grey) columns in 2000 are more pronounced at first glance among the most advanced regions. Likewise, it can be concluded that disparities among regions in the Q₃ and Q₂ range relatively decreased due to GDP growth while the distribution changes are barely visible in the regions located between the median (Q₂) and the least developed region. Although it is possible to assume from visual comparison in this case that the absolute differences are slightly higher, when considering the growth factor, which is also evident from the diagram, it is obvious that the change of disparities range will be practically minimal in a relative statement. Just the information about changes in the GDP values is such a major benefit, which allows the inferring of more complex conclusions from a Pareto chart about regional development, not only of changes in disparities, but also in terms of changes in economic performance, or lost growth. The diagram also shows that the deviation of the four most developed (metropolitan) regions significantly grew from other ones.

Fig. 1: The Pareto chart of disparities in GDP of the V4 regions (2000 and 2014)



Notes: columns express the GDP per capita in 2000 and 2014 (C – Czech, H – Hungarian, P – Polish, S – Slovak regions; lower letters refer to 2000, upper letters to 2014); full line indicates the cumulative relative share of GDP per capita in 2000; dotted line analogically for 2014; dot-dashed line represents an equal distribution of GDP per capita among all regions; Q₁, Q₂ and Q₃ indicate quartile borders.

Source: own calculations based on Eurostat (2016)

As shown in Fig. 1, it is clear when evaluating a lower number of regions, that it is possible to monitor changes in disparities within the partial groups to a certain extent. For this issue the color resolution of columns is most appropriate. However, due to the

black and white color scheme that is available for figures in this journal, we provide only letter descriptions in our diagrams which is less appropriate because it does not allow to utilize the full potential of visualization capability. In terms of the development of regional disparities within each country, it is possible, due to significantly diversified growth, to quite safely state that between 2000 and 2014 there was a divergence between the regions of Slovakia (S). The changes in position within the sample and acquisitions of different size are less obvious for other countries, and therefore it is not possible to derive reliable conclusions for the development of their internal disparities. Furthermore, it is possible to see that Slovak regions are associated more with higher growth, causing their movement to the left in the diagram, or towards the developed regions. Similar tendencies are also evident with Polish regions (P). The opposite tendencies, or the fall in ranking, are again visible in Hungarian regions (H), four of them located among five of the least developed regions in 2014. Downward tendencies are also visible in some Czech regions (C), even though they all were located in the middle of more developed regions in 2014.

In two following sub-sections we will split our interval and focus on two sub-periods i.e. 2000-2007 and 2007-2014. This is due to confirm that Pareto chart is a valuable tool to monitor the changes in regional disparities. Since we provided detailed description of Pareto chart in this section, we will comment the following sub-periods only in brief. Of course, conclusions changes but the principles remain the same. In addition, one should assume that results of the late period would be different, since regions experienced economic crisis during that time. We welcome this fact, because it allows us to show applicability of Pareto chart on various periods of economic cycle. However, our objective is to demonstrate the applicability of chart, not to examine the reasons for development of regional disparities patterns. Hence we will focus on the aim and not to discuss the impacts of economic crisis or other factors on our results.

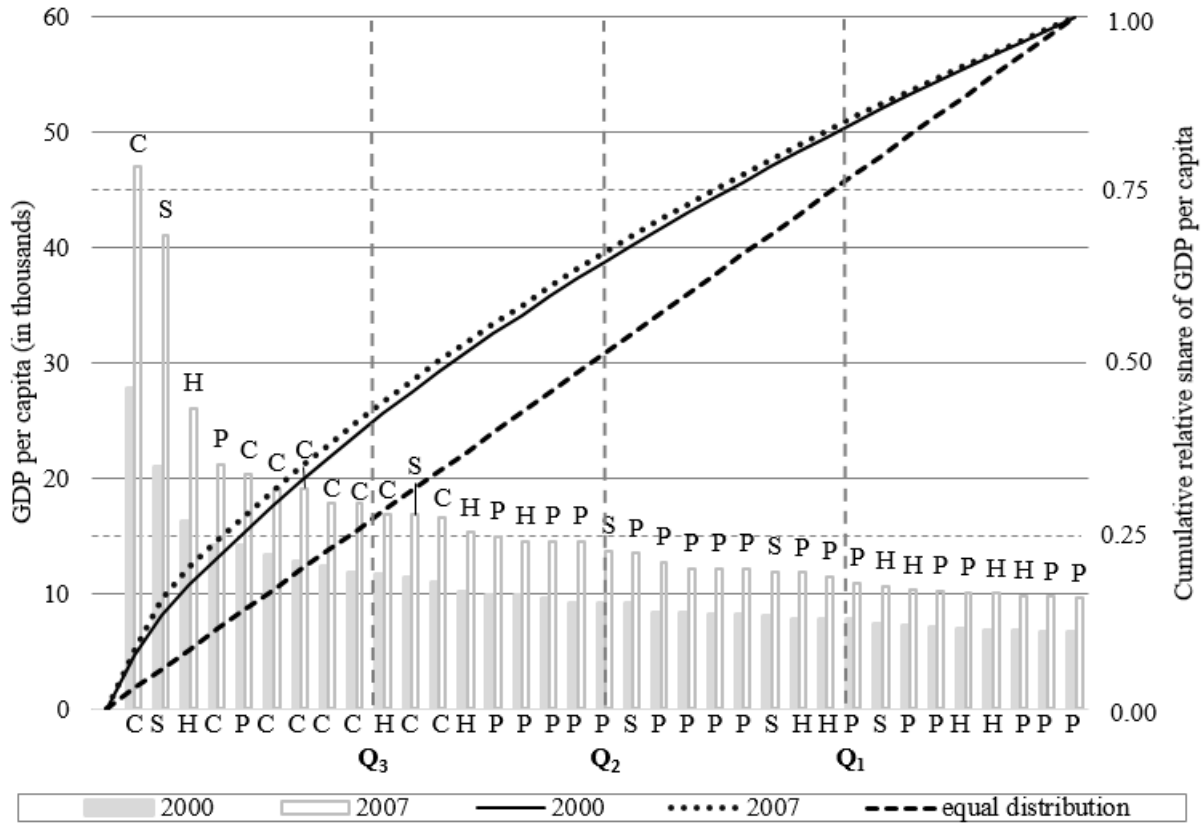
3.1 Application of Pareto chart on sub-period of 2000-2007

The Pareto chart applied on the sub-period of 2000-2007 is shown in Fig. 2. In this case again, thanks to the lines expressing distribution through the cumulative relative GDP per capita, increase in regional disparities is seen at the first sight. This is due to higher deflection of (black dotted) line which expresses disparity in 2007 vis-a-vis the line of 2000 (full black). Based on the course of 2007 line one can suggest that disparities increased rapidly between the most developed region and Q_3 . This change is followed by a convergence between the lines in their following course. This development indicates decrease in GDP per capita disparities among the other regions of Visegrad Group countries, i.e. between Q_3 and the least developed region.

The interpretation of change in columns between 2000 and 2007 confirms the results based on the line graphs, i.e. largest increase in disparities is obvious among the most developed regions (between that most developed and Q_3). In particular, the capital regions of the Czech Republic, Slovakia and Hungary experienced pretty large growth (three highest columns in 2007). In the following sample sections, the changes in the range of disparities are less visible and hence hard to interpret. In the terms of disparities within particular countries, we can assume that Slovak regions (S) seem to diverged since it is possible to see that the gaps in per capita GDP between Slovak regions are larger. Besides, Slovak regions are associated more with higher growth, causing their movement to the left in the diagram, or towards the

developed regions (which is similar to conclusions about changes between 2000 and 2014). The disparities between the Czech regions (C) seem to remain more or less similar except one (capital region) which grew largely. Based on this fact we can assume disparities between the Czech regions increased. By focusing on Hungarian regions (H) one can suppose some increases in range of disparities as well. This is due to slower growth of the less developed Hungarian regions for one side (4 of them were situated in the lower quartile of all Visegrad Group regions in 2007), and for the other side higher growth of remaining 3 regions. In the case of Polish regions (P), it is hard to develop any qualified conclusions based on their columns in Fig. 2.

Fig. 2: The Pareto chart of disparities in GDP of the V4 regions (2000 and 2007)



Notes: see notes below Fig. 1, symbols hold here analogically for 2000 and 2007.

Source: own calculations based on Eurostat (2016)

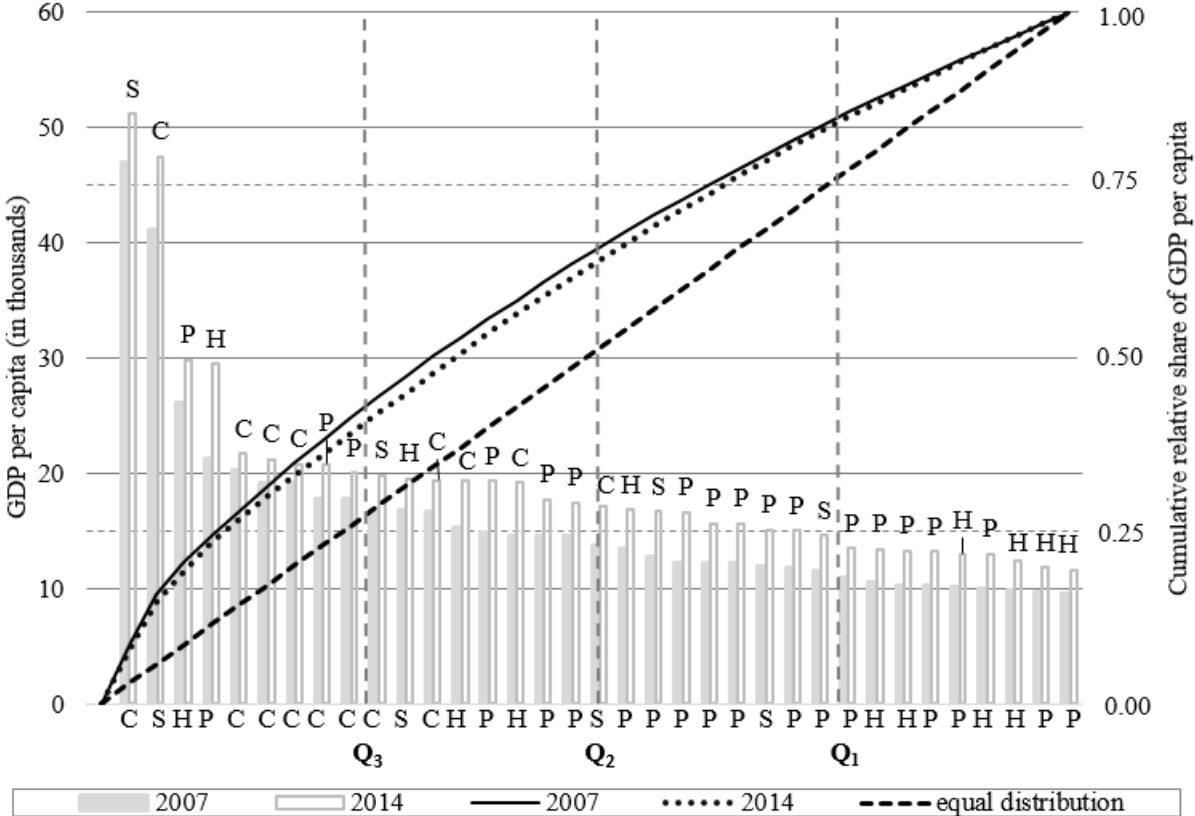
In a summary, based on the Pareto chart we can suggest the regions of Visegrad Group diverged in general between 2000 and 2007. This change has been caused due to divergence among the most developed regions while the diagram suggests that the rest of our sample (between Q₃ and the least developed region) rather converged. Besides the changes in columns graph seem that in the terms of particular countries the Czech Republic, Hungary and Slovakia experienced rather divergence as well.

3.2 Application of Pareto chart on sub-period of 2007-2014

Fig. 3 shows the application of Pareto chart on sub-period of 2007-2014. Over and over again, the first look is enough to draw some general conclusions about the change in range of disparities between examined years. The disparities in GDP per capita of the Visegrad Group regions decreased since the deflection of 2014 (dotted) line is lower than that of 2007 (full) line. Hence, we can suggest that regional disparities decreased in general. Nevertheless, by examining the sections delimited by quartiles

we can see that some signs of convergence are obvious among the more developed regions (upper half), nay but among the less developed (lower half). The evidence for this is found in courses of both lines since they rather diverge among the upper half regions (i.e. range of disparities decreases since the gap to the equal distribution line is lower) and rather converge among that lower (i.e. the dotted line diverges from the equal distribution line or converges to the full line, respectively; which means the range of disparities rather increases in this sub-sample).

Fig. 3: The Pareto chart of disparities in GDP of the V4 regions (2007 and 2014)



Notes: see notes below Fig. 1, symbols hold here analogically for 2007 and 2014.

Source: own calculations based on Eurostat (2016)

The columns graph shows convergence between the Q₃ and Q₂ since it is obvious that the relative gaps among the regions are lesser in 2014 vis-a-vis 2000. The changes in other particular sections of our sample are not predicative enough, so we cannot argue about changes in range of disparities for them. This is due to relative lower increase in the absolute GDP per capita values which result in low number of “well-visible” changes in our sample. From the last point of view, we can say that the gaps in GDP per capita among the Czech regions (C) seem relatively lower which indicates convergence among Czech regions. Furthermore, one can assume that range of disparities among the 3 regions of Slovakia (S) remained similar but, the capital region experienced higher growth which could result to change in the range of disparities among Slovak regions (one may guess the disparities increased but the outlyiness of capital region makes the interpretation harder).

3.3 Validation of results through σ -convergence

As mentioned before, to evaluate the relevance of the conclusions arising from the visual evaluation of the disparities development through the Pareto chart,

the coefficient of variation is used, which falls within the so-called σ -convergence approaches. The results of the analysis of regional disparities development of the Visegrad Group (V4) through this approach are presented in Tab. 2.

Tab. 2: σ -convergence - disparities in GDP of the V4 regions (2000, 2007 and 2014)

	2000	2007	2014		2000	2007	2014
V4	41.42%	49.94%	44.36%	V4	41.42%	49.94%	44.36%
Q4 to Q3	31.00%	40.33%	39.01%	CZ	36.28%	43.97%	39.71%
Q3 to Q2	8.93%	7.17%	5.10%	HU	32.85%	39.40%	36.73%
Q2 to Q1	5.51%	5.72%	5.52%	PL	20.87%	21.90%	24.58%
Q1 to Q0	4.68%	3.95%	5.17%	SK	49.41%	56.56%	58.30%

Source: own calculations based on Eurostat (2016)

Let us follow the paper structure and start with validation of our conclusion developed for the changes between 2000 and 2014. Within all regions of the Visegrad Group it is noticeable that actually there is only little change in the range of disparities (from 41.42% to 44.36%). In terms of development within individual sections bordered by quartiles it is then confirmed that indeed there was the most dramatic increase in disparities – 8 percentage points (pp) – among the most developed regions, while there was some decrease (by about 3.8 pp) in the regions between Q₃ to Q₂ vis-a-vis. At the same time, the conclusion of the same extent of disparities in the half of less developed regions has been confirmed since in the Q₃ to Q₂ range there was virtually no change recorded, and the change among the least developed regions reached only 0.5 pp. In the context of countries, the conclusion about a change in range of regional disparities among Slovak regions has been acknowledged by the σ -convergence. It is evident that the value of its variation coefficient increased from 49.41% to 58.30%. Changes in other countries are then indeed minimal, or up to 4 pp among regions of the Czech Republic, Hungary and Poland, which further confirms the presentation of the visual evaluation of disparities based on the Pareto chart.

Now we approach to the first sub-period i.e. 2000-2007. We can see there is higher change in the range of disparities (from 41.42% to 49.94%) by all the regions of Visegrad Group countries. In addition, the coefficients of variation confirm that disparities increased between the most developed region and Q₃ (by about 10 pp), while rather converged in the other ranges – Q₃ to Q₂ by about 1.8 pp; Q₁ to the least developed region by about 0.7 pp. For the range between Q₂ to Q₁ the measurement indicates virtually divergence (by about 0.2 pp) but, it is pretty clear that such a minimal difference cannot be tracked by the limits of human eyesight. Besides, we developed some conclusions about changes in ranges of disparities within particular countries as well. We assumed divergence in all countries except Poland, where we couldn't find unambiguous results. We found our estimates to be consistent with the results of σ -convergence measurements since the range of disparities increased as follows, according to the coefficients of variation: from 36.28% to 43.97% for the Czech Republic, 32.85% - 39.40% for Hungary and 49.41% - 56.56% for Slovakia.

The Pareto chart results of the sub-period 2007-2014 can be considered as confirmed as well. The disparities of whole sample decreased from 49.94% to 44.36%. The overall decrease in range of disparities happened due to convergence among the regions of upper half regions. The coefficients of variation found reduce in disparities between the most developed region and Q₃ (by about 1.3 pp) and in the range between Q₃ to Q₂ (by about 2.1 pp). At the same time, the results found virtually stable range of

disparities between the regions from Q_2 to Q_1 – decrease by about 0.2 pp, and increase of disparities in the lower quartile (by about 1.2 pp). In terms of countries, we can confirm reducing in range of disparities among the Czech regions – by about 4.3 pp. The ranges of disparities in other countries changed as well but by about half as much.

Conclusion

The intention of this article was to show the possibilities of the alternative evaluation of the development of regional disparities, whose credible quantification is the alpha and omega of every modern regional policy. As a possible contribution to the filling of a certain “vacuum” between nowadays conventionally used trivialities, but information-sparse attitudes, and vice versa highly sophisticated, but also demanding and more difficult to interpret approaches for measuring disparities, there was introduced the method called Pareto chart. The aim of the paper was to demonstrate and assess its usefulness for the evaluation of the development of regional disparities.

Due to the above-discussed facts it can probably be said that the comparison of the conclusions about the development of disparities based on the Pareto chart analysis and the results of the disparities analysis made with σ -convergence access clearly confirmed that a Pareto chart can be used as a sufficiently qualified tool to evaluate the development of regional disparities, which joins the advantages of simplicity and ease of interpretability, while retaining information useful for sub-base analysis of the causes of the development of these disparities in terms of changes within the sample of regions. The developed conclusions based on the Pareto chart was not in any way inconsistent with the results obtained through the σ -convergence approach. Even though we examined three different situations – including both convergence and divergence processes, we found the estimates based on Pareto charts confirmed in virtually every case. Moreover, the diagram displays other useful information such as growth, extreme values, and even changes in the positions of specific regions. Thanks to these parameters, it is possible on the base of this chart to attain a more comprehensive view of regional development within a particular territorial unit.

However, it must also be noted that the assessment of regional disparities using Pareto chart could mean certain difficulties arising from visual assessment. There can be designated opacity that is predictable while assessing multiple periods within a single field of the graph. Another limitation of interpretation, closely related to the imperfections of the human eye, is the very difficult identifiability, or non-identifiability, of very small changes. The question is how important are such relatively small changes when drawing conclusions about the development of disparities. However, it can be stated that larger changes are easier to catch and interpret via Pareto chart. Considering this, it would be usually better to apply the chart on larger period where one can expect some higher changes in development of examined indicators. Furthermore, we guess that the color resolution of columns is most appropriate for the presentation of Pareto chart. It should also be noted that the diagram is a tool for assessing the development of disparities, but not a tool to quantify its extent. In more complex analyses it would undoubtedly be appropriate to add one of the other methods, whose ambitions lie precisely in estimating values.

To conclude, it is a very interesting alternative assessment of regional disparities, which undoubtedly has, either individually or as a suitable complement to another technique, a potential usefulness not only in professional scientific studies, but may

with clarity via graphical interpretation be understandable enough to inexpert audiences from different disciplines, decision makers from within the political-bureaucratic apparatus, and also the broad professional and unprofessional public.

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