

## Continuity of Demarcation Process of the Regions for Concentrated State Support

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### Anotace

Článek analyzuje kontinuitu procesu vymezování českých regionů (NUTS 4) se soustředěnou podporou státu. Smyslem této podpory je redukovat negativní disparity mezi jednotlivými regiony. Proces vymezování regionů zahrnuje kritéria výběru jako míra nezaměstnanosti, počet uchazečů o práci na jedno pracovní místo, daně z příjmu, počet soukromých podnikatelů a kupní síla. Tato kritéria a jejich váhy se v průběhu 20 let měnily.

V tomto článku jsou analyzovány změny používaných kritérií a jejich vah v letech 1991 – 2010. Pro tuto analýzu a především pro analýzu vah kritérií jsou použity dvě různé metody - Analytický hierarchický proces a Analytický síťový proces. Těmito metodami jsou váhy kritérií syntetizovány a výsledky ukazují kontinuitu procesu výběru regionů i přes změny hodnocení v různých obdobích.

### Klíčová slova

Vícekritériální rozhodování, Analytický hierarchický proces (AHP), Analytický síťový proces (ANP). Regiony se soustředěnou podporou státu.

### Abstract

The paper analyses the continuity of the demarcation process of Czech regions for the state support. This support aims to reduce negative disparities among the regions. The process of demarcation of the region includes criteria as an unemployment rate, number of applicants per one job vacancy, income tax rate, number of private entrepreneurs and purchasing power. These criteria and weights of these criteria have been changed during the last 20 years.

The main aim of this paper is the analysis of the criteria set and the criteria weights modification during the years 1991 – 2010 and the examination of the modification of values of the criteria weights using two different methods - Analytic Hierarchy Process and Analytic Network Process. These methods are used for synthesis of the criteria weights, which shows the continuity of the region demarcation process during its modification in time.

### Key words

Multi-criteria Decision Making, Analytic Hierarchy Process (AHP), Analytic Network Process (ANP). Regions with Concentrated State Support.

### Introduction

State support of the disadvantaged areas within the European Union has to promote the economic development. This kind of the state aid is known as national regional aid. According to the guidelines of the European community the Government and the Ministry for Regional Development and Ministry of Industry and Trade, Czech Republic demarcate regions for concentrated state support. The regions

with concentrated state support are divided into three subcategories: structurally challenged regions, economically weak regions and regions with high unemployment. The characteristics of the regions are negative features of structural changes, lower economic level and unemployment exceeding the state unemployment average. From a general point of view, they are less developed in many socio-economic indicators. The state support endeavours to reduce negative

disparities among these regions (Standing 1996).

Regions, their disparities, advantages and disadvantages are studied by many authors (Standing, 1996, Abrahám, 2007, Viturka et al, 2011). Many authors also deal with the process of the demarcation of disadvantaged regions or in evaluation of regions from various points of view; they apply different approaches and criteria of the regions evaluation and comparisons as well as different exact (mathematical) methods used for this evaluation (Klufová et al, 2010, Nevima, Ramík, 2009, 2010, Varivoda et al, 2010, Vostrá Vydrová et al, 2011, Kloudová, 2009, Kloudová, Chwaszcz, 2012) but nobody analyses the used criteria and weights and their changes over time.

Governmental selection process used in the Czech Republic was the subject of modifications during the years 1991 - 2010. The first document dealing with the general issue of regional development after the year 1989 was the Government Resolution No. 481 of 20<sup>th</sup> November 1991; it considered the fundamental problems of economic and social development of territorial units and defining priorities for regional policy in the Czech Republic. Government Resolution No. 235 of 8<sup>th</sup> April 1998 "Principles of regional policy of the Government of the Czech Republic" abolished the previous Government Resolution on this issue and confirmed the breakdown of regions with concentrated state support to structurally affected regions and economically weak regions.

Government Resolution No. 682 from 12<sup>th</sup> July 1999 "The Regional Development Strategy of the Czech Republic" included a strategic vision for regional development till 2010, with detailed breakdown of tasks by 2003. Its annex "Types and definition of regions with concentrated state support" has created a new tool for their establishment and minimized the influence of subjective factors and influences. Methodologies for the definition of problematic regions were selected based on the system of input parameters different for structurally affected regions and economically weak regions.

An organizational change came in 2002. According to the Act No. 47/2002 Collection of Law, the regional business support transferred from the Ministry of regional development to the Ministry of industry and trade.

According to its policy statement, on the 16<sup>th</sup> of July 2003 the Government adopted

the Resolution No. 722 on the definition of regions with concentrated state support for the period 2004 - 2006. The next update is consistent with the new programming period of the European Union beginning in 2007. Annex to this Resolution updated the set of indicators for structurally affected and economically weak regions. In addition, it introduced a new category of regions with far above-average unemployment.

The selection of regions for concentrated state support for the years 2007-2013 was established by Government Resolution No. 560 of 17<sup>th</sup> May 2006 "Regional Development Strategy of the Czech Republic". Under this Resolution there remains a breakdown to structurally affected regions, economically weak regions and regions with highly above-average unemployment.

The governmental process of demarcation of the region includes criteria as an unemployment rate, number of applicants per one job vacancy, income tax rate, number of private entrepreneurs and purchasing power. The criteria values are from the databases of the Czech Statistical Office and weights of these criteria have been set by the government.

The main aim of this paper is the analysis of the used criteria and their weights modification during the years 1991 – 2010. The synthesis of the criteria weights based on the previous data are calculated using the AHP and ANP method. Comparisons of the received results show the continuity of the region demarcation process during its modification in time.

## **Materials and methods**

The demarcation of the disadvantaged regions required establishing such methodological procedures that would eliminate a subjective approach. In the year 1999 the initial outlines were given by the above-mentioned „Principles of regional policy of the Government of the Czech Republic”.

### **Demarcation of the structurally affected regions**

Structurally affected regions were defined according to the following four criteria. The values of each criterion in the given region were transformed into proportional coefficients, with the higher value representing the worth situation. These coefficients were aggregated using the weights set

Proportion of employment in industry	Number of entrepreneurs	Development of employment in industry	Unemployment		
0.3	0.1	0.2	0.4		
			Long-term unemployment	Unemployment	Demand of the job
			0.3	0.4	0.3
Global weights					
0.3	0.1	0.2	0.12	0.16	0.12

Source: own processing

Table 1: Criteria weights for the demarcation of structurally affected regions (SRR 2000).

Tax revenue	Population density	Average wage	Proportion of employment in agriculture, forestry and fishing	Development of employment in agriculture, forestry and fishing	Unemployment		
0.1	0.1	0.15	0.2	0.15	0.3		
					Long-term unemployment	Unemployment	Demand of the job
					0.3	0.4	0.3
Global weights							
0.3	0.1	0.15	0.2	0.15	0.09	0.12	0.09

Source: own processing

Table 2: Criteria weights for the demarcation of economically weak regions (SRR 2000).

Unemployment		
Long-term unemployment	Unemployment	Demand of the job
0.3	0.4	0.3
Global weights		
0.3	0.4	0.3

Source: own processing

Table 3: Criteria weights for the demarcation of regions with far above-average unemployment (SRR 2000).

by the Government. The analysis was carried out till 2006. The criteria and their weights are presented in Table 1 (DVS 2009, SRR 2000).

### Demarcation of the economically weak regions

Economically weak regions were selected according to the specific set of criteria (Table 2). The values of each criterion in the given region were again transformed into proportional coefficients. The coefficients were aggregated using the weights set by the Government. The analysis was carried out for the period till the year 2006. The applied set of the criteria and weights is presented in Table 2

(DVS 2009, SRR, 2000).

### Demarcation of the regions with far above-average unemployment

The regions with far above-average unemployment were firstly defined in 2003 only from the unemployment point of view. The values of each criterion in the given region were transformed into proportional coefficients, with the higher value representing the higher unemployment. The coefficients were aggregated using the weights set by the Government. The analysis was carried out until 2006.

Tax revenue	Number of entrepreneurs	Purchasing power	Unemployment		
0.15	0.15	0.3	0.4		
			Long-term unemployment	Unemployment	Demand of the job
			0.3	0.4	0.3
<b>Global weights</b>					
0.15	0.15	0.3	0.12	0.16	0.12

Source: own processing

Table 4: Criteria weights for the demarcation of disadvantaged regions after 2006 (DVS 2009).

In the Table 3 there are the used criteria and their weights (DVS 2009, SRR 2000).

### Changes of process of regions demarcation in 2006

During the year 2006 the process of selection of the regions for concentrated state support was transformed. The set of the applied criteria was changed as well as the weights of individual criteria. The process is now unified and based only on four criteria and three sub-criteria.

The statistical values of each indicator in the regions were also recalculated into the appropriate relative weighting and the calculation was done under the following principle: the higher value of a coefficient, the worse situation in the region. And again, the coefficients were aggregated using the weights set by the Government. The following criteria (Table 4) were included in a selection process of regions (DVS 2009, SRR 2000).

### Multiple criteria methods used for the analysis

The above described process for the selection of the regions represents specific multiple criteria problems. These problems are solved by the Government of the Czech Republic using simple additive weighting method with the data from the statistic databases and politically set weights, but this weights are changed during the time.

In this paper the multiple criteria decision-making methods were also used for the analysis of continuity of this process, mainly of the consistency of the criteria set and their weights. In particular, we chose the Analytic Hierarchy Process (AHP) and the Analytic Network Process (ANP).

The AHP is a method which derives global

preferences from partial preferences that represent relative measurements of the hierarchical dependences of decision elements (Saaty, 1980, 1999, 2006). It is generalized by the ANP method (Saaty, 2001, 2003) which does not require independence among decision elements and therefore incorporates more complex relations.

- Analytical Hierarchical Process

Problem hierarchy construction is the first step of the AHP which describes the simple linear dependency among the elements.

Local weights are calculated using pairwise comparisons in the second step of the AHP. The consistency of these judgements has to be controlled.

In the third step the best alternative selection is based on synthesis of the weights throughout the hierarchy.

- Analytical Network Process

The first step of ANP is based on the creation of a control network which describes dependency among decision elements. The ANP allows inner dependence within a set (clusters) of elements, and outer dependence among different sets (clusters).

In the second step pairwise comparisons of the elements within the clusters and among the clusters are performed according to their influence on each element in another cluster or elements in their own cluster. So the ANP prioritizes not only decision elements but also their groups or clusters as is often the case in the real world. The consistency of these comparisons has to be controlled.

The third step consists of the supermatrix construction. The priorities derived from the pairwise comparisons are entered

into the appropriate position in this supermatrix. This supermatrix has to be normalized using clusters weights.

In the fourth step the limiting supermatrix is computed and global preferences of decision elements are obtained. These preferences serve as the best decision selection or for the purpose of analysis of preferences of decision-making elements.

The Super Decisions software system (<http://www.superdecisions.com/>) was used for calculation of following AHP and ANP models. The program was written by the ANP Team working for the Creative Decisions Foundation.

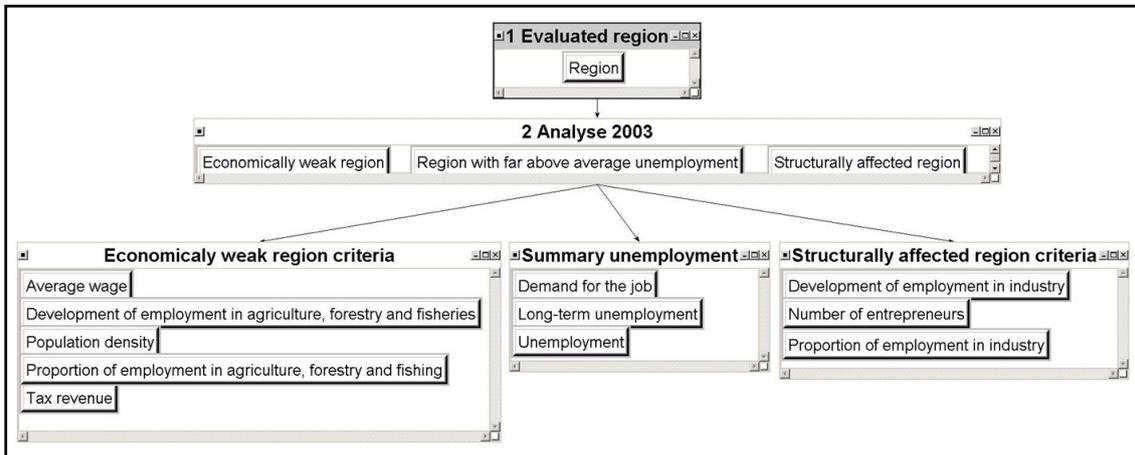
These methods were selected because a decision

structure had to consist of all the criteria involved in the regions characteristics which had been mentioned earlier and because there were many existing dependencies among the criteria. The AHP and ANP models used in these analyses are described in the following sections.

**Analytic Hierarchy Process model**

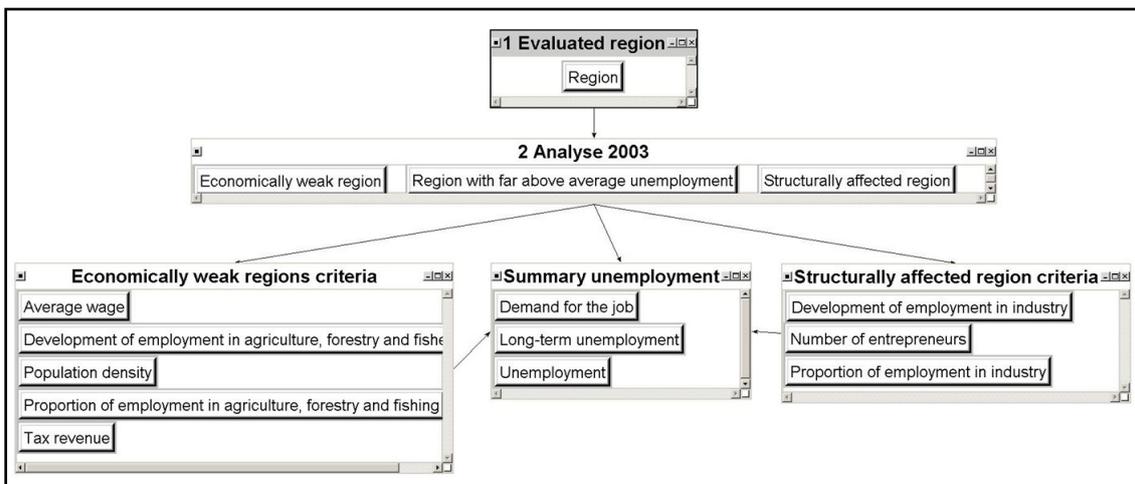
In the first analysis of criteria weights the AHP method was used.

- Problem hierarchy (Figure 1) has the following levels and elements:
  - The first level represents the goal, e.g. the supported region selection according to the criteria weights,



Source: own processing

Figure 1: AHP hierarchy (authors using Super Decisions).



Source: own processing

Figure 2: ANP network (authors using Super Decisions).

- The second level includes all three types of regions according to the analysis from the year 2003,
- The third level includes the groups of criteria, and
- The fourth level includes all criteria.
- Local priorities or preferences were set according to the government policy. Missing information (for instance the weights of different types of regions) were set equally, because the region can be selected by all possible ways.
- The consistency of these judgments was controlled.
- Synthesised weights of decision criteria obtained in the third step of the AHP were then used for a continuous analysis of the whole region selection process.

**Analytic Network Process model**

The second analysis was made using the ANP method:

- The first step of ANP was based on the creation of a control network which described the inner and outer dependency among used criteria.
- For our analysis we augmented the AHP

hierarchy by outer dependencies between criteria which can describe the situation of unemployment from a different point of view.

- Local weights were used as in the AHP model; the added dependencies were estimated according to the expert judgment of the experts from the Department of Economics.
- The super-matrix was constructed and limiting super-matrix was computed to obtain the global criteria weights which were then analysed.

**Results and discussion**

The analysis of the modification of the criteria and their weights, the investigation of continuity or discontinuity of the selection process of the regions for concentrate state support is based on the dependencies in the initial criteria structure. Using the AHP and ANP methods we synthesised the initial weights and compared them with newly applied criteria weights. The AHP and ANP methods were used because they include the interrelations among groups of criteria, their dependencies.

Using Super Decisions software we can graphically describe criteria dependencies in the evaluation processes of the regions with the concentrate state

WEIGHTS	Weights set by the government (1996, 2000)			Authors analysis	Weights set by the government (2003)
	Economically weak region	Region with far above average unemployment	Structurally affected region	AHP analysis	Regions with Concentrated State Support - 2006
Tax revenue	0.1			<b>0.03</b>	<b>0.15</b>
Population density	0.1			<b>0.03</b>	
Proportion of employment in agriculture, forestry and fishing	0.2			<b>0.07</b>	
Average wage	0.15			<b>0.05</b>	
Development of employment in agriculture, forestry and fisheries	0.15			<b>0.05</b>	
Proportion of employment in industry			0.3	<b>0.10</b>	
Number of entrepreneurs			0.1	<b>0.03</b>	<b>0.15</b>
Development of employment in industry			0.2	<b>0.07</b>	
Long-term unemployment	0.09	0.3	0.12	<b>0.17</b>	<b>0.12</b>
Unemployment	0.12	0.4	0.16	<b>0.23</b>	<b>0.16</b>
Demand for the job	0.09	0.3	0.12	<b>0.17</b>	<b>0.12</b>
Purchasing power					<b>0.3</b>

Source: own processing

Table 5: The AHP comparison of the criteria weights.

support. The initial systems of evaluation criteria of the regions and their weights were described in Table 1, Table 2 and Table 3 (see above).

The new system of criteria used from the year 2006 consists of the previous criteria covering

the unemployment characteristic of the regions and three other criteria; the criteria “Tax revenue” and “Number of individual entrepreneurs” were already used for the evaluation but not for all regions and the criterion “Purchasing power of people” is new one (Table 4).

Unweighted Supermatrix		1 Evaluated region			2 Analyse 2003				Economically weak regions criteria				Structurally affected region criteria			Summary unemployment		
		Region	Economically weak region	Region with far above average unemployment	Structural affected region	Tax revenue	Population density	Proportion of employment in agriculture, forestry and fishing	Average wage	Development of employment in agriculture, forestry and fisheries	Proportion of employment in industry	Number of entrepreneurs	Development of employment in industry	Long-term unemployment	Unemployment	Demand for the job		
1 Evaluated region	Region																	
2 Analyse 2003	Economically weak region	0.33																
	Region with far above average unemployment	0.33																
	Structural affected region	0.33																
Economically weak regions criteria	Tax revenue		0.1															
	Population density		0.1															
	Proportion of employment in agriculture, forestry and fishing		0.2															
	Average wage		0.15															
Structurally affected region criteria	Development of employment in agriculture, forestry and fisheries		0.15															
	Proportion of employment in industry				0.3													
	Number of entrepreneurs				0.1													
Summary unemployment	Development of employment in industry				0.2													
	Long-term unemployment		0.09	0.3	0.12		0.4	0 / 0.7	0.4	0.4		0.4						
	Unemployment		0.12	0.4	0.16		0.6	0 / 0.3	0.2	0.6		0.2						
	Demand for the job		0.09	0.3	0.12				0.4			0.4						

Source: own processing

Table 6: Not weighted super-matrix of the ANP analysis.

**Analysis of the criteria and their weights by AHP method**

Firstly, the criteria weights were analysed by AHP methods. The criteria hierarchy is presented in Figure 1 and the criteria weights are in Table 1, Table 2 and Table 3.

We suppose the equal weights of all hierarchy elements except the known weights. Using Super-Decisions, we obtained the following result of the analysis (Table 5).

In the Table 5 only five highlighted criteria are those that have nonzero weights in the new region selection process and in synthesis made by the AHP method also. These results seem to show an important discontinuity in the region evaluation process because non-zero weights were calculated for all criteria used in the past. It would mean that the set of criteria used in past was different from the set of the criteria newly used. We expected this result because this way of the weights analysis does not include the evident cross dependencies among the criteria characterizing the unemployment and their relations.

**Analysis of the criteria and their weights by ANP method**

The set of criteria are now analysed including network dependencies by the ANP methods. The dependencies among the criteria and

the pairwise comparisons of these criteria are based on the discussions with the experts from the Department of Economics. The set of criteria were split into three clusters. The connections describe all dependencies among the criteria which are very important for this evaluation. We added the outer dependencies between criteria describing the situation of unemployment. Figure 2 shows this criteria network for comparing the original weights and weights which are used now.

The unweighted supermatrix gives a good impression of used connections and their weights. We used two different data.

- The analysis **ANP 1** uses the weights in Table 6. The preferences of the Long-term unemployment and the Unemployment in view of Average wage were not considered; therefore these weights are equal to 0.
- The analysis **ANP 2** examines the results obtained by adding a new group of interrelations. The preferences of the Long-term unemployment (with weight 0.7) and the Unemployment (with weight 0.3) in view of Average wage were added.

The results of both analyses can be seen in Table 7. The analysis **ANP 2** presents high continuity in the process of region evaluation. The initial

WEIGHTS	Weights set by the government (1996, 2000)			Authors analysis		Weights set by the government (2003)
	Economically weak region	Region with far above average unemployment	Structurally affected region	ANP analysis 1	ANP analysis 2	Regions with Concentrated State Support - 2006
Tax revenue	0.1			<b>0.03</b>	<b>0.03</b>	<b>0.15</b>
Population density	0.1			<b>0.03</b>	<b>0.03</b>	
Proportion of employment in agriculture, forestry and fishing	0.2					
Average wage	0.15			<b>0.05</b>		
Development of employment in agriculture, forestry and fisheries	0.15					
Proportion of employment in industry			0.3			
Number of entrepreneurs			0.1	<b>0.03</b>	<b>0.03</b>	<b>0.15</b>
Development of employment in industry			0.2			
Long-term unemployment	0.09	0.3	0.12	<b>0.28</b>	<b>0.32</b>	<b>0.12</b>
Unemployment	0.12	0.4	0.16	<b>0.35</b>	<b>0.37</b>	<b>0.16</b>
Demand for the job	0.09	0.3	0.12	<b>0.22</b>	<b>0.22</b>	<b>0.12</b>
Purchasing power						<b>0.3</b>

Source: own processing

Table 7: The ANP comparison of the criteria weights.

criteria system and their weights are consistent with the criteria system used in the new selection process of regions with state support. The initial and new weights of criteria, which are equal to 0, show the criteria not used in demarcation process, on the contrary the used criteria have non-zero weights in the new region selection process and in synthesis made by the AHP method. These criteria are highlighted in the Table 7. Exceptions are the criteria "Population density" which has not zero weight and is not longer used and the "Purchasing power" criterion which not used in the initial method and is added newly. Generally six criteria are not longer used and five criteria are still used. The differences in values of criteria weights can be explained by the former three types of region (structurally affected or economically weak region or a region with far above-average unemployment) defined by different sets of criteria.

## **Conclusion**

The demarcation process of the regions with concentrated state support is based on the set of criteria and weights specified by the Czech Government according to the EU policies. Applying the weights, all indexes characterising the evaluated regions according to the criteria are aggregated.

The selection process has been modified during the years; the most important modification was in the year 2003, because the Czech regions are from now evaluated according to the single set

of the criteria. We show that the idea and the continuity of the whole process of demarcation of the regions with concentrated state support are maintained. The new set of the criteria and their weights corresponds to the criteria and weights obtained by the ANP 2 analysis based on the initial idea of this process.

This result will be used as a guide for the design of new methods for the selection of regions without the need to establish criteria weights. However the selection of regions for the concentrated state support is a political decision; the different quantitative methods for selection of these regions, the correlation of used criteria, the methods for setting of criteria weights and the application of the Data Envelopment Analysis method, which does not require predetermined weight of criteria will be discussed.

This paper also showed the possibility of the AHP and especially ANP methods not only for multiple criteria decision-making in the classic sense but also for such type of analysis.

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