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INFLUENCE OF REGIONAL MISMATCH ON THE EMPLOYMENT PROCESS IN SELECTED TRANSITION COUNTRIES[1]

The main emphasis of this work concentrates on determining unemployment caused by mismatch, in other words on the portion of the structural unemployment and on determining influence of regional mismatch on the entire employment. Therefore, vacancies and flows of unemployment and new employed are compared at a well-defined regional disaggregated level. The course of the research, firstly applies the existing theoretical models, by which the values for five different regional mismatch indicators for the selected group of countries are calculated. Secondly, a disaggregated empirical analysis of the matching function according to the regions in all selected countries is conducted.

Modelling of matching function by region results from estimation of the transcendental logarithmic (translog) function form. The analysis proves that for the Czech Republic, Croatia and Slovakia a parallel existence of demand and supply surplus on the regional level points to the existence of mismatch in the labour market. It has also been confirmed that an increase in the mismatch indicator in the labour market leads to a decrease in the total employment.

Key words: labour market, regional mismatch, transition economies, employment process

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1. Introduction

The main emphasis of this study is placed on the growing problem of structural unemployment in the selected group of transition countries. Notwithstanding the fact that the countries from the selected group have passed through the transformation process from the pre-transition economic system into the market-based economy, they all are still undergoing structural changes. The focus is primarily on the newly arisen structural changes in the labour market caused by the restructuring process, and not on the legacy of the past. As a result of this changes, certain expenses arise in all areas of economy.

Hence, disequilibrium between the pre-transitional regional and industrial concentration of workers and the new structure of demand for goods and services appear in the labour market. The mentioned disequilibria, and with it the rigidities of the labour market, can be caused by low geographic and qualification mobility. In such way, it comes to the maladjustment (mismatch) between the existing regional labour force supply and the existing regional demand, as the prevailing regional or qualifications supply are not adjusted to the new economic needs. Such disequilibria between the labour demand and supply leads to the impossibility of linking up unemployed persons with available vacancies. This survey concentrates on the regional disequilibria. Consequently, if in a certain region there is greater unemployment than the frictional one, and if a certain region shows greater number of available vacancies than in conditions of frictional unemployment, one talks about the existence of structural disequilibrium or mismatch[2], and such unemployment is called structural unemployment. That kind of situation appears when the proper adjustment (matching) between the existing demand of workers with particular regional needs does not exist, that is when there are available vacancies in particular region, but no one in this region wants them or is not in position to fill them up. Such structural disequilibria is caused by regional mismatch.

Today, an unique opinion about the relative importance of many potential causes of increased unemployment does still not exist. However, estimations about absolute share of mismatch in explaining unemployment show important, although very different values[3]. In such way, it is obvious that mismatch can explain only a portion of unemployment and it is considered as just one cause of increased unemployment. The main emphasis of this work concentrates on determining

[2] The most quoted definition of the concept of mismatch is by Turvey (Turvey, 1977) "…there is a mismatch between vacant jobs and unemployed workers such that if the latter were available with different skills and/or in different places the level of unemployment would fall".

[3] For example, the portion of mismatch in German unemployment is estimated around 20% (SVR, 1994: 254), while in Great Britain it is estimated around one third of the total unemployment (Jackman, Layard, Savouri, 1991: 71).

unemployment caused by mismatch in other words on the portion of the structural unemployment and on determining influence of regional mismatch on the entire employment. Therefore, vacancies and flows of unemployment and new employed are compared at a well-defined regional disaggregated level.

The structure of this article is as follows. Section two represents analytical framework. It contains the main hypothesis and aims of the research. In continuation, matching function is defined and this section also provides an assessment of available data and methodology, as well as measured values for five different regional mismatch indicators in the selected transition countries. Section three presents main empirical results and provides some possible explanations for the increased unemployment in transition countries. Finally, section four highlights the main points of the research.

2. Analytical framework and model specification

This paper seeks to determine the share of structural unemployment in the overall unemployment caused by mismatch, as well as the functioning of matching process in the single disaggregated market in the selected group of countries[4]. Namely, from the existing aim and purpose of the research, basic research hypothesis arises:

H1: Increase in the mismatch indicators in the labour market (of the selected countries) leads to a decrease in the overall employment.

H2: Parallel existence of a demand and supply surplus on the regional level points at the existence of mismatch in the labour market.

The main hypothesis H1 is proven by modelling previously calculated mismatch indicators using time modelling, while the main hypothesis H2 is proven by the disaggregated analysis of the matching function according to the regions.

In the empirical part, a quantitative methodological approach of the research on the disaggregated level is used in order to obtain a greater significance of the gained results. The data include the observation of aggregated data on the regional level observed in the course of more time intervals (*time-series* data). The course of the research, firstly applies the existing theoretical models, by which the values for five different regional mismatch indicators for the selected group of countries are calculated. Secondly, a disaggregated empirical analysis of the matching function according to the regions in all selected countries is conducted.

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[4] Croatia and the selected group of CEEC-5 countries (Central and Eastern European countries), the Czech Republic, Hungary, Poland, Slovenia and Slovakia are included in the analysis.

The entire empirical analysis is based on the multiple-regression analysis of the disaggregated matching function and on the measuring of mismatch influence for the period of time modelling.

2.1. Defining matching function

By defining a model of the matching function[5] as the best specification of hiring process, a matching function, which is a peculiar form of Cobb-Douglas production function, is used (Blanchard, Diamond, 1992: 354). The matching problem alone simply leads to facing supply and demand in the labour market. The simplest form of the matching function leads to the connection of newly employed *(O-outflow)*[6] on one side, and vacancies *(V-vacancies)* and number of unemployed workers *(U-unemployed)* on the other:

$$O = f(U,V) \qquad (1).$$

According to the equation *(1),* the matching function could be written in the form of Cobb-Douglas production function as follows (Blanchard, Diamond, 1992; Lindeboom, van Ours, Renes, 1994; Saint-Paul, 1996):

$$O = \beta U^{\alpha_1} V^{\alpha_2} \qquad (2)$$

where *O* designates a number of employed persons (or *outflow* from unemployed to employed[7]), β stands for efficiency of labour market (or technological progress), *U* for number of unemployed, *V* for number of vacancies, and α_1 and α_2 stands for parameters. In such way, the matching process is identified with the production process, where new hiring or *outflow* represents output which proceeds from the process of coordination of two inputs (unemployed and vacancies) on the both market sides (Saint-Paul, 1996: 21). Parameters α_1 and α_2 simultaneously signify

[5] As a synonym for matching function the term job hiring function is usually used. See more in Jackman, Roper (1987).

[6] Dependent variable outflow signifies in fact a number of new employed workers, because it comprises flows of workers from the pool of unemployed to employed.

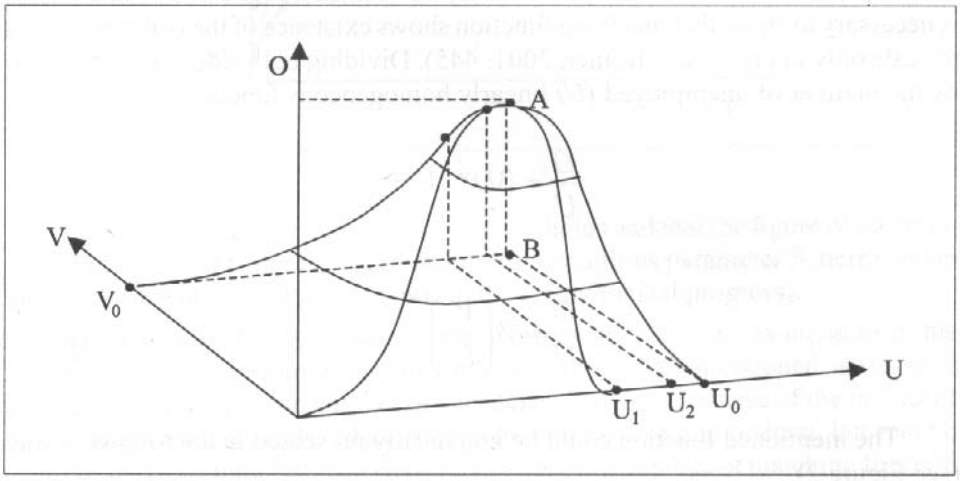
[7] Mentioned outflow from unemployed to employed or new employment or hiring corresponds in fact to the expected number of matching (Puhani, 1999: 2).

the coefficient of partial elasticity and explain the relative importance of supply and demand in the labour market[8].

Function of newly employed or matching function *O* is a function of two independent variables *U* and *V*, and can spatially be presented in three dimensions (see Figure 1).

Figure 1.

MATCHING FUNCTION



[8] Above mentioned could be proved by partial derivation of single independent variable in the following way:

$$E_{O,U} = \frac{\frac{dO}{dU}}{\frac{O}{U}} = \frac{U}{O}\frac{dO}{dU} = \frac{U}{\beta U^{\alpha_1} V^{\alpha_2}} \beta V^{\alpha_2} \alpha_1 U^{\alpha_1 - 1} = \alpha_1 \qquad (2a)$$

$$E_{O,V} = \frac{\frac{dO}{dV}}{\frac{O}{V}} = \frac{V}{O}\frac{dO}{dV} = \frac{V}{\beta U^{\alpha_1} V^{\alpha_2}} \beta U^{\alpha_1} \beta V^{\alpha_2 - 1} = \alpha_2 \qquad (2b)$$

In case of $\alpha_2 = 1 - \alpha_1$ or in case of the constant returns to scale $(\alpha_1 + \alpha_2 = 1)$ *matching* function is given as:

$$O = \beta U^{\alpha_1} V^{1-\alpha_1} \qquad (3)$$

but because of simplicity, instead of α_1 just α could be written:

$$O = \beta U^{\alpha} V^{1-\alpha} \qquad (3)$$

In order to enable a graphical interpretation, it is supposed that matching function has constant returns to scale in order to show relation between *O/U* and *V/U*. It is necessary to stress that matching function shows existence of the constant returns to scale only in rare cases (Romer, 2001: 445). Dividing both sides of equation *(3)* by the number of unemployed *(U)* linearly homogeneous function is derived:

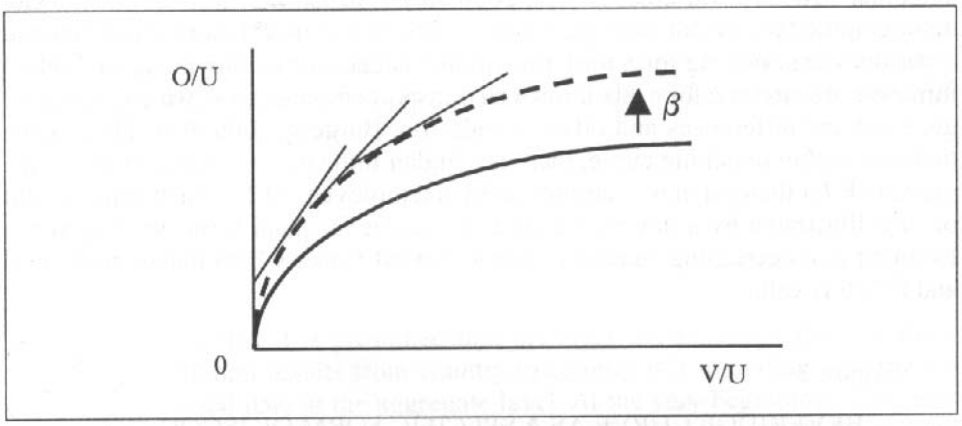
$$\frac{O}{U} = \beta U^{\alpha-1} V^{1-\alpha}$$

$$\frac{O}{U} = \beta \left(\frac{V}{U} \right)^{1-\alpha} \qquad (4).$$

The mentioned function could be graphically presented in the following way (see Figure 2).

Figure 2.

MATCHING FUNCTION AS A SPECIFIC FORM OF PRODUCTION FUNCTION



Concerning that relation $0 < (1-\alpha) < 1$ holds and that the figure of equation 4 is of exponential form, the function moves upwards as parameter β increases (in the case of equation 4, β corresponds to the technological progress).

The increase in the vacancies by unemployed *(V/U)* causes increase in the number of newly employed by unemployed *(O/U)*. The mentioned increase is smaller and smaller as the number of vacancies increases, because of the impact of decreasing returns to scale. Marginal product factors are diminishing, but remain positive, and matching function has a concave form. The slope of matching function is more laid down, which is also shown by a tangent line.

If in some region or country successful adjustment process between vacancies and unemployed workers exists, matching is more efficient. The mentioned process could be identified with accessibility of newer and more efficient production methods or with new discoveries, which could bring to the production increase. Such changes in technology create technological progress *(β)*. The technological progress appears also as a result of new innovations in the production process, and that process is graphically shown by the upward shift of the production function (see Figure 2). In the labour market could such innovations[9] be explained by a lar-

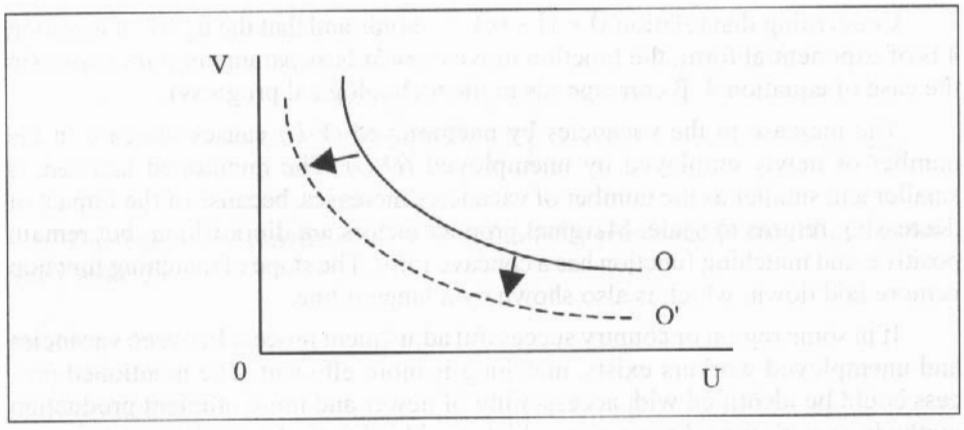
[9] Innovations include specific reforms as computerization of employment offices, announcing of jobs on Internet, and increased government funds for improving matching process. Government usually makes effort to enlarge efficiency of the matching process by investing in active policies in the labour market (Petrongolo, Pissarides, 2001: 399). For example, improved computerization of employment offices can decrease a duration of a job searching period.

ger flexibility and efficiency of the market alone, and therefore matching function shifts upwards.

It could be concluded that such improved and more efficient matching could lead to higher matching function. The value of parameter β denotes the total effectiveness of the matching process in the labour market, which contains time trend and other structural variables (Profit, 2000: 46)[10]. Structural variables can include demographic factors (for example, young workers will invest more effort than the older ones in searching for a job), prevailing channels of employment, individual initiative in searching for a job, improved transport circumstances which decreased geographical differences and others (Anderson, Burgess, 2000: 93). That means that on a higher matching curve, there is a higher influence of vacancies by unemployed *(V/U)* than on newly employed by unemployed *(O/U)*. Such effect could be also illustrated by a downward shift of specific isoquant form (see Figure 3). Isoquant is a decreasing function with increased slope, which means that O'<0 and O''>0 is valid.

Figure 3.

BEVERIDGE CURVE AS A SPECIFIC FORM OF ISOQUANT



[10] A measure of successful matching speed, which is needed on the occasion of job searching process, is quoted in literature. Therefore, the efficiency parameter β in the labour market illustrates a speed by which potential contacts result in matching by given number of job seekers and number of vacancies. It is emphasized that a value of parameter β differs in the case of employed and unemployed workers, but it is not known if this differences exist because of workers' or employers' decisions. The efficiency of the matching process for the employed is the greatest through announcements and informal channels, while in the case of the unemployed it is the largest through employment offices and in smaller amount through informal channels (Lindeboom, Ours, Renes, 1994: 47-55).

Downward shift of isoquant indicates an improved effect of the matching process. The isoquant shows a constant quantity of hiring along with a modified number of vacancies and unemployed, and corresponds to the Beveridge curve. It is possible to observe that with equal number of vacancies, a number of unemployed decreases, which means that with the existence of the equal number of vacancies and unemployed, it is possible to attain higher employment. If the matching process is more successful, it is possible to decrease mismatch in the labour market in such a way. It is possible to expect that in the case of mismatch existence, opposite effect appears. The main point here is to analyse the influence of regional mismatch on the total hiring in a country.

2.2. Methodology and data description

Considering that it is presumed that the mentioned disaggregated analysis would show different results from country to country it is important to explain a distribution of used data at the aggregate level. At the very beginning of the empirical analysis, it is important to stress that data for the regional disaggregated analysis were available for all selected countries except Hungary. The empirical analysis is carried out in consideration with the theoretical form of the matching function from equation *(2)*.

The inadequacy of matching function comes form the fact that it does not observe job-to-job flows. The main presumption is that vacancies are filled exclusively from the category of unemployed. The problem of matching alone could be most easily attributed to the confrontation of labour supply and demand. In such a way, the simplest form of matching function leads to the connection of newly employed *(O-outflow)* on one side, and vacancies *(V-vacancies)* and the total number of unemployed workers *(U-unemployed)*, which include unemployed (state on 31.12. of previous year) and all newly registered at employment offices during current year, on the other.

Relation of the mentioned variables by regions in the case of the selected transition countries is analysed according to the data from the state employment offices[11]. The number of newly employed is registered as a category from the register. According to the equation *(2),* for a purpose of the econometric analysis by regions, matching function could be written as:

$$O = \beta U^{\alpha_1} V^{\alpha_2} e^{\varepsilon} \qquad (5)$$

[11] Namely, the Labour Force Survey does not include data on labour demand, so this is also the main reason why registered data from employment offices are used. This figure is also not the most adequate one. It causes a severe underestimation of the labour demand, especially in the more dynamic labour markets where many new jobs are created in small, often not perfectly legal private companies.

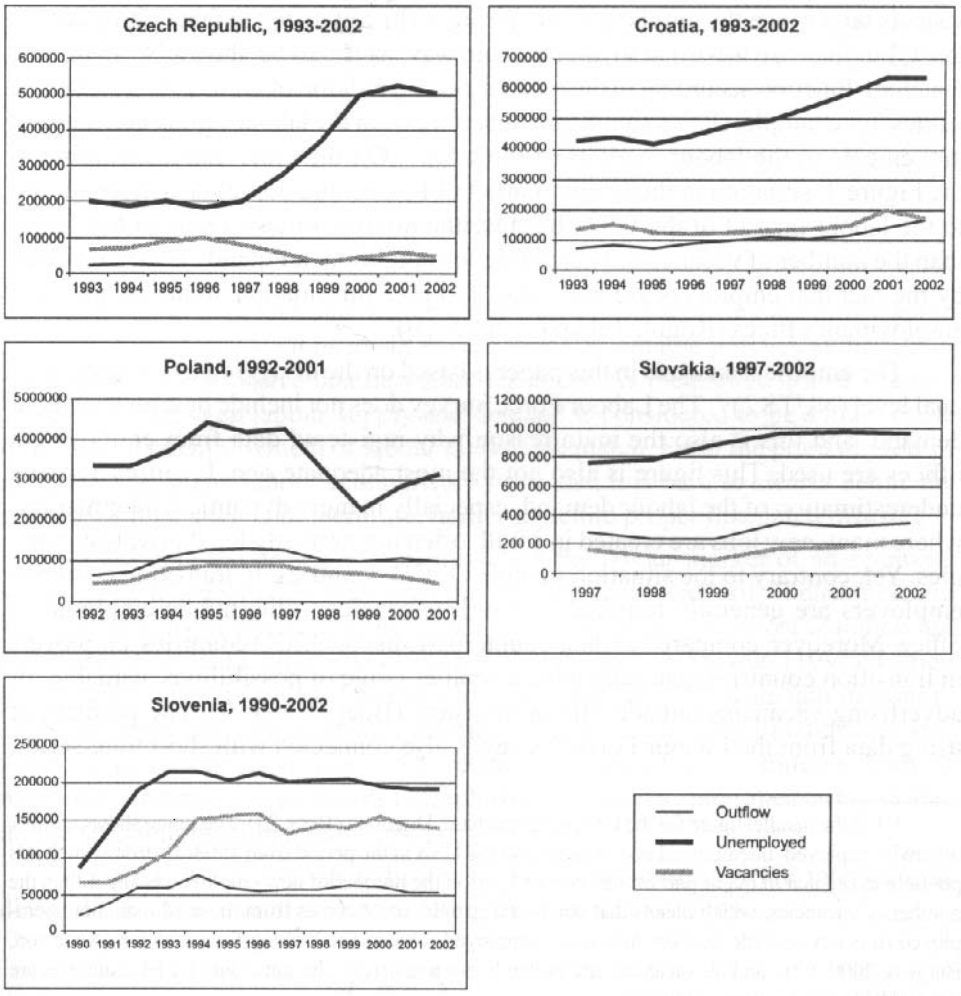
where *O* stands for the number of newly employed workers (*outflow* from the unemployed to the employed), β denotes labour market efficiency, *U* number of the unemployed, *V* number of the vacancies, α_1 and α_2 denotes parameters, which show relative importance of supply and demand in the labour market, ε is unknown random variable, while *i* denotes regions in some observed period *t*. The further empirical analysis is based on the matching function form from the equation 5.

Before the implementation of the disaggregated analysis of matching function, a graphical figure of aggregate data (unemployed, newly employed *(outflow)* and vacancies) in each country, which will be used in the whole analysis, is given (see Figure 4).

Yet, contrary to the situation in most OECD countries, in transition countries employers are generally required to report vacancies to the public employment office. Moreover, compared to their counterparts in OECD countries, employers in transition countries generally have a smaller range of possibilities available for advertising vacancies outside official registers (Boeri, 1994: 9). The problem of using data from Labour Force Survey is also connected with short time-series, because in some selected countries it has been used since 1996. For example, the Czech Republic started to collect data according to regional classification NUTS 2 during 2001 (Franco, 2002: 10).

Figure 4.

AGREGATE MOVEMENTS OF NEWLY EMPLOYED *(OUTFLOW),* UNEMPLOYED AND VACANCIES



Source: for the Czech Republic: for number of unemployed - *Unemployment Development in CR*, Monthly Statistics reports, Ministry of Labour and Social Affairs of the Czech Republic, Employment Service Administration; for unemployed - *Labour Market in the Czech Republic 1993-2002,* Czech Statistical Office, Prague, 2002; for vacancies - Monthly Statistics reports, Ministry of Labour and Social Affairs of the Czech Republic, Employment Service Administration; for Croatia - Croatian Employment Office Database; for Poland - Database of Central Statistical Office, Warsaw; for Slovakia - National Labour Office - Bratislava; for Slovenia - National Data Base from Employment Office in Ljubljana.

The previous figure shows rather black pictures in respect to the question of solving the problem of unemployment in the Czech Republic, Croatia and Slovenia concerning a high number of total unemployed persons during the whole observed period. The current state however shows a possible optimistic exit from such situation. Namely, the average number of the registered needs or vacancies in all years is larger than the number of new hirings. This refers to the fact that vacancies exist, but they are not filled in appropiriate way, as it will be shown by modelling matching function according to the regions. Such condition of the exisiting aggregate values, for example, shows significant departure from the labour supply and demand movements in the labour markets of the USA[12]. On the other hand, according to the Figure 4, situation in the labour market of Poland and Slovakia is more similar to the labour market of the USA, because the number of new employed is larger than the number of vacancies. The mentioned condition in Poland can be explained by the fact that employers are not obliged to give information about vacancies to employment offices (Rogut, Tokarski, 2002: 70).

The empirical analysis in this paper is based on the disaggregated data on regional level (NUTS 2)[13]. The Labour Force Survey does not include data on the labour demand, and this is also the main reason why registered data from employment offices are used. This figure is also not the most adequate one. It causes a severe underestimation of the labour demand, especially in more dynamic labour markets where many new jobs are created in small, often not perfectly legal private companies. Yet, contrary to the situation in most OECD countries, in transition countries employers are generally required to report vacancies to the public employment office. Moreover, compared to their counterparts in the OECD countries, employers in transition countries generally have a smaller range of possibilities available for advertising vacancies outside official registers (Boeri, 1994: 9). The problem of using data from the Labour Force Survey is also connected with short time-series,

[12] For the parallel figure for the USA see Blanchard, Diamond (1989: 23). The figure shows number of newly employed, unemployed and vacancies in the USA in the period from 1968-81, from which it is possible to see that in major part of the observed period the number of new employed is larger than the number of vacancies, which means that one part of employment comes from those who are not unemployed (it is not possible to know how many employed workers are looking for a new job (Anderson, Burgess, 2000: 97)), and all vacancies are probably not registered. The same data for EU countries are not available for the observed period.

[13] NUTS - Nomenclature of Territorial Units for Statistics. The NUTS Regulation lays down the following minimum and maximum thresholds for the average size of the NUTS regions:

LEVEL	Minimum	Maximum
NUTS 1	3 million	7 million
NUTS 2	800 000	3 million
NUTS 3	150 000	800 000

See more in the document: "Introduction to the NUTS and the Statistical regions of Europe" on: http://europa.eu.int/comm/eurostat/ramon/nuts/introduction_regions_en.html

because in some selected countries has been used since 1996. For example, the Czech Republic started to collect data according to the regional classification NUTS 2 during 2001 (Franco, 2002: 10).

As the empirical analysis tries to confirm or reject the main hypothesis H1 by enlarging starting matching model with regional mismatch indicators as a new independent variable, mismatch indicators should firstly be calculated. Namely, the main issue is to explore the regional mismatch influence on the total employment movements in the selected transition countries.

2.3. Measuring regional mismatch indicators

Considering the fact that the results of mismatch measuring are important in the case of making decisions about development of suitable policies in the labour market, they have to give unambiguous argument. As mentioned above, the maladjustment between labour supply and demand is considered to be a main cause of structural unemployment or labour market mismatch. From the point of view of methodology, many labour economists[14] stress that it is hard to clearly define the concept of mismatch and, therefore, harder to define proper mismatch measure.

To estimate the presence of mismatch in the labour market of an economy successfully it is necessary to have an appropriate analytical tool. Today, there are several concepts of measuring mismatch in the literature. The most common are the concepts of: Jackman, Roper (1987); Jackman, Layard, Savouri (1991); Lillien (1982) and Lambert (1988). The fundamental shortage of all mismatch indicators comes from the fact that an unique definition of the concept of mismatch does still not exist. In continuation, a brief theoretical overview of the existing methods of five different mismatch measures is emphasized, as well as their measuring values in five selected transition countries.

The first two mismatch indicator measures are based on the intersectoral disequilibria. The natural way of defining mismatch is as follows:

$$M_1 = \frac{1}{2}\sum\nolimits_i \left| u_i - v_i \right| , \qquad (6)$$

which value is zero if there is no mismatch, in other words when the labour supply is equal to the labour demand in all regions (when $u_i = v_i$ for all i). If the number of

[14] Among which: R. Jackman, R. Layard, S. Savouri, W. Franz, G. Brunello, C.R. Bean, C.A. Pissarides, R.B. Freeman, D. Soskice, K.G. Abraham and others. See more in Padoa Schioppa (1991).

unemployed and vacancies differs among regions, the value of regional mismatch indicator is between 0 and 1. The upper limit, $M_1=1$, appears when all unemployment is concentrated in one unique region and all vacancies are in another region. The advantage of mismatch indicator M_1 comes from the fact that in its calculation the values of unemployed and vacancies for all regions are used, so it can therefore be considered as complete mismatch measure.

Jackman and Roper define the alternative mismatch indicator:

$$M_2 = 1 - \sum_i (u_i v_i)^{1/2} \qquad (7).$$

As in equation *(6)* or mismatch indicator (M_1), the optimal allocation of unemployment inside regions is achieved when M_2 is zero ($u_i=v_i$ for all i)[15]. When there is no matching at all, in other words, when $u_i v_i=0$ for all i, M_2 acquires a maximal value 1 and full mismatch is considered. This means that one region contains all unemployed and other all vacancies.

The second two mismatch indicators measures are based on the NAIRU model. The main problem in measuring previously mentioned two indicators (M_1 and M_2) is a fact that, vacancy data on the disaggregated level are needed for their calculation. These data are usually not available in most of the countries. Jackman, Layard and Savouri (1991) have therefore suggested a third mismatch indicator, advantage of which is a fact that it is exclusively based the number of unemployed and employed, so for its calculation data on vacancies are not needed:

$$M_3 = \frac{1}{2}\mathrm{var}\left(\frac{U_i / N_i}{\sum U_i / \sum N_i}\right) \qquad (8)$$

where U_i indicates a number of unemployed and N_i a number of employed workers[16]. This indicator comes from the NAIRU theoretical framework, in other words from the fact that a long-term equilibrium is attained at the minimal total unemployment. When a number of unemployed is the same in all regions, than there is no mismatch

[15] The proof for optimal allocation of unemployment inside the regions:

$$\sum_i (u_i v_i)^{1/2} = \left| \begin{matrix} \max \Leftrightarrow \\ u_i = v_i \forall i \end{matrix} \right| = \sum_i (u_i)^{2*1/2} = \sum_i u_i = 1$$

[16] In calculation of mismatch indicator M_3 variance is used. Among measures of dispersion it has the same meaning as arithmetic mean among middle values considering that all values of numerical variable participate in its calculation. Therefore, it is considered a full measure of dispersion what is also its main advantage (Gujarati, 1992: 39-42). Amartya K. Sen has criticized the use of variance stressing it depends on arithmetic mean. Such imperfection does not exist by applying the coefficient of variation (Sen, 1985: 31-32).

and the value of mismatch indicator M_3 is zero. In other cases, value ranges from 0 and 1 (Pauer, 2000: 167).

Furthermore, Jackman, Layard and Savouri, (1991: 70) derive following mismatch indicator defining unemployment value caused by mismatch:

$$M_4 = \frac{1}{2}\text{var}\frac{u_i}{u}. \qquad (9)$$

where *var* stands for variance. The indicator M_4 is zero when all regional unemployment rates are equal to aggregate one. In that case, labour supply and demand become equal and there is no mismatch. Calculating a degree of mismatch (according to equation *(9)*) in Great Britain in 1985, Jackman, Layard and Savouri have found that mismatch accounts for around 30% of total structural unemployment, so its importance cannot be excluded (Jackman, Layard, Savouri, 1991: 71).

The fifth mismatch measure is based on the leading region. So far, the analysed mismatch indicators have proceeded from the assumption that wages in each region depend only on unemployment rates in a single region. If a situation of high centralization of collective bargaining is assumed, it is expected that changes in nominal wages in certain leading region (a region with the lowest unemployment rate) will play a dominant role in determining regional wages. Therefore, Jackman, Layard and Savouri (1991) have assumed that wages depend only on unemployment in some leading regions (e.g., as it is a case of south England or in the area of certain nation's capitals), which unemployment rate is denoted by u_L. According to the above mentioned, a mismatch indicator M_5 is derived[17]:

$$M_5 = \log u - \log u_L \qquad (10).$$

Considering the definition of unemployment rate in the leading region, it follows that a mismatch indicator M_5 is greater than a mismatch indicator measured according to the assumption that wages depend on unemployment in the same region (the basic model). The fact is that for a certain group of unemployment rates the minimum level of unemployment is much larger in the case of basic model, than in the case of the leading region model.

At the end, it could be concluded that mismatch indicators M_1, M_2, M_3 and M_4 are theoretically the most valuable as a mismatch measures. By calculating these four mismatch indicators, values for unemployment, employment and vacancies in

[17] Wages in certain region can depend on the unemployment in that region (u_i), but also on the unemployment in leading region (u_L): $\log W_i = \beta_i - \gamma_1 \log u_i - \gamma_2 \log u_L$.

real and absolute amount for all regions are used, and in such way these indicators can be considered as complete mismatch measures. In the case of the mismatch indicator M_5, a value for indicator is calculated as a difference between the total average regional unemployment rate and lowest regional unemployment rate. In such way, the comparison of all other regions with average regional unemployment rate is excluded from calculation. If all other regional unemployment rates were included, the mismatch indicator M_5 would be more representative. Even in the case of Rawl's theory of justice[18], a mismatch indicator calculated in this way cannot be considered a representative indicator of regional disequilibria in certain country, because the condition of the worst-placed region is not satisfied (namely, in the case of the mismatch indicator M_5, the leading region in the country is observed). Therefore, theoretically speaking mismatch indicators M_1-M_4 are more representative, because in their calculation all values for all variables according to the regions are included.

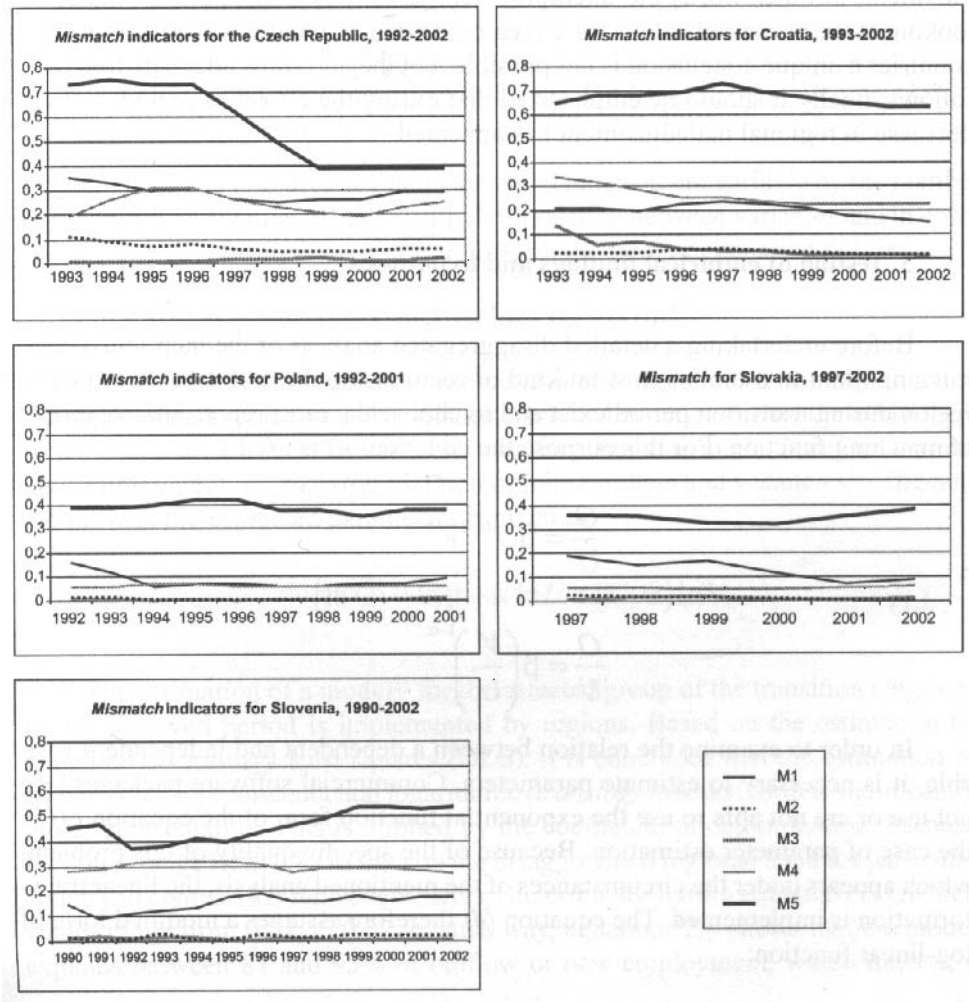
Considering the fact that there is still no unique definition of the mismatch concept, an unique method of measuring mismatch indicators does not exist. All mentioned indicators in theoretical part are derived from the disaggregated level and fundamental difference follows from the starting data, which are used in the calculation. This is also the main reason why there are different empirical results in five selected transition countries concerning unemployment size caused by mismatch.

The following figure (see Figure 5) shows calculated values for regional mismatch indicators (M_1-M_5) for the selected transition countries in the observed time period. In such a way, it is much easier to observe their common movements.

[18] See more in Rawls, J. (1971) A Theory of Justice, Cambridge, Mass.: Harvard University Press.

Figure 5:

REGIONAL MISMATCH INDICATORS OF SELECTED TRANSITION COUNTRIES



Source: for the Czech Republic: for number of unemployed - *Unemployment Development in CR*, Monthly Statistics reports, Ministry of Labour and Social Affairs of the Czech Republic, Employment Service Administration; for unemployed - *Labour Market in the Czech Republic 1993-2002,* Czech Statistical Office, Prague, 2002; for vacancies - Monthly Statistics reports, Ministry of Labour and Social Affairs of the Czech Republic, Employment Service Administration; for Croatia - Croatian Employment Office Database; for Poland - Database of Central Statistical Office, Warsaw; for Slovakia - National Labour Office - Bratislava; for Slovenia - National Data Base from Employment Office in Ljubljana.

The results of the empirical analysis confirm the expectations and show certain differences in measured values for some regional mismatch indicators. It is obvious that in all selected transition countries values for particular mismatch indicators differ greatly. Therefore, it is very hard to estimate the real size of structural unemployment, in other words the unemployment caused by mismatch. All together, looking at the measured values for all regional mismatch indicators in the selected countries a unique conclusion is not possible, but they do show adequate trend. As follows, finally it should be emphasized that during the observed period, a slight decrease in regional maladjustment has appeared.

3. Testing of empirical findings and hypothesis

Before undertaking a detailed disaggregated analysis of the mentioned data, it is important to establish in what kind of relationship the real data according to region during transition period exist and to choose the most representative model of matching function. For this purpose the equation *(4)* is used:

$$\frac{O}{U} = \beta U^{\alpha-1} V^{1-\alpha}$$

$$\frac{O}{U} = \beta \left(\frac{V}{U} \right)^{1-\alpha}$$

In order to examine the relation between a dependent and independent variable, it is necessary to estimate parameters. Commercial software packages[19] do not use or are not able to use the exponential function form of the equation *(4)* in the case of parameter estimation. Because of the specific quality of this problem, which appears under the circumstances of the mentioned analysis, the linear transformation is implemented. The equation *(4)* therefore assumes a modified form of log-linear function:

$$\ln\left(\frac{O_i}{U_i}\right) = \ln\beta + (1-\alpha)\ln\left(\frac{V_i}{U_i}\right) + \varepsilon_i, i = 1, 2, \ldots n \qquad (11)$$

where *O* stands for outflow or newly employed, *U* for new registered at employment offices and *V* for vacancies, β for efficient labour market, α_1 i α_2 denotes para-

[19] E-Views, SAS and SPSS.

meters which show relative importance of labour supply and demand, ε unknown random variable.

The parameters in regression models are estimated by a method of ordinary least squares (OLS)[20]. The model with estimated parameters is given as equation *(12)*:

$$\left(\ln\frac{\hat{O}_i}{\hat{U}_i}\right)=\ln\hat{\beta}+(1-\hat{\alpha})\left(\ln\frac{\hat{V}_i}{\hat{U}_i}\right) \qquad (12)$$

In order to avoid dividing dependent and independent variable by the number of unemployed creation of statistically false relation between variables and in order to have easier interpretation of the results, modification of equation *(11)* is:

$$\ln O=\ln\beta+\alpha\ln U+(1-\alpha)\ln V$$

By previous modification, a transcendental logarithmic *(translog)* function form is obtained, which gives less biased estimated parameters than the initial form of the equation *(11)*. In such way, new matching function model is defined, where new employment is a *translog* function of job searchers and vacancies[21]. The new model with the estimated parameters is given as:

$$\left(\ln\hat{O}\right)=\ln\hat{\beta}+\hat{\alpha}\ln U+\left(1-\hat{\alpha}\right)\ln V \qquad (13)$$

The estimation of a model[22] for the selected group of the transition countries in the observed period is implemented by regions. Based on the estimation by a method of ordinary least squares (OLS), it is concluded that the estimation of equation *(13)* or transcendental logarithmic *(translog)* function form is significantly more representative. This is implied by the coefficient of determination, because its values range from 0,87 to 0,95 on the disaggregated regional level for particular country in comparison with coefficient of determination from equation *(11)*, which values range from 0,04, to 0,57. In such way, equation *(13)* shows that the model explains between 87 and 95% of outflow or new employment, which hints at a

[20] This method is also used in assessment of other numerous standard models of economic growth (i. e. Solow growth model), which presume the existence of the Cobb-Douglas production function (Mankiw, Romer, Weil, 1992: 411).

[21] Many other authors have used this modification (see more in Boeri, 1994; Fazekas, 2000: 13-15; Warren, Jr. 1996: 136).

[22] Estimation is done for 14 macro regions in the Czech Republic, 21 counties in Croatia, 14 voivodships in Poland, 8 macro regions in Slovakia and 10 regions in Slovenia.

relatively high model representative quality. With it, it is confirmed that the model of matching, that is new hiring or outflow *(O),* is much better described with the two independent variables – unemployed persons *(U)* and available vacancies *(V)* or by equation *(13)*. Besides, the empirical analysis of matching function, which is the main research problem here, refers to the analysis of a new hiring variable or outflow *(O)*, which is a dependent variable in equation *(13),* and not to the analysis of equation *(11)*, where $\frac{O}{U}$ is a dependent variable. The residuals are very narrow, range from -0,8 to 0,5, and it is once more confirmed that the used variables are adequate for estimating model, and that there are no other variables which are not included in this model and have strong influence on the dependent variable.

3.1. Times-series modelling of matching function on regional level

The modelling of matching function by region is conducted out the estimation of equation *(13)* or the transcendental logarithmic *(translog)* function form, because it is concluded that this form is significantly more representative. The mentioned estimation is carried out separately by regions in the selected group of countries, in order to find out in which region is the most adjusted matching achieved or in which region of a particular country there is the largest adjustment between supply and demand.

In such case, matching function of particular region in the observed period is examined. The estimation of matching function is conducted according to the equation *(13)* for each region separately in the observed period. For the purpose of this analysis the equation *(13)* is a slightly modified and given as:

$$\ln \hat{O}_i(t) = \ln \beta + \alpha \ln U_i(t) + (1-\alpha) \ln V_i(t) \qquad (14)$$

where *i* stands for region in period *t*, which relates to the observed period.

The following table shows in how many regions is the presumed model reliable. Regarding that in all countries and in all observed years the regression coefficients close to the independent variable are significant, it turns out that the chosen model is reliable for analysis of coordinated labour market separately by regions in the Czech Republic, Croatia and Slovakia (see table 1).

Table 1.

SIGNIFICANCE OF A MODEL SEPARATELY BY EACH REGION

	Czech Republic	**Croatia**	**Poland**	**Slovakia**	**Slovenia**
Number of significant regions[23]	8	9	0	3	0
Portion of significant regions in total number of regions (%)	57,5	42,9	0	37,5	0
Portion of population of significant regions in total population (%)	58	36,5	0	38,7	0

In the case of Poland and Slovenia, both regression coefficients are not significant in either models, so those obtained models of the matching function separate by regions are not to be considered reliable. Table 1 further shows that in the Czech Republic the estimated model is a reliable indicator for 8 from 14 regions, which together comprises 58% of the total population. In Croatia, the estimated model is a reliable indicator for 9 from 21 regions, which together comprise 36,5% of the total population, and in Slovakia, the model is a reliable indicator for 3 from 8 regions, which comprise 38,7% of the total population. By observing territorial covering of the estimated model, it is concluded that only in Croatia this model covers a larger portion of regions than population in relation to other countries.

The next table shows regions in which the estimated model explains the worst or best adjustment of labour market by regions in the observed period (see Table 2).

[23] Quoted are only those regions where both regression coefficients are significant on the level of 5%.

Table 2.

JOINT TABLE FOR MATCHING FUNCTION ESTIMATION ACCORDING TO EACH REGION INDIVIDUALLY

Region	Czech Republic	Croatia	Poland	Slovakia	Slovenia
The worst case	lnO=3035,1 +0,03lnU +0,02lnV *(Ostrava region)*	lnO=3,84+0,65lnU +0,69lnV *(Virovitičko-podravska county)* and lnO=-31,33 +4,49lnU -0,95lnV *(Splitsko-dalmatinska county)*	There are no regions in which both of the regression coefficients are significant	lnO=-4,1+0,92lnU +0,39lnV *(Trenciansky kraj)*	There are no regions in which both of the regression coefficients are significant
R^2	**0,84**	**0,87**	**-**	**0,87**	**-**
DW statistics	**2,1503**	**2,1234**	**-**	**2,0213**	**-**
The best case	lnO=1400,7 +0,04lnU -0,14lnV *(Plzeň region)*	lnO=-7,52 +1,12lnU +0,67lnV *(Ličko-senjska county)*	There are no regions in which both of the regression coefficients are significant	lnO=-2,84 +0,72lnU +0,49lnV *(Prešavsky kraj)*	There are no regions in which both of the regression coefficients are significant
R^2	**0,98**	**0,97**	**-**	**0,96**	**-**
DW statistics	**2,3211**	**1,9561**	**-**	**1,8591**	**-**

Legend: Only the regions in which both regression coefficients along with an independent variable are significant. Coefficients are significant on the significance level of 5%. "-" means that there is no model in which both of the regression coefficients are significant.

The selected matching function model is the worst in explaining new hiring *(outflow)* in region Ostrava in the Czech Republic, Virovitičko-podravska and Splitsko-dalmatinska county in Croatia and in Trenciansky kraj in Slovakia. The values for the coefficient of determination range from 0,84 to 0,87. The model is the most representative and it therefore explains in a best way new hiring in Plzeň region in the Czech Republic, Ličko-senjska county in Croatia, and in Prešovsky kraj in Slovakia. The values for the coefficient of determination range from 0,96 to 0,98.

In particular countries, a simultaneous existence of labour demand and supply surplus on the regional level or the existence of the regional mismatch in the labour market (in the Czech Republic in two regions, in all regions in Croatia and Slovakia) has been observed, whereas this has not been confirmed in Poland and Slovenia. A value for the calculated mismatch indicators for Poland leads also to the same conclusion, considering that the values for all five calculated indicators in the observed period are on the decrease. This cannot be concluded for Slovenia, based on the calculated values for mismatch indicators, because values for two mismatch indicators in the observed period are on the decrease and values for three indictors are on the increase. In such way it was proved for the Czech Republic, Croatia and Slovakia that a parallel existence of a demand and supply surplus on the regional level points to the existence of the mismatch in the labour market, and with it the starting hypothesis H2 has been confirmed.

The confirmed regional maladjustment probably results partly from weak regional mobility and partly it is caused by the influence of regional mismatch on total hiring *(outflow)*. Considering that one of the main aims is to determine the influence of regional mismatch on the total hiring it is important to relate the regional mismatch indicators with hiring function during the observed period. Therefore, further analysis implements estimation of regional mismatch on the total new hiring.

3.2. Influence of regional mismatch on total employment

In order to analyse the mismatch influence on regional level during the observed period in the starting equation *(13)* as a new independent variable previously calculated values for five different regional mismatch indicators (see Figure 5) are introduced. Such analysis has not been conducted in the empirical researches in the world so far, but it serves for the acceptance or rejection of the hypothesis H1. By introducing a mismatch indicator as a new independent variable in the model of matching function, it is possible to determine how much does mismatch explain a dependent variable or *outflow*. Therefore, for the needs of this analysis, the starting equation is modified and given as:

$$\ln O_i(t) = \ln \beta + \alpha \ln U_i(t) + (1-\alpha) \ln V_i(t) + bM_j(t) \qquad (15)$$

where *i* stays for a region in the observed time period *t*, *j* denotes previously calculated values for mismatch indicators for each separate year. Considering that five different mismatch indicators (M_1, M_2, M_3, M_4 i M_5) exist, there are also five

different estimated equations for each country. The following table shows well laid out picture of influence of previously defined mismatch indictors on matching function of each observed country.

Table 3.

INFLUENCE OF INDIVIDUAL MISMATCH INDICATORS ON MATCHING FUNCTION OF INDIVIDUAL COUNTRY

Mismatch indicator	**Czech Republic**	**Croatia**	**Poland**	**Slovakia**	**Slovenia**
$\mathbf{M_1}$	lnO=0,64 +0,74lnU +0,14lnV -0,68M_1	lnO= -0,47+0,34lnU -1,77lnV-1,77M_1	lnO=1,47+0,56lnU +0,28lnV-3,7M_1	-	lnO= -0,41+0,84lnU +0,11lnV-1,5M_1
$\mathbf{M_2}$	-	lnO= -0,73+0,63lnU +0,34lnV-5,1M_2	lnO=1,37+0,55lnU +0,28lnV-18,6M_2	-	-
$\mathbf{M_3}$	-	lnO= -0,35+0,55lnU +0,38lnV-3,34M_3	lnO=1,45+0,42lnU +0,42lnV-16,8M_3	lnO=2,1 +0,63lnU +0,13lnV -12,8M_3	-
$\mathbf{M_4}$	lnO=0,74 +0,73lnU +0,16lnV -1,1M_4	lnO=0,50 +0,53lnU +0,41lnV -3,46M_4	-	-	lnO= -1,4+0,85lnU +0,07lnV-1,2M_4
$\mathbf{M_5}$	-	-	lnO=1,1+0,46lnU +0,38lnV-0,75M_5	-	-
R^2	**0,94-0,95**	**0,90-0,94**	**0,88-0,93**	**0,94**	**0,95-0,96**
DW statistics	**1,7928**	**2,1322**	**1,8152**	**1,9251**	**2,2631**

Legend: All coefficients are significant on the significance level of 5%. "-" - denotes that regression coefficients along with a mismatch indicator are not significant on the level of 5%.

The table shows that in 13 models, out of 25 estimated matching functions in which the influence of regional mismatch on the total hiring has been determined, the regression coefficients were significant. In those models is the coefficient of determination larger than 0,88, which implies large representative quality of estimated models. The estimated matching model has the most representative quality in the case of Slovenia.

In all the above-mentioned regression models and in all observed years the regression coefficients alongside an independent variable are significant. The

selected trans-log model of matching function represented by equation *(15)* is considered very reliable for the analysis of regional mismatch influence on the total employment.

The values of regression coefficients in front of mismatch indicator are the lowest in the case of the Czech Republic and Slovenia, which means that increased regional mismatch in those countries, influence at least a reduction of new hiring. Such result was expected for Slovenia, because the regional time-series modelling of the matching function in Slovenia found out that there is no mismatch or maladjustment in the regional labour market. The values of regression coefficient are the largest in front of mismatch indicator in Poland and Slovakia, showing that in those two countries regional mismatch decreases new hiring the most.

The analysis of the regional mismatch influence on the overall employment shows that an increase in the regional mismatch influences a decrease in the overall matching process that is a number of new hiring in all the selected countries. In such way, it has also been confirmed that an increase in the mismatch indicator in the labour market leads to a decrease in the total employment, and with this a starting hypothesis H1 has been confirmed.

4. Conclusion

Due to heterogeneous definition of a mismatch hypothesis as well as different theoretical ways of measuring mismatch indicators, the gained results for individual mismatch indicators should be taken with precaution. However, it is important to stress that they do show a corresponding trend. In a greater number of countries their values grow and this indicates an increase in the regional maladjustment and at the same time, an increase in portion of structural unemployment caused by mismatch.

By the overall empirical disaggregated analysis in the labour market of the selected group of countries, the following guidelines for economic policy makers have been defined. First and foremost, it is important to carry out a disaggregated labour market analysis in every country using a *translog* model of matching function, as it was proven to be reliable. In such way, the real reasons of the supply and demand maladjustment in the labour market shall be identified, and it shall be possible to apply appropriate measures for decreasing the existing mismatch. A mismatch process can become more efficient and the labour market more flexible if an improved mediation in searching for employment, improved system of education, training and lifelong education, reforms of taxation system and unemployment benefits, more flexible working hours, and measures for improving labour mobility are applied.

Modelling of matching function by region results from estimation of the transcendental logarithmic *(translog)* function form. The analysis proves that for the Czech Republic, Croatia and Slovakia a parallel existence of demand and supply surplus on the regional level points to the existence of mismatch in the labour market, and with it the starting hypothesis H2 has been confirmed. The values of the regression coefficients in front of the mismatch indicator are the lowest in the case of the Czech Republic and Slovenia, which means that in those countries regional mismatch increase influence the reduction of new hiring the least. The values of regression coefficient are the largest in front of the mismatch indicator in Poland and Slovakia, showing that in those two countries regional mismatch mostly decreases new hiring. It has also been confirmed that an increase in the mismatch indicator in the labour market leads to a decrease in the total employment, and with this the starting hypothesis H1 has been confirmed.

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UTJECAJ REGIONALNOG MISMATCH-A NA PROCES ZAPOŠLJAVANJA U ODABRANOJ SKUPINI TRANZICIJSKIH ZEMALJA

Sažetak

Temeljni cilj ovog istraživanja usmjeren je na određivanje udjela nezaposlenosti uzrokovane mismatch-om, odnosno na utvrđivanje udjela strukturne nezaposlenosti i utjecaja regionalnog mismatch-a na ukupno zapošljavanje. Stoga se uspoređuju slobodna radna mjesta i tijekovi nezaposlenih i novo zaposlenih na nivou regija. Samo istraživanje prvotno ukazuje na postojeće teorijske modele putem kojih se ujedno izračunava pet različitih regionalnih mismatch indikatora za odabranu skupinu zemalja. U nastavku se provodi dezagregirana empirijska analiza matching funkcije prema regijama za odabranu skupinu zemalja.

Modeliranje matching funkcije po regijama provodi se putem *translog* oblika. Empirijskom analizom utvrđuje se paralelno postojanje viška ponude i potražnje na regionalnom nivou u Češkoj, Hrvatskoj i Slovačkoj čime se potvrđuje postojanje mismatch-a na tržištu rada. Također se potvrđuje kako porast mismatch indikatora na tržištu rada dovodi do smanjivanja ukupnog zapošljavanja.

Ključne riječi: tržište rada, regionalni mismatch, tranzicijske ekonomije, proces zapošljavanja.