

## Theoretical and empirical framework of measuring mismatch on a labour market\*

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### **Abstract**

*The main emphasis of this article is focused on the growing problem of structural unemployment in selected group of transition countries. Namely, if a certain region has a greater degree of unemployment rate than the frictional one, and if another region shows greater number of available vacancies than in conditions of frictional unemployment, it is referred to as structural disequilibrium or mismatch. Such unemployment is called structural unemployment. The estimates clearly show that the mismatch explains only a portion of unemployment and could be considered as a factor of increased unemployment. The empirical study refers to measuring the structural unemployment caused by regional mismatch in selected transition countries by known theoretical methods of mismatch indicators. The empirical findings of the cross-country data sets suggest that the values for the particular mismatch indicators differ in a great extent. Therefore, it is very hard to estimate the real size of structural unemployment. The measured values for all mismatch indicators cannot give a uniform conclusion, but they show corresponding trend.*

**Key words:** labour market, structural unemployment, region, mismatch, transition economies

**JEL classification:** J41, J61, J63, O57

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\* Received: 20-11-2005; accepted: 25-04-2006

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<sup>2</sup> Author thanks for the whole-hearted help in collecting data to Fillipová Martina and Vavreckova Jana from Research Institute for Labour and Social Affairs in Praha, to Marica Baric, Biserka Bulic and Sanja Crnkovic-Pozaic from Croatian Employment Office in Zagreb, to Jan Kosta from University of Bratislava, to Tomasz Tokarski from Institute of Economics, University of Lodz, Janusz Czarnecki from Central Statistical Office of Poland, Warsaw and to Karmen Leskošek and Sonja Pircher from Employment Service of Slovenia, Ljubljana. The author wishes to express her great appreciation to Professor Ivo Bičanić, Professor Ivo Družić and Professor Soumitra Sharma for their constructive input.

## 1. Introduction

Stable high unemployment rates and low participation of workers in the labour force along with moderate economic growth in the majority of developed and transition European countries indicate complex change in the labour market. The unemployment problem is not as simple as it seems at the first sight, i. e. it does not concern the supply and demand disequilibrium in the labour market only. This is particularly not the case of the transition countries that have undergone the transformation process from the pre-transition economic system into the market-based economy. The paper will primarily focus on the newly arisen structural changes in the labour market caused by the restructuring process. These changes in the labour market lead to the disequilibrium between labour demand and supply, which could be intensified by low geographic mobility, results in the regional maladjustment (mismatch) between the existing regional labour force and the existing demand. Such regional disequilibrium between the labour demand and supply leads to a linking lack of opportunities for the unemployed persons and the available vacancies, which requires an analysis of regional mismatch.

The concept of mismatch can be simply defined as the existence of a disequilibrium or a maladjustment between labour supply and demand, more precisely, the notion of mismatch shows the impossibility of connecting the existing unemployment and vacancies at a disaggregated level. The existing labour supply is finding it more and more difficult to adapt to the changeable labour demand, in connection with the increasing competitiveness at the global market and the accelerated technological changes. The most quoted definition<sup>3</sup> of the concept of mismatch is by Turvey (Turvey, 1977: 210) “...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”. Based on this definition, the unemployment and vacancies in this paper are compared at a well-defined disaggregated level.

The type of unemployment caused by mismatch is characterised by simultaneous existence of the labour demand and supply surpluses (concurrent existence of a large number of the unemployed and the large number of vacancies) or the disequilibrium at some micro market. If there is a labour demand or supply surplus at some micro market or region, then structural disequilibrium or mismatch appears, which hints at the existence of structural unemployment. If there is no mismatch in the labour market, conditionally it could be concluded that the equilibrium between the labour demand and supply is established. Therefore, even if there is no mismatch it is not possible to expect the unemployment rates to equal the vacancy rates at the aggregate or regional levels (Jackman, Roper, 1987: 10). In that way, the labour market is not likely to achieve complete equilibrium, which differentiates it from goods and money markets. From Turvey's (1977) definition, it is obvious that the concept of mismatch cannot be identified by simple facing unemployed workers with vacancies at the

<sup>3</sup> Many authors quoted this definition in their work, among them also Jackman, Roper (1987) and Entorf (1998).

aggregate level, but it is necessary to compare the time-series of outflow from the pool of the unemployed, newly unemployed and vacancies at some disaggregated level. In this article the concept of mismatch is examined in the selected transition countries on the regional level by known theoretical methods of mismatch indicators.

The concept of mismatch is also more often considered as the main reason of the persistent high unemployment in the EU, because relatively high growth rates in the last twenty years can hardly explain the situation of relatively high unemployment rates. Therefore, the mismatch or maladjustment between the vacancies and the unemployed is emphasised as the main cause. In case of transition countries, the increase in GDP from 1995 is continually tied with an increase in employment, but so far the increase in employment is small relatively compared to the increase in the GDP. This means that hidden unemployment has decreased, or that there is a high degree of mismatch between the labour supply and demand. The presence of a high mismatch is the result of significant changes in the structure of product markets during the 1990s in transition countries, which has brought about changes in the structure of the labour demand, uncoordinated with the labour supply. This maladjustment, or better say labour market rigidity, may have been due to low geographic mobility and low skills mobility related to housing problems and to workers' unwillingness or inability to retrain (Rogut, et al., 2002: 63). Weak efficiency of the labour market at the beginning of the transition process could be explained by the fact that employment offices and the unemployed were unaccustomed to the new competitive market economy or active search for jobs.

For analysing the contemporary matching problems in the labour markets of national economies, it is necessary to understand the appropriate theoretical framework and carry out conclusions on the basis of accessible data and econometric models. Therefore, firstly it is important to estimate the standard measures of mismatch i. e. mismatch indicators. Most of the indicators<sup>4</sup> during the 1980s do not show a significant increase of mismatch according to qualification levels (Padoa Schioppa, 1991a). The empirical results of the mismatch indicators at the regional levels are less doubtful and show existence of increasing regional mismatch (Abraham, 1991: 478). This empirical analysis refers to the measurement of the structural unemployment caused by regional mismatch in the selected transition countries.

Our research focuses on the increasing structural unemployment problem by measuring the mismatch indicators in Croatia and CEEC-5 (Central and Eastern European countries – Czech Republic, Hungary<sup>5</sup>, Poland, Slovenia and Slovakia). A comparison between Croatian and CEEC-5 labour markets is provided since this selected group of countries is the most developed group among the transition

<sup>4</sup> These indicators were used by Jackman, Layard, Savouri (1991), Layard, Nickell, Jackman (1991) and Padoa Schioppa (1991a). Layard, Nickell, Jackman have found out proofs of increasing mismatch only in Sweden (Layard, Nickell, Jackman, 1991: 329) and showed that the level of mismatch in Great Britain accounts for approximately 30% of the total unemployment (Layard, Nickell, Jackman, 1991: 310).

<sup>5</sup> As the data for Hungary is not available at the disaggregated level by region mismatch measuring was not possible.

countries (according to the level of GDP per capita) joining the EU in 2004. This group of countries made a significant progress among the transition countries as they had implemented market reforms, established macroeconomic stability, price and market liberalization, introduced new regulations for foreign direct investments, and privatised the state firms. Croatia aspires to become the member of the EU in the near future. An analysis of labour market mismatch indicators could be valuable for Croatia's economic policy. Keeping this in mind, we try to analyse Croatian labour market maladjustments and compare to the group of most developed countries that have recently (in May 2004) joined to the EU.

## 2. Methodological issues

Considering the fact that the results of measuring mismatch are important for developing suitable policies in the labour market, they have to provide an unambiguous argument. As previously mentioned, the maladjustment between the labour supply and demand is considered as the main cause of structural unemployment or labour market mismatch. Methodologically many labour economists<sup>6</sup> stress that it is hard to define clearly the concept of mismatch and, therefore, harder to define proper mismatch measures. However, in labour economics three approaches are familiar (Padoa Schioppa, 1991a: 1).

The first one associates mismatch with short-run sectoral shocks, which usually balance out at the aggregate level, but temporarily increase both unemployment and vacancies. Other two approaches examine mismatch as a more permanent and continuous phenomenon.

Second approach stresses that frictional unemployment is unavoidable. It defines mismatch as the distance between the unemployment rate and an optimal unemployment rate. "Optimal" assumes that, at given vacancy rates, the allocation of unemployed persons among regions (or occupations, skills, etc.) maximizes employment. The optimal rate is established when the vacancy/unemployment ratio ( $V/U$ , where  $V$  stands for the number of vacancies and  $U$  for the number of unemployed) is equal at all micro markets. The corresponding mismatch indicators measure the intersectoral dispersion of  $V/U$  ratios (Jackman, et al., 1987).

Third approach, defines mismatch as a distance between the unemployment rate and a minimum rate, harmonized with the stable price level. This minimum is reached under the assumption of the NAIRU framework by which all unemployment rates are identical at every micro market. The corresponding mismatch indicator measures the variance of the relative unemployment rates in an economy (Jackman, et al., 1991).

Still there is no unique opinion about the relative importance of potential causes of increased unemployment. However, estimations about absolute importance of mis-

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<sup>6</sup> See more in Padoa Schioppa (1991b).

match in explaining unemployment show significant, although different, values. The proportion of unemployment caused by mismatch in total German unemployment has been estimated at around 20% (SVR, 1994: 254), and in Great Britain around one third of total unemployment (Jackman, et al., 1991: 71). These estimates clearly show that mismatch accounts for only a portion of total unemployment and could be considered as a cause of increased unemployment. This empirical analysis focuses precisely on determining the unemployment caused by mismatch, in other words, on determining the proportion of structural unemployment.

Previous empirical results show that problems, when measuring mismatch in the labour market, can result from initial circumstances that researchers meet occasionally. One problem is related to the data that is too little disaggregated. Another likely problem could be related to the data considering vacancies which come from official statistics and include only those job searchers who are registered at the employment offices. In the real world it is common that there is a small part of job searchers who never register at the employment offices, because they solve their unemployed status at the labour market with their acquaintances, intelligence and/or self-employment. Therefore, employers never register that number of vacancies at the employment offices. The number of job searchers who will find a job on their own is hard to estimate<sup>7</sup>. Incomplete initial data about vacancies point out that aggregate mismatch indicators could show completely different results from disaggregated ones. Therefore, measuring mismatch in the labour market could lead to rather questionable conclusions.

The empirical analysis of measuring mismatch in the labour market in this paper is based on disaggregated data on regional level (NUTS<sup>8</sup> 2). Labour Force Survey does not include the data on labour demand, which explains why the registered data from employment offices is used. This figure is also not the most adequate one. It causes a

<sup>7</sup> German institute for labour and profession research (*Institute für Arbeitsmarkt- und Berufsforschung (IAB)*, German Employment Institute) in its research from 1990 comes to a conclusion that only 40% of all vacancies are mediated through employment offices. That number is a little higher for unskilled workers (47%) while it is smaller for the skilled (around 38%) which is logical, because there is a greater possibility that the second group is more efficient in finding a job than the first one (Reyer, Spitznagel, Kretschmer, 1990).

<sup>8</sup> NUTS - *Nomenclature of Territorial Units for Statistics*. Regional division in selected group of countries is adequate to regional division NUTS 2 and NUTS 3 of European Union. This classification was established by Eurostat in 1988 following unique regional statistics of EU. According to this classification distribution, the regional division NUTS 1 level designates country, distribution according to the regional division NUTS 2 level designates macro-regions, and distribution according to the NUTS 3 designates micro-regions. 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](http://europa.eu.int/comm/eurostat/ramon/nuts/introduction_regions_en.html)

severe underestimation of labour demand, especially in the 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 OECD countries, employers in transition countries generally have a smaller range of possibilities available to them to advertise 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 in use since 1996. For example, the Czech Republic started to collect data according to the regional classification NUTS 2 during 2001 (Franco, 2002: 10).

### 3. Theoretical overview of available methods of measuring mismatch

To successfully estimate the presence of mismatch in the labour market of an economy it is necessary to have appropriate analytical tools. Today several concepts of measuring mismatch are present in literature. The most common are 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 a unique definition of the concept of mismatch is still unavailable. In continuation, we provide a theoretical overview of the existing methods of measuring mismatch, and analyse their advantages and disadvantages.

#### 3.1. Mismatch indicators based on intersectoral disequilibria

Jackman and Roper (1987) supplied the foundation for calculating mismatch indicators based on Turvey's most cited definition of the structural unemployment. To make this definition operative in empirical estimations they specify the job hiring function ( $H$ ) or the matching function:

$$H_i = h_i(u_i, V_i) \quad (1)$$

where  $U_i$  and  $V_i$  stand for the number of the unemployed and the vacancies in category  $i$  (region, occupation, skill etc.), and  $h_i$  is defined as:  $h_i = H_i/N_i$  where  $N_i$  stands for the number of the employed in category  $i$ . Matching function  $h_i$  is linearly homogeneous function of the unemployed and the vacancies. Function  $H$  is equal and convex for all the regions  $i$ , and satisfies linear homogeneity:

$$H_i = V h_i \left( \frac{u_i}{V_i} \right) \quad (2)$$
$$h' > 0, h'' < 0$$

where  $h_i(U_i / V_i)$  represents the amount of regional employment. Unemployment caused by mismatch decreases to zero when the total number of employed is maximised<sup>9</sup>.

According to Turvey (1977); Jackman and Roper (1987) define structural unemployment as regional allocation of the existing number of the unemployed that, along with regional allocation of vacancies, maximises aggregate employment:

$$\max H = \max \sum_i H_i = \max \sum_i V_i h_i \left( \frac{U_i}{V_i} \right) \quad (3)$$

subject to that  $\sum_i U_i$  constant and  $V_i$  is given<sup>10</sup>.

Considering that the necessary condition of the extreme value in equation (3) shows that  $h'(U_i / V_i) = \text{const}$  for all  $i$ , the only possible solution to the allocation problem is that the ratio of the unemployed and the vacancies be equal in all regions. It means that in this case there is a mismatch equilibrium (Jackman, et al., 1987: 11). Furthermore,  $U_1 / V_1 = U_2 / V_2 = \dots = U_k / V_k$  yielding  $u_1 = v_1, u_2 = v_2, \dots, u_k = v_k$ , where  $u_i = U_i / \sum_i U_i$  and  $v_i = V_i / \sum_i V_i$ . In other words, this means a portion of the unemployed in the region  $i$  in relation to the total number of the unemployed in an economy and a portion of vacancies in the region  $i$  in relation to the total number of vacancies in an economy. According to the above mentioned, it follows that the natural way of defining mismatch is:

$$M_1 = \frac{1}{2} \sum_i |u_i - v_i| \quad (4)$$

whose value is zero if there is no mismatch, i. e. when labour supply is equal to labour demand in all regions (when  $u_i = v_i$  for all  $i$ ). If the numbers of the unemployed and the vacancies differ 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 situated in another.

The mismatch indicator  $M_1$  is frequently used in empirical studies by Layard and Nickell (1986), who have calculated the above mentioned indicators for occupations, regions and industries in Great Britain; Jackman and Roper (1987) who have calculated the mentioned indicators for Great Britain, France and the Nordic countries; and Boeri (1994) for Bulgaria, Czech Republic, Hungary, Poland, and Slovak Republic, and Boeri and Scarpetta (1996) for Bulgaria, Czech Republic, Hungary, Poland, Romania, and Slovak Republic). Boeri and Scarpetta (1996), emphasize that the value of mismatch indicator  $M_1$  in the selected transition countries implies the existence of a portion of structural unemployment in total unemployment. That portion presents the number of unemployed workers (or vacancies) who should

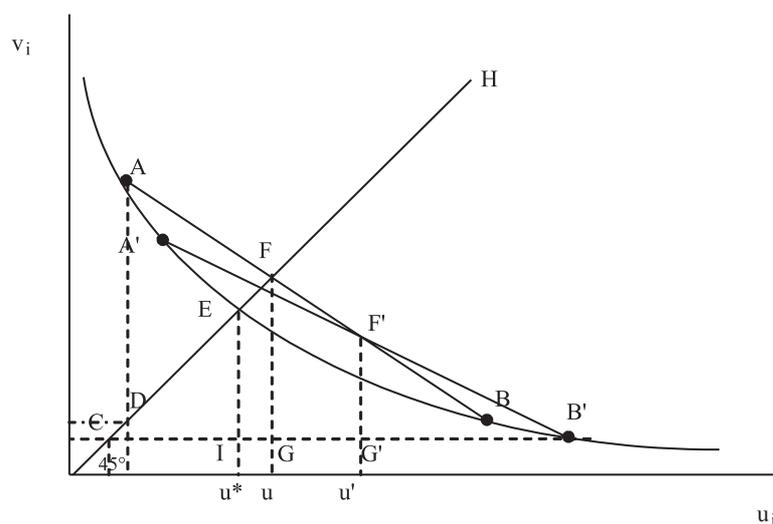
<sup>9</sup> That means that structural unemployment is brought down to minimum.

<sup>10</sup> When  $V_i$  is given then  $U_i$  is variable.

be reallocated from one region to another in order to achieve structural equilibrium or the situation of perfect matching. They have calculated the mismatch indicator  $M_I$  during the 1991-1994 time period in some transition countries and the obtained results have shown that the rate of structural unemployment was 20% in Bulgaria, 38% in the Czech Republic, 27% in Hungary, 34% in Poland, around 30% in Slovakia, and the highest figure of approximately 41% was recorded in Romania (Boeri, et al., 1996: 237-238). The advantage of the mismatch indicator  $M_I$  lies in the fact that the calculations included the values for the unemployed, the employed and the vacancies for all regions. Therefore,  $M_I$  can be considered as a complete mismatch measure.

This concept of mismatch indicator  $M_I$  could be graphically presented in the following two-region model (see figure 1).

Figure 1: Portion of unemployment caused by mismatch



Source: modified according to Jackman, Roper (1987: 13)

Figure 1 shows the aggregate employment function ( $H$ ) and the aggregate relation between the unemployment rate ( $u$ ) and the vacancy rate ( $v$ ). Points A and B show the values of the unemployed and vacancies ( $u_i, v_i$ ) in both regions. The total value for  $u$  and  $v$  in the entire economy is given by point F<sup>11</sup>. In points A and B, the regional values  $U_i / V_i$  differ as well as the values of hiring  $h_i$ . The mismatch equilibrium is achieved along the line H<sup>12</sup>, and interregional exchange of the unemployed has to last until some point on the line H is achieved. In that case, the portion of the

<sup>11</sup> It is assumed that both regions are of the same size. Therefore, the point F is in the middle of the distance A and B.

<sup>12</sup> Line H presents the equilibrium  $v_i = u_i$ , because line H is presented at a 45° angle. In the original paper (Jackman, Roper: 1987) line H is not under 45° angle, but authors claim that there is an equilibrium between  $v_i$  and  $u_i$  on line H. This is questionable therefore line H shown here is at angle of 45°.

unemployment caused by mismatch is minimized. This can be illustrated in points C and D, where regional values  $U_i / V_i$  are equal.

The curve AEB shows regional combinations of the unemployed ( $u$ ) and vacancies ( $v$ ) at some hiring level, and describes the Beveridge curve<sup>13</sup>. Values  $u$  and  $v$  reach minimum in point E. At that point, regional and aggregate values  $U_i / V_i$  equalize, as well as regional and aggregate values of hiring, so mismatch is minimised. The distance  $IG$  shows the value of unemployment caused by mismatch.

In order to calculate that value, as in the case of the mismatch indicator  $M_1$ , the hiring function of the Cobb-Douglas type of production function is used. This is a special form of matching function that takes the following form:

$$H_i = \beta U_i^{\frac{1}{2}} V_i^{\frac{1}{2}},$$

and in aggregate form:

$$H = \sum_i H_i = \beta U_i^{\frac{1}{2}} V_i^{\frac{1}{2}} \sum_i (u_i v_i)^{\frac{1}{2}} \quad (5).$$

This form leads to the known shape of  $u/v$  curve (as in the case of isoquants by Cobb-Douglas production function) and it is therefore a standard approximation in empirical results. Some authors<sup>14</sup> argue for a selection of  $\alpha=1/2$  in linear homogeneous Cobb-Douglas hiring function. Total hiring in an economy is maximised when the last term of the equation (5) equals 1. That is valid under the assumption that all regional values  $U_i / V_i$  are equal. Jackman and Roper (Jackman, et al., 1987: 13) use equation (5) to define the alternative mismatch indicator:

$$M_2 = 1 - \sum_i (u_i v_i)^{\frac{1}{2}} \quad (6).$$

As in the equation (4) or mismatch indicator  $M_1$ , the optimal allocation of unemployment inside the regions is obtained when  $M_2$  is zero ( $u_i=v_i$  for all  $i$ ). When there is no matching at all, in other words when  $u_i v_i=0$  for all  $i$ ,  $M_2$  acquires maximal value 1 and existence of full mismatch is considered. It means that one region contains all unemployed and other all vacancies. The portion of unemployment in whole economy is  $1-M_2$  in the equilibrium point E. The difference between real ( $U$ ) and equilibrium unemployment ( $U^*$ ) represents unemployment caused by mismatch (see figure 1):

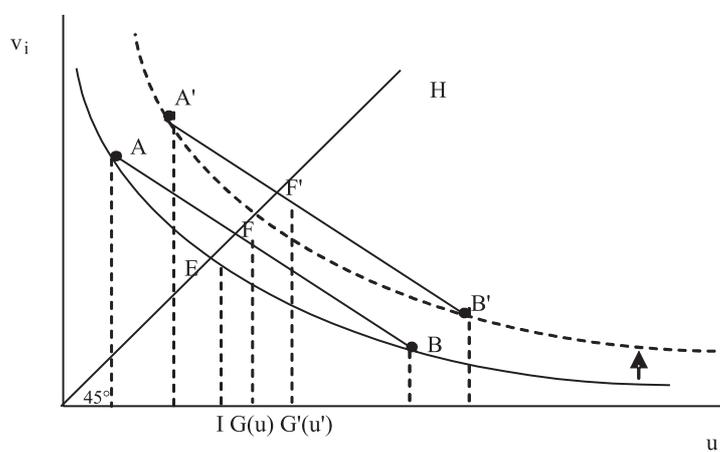
$$U - U^* = M_2 U$$

<sup>13</sup> The negative relationship between the unemployed and the vacancies was firstly identify by William Beveridge in the 1940-ties.

<sup>14</sup> See more in Layard, Nickell, Jackman (1991: 328), who have justified their selection citing Pissarides (1986) and Blanchard, Diamond (1990), and according to their own empirical proofs.

The indicators  $M_1$  and  $M_2$  take into consideration the regional equilibrium on condition of unchanged total demand. This also generates their disadvantages, because cyclical oscillations of the mentioned mismatch indicators do not result exclusively from the changes of structural factors, but from the different regional effects on the side of the aggregate demand. Even when cyclical oscillations in all regions have equal efficiency<sup>15</sup>, it is possible to identify mismatch in the indicators change. For example, it is possible for a region to be affected by a neutral negative shock<sup>16</sup> on the demand side, which equally increase or decrease regional unemployment and the number of vacancies. Figure 2 shows the influence of these shocks on the demand side.

Figure 2: Increase of unemployment and vacancies in both regions



Source: Original made by author

The increase of  $u_i$  and  $v_i$  in both regions in figure 2 is shown by the shift of the convex curve  $u/v$  to the northwest. Points A' and B' show regional values for  $u$  and  $v$ , and point F' the values for  $u$  and  $v$  in the entire economy after a change in demand. The aggregate unemployment increases from  $\overline{u}$  to  $\overline{u'}$  while the unemployment caused by mismatch increases from  $\overline{IG}$  to  $\overline{IG'}$ , by the value  $\overline{GG'}$ , also represented by the mismatch indicator  $M_1$ <sup>17</sup>. If the number of the unemployed is larger than the number of vacancies, which is often the case in reality,  $M_1$  and  $M_2$  behave pro-cyclically.

### 3.2. Mismatch indicators based on NAIRU model

The main problem in measuring the above mentioned two indicators ( $M_1$  and  $M_2$ ) is the fact that for their calculation, vacancy data on disaggregated level is needed. This

<sup>15</sup> That means that 1% change in total demand in one economy causes 1% change of demand in all regions.

<sup>16</sup> Neutral negative shock presumes a shock that equally influences all regions.

<sup>17</sup> Because of convexity of the  $u/v$  curve, absolute difference between unemployment and vacancies increases, and as a consequence the mismatch indicator  $M_1$  also increases.

data is usually not available in most countries. Therefore, Jackman, Layard and Savouri (1991) have suggested a third mismatch indicator, whose advantage is in a fact that it is exclusively based on the numbers of the unemployed and the employed. Therefore, data on vacancies is not needed for its calculation:

$$M_3 = \frac{1}{2} \text{var} \left( \frac{\frac{U_i}{N_i}}{\frac{\sum U_i}{\sum N_i}} \right) \quad (7)$$

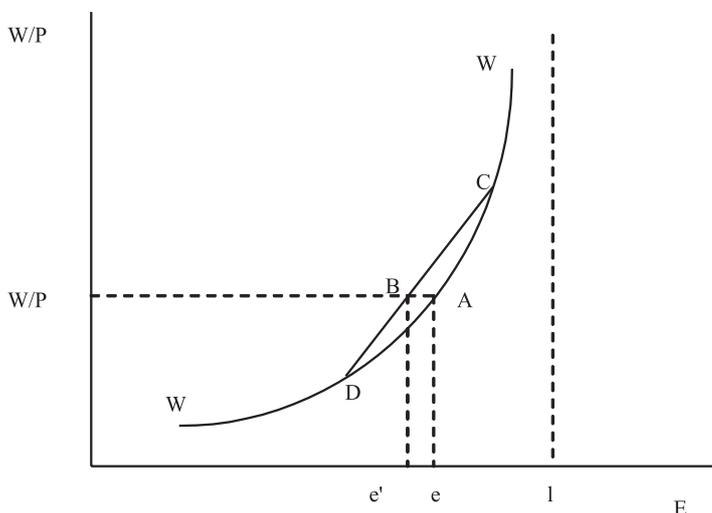
where  $U_i$  indicates a number of the unemployed and  $N_i$  a number of the employed workers<sup>18</sup>. This indicator comes from the NAIRU<sup>19</sup> theoretical framework, in other words from the fact that long-term equilibrium is attained at minimal total unemployment level. When a number of the unemployed is the same in all regions then there is no mismatch and the value of the mismatch indicator  $M_3$  is zero. In other cases, the value of the mismatch indicator  $M_3$  ranges from 0 and 1 (Pauer, 2000: 167).

Policy makers are usually interested only in the aggregate unemployment and they are not in explaining every single disaggregated rate. For example, they are interested if the increase in structural disequilibrium can explain the present high unemployment in Europe. The presence of a unique indicator, which can estimate the relationship between structural unemployment and average unemployment levels, is questionable. The following analysis will offer an affirmative view.

<sup>18</sup> In calculating 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 a use of variance stressing that it depends on middle value. Such imperfection does not exist by application a coefficient of variation (Sen, 1985: 31-32).

<sup>19</sup> NAIRU - non-accelerating inflation rate of unemployment.

Figure 3: Mismatch indicator based on NAIRU framework



Source: Jackman, Layard, Savouri (1991: 68).

In the two-region model Figure 3 shows the function of the real wages ( $WW$ ), which is equal for both regions. In point A there is a long-term equilibrium and there is no interregional migration, because unemployment rates in both regions are equal and aggregate unemployment is equal to value A. That means that in point A unemployment caused by mismatch is minimal. The regional unemployment rate ( $u_i$ ) and the total unemployment rate ( $u^*$ ) in point A coincide<sup>20</sup>, while regional differences in real wages correspond to differences in migration costs. The average level of real wage is equal to the value  $W/P$ . If regional unemployment rates differ as in points C and D, and if the average real wage remains unchanged, aggregate employment (unemployment) decreases (increases)<sup>21</sup>. Considering that regional differences in real wages do not correspond to the differences in migration costs, short-term disequilibrium emerges. With interregional migrations and regional changes in real wages new long-term equilibrium could be established. During this process of adjustment, unemployment caused by mismatch in the amount of  $ee'$  emerges, and new equilibrium is established along the real wage curve ( $WW$ ).

To derive the appropriate mismatch indicator, Jackman, Layard and Savouri (1991) presuppose the Cobb-Douglas production function with constant returns to scale for which nominal function of prices ( $P$ ) is:

$$P = \prod_i W_i^{\alpha_i} e^{-A}, \left( \sum_i \alpha_i = 1 \right) \quad (8)$$

<sup>20</sup> The mentioned quantity of unemployment is equal to the distance from  $l$  to  $e$ .

<sup>21</sup> The mentioned value is equal to the distance from  $l$  to  $e'$  or to point B.

where  $W_i$  stays for wages in region  $i$ ,  $\alpha_i$  for regional labour productivity in region  $i$ , and  $A$  is a composite index of technological progress and market competitiveness.

The technological progress ( $A$ ) has a negative sign in this case, because increase in productivity includes implicitly decrease in prices<sup>22</sup>. By setting prices on unit level<sup>23</sup> and finding the logarithm of the equation (8), the price function gives expression for possible real wage border:

$$A = \sum \alpha_i \log W_i .$$

Furthermore, the function of real wages is assumed (Grubb (1986)):

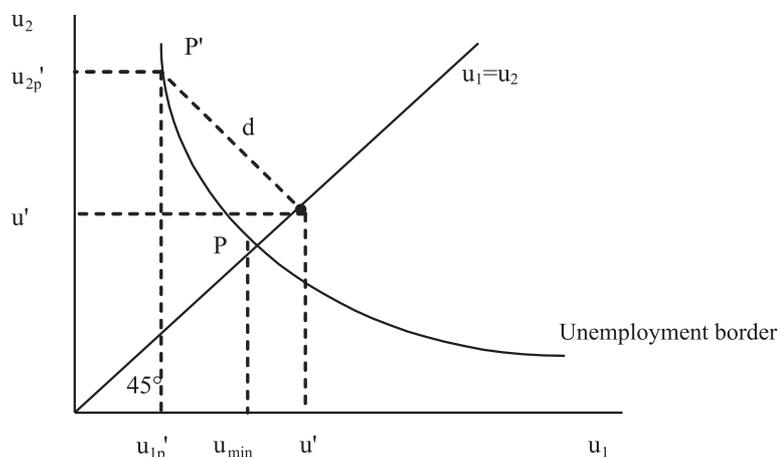
$$\log W_i = \beta_i - \gamma \log u_i , \quad (9)$$

where  $\gamma$  stays for real wage elasticity in relation to unemployment. By substituting the wage function (9) in the price function (8) unemployment border appears:

$$A = \sum \alpha_i \beta_i - \gamma \sum \alpha_i \log u_i \quad (10)$$

which shows all combinations of regional unemployment rates harmonized with constant rate of inflation. Minimizing total unemployment at stable inflation (NAIRU) could be illustrated by the following two-regional model (it is assumed that both regions are of equal size ( $\alpha_1 = \alpha_2 = 1/2$ )).

Figure 4: Minimum total unemployment at stable inflation (NAIRU)



Source: modified according to Jackman, Layard, Savouri (1991: 69).

<sup>22</sup> This case is valid just under assumption of perfect competition. Considering that in the real world markets are not perfect, enterprises have specific monopoly power, so the increase in productivity leads to the increase in prices.

<sup>23</sup> In that a way, constant price levels are assumed.

The unemployment border is convex (see figure 4) and the lowest possible average level of unemployment ( $u_{min}$ ) is in point P where unemployment is equal in both regions ( $u_1=u_2$ ). In that point there are no interregional migrations and unemployment caused by mismatch is reduced to zero. If regional unemployment rates differ, as seen in point P', then total unemployment moves away from its minimal value and is equal to  $u'$ . Aggregate unemployment is higher if unemployment rates ( $u_i$ ) deviate more from each other. In that case, distance  $u'u_{min}$  indicates unemployment caused by mismatch. The re-establishment of long-term equilibrium in point P is possible to attain only by interregional migrations, while, according to the model assumption, the possibility of different real wages in each region is excluded.

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

$$M_4 = \frac{1}{2} \text{var} \frac{u_i}{u} \quad (11)$$

where *var* stands for variance. Indicator  $M_4$  is zero when all regional unemployment rates are equal to the aggregate one. In that case, labour supply and demand become equal and there is no mismatch. Calculating the degree of mismatch (according to the equation (11)) in Great Britain in 1985, Jackman, Layard and Savouri have found that mismatch accounts for approximately around 30% of the total structural unemployment, and hence its importance cannot be excluded (Jackman, et al. 1991: 71).

In contrast to the indicators  $M_1$  and  $M_2$ , which behave procyclically in some circumstances, the indicators  $M_3$  and  $M_4$  are stable at times of regional neutral shocks. If the regional unemployment increases by the same amount as the aggregate unemployment, due to negative shock on the demand side, the variance ( $u_i/u$ ) will stay unchanged as well as a portion of unemployment caused by mismatch in aggregate unemployment.

### 3.3. Mismatch indicators based on leading region

The mismatch indicators analysed so far are based on the assumption that wages in each region depend solely on unemployment rates in a given region. If a situation of high centralization of collective bargaining is assumed, it is expected that changes in nominal wages in a leading region (i. e. a region with the lowest unemployment rate) will have a dominant role when determining regional wages. Therefore, Jackman, Layard and Savouri (1991) have assumed that wages depend merely on unemployment rates in some leading regions (e.g., as the case is in the south of England, or in the areas of some nations' capitals), whose unemployment rates are defined by  $u_L$ . Thus, the following wage function is assumed:

$$\log W_i = \beta_i - \log u_L \quad (12)$$

The regional real wage is expressed as a dependence on the leading region unemployment rate ( $u_L$ ). The function of unemployment border is derived from the wage function:

$$A = \sum \alpha_i \beta_i - \gamma \log u_L \quad (13).$$

This border also illustrates the lowest unemployment level ( $u_L$ ) in the entire economy, because it is assumed that unemployment in other regions cannot be lower than in a leading region. In the equilibrium<sup>24</sup>, it is also valid that in no other region unemployment can be lower than in a leading region, because real wages in a region depend on unemployment  $u_L$  and unemployment in each particular region does not put pressure on wages in the same region. If unemployment in a region  $i$  is higher, according to equation (12), it will not have any larger pressure on real wage  $W_i$ . In that case, interregional migrations appear, and last until all regional  $u_i$  is equalized with  $u_L$  as well as with the total unemployment rate in an economy. Every deviation of aggregate unemployment  $u$  from unemployment  $u_L$  results from structural factors. According to the above mentioned, a mismatch indicator  $M_5$  is derived<sup>25</sup>:

$$M_5 = \log u - \log u_L \quad (14).$$

The definition of unemployment rate in leading regions states that the mismatch indicator  $M_5$  is greater than the mismatch indicator measured according to the assumption that wages depend on unemployment in the same region (the basic model). The fact is, for certain groups of unemployment rates the minimum level of unemployment is much larger in the case of the basic model than in the case of the leading region (Jackman, et al., 1991: 73):

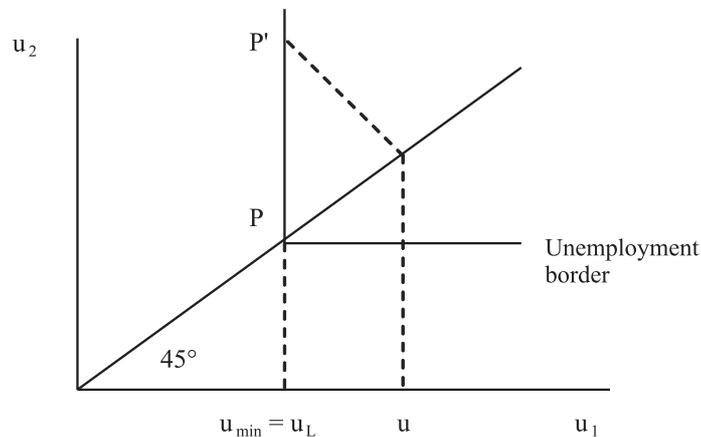
$$\log u_{\min} = \sum_i \alpha_i \log u_i, \left( \sum_i \alpha_i = 1 \right).$$

The minimum level of unemployment ( $u_{\min}$ ) is equal to the geometric mean of all unemployment rates in each region, while in the case of the leading region the lowest unemployment rate is  $u_L$ . The gap between  $u$  and  $u_{\min}$  is larger in the model of the leading region than in the basic model. The mentioned equilibrium in the case of the leading region could be presented by Figure 5.

<sup>24</sup> In the equilibrium state the possibility of interregional migrations is omitted.

<sup>25</sup> Wages in a region can depend on the unemployment in that region ( $u_i$ ), as well as on unemployment in the leading region ( $u_L$ ):  $\log W_i = \beta_1 - \gamma_1 \log u_i - \gamma_2 \log u_L$ .

Figure 5: Unemployment border in the leading region



Source: Jackman, Layard, Savouri (1991: 73)

In Figure 5 region 1 represents the leading region with unemployment rate  $u_{\min}$ . Considering the assumption that the leading region has the lowest unemployment rate, unemployment border is under rectangle ( $90^\circ$  angle). In the equilibrium point P, regional unemployment rates  $u_1$  and  $u_2$  are equal, so there is no interregional migration and no mismatch. The total unemployment is equal to the unemployment in the leading region. If unemployment in region 2 increases more than unemployment in region 1 ( $u_2 > u_1$ ), the total unemployment will increase at the level  $u$  in the point P'. As the decrease of real wages in region 2 cannot be equalized by the aforementioned equilibrium according to the assumption of the model, the new equilibrium is re-established by interregional migrations. The difference between real aggregate unemployment ( $u$ ) and minimum unemployment ( $u_{\min}$ ) is equal to the unemployment caused by mismatch.

As it is true for the mismatch indicators  $M_3$  and  $M_4$ , the mismatch indicator  $M_5$  also often shows basic feature that it is economically stable at moments of regional neutral shock impacts. Previously has been emphasized that indicators  $M_1$  and  $M_2$  behave procyclically in such situations.

### 3.4. Theoretical considerations of mismatch methods

Finally, it could be concluded that theoretically, as mismatch measures,  $M_1$ ,  $M_2$ ,  $M_3$  and  $M_4$  are the most valuable mismatch indicators. By calculating these four mismatch indicators, values for unemployment, employment and vacancies in real and absolute amounts for all regions are used, and in such a way these indicators can be considered as complete mismatch measures. In the case of the mismatch indicator  $M_5$ , the value for indicator is calculated as a difference between total average regional unemployment rate and the lowest regional unemployment rate. In such a way, the comparison of all other regions with average regional unemployment rate is excluded

from the calculation. If all other regional unemployment rates were included, the mismatch indicator  $M_5$  would be more representative.

In calculating the mismatch indicators  $M_1$  and  $M_2$ , unemployment and vacancy rates for all regions are used, i. e. the values on the side of labour supply and demand. In calculating the mismatch indicators  $M_3$  and  $M_4$  the values for the unemployed and the employed are used, i. e. only the data on the labour supply side. Therefore, as the most appropriate measure of adjustment in the labour market, mismatch indicators  $M_1$  and  $M_2$  are considered, because they simply show the functioning of supply and demand in the market.

The fundamental disadvantage of all five mismatch indicators results from the fact that there is still no unique definition of mismatch concept. This is also the main reason, why several different methods for measuring mismatch indicators appear in literature. This leads to very different empirical results about the actual unemployment caused by mismatch. The theoretical framework, which includes different starting variables in a calculation process, influences the value of indicators. Therefore, the obtained results for single indicators should be taken with caution, but still it is important to stress that they show an adequate trend. This is also the main reason why many authors calculated them. The results are more representative if input data is more disaggregated according to regions and time (Pauer, 2000: 132).

#### 4. Results - Empirical data analysis of mismatch indicators

Considering the fact that there is still no unique definition of the mismatch concept, no unique method of measuring mismatch indicators exists. All mentioned indicators above are derived from disaggregated level and an essential difference follows from different input data used in their calculation. This is also the main reason why different empirical results about the actual unemployment size caused by mismatch do appear. As the differences in the size of geographic units in different regions could affect the measure of regional mismatch, the EU methodology on regional level according to NUTS level Regulation is used. The comparison according to level NUTS 2 and NUTS 3 is used<sup>26</sup>, as it is considered optimal for planning and regional analysis, because of their intermediate role between state and local authorities.

For calculating mismatch indicators  $M_1$  and  $M_2$  disaggregated data on the unemployed and vacancies are used. The indicator  $M_3$  uses data on the unemployed and the employed, while indicators  $M_4$  and  $M_5$  use merely the data on unemployed workers. Yearly regional data was used in calculations. The analysed period differs

<sup>26</sup> In the case of small countries according to number of population and surface, the level NUTS 2 designates country. In the case of transition countries, such are Estonia, Latvia, Lithuania, Croatia and Slovenia. In the EU that is a case for Denmark and Netherlands. The size of Malta and Cyprus is so small that regional division according to NUTS level regulation does not exist. Mentioned administrative distribution is also one of *Acquis communautaire* conditions or precondition for EU membership and receiving assistance from EU structural funds.

according to the data availability for each country. Indicators show the existence of regional maladjustment between vacancies and the unemployed or the existence of structural unemployment in total unemployment (Boeri, et al., 1998: 20). In the following tables all previously mentioned mismatch indicators by region for the selected transition countries are calculated. Only a few authors have conducted the research on mismatch indicators for the transition countries. Boeri and Scarpetta calculated some variation of mismatch indicator  $M_1$  (Boeri, 1994: 10-11; Scarpetta, 1995: 57), while other mismatch indicators were not measured. Therefore, the importance of these results is even more significant.

Table 1: Empirical results for particular mismatch indicators according to disaggregated data by 14 macro-regions, Czech Republic, 1992-2002

Year	$M_1$	$M_2$	$M_3$	$M_4$	$M_5$
1993	0.35	0.11	0.006	0.19	0.73
1994	0.33	0.09	0.007	0.26	0.75
1995	0.30	0.07	0.007	0.31	0.73
1996	0.31	0.08	0.015	0.31	0.73
1997	0.26	0.06	0.016	0.26	0.62
1998	0.25	0.05	0.020	0.23	0.49
1999	0.26	0.05	0.021	0.21	0.39
2000	0.26	0.05	0.015	0.19	0.39
2001	0.29	0.06	0.015	0.23	0.39
2002	0.29	0.06	0.024	0.25	0.39

Source: 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

As mentioned earlier, because of lack of a unique definition of mismatch and because of the problems of data using it was expected that the results of some indicators would be different. This is also confirmed in the case of the Czech Republic. It is stressed that indicators from  $M_1$  to  $M_4$  could be considered representative, since all values for the needed variables by region were used in the calculations. It is worth mentionine that all results should be taken with a caution, but their trend shows the actual state of the regional labour market. In the case of the Czech Republic, giving any evaluations is hard, because during the observed period  $M_1$  and  $M_2$  decreased, and  $M_3$  and  $M_4$  increased. However it is possible to conclude that the increase of indicators  $M_3$  and  $M_4$  is slightly larger than the decrease of indicators  $M_1$  and  $M_2$ . Therefore, it can be concluded that in spite of the lowest unemployment rates among

all selected transition countries during observed period, there is an increase of regional maladjustment in the Czech Republic.

Table 2: Empirical results for particular mismatch indicators according to disaggregated data by 21 macro-regions, Croatia, 1993-2002

Year	M <sub>1</sub>	M <sub>2</sub>	M <sub>3</sub>	M <sub>4</sub>	M <sub>5</sub>
1993	0.21	0.028	0.14	0.34	0.65
1994	0.21	0.029	0.06	0.32	0.68
1995	0.20	0.027	0.07	0.29	0.68
1996	0.23	0.036	0.04	0.25	0.69
1997	0.24	0.039	0.03	0.25	0.73
1998	0.23	0.033	0.03	0.24	0.69
1999	0.21	0.026	0.02	0.23	0.67
2000	0.18	0.024	0.02	0.23	0.65
2001	0.17	0.019	0.02	0.23	0.63
2002	0.15	0.017	0.01	0.23	0.63

Source: Croatian Employment Office Database

In Croatia's case the trend of all indicators is the same and shows that in the period from 1993 until 2002 the regional mismatch has decreased (see Table 2). The largest differences among the values of the particular indicators can be identified in indicator  $M_4$  ranging from 0,34 to 0,23 during last ten years. Though it was not expected that during that time period the regional mismatch would decrease, but the measured indicators show that these regional maladjustment in Croatia's labour market have decreased. According to the NUTS level Regulation, Croatia and Slovenia as a country are considered to be at NUTS 2 level and their regions (counties) are at NUTS 3 level. At the level NUTS 3 in Croatia some smaller territorial parts (municipalities) were affected by war and some were not, so if the NUTS 3 level division would be treated as a different set of regions, smaller territorial levels should be taken into account<sup>27</sup>. In such way mismatch concept analysis in Croatia would not be comparable with other countries in a selected group.

<sup>27</sup> It was not possible to use NUTS 3 division for the Czech Republic, Poland and Slovakia, because 3 main indicators are not recorded in this countries at such disaggregated level.

Table 3: Empirical results for particular mismatch indicators according to disaggregated data by 21 macro-regions, Poland, 1992-2001

Year	$M_1$	$M_2$	$M_3$	$M_4$	$M_5$
1992	0.16	0.02	0.01	0.06	0.39
1993	0.12	0.02	0.005	0.06	0.39
1994	0.06	0.004	0.002	0.07	0.40
1995	0.07	0.004	0.003	0.07	0.42
1996	0.07	0.003	0.002	0.06	0.42
1997	0.06	0.003	0.003	0.06	0.38
1998	0.06	0.004	0.004	0.06	0.38
1999	0.07	0.005	0.005	0.06	0.35
2000	0.07	0.005	0.005	0.06	0.38
2001	0.09	0.006	0.007	0.06	0.38

Source: Database of Central Statistical Office, Warsaw

In the case of Poland, similar to Croatia, all mismatch indicators in the observed period show that the regional maladjustment has decreased. It could be noticed that oscillations of all regional mismatch indicators during the selected period are very small, especially in the case of indicators  $M_4$  and  $M_5$ , which have not changed at all.

Table 4: Empirical results for particular mismatch indicators according to the disaggregated data by 8 macro-regions, Slovakia, 1997-2002

Year	$M_1$	$M_2$	$M_3$	$M_4$	$M_5$
1997	0.19	0.03	0.007	0.056	0.361
1998	0.15	0.02	0.016	0.055	0.349
1999	0.17	0.02	0.021	0.052	0.324
2000	0.12	0.01	0.005	0.053	0.319
2001	0.07	0.004	0.006	0.058	0.349
2002	0.09	0.007	0.008	0.063	0.378

Source: National Labour Office - Bratislava

In Slovakia the regional mismatch indicators  $M_1$  and  $M_2$  have decreased. At the same time, a small increase of mismatch indicators  $M_3$ - $M_5$  occurred and a mismatch indicator  $M_5$  relatively increased to the greatest extent. By examining all indicators, it could be concluded that the trend of their decrease is larger than the trend of their

increase. Thus, it could be concluded that during the observed period, regional maladjustment in Slovakia was reduced.

Table 5: Empirical results for particular mismatch indicators according to disaggregated data by 8 macro-regions, Slovenia, 1990-2002

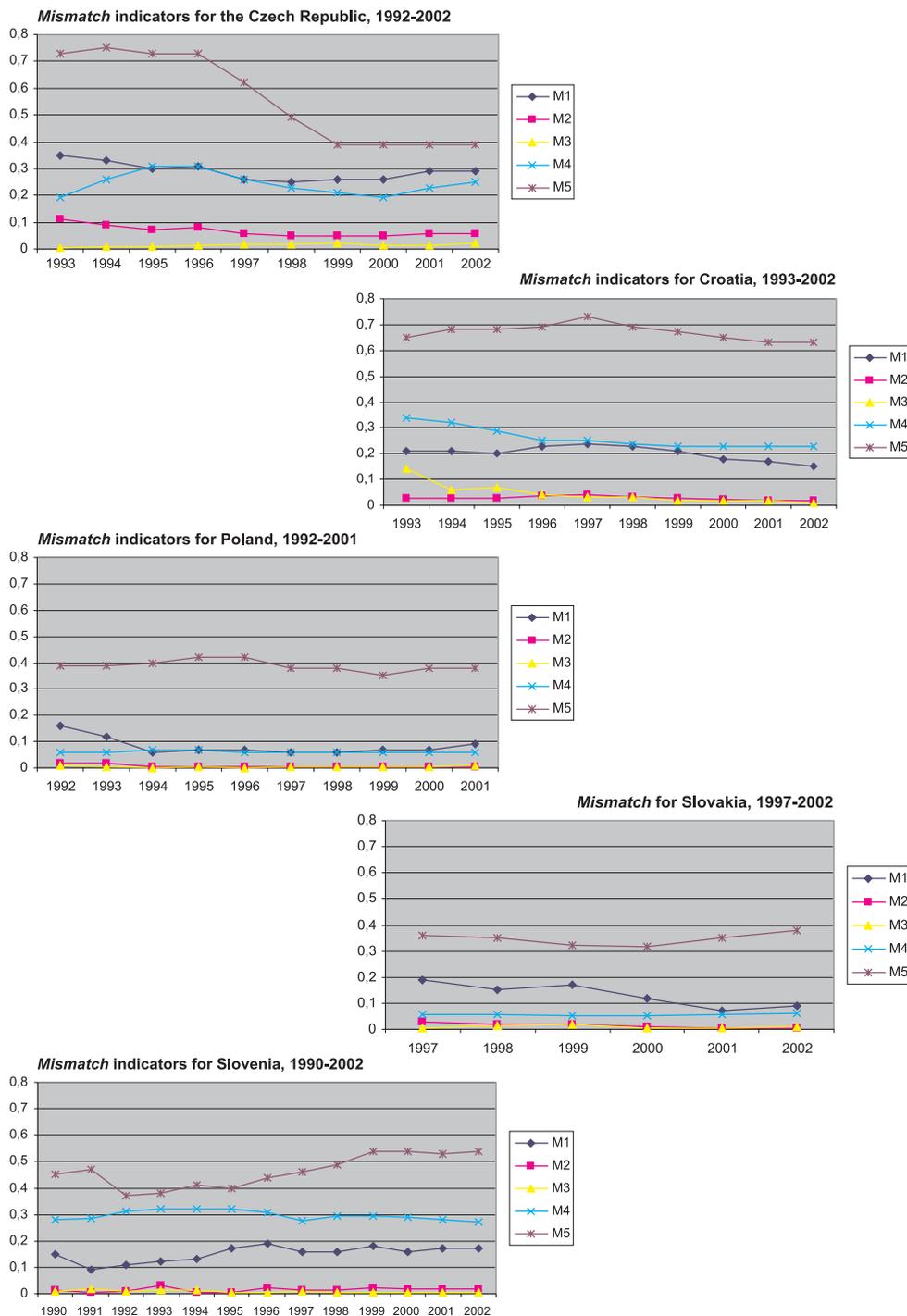
Year	$M_1$	$M_2$	$M_3$	$M_4$	$M_5$
1990	0.15	0.015	0.009	0.282	0.45
1991	0.09	0.006	0.019	0.285	0.47
1992	0.11	0.008	0.009	0.312	0.37
1993	0.12	0.293	0.015	0.32	0.38
1994	0.13	0.004	0.012	0.319	0.41
1995	0.17	0.005	0.006	0.322	0.40
1996	0.19	0.022	0.003	0.307	0.44
1997	0.16	0.015	0.008	0.277	0.46
1998	0.16	0.015	0.005	0.292	0.49
1999	0.18	0.021	0.003	0.293	0.54
2000	0.16	0.017	0.003	0.288	0.54
2001	0.17	0.018	0.003	0.281	0.53
2002	0.17	0.016	0.003	0.27	0.54

Source: National Data Base from Employment Office in Ljubljana

In case of Slovenia, the mismatch indicators  $M_3$  and  $M_4$  have decreased, while all other indicators increased which shows that regional mismatch has increased in Slovenia during the observed period. The mismatch indicator  $M_5$  has increased to the utmost, wherewith it is shown that in the previous period the differences in the movement between the lowest regional and the average total regional unemployment rates increased.

The following figure (see Figure 6) shows the revised images of all previously calculated mismatch indicators ( $M_1$ - $M_5$ ) for the selected transition countries in the observed time period.

Figure 6: Mismatch indicators of selected transition countries



Source: according to the tables from 1 to 5

## 5. Conclusion

One reason for high stable unemployment rates and low participation in the labour force of the selected transition countries seems to be the mismatch between the regional distribution of unemployed persons and available vacancies. The problem is that in the absence of large interregional migration flows the regional mismatch between the processes of job destruction and job creation has resulted in a rapid build-up of persistent structural unemployment. Such a situation is even more common in transition countries that have been increasingly affected by the restructuring process during the 1990s.

The results of the empirical analysis confirm the expectations and show some differences in the measured values for some mismatch indicators. It is obvious that in all selected transition countries the values of the particular mismatch indicators differ considerably. Therefore, it is very hard to estimate the real size of structural unemployment, in other words unemployment caused by mismatch. Generally speaking, the measured values of all mismatch indicators in the selected countries do not offer a conclusion, but can show adequate trends.

Namely, only in case of Croatia and Poland the values of all mismatch indicators in the selected period decreased, and in Poland the smallest oscillation in the movement of the mismatch indicator  $M_5$  was identified, which shows a small decrease in structural unemployment. Therefore, it can be said that in the last decade the regional mismatch in Croatia and Poland have slightly decreased, as a consequence of better regional matching. In Slovenia the values for all mismatch indicators, except for indicators  $M_3$  and  $M_4$ , have increased. In comparison to other countries in the observed period the values for the mismatch indicators  $M_5$  are the highest in Croatia. Its value shows the differences in the movements among the lowest regional and average regional unemployment rates. The conclusion follows that the largest regional differences in regional mismatch movements have been noticed in Croatia. Considering that indicator  $M_5$  was relatively large during the whole observed period the existence of steady regional differences in Croatia is confirmed. In context to the mismatch indicator  $M_5$ , regional differences between the regions with the lowest unemployment rate and the average unemployment rate increased in Slovenia and decreased in the Czech Republic. Analysing all five mismatch indicators together for Slovakia, it could be concluded that the decreasing trend is larger than the increasing trend. Thus, the final conclusion is that during the observed period a slight decrease in regional maladjustment has appeared in Slovakia.

To sum up, the empirical results and their analysis have shown that the existence of the standard regional mismatch points to a problem of increased overall unemployment in all selected transition countries during the observed period. Except for the standard regional mismatch, it is obvious that the overall employment has also decreased due to the efficiency of technology matching. Therefore, future analyses should concern the empirical disaggregated estimation of the matching function.

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## Teorijski i empirijski okvir mjerenja mismatch-a na tržištu rada

Alka Obadić<sup>1</sup>

### Sažetak

Istraživanje u radu je usmjereno na rastući problem strukturne nezaposlenosti u odabranoj skupini tranzicijskih zemalja. Naime, ukoliko određena regija ima višu stopu nezaposlenosti od frikcijske i ukoliko druga regija ima veći broj slobodnih radnih mjesta nego u uvjetima frikcijske nezaposlenosti, navedeno ukazuje na postojanje strukturne neravnoteže ili mismatch-a. Takav tip nezaposlenosti naziva se strukturna nezaposlenost. Procjene jasno pokazuju kako se mismatch-om može objasniti samo dio postojeće nezaposlenosti, te se može smatrati faktorom rastuće nezaposlenosti. Empirijski dio istraživanja odnosi se na mjerenje strukturne nezaposlenosti uzrokovane regionalnim mismatch-om putem poznatih teorijskih metoda mismatch indikatora u odabranoj skupini tranzicijskih zemalja. Empirijski rezultati komparativno ukazuju kako se vrijednosti pojedinih mismatch indikatora u velikoj mjeri razlikuju. Stoga je teško procijeniti stvarnu veličinu strukturne nezaposlenosti. Izmjerene vrijednosti za sve mismatch indikatore ne mogu pružiti jedinstven zaključak, ali ukazuju na odgovarajući trend.

**Ključne riječi:** tržište rada, strukturna nezaposlenost, regija, mismatch, tranzicijske ekonomije

**JEL klasifikacija:** J41, J61, J63, O57

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