# Features of the Regional Labor Markets in the Czech Republic

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***Abstract***

We use the Labor Office data for the regions of the Czech Republic to investigate some of the structural features of the respective labor markets. We build our approach on the matching function of the search model of the labor market. In the paper we show how the regional labor markets differ with respect to vacancies, unemployment, matches between unemployed and vacancies, probability of finding a job and labor market tightness. We also demonstrate how these characteristics evolved over time. We show that the labor markets were really hit the hardest several years after the great recession began to affect the Czech Republic. We go on to estimate the matching function for the respective regional labor markets and show that the sensitivity of the probability of finding a job to the labor market tightness generally increased over time, which we interpret as a positive sign. We set our results in the framework of some of the earlier work which has been done. With all the data and estimates used we are able to pinpoint the most troubled regions as far as the structural features of the labor market are concerned.

***Keywords***

*Generalized methods of moments, matching in the labor market, regional labor markets, structural features*

***JEL code***

*J63, J64, R10*

## INTRODUCTION

The research presented in this paper is directed at the analysis of the Czech Republic from a regional perspective, which we feel is a significantly disregarded issue.

Partially, it is comprehensible because the general economic data available for the respective regions is generally much more scarce than for the whole economy. On the other hand, the data supply for the labor market characteristics is very rich even at the level of regions. It is the regional data we explore in this paper, especially from the perspective of the search model of the labor market.

We resort to the Labor Office data which offer, in some respects, a detailed view of the regional labor markets and as it is evidenced by (non)existing research are rarely used. Of course, the Labor Office data do not enable to make comparisons between different economies due to the specifics of national laws on which this data is based. However, international comparison is not a subject of this paper.

First we give a concise overview of key economic issues of the regions which are also central to the econometrical analysis that follows.

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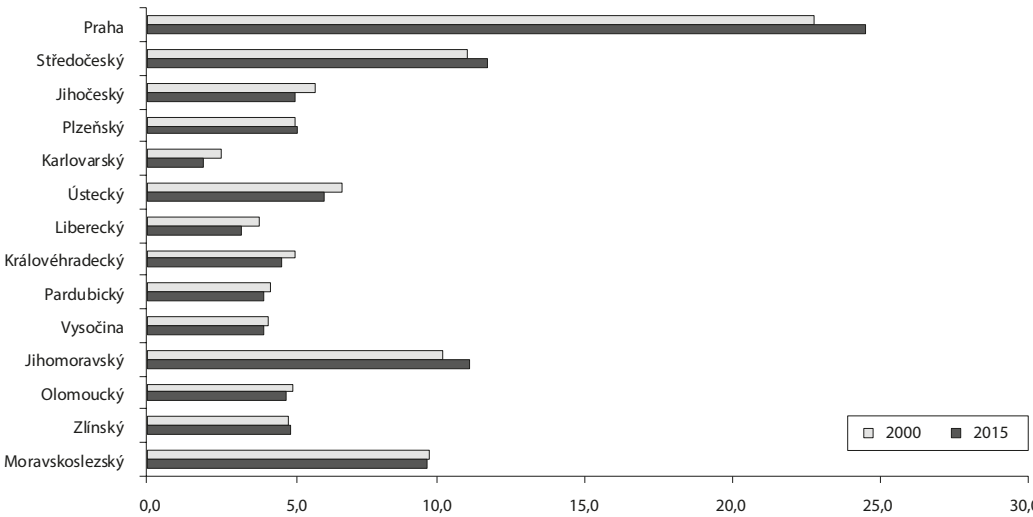
## 1 ECONOMIC PERFORMANCE OF THE REGIONS

In international comparison, according to the national accounts data for employment measured in persons, the Czech Republic has a high share of the secondary sector in the overall employment rate, which has slightly decreased to 37% over the years. Since the transformation of the economy in the 1990s, the tertiary sector has grown and thus has influenced positively the overall development of employment. The decline of employment in the primary sector stopped at less than 3%.

Individual sectors of the economy have considerable differences in the level of labor productivity and thus the sectoral structure of regions plays an important role in their economic performance. Figure 1 shows the share of regions in the GDP of the Czech Republic in the long-term development.

**Figure 1** The share of regions in the GDP of the Czech Republic in 2000 and 2015 (in %)




**Source:** CZSO, based on nominal GDP (gross domestic product)

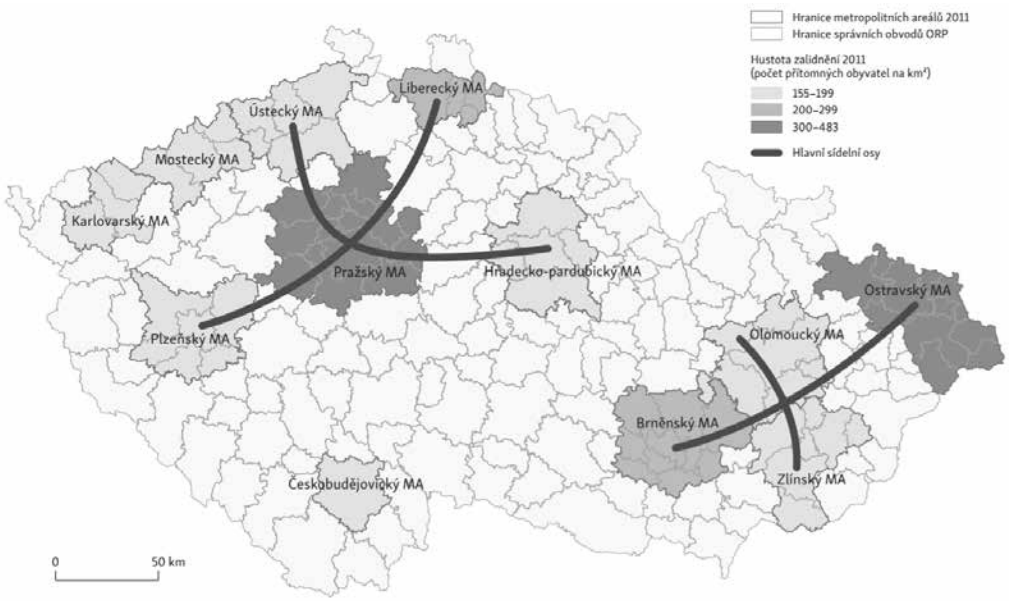
The situation in the labor markets stems, to a large extent, from the sectoral structure, and that's why it is not surprising that in most cases four economic sections (as defined by CZ-NACE classification) secure around two thirds of the economic performance given by GDP of each region. In the Czech Republic, it is particularly the manufacturing industry because after the transformation of the Czech Republic the share of raw material extraction in the formation of the gross value added fell to less than 2%, even though in regions Ústecký and Moravskoslezský it still accounts for about 5%.

However, one should not overestimate the significant role of the manufacturing industry as the whole section because it is becoming apparent that also individual subsections have an important effect on the economic performance of a region. For example, the relatively average performance of region Liberecký with the share of the manufacturing industry in the employment rate for a long time oscillating around 43% is evidence to that.

Thus, when researching regional differentiation, it is necessary to go deeper towards economic-geographical indexes describing distribution of activities. The highest values of labor productivity (both by gross value added and gross domestic product) are achieved particularly in the sections of commercial services, insurance industry, finance, the progressive tertiary sector in general and in the quaternary/

knowledge sector. Thus, the crucial conditioning agent of the regional differentiation is the concentration of these highly productive activities into core regions, metropolitan areas in the center of the regions. Due to the high concentration of population in the Czech Republic (even though in international comparison with the developed European countries is still average) in the metropolitan areas, which are present in almost all regions, differentiation on the level of regions is essentially comparable to the differentiation in accordance with metropolitan areas (Hampl and Marada, 2015), to which also their economic orientation and development are considerably related. Figure 2 shows the main areas of concentration of population on the map of the Czech Republic – the main settlement axes and metropolitan areas as defined by Hampl and Marada (2016).

**Figure 2** Metropolitan areas in the Czech Republic in 2011




**Source:** Hampl and Marada (2016)

Due to the extremely close connection between the concentration of population and economic activities and the structure of employment, the following numbers are not surprising. According to the data for employment measured as persons in 2015, the region Vysočina has the highest share of agriculture, forestry and fishing, almost 8 %, which relates to natural conditions and vast agricultural areas but also to the non-existence of an independent core region of Jihlava, capable – as a result of the extreme attractiveness of Prague and Brno, in terms of time accessibility – to attract also better service functions. However, in accordance with the study Hampl and Marada (2016), the formation of the regional center of Jihlava can, in the longer perspective, change this in the future.

On the contrary, Prague has the lowest share of the secondary sector, almost only 15%, and thus the remaining 84% are constituted by the tertiary sector and the knowledge sector. Moreover, from the viewpoint of development, an interesting thing is the overall decrease in the share of Prague in the gross domestic product of the Czech Republic as a consequence of the transfer of a certain part of its economic potential to the region Středočeský (see Figure 2). In the Czech Republic, the dominant

secondary sector was represented mostly in regions Zlínský, Liberecký and Vysočina, over 45%. Regions Zlínský, Vysočina have the lowest share in the tertiary sector, below 50%.

Region Středočeský has been getting closer to Prague in the percentage of people employed in the first four major groups, which is a direct consequence of the process of metropolization, suburbanization, thus migration i.a. of also these persons in the higher positions who commute to the city. Especially smaller regions are in most cases more sectoral narrowly focused. Olomoucký region has the most people employed in employment group 7 (craftsmen and servicemen), Plzeňský region in group 8 (machine and tool operators, assemblers), Karlovarský region in group 5 (services and sale) and Královéhradecký region in the unflattering group 9 – the least qualified and unskilled laborers.

The sectoral and professional structures and the concentration of people in the metropolitan areas are interwoven with the educational structure of population, which is shown in the last columns of Table 1. The first 4 major groups require a higher level of formal education than groups 5 and higher. Compare regions Karlovarský and Ústecký with the highest percentage of employment of people with elementary education on the one hand, and, on the other hand, Prague and region Jihomoravský employing the highest number of university educated people.

**Table 1** Percentage of workers in accordance with the classification of employment in regions in 2015 (in %)

| | CZ- ISCO | | | | | | | | Education | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Region/NUTS 3 | Legislators and workers in management | Specialists | Technical and professional workers | Office workers | Workers in services and sale | Craftsmen and servicemen | Machine and tool operators, assemblers | Assistants and unqualified workers | Elementary and without education | Secondary without A levels | Secondary with A levels | University |
| Total | 5.4 | 15.1 | 17.0 | 9.2 | 15.4 | 17.2 | 13.6 | 5.6 | 4.0 | 35.2 | 37.5 | 23.3 |
| Prague | 8.1 | 29.0 | 17.6 | 11.7 | 14.5 | 10.2 | 5.0 | 3.6 | 2.7 | 17.1 | 39.5 | 40.7 |
| Středočeský | 6.6 | 14.9 | 16.9 | 10.2 | 16.0 | 16.2 | 12.9 | 4.8 | 2.8 | 35.3 | 39.4 | 22.5 |
| Jihočeský | 4.4 | 10.8 | 16.7 | 7.5 | 16.5 | 18.4 | 17.3 | 5.1 | 3.8 | 39.8 | 37.1 | 19.3 |
| Plzeňský | 5.0 | 11.6 | 16.9 | 8.2 | 14.2 | 16.9 | 19.0 | 6.0 | 5.8 | 38.0 | 37.0 | 19.2 |
| Karlovarský | 5.3 | 8.7 | 13.5 | 8.3 | 18.9 | 20.7 | 16.4 | 7.1 | 9.2 | 40.9 | 36.6 | 13.2 |
| Ústecký | 3.5 | 10.1 | 18.0 | 9.0 | 18.5 | 19.3 | 15.1 | 5.7 | 7.5 | 39.5 | 37.8 | 15.1 |
| Liberecký | 4.0 | 11.2 | 18.1 | 7.7 | 15.1 | 20.4 | 17.1 | 5.3 | 5.4 | 40.3 | 36.6 | 17.6 |
| Královehradecký | 5.4 | 13.5 | 17.3 | 8.8 | 14.1 | 18.6 | 13.2 | 7.6 | 4.5 | 37.5 | 38.1 | 19.9 |
| Pardubický | 4.5 | 11.8 | 17.1 | 8.7 | 13.6 | 19.2 | 15.2 | 7.5 | 3.3 | 40.0 | 37.5 | 19.3 |
| Vysočina | 3.9 | 10.7 | 15.6 | 7.9 | 14.7 | 20.7 | 18.4 | 4.9 | 3.1 | 43.2 | 37.2 | 16.6 |
| Jihomoravský | 6.4 | 18.0 | 18.9 | 9.4 | 14.1 | 16.3 | 10.4 | 5.2 | 3.0 | 31.4 | 37.2 | 28.5 |
| Olomoucký | 3.7 | 13.2 | 15.0 | 9.5 | 15.0 | 20.9 | 14.4 | 5.7 | 3.1 | 40.7 | 34.7 | 21.5 |
| Zlínský | 4.6 | 13.1 | 15.3 | 7.2 | 15.4 | 19.8 | 17.4 | 5.8 | 3.2 | 41.4 | 34.5 | 20.9 |
| Moravskoslezký | 5.1 | 13.2 | 16.9 | 9.2 | 15.7 | 17.0 | 14.7 | 7.1 | 4.1 | 37.5 | 37.1 | 21.3 |

**Source:** MLSA (2015)

## 2 BASICS OF THE SEARCH MODEL AND CORRESPONDING DATA

We build the analysis on the concept of the search model, which was developed by Pissarides (1979) and Pissarides (1985) and its summary can be found in Mortensen and Pissarides (1999)

or Pissarides (2000). The search model has served as the key tool for analyzing the issues related to labor markets.

The model consists of three parts: the first one describes the relation between the unemployment rate and the vacancy rate under the condition of long-run equilibrium, which is known as the Beveridge curve (or function) and is frequently used to characterize the evolution of labor markets; the second is the job curve (function), which is basically the demand for labor; and the third is the wage curve reflecting the conditions of supply of labor.

There is no clear-cut way to use the whole model on regional level because it requires calibration of various parameters which are impossible to estimate for regions or it wouldn't make much sense to try to estimate them on such a level of disaggregation.

To formulate an empirical version of the model which would be able to analyze both cyclical and structural aspects of the labor market, it would be crucial to endogenize the job destruction process and search intensity of the unemployed. Versions of the search model with constant job destruction rate and search intensity cannot be considered competent to attack the issue of cyclical and structural changes in the labor market, see Pissarides (2000). To achieve the first, it would be necessary to find a way to estimate or calibrate the reservation productivity, which should be rightly considered as varied among the regions in questions. Though not an easy job, this may be done reasonably at the level of the whole economy. However, we do not think there is sufficient data to try to go into this level of precision on regional level. Also we don't employ the Beveridge function for the following reason.

Frequently the Beveridge function is plotted or estimated to draw conclusions as to whether there have been structural changes in the labor market in question. However, the shifts in the function don't need to represent structural changes as it is often assumed. If we take the basic version of the model, with exogenous separation (job destruction) rate, the demand shocks do not shift the Beveridge curve. However, with endogenous separation rate as a function of idiosyncratic shocks to productivity, increases in demand that translate into a rising productivity, the Beveridge curve does shift and thus would lead us to falsely believe, by working with the unemployment and vacancy rates only, that a structural shift has occurred. Pissarides (2008) warns against using the Beveridge curve in this widespread way.

Our analysis rests on a crucial relation of the search model which is the matching function. Let $u$ be the unemployment rate, $v$ the vacancy rate, $m$ the rate of matches between the vacancies and unemployed in a given period of time, $L$ labor force, then the matching function is defined:

$$mL = f(vl, ul). \tag{1}$$

The matching function is assumed to be homogeneous of degree one. Frequently it is assumed it has the form of the Cobb-Douglas function, nevertheless, we don't restrict the empirical model to this assumption. However, the assumption of homogeneity of degree one enables to restate the function as follows:

$$\frac{m}{\mathrm{u}} = f\left(\frac{v}{u}\right). \tag{2}$$

The ratio of the vacancy rate and the unemployment rate is called the tightness of the labor market, denoted $\theta$, and the ratio of the rate of matches and the unemployment rate is the probability of finding a job in a given period of time, $p(\theta)$:

$$p(\theta) = f(\theta). \tag{3}$$

According to the matching function the probability of finding a job is a positive function of the labor market tightness: with increases in the number of vacancies relative to the unemployed the probability of finding a job also increases.

What we focus on in the empirical part is the exact relation between the two, i.e. the sensitivity of the probability of finding a job on the labor market tightness. It makes sense to investigate the behavior of both variables on the regional level. Differing relationship between the two may point to structural changes in the labor markets.

### 2.1 The empirical model

To estimate the matching function (3) it must be taken into account that the endogeneity problem arises as both sides of the relationship are functions of the unemployment rate. To tackle this problem we resort to instrumental variables, more precisely we employ the generalized method of moments.

The endogeneity problem is manifested by correlation between the explanatory variables and the residuals which precludes an efficient use of ordinary least squares. The idea of using instruments is to pick additional variables which are correlated with the explanatory variables but uncorrelated with the residuals to filter out the correlation from the original equation.

We estimate the matching function in the form:

$$p(\theta)_t = \alpha + \beta\theta_t\, \varepsilon_t. \tag{4}$$

The parameter α represents the constant, β the sensitivity of the probability of finding a job on the labor market tightness and ε stands for the error term.

We use as instruments the current and lagged values of the gross domestic product in 2010 prices. We will give more details on the samples, data used and instruments below.

### 2.2 Key data

Before the analysis of the estimates of Formula (4), we will draw a more general picture of the regional labor markets using the data entering the search model of the labor market.

We use the monthly data collected by the Ministry of Labor and Social Affairs (MLSA) for the respective regions of the Czech Republic. We work with the disaggregation in form of NUTS3, which means we work with 14 regions and also with the economy as a whole.

The whole sample covers the months from 2000 to 2015. We first present the data on the probability of finding a job, the labor market tightness, the matching rate, the separation rate, the unemployment rate and the vacancy rate.

The labor force data we use in the analysis comes from Labor Force Survey (LFS) statistics as collected and presented by the Czech Statistical Office (CZSO). However, the data supplied by the CZSO are quarterly. We transformed it into monthly data using quadratic interpolation.

The matching rate is defined as the number of placed (those unemployed registered at the Labor Offices who in the given month left the Labor Office because they found a job) relative to the labor force.

The separation rate is defined as the number of those who in a given month entered the Labor Office relative to the labor force.

The unemployment rate is defined as the ratio of the registered applicants for jobs at the Labor Offices to the labor force.

The vacancy rate is defined as the ratio of the number of vacancies reported to the Labor Offices to the labor force.

However, the estimates of (4) remain unaffected by the use of labor force data from a different statistics. The reason is that labor market tightness may be computed as a ratio of vacancies and unemployed

(registered applicants) and probability of finding a job as a ratio of number of placed and unemployed (registered applicants). This means that only the Labor Office data is used to compute the input for the estimation.

Figures 3–17 in the Appendix present the respective seasonally adjusted data for all the regions in question including the Czech Republic as a whole.

The data show that, naturally, the great recession, which hit the Czech Republic in the last quarter of 2008, manifested itself by a sharp decrease in the vacancy rate, which kept at low figures until 2014, and a sharp increase in the unemployment rate. This was reflected in a sharp increase in the labor market tightness, which also returned to increase in 2014. The probability of finding a job decreased with the decrease of the labor market tightness.

However, as the data show, the labor market was struck the most not with the onset of the great recession, but much later in 2011–2013. The unemployment rate increased significantly again in 2013 with an expected impact on the labor market tightness. This was also reflected in a significant decrease in the probability of finding a job in the period of 2011–2013. The matching rate also decreased significantly in this period, in 2011–2012, while the separation rated was typically marked with a sharp increase in 2009 and 2011. This pattern is found in all of the regions, of course the exact figures differ.

Now let us consider the development outside the years marked by the great recession. The labor market tightness in the Czech Republic was generally lower than before the crises. This is not true especially in Plzeňský region, Karlovarský region, Ústecký region, Pardubický region and Jihomoravský region where the figures before and after the great recession were more or less the same, and in Moravskoslezský region where it was higher after the crisis.

In the Czech Republic as a whole the labor market tightness fluctuated, with the exception of the crisis years, around 10%. It was generally higher in Moravskoslezský region and significantly lower in Ústecký region, Královéhradecký region, Jihomoravský region, Vysočina and Olomoucký region.

The question is why it was so. It might have been due to a generally higher unemployment rate or generally lower vacancy rate or both.

The lower labor market tightness is explained by a significantly lower vacancy rate in Ústecký region and Královéhradecký region.

On the other hand, in the cases of Olomoucký and Jihomoravský region it is explained especially by higher than average unemployment rate. This also holds for Ústecký region, which means that this region has both: relatively higher unemployment rate and relatively lower vacancy rate. In the case of Vysočina the reason for the relatively lower labor market tightness throughout the whole period, except for the crisis, is more related to a lower vacancy rate.

The probability of finding a job marked a significant increase in 2007 when it neared 10% for the Czech Republic as whole. The less successful regions were again: Ústecký region, Královéhradecký region and Moravskoslezský region where even in the period of the most significant positive impacts of the ongoing expansion of the economy were, in terms of the probability of finding a job, less than 10%, and in some cases less than 8%.

On the other hand, for the economy as a whole, the probability of finding a job hit the bottom in 2012 when it reached approximately 4%. Once again Ústecký region, Královéhradecký region and Moravskoslezský region reached figures under 3% together with Prague.

The inspection of the data thus shows that the less favorable regions in the Czech Republic are Ústecký region, Královéhradecký region and Moravskoslezský region, in the first place, followed by Olomoucký region and possibly Vysočina.

To shed more light on the structural nature of the regional labor markets we proceed to estimate the matching function (3).

### 2.3 Statistical properties of the data

The data necessary to carry out the estimation was already described above. Tables 2a and 2b present their statistical properties in the whole sample: January 2000–December 2015. Stationarity was tested by augmented Dickey-Fuller test and as it is indicated in the tables not all of the series are stationary in the whole sample.

This problem is resolved by running two estimates. The first one in the sample from January 2000 to December 2007 and the second running from January 2010 to December 2015. Within these two samples the series are stationary at the level of statistical significance of at least 10%. In other words the stationarity of some of the series in the whole sample is precluded by the significant and rather persistent changes in the years around the end of the economic expansion and the crisis.

Generally most of the series do not follow normal distribution, which, however, does not present problems to the estimation in question.

As we have already indicated above, the instrumental variable used in all of the estimations was gross domestic product (GDP). The statistical properties are given in the last row of Table 2a. As well as the labor force series, gross domestic product is published with quarterly frequency. To obtain a monthly series, we once more used quadratic interpolation. The underlying series was the seasonally adjusted one in 2010 prices as published by the Czech Statistical Office. The statistical properties presented in Table 2a as far as GDP is concerned is already for logarithmic differences, therefore the augmented Dickey-Fuller test confirms stationarity. Gross domestic product in levels is, of course, significantly nonstationary.

**Table 2a** Statistical Properties of Labor Market Tigntness

| Region | Variable | Mean | Standard dev. | Normality | Stationarity |
|---|---|---|---|---|---|
| Prague | LMT | 0.491 | 0.416 | 220.645*** | –2.167 |
| Středočeský | LMT | 0.221 | 0.168 | 124.736*** | –2.577* |
| Jihočeský | LMT | 0.195 | 0.133 | 68.325*** | –1.786 |
| Plzeňský | LMT | 0.284 | 0.259 | 184.886*** | –3.114** |
| Karlovarský | LMT | 0.120 | 0.077 | 68.796*** | –2.356 |
| Ústecký | LMT | 0.063 | 0.039 | 80.618*** | –1.541 |
| Liberecký | LMT | 0.165 | 0.094 | 21.672*** | –2.806* |
| Královéhradecký | LMT | 0.184 | 0.126 | 45.027*** | –2.210 |
| Pardubický | LMT | 0.220 | 0.192 | 115.809*** | –2.067 |
| Vysočina | LMT | 0.132 | 0.097 | 43.040*** | –2.047 |
| Jihomoravský | LMT | 0.113 | 0.094 | 180.104*** | –2.599 |
| Olomoucký | LMT | 0.103 | 0.073 | 41.325*** | –1.782 |
| Zlínský | LMT | 0.128 | 0.110 | 68.839*** | –2.257 |
| Moravskoslezský | LMT | 0.071 | 0.060 | 104.345*** | –2.550 |
| Czech Republic | LMT | 0.150 | 0.110 | 109.644*** | –2.764* |
| Czech Republic | GDP | 0.002 | 0.003 | 1221.660*** | –3.336** |

**Note:** LMT stands for labor market tightness. GDP signifies GDP growth. Normality was tested by Jarque-Bera test under the null of normal distribution, test statistic is given; stationarity was tested by augmented Dickey-Fuller test under the null of unit root, t-Statistic is given; *, **, *** signifies rejection of the null at 10%, 5%, 1% of statistical significance, respectively. Estimates for the whole sample: 2000–2015.

**Source:** Own estimates

**Table 2b** Statistical Properties of Probability of Finding a Job

| Region | Variable | Mean | Standard dev. | Normality | Stationarity |
|---|---|---|---|---|---|
| Prague | PFJ | 0.082 | 0.020 | 30.013*** | –2.676* |
| Středočeský | PFJ | 0.088 | 0.018 | 40.489*** | –2.486 |
| Jihočeský | PFJ | 0.109 | 0.022 | 20.841*** | –2.638* |
| Plzeňský | PFJ | 0.092 | 0.017 | 24.156*** | –2.320 |
| Karlovarský | PFJ | 0.070 | 0.016 | 5.259* | –2.280 |
| Ústecký | PFJ | 0.058 | 0.011 | 14.641*** | –2.648* |
| Liberecký | PFJ | 0.084 | 0.019 | 4.401 | –2.627* |
| Královéhradecký | PFJ | 0.095 | 0.021 | 12.388*** | –2.719* |
| Pardubický | PFJ | 0.094 | 0.019 | 11.612*** | –2.663* |
| Vysočina | PFJ | 0.092 | 0.019 | 16.406*** | –3.071** |
| Jihomoravský | PFJ | 0.075 | 0.012 | 14.944*** | –2.644* |
| Olomoucký | PFJ | 0.075 | 0.014 | 13.814*** | –2.657* |
| Zlínský | PFJ | 0.079 | 0.037 | 8.242** | –2.999** |
| Moravskoslezský | PFJ | 0.058 | 0.010 | 9.379** | –2.800* |
| Czech Republic | PFJ | 0.076 | 0.014 | 46.256*** | –2.645* |
| Czech Republic | GDP | 0.002 | 0.003 | 1221.660*** | –3.336** |

**Note:** PFJ is probability of finding job. Normality was tested by Jarque-Bera test under the null of normal distribution, test statistic is given; stationarity was tested by augmented Dickey-Fuller test under the null of unit root, t-Statistic is given; *, **, *** signifies rejection of the null at 10%, 5%, 1% of statistical significance, respectively. Estimates for the whole sample: 2000–2015.
**Source:** Own estimates

## 3 RESULTS

The sound application of the generalized method of moments in the estimation of Formula (3) required instruments. These were in all of the cases: constant, the current GDP as described above and GDP at one lag. Only in the case of the estimation for Prague in the sample 2010–2015 two lags of GDP were used. This has no other than a purely statistical explanation: two lags were needed to obtain a set of statistically valid instruments.

Table 3 summarizes the key output of the estimates. The number of observations is given for each sample. It shows estimates of $\alpha$ and $\beta$ as in Formula (4) and the statistical significance of the estimates. The validity of the instruments was tested by the traditional J-statistic with null hypothesis of the model being valid and also by the Eichenbaum-Hansen-Singleton test, which is based on the comparison of the J-statistic of the equation with the instruments given and of another model which excludes part of the instruments.

The autocorrelation of the residuals was first evaluated by the Durbin-Watson statistic, which is given in Table 3. We also checked it with help of Ljung-Box statistic up to the lag of 12 (that is up to one year). This result is not reported as it requires a lot of space. The tests showed no statistically significant remaining autocorrelation in the residuals.

We also checked for normality of the residuals with the help of Jarque-Bera test. We did not encounter any problems with non-normality and we do not present these results.

Throughout the estimation we used the White weighting matrix which assures heteroscedasticity consistent estimates.

The estimates of the sensitivity of the probability of finding a job on the labor market tightness are positive as expected with the exception of the estimate for Prague in the first sample; also it should be noted that the estimate for Plzeňský region was not statistically significant in the first sample.

Generally, the estimates show that the responsiveness of the probability of finding a job to the labor market tightness increased over the years, as the estimates within the second sample generally give higher values than in the first sample. The only exceptions are Liberecký region and Moravskoslezský region.

We interpret the increase in the responsiveness as a positive sign of the structural characteristic of a labor market because it means that the information which makes part of its structure, vacancies and unemployed, faster translates into results, i.e. matches. However, we elaborate more on this finding further below.

**Table 3** GMM Estimates

| Region | Sample (number of observations) | α | β | J-statistic | Durbin-Watson | Orthogonality test | R-squared |
|---|---|---|---|---|---|---|---|
| Prague | 2000–2007 (94) | 0.108*** | -0.018*** | 5.750 | 2.184 | 4.432 | 0.720 |
| Prague | 2010–2015 (72) | 0.017 | 0.104* | 2.147 | 1.869 | 1.363 | 0.897 |
| Středočeský | 2000–2007 (95) | 0.093*** | 0.023** | 0.507 | 2.237 | 0.507 | 0.643 |
| Středočeský | 2010–2015 (72) | 0.060*** | 0.115*** | 2.150 | 2.318 | 2.150 | 0.875 |
| Jihočeský | 2000–2007 (95) | 0.115*** | 0.034** | 0.498 | 2.159 | 0.498 | 0.691 |
| Jihočeský | 2010–2015 (72) | 0.074*** | 0.119*** | 0.055 | 2.250 | 0.055 | 0.846 |
| Plzeňský | 2000–2007 (95) | 0.099*** | 0.003 | 0.328 | 2.064 | 0.328 | 0.50 |
| Plzeňský | 2010–2015 (72) | 0.070*** | 0.067*** | 1.445 | 2.318 | 1.445 | 0.830 |
| Karlovarský | 2000–2007 (95) | 0.072*** | 0.058** | 0.584 | 2.530 | 0.584 | 0.684 |
| Karlovarský | 2010–2015 (72) | 0.051*** | 0.117*** | 2.226 | 2.073 | 2.226 | 0.872 |
| Ústecký | 2000–2007 (95) | 0.051*** | 0.173*** | 1.329 | 2.400 | 1.329 | 0.640 |
| Ústecký | 2010–2015 (72) | 0.027*** | 0.496*** | 1.677 | 2.221 | 1.678 | 0.863 |
| Liberecký | 2000–2007 (95) | 0.071*** | 0.129*** | 1.781 | 2.333 | 1.781 | 0.776 |
| Liberecký | 2010–2015 (72) | 0.060*** | 0.080* | 0.047 | 2.207 | 0.047 | 0.837 |
| Královéhradecký | 2000–2007 (95) | 0.074*** | 0.119*** | 0.055 | 2.250 | 2.068 | 0.846 |
| Královéhradecký | 2010–2015 (72) | 0.054*** | 0.214*** | 1.035 | 1.982 | 1.035 | 0.923 |
| Pardubický | 2000–2007 (95) | 0.092*** | 0.038*** | 1.257 | 2.168 | 1.257 | 0.618 |
| Pardubický | 2010–2015 (72) | 0.062*** | 0.136*** | 1.288 | 2.163 | 1.288 | 0.874 |
| Vysočina | 2000–2007 (95) | 0.087*** | 0.074** | 1.291 | 2.390 | 1.291 | 0.699 |
| Vysočina | 2010–2015 (72) | 0.061*** | 0.265*** | 0.368 | 2.149 | 0.368 | 0.834 |
| Jihomoravský | 2000–2007 (95) | 0.070*** | 0.056*** | 0.166 | 2.409 | 0.166 | 0.771 |
| Jihomoravský | 2010–2015 (72) | 0.052*** | 0.193*** | 0.119 | 2.120 | 0.119 | 0.866 |
| Olomoucký | 2000–2007 (95) | 0.067*** | 0.103*** | 0.983 | 2.009 | 0.982 | 0.582 |
| Olomoucký | 2010–2015 (72) | 0.050*** | 0.208*** | 0.754 | 1.839 | 0.754 | 0.871 |
| Zlínský | 2000–2007 (95) | 0.074*** | 0.049** | 0.963 | 2.182 | 0.963 | 0.779 |
| Zlínský | 2010–2015 (72) | 0.062*** | 0.124*** | 1.003 | 1.884 | 1.003 | 0.892 |
| Moravskoslezský | 2000–2007 (95) | 0.052*** | 0.115*** | 1.176 | 2.381 | 1.176 | 0.802 |
| Moravskoslezský | 2010–2015 (72) | 0.052*** | 0.091*** | 0.839 | 2.108 | 0.839 | 0.868 |
| Czech Republic | 2000–2007 (95) | 0.074*** | 0.034** | 0.517 | 2.292 | 0.517 | 0.744 |
| Czech Republic | 2010–2015 (72) | 0.057*** | 0.121*** | 1.089 | 1.981 | 1.089 | 0.903 |

**Note:** Estimates of the coefficients are under the null of being equal to zero; J-statistic refers to Sargan-Hansen test of over-identifying restrictions under the null of validity; besides Durbin-Watson the autocorrelation was also checked by Ljung-Box test up to the order of 12 lags, these results are not reported; orthogonality of instruments was tested by Eichenbaum-Hansen-Singleton test under the null of validity of instruments; *, **, *** signifies rejection of the null at 10%, 5%, 1% of statistical significance, respectively.

**Source:** Own estimates

In this respect the relatively highest responsiveness is found in Ústecký region, Vysočina, Královéhradecký region, and Olomoucký region. The relatively highest increases in the responsiveness between the two samples were identified in Středočeský region, Prague, and Plzeňský region.

The results of our paper may be related to Galuščák and Munich (2007). Nevertheless, not directly, because the sample is completely different and also the formulation tested differs a lot. Galuščák and Munich (2007) also use regional data but in the end make a panel estimation, which might be explained by the relatively short series they had to use. The most interesting of their results is the procyclicality of the sensitivity of the number of the newly employed to the stock of unemployed and the inflow of unemployed.

Panel data is used also by Pedraza (2008) who focuses on the examination of the efficiency of the matching process with respect to other variables. He finds that the matching efficiency is positively influenced by the level of education of the labor force.

Most recent and relevant paper by Němec (2015) also makes use of the MLSA data, however, as in the case of the already mentioned studies, he resorts to panel analysis. He finds that the matching efficiency is negatively influenced by the number of the unemployed of 50 years and older and by the number of the long-term unemployed.

The sensitivity of reactions of probability of finding a job with respect to labor market tightness to the economic cycle may be well supposed given the results presented in Table 3. However, to reach a conclusion whether or not it is really there, it should be also tested a possible structural change in the behaviour, perhaps provoked by the crisis. This, however, requires a different econometrical approach. We follow up on this question in a subsequent research.

## CONCLUSION

The estimates detected as the most problematic regions: Ústecký region, Moravskoslezský region, Královéhradecký region and partially Olomoucký region and Vysočina. It was in the first three where even during the economic expansion the probability of finding a job increased relatively less than in the other regions and on the other hand dropped the most in the aftermaths of the great recession. The latter holds for Olomoucký region and Vysočina as well.

Also we found relatively lower labor market tightness due to low vacancy rate in Ústecký region, Vysočina and Královéhradecký region. Lower labor market tightness due to relatively high unemployment rate was found in Olomoucký, Jihomoravský and Ústecký region.

To draw a few connections with the socio-economic situation in the regions we presented in the paper, we saw that lower levels of education dominate in these regions: the share of secondary education without A levels together with elementary or no education dominates in Karlovarský region, Ústecký region, and Vysočina. The share of assistants and unqualified workers in the employment reaches over 6% in Plzeňský region, Karlovarský region, Královéhradecký region, Pardubický region and Moravskoslezský region, in Ústecký region it is close to 6%.

Although the Czech Statistical Office, CZSO (2016), points to an increasing level of the percentage of those with higher education across the whole economy, the situation remains quite diverse among the respective regions as we could see in the text.

The results point to some significant differences in the performance of the respective regions of the Czech Republic, which does not come as a big surprise. What comes much more baffling are discussions which proclaim that much support directed toward the technical secondary, and very often without A levels, education should be anyhow beneficial for the future development of the economy.

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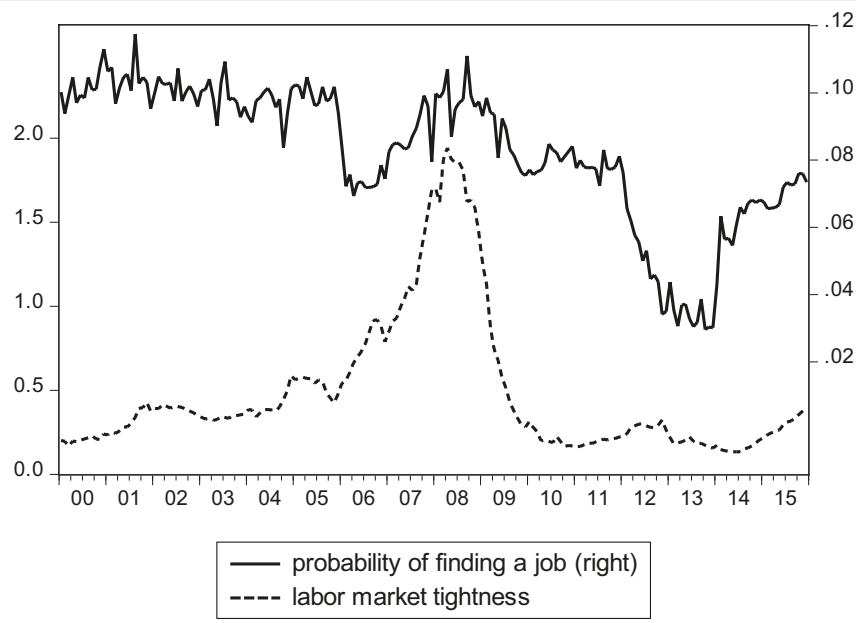
# APPENDIX

**Figure 3** Prague

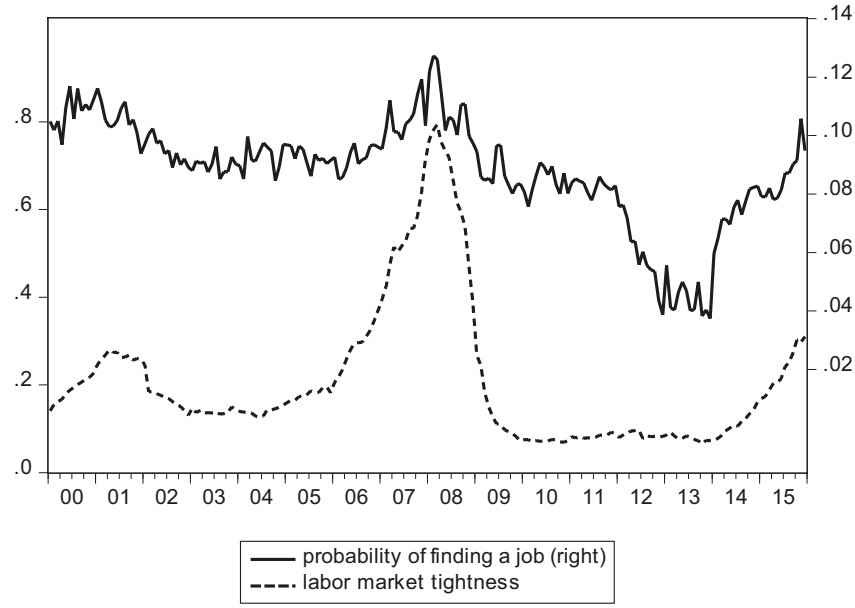



**Source:** MLSA, own calculations


**Source:** MLSA, own calculations


**Source:** MLSA, own calculations

**Figure 4** Středočeský region

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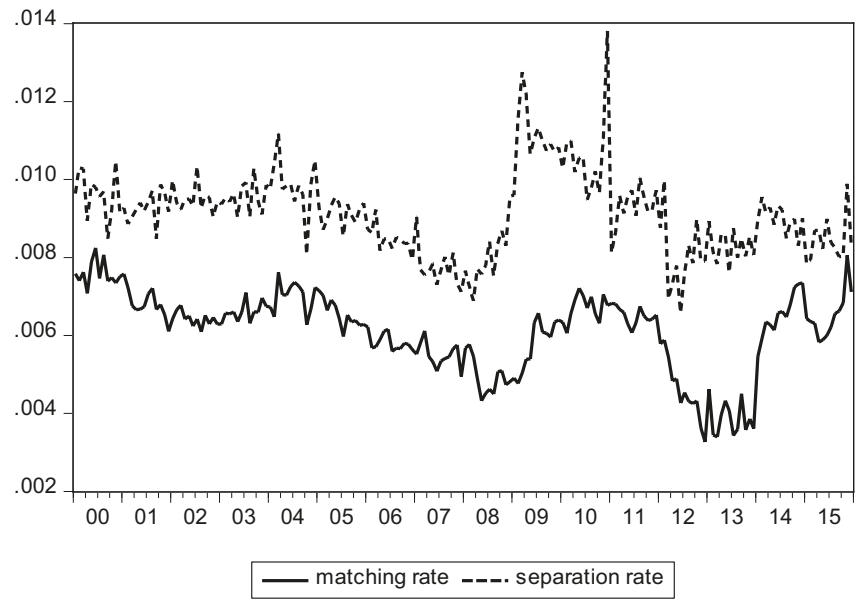
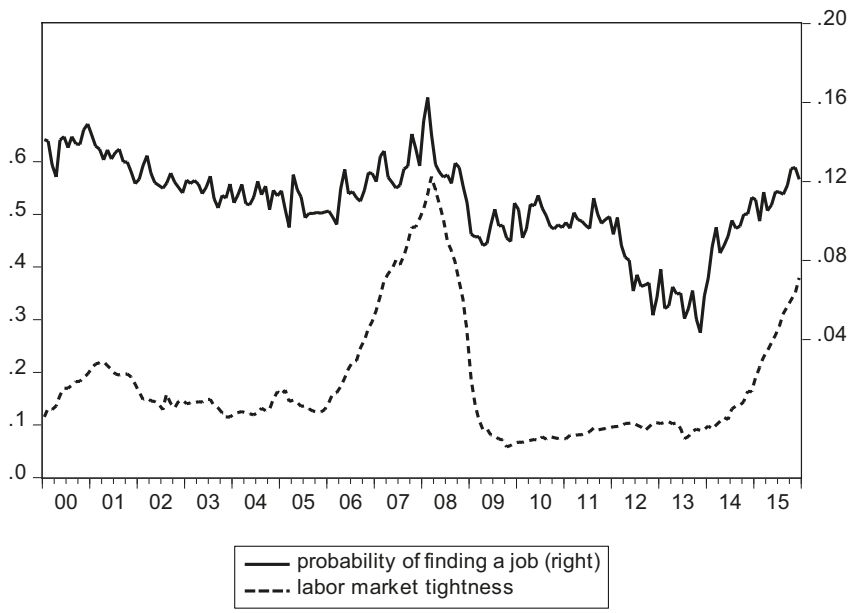



**Source:** MLSA, own calculations


**Source:** MLSA, own calculations

**Figure 5** Jihočeský region

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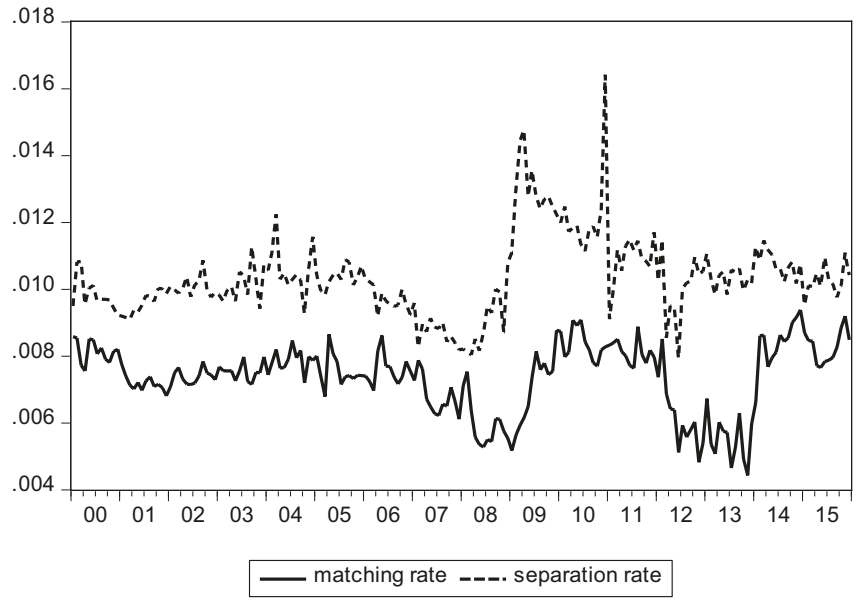


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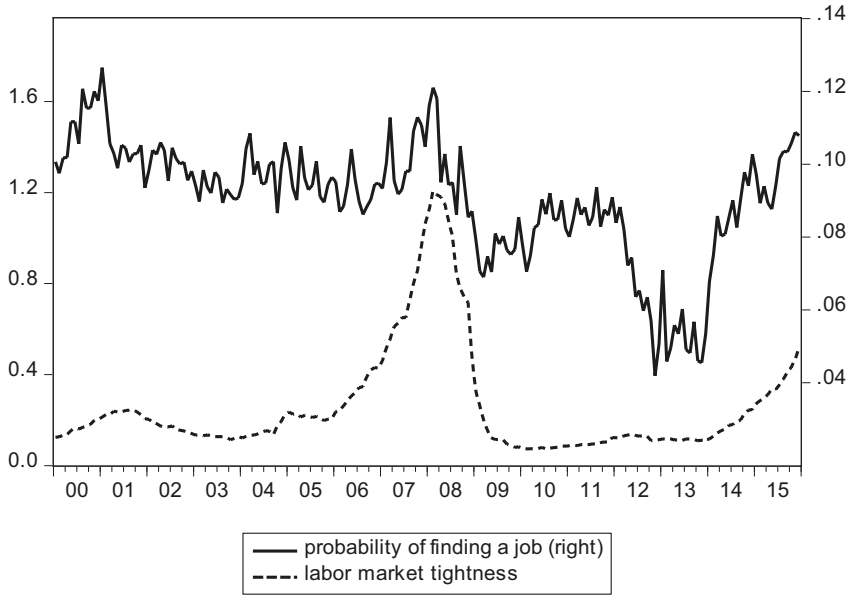
**Source:** MLSA, own calculations

**Figure 6** Plzeňský region

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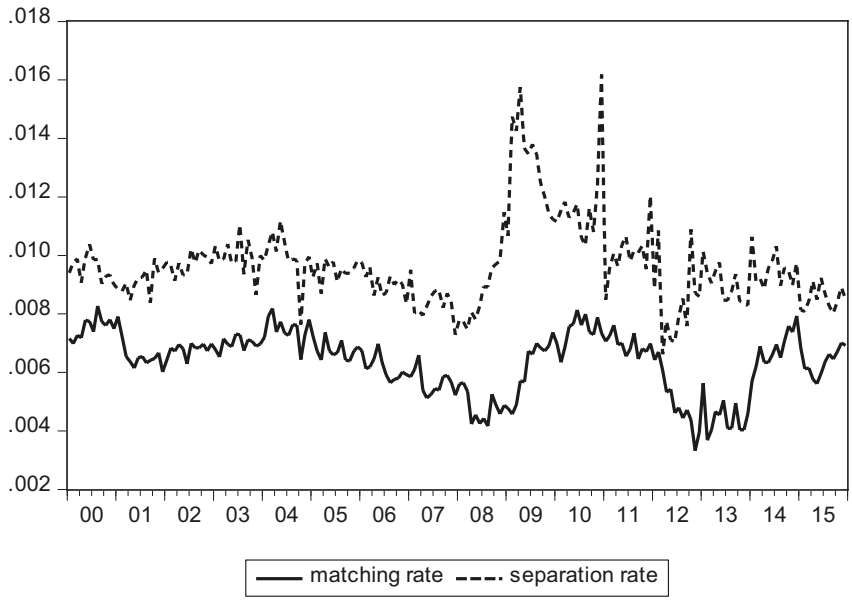


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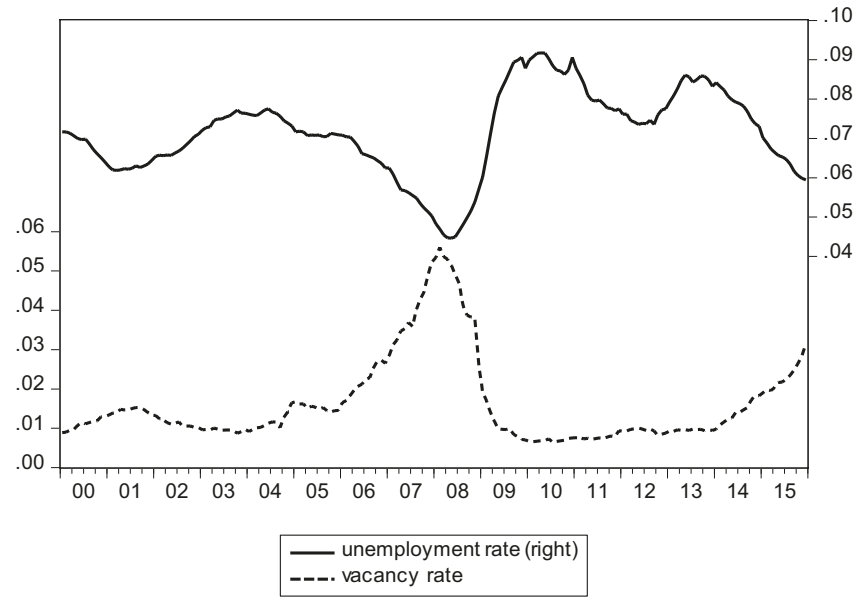


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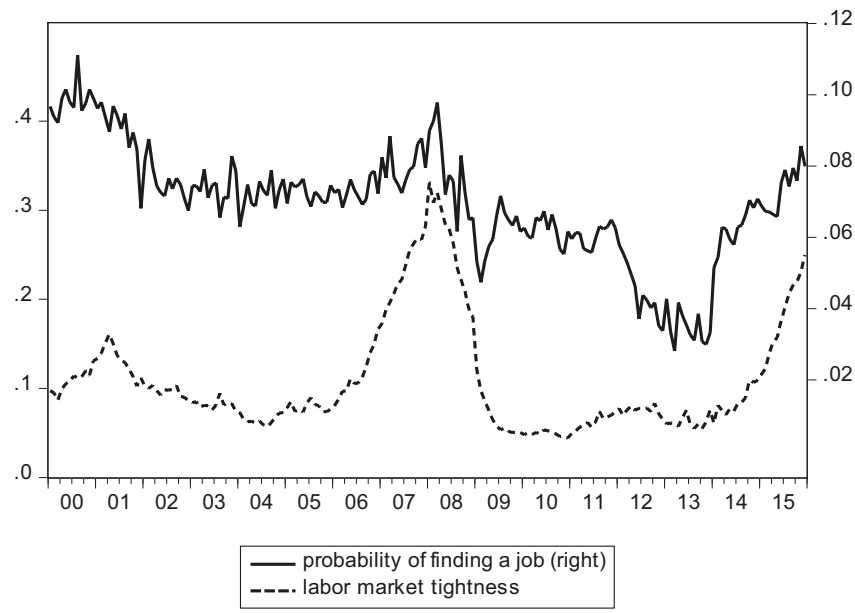
**Figure 7** Karlovarský kraj

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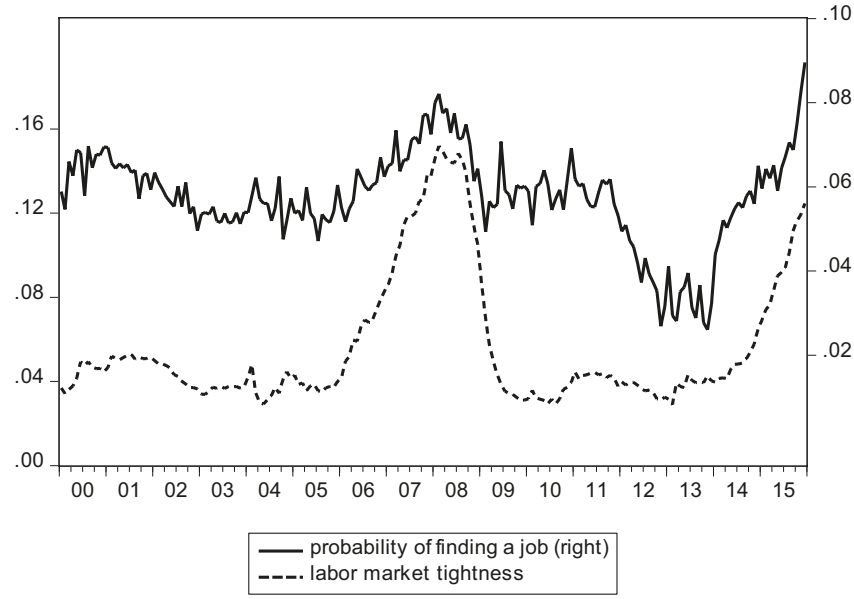
**Source:** MLSA, own calculations


**Source:** MLSA, own calculations

**Figure 8** Ústecký kraj

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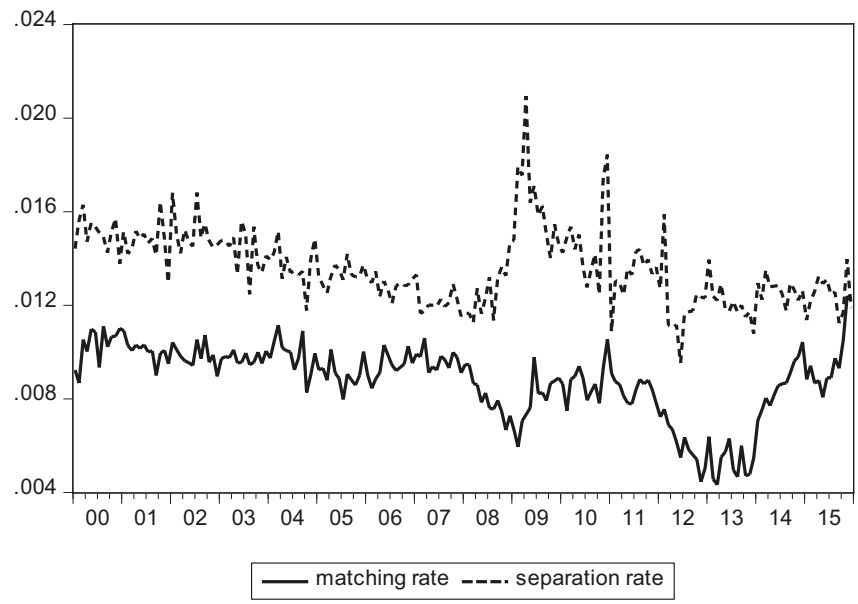


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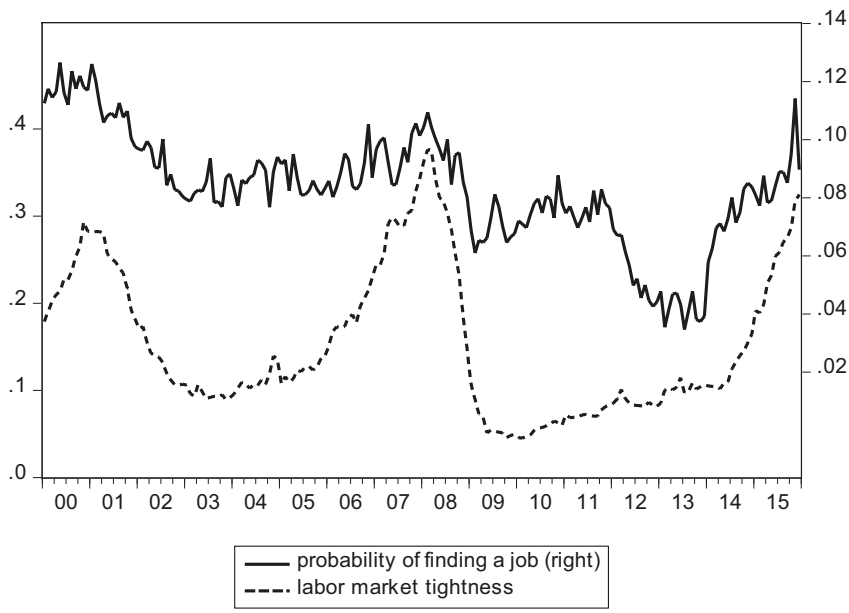
**Source:** MLSA, own calculations

**Figure 9** Liberecký region

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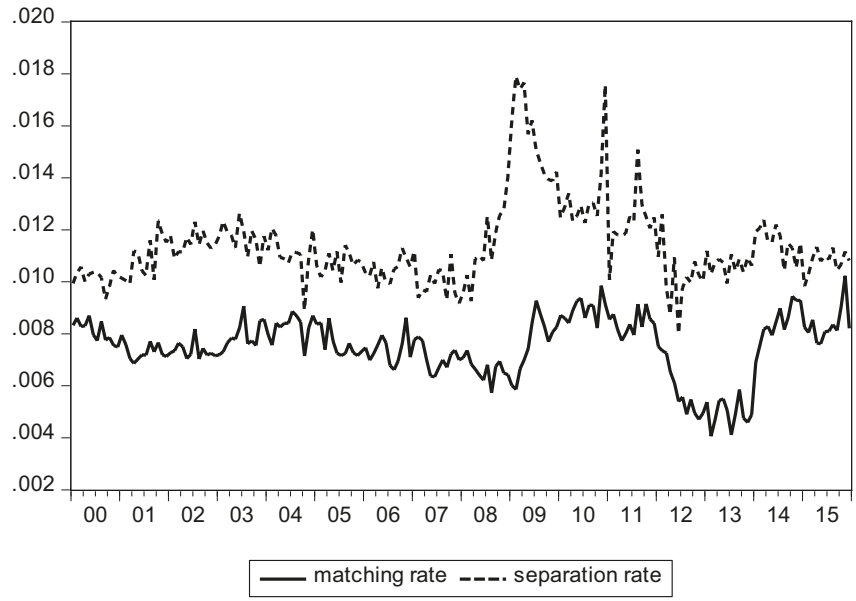


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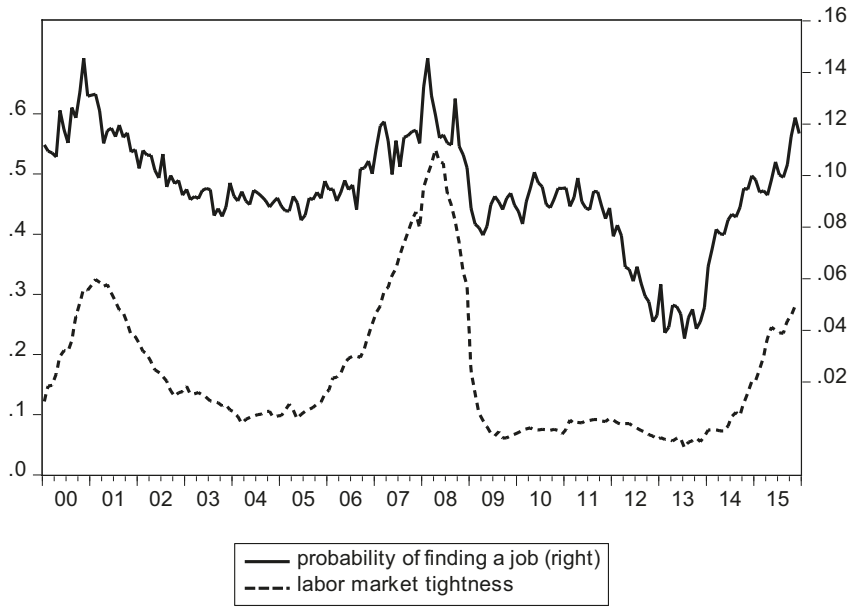
**Source:** MLSA, own calculations

**Figure 10** Královéhradecký region

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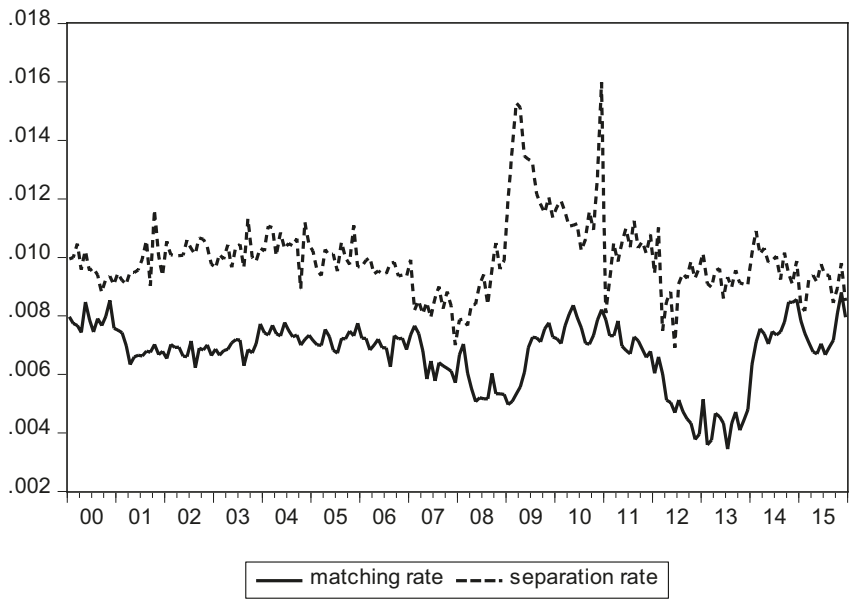


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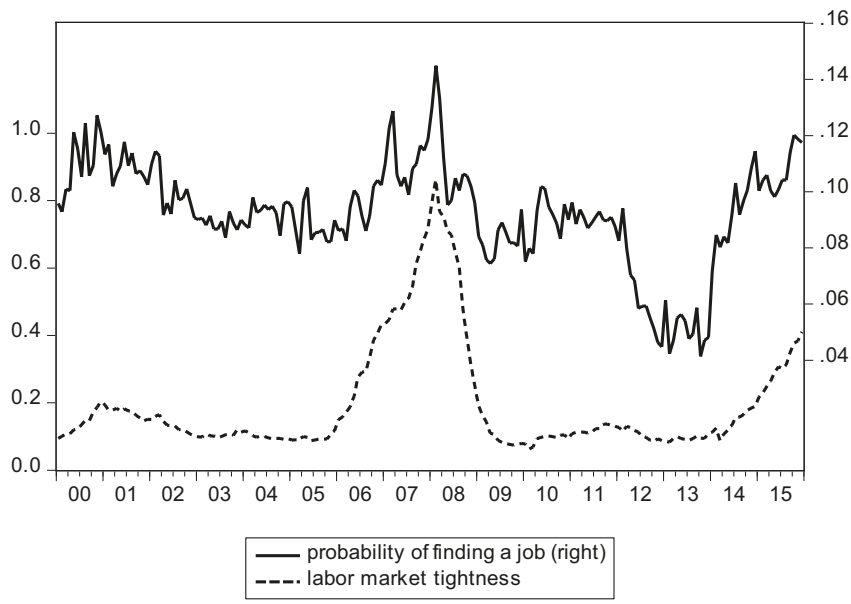
**Source:** MLSA, own calculations

**Figure 11** Pardubický region

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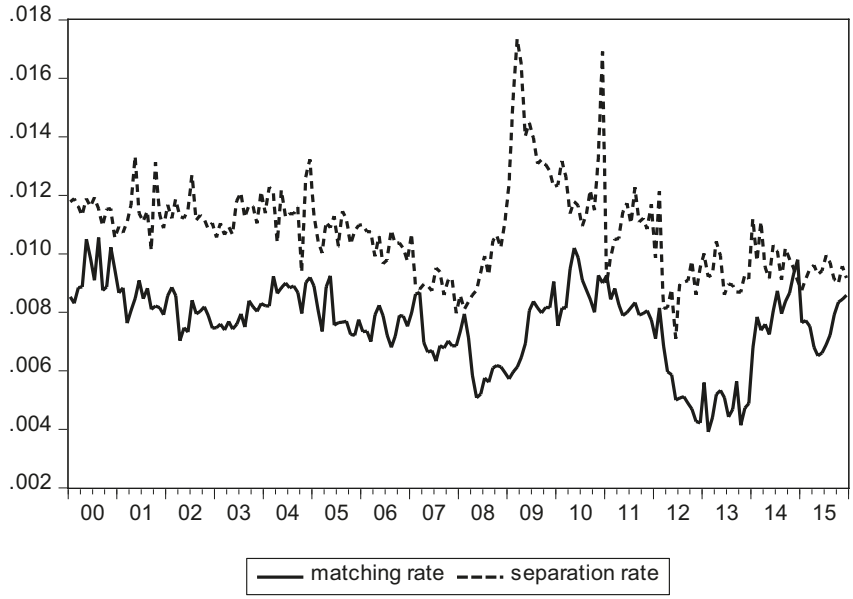


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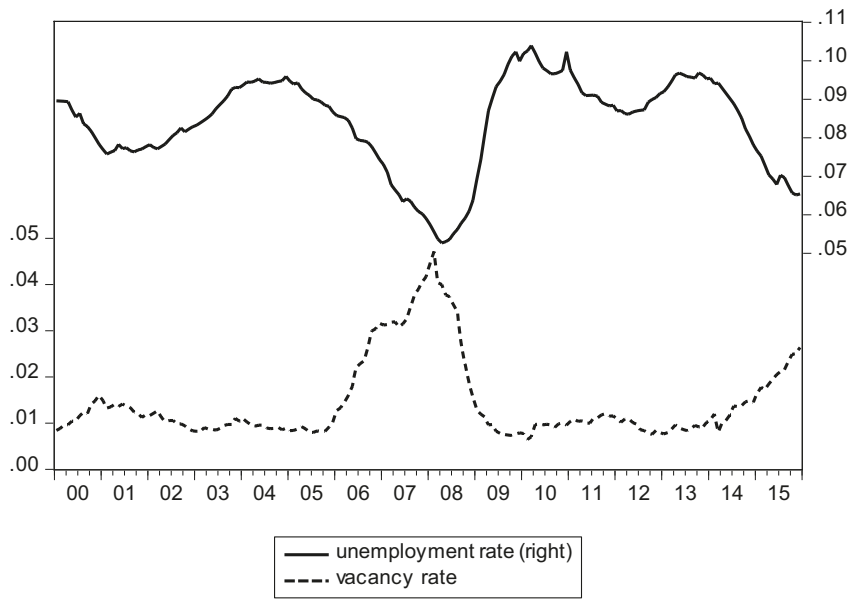
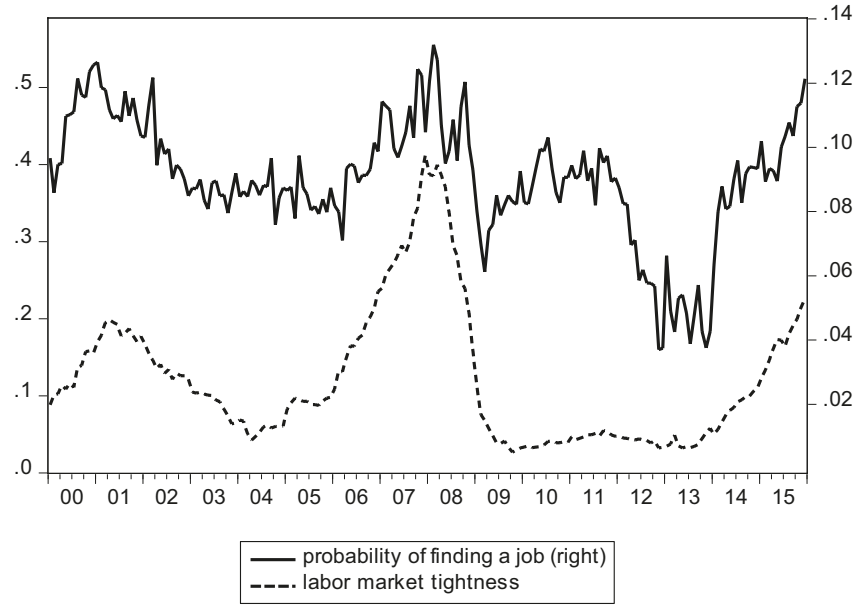



**Source:** MLSA, own calculations

**Figure 12** Vysočina region

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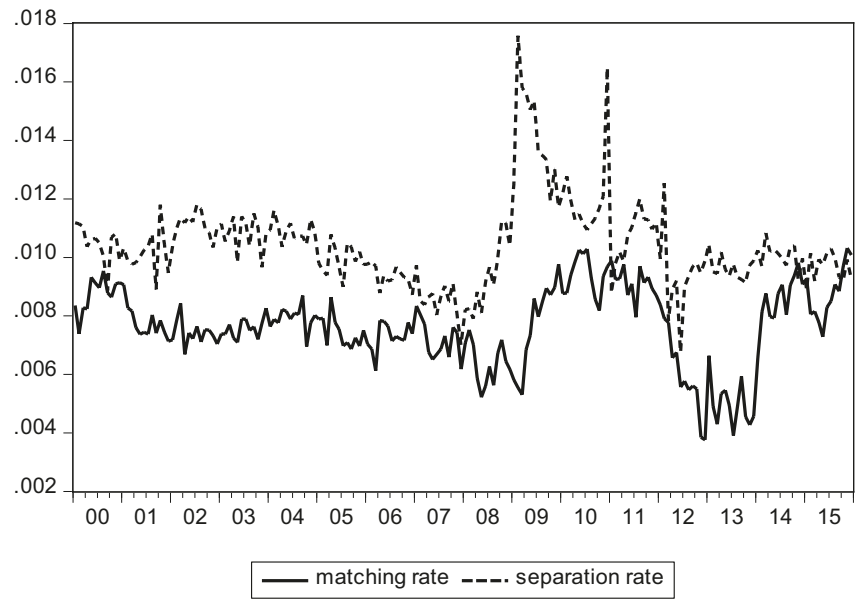


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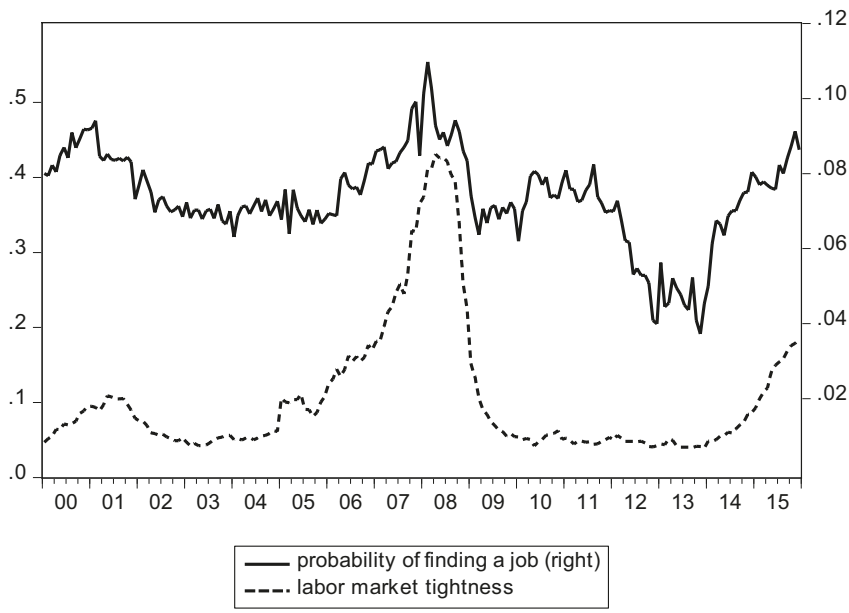
**Figure 13** Jihomoravský region

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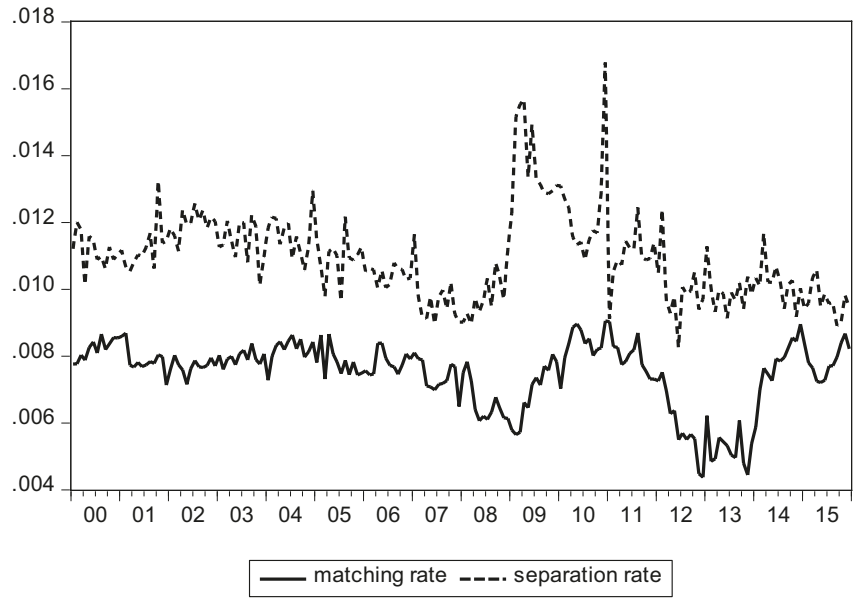


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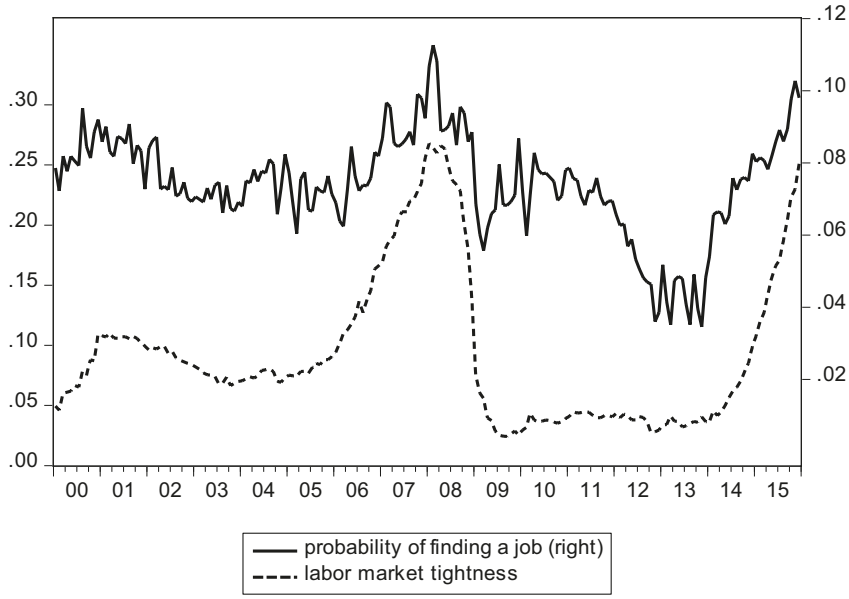
**Figure 14** Olomoucký region

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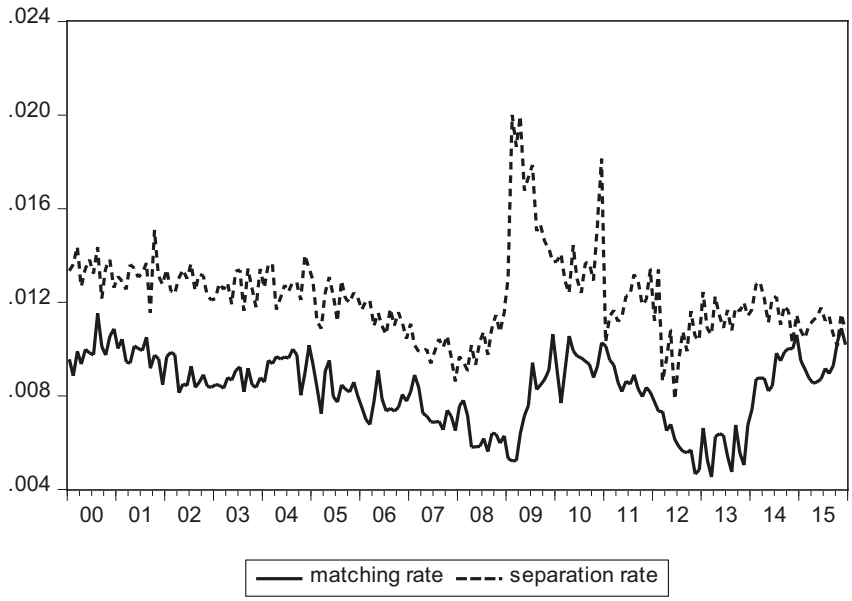


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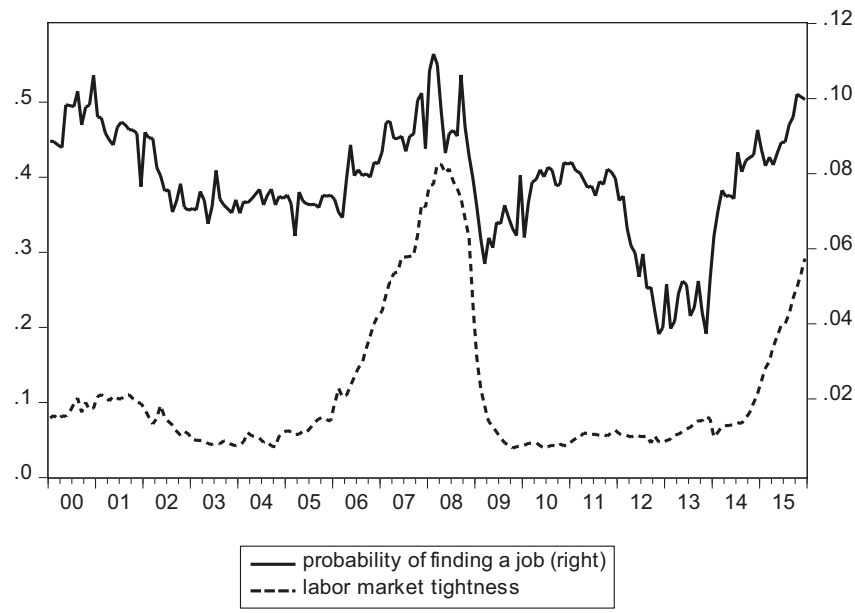
**Figure 15** Zlínský region

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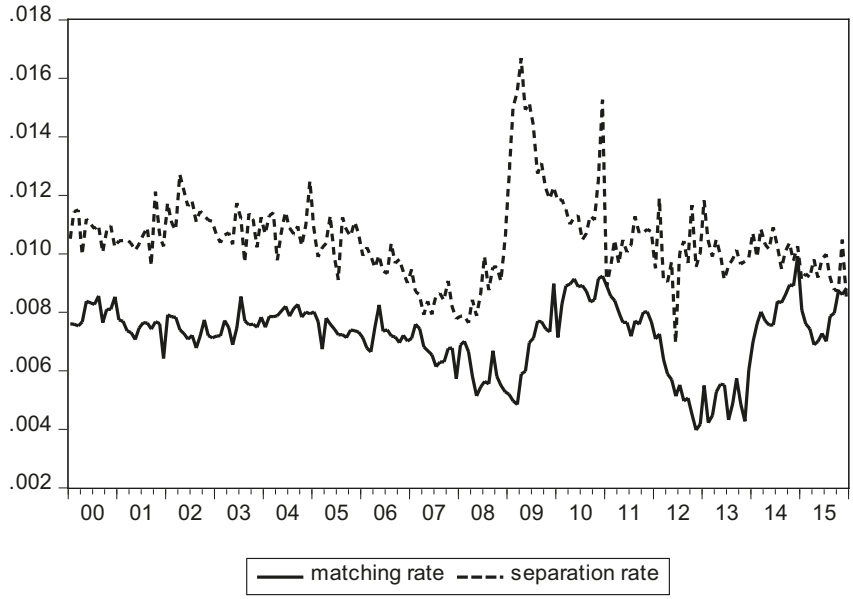


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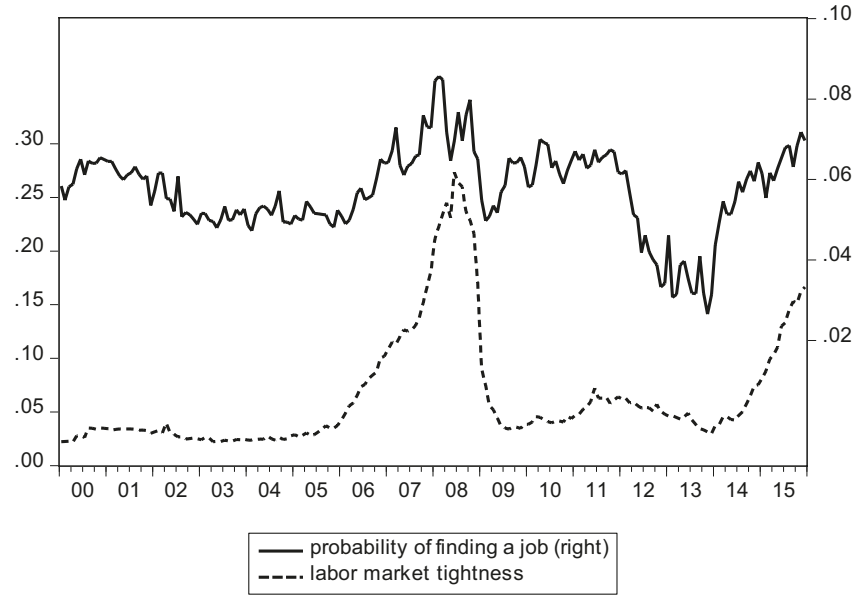
**Figure 16** Moravskoslezský region

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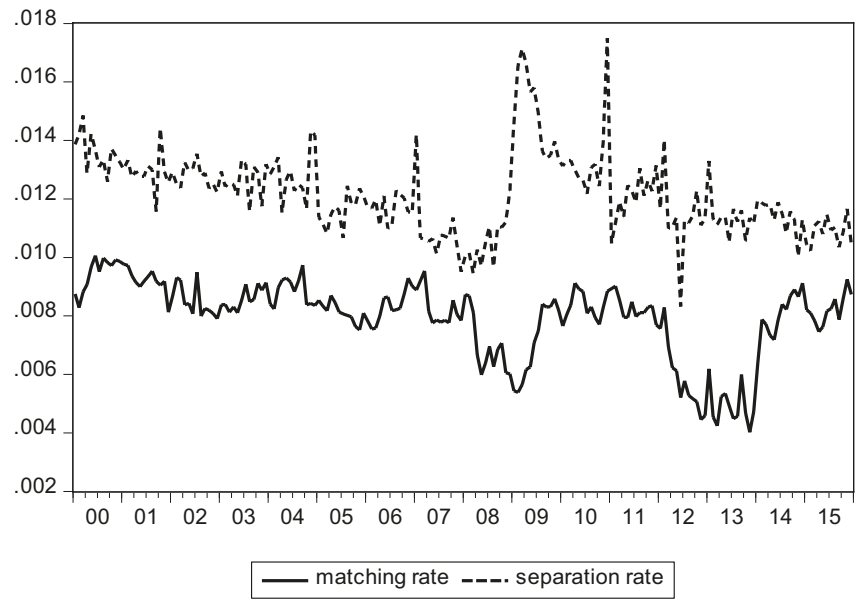


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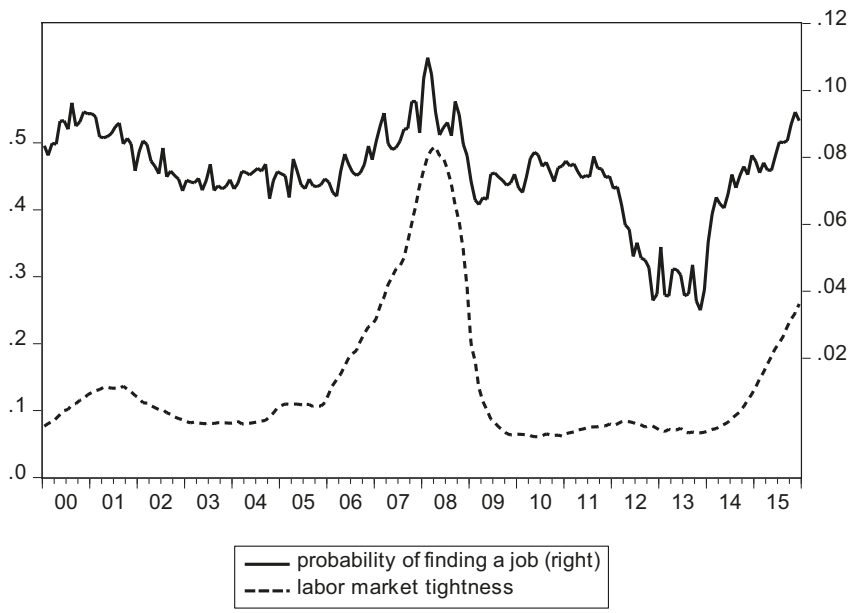
**Figure 17** Czech Republic

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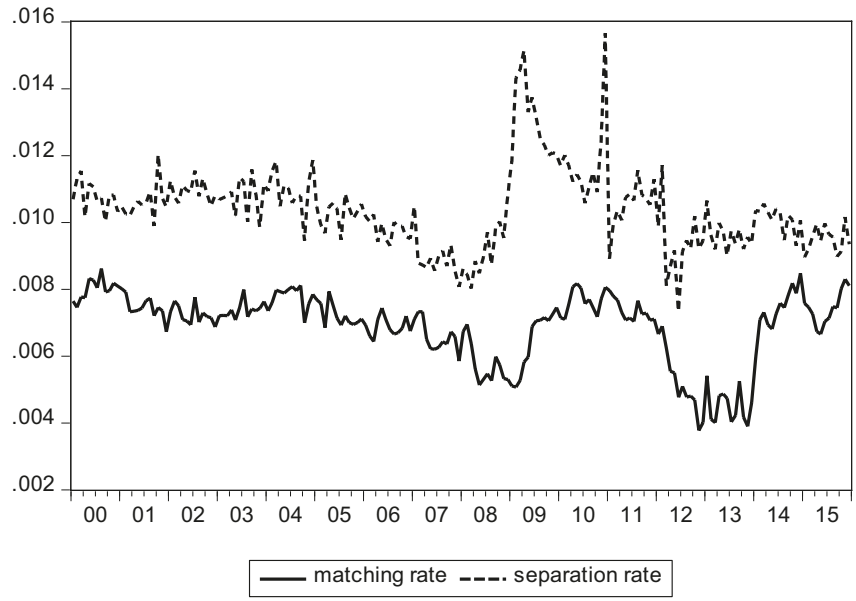


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