Explaining regional unemployment in Croatia: GVAR approach

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The paper models the effects of various macroeconomic and business indicators as well as environmental impacts for the period from January 2002 to December 2013 in order to explain the differences in the Croatian regional unemployment. The paper proposes use of relatively novel methodology for modelling regional unemployment. The applied methodology enables joint modelling of all Croatian counties in a single (global) model and employing a rich set of variables, as well as accounting for interactions among regional labor markets, economic activities and firms. The study indicates an absence of conventional market economies adjustment mechanisms on the regional labor markets. Low flexibility of the regional labor markets combined with strong dependence on national dynamics makes regions highly exposed to the occurrence of economic downturn.

Key words: Croatia, GVAR, regional unemployment.

INTRODUCTION

One year after the EU accession Croatia is still searching for the path towards successful integration in the European Union[1]. Regional topics are of particular concern, as the EU promotes a balanced regional development through financial support from its regional policy instruments (Structural Funds and the Cohesion Fund) along the lines of the EU long-term goals for growth and jobs ("Europe 2020"). One of the declared goals of the Europe 2020 strategy is to raise the employment rate of the population aged 20–64 from the current 70.1% to at least 75%. Apart from the EU target of 75%, in order to account for country specifics, national targets are also set, the lowest being for Croatia (62.9%). Although the gap to the national target has been decreasing from 2013 onwards (Figure 1),

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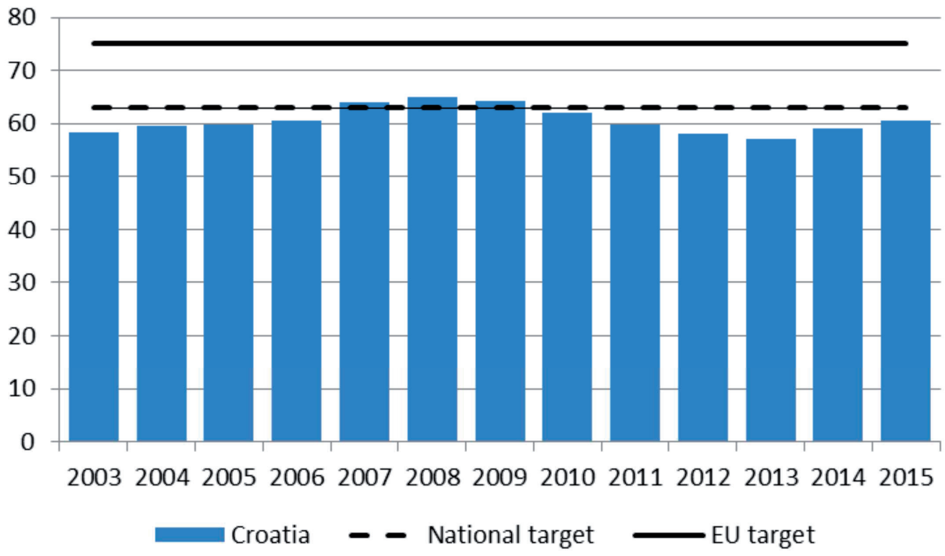
it is still quite large compared to the EU target. Meanwhile, in addition to lower employment rates, Croatia continues to struggle with high unemployment as its 17% unemployment rate is quite far from the EU average (10%). Of the EU countries, only Greece and Spain have higher unemployment rates (26.5 and 24.5%, respectively).

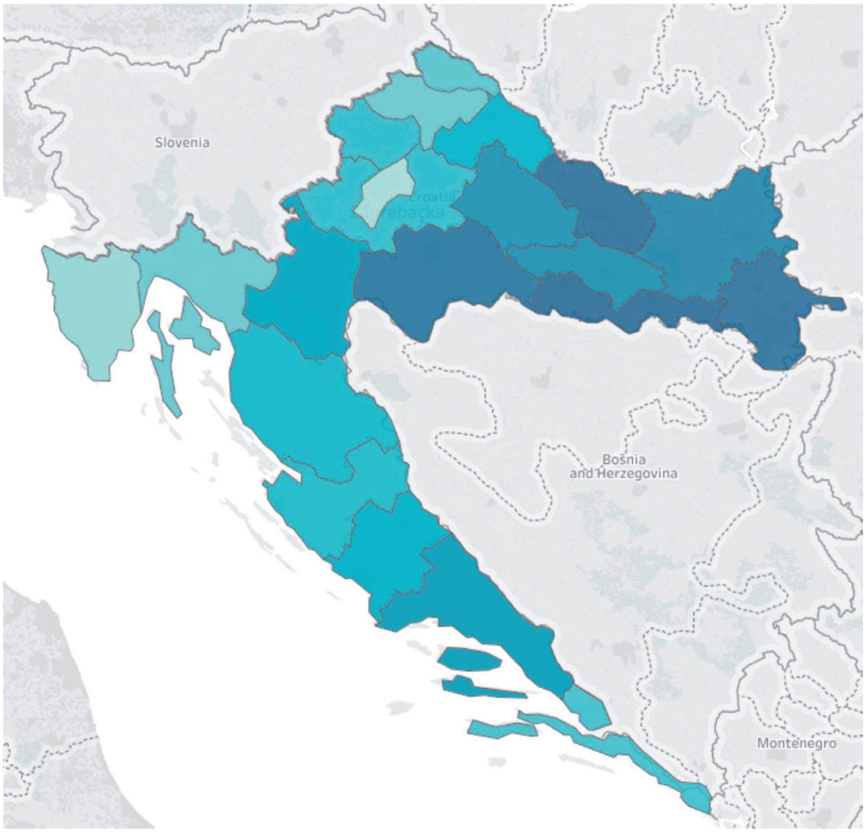
Figure 1
Croatian employment rates, age group 20 to 64 (2003-2015)



Source: Eurostat.

In addition to high unemployment rates on the national level in Croatia, Figure 2 reveals large disparities in the regional labor markets (darker shaded areas indicate counties with higher unemployment rates). The highest unemployment rate is recorded in Slavonski Brod-Posavina (37%). On the other hand, the City of Zagreb has the lowest unemployment rate (10.8%). Two more counties (Istria and Varazdin) have unemployment rates below the national average, while Primorje-Gorski kotar County has unemployment rate equal to the national average. Among nine counties with the highest unemployment rates, eight are located in the Eastern and Central Croatia and one is situated in the coastal part. This is along the lines of the study performed almost ten years ago (Luo, 2007), showing the persistence of differences in the regional labor markets. Therefore, the regional unemployment issue deserves attention and a detailed empirical analysis.

Figure 2
Regional unemployment rates in Croatia in 2013



Source: Croatian Bureau of Statistics.

The question is what distinguishes a group of counties with higher unemployment rates from the counties with lower unemployment rates? What are the potential developments that could describe regional unemployment dynamics? In order to provide an answer, numerous studies applied various modelling frameworks and variables. Blanchard and Katz (1992) presented a model which turned out to be a benchmark model for the regional unemployment analysis. Their study was performed for US states and it linked regional unemployment rate with labor supply, labor demand and wage setting factors. Their model setup enables interactions, hence regional unemployment both affects and is being affected by a selected set of explanatory variables[2]. Theoretical foundations set in Blanchard and Katz (1992) were further

[2] See Elhorst (2003) for a detailed overview on fundamental types of models and explanatory variables employed in studying regional unemployment determinants.

employed in studying regional and national unemployment differences in the EU countries (for instance Decressin and Fatas (1995) and later on in Zeilstra and Elhorst (2014)). However, regarding differences in US and EU labor markets, Blanchard and Katz (1992) emphasised migrations as an important adjustment mechanism, while Decressin and Fatas (1995) put emphasis on labor force behaviour, as the EU market is considerably less mobile. In contrast to established market economies, CEE countries are still on the path to incorporate labor market adjustment mechanisms with high regional dispersion in the unemployment rates, as well as its persistence. More specifically, Gacs and Huber (2005), as well as Bornhorst and Commander (2006) find that regional labor market mobility is very limited in the CEE countries and that most of the adjustments is carried through changes in the participation. Jurajda and Terrell (2009) show that a lack of convergence in the regional unemployment rates is due to the differences in the regional endowment of human capital.

On the regional level, the empirical research of unemployment dynamics in Croatia is scarce. Botrić (2004) analyzes differences between regional and national unemployment dynamics and finds that the regional impacts on the labor market in Croatia are much more pronounced than in some EU candidate countries. The author suggests that the economic structure (agricultural in the Eastern and industrial in the Central region) could be the primary reason for the differences between the regional and the county level unemployment dynamics. Botrić (2007) finds evidence of ineffectiveness of geographical mobility to influence regional disparities in the labour market as the populations tend to migrate towards areas with lower unemployment rates and higher average wages. Obadić (2004) finds excess labor supply for some counties, excess demand for others, and for two counties both. The author believes that weak geographic and qualification mobility is the main reason for the existence of a mismatch. Puljiz and Maleković (2007) find that the convergence in per capita income among counties is not yet in sight. Furthermore, in addition to rising inequalities on the national level, the authors find that within-county inequalities are rising as well, suggesting heterogeneity of some counties. Luo (2007) examines regional differences in wages and employment and finds that both individual and regional characteristics played an important role in the determination of employment and earnings. The author points out that a large part of the differences in regional labour market performance is due to the differences in human capital endowment. Through the analysis of a regional gross domestic product dynamics in Croatian regions, Botrić *et al*. (2007) identify common development patterns and find that more developed regions have fewer problems with the labor market. In studying the efficiency of the Croatian Employment Service in matching the unemployed workers with open job positions on a regional level, Tomić (2014) finds that regional income has a positive effect on the matching efficiency and that the efficiency of the matching process is primarily demand-driven. By applying panel data methodology in studying labor market adjustment mechanisms Erjavec and Jakšić (2015) find that limited wage flexibility is the main contributor to the low flexibility of the labor market to occurrence of the macroeconomic shocks. Furthermore, both the counties with lower unemployment rates and the regions with higher unemployment rates exhibit a lack of labor market adjustment (Erjavec and Jakšić, 2016).

So far the empirical research verified the existence of differences in the Croatian regional labor markets. However, the factors that could explain the differences in the dynamics of the regional unemployment in Croatia have not been thoroughly investigated yet. This paper analyses the effects of macroeconomic, business indicators and environmental impacts on unemployment in Croatian counties for the period from January 2002 to December 2013 using a Global Vector Autoregressive (GVAR) approach. The paper should contribute to the literature by improving on three key conceptual and methodological aspects. First of all, this is the first study that assesses the role of business indicators, economic activity and climate indicators in explaining the differences in regional unemployment dynamics in Croatia. Second, the model applied in this paper is the first attempt to model the possible interactions among Croatian regional labor markets, as well as the interactions between the analysed variables. Third, the applied methodology enables modelling variables as weakly exogenous and in that way deals with Zeilstra and Elhorst (2014) finding that some of the explanatory variables used in explaining regional unemployment are not strictly exogenous.

The paper explores the strength and existence of linkages among the Croatian regional labor markets and analyses the intensity and significance of responses of regional unemployment to shocks (unexpected changes) in regional economic activity, labor market and climate indicators. In order to raise the regional employment rate it is essential to learn about the dynamics of regional unemployment as well as its sensitivity to various shocks which could represent possible measures of economic policy towards regional labor markets, as well as the effect of climate indicators. Therefore, shocks in variables (regional GDP, equity prices or exchange rate) employed in the model could be interpreted as measures towards regional firms, wages or banks. Or, more precisely, as fiscal policy shocks (decrease in tax, surtax or compulsory social benefits leading to an increase in wages; subsidies or incentives to firms or a decrease of tax burden) and monetary policy shocks (due to high eurisation of Croatian economy, monetary policy shocks are more likely to manifest as changes in the exchange rates than changes in the interest rates). Furthermore, in order to get a better insight into the determinants of regional labor market dynamics, the relative importance of various factors in explaining regional unemployment is explored in the paper. Finally, knowledge on sensitivity of regional unemployment to shocks and key variables that influence regional unemployment dynamics facilitate understanding on potential regional labor market adjustment mechanisms. Primarily, this paper analyses possible wage adjustment and labor demand adjustment (through changes in vacancies, companies' stock market value and economic activity). Important factor influencing adjustment mechanisms is the extent to which regional unemployment dynamics rely on national dynamics, i.e. is the impetus mainly generated by local companies or by the central government. Additionally, features of unemployment (for instance long-term unemployment) play a vital role in labor market flexibility. And finally, as a significant part of national wealth is denominated in euros, monetary policy as a possible channel of influence is also explored in the paper.

The GVAR approach applied in the paper enables modelling possible feedback effects among regional unemployment and its determinants, thus allowing interaction similar to Blanchard and Katz (1992) on the level of variables within the individual county. Furthermore, the approach also allows for interaction among the developments in the regional labor market of different counties. The incorporation of interactions is the main advantage of the GVAR approach compared to previous research, which mostly apply panel data methodology. The tools within GVAR approach that allow tackling the issues mentioned above are: (1) impact elasticities (for the assessment of strength and existence of linkages among the Croatian regional labor markets); (2) generalised impulse response functions (for the analysis of intensity and significance of responses of regional unemployment to shocks in regional economic activity, labor market and climate indicators) and (3) generalised forecasting error variance decomposition (to explore the relative importance of various factors in explaining regional unemployment dynamics).

The paper is organized in four sections. Following the introduction, the second section gives a brief overview of the data sets and the methodology applied in the empirical analysis of the main determinants of the regional unemployment dynamics in Croatia. The results of the performed empirical analysis are presented in the third section, while the final section provides a summary of the main findings and gives some concluding remarks.

DATA AND METHODOLOGY

Regions are connected through numerous channels of interaction. Therefore, separate modelling of individual regions would neglect regional interdependencies and spillover effects that occur due to regional interactions (trade in goods and services, financial assets, movement of labor and capital). However, joint modelling of such large-scale system is not feasible using conventional models due to proliferation of parameters as the dimension of the models grows. Therefore, a Global Vector Autoregressive (GVAR) methodology, introduced in Pesaran *et al*. (2004), was employed as an appropriate framework for modelling, as it enables modelling high-dimensional systems in a theoretically coherent and statistically consistent manner. The approach solves the dimensionality problem by decomposing the underlying large dimensional VAR models into a smaller number of conditional models, which are linked together through cross sectional averages.

Basically, GVAR approach can be described as a two-step procedure. First, small scale country (or region) specific models are estimated as conditional on other spatial sub-units. These models (referred to as VARX* models) include domestic variables and starred[3] variables defined as weighted cross section averages of variables of other regions which are treated as weakly exogenous (long-run forcing). Following that, individual regions VARX* models are stacked and solved simultaneously as one large global VAR model. GVAR allows for interdependencies across individual variables within a given region and/or across regions, since lags of all variables enter individual equations and the reduced form errors are allowed to be cross-sectionally dependent. For a detailed overview on GVAR approach and numerous empirical applications, see Chudik and Pesaran (2014).

Considering the dimensions of the analysed GVAR models, the most important requirement for the validity of the approach is that the obtained model is

[3] Starred variables are intended to capture unobserved factors which counties are exposed to.

dynamically stable. Namely, eigenvalues of the estimated global model should be on or inside the unit circle. A possible factor contributing to the model instability is the presence of residual serial correlation. Therefore, it is important to perform appropriate residual serial correlation test. Another important requirement of the GVAR approach is that the 'idiosyncratic' shocks of individual county models should be cross-sectionally 'weakly correlated' and as a result the weak exogeneity of the foreign variables is ensured. The rationale behind is that by conditioning the county-specific models on weakly exogenous starred variables (introduced in the model as proxies for common unobserved factors), the degree of correlation of the remaining shocks across regions should be modest. Besides formal statistical test for weak exogeneity of starred variables, a simple diagnostic of the extent to which the starred variables have been effective in reducing the cross-section correlation of the variables in the GVAR model is provided by the average pairwise cross-section correlations for the levels and those of the associated residuals over the selected estimation period. The decrease in correlations of the residuals of the individual county models also insures that the focus of the empirical analysis is not diverted by spurious comovements between the analysed variables, i.e. that the correlation between the variables is not induced by the trends contained in these variables.

Given that the diagnostics of the model are satisfying, the solution of the global model can be used for various purposes. In the context of this paper, the most important analytical outputs of the GVAR model are contemporaneous effects of starred variables on their domestic counterparts, generalised impulse response functions and generalised forecasting error variance decomposition.

Contemporaneous effects of starred variables on their domestic counterparts are interpreted as impact elasticities between unemployment in one county (domestic variables) and unemployment in other counties (starred variables). They reveal (in) existence of linkages between the regional labor markets depending on the size and statistical (in)significance of the estimated coefficients.

A very important tool in the analysis of the dynamic systems is the impulse response function which provides information on the potential reaction of the analysed variables system to shocks. In order to avoid variable ordering problems, generalised impulse response functions (GIRF) are usually applied in the GVAR framework. GIRF indicates how the effects of variable-specific shocks on the future states of all the variables in the dynamic model, develop in time. Hence, GIRF could indicate potential regional labor market adjustment mechanisms or the inexistence of such mechanisms.

Generalised forecasting error variance decomposition (GFEVD) estimates the proportion of the variance of the *h*-step ahead forecast errors of each variable that is explained by conditioning on contemporaneous and future values of the generalised shocks of the system. In other words, GFEVD presents the relative contributions of the shocks to reducing the mean square error of forecasts of individual endogenous variables at a given horizon *h*. GFEVD is not sensitive to ordering of the variables in the county specific models which is very useful in the multi-county models like the one applied in this paper.

As the GVAR approach is data intensive, monthly data had to be employed instead of yearly or quarterly data. Therefore, the dataset employed in this paper consists of the monthly data spanning from January 2002 to December 2013, which makes a total of 144 observations. The dataset covers 20 counties in which the city of Zagreb and Zagreb County were merged into one category as they, basically, constitute a single labor market with their intense daily commuting.

The selection of variables employed in this paper follows the theoretical framework set up in Blanchard and Katz (1992) and Zeilstra and Elhorst (2014). However, some of the variables could not be employed in this study due to insufficient data span (data available on yearly basis that cannot be interpolated or do not exhibit much variation on monthly basis, such as the data on migration and natural rate of change in population) or due to inexistence of appropriate data (the data on commuting). The employed empirical model includes five endogenous variables: unemployment level (as a central variable of the model), real regional gross domestic product (GDP) in 2010 prices, real regional net wages in 2010 prices, regional equity price index and vacancies. Additionally, exchange rate, temperature and precipitation were included as global variables to proxy for common observed factors. Individual county models also include starred variables defined as weighted averages of corresponding endogenous variables. A detailed overview of the employed variables is presented in Table 1.

Table 1
County composition of endogenous and starred variables in the GVAR model

Variables	Number of counties	
Endogenous		
Unemployment (*u*)	20	
Real regional GDP (*y*)	20	
Real regional wages (*w*)	20	
Equity prices (*eq*)	17	Excluding: Lika-Senj, Međimurje and Dubrovnik-Neretva
Vacancies (*v*)	20	
Exchange rate (*ex*)	1	Zagreb
Temperature (*temp*)	1	Zagreb
Precipitation (*prec*)	1	Zagreb
Exogenous		
Unemployment (u^*)	20	
Real regional GDP (y^*)	20	
Real regional wages (w^*)	20	
Equity prices (eq^*)	20	
Vacancies (v^*)	20	
Exchange rate (*ex*)	19	Excluding: Zagreb
Temperature (*temp*)	19	Excluding: Zagreb
Precipitation (*prec*)	19	Excluding: Zagreb

To get a better insight into the unemployment dynamics, monthly unemployment rates (original and seasonally adjusted) are presented in the Figure A1 in the Appendix. Official unemployment rates data at the county level are not published on monthly basis. Therefore, the unemployment rate has been calculated as the ratio of the number of unemployed (obtained from the Croatian Employment Service (CES)) to the total sum of both the employed (obtained from the Croatian Bureau of Statistics (CBS)) and unemployed. The figure illustrates that tourism oriented regions exhibit a strong seasonal demand for labor. Generally, unemployment rates in all counties displayed decreasing trends throughout the period from 2002 to 2009, when the unemployment rate started to increase. At the end of the analysed period, the rising trend is still present, suggesting that the rising unemployment issue is more than just a temporary crisis effect. Log of unemployment was used in the study as the data on unemployment rates turned out to be integrated of order two[4], *I*(2), and therefore made the model dynamics unstable. All other variables (besides climate indicators) are also in logs. Regional GDP measures a region's output and thus acts as a proxy for the degree of economic activity in the region and regional labor demand. Yearly data on the regional level GDP were obtained from CBS. However, as all other variables were available on monthly basis, monthly regional GDP series was interpolated according to the (quarterly) dynamics of the national GDP[5] and monthly data on industrial production.

Wages were included in the model as a potential equilibrating mechanism. The data on wages[6] were obtained from the CBS. Equity price variable reflects the price movement for equities in a certain county. The variable was added as it is expected that the equity price decrease could be related to bankruptcy or downsizing due to unfavourable economic conditions and thus leads to an increase in unemployment. Composite stock exchange index was defined for each county using individual company's stock market performance data which were taken from Zagreb Stock Exchange (ZSE) website. In defining the index, individual stocks were weighted according to their market capitalisation. The fact that the majority of firms is registered in the City Zagreb and that some counties have a significantly smaller number of firms registered in their counties is not an obstacle due to the employed approach. Namely, GVAR approach enables modelling influences that non-resident companies have on the corresponding county through starred variables that are defined as weighted averages of equity price variables in other counties. Vacancies[7] were included in the model to proxy for labor demand. The data were obtained from the CES.

Additionally, global variables were added to the model to proxy for common observed global factors. The exchange rate

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[4] A time series is integrated of order *d* if the series becomes stationary after being first differenced *d* times.

[5] Correlations between national and regional level GDP are very high, ranging from 0.915 to 0.996 (Table A1 in the Appendix), with the exception of one county (Lika-Senj) the correlation of which to the national GDP is 0.708. Thus, approximating regional level of GDP by using dynamics on the national level seems to be justified.

[6] This paper employs the data on wages in incorporated businesses only, as only those are available on monthly basis.

[7] Vacancies and real regional GDP were not standardised to account for the differences in county size for two reasons. First, standardising resulted in *I*(0) variables, while other variables were *I*(1). Secondly, all the variables enter the vector error correction model in the first differences. The first differencing variables that are in logs actually mean that the variables enter the vector error correction model in relative terms.

variable was added in the model as the savings are predominantly denominated in euro as well as the credit obligations which are also linked to the euro. Therefore, the exchange rate movements affect both the population wealth and their indebtedness. The Croatian national bank (CNB) was the source for the data on the exchange rate. Temperature and precipitation variables were added as a proxy for environmental impacts. Due to 'sea and sun' oriented tourism, climate indicators could have an impact on tourism oriented regions and thus the employment in the period from May to October. The data for the climate indicators were obtained from CBS. At first glance it may seem inappropriate to model climate indicators as weakly exogenous and not strictly exogenous variables. However, a certain feedback exists through pollution as a consequence of urbanisation and industrialisation.

Finally, due to the presence of a seasonal component, all data were seasonally adjusted using TRAMO/SEATS prior to the empirical analysis. Vector of endogenous variables ($\mathbf{x}_{it}$) contains uneployment (u_{it}), real regional GDP (y_{it}), real regional wages (w_{it}), equity prices (eq_{it}) and vacancies (v_{it}), for county i = 1,...,19 (all variables are in logs), i.e.

$$\mathbf{x}_{it} = (u_{u}, y_{u}, w_{u}, eq_{u}, v_{it})'.$$

As a reference county, Zagreb () is modelled differently to account for the fact that Croatia is highly centralised. The model for Zagreb also includes a log of exchange rate (ex_t), average monthly temperatures ($temp_t$) and average monthly precipitation ($prec_t$) as additional endogenous variables. Due to modelling requirements, global variables had to be entered as endogenous in one individual model. Zagreb was the obvious candidate, being the largest urban agglomeration in Croatia and as such is the biggest polluter in Croatia. Hence, the vector of endogenous variables for Zagreb is defined as:

$$\mathbf{x}_{0t} = (u_{0t}, y_{0t}, w_{0t}, eq_{0t}, v_{0t}, ex_t, prec_t, temp_t)'.$$

Besides variable selection, another important issue in defining the global model concerns the weights employed in the model. Weights have a vital role in connecting the individual county models and show the degree to which one county depends on the remaining counties. On the country level, data that describe interactions between countries (trade or financial data) are usually employed as weights. As no such data exist on the regional level, distance weights were applied, similar to Vansteenkiste (2007). Distance weights employed in this paper were calculated as the inverse of the distance between the counties capitals. Therefore, the neighbouring counties should have larger weight. The resulting 20 × 20 matrix of the weights is presented in Table A2 in Appendix, while counties' abbreviations are listed in Table A1 in the Appendix. The shares of each region are displayed in columns. Based on this matrix of weights, starred variables can be calculated for the real regional GDP, regional unemployment, regional wages, vacancies and equity prices data. A vector of starred variables also includes global variables:

$$\mathbf{x}^*_{it} = (u^*_{it}, y^*_{it}, w^*_{it}, eq^*_{it}, v^*_{it}, ex_t, temp_t, prec_t)' \text{ for } i = 1,...,19.$$

and for Zagreb,

$$\mathbf{x}^*_{0t} = (u^*_{0t}, y^*_{0t}, w^*_{0t}, eq^*_{0t}, v^*_{0t})'.$$

Basic requirement of the GVAR approach is that the starred variables are weakly exogenous with respect to the long-run parameters of the conditional model (error-correction form of the underlying VARX* specification). Following the estimation of the individual VARX* models (described in the following section), *F*-tests for the joint significance of the error-correcting terms are taken from the conditional VARX* models in the partial models for the corresponding weakly exogenous variables which were performed (Harbo *et al*., 1998 and Johansen, 1992). The number of lags in the partial models (p^*_i and q^*_i) was selected according to Akaike information criteria (AIC). The results of conducted tests are summarized in Table A1 in the Appendix and they suggest that at the 5% level weak exogeneity assumptions were rejected in only two out of 157 conducted tests, i.e. a fraction of only 1.3%. Furthermore, at 1% level, weak exogeneity assumptions could not be rejected in any of 157 conducted tests.

In order to assess the order of integration of the analysed variables, Augmented Dickey-Fuller (ADF) and weighted symmetric (WS) ADF tests were performed (Park and Fuller, 1995). In all counties both tests indicate that the key variables of the study (unemployment and regional GDP) are $I(1)$[8].

Under the assumption that the starred variables are weakly exogenous, individual VARX* models were estimated according to techniques developed by Harbo *et al*. (1998) and Pesaran *et al*. (2000). Lag orders for the endogenous variables, p_i, were selected according to AIC and were not allowed to be greater than 2. Lag orders for the starred and global variables, q_i, were set to 1. After that the corresponding cointegrating VARX* models were estimated and the rank of their cointegrating space was selected using trace statistics due to its better small sample performance compared to maximum eigenvalue statistics, which is also less robust to departures from normal errors (Cheung and Lai, 1993). However, the final choice of lag orders and the rank of cointegrating space were set in accordance with the results of diagnostics tests. Appropriate vector error correction model had a restricted trend and unrestricted intercept. Individual county models were then estimated subject to reduced rank restrictions and the corresponding error correcting terms[9] were derived.

EMPIRICAL RESULTS

Before turning to the results of the estimated GVAR model[10], it is essential to assess the model diagnostics. The results (Table A3 in the Appendix) for tests of residual serial correlation were satisfactory considering the dimensions of the model. The F-statistics for testing residual serial correlation are based on the residuals from the estimated VARX* models. The *F*-statistic indicating residual serial correlation was statistically significant in 10 out of 100 conducted tests, i.e. a fraction of only 10%. Furthermore, at the 1% level only three *F*-statistics (fraction of only 3%) were statistically significant.

In performing the dynamic analysis (generalised impulse response function – GIRF and generalised forecast error variance decomposition – GFEVD), an important prerequisite is the stability of the underlying GVAR model. The eigenvalues of the estimated GVAR model indicate that the model is stable. There are 200 eigenva-

[8] Assuming that all variables are $I(1)$ allows long-run relationships to be interpreted as cointegrating, which is not a matter of the utmost importance in the context of this research. Bearing that in mind, the results of the unit root test, along with other results that are not reported in the paper, such as eigenvalues of the GVAR model, are available upon request.

[9] Used for conducting weak exogeneity tests.

[10] The empirical results were obtained using the GVAR Toolbox 2.0 (Smith and Galesi, 2014), which is based on MATLAB code.

lues, out of which 66 are equal to one, and the remaining 134 eigenvalues have moduli all less then unity. Unit eigenvalues of the system indicate that some shocks will have permanent effects on the levels of endogenous variables.

Additionally, another important diagnostic which ensures that the model tracks the comovements between the variables themselves and not between their trends (spurious correlation) are the average pairwise cross-section correlations. For every county and for each given variable, the pairwise correlation of that county with each of the remaining counties was calculated, as well as averaged across counties (Table A4 in the Appendix). Large correlations for the variable levels indicate strong comovements between the variables. However, those correlations are spurious and partly induced by common unobserved factors. The correlations of the residuals from the VARX* models are very small and do not depend on the choice of the variable or county which indicates that the model has been successful in capturing common unobserved effects determining regional unemployment.

Contemporaneous effect of starred variables on their domestic counterparts (Impact elasticities)

The contemporaneous effects of a 1% change to unemployment in other counties on the individual counties unemployment are reported in Table 2 (with robust *t*-ratios in the parenthesis). For instance, a coefficient of 0.54 (Karlovac) indicates that a 1% increase in starred unemployment in a given month leads to an increase of 0.54% in the Karlovac county within the same month. Counties are divided into three groups: counties whose coefficients are above one (coefficient larger than one indicates an overreaction to starred unemployment changes and strong linkages among labor markets), counties in which coefficients are between one and 0.8 (indicating close comovements between regional labor markets), and counties whose coefficients are smaller than 0.8 (suggesting slightly weaker linkages among the regional labor markets).

Table 2

Contemporaneous effect of starred variables on their domestic counterparts (Impact elasticities) – unemployment

County	Coefficient >1	County	Coefficient <1, 0,8>	County	Coefficient <0,8
Krapina-Zagorje	1,21 (9,29)	Varaždin	0,98 (13,56)	Bjelovar-Bilogora	0,77 (13,5)
Istria	1,1 (10,26)	Požega-Slavonia	0,98 (6,33)	Virovitica-Podravina	0,76 (9,38)
Međimurje	1,07 (13,2)	Dubrovnik-Neretva	0,91 (14,38)	Vukovar-Sirmium	0,73 (8,32)
Primorje GK	1,04 (18,78)	Šibenik-Knin	0,88 (12,2)	Split-Dalmatia	0,72 (12,04)
Lika-Senj	1,02 (7,37)	Osijek-Baranja	0,88 (15,98)	Zadar	0,68 (7,3)
Koprivnica-Križevci	1,02 (8,13)	Slavonski Brod-Posavina	0,85 (13,14)	Karlovac	0,54 (6,61)
		Zagreb	0,81 (9,18)		
		Sisak-Moslavina	0,81 (13,31)		

Source: Author's calculations.

Table 2 shows that in most counties linkages among regional labor markets are positive and strong, thus confirming findings from Puljiz and Maleković (2007) that national and regional unemployment rates have similar dynamics. The *t*-ratios, computed using White's heteroskedasticity consistent variance estimator, indicate that all contemporaneous effects were significant, suggesting the existence of spillovers in the regional labor markets. Furthermore, counties with larger unemployment rates generally have smaller coefficients, indicating weaker reaction of their labor markets to movements in other counties' labor markets.

Generalised impulse response functions

As the estimated GVAR model is dynamically stable, the effects of various shocks can be analysed by means of generalised impulse response functions. Sensitivity of the regional unemployment to various shocks could be used as guidance in formulating the set of economic policy measures aimed at reducing regional unemployment. Due to the access to the EU structural funds, the regional approach is of distinct interest. In order to decrease unemployment rates, labor market analysis should take into account the regional characteristics. If the regional labor markets display different patterns of sensitivity to various shocks, there is a possibility that a similar set of policy measures could have a different impact on their labor markets. As the sensitivity to shocks and possible spillovers among regions determine the efficiency of a policy measure, the findings of the paper could provide guidance to policy makers in formulating appropriate measures for a particular region.

Figure 3 shows the effects of selected shocks on unemployment after one year for all the counties in the model. All figures depict bootstrap median estimates along with 90 percent bootstrap confidence bands.

How do Croatian regions respond (adjust) to regional labor market shocks? The effects of a positive one standard error county specific shock in unemployment are illustrated in panel a) of Figure 3 and are positive and statistically significant in seven counties, including the counties with high unemployment rates (Sisak-Moslavina, Virovitica-Podravina, Požega-Slavonia and Split-Dalmatia) and low unemployment rates (Zagreb, Varaždin and Zadar). Generally, the effect of a shock is stronger in the counties with lower unemployment rates. However, as the effect is mostly not statistically significant it seems that, overall, counties do not adjust to the occurrence of regional labor market shocks, which is not surprising considering that long term unemployment rates in Croatia are about twice the EU average (European Commission, 2016).

As for county specific shocks in regional economic activity, in seven counties the effects of shocks show the expected sign, i.e. an increase in regional GDP (panel b) leads to a decrease in unemployment. In three counties (Lika-Senj, Bjelovar-Bilogora and Slavonski Brod-Posavina), an increase in regional GDP leads to an increase in regional unemployment, while in ten counties the effects on regional unemployment are not statistically significant.

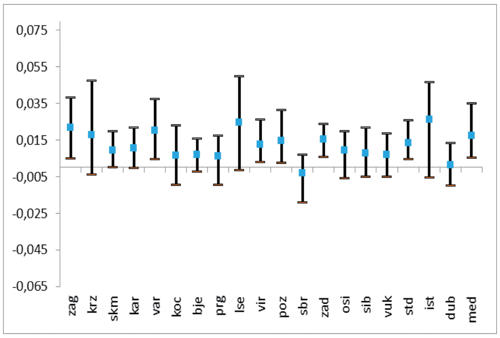
On the other hand, an increase in regional wages (panel c) does not have a statistically significant effect on regional unemployment. Therefore, it is not very likely that policy measures oriented on wages will affect regional unemployment. This result confirms findings from previous research (Erjavec and Jakšić, 2015) and is in accordance with European Commission's country specific recommendations (European Commission, 2015) which point to a limited wage adjustment and low flexibility of the system which makes it difficult to adapt to the changes in the macroeconomic environment.

As for labor demand shocks (vacancies – panel c), they are statistically significant only in two counties (Istria and Koprivnica-Križevci), which could be an evidence of a mismatch between the skills needed by the employers and the skills of the unemployed.

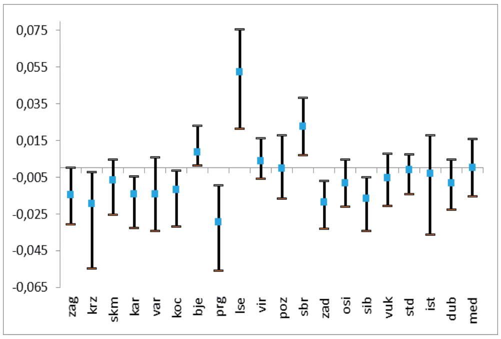
Figure 3

Generalized impulse responses of selected one standard error shocks, effects on unemployment

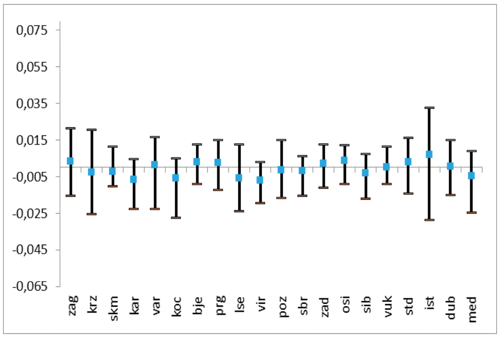
a) positive county specific shock to unemployment



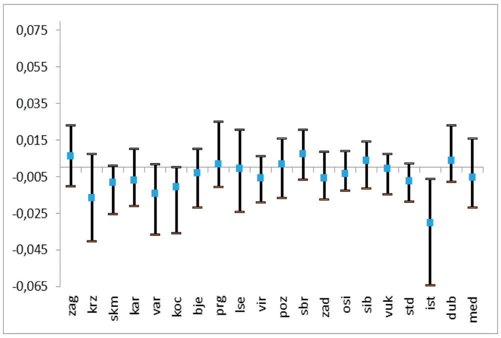
b) positive county specific shock to regional GDP



c) positive county specific shock to wages



d) positive county specific shock to vacancies



Source: Author's calculations.

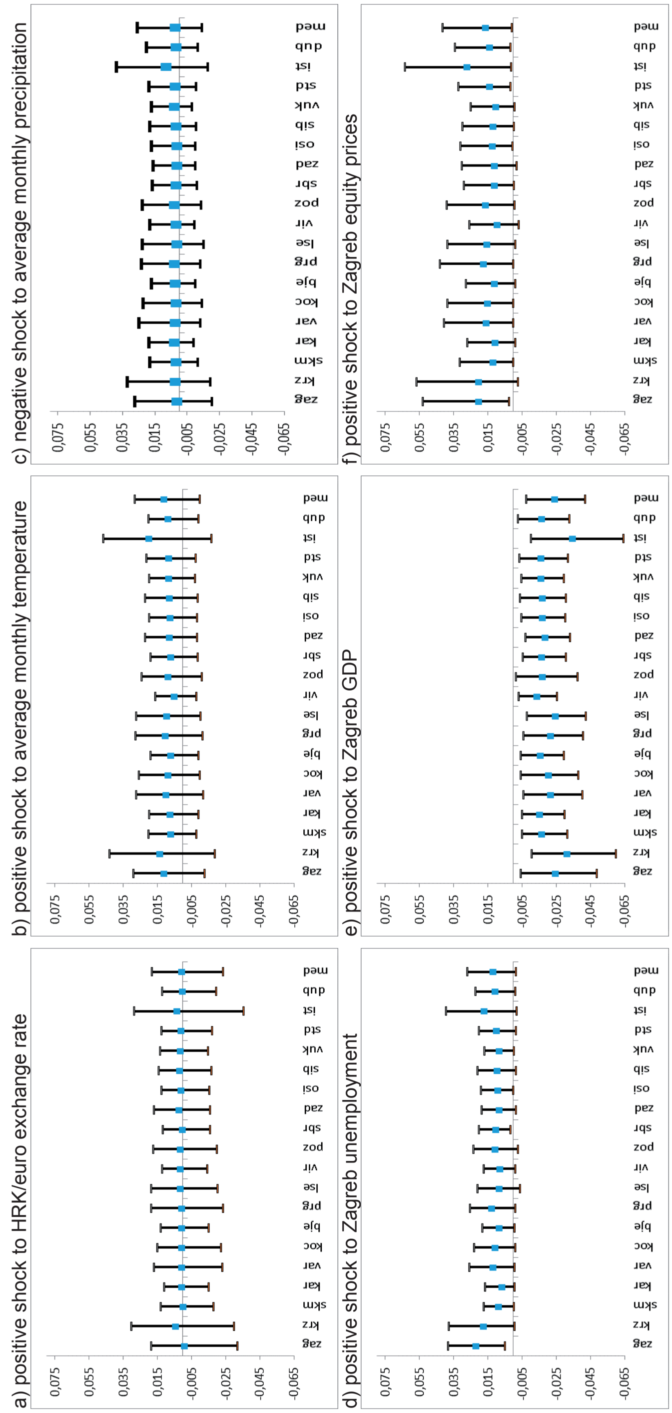
Figure 4 depicts the effects of one standard error shock in global variables on regional unemployment (panels a to c).

A depreciation of HRK/euro exchange rate (panel a) by 0.14% does not have a statistically significant effect on regional unemployment. As for climate indicators, the effects of shock in temperatures (panel b) and an average monthly precipitation (panel c) decrease of 3.04 mm is not statistically significant. Same results hold for all counties, regardless of the prevailing economic activity or the size of the unemployment rate.

Due to the fact that Croatia is highly centralised, the effects of shocks in Zagreb indicators are also depicted in Figure 4 (panels d-f). Similar to county specific shocks, shocks in Zagreb vacancies and wages were not statistically significant and hence were not reported in Figure 4.

A shock in Zagreb GDP leads to a statistically significant decrease in regional unemployment in all counties. Thus, an increase of the economic activity in Zagreb has a larger effect on the regional unemployment than the county specific increase in the regional GDP of the individual counties. A shock in Zagreb equity prices is statistically significant in ten counties. However, it leads to an increase of regional unemployment instead of a decrease. Therefore, an increase of company's market value is more connected with restructuring and thus downsizing. Furthermore, a shock in Zagreb unemployment is statistically significant only in three counties (Zagreb, Osijek-Baranja and Slavonski Brod-Posavina). Nevertheless, the results indicate an existence of spillovers from Zagreb to the rest of the Croatian regions, thus confirming that Croatia is highly centralised and that Croatian local governments other than Zagreb have low fiscal capacity.

Figure 4
Generalized impulse responses of one standard error shocks in global and Zagreb variables, effects on unemployment



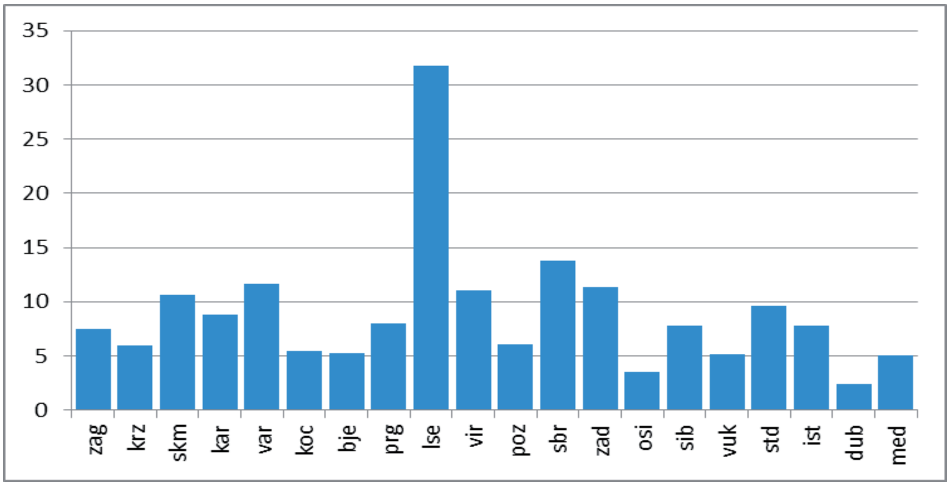
Source: Author's calculations.

Generalised forecast error variance decomposition

The assessment of the relative importance of various factors on regional unemployment dynamics is carried through a generalised forecast error variance decomposition (GFEVD). Figure 5 shows that after one year the greater share (from 68.3 to 97.6%) of the forecast variance of the regional unemployment is explained by national variables, which is along the lines of Gacs and Huber (2005) results for the CSEE countries. Therefore, the differences in the regional labor markets in Croatia are mainly due to different reactions of regional labor markets to national shocks. This is a reasonable finding, especially considering the low fiscal capacity of local government units.

Figure 5

Share of the forecast error variance of regional unemployment explained by the regional factors



Source: Author's calculations.

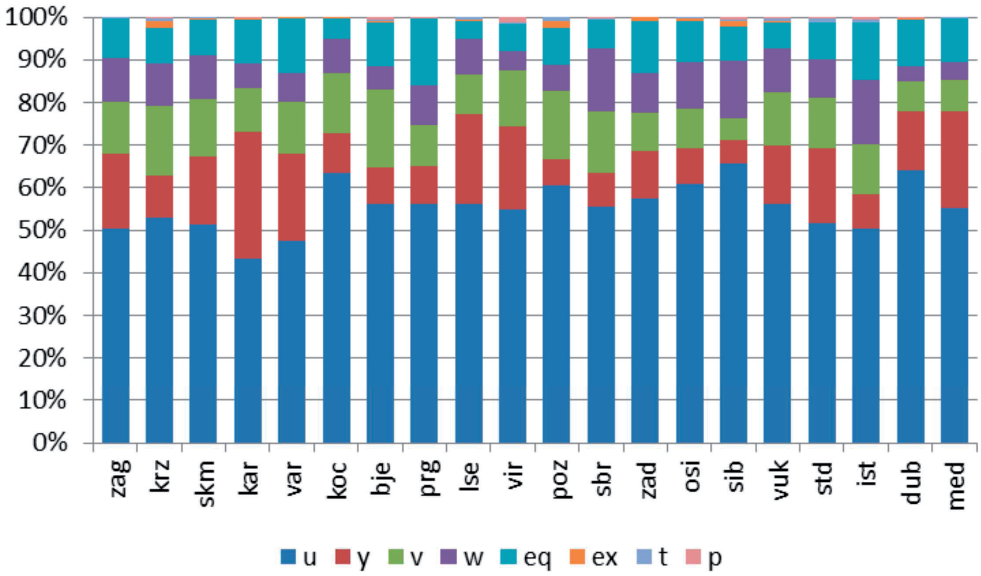
Figure 6 and Table A5 in the Appendix show the share of the forecast error variance of regional unemployment explained by conditioning on contemporaneous and future innovations of the country equations.

On impact, regional unemployment dynamics is predominantly explained by unemployment itself with the share above 40% for all counties (43.2 - 65.9%). Twelve months later, the share of unemployment dynamics explained by unemployment is around 20% (14.6% to 24.1%).

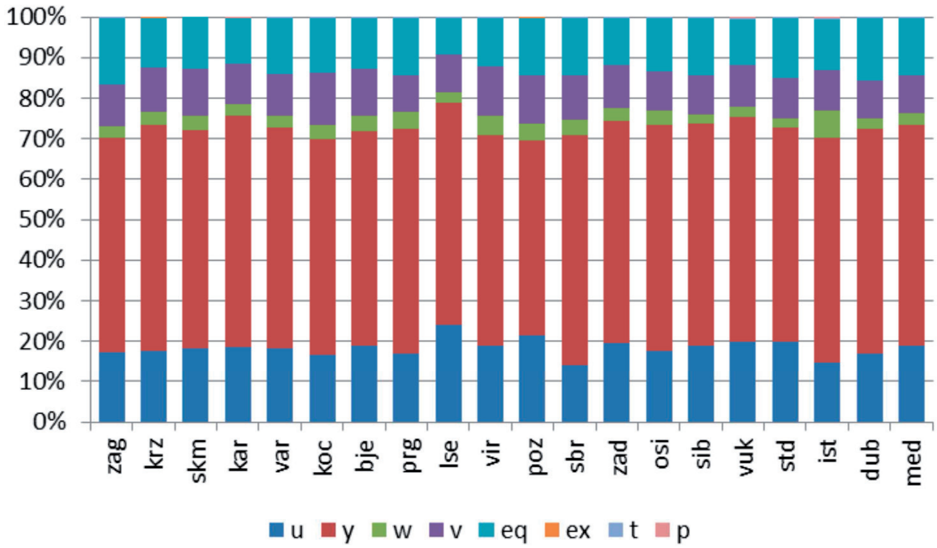
Figure 6

Share of the forecast error variance of regional unemployment explained by analysed variables

a) on impact



b) after one calculations



Source: Author's calculations.

Although on impact the share of regional GDP in explaining regional unemployment dynamics is modest in most counties (5.3 - 30%), after one year it explains most of the regional unemployment dynamics, its share ranging from 48.3% (Požega-Slavonia) to 569% (Karlovac). A high share of GDP indicates a large dependence of regional labor market dynamics on general macroeconomic conditions (Blanchard and Katz, 1992).

On impact the share of forecast error variance of regional unemployment explained by equity prices variables is between 4.1% and 15.9%. After one year, it is in the range from 9.1% (Lika-Senj) to 16.5% (Zagreb). The low share of equity prices variables is not surprising considering the insufficient job creation as the consequence of strongly regulated Croatian labor market and consequently strong employment protection. That is why private companies do not have an incentive to locate their facilities in regions with higher unemployment rates, as laying off workers is complicated and expensive (Vukšić, 2014).

Wages explain a small share of the forecast error variance of regional unemployment. On impact the share is from 5.1% to 18.2% and after a year it is below 7% in all counties (2.4 - 6.7%). Similar to wages, vacancies explain 3.4 - 15.1% on impact and 9.3 - 12.7% after a year. On impact the share of the HRK/euro exchange rate in explaining the unemployment dynamics is below 1% in all counties except Šibenik-Knin, Požega-Slavonia and Krapina-Zagorje, where the share is around 2%. Hence, in a highly eurised country such as Croatia, monetary policy shocks do not have much impact in explaining regional unemployment dynamics. Climate indicators explain a negligible part of the unemployment dynamics. The share is a bit higher (1.2%) for precipitation in Virovitica-Podravina which is an agricultural county.

Therefore, as there is no clear pattern which would distinguish a group of counties with higher unemployment rates from counties with lower unemployment rates, the results of the dynamic analysis indicate that the responses of regional labor markets to shocks and the pattern of the factors that explain regional unemployment dynamics are similar.

Therefore, the results of the dynamic analysis suggest that the main problems of the Croatian regional labor markets are low flexibility of the labor market and inexistence of adjustment mechanisms such as wage adjustment. Statistical insignificance of labor demand shocks suggests that the skills and expertise employers need and the skills of the unemployed do not match, which once again highlights the problem of long-term unemployment rates and their persistence.

CONCLUSION

Regions are connected through numerous channels of interaction. Consequently, regional policy analysis and measures towards regional labor markets should account for interactions and spillovers among regional labor markets, economic activities and firms. Impact elasticities and the results of the dynamic analysis performed in this paper indicate that spillovers between counties exist. However, the national component is dominant over region-specific contributions. Furthermore, the results of the empirical analysis indicate that Croatian regional labor markets are not flexible and are therefore highly fragile in the event of the occurrence of macroeconomic shocks. Indeed, this is confirmed as the economic activity explains most of the regional unemployment dynamics and the differences in the regional labor markets in Croatia are mainly due to different reactions of regional labor markets to national shocks. A strong dependence on national dynamics and general macroeconomic conditions mean that there is no buffer in the case of economic downturn that would alleviate the negative effects (poverty and unemployment). It is especially important to note the irrelevance of wages and labor demand shocks as regional labor market adjustment mechanisms. Therefore, the results indicate that a conventional set of policy measures oriented towards wages or companies would not have a statistically significant impact on Croatian regional unemployment. The same applies for monetary policy measures that would not have much impact on regional unemployment dynamics in a highly eurised country such as Croatia. Therefore, a set of policy measures should be well thought of and carefully designed and it should primarily be county specific.

The reliance on monthly data disabled inclusion of proxies for other potential adjustment mechanisms such as migration and labor supply in this paper. However, as in a globalised setting shocks (changes in policy measures, technology shocks or economic downturns) transmit faster, counties are more exposed and vulnerable to unexpected changes. Therefore, monthly dynamics is much more informative compared to a yearly snapshot. Additionally, some of the possibly interesting variables (mainly demographic) do not exhibit enough variation even on yearly basis, meaning that their inclusion would add little descriptive power to the analysis.

As other countries in the region experience similar problems (mismatch and structural adjustment), the approach applied in this paper could be applied for modelling regional unemployment in those countries as well (accounting for national characteristics in the variable selection stage).

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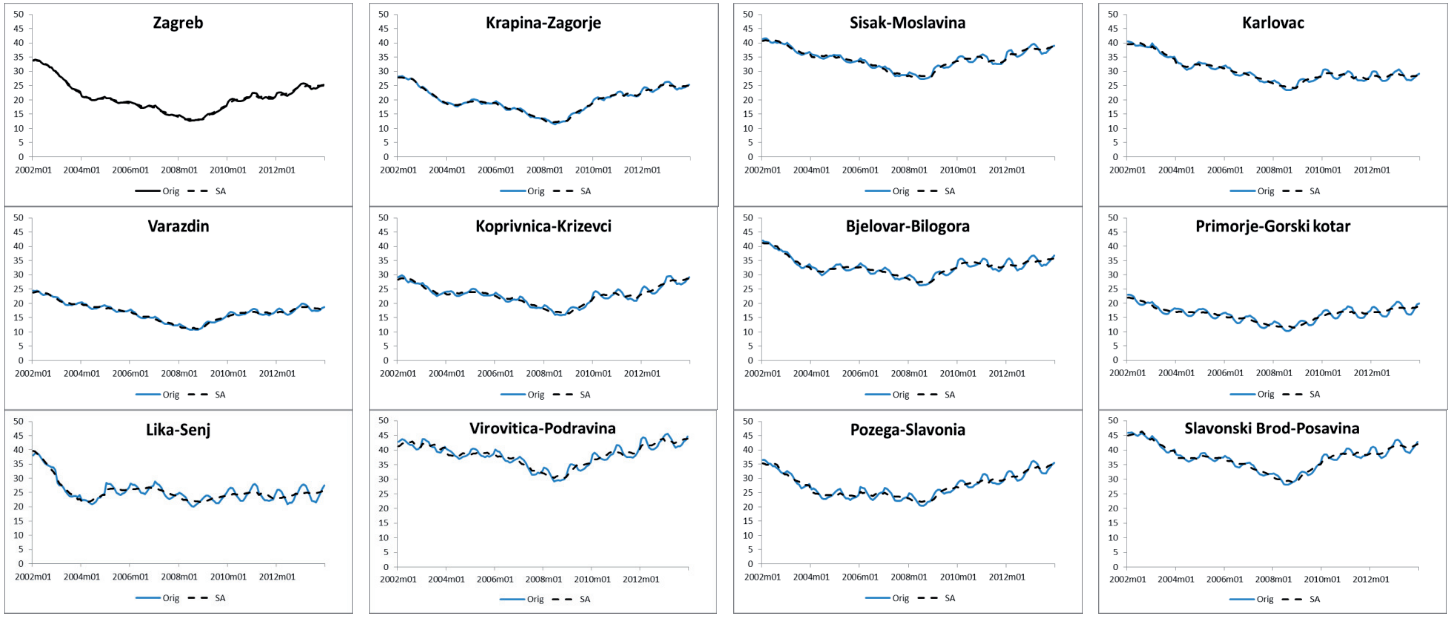
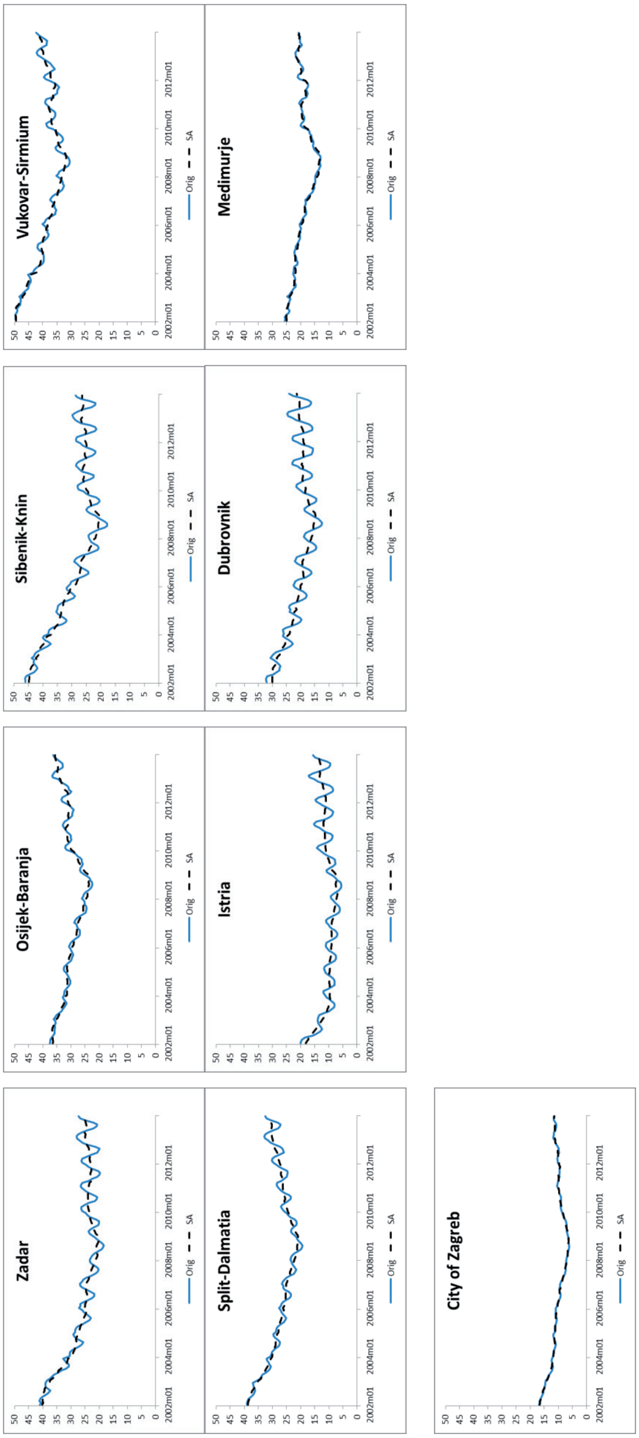
APPENDIX

Figure A1

Unemployment rate (original and seasonally adjusted data)





Source: Authors calculations; CBS and CES.

Table A1
Correlations between national and regional level GDP (2002-2013) and results of weak exogeneity tests of the starred variables

County	Abbreviation	*Correlation*	p_i^*	q_i^*	*F*-test	*y**	*u**	*w**	*eq**	*v**	*ex*	*temp*	*prec*
Zagreb	zag	0,996	1	2	F(2,120)	0,07	0,51	0,98	0,30	0,42			
Krapina-Zagorje	krz	0,915	1	2	F(2,117)	0,13	2,32	0,15	0,32	1,13	0,78	0,44	0,36
Sisak-Moslavina	skm	0,962	1	2	F(2,117)	1,20	0,80	1,00	0,16	0,12	0,24	1,04	0,13
Karlovac	kar	0,962	1	2	F(2,117)	0,22	1,17	0,23	0,00	0,23	2,15	0,91	0,88
Varaždin	var	0,977	2	2	F(1,113)	0,62	1,63	1,78	0,03	0,01	2,64	0,88	0,01
Koprivnica-Križevci	koc	0,961	1	2	F(1,118)	0,31	2,25	0,55	0,06	0,05	0,33	3,21	0,04
Bjelovar-Bilogora	bje	0,972	1	2	F(2,117)	1,11	0,41	0,06	0,53	0,13	0,11	1,14	0,55
Primorje-GK	prg	0,992	1	2	F(2,117)	0,35	0,62	0,88	0,45	1,87	1,41	0,67	1,46
Lika-Senj	lse	0,708	1	2	F(2,118)	0,03	0,03	0,38	1,13	2,07	0,67	2,85	**4,55**
Virovitica-Podravina	vir	0,927	2	2	F(2,112)	1,27	0,54	0,43	0,03	1,61	0,65	1,14	1,21
Požega-Slavonia	poz	0,967	1	2	F(1,121)	1,40	0,05	0,77	0,06	0,53	3,49	0,24	0,03
Slavonski Brod-Posavina	sbr	0,989	1	2	F(2,117)	0,69	0,08	0,54	0,71	0,88	0,67	0,98	0,54
Zadar	zad	0,994	1	2	F(2,117)	0,39	1,30	0,08	2,95	0,03	1,41	0,13	0,11
Osijek-Baranja	osi	0,993	1	2	F(2,117)	1,67	1,21	0,11	0,20	1,15	0,44	0,86	0,61
Šibenik-Knin	sib	0,983	1	2	F(2,117)	0,13	0,11	1,16	0,70	2,27	0,43	0,53	1,38
Vukovar-Sirmium	vuk	0,990	1	2	F(1,118)	0,24	1,06	0,68	0,89	1,11	2,48	0,99	0,99
Split-Dalmatia	std	0,994	1	2	F(2,117)	0,32	0,02	1,20	0,44	0,85	1,83	0,63	0,21
Istria	ist	0,993	1	2	F(2,117)	1,15	1,24	0,55	0,04	0,55	0,59	0,53	0,18
Dubrovnik-Neretva	dub	0,994	1	2	F(1,119)	1,36	2,31	0,65	0,63	**3,93**	1,07	0,02	1,41
Međimurje	med	0,986	2	2	F(1,115)	1,56	2,03	2,14	1,39	2,14	0,04	0,13	0,72

Note: Coefficients significant at 5% level are highlighted.
Source: Author's calculations.

Table A2
Weight matrix

	Zag	krz	skm	kar	Var	koc	bje	prg	lse	vir	poz	sbr	zad	osi	sib	vuk	std	ist	dub	med
zag	0	0,017	0,018	0,018	0,013	0,010	0,012	0,005	0,005	0,007	0,006	0,005	0,003	0,004	0,003	0,003	0,003	0,004	0,002	0,011
krz	0,017	0	0,008	0,009	0,007	0,006	0,007	0,004	0,004	0,005	0,004	0,004	0,003	0,003	0,002	0,003	0,002	0,003	0,002	0,008
skm	0,018	0,008	0	0,013	0,007	0,006	0,007	0,005	0,004	0,008	0,007	0,007	0,003	0,004	0,003	0,004	0,003	0,004	0,002	0,007
kar	0,018	0,009	0,013	0	0,007	0,006	0,007	0,008	0,006	0,005	0,004	0,004	0,004	0,003	0,003	0,003	0,003	0,005	0,002	0,007
var	0,013	0,007	0,007	0,007	0	0,022	0,010	0,004	0,003	0,009	0,004	0,004	0,002	0,004	0,002	0,004	0,002	0,003	0,002	0,067
koc	0,010	0,006	0,006	0,006	0,022	0	0,019	0,003	0,003	0,015	0,006	0,004	0,002	0,005	0,002	0,005	0,002	0,003	0,002	0,017
bje	0,012	0,007	0,007	0,007	0,010	0,019	0	0,004	0,003	0,016	0,008	0,006	0,002	0,005	0,002	0,005	0,002	0,003	0,002	0,010
prg	0,005	0,004	0,005	0,008	0,004	0,003	0,004	0	0,007	0,003	0,003	0,003	0,004	0,002	0,003	0,002	0,003	0,014	0,002	0,004
lse	0,005	0,004	0,004	0,006	0,003	0,003	0,003	0,007	0	0,003	0,003	0,003	0,009	0,002	0,005	0,002	0,004	0,004	0,002	0,003
vir	0,007	0,005	0,008	0,005	0,009	0,015	0,016	0,003	0,003	0	0,010	0,006	0,002	0,008	0,002	0,006	0,002	0,003	0,002	0,008
poz	0,006	0,004	0,007	0,004	0,004	0,006	0,008	0,003	0,003	0,010	0	0,024	0,002	0,010	0,003	0,006	0,003	0,003	0,002	0,004
sbr	0,005	0,004	0,007	0,004	0,004	0,004	0,006	0,003	0,003	0,006	0,024	0	0,002	0,011	0,002	0,010	0,003	0,002	0,002	0,003
zad	0,003	0,003	0,003	0,004	0,002	0,002	0,002	0,004	0,009	0,002	0,002	0,002	0	0,002	0,014	0,002	0,006	0,003	0,003	0,002
osi	0,004	0,003	0,004	0,003	0,004	0,005	0,005	0,002	0,002	0,008	0,010	0,011	0,002	0	0,002	0,028	0,002	0,002	0,002	0,004
sib	0,003	0,002	0,003	0,003	0,002	0,002	0,002	0,003	0,005	0,002	0,003	0,002	0,014	0,002	0	0,002	0,012	0,003	0,003	0,002
vuk	0,003	0,003	0,004	0,003	0,004	0,005	0,005	0,002	0,002	0,006	0,006	0,010	0,002	0,028	0,002	0	0,002	0,002	0,002	0,003
std	0,003	0,002	0,003	0,003	0,002	0,002	0,002	0,003	0,004	0,002	0,003	0,003	0,006	0,002	0,012	0,002	0	0,002	0,004	0,002
ist	0,004	0,003	0,004	0,005	0,003	0,003	0,003	0,014	0,004	0,003	0,003	0,002	0,003	0,002	0,003	0,002	0,002	0	0,002	0,003
dub	0,002	0,002	0,002	0,002	0,002	0,002	0,002	0,002	0,002	0,002	0,002	0,002	0,003	0,002	0,003	0,002	0,004	0,002	0	0,002
med	0,011	0,008	0,007	0,007	0,067	0,017	0,010	0,004	0,003	0,008	0,004	0,003	0,002	0,004	0,002	0,003	0,002	0,003	0,002	0

Source: Authors calculations.

Table A3

F-Statistics for tests of residual serial correlation for county-specific VARX models*

County	p_i	q_i		y	u	w	*eq*	*v*	*ex*	*temp*	*prec*
zag	2	1	F(4,110)	0,69	1,13	1,11	1,04	**2,62**	0,45	0,60	0,71
krz	2	1	F(4,110)	0,19	1,13	1,35	1,99	0,36			
skm	1	1	F(4,115)	0,42	2,41	0,23	1,01	0,68			
kar	2	1	F(4,110)	0,58	1,52	**3,92**	0,79	0,10			
var	1	1	F(4,115)	1,15	0,61	1,34	2,09	1,15			
koc	2	1	F(4,110)	2,21	0,69	1,65	**2,81**	2,44			
bje	1	1	F(4,115)	0,07	0,05	1,01	2,19	0,65			
prg	1	1	F(4,115)	1,66	1,65	**4,60**	1,95	**3,32**			
lse	2	1	F(4,112)	1,25	0,48	**2,91**		0,61			
vir	1	1	F(4,115)	0,75	1,01	0,39	2,29	0,20			
poz	2	1	F(4,110)	0,76	1,62	0,55	1,96	0,80			
sbr	1	1	F(4,115)	0,41	0,88	2,18	0,54	0,33			
zad	2	1	F(4,110)	0,42	1,60	**4,17**	0,43	0,78			
osi	1	1	F(4,115)	0,50	0,93	0,23	1,06	1,21			
sib	1	1	F(4,115)	0,21	**2,53**	0,64	0,41	1,37			
vuk	2	1	F(4,110)	0,13	0,61	1,38	1,15	**2,49**			
std	2	1	F(4,110)	0,25	1,15	1,65	1,51	0,84			
ist	2	1	F(4,110)	1,32	2,29	**2,55**	0,86	1,00			
dub	1	1	F(4,116)	1,39	1,62	1,47		1,72			
med	1	1	F(4,116)	1,28	0,45	0,39		0,60			

Note: Coefficients significant at 5% level are highlighted.

Source: Author's calculations.

Table A4

Average Pairwise Cross-Section Correlations: Variables and Residuals

	Y		u		w		eq		v	
	Levels	VECMX* Residuals	Levels	VECMX* Residuals	Levels	VECMX* Residuals	Levels	VECMX* Residuals	Levels	VECMX* Residuals
Zag	0,722	0,033	0,871	-0,044	0,925	-0,006	0,378	0,090	0,389	0,004
Krz	0,606	-0,050	0,803	-0,051	0,907	-0,111	0,080	-0,010	0,330	-0,023
Skm	0,662	-0,077	0,867	-0,019	0,926	-0,086	0,135	-0,126	0,375	-0,041
Kar	0,705	-0,025	0,601	-0,019	0,893	-0,022	0,213	-0,015	0,417	-0,005
Var	0,733	-0,081	0,872	-0,041	0,833	-0,060	0,188	-0,029	0,345	-0,004
Koc	0,738	-0,063	0,856	-0,054	0,916	-0,049	0,338	0,048	0,259	-0,016
Bje	0,744	-0,128	0,814	-0,033	0,887	0,041	0,206	-0,041	0,283	-0,049
Prg	0,728	0,017	0,872	-0,023	0,930	0,086	0,287	0,013	0,380	-0,027
Lse	0,138	-0,103	0,642	-0,064	0,424	-0,155			0,259	-0,051
Vir	0,566	-0,114	0,862	-0,054	0,910	-0,105	0,335	0,077	0,255	-0,063
poz	0,532	-0,049	0,817	-0,056	0,847	-0,067	0,140	-0,019	0,170	-0,033
sbr	0,795	-0,118	0,873	-0,046	0,920	-0,071	0,238	0,003	0,276	-0,031
zad	0,753	0,033	0,753	-0,024	0,914	-0,006	0,207	0,012	0,308	0,015
osi	0,772	0,034	0,859	-0,015	0,894	0,055	0,205	0,012	0,406	-0,026
Sib	0,744	0,026	0,676	-0,017	0,904	-0,100	0,261	-0,025	0,183	-0,046
vuk	0,817	-0,090	0,865	-0,019	0,909	0,029	0,108	-0,019	0,380	-0,013
Std	0,795	0,018	0,867	0,011	0,927	0,074	0,304	0,005	0,407	-0,010
Ist	0,784	0,016	0,682	-0,053	0,920	0,080	0,373	0,044	0,417	-0,009
dub	0,756	0,048	0,839	-0,001	0,922	-0,004			0,322	-0,023
med	0,714	-0,035	0,860	-0,063	0,916	-0,072			0,203	-0,011

Source: Authors calculations.

Table A5

Share of the forecast error variance of regional unemployment explained by analysed variables

	On impact								*After one year*							
County	*u*	*y*	*w*	*v*	*eq*	*ex*	*temp*	*prec*	*u*	*y*	*w*	*v*	*eq*	*ex*	*temp*	*prec*
zag	50,46	17,45	12,17	10,47	9,28	0,05	0,10	0,03	17,27	53,08	2,90	10,10	16,49	0,03	0,09	0,04
krz	52,94	9,87	16,42	9,88	8,28	1,72	0,57	0,31	17,69	55,75	3,24	10,85	12,33	0,05	0,07	0,02
skm	51,18	16,29	13,25	10,32	8,49	0,03	0,40	0,03	18,41	53,68	3,71	11,27	12,81	0,03	0,05	0,03
kar	43,19	30,05	10,18	5,76	10,32	0,15	0,03	0,32	18,61	56,92	3,08	9,77	11,29	0,02	0,15	0,16
var	47,44	20,41	12,22	6,79	12,99	0,10	0,04	0,00	18,21	54,49	3,05	10,34	13,73	0,00	0,13	0,05
koc	63,50	9,15	14,32	8,10	4,77	0,04	0,05	0,07	16,72	53,27	3,57	12,67	13,63	0,01	0,11	0,02
bje	56,11	8,67	18,21	5,37	10,26	0,57	0,24	0,57	18,96	52,96	3,75	11,65	12,52	0,00	0,10	0,06
prg	56,06	9,19	9,60	9,10	15,85	0,00	0,00	0,20	17,10	55,41	4,00	9,26	14,01	0,01	0,18	0,02
lse	56,09	21,12	9,36	8,41	4,09	0,33	0,59	0,02	24,12	54,82	2,38	9,43	9,06	0,01	0,14	0,04
vir	55,00	19,43	13,16	4,45	6,43	0,03	0,29	1,22	18,90	52,02	4,61	12,44	11,88	0,01	0,07	0,07
poz	60,76	6,00	15,89	6,26	8,71	1,62	0,75	0,01	21,40	48,26	3,96	12,03	14,23	0,02	0,04	0,06
sbr	55,45	8,14	14,46	14,64	6,70	0,02	0,19	0,39	14,10	56,61	4,13	10,90	14,12	0,00	0,08	0,05
zad	57,50	11,08	8,98	9,38	12,11	0,84	0,05	0,06	19,64	54,89	3,05	10,59	11,54	0,06	0,22	0,02
osi	60,84	8,46	9,22	11,07	9,63	0,61	0,16	0,02	17,67	55,81	3,57	9,59	13,19	0,00	0,12	0,04
sib	65,87	5,34	5,09	13,32	8,02	1,55	0,07	0,73	18,96	54,65	2,36	9,72	13,98	0,09	0,20	0,05
vuk	56,19	13,86	12,22	10,55	5,87	0,44	0,58	0,29	19,81	55,48	2,49	10,41	11,32	0,01	0,35	0,14
std	51,63	17,50	12,08	8,83	8,73	0,07	0,72	0,43	19,76	52,91	2,45	9,97	14,49	0,00	0,33	0,09
ist	50,52	7,99	11,79	15,07	13,25	0,16	0,49	0,74	14,63	55,71	6,69	9,86	12,38	0,00	0,59	0,13
dub	64,23	13,72	7,00	3,42	11,13	0,23	0,02	0,24	16,94	55,40	2,68	9,26	15,44	0,02	0,19	0,07
med	55,10	22,87	7,28	4,36	10,17	0,01	0,12	0,09	18,91	54,66	2,67	9,29	14,21	0,01	0,20	0,04

Source: Author's calculations.

Sažetak

OBJAŠNJENJE REGIONALNE NEZAPOSLENOSTI U HRVATSKOJ: GVAR PRISTUP

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U ovom radu je istražen učinak različitih makroekonomskih i poslovnih indikatora kao i klimatskih utjecaja u razdoblju od siječnja 2002. do prosinca 2013. godine, kako bi se objasnile razlike u nezaposlenosti između županija RH. U radu se koristi relativno nova metodologija za modeliranje regionalne nezaposlenosti. Primijenjeni ekonometrijski pristup omogućuje zajedničko modeliranje svih županija RH u okviru jedinstvenog (globalnog) modela kao i korištenje velikog broja varijabli i modeliranje međusobnih utjecaja između regionalnih tržišta rada, ekonomskih aktivnosti i poduzeća. Rezultati istraživanja ukazuju na izostanak uobičajenih mehanizama prilagodbe regionalnih tržišta rada prisutnih u razvijenim tržišnim ekonomijama. Uslijed niske fleksibilnosti regionalnih tržišta rada i visoke ovisnosti o nacionalnoj razini, županije su izrazito izložene negativnim posljedicama pada ili usporavanja ekonomske aktivnosti.

Ključne riječi: Hrvatska, GVAR, regionalna nezaposlenost.