Regional convergence of unemployment rate in Romania

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Abstract: In this research a convergence analysis is made for regional unemployment rate in Romania using the spatial econometrics techniques and panel data approach. For the 42 counties of Romania there is strong evidence of divergence process over the period from 1991 to 2015, only the fixed effects models being valid. The annual divergence rate was about 9.11% on this horizon and the time necessary for filling half of the gap from steady state is about 3 years. However, a spatial error model for 2000-2015 indicated a decrease of divergence rate for unemployment rate (5.49%), suggesting a lower degree of disparities in the last years.

Keywords: convergence rate, unemployment rate, fixed-effect model, spatial lag model, spatial error model

JEL Classifications: C21, C12, F43

Introduction

In cross-regions studies the convergence analysis depends on the data availability, the problem of omitted variables could not be solved, according to Magrini (2003) that proposed the use of panel data fixed effects model. Islam (1995) stated that panel data methods solve disadvantaged determined by the homogeneity and omitted variable. Higher convergence rates are obtained for fixed-effects model approach compared to cross-sections regressions. However, the similarities among neighboring regions have been neglected in most of the studies.

In this paper, the results of an empirical study of the long-run convergence of unemployment rate in Romania (1991-2015) were presented. The data are aggregated at a level of spatial resolution (the NUTS 3 EU regions corresponding to the 42 Romanian counties). More methods were employed in...
this case: a cross-section regression based on OLS estimation, some spatial models (Spatial lag model and spatial error model) and a panel data model (fixed-effects model). Recent achievements in literature consider spatial panel data models including lags for dependent variable and explanatory variable in time and space in order to evaluate the magnitude of indirect and direct effects (Elhorst, 2014). In the case of direct effects, we test if a certain explanatory variable had effects on the dependent variable. The indirect effects suppose that spatial spillovers are present. In this study, we are interested to count separately for the spillovers using spatial models.

The paper is organized in several sections. A short review of the literature is made, being followed by the presentation of the convergence methodology based on spatial econometric techniques.

After the description of the empirical data, the results of the empirical analysis based on the 42 Romanian counties (European NUTS-3 level) and the unemployment rate registered in the period from 1991 to 2015. There are differences between the estimates of convergence speed and the parameter half-life.

**Literature review**

The spatial econometric approach was intensively used in many studies related to regional convergence in Europe and USA, among them being those of Rey and Montouri (2000), Le Gallo et al. (2003), Arbia and Basile (2005), Ertur and Koch (2007), Buccellato (2007), Dall’erba and Gallo (2008), Clinch and O’Neill (2009), Rodriguez-Pose and Ezcurra (2010), Kerr and O’Connell (2012).

Some researchers realized convergence studies using spatial econometric methods to analyze the dynamics of regional income convergence. Rey and Montouri (1999) and Rey and Dev (2006) assessed sigma and beta convergence and they found significant spatial dependence in USA. Higgins, Levy, and Young (2006) explained that the convergence process in USA is influenced by the spatial autocorrelation. Most of the studies analyzed the convergence of income level: Barro and Sala-i-Martin (1995), Cuadraro Roura (2001), Tondl (2001), Baumont et al. (2003), Meliciانi and Peracchi (2006), Paas and Schlitte (2006), Anagnostou et al. (2008)). Few of the studies are interested in the unemployment rate convergence.

Fagerberg, Verspagen, and Caniels (1997) showed that employment rate in poor countries increases faster than in the rich ones that tend to reduce their unemployment rates.

Boone and Maurel (1998) analyzed the correlation between the industrial production and unemployment cycles for the convergence analysis. Baddeley, Martin and Tyler (1998) observed an increase in convergence process of
unemployment rates in some countries of the European Union. Overman and Puga (2002) considered as important problem the high unemployment and large regional inequalities.

In one study, Hein and Truger (2005) explained that low growth in European zone and high unemployment generated the hint of reconsidering the convergence criteria.

Moreover, Jurajda and Terrell (2009) observed high disparities of regional unemployment rate in post-communist countries, the unemployment convergence being explained by migration and flow of foreign direct investment.

Furceri and Zdzienicka (2011), Demidova and Signorelli (2011), Marelli, Patuelli and Signorelli (2012) studied the evolution of regional unemployment rate in the European Union before and after the economic crisis. The absolute beta-convergence is obvious if there is a significant and negative relationship between economic growth for income per capita and the initial level of the same indicator.

The economic literature widely discussed the problem of unemployment disparities as Baddeley, Martin and Tyler (1998) explained. The disparities are seen as an opposite phenomenon to convergence. There are two definitions for disparity: the difference between the unemployment rate in a region and the reference value of unemployment (for example, average unemployment rate) and the ratio between these two values. High disparities are translated into low convergence of unemployment rate.

Estrada, Galí, and López-Salido (2013) studied the convergence in unemployment, current account, relative prices and inflation in the euro area. The large dispersion in unemployment rates is caused by few factors, among them being the existence of asymmetric shocks and the propagation mechanisms, the low mobility of labour force within the euro zone and the lack of any fiscal union that might stabilize the risk-sharing device in front of the country-specific shocks. The expansionary phase of the EMU (1999–2007) is characterized by a general decline in the unemployment rate, excepting the case of Portugal, while the dispersion reduced. After 2007, the unemployment rate suffered a general increase. The authors assessed the convergence in unemployment by computing: unemployment dispersion, variance for difference-in-difference unemployment, $\sigma$-convergence and $\beta$-convergence. The dispersion in level and in difference-in-difference unemployment rate tended to increase in periods of recessions. In the expansionary period, $\sigma$-convergence took the form of unemployment rate decline and a consistent $\beta$-convergence was observed. During the 2008-2012 period, no evidence of $\beta$-convergence was found.

The $\sigma$ and absolute $\beta$-convergence were assessed by Marelli and Signorelli (2015) in euro area 18, EU-15 and EU-27 in two distinct periods 1999–2007 and
A significant $\sigma$ and $\beta$-convergence were observed in all regions during 1999-2007, while in the second period, because of the economic crisis, no evidence of convergence was found.

Cuestas, Monfort and Ordóñez (2015) analyzed the unemployment convergence in Central and Eastern European Countries using a nonlinear logistic smooth transition autoregression system and comovement analysis. The authors identified two convergence clubs regarding unemployment: a convergence club including the Baltic Countries, Hungary, and Poland, and a club with Czech Republic and Slovak Republic.

**Methodology**

The beta-convergence assumes exogenous saving rates, closed economic system and production function with capital productivity in decrease and constant returns to scale. Barro and Sala-i-Martin (1992) proposed a model that is adapted to use for unemployment rate as Estrada, Galí, and López-Salido (2013) made for studying the convergence in unemployment rate in the euro area and by Marelli and Signorelli (2015) for checking the unemployment convergence in Europe. The variant with logarithm is proposed because there are some outliers because of the high disparities in unemployment between the regions. It is also the case of Romania, where the unemployment in the capital and other developed counties are considered outlier compared to most of the regions in the country.

\[
\ln \left[ \frac{y_{T,i}}{y_{0,i}} \right] = \mu_i + \varepsilon_i \quad (1)
\]

\[
\ln \left[ \frac{y_{T,i}}{y_{0,i}} \right] - \text{growth rate of unemployment rate on the analyzed period}
\]

- $y_0$: unemployment rate value in the first year ($T=1991$)
- $y_T$: unemployment rate value in the last year ($T=2015$)
- $\varepsilon_i$: error term independently distributed of $\ln y_{0,i}$ ($\varepsilon_i \rightarrow N(0, \sigma^2)$)

\{\varepsilon_1, \varepsilon_2, ..., \varepsilon_n\} - independent observations of probability model

- $\mu_i$: systematic element

- $\tau$: convergence speed (it shows how developed economies converge towards steady state)

\[
\mu_i = \alpha + (1 - e^{-\tau k}) \ln y_{0,i} \quad (2)
\]

If $\beta = (1 - e^{-\tau k})$ and $\beta$ is estimated using OLS method. Absolute convergence is obvious if $\beta$ is significant and negative (all the counties converge to the same unemployment rate).

According to Arbia (2006), a first model that considers the spatial dependence is the spatial autoregressive model (SAR model).
The first model is rewritten in order to take into account the structure and the intensity of spatial effects given by the row-standardized matrix of spatial weights \( W = \sum_{j=1}^{n} w_{i,j} \):

\[
\ln \left( \frac{y_{TI}}{y_{0I}} \right) = \alpha + \beta \ln y_{0I} + \rho \sum_{j=1}^{n} w_{i,j} \ln \left( \frac{y_{TI}}{y_{0I}} \right) + \epsilon_i (3)
\]

\( \rho \) - parameter of spatially lagged dependent variable
\( \epsilon_i \) - error term that is normally and independently distributed of \( \ln y_{0I} \) and \( \sum_{j=1}^{n} w_{i,j} \ln \left( \frac{y_{TI}}{y_{0I}} \right) \), if the effects of spatial dependence are captured by lagged term

The spatial error model (SEM) leaves the systematic element unchanged and models the error as Markovian random field.

\[
\epsilon_i = \delta \sum_{j=1}^{n} w_{i,j} \epsilon_i + \varphi_i (4)
\]

\( \varphi_i \) - error term independently distributed of \( \ln y_{0I} \) \( (\epsilon_i \sim N(0, \sigma^2_\varphi)) \)

Many studies analyzed the regional convergence, the most important ones belonging to Rey and Montouri (2000) and Le Gallo, Ertur and Baoumant (2003), that used the minimal growth regression model specification.

The panel data approach corrects the bias resulted from heterogeneity and omitted variables as Islam (2003) stated. The panel data takes into consideration the differences between regions from technological point of view. The model is rewritten in the following form in order to consider the panel data approach:

\[
\ln \left( \frac{y_{t+\kappa I}}{y_{tI}} \right) = \alpha_i + \beta \ln y_{tI} + \epsilon_i (5)
\]

\( i \) - index for counties
\( t \) - time index

\( \ln \left( \frac{y_{t+\kappa I}}{y_{tI}} \right) \) - annual growth rate of unemployment rate

\( \ln y_{tI} \) - value of unemployment rate at the beginning of each period

\( \alpha_i \) - time invariant parameters that stands for the individual-specific effect not taken into account in the regression model (we have a fixed-effect panel data model if \( \alpha_i \) are fixed parameters).

The fixed-effect model (a type of panel data model) is employed in this case, because the study refers to a precise set of cross-sections.

**The convergence analysis for unemployment rate in Romanian counties**

The study focuses on the Romanian counties, corresponding to the European NUTS-3 level in the EU classification. The analysis uses the database on unemployment rate provided by the National Institute of Statistics for the 42 counties, including the capital- Bucharest- over the period 1991-2015.

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unemployment rate is computed as the proportion of unemployed people in the active population.

For the analyzed period, the results of the convergence analysis for the Romanian provinces’ unemployment rates are provided. The OLS cross-sectional estimates for the unconditional model are displayed, the data being processed in GeoDa and Stata.

Table 1: Convergence of unemployment rate in the 42 Romanian counties (1991-2015) – Unconditional Model – OLS Estimates (p-values in brackets)

<table>
<thead>
<tr>
<th></th>
<th>Constant 0.1559 (0.61)</th>
<th>Unemployment rate coefficient 0.0299 (0.117)</th>
<th>Adjusted-R squared 0.389</th>
<th>Akaite information criterion (AIC) 58.033</th>
<th>Jarque-Bera statistic 6.999 (0.0302)</th>
<th>Statistic of Breusch-Pagan heteroskedasticity test 0.963 (0.3482)</th>
<th>Statistic of White robust heteroskedasticity test 0.9332 (0.6573)</th>
<th>Moran’s I (error) 1.62322 (0.10454)</th>
<th>Lagrange Multiplier (lag) 2.08411 (0.14883)</th>
<th>Robust LM (lag) 0.83741 (0.36013)</th>
<th>Lagrange Multiplier (error) 1.78615 (0.181396)</th>
<th>Robust LM (error) 0.539449 (0.46266)</th>
<th>Lagrange Multiplier (SARMA) 2.62356 (0.26933)</th>
</tr>
</thead>
</table>

Source: author’s computations

The unconditional model is not valid, the slope being insignificant at 5% level of significance. Other estimations were made using maximum likelihood method, but the slope is still not significant. The Moran’s I statistic value shows that there is no spatial autocorrelation in residuals. For spatial models, we used maximum likelihood estimates.

Table 2: Convergence of unemployment rate in the 42 Romanian counties (1991-2015) – Spatial Lag Model and Spatial Error model – Maximum Likelihood Estimates (p-values in brackets)

<table>
<thead>
<tr>
<th>Spatial lag model</th>
<th>W_Y 0.9905 (0.00)</th>
<th>Constant 0.7110 (0.67)</th>
<th>Spatial error model</th>
<th>Constant 0.019 (0.9)</th>
<th>X 0.3114 (0.00)</th>
<th>Lambda 0.8402</th>
<th>AIC -6.5532</th>
<th>Breusch-Pagan test 0.4483 (0.5227)</th>
</tr>
</thead>
</table>

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The two types of spatial models are not valid, being enough insignificant coefficients in the models. There is enough evidence that there is spatial autocorrelation, LR test indicating this. However, the errors seem to be homoscedastic.

Table 3: Convergence of unemployment rate in the 42 Romanian counties (1991-2015) – Fixed-effect Model (p-values in brackets)

<table>
<thead>
<tr>
<th>Constant</th>
<th>2.0786 (0.00)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment rate</td>
<td>2.4887 (0.00)</td>
</tr>
<tr>
<td>Sigma (alfa)</td>
<td>1.5952</td>
</tr>
<tr>
<td>Sigma (eps)</td>
<td>0.5451</td>
</tr>
<tr>
<td>Rho</td>
<td>0.3382</td>
</tr>
<tr>
<td>F test that all alfa_i=0</td>
<td>175.26 (0.00)</td>
</tr>
<tr>
<td>R-squared within</td>
<td>0.7901</td>
</tr>
<tr>
<td>R-squared between</td>
<td>0.0004</td>
</tr>
<tr>
<td>R-squared overall</td>
<td>0.2198</td>
</tr>
<tr>
<td>Correlation (alfa_i, x beta)</td>
<td>-0.2641</td>
</tr>
</tbody>
</table>

The value of β of the initial unemployment rate of Romanian counties calculated over the entire period is 1.402. It is positive and significant, showing the divergence process. According to the value of interclass correlation, 33.82% of the variance is due to differences across panels.

Table 4: Speed of convergence and “half-life” for different model specifications (1991-2015)

<table>
<thead>
<tr>
<th></th>
<th>Speed of convergence</th>
<th>Half-life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beta-convergence</td>
<td>-0.0304</td>
<td>9.921058</td>
</tr>
<tr>
<td>Spatial lag-model</td>
<td>-0.033</td>
<td>10.15973</td>
</tr>
<tr>
<td>Spatial error-model</td>
<td>-0.04</td>
<td>10.76691</td>
</tr>
<tr>
<td>Fixed-effects model</td>
<td>-0.03</td>
<td>9.883584</td>
</tr>
</tbody>
</table>

The time necessary for filling half of the gap from steady state is about 10 years for the sample when the valid fixed-effect model is used. The speed of divergence is low (around 3%). Even if the other models are not valid, the speed of divergence is also low.
Table 5: Convergence of unemployment rate in the 42 Romanian counties (2000-2015) – Spatial Lag Model and Spatial Error model – Maximum Likelihood Estimates (p-values in brackets)

<table>
<thead>
<tr>
<th>Spatial lag model</th>
<th>Spatial error model</th>
<th>( W_Y )</th>
<th>(-0.1438 (0.782))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>Constant</td>
<td>0.1422 (0.12)</td>
<td>X</td>
</tr>
<tr>
<td>( X )</td>
<td>( \lambda )</td>
<td>-0.0548 (0.13)</td>
<td>R-squared</td>
</tr>
<tr>
<td>R-squared</td>
<td>R-squared</td>
<td>0.9375</td>
<td>0.9405</td>
</tr>
<tr>
<td>AIC</td>
<td>AIC</td>
<td>-60.8554</td>
<td>-61.9503</td>
</tr>
<tr>
<td>Breusch-Pagan test</td>
<td>Breusch-Pagan test</td>
<td>1.4482 (0.259)</td>
<td>0.3584 (0.58)</td>
</tr>
<tr>
<td>LR test for spatial autocorrelation</td>
<td>LR test for spatial autocorrelation</td>
<td>96.0474 (0.00)</td>
<td>95.0463 (0.00)</td>
</tr>
</tbody>
</table>

Source: author’s computations

For a shorter horizon (2000-2015) the spatial error model explained better the regional disparities between unemployment rates in Romanian counties. The divergence speed is around 2.9% which is lower than the value on the entire period (around 3%). However, the difference is quite insignificant.

Conclusions

The analysis of unemployment spatial dependence at the county level in Romania brought evidence of divergence. This analysis finds significant evidence of spatial dependence of unemployment rate in Romanian counties. On the analyzed period (1991-2015) the spatial models and the cross-section model were not valid, but on a shorter time period (2000-2015) there is statistically significant evidence that the coefficient for spatial error model differs from zero. On the entire period, the fixed-effects model proved suitable for modeling the regional unemployment rates. The results indicated a divergence speed of around 3% during 1991-2015 and around 2.9% on the shorter period (2000-2015). The difference between the speeds is not significant. The slow decrease in the divergence speed might also be explained by the recent economic crisis that brought higher unemployment rate in poor countries from North-East of Romania when in Ilfov-Bucharest and several rich countries the increase in unemployment was not so high. So, the gap between rich and poor regions in the country accelerated in the crisis period, even if the disparities reduced before crisis. The research is limited by the disadvantages of the applied numerical methods. In a future research some
spatial panel data models should be developed in order to assess the disparities in unemployment rate in Romanian counties.

References


