ANALYSIS OF THE EMPLOYMENT GROWTH AT REGIONAL LEVEL USING EVIEWS SOFTWARE

Gogâltan Nicoleta Maria[1]

ABSTRACT

Because of its rigorous side, the economic modelling represents a resources optimisation managerial instrument (material, human, financial) with its objectives set for a certain period of time, giving the opportunity to take the best decision in certain given conditions, without altering the reality. In relation to the economic theories, the models have a complex and diverse nature. The frequent transformations and adaptations that take place in the economic science do not allow for the possibility of a methodological systematisation of the mathematical models which are being used. The economic model is defined as a simplified representation of an economic reality, while the modelling method is a scientific instrument which aims at forming useful representations for the proper understanding of some activities/fields of economic nature.

Key words: model, regression, panel data, employment, eviews

The advances in the field of spatial econometrics provide researchers with new ways to address regression problems that are associated with the existence of spatial dependence in regional data sets, most of the applications being single-equation models. Yet, for many economic problems, there are both endogenous variables and data on observations that interact across space.

The empirical literature on the efforts to develop the regional models so that they can incorporate the role of space in explaining variations in economic growth is also mostly limited to cross sectional data.

Panel data are generally more informative, contain more variation, and have less collinearity among variables. The greater degree of freedom that results from the use of panel data also increases estimation efficiency. Specifications of more complicated behavioral relationships that cannot be normally addressed using either cross-sectional or time-series data are possible with the use of panel data. Thus, the rationale for the development and implementation of a spatial panel data model is the improvement in the accuracy of hypothesis testing and subsequent inferences about interdependences among the model's core variables.

The theoretical base of the interdependencies between population (migration behavior), employment and income is the idea that households and firms are both mobile and that households location decisions maximize utility, while firm location decisions maximize profits. That is, households migrate to capture higher wages or incomes and firms migrate to be near growing consumer markets. These actions change the incomes of regional (local) economies. However, household location decisions are likely to be influenced not only by

[1] TA, Romanian-American Univeristy

job and income opportunities, but also by factors such as local public goods and services, social and natural amenities, demographic factors, and the region's location.

Similarly, location decisions of firms are expected to be influenced not only by population and income (i.e., growing consumer markets), but also local business climate, wage rates, tax rates, local public services and regional location. Firm location decisions are also influenced by financial incentives that local governments may offer to create jobs, spur income growth and enhance the economic opportunities of the local population. According to the median-voter model of local fiscal behavior, local public expenditures, however, approximate the choices of the utility-maximizing median voter and so depend of income and other revenue sources such as property taxes, income taxes and other factors that determine consumer preferences.

Regional factors that affect households', firms' and local governments' decisions are, however, more likely to lack independence and exhibit spatial autocorrelation. Spatial autocorrelation or spatial dependence refers to the statistical property where the dependent variable or error term at one location is correlated with observations on the dependent variable or error term at other locations (Anselin, 1988).

Based on these assumptions, the following hypotheses appear:

1. Employment growth, migration behavior, median household income growth and local public expenditures per capita growth rates are interdependent and are jointly determined by county-level variables.
2. Employment growth, migration behavior, median household income growth and local public expenditures per capita growth rates in any county depend on initial conditions in that county.

The statistical data are taken from the official statistics – Romania Statistical Yearbook, National Forecast Commission, and Tempo-online data. The time period of the reporting is 1996-2015. For the construction of the data base at the basis of the modelling, we considered the annual values of the regional economic indicators, with the help of which can be appreciated the status and the dynamics of the economy at the level of Romania's regions. The lack of data regarding the household income at regional level determined the realization of the study without this indicator, using data regarding the monthly net median wage.

In order to ensure the comparability of the data, we will make certain transformations on the statistical data, and the results obtained constitute the data base for the applied research.

To test the above formulated hypothesis, we used a panel data model of employment growth, migration behavior, monthly net median wage and local public expenditures, including the effect upon the eight development regions in Romania. The degree of freedom and efficiency increases with the use of panel data, because they provide more information, more variables, and they are less likely to be collinear. The empirical application of the panel data utilizes a one-way error component model following Baltagi model (1995)[2].

The model equation is specified as follows:

2 Jula D., Econometrie, Conference from 9th of April 2011/SPODE programme, Romanian Academy, http://www.postdoc.acad.ro/data/files/ECONOMETRIE_-_prof.Jula.pdf

$$EMP_t^* = f_1[(INM_t), (OTM_t), (MYH_t), (GEX_t), (EMP_{t-1})]$$

where $\mathbf{EMP_t^*}$, $\mathbf{INM_t^*}$, $\mathbf{OTM_t^*}$, $\mathbf{MYH_t^*}$ și $\mathbf{GEX_t^*}$ are vectors of dimension NT x 1 of the equilibrium levels of private non-farm employment, national out-migration, national in-migration, monthly net median wage and respectively per capita local public expenditures; t indexes time.

The theory[3] suggests that employment, population and median household income likely adjust to their equilibrium level with a substantial lag (i.e., initial conditions). Following the theory, a distributed lag adjustment is introduced and the corresponding partial-adjustment process resulted to the specification of the empirical model as follows:

$$\mathbf{EMPR}_t = \alpha_1 + \beta_{11}\mathbf{INMR}_t + \beta_{12}\mathbf{OTMR}_t + \beta_{13}\mathbf{MYHR}_t + \beta_{14}\mathbf{GEXR}_t + \sum_{k=1}^{K_1}\gamma_{1k}\ln\left(X_{t-1,k}^{em}\right) - \eta_1\ln(\mathbf{EMP}_{t-1}) + \mathbf{u}_{t,1} \qquad (1.2.a)$$

where α_r, β_{rq}, λ_{rl}, γ_{rk} for k=1,..., K_r; r, l=1,...5; *și* q=1,...4 are the parameter estimates of the model and K_r is the number of exogenous variables in the respective equations. $\mathbf{EMPR}_t$, $\mathbf{INMR}_t$, $\mathbf{OTMR}_t$, $\mathbf{MYHR}_t$ și $\mathbf{GEXR}_t$ represent the log difference between the end and beginning period values of private non-farm employment, gross in-migration, gross out-migration, median household income and local government expenditures per capita, respectively. Hence, they represent the growth rates of the respective variables.

The subscript t-1 refers to the indicated variable lagged one period, and η_r for $r = 1,\ldots,5$ are the speed of adjustment parameters that represent, respectively, the rate at which employment, in-migration, out-migration, monthly net median wage and local public expenditure adjust to their respective (steady state) equilibrium levels. They are interpreted as the shares that were realized in each period. $\mathbf{u}_{t,r}$ for r=1,..., 5 are the vectors of disturbances at dimension NT x 1.

Moran I test statistic (Anselin, Kelejian, 1997) for models with endogenous regressors confirmed the existence of spatial autocorrelation in the errors in all equations. Therefore, the disturbance vector is generated as:

$$\mathbf{u}_{t,r} = \boldsymbol{\rho}_r\mathbf{u}_{t,r} + \boldsymbol{\varepsilon}_{t,r},\ r=1,\ldots,5$$

This specification relates the disturbance vector to its own spatial lag.

Dependent Variables

The dependent variables are the growth rates of employment, gross in- and out-migration, monthly net median wage and per capita direct local government expenditures.

- **EMPR**: The growth rate of employment is measured by the log-difference between the levels of private non-farm employment;
- **INMR**: The growth rate of gross in-migration is measured by the log-difference between the levels of gross in-migration into a given county;

[3] Edmiston, 2004; Deller, 2001; Henry, 1999; Boarnet, 1994; Duffy, 1994, Carlino and Mills, 1987.

- **OTMR**: The growth rate of gross out-migration is measured by the log-difference between the levels of gross out-migration away from a given county. Note that the effects of migration on the sending and on the receiving counties depend critically on the characteristics of the migrants themselves, and that for any county in-migrants and out-migrants are unlikely to have identical characteristics. Moreover, certain variables that explain gross in-migration are not relevant for explaining gross out-migration and the magnitudes of the influence of certain variables on gross in-migration is likely to be different from the magnitude of these variables on gross out-migration;
- **MYHR**: The log-difference between the levels of monthly net median wage in a given county is used to measure his growth rate;
- **GEXR**: Local governments spend money on local public services such as education, recreation, police and infrastructure. The growth rate od direct local government expenditures per capita is measured by the log-difference between the levels of per capita local government expenditures.

Independent variables

Independent variables include demographic, human capital, labor market, housing, industry structure and amenity and policy variables. In line with the expert studies (theoretical or practical), unless otherwise indicated, the initial values of the independent variables are used in the analysis. This formulation reduces the problem of endogeneity. All independent variables are in log form, except those that can take negative or zero values.

The advantages of panel type data analysis

- This analysis can restore individual specifications, the invariant structures of a certain statistical unit, at a certain moment in time; thus, the distortion induced by aggregating the data can be reduced or eliminated;
- The panel type analysis brings more information by intercepting individual variability;
- The phenomenon of variables multicollinearity is reduced;
- Increases the number of grades of freedom – and implicitly the power of the tests, therefore the degree of confidence in the results obtained;
- Increases the efficiency and consistence of the econometric estimates;
- Permits the construction and testing of more complex behavioral models than the models based on the analysis of time-series or cross-sectional structures.
- The panel type analysis permits a better analysis of the structural adjustments dynamics (Jula D., 2011).

Considering that we use simultaneously cross-sections as well as time-series, we will resort to the combined analysis of the cross-sections with the time-series – data panel analysis using the instruments offered by the software package EViews 7.2, with the help of which we will analyze the variables system from the econometric model on the basis of ″pools of time series and cross-sections data″.

For the models' consistency we included positioning variables represented by the national level of the out-migration, in-migration, monthly net median wage, employment and public local expenditures indicators.

We test the steadiness of the series in the panel, using the methodology proposed by Im, Pesaran & Shin. The results are presented in the following EViews table:

Null Hypothesis: Unit root (individual unit root process)

Series: EMPR_NV, EMPR_CE, EMPR_NE, EMPR_SE, EMPR_BI, EMPR_SM, EMPR_SV, EMPR_VE, INMR_NV, INMR_CE, INMR_NE, INMR_SE, INMR_BI, INMR_SM, INMR_SV, INMR_VE, OTMR_NV, OTMR_CE, OTMR_NE, OTMR_SE, OTMR_BI, OTMR_SM, OTMR_SV, OTMR_VE, MYHR_NV, MYHR_CE, MYHR_NE, MYHR_SE, MYHR_BI, MYHR_SM, MYHR_SV, MYHR_VE, GEXR_NV, GEXR_CE, GEXR_NE, GEXR_SE, GEXR_BI, GEXR_SM, GEXR_SV, GEXR_VE,

Sample: 1995 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Total number of observations: 597
Cross-sections included: 40

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	1.39559	0.9186

** Probabilities are computed assuming asymptotic normality** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Series	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
EMPR_NV	-0.2805	0.9017	-1.508	1.011	0	1	12
EMPR_CE	-1.0994	0.6748	-1.491	1.206	1	1	11
EMPR_NE	-1.5069	0.4929	-1.491	1.206	1	1	11
EMPR_SE	-1.0517	0.6934	-1.491	1.206	1	1	11
EMPR_BI	0.7341	0.9870	-1.508	1.011	0	1	12
EMPR_SM	-1.5748	0.4613	-1.491	1.206	1	1	11
EMPR_SV	-2.5658	0.1280	-1.491	1.206	1	1	11
EMPR_VE	-0.8035	0.7810	-1.508	1.011	0	1	12
INMR_NV	-2.3005	0.1840	-1.514	0.923	0	2	15
INMR_CE	-2.9976	0.0580	-1.514	0.923	0	2	15
INMR_NE	-3.0243	0.0553	-1.514	0.923	0	2	15
INMR_SE	-3.5118	0.0229	-1.514	0.923	0	2	15
INMR_BI	0.1161	0.9548	-1.500	1.060	1	2	14
INMR_SM	-2.7151	0.0944	-1.514	0.923	0	2	15
INMR_SV	-3.3682	0.0298	-1.514	0.923	0	2	15
INMR_VE	-2.6326	0.1085	-1.514	0.923	0	2	15
OTMR_NV	-2.8904	0.0699	-1.514	0.923	0	2	15

Series	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
OTMR_CE	-3.1877	0.0413	-1.514	0.923	0	2	15
OTMR_NE	-0.7859	0.7917	-1.500	1.060	1	2	14
OTMR_SE	-3.0468	0.0531	-1.514	0.923	0	2	15
OTMR_BI	-0.8955	0.7554	-1.360	1.215	2	2	13
OTMR_SM	-2.5323	0.1279	-1.514	0.923	0	2	15
OTMR_SV	-2.7593	0.0876	-1.514	0.923	0	2	15
OTMR_VE	-2.8493	0.0751	-1.514	0.923	0	2	15
MYHR_NV	-0.7986	0.7952	-1.511	0.953	1	4	18
MYHR_CE	-0.6826	0.8271	-1.511	0.953	1	4	18
MYHR_NE	-1.1778	0.6565	-1.375	1.152	3	4	16
MYHR_SE	-0.0097	0.9464	-1.520	0.865	0	4	19
MYHR_BI	0.5288	0.9831	-1.520	0.865	0	4	19
MYHR_SM	0.3776	0.9761	-1.520	0.865	0	4	19
MYHR_SV	0.1277	0.9593	-1.520	0.865	0	4	19
MYHR_VE	0.4926	0.9816	-1.520	0.865	0	4	19
GEXR_NV	0.6401	0.9860	-1.516	0.909	0	3	16
GEXR_CE	-0.5459	0.8557	-1.503	1.011	1	3	15
GEXR_NE	0.5442	0.9826	-1.516	0.909	0	3	16
GEXR_SE	-0.6020	0.8426	-1.503	1.011	1	3	15
GEXR_BI	0.1157	0.9547	-1.373	1.147	2	3	14
GEXR_SM	-3.5137	0.0217	-1.516	0.909	0	3	16
GEXR_SV	-0.2564	0.9107	-1.503	1.011	1	3	15
GEXR_VE	1.1069	0.9955	-1.516	0.909	0	3	16
Average	-1.2796		-1.499	0.990			

The probability of an unit root existing in the panel is 0.92, much above the standard threshold of 0.05. Because of this we reject the hypothesis of steadiness of the analyzed series. We test the hypothesis that the series are I(1) – Ist order integrated. The EViews table is the following:

Null Hypothesis: Unit root (individual unit root process)

Series: EMPR_NV, EMPR_CE, EMPR_NE, EMPR_SE, EMPR_BI, EMPR_SM, EMPR_SV, EMPR_VE, INMR_NV, INMR_CE, INMR_NE, INMR_SE, INMR_BI, INMR_SM, INMR_SV, INMR_VE, OTMR_NV, OTMR_CE, OTMR_NE, OTMR_SE, OTMR_BI, OTMR_SM, OTMR_SV, OTMR_VE, MYHR_NV, MYHR_CE, MYHR_NE, MYHR_SE, MYHR_BI, MYHR_SM, MYHR_SV, MYHR_VE, GEXR_NV, GEXR_CE, GEXR_NE, GEXR_SE, GEXR_BI, GEXR_SM, GEXR_SV, GEXR_VE

Sample: 1995 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Total number of observations: 569
Cross-sections included: 40

Method	Statistic	Prob.**
Im, Pesaran and Shin W-stat	-16.5123	0.0000

** Probabilities are computed assuming asymptotic normality

Intermediate ADF test results

Series	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
D(EMPR_NV)	-1.1633	0.6441	-1.488	1.255	1	1	10
D(EMPR_CE)	-2.6465	0.1134	-1.506	1.040	0	1	11
D(EMPR_NE)	-2.2093	0.2142	-1.488	1.255	1	1	10
D(EMPR_SE)	-1.8515	0.3381	-1.488	1.255	1	1	10
D(EMPR_BI)	-1.1982	0.6294	-1.488	1.255	1	1	10
D(EMPR_SM)	-1.6102	0.4419	-1.488	1.255	1	1	10
D(EMPR_SV)	-1.5260	0.4839	-1.506	1.040	0	1	11
D(EMPR_VE)	-2.3805	0.1674	-1.506	1.040	0	1	11
D(INMR_NV)	-6.2699	0.0002	-1.512	0.952	0	2	14
D(INMR_CE)	-5.9663	0.0003	-1.512	0.952	0	2	14
D(INMR_NE)	-6.8411	0.0001	-1.512	0.952	0	2	14
D(INMR_SE)	-5.7810	0.0005	-1.512	0.952	0	2	14
D(INMR_BI)	-8.7495	0.0000	-1.512	0.952	0	2	14
D(INMR_SM)	-6.2821	0.0002	-1.512	0.952	0	2	14
D(INMR_SV)	-6.3268	0.0002	-1.512	0.952	0	2	14
D(INMR_VE)	-6.4086	0.0002	-1.512	0.952	0	2	14
D(OTMR_NV)	-5.9692	0.0003	-1.512	0.952	0	2	14
D(OTMR_CE)	-6.0301	0.0003	-1.512	0.952	0	2	14
D(OTMR_NE)	-6.8221	0.0001	-1.512	0.952	0	2	14
D(OTMR_SE)	-6.2091	0.0002	-1.512	0.952	0	2	14
D(OTMR_BI)	-7.1494	0.0001	-1.512	0.952	0	2	14
D(OTMR_SM)	-6.5332	0.0001	-1.512	0.952	0	2	14
D(OTMR_SV)	-6.1569	0.0003	-1.512	0.952	0	2	14
D(OTMR_VE)	-6.7303	0.0001	-1.512	0.952	0	2	14
D(MYHR_NV)	-2.2611	0.1937	-1.519	0.880	0	3	18
D(MYHR_CE)	-2.2464	0.1982	-1.519	0.880	0	3	18
D(MYHR_NE)	-2.9830	0.0568	-1.508	0.973	1	3	17
D(MYHR_SE)	-2.4719	0.1381	-1.519	0.880	0	3	18
D(MYHR_BI)	-3.5216	0.0196	-1.519	0.880	0	3	18
D(MYHR_SM)	-2.7497	0.0854	-1.519	0.880	0	3	18
D(MYHR_SV)	-2.8784	0.0676	-1.519	0.880	0	3	18
D(MYHR_VE)	-2.7097	0.0917	-1.519	0.880	0	3	18
D(GEXR_NV)	-2.4614	0.1433	-1.514	0.923	0	2	15
D(GEXR_CE)	-2.2050	0.2123	-1.514	0.923	0	2	15
D(GEXR_NE)	-2.4378	0.1487	-1.514	0.923	0	2	15
D(GEXR_SE)	-2.1941	0.2157	-1.514	0.923	0	2	15
D(GEXR_BI)	-3.2907	0.0358	-1.500	1.060	1	2	14
D(GEXR_SM)	-6.1198	0.0002	-1.514	0.923	0	2	15

Series	t-Stat	Prob.	E(t)	E(Var)	Lag	Max Lag	Obs
D(GEXR_SV)	-2.2026	0.2130	-1.514	0.923	0	2	15
D(GEXR_VE)	-2.3340	0.1748	-1.514	0.923	0	2	15
Average	-4.0970		-1.510	0.982			

From the anterior table resorts that Ist order differentiated series are steady (the probability attached to the test is inferior to the standard threshold of 0.05). We admit the hypothesis that the analyzed series are I(1) and, consequently, the models built use the series in first difference.

The statistics of the model's equations give us the following clues in the model's specification:

Dependent Variable: D(EMPR?)
Method: Pooled Least Squares
Sample (adjusted): 1997 2008
Included observations: 12 after adjustments
Cross-sections included: 8
Total pool (balanced) observations: 96
White period standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INMR?)	-0.002250	0.001594	-1.411916	0.1615
D(OTMR?)	0.004297	0.001136	3.782701	0.0003
D(MYHR?)	0.202015	0.037376	5.404966	0.0000
D(GEXR?)	0.000943	0.000166	5.669024	0.0000
OTMR_RO	-0.000180	1.57E-05	-11.45982	0.0000
MYHR_RO	0.291378	0.024935	11.68542	0.0000
GEXR_RO	-0.007818	0.000674	-11.59702	0.0000

R-squared	0.400763	Mean dependent var	2.844792
Adjusted R-squared	0.360365	S.D. dependent var	39.36673
S.E. of regression	31.48439	Akaike info criterion	9.806982
Sum squared resid	88222.76	Schwarz criterion	9.993966
Log likelihood	-463.7352	Hannan-Quinn criter.	9.882564
Durbin-Watson stat	2.695314		

Eviews 7.2 processing

- The coefficient of determination R^2 has normal values for an estimate in differences, that is 40% (0.400763), which indicates us the effect that the variation of the factors in the model has upon the variation of the endogenous variable (EMPR),
- A specificity of the EViews system is the fact that it reports the probability attached to the bilateral t-Student test. In these conditions, for the unilateral standard test in the EMPR equation, the probability of Ist grade risk is, 0.1615/2 = 0.08, which

means that we can accept the INMR variable with a degree of confidence higher than 90%.

- EMPR is correlated slightly negatively with the in-migration growth rate and positively with the out-migration, monthly net median wages and local expenditures growth rates. This is consistent with the theoretical expectations related to the fact that:
    - In-migrants can represent an important source of labor force and capital for the business development and even for the incitation of employment;
    - An increase of monthly net median wages which can result from the additional demand and from the encouragement of business development (including new businesses);
    - Local expenditures (education, health, etc.) can have a positive effect on companies' localization and business development;
    - A positive effect of out-migration growth rate upon employment (EMPR) is possible because: (1) OTMR positive and correlated with the size of the county's population, and (2) OTMR can collect the effects resulted from the size of the county's population upon employment.

In a broad understanding, the results obtained from the application of econometric models must correspond to the theoretical and practical expectances presented by the economic literature about balances growth, providing a real support (of backup) to its hypotheses. Thus, the parameters estimated in the model must show the existence of simulated feedback among the analyzed endogenous variables.

From the analyses made, the endogenous variables coefficients are statistically significant at a level of confidence of 95%. This indicates the existence of a strong interdependence among employment growth rate, in-migration growth rate, out-migration growth rate, wages growth rate and public local expenditures growth rate. The causality direction indicated by the coefficients is also consistent from the expectances perspective.

Secondly, the results show the existence of a conditional convergence from the endogenous variables perspective. This indicates statistically significant coefficients regarding the dependent variable. The implications are related to the employment growth rate, net out-migration and in-migration, monthly net wages and local expenditures, compared to the counties with high initial levels.

The empirical findings suggest the existence of significant feedback among the growth rates of employment, gross out-migration/in-migration, monthly net median wages and local expenditures at regional level in Romania.

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