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Article

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Regional patterns of Romanian emigration. A Geographically Weighted Regression Model

Zizi GOSCHIN[1]

Abstract: *Analyses of emigration flows and their factors of influence are usually conducted at aggregate country level, thus ignoring the existence of large regional inequalities. Since regions are very diverse, the key drivers of emigration are likely to change in space and act with variable intensity, creating different regional patterns. The presence of broad regional inequalities and the concentration of high emigration flows in a few regions, as in the Romanian case, require specific investigation tools, such as the geographically weighted regression (GWR) which is able to highlight the spatial variations in regression parameters. This method provides coefficient estimaties that change from one region to another, according to spatially defined weights; therefore it lets the model to fluctuate territorially, capturing the real spatial patterns of the phenomenon under investigation. Starting from these considerations we analysed the main determinants of the emigration flows in Romania with a GWR model, using new regional migration data issued by the National Institute of Statistics following the last census. We explored the counties' vulnerability to emigration in relation to several important influence factors: local development level, earnings, employment, and education. Our findings provide some new insights into this topic, revealing sizeable territorial variation in emigration determinants and pointing to the counties that are more strongly afected by certain factors of influence. These results represent an improvement compared to those provided by the traditional global models, which are unable to distinguish the spatial variation in estimations. The county-specific estimates resulting from the GWR model represent useful information for shaping appropriate migration policies, specifically tailored to meet the local needs.*

Keywords: *push factors; geographically weighted regression; counties; Romania*

JEL Classification: *C52, R12, J6.*

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1. Introduction

For Romania, the topic of emigration has a particular relevance, since its steady increase in scale and its cumulative demographic, social, economic and political effects are becoming more and more alarming. A *wealth of research* on Romanian emigration phenomenon has been undertaken recently (e.g., Rotila, 2008; Vlădescu *et al.*., 2008; Sandu, 2010; Roman and Voicu, 2010; Boboc *et al.*., 2011; Driouchi *et al.*., 2012; Roman and Goschin, 2012 and 2014; Hinks and Davies, 2015, among others), illustrating the growing interest among scholars in identifying its determinants and assessing its broad social, economic and political implications.

Analyses of emigration flows and their factors of influence are usually be conducted at aggregate (country) level, therefore neglecting the consequences of increasing differences across regions. Migration studies should acknowledge to a greater degree that the factors influencing migration are likely to vary in space, generating unbalanced territorial effects. Existence of broad regional inequalities in general, and in emigration behaviour, in particular, should be addressed with specific investigation tools, such as the geographically weighted regression (GWR) which is able to highlight the spatial variations in regression parameters.

Since most of the empirical research on migration determinants places poverty, lack of employment and low entrepreneurial and educational opportunities among top reasons for emigration, we used the variables capturing these factors for analysing the main causes of the Romanian emigration flows, with a GWR model. To this aim we exploited the regional migration database at county level (NUTS 3) issued by the National Institute of Statistics following the 2011 census.

Our findings reveal a big territorial variation in emigration determinants, pointing to the counties that are more strongly influenced by certain factors. These results represent not only a novelty, but also an improvement compared to those provided by the traditional global models, which are unable to distinguish the spatial variation in estimations. The county-specific estimates resulting from the GWR model represent useful information for shaping appropriate migration policies, to meet the local needs.

The rest of the paper is structured as follows. After a short overview of the international and national literature on the determinants of emigration in Section 2, focusing on the "push" (rejection) factors specific to the migrant's county of origin, we will present in Section 3 the GWR model built for our research, as well as other spatial methods that we are going to employ. Section 4 displays the results and discusses their econometric validity, as well as their economic significance and implications for the strategies targeting emigration. Finally, Section 5 concludes by resuming the main findings and setting directions for future research on this topic.

2. Literature on emigration determinants

The international literature tackling the factors that propel emigration revealed that this phenomenon is triggered mainly by positive (attraction) factors specific to the country of destination in opposition to negative (rejection) factors characteristic to the country of origin. Although very popular among scholars, the traditional "push-pull" models relying on economic, social and environmental differentials between sending and receiving countries, especially income gaps, have been criticized lately for their failure to capture the non-economic factors and the individuality of human decisions (*e.g.,* de Haas, 2011).

The national literature on emigration displays various topics, including the demographic profile of the migrants, the social and economic effects produced by large emigration, brain-drain, remittances, circular migration, return migration, and so on (Ghita *et al.*., 2007; Rotila, 2008; Silas and Simina, 2008; Sandu, 2005 and 2010; Rotila, 2008; Vlădescu *et al..,* 2008; Roman and Voicu, 2010; Boboc *et al.*., 2011; Driouchi *et al.*., 2012; Roman and Goschin, 2012 and 2014; Hinks and Davies, 2015).

Empirical studies undertaken so far indicate as factors playing a major role in the emigration decision the income differential between Romania and the destination countries, the anticipation of bigger business opportunities and less corruption abroad, lower risk of unemployment, positive career expectations, better economic and social climate, etc. (*e.g.* Litan, 2009; De Sousa and Duval, 2010; Roman and Ileanu, 2010; Roman, 2011; Stoiciu *et al.*., 2011; Stănculescu *et al..,* 2011; Goschin and Roman, 2012 and 2014). For instance, many Romanian emigrants head towards Germany and the United Kingdom, both rich countries having among the smallest unemployment rates in the European Union. The recent economic crisis set new challenges for migration research, as important changes occur in the traditional migration corridors.

Although a large part of the research performed on Romanian emigration was directed towards identifying its main determinants and effects, only few studies addressed this issue from a regional perspective (*e.g.* Gheţău, 2005; Simina, 2008; Prada *et al.,* 2015; Goschin, 2015).

The 2011 Census data provided the much needed regional statistics on the Romanians that settled abroad, boosting this line of research. For instance, Prada *et al.* (2015) found that regional emigration correlates weakly with the development level because all regions, not only the poor ones, pull out significant flows of emigrants, and identified specific features of the regional labour markets that exert a decisive impact on migration. Exploiting the same 2011 Census data, Goschin (2015) showed that long-term emigration and short-term emigration have different territorial distribution, but share

some common factors of influence, such as low regional development and high human capital.

Since spatial heterogeneity is very likely to affect regional migration data, the researchers have to address this issue in the regression models they are using for empirical analyses. From this perspective, the geographically weighted regression is an appropriate investigation tool and could fill a gap in the existing literature on Romanian emigration.

3. Methods employed in the analysis

Researchers in regional economics constantly search for new and improved instruments to allow for a deeper understanding of the economic factors and processes that unfold in different locations. The main aim is to capture the characteristics, particularities and specificities of each region, thus enabling the design of appropriate economic policies.

Such a method, well adapted to the needs of regional research, is the geographically weighted regression (GWR) model (Brunsdon *et al.,* 1996; Fotheringham and Brunsdon, 1999; Fotheringham *et al.,* 2002; Wheeler and Tiefelsdorf, 2005). Unlike the usual regression models which estimate global coefficients that apply equally to all regions, this method provides coefficient estimations that change from one region to another, according to spatially defined weights. Consequently, GWR lets the model to fluctuate territorially, capturing the real spatial patterns and providing a better image of spatial variation of the phenomenon of interest, compared to traditional global models.

The customary specification of the geographically weighted regression is as follows (Charlton and Fotheringham, p. 1):

$$y_i(r) = \beta_{0i}(r) + \beta_{1i}(r)x_{1i} + \beta_{2i}(r)x_{2i} + \ldots + \beta_{ni}(r)x_{ni}$$

where the intercept and all coefficients are region-specific and the relative location of each region r in the larger area is considered by means of geographical weighting.

The beta coefficients of the GWR model are estimated as follows (Charlton and Fotheringham, p. 1):

$$\hat{\beta}(r) = (X^T W(r) X)^{-1} X^T W(r) y$$

where W(r) is the weight matrix specific for the region r, capturing its location in a larger area (country).

Besides the GWR model, the other methods employed in our analysis include comparing the counties' emigration level with descriptive statistics, measuring the

impact of spatial interactions on the scale of emigration flows using specially designed weights matrices, as well as computations of spatial autocorrelation indicators, at a global level - Moran's I, and at local level - LISA. Given the relatively small spatial scale of our analysis, we opted for close distances in spatial interactions, using the 1st order of neighbourhood (counties that share a common border).

The variables employed in our analysis have been selected so as to reflect the potential reasons for emigration, naturally within the limits of available official statistics. Our variables are representing three categories: regional development proxied by Gross Domestic Product per capita (GDPcap), local labour market captured by average wage (Wage) and unemployment rate (Unempl), as well as education, measured with two variables: the shares in stable population aged 10 years and over of secondary education graduates (Edu-scd) and that of university graduates (Edu-ter).

Our main source of information is the new database from the Romanian 2011 Census (NIS, 2015) supplemented with other NIS data for regional GDP, wage and unemployment rate at county level. We also had to calculate some derivative indicators such as GDP per capita and the shares of secondary and tertiary education graduates.

4. Results and discussion

The values of autocorrelation index Moran's I are positive and significant for all variables in our model (Table 1), indicating a general tendency to cluster for all variables. This means that neighbours tend to share similar values on each variable of interest for our research.

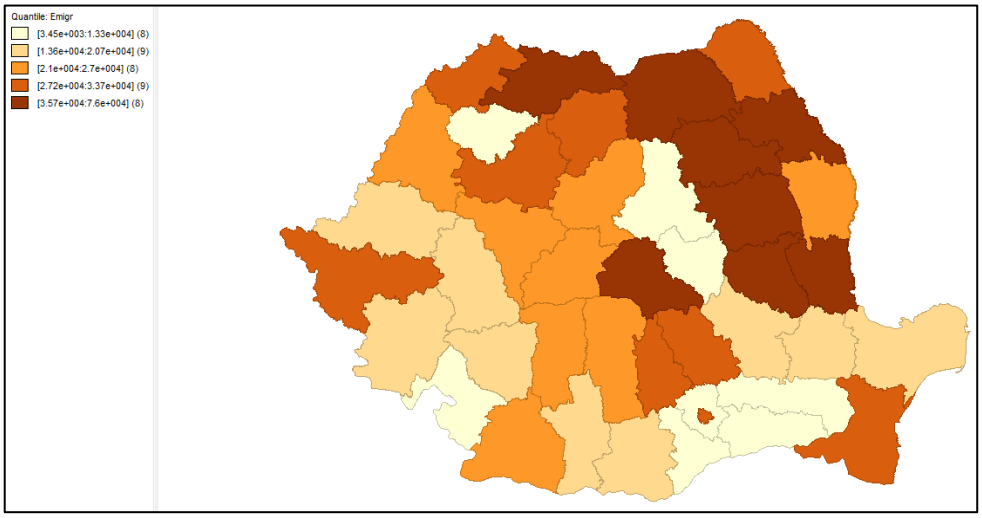
Table 1 – The spatial autocorrelation index

Variable	Moran			
	Index (pseudo p-value)	Mean	S.D.	Z-Value
Emigration	0.2616 (0.004)	-0.0244	0.0891	3.1865
GDP per capita	0.4066 (0.001)	-0.0255	0.0865	4.9946
Unemployment rate	0.2688 (0.003)	-0.0236	0.0968	3.0218
Average wage	0.3699 (0.001)	-0.0209	0.0891	4.3883
Tertiary education	0.1459 (0.033)	-0.0261	0.0860	2.0004
Secondary education	0.1705 (0.0130)	-0.0250	0.0883	2.2139

Source: own processing in GeoDa 1.2.

Figure 1, illustrating the number of emigrants by county, based on 2011 Census data, confirms the disposition of low or high values to cluster, supporting the hypothesis of positive spatial dependence, *i.e.* neighbours tend to be alike.

Figure 1. Number of emigrants by county, 2011

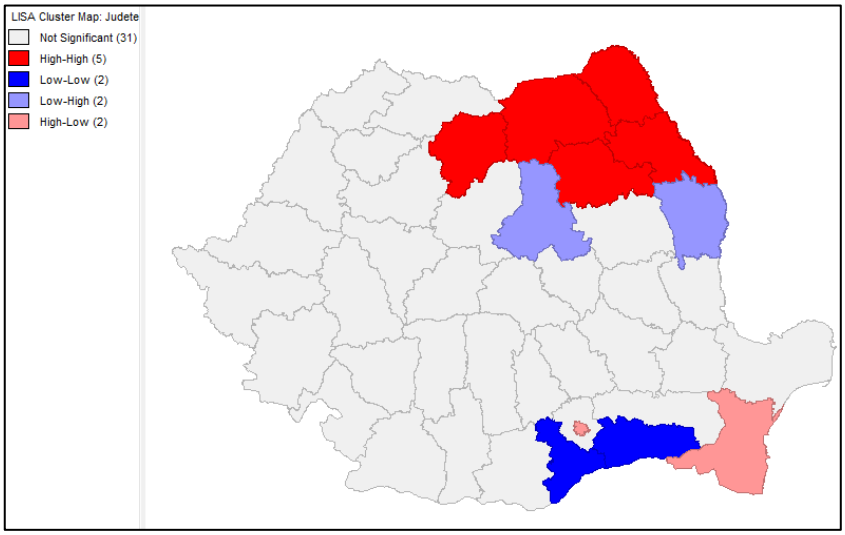


Source: own processing

The cluster map for the number of emigrants by county (Figure 2), based on the values of the local indicator of spatial association – LISA, reinforces the previous findings and identifies the "hot spots", *i.e.* the locations of significant similar/dissimilar associations. This map shows a group of high migrant sender counties in North-East, while in South a cluster of low migration flows is located.

Further in our analysis, we applied a GWR regression, using a Gaussian Model with an adaptive bi-square geographic kernel. We made use of the method of independent variables standardisation, the Golden section search method for optimal bandwidth and Akaike Criterion - AICc for optimal bandwidth selection. The number of nearest neighbours in the GWR model is 5.

Figure 2. LISA cluster map for the number of emigrants by county



Source: own processing

The Adjusted R-squared and Akaike criterion provided by the output (Table 2) clearly show that GWR is an improvement to the global OLS regression.

Table 2 – The results

Variable	Minimum	Lower Quartile	Mean	OLS global coefficient (t statistic)	Upper Quartile	Maximum
Intercept	19205.51	21737.81	24078.22	26322.31*** (11.94)	27075.61	32628.81
GDP cap	-71370.97	-33283.72	-24901.56	-22102.94***	-71370.97	-33283.72
Umenpl	-12907.73	-6562.97	-4068.31	-5728.10* (-2.0696)	-1649.66	1450.24
Edu-ter	8100.43	11423.17	21032.08	18510.73** (3.6436)	27923.99	52588.51
AIC	-	-	925.6544	930.1316	-	-
Adjusted R-squared	-	-	0.493720	0.269330	-	-
F statistic	-	-	2.67255*	-	-	-

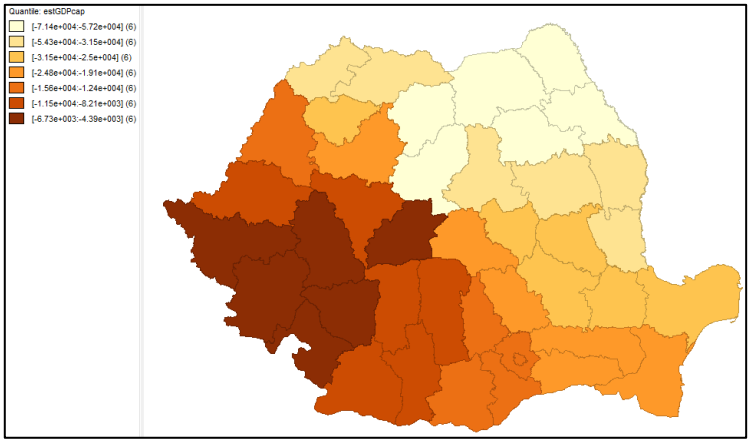
Significance level: * - 1%, ** - 5%, and *** - 10%

The coefficient estimations for all variables included in our model change heavily from one region to another, according to spatially defined patterns. Thus, the coefficients

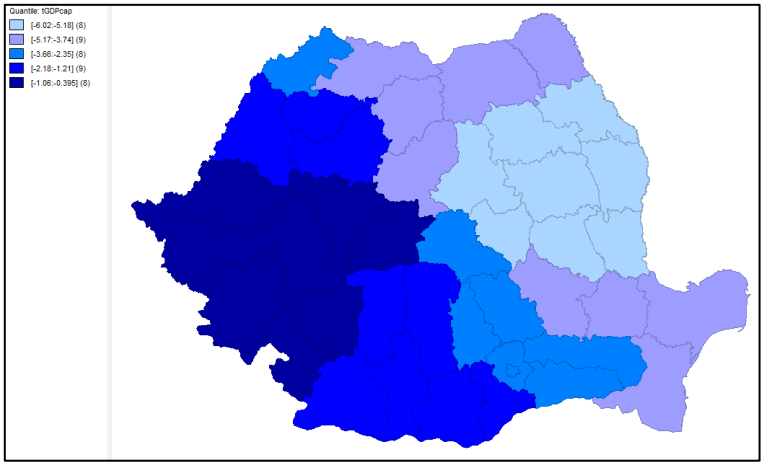
estimated for GDP per capita fluctuate from a minimum of -71370.97 in the Suceava County to a maximum of -4392.99 in the Sibiu County, instead of a constant -22102.94 for the global OLS model (Table 2).

The estimated coefficients for GDP per capita reveal a high spatial variation in this coefficient while remaining always negative (Figure 3). This shows that the lower the local development level, the higher the emigration flows. However, this effect is much stronger in Eastern Romania, where the poorer counties are concentrated.

Figure 3. Estimated coefficients (a) and t-statistic (b) for GDP per capita



(a)

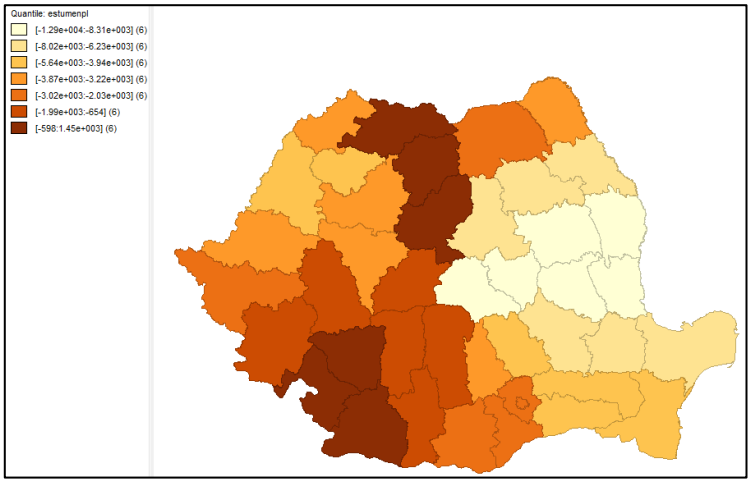


(b)

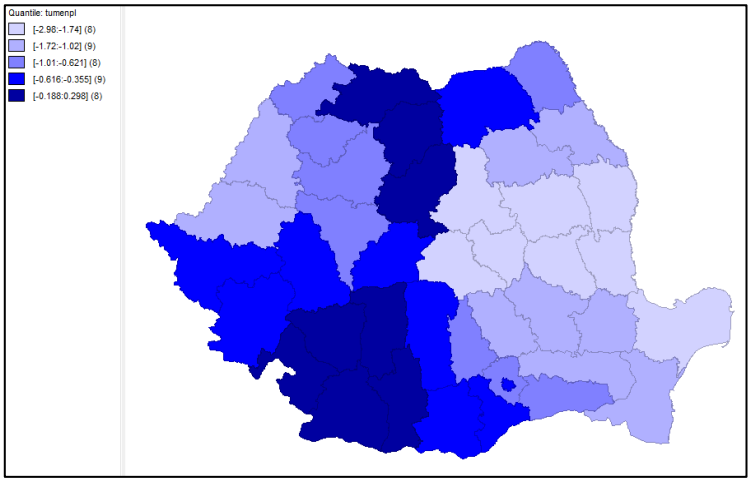
Source: own processing

In addition to local parameter estimates in Figure 3(a) we provide the significance map in Figure 3(b). The p-values displayed in Figure 3(b) indicate that estimations of GDP per capita are more significant in the less developed counties in the East, compared to the West.

Figure 4. Estimated coefficients (a) and t-statistic (b) for unemployment



(a)



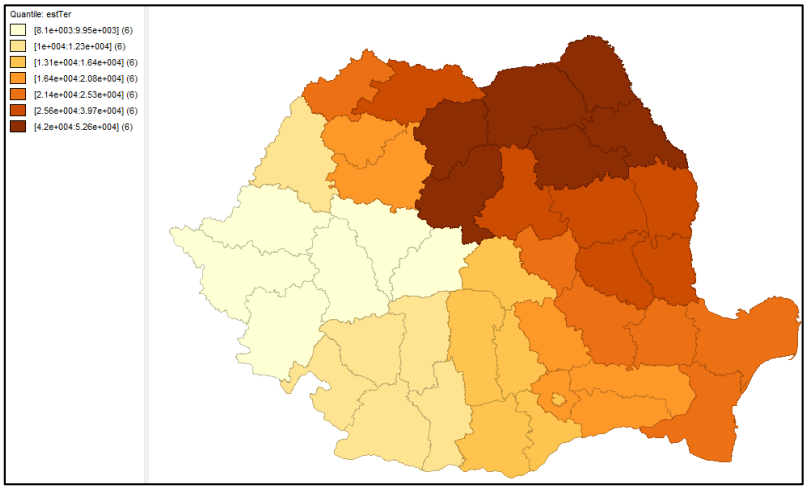
(b)

Source: own processing

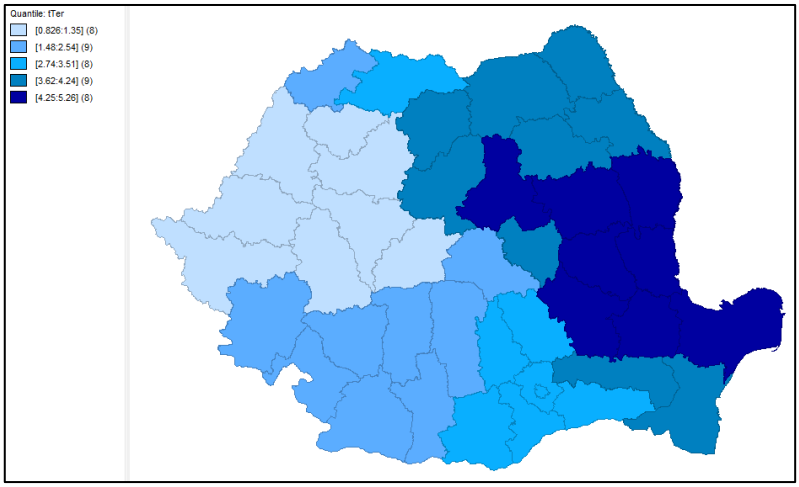
Another variable presenting high differences in its geographically varying coefficients is unemployment (Figure 4). Even the sign of the coefficient changes locally for the variable unemployment, indicating opposed influences of this factor in different locations, according to specific regional characteristics. These high differences among local results demonstrate that GWR allows for a better image of spatial variation of the emigration phenomenon, compared to the usual OLS regression. The Eastern part of Romania is again characterized by the lowest parameter estimates, *i.e.* strongest negative influence of unemployment on emigration. This result is expected, since the big unemployment rates in East naturally produce stronger effects when it comes to emigration.

The estimated coefficients for the variable tertiary education indicate that educated population in eastern areas is more prone to emigrate. This variable exerts a considerably smaller and less significant influence in the Western counties, which should be interpreted in relation to regional development. It seems that educated persons from less developed areas are more inclined to emigrate compared to the ones from more developed counties, as tertiary education provides better chances for escaping poverty through emigration.

Figure 5. Estimated coefficients (a) and t-statistic (b) for tertiary education



(a)

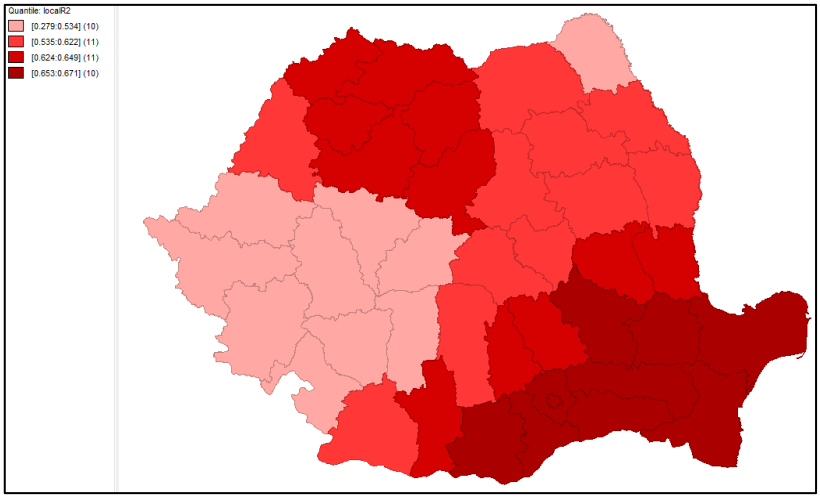


(b)

Source: own processing

The values of the coefficient of determination (R-squared) indicate that all local regressions fit our data well, with only ten counties, mainly un South-West, situated below the 0.5 threshold (Figure 6), but still remaining fairly significant.

Figure 6. The coefficient of determination (R-squared) by county



Source: own processing

To sum up, higher/lower local parameter estimates clearly cluster, indicating a general East-West divide, the Eastern part being influenced to a larger extent by the emigration determinants included in our analysis. Our results reinforce conclusions from previous studies. For instance Prada *et al.*, (2015) also highlighted the higher propensity for emigration in the less developed areas, such as Moldova.

The scale and implications of emigration from certain counties pose difficult challenges that need immediate attention from both local and national decision makers. Migration is mostly a negative phenomenon for the sending countries, but if properly managed it can provide some benefits as well. A way for harvesting positive effects from emigration is to adopt policy measures that enable remittances to stimulate economic growth, by directing them more towards saving and investment, instead of mere consumption. Such a shift requires financial education and appropriate tax incentives.

Another way to benefit from emigration is to encourage return migration, especially of highly educated that would convey international know-how and experience. This would convert “brain drain” into “brain gain” and would boost domestic development.

5. Final remarks

Emigration from Romania has been gaining increasing attention lately, but traditional regression models that have been used to explore its determinants provide common estimates for all counties, neglecting the sizeable differences in socio-economic conditions, as well as meaningful dissimilarities in local attitudes and propensity towards migration.

The GWR model reveals these differences by estimating county-specific values of the parameters, therefore overcoming the limits of OLS as regards spatial heterogeneity. Our results clearly show that GWR estimates are better than OLS, giving that high spatial variation occurs in coefficient estimations for all variables, particularly in the case of unemployment.

The results from our empirical research indicate that the Romanian East-West divide in economic development is mirrored by emigration behavior, with the Eastern less developed counties supplying more emigrants, especially tertiary educated ones. Higher unemployment in Eastern countries also contributes to its larger emigration propensity.

Our findings convey relevant policy messages, calling for appropriate strategies targeting young and educated persons that hold a high share in the new emigration wave. Failing to address the root causes of emigration of highly educated persons entails significant demographic, social and economic risks.

Further research on this topic should test different spatial weights matrices and try to include other explanatory variables in the GWR model in order to enhance its predictive capacity.

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