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FACTORS THAT PROMOTE EXPORT CONVERGENCE: A SPATIAL ANALYSIS IN ROMANIA

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Abstract

This paper combines two topics of high interest for regional development in Romania - international trade and real convergence – in an attempt to better understand their recent trends. Aiming to use the most appropriate and up to date instruments for our analysis, we tested the conditional beta convergence model both in its classic regression specification and in the spatial regression framework that allowed us to address properly the territorial dimension of the

phenomenon by accounting for spatial autocorrelation in exports. Although the hypothesis of sigma convergence in export flows does not hold, we found a significant process of conditional beta convergence among the Romanian counties, for various model specifications and time intervals. Our results confirm that the prerequisites for real convergence in Romanian exports are already met and sigma convergence might appear in the future.

Keywords: export, sigma and beta convergence, economic crisis, spatial model, county, Romania.

JEL classification: R10, R12, R58

1.Introduction

In today's globalized world international trade represents an essential driver of economic development, at county and regional level alike. Imports provide the missing or scarce inputs for national production process and convey technological advancements, while exports supply the much needed foreign currency to pay for the imports. This puts international trade in the focus of attention from both policy makers and scholars.

Real convergence is another important topic for regional development, given the steady deepening of economic and social inequalities worldwide. Although in some parts of the world, e.g. the European Union, progress has been made in alleviating economic gaps between countries, internal development disparities seem to increase. In this context, boosting the economic growth in less developed regions, by means of supplying additional resources, is seen as an appropriate strategy for mitigating the growing economic disparities.

Our paper reunites these two topics of high interest - international trade and real convergence – in an attempt to reveal their recent developments in Romania. Although real convergence is widely researched, most empirical works focus on income and productivity convergence, while trade convergence has been rarely addressed in the mainstream international literature and, to the best of our knowledge, is totally missing from the Romanian economic studies.

Thus, our empirical endeavor towards export convergence analysis is contributing to an under researched topic, while providing new useful information for policy makers. Since this area of research is constantly enriched with new and efficient investigation tools (e.g. specific statistical tests of sigma convergence, spatial models of beta convergence, etc.) we aim at using the most appropriate and up to date instruments for addressing properly the territorial dimension of the phenomenon. Another novelty is the shift from trade as a determinant of economic convergence in previous research (Ben-David and Loewy, 1998; Ben-David andKimhi, 2004; Cameron, 2005, etc.) to a model focused primarily on export convergence. This perspective is justified by the need to

better understand the factors that influence regional export growth in order to design the appropriate strategies and policies for enhancing the export performance in the lagging regions.

The main research questions that we address in this paper are: What drives the convergence of exports among the Romanian counties? and Are this factors stable in time, regardless the phases of the economic cycle? To this aim we target the interval from 2001 to 2014, and two relevant sub-intervals. The first sub-interval, 2001 to 2007, captures the pre-accession to EU and is also an economic boom period, while the second,2008-2014, represents the post-accession period, marked by the severe economic crisis and the subsequent slow recovery.

The remainder of this paper proceeds as follows. The next section investigates the relevant literature on export and real convergence, focusing on the regional perspective of the research. Section 3 introduces the various statistical instruments to be used in our empirical research, highlighting the possibility to capture the territorial interactions by means of spatial indicators and regression models. Section 4 presents the results and discusses their statistic and economic relevance, while section 5 concludes by summarising the main findings and tracing directions for further research.

2.Literature review

Real convergence is a long-running topic in regional economics, usually addressed in the context of economic and social disparities which it is expected to alleviate. Starting from the seminal works of Barro and Sala-i-Martin (1995, 2004) many scholars tested the convergence hypothesis in various time and space settings, focusing mostly on GDP and income convergence (Egger and Pfaffermayr, 2006; Villaverde, 2006; Dall'erba and Le Gallo, 2008; Checherita, 2009, etc.).

In the context of sustainable development, international trade can exert a major influence on the process of regional growth and convergence, but might also contribute to higher economic and social inequalities. The regional degree of competitiveness, specialization and performance are closely linked to regional demand for imports, as well as to regional supply for exports. Empirical papers mostly addressed the issue of trade in relation to income and/or technological convergence (Ben-David and Loewy, 1998; Ben-David and Kimhi, 2004; Cameronet al., 2005), paying far less attention to trade convergence *per se*. Some authors stressed that higher export flows from underdeveloped to developed countries can boost the convergence process among these countries (e.g. Ben-David and Kimhi, 2004), while others doubt such findings (Cameron et al., 2005). It has been also shown that export convergence and technological specialisation tend to evolve in the same direction(Laursen, 2000).

Economic crises are expected to impact strongly on the export flows, reducing their amplitude, changing their structure and having long-lasting effects on the subsequent recovery process (Berman, 2009; Fenga and Lin, 2013). On the contrary, Romanian exports seem to have overcome rapidly and with minor inconveniences the challenges of the recent economic and financial crisis. For instance, Georgescu (2012) didn't find evidence of decline in Romanian exports' competitiveness amid the recent global economic crisis. Following an initial drop of about 14% in 2009, exports quickly recovered and even outrun the pre-crisis figures. This achievement is even more praiseworthy if we consider the large share of EU counties in Romanian exports.

Romanian economy has reached a level of trade openness which brings many opportunities, but also increased vulnerability to external shocks such as the recent global economic crisis (Grigore and Mitroi, 2009; Zaman and Vasile, 2012). The positive evolution of trade at national level failed to counteract the negative effects of the economic crisis (Zaman et al., 2016). Romanian counties have been more successful in mitigating the negative impact of the economic crisis in foreign trade than in GDP: according to 2014 official statistical data many counties failed to recover entirely the GDP decline due to the crisis (Zaman and Goschin, 2015), while only a few were situated below their pre-crisis levels of exports (Zaman and Goschin, 2016). At the territorial level, the international trade was not favourable for those counties who focused their exports on low technology products, exploiting mainly their natural resources. This type of exports leads to low incomes from international trade and implicitly to a low potential of endogenous growth at local level, primarily due to deteriorating terms of trade (Zaman et al., 2016).

3.Methods, variables and data

Since empirical investigations on this topic require statistical methods adapted to the regional scale of the analysis, we combined traditional convergence methods, such as sigma and beta convergence introduced by Barro and Sala-i-Martin (1995) with spatial modeling.

Sigma convergence (σ) means the decrease in territorial dispersion of the variable of interest. This process is measured based on the coefficient of variation of a variable y across regions, as follows:

$$\sigma = \frac{\sqrt{\frac{\sum_{i=1}^{n}(y_i - \bar{y})^2}{n}}}{\bar{y}} \qquad (1)$$

If its values diminish over time, it leads to lower dispersion of the variable y across the territorial units, indicating convergence, while the opposite process signals divergence.

Beta convergence means that the underdeveloped regions tend to growth faster and catch-up with the developed ones. Sigma convergence implies beta convergence, but the reverse does not necessarily hold, as beta convergence may occur without reducing the GDP dispersion (Wodon and Yitzhaki, 2005). This happens when economic shocks are more powerful in certain regions, increasing the initial dispersion among regions (Barro and Sala-i-Martin, 1995).

The beta convergence concept derives from the neoclassical growth model (Barro and Sala-i-Martin, 2004) and the absolute (unconditional) β convergence model is based on the assumption of structural homogeneity among the territorial units. Conditional β convergence (Galor, 1996) takes into account the technological or institutional differences between countries or regions by including additional variables in the model to capture local characteristics.

In order to better account for the inter-county disparities, we will use in this analysis the conditional β convergence model. Firstly, a classic conditional beta convergence model will be employed, as follows:

$$EXP\_rate_i = a + b \cdot \ln EXP\_initial + \sum_k c_k \ln X_{ki} + \varepsilon_i \qquad (2)$$

where EXP_rate represents the average annual growth rate of the export flows over the period under investigation, $EXP\_initial$ is the export flow at the beginning of the period, X_k are the regressors (additional factors of influence on the convergence process) and ε is the error term. In the case of an ongoing convergence process, the lower exporting regions exhibit higher average growth rates compared to the regions that had been better performing initially, therefore the coefficient b in the regression equation should be negative. On the contrary, a positive b coefficient means that bigger exporters continue to outdistance the lesser exporting regions, i.e. divergence.

Since neighbor regions most likely share common characteristics, we will test for spatial dependence in the annual average growth rate of export per capita over the period of interest by employing Moran's *I* indicator (Anselin and Rey, 1991):

$$MI = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(x_i - \bar{x})(x_j - \bar{x})}{(\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij})\sum_{i=1}^{n}(x_i - \bar{x})^2}, \qquad (3)$$

where x_i and x_j represent the annual average growth rate of export per capita in the regions i and j respectively, $\bar{x}$ stands for the average and w_{ij} are the spatial weights (more specifically $w_{ij} = 1$ if regions *i* and *j* are neighbours, and $w_{ij} = 0$ otherwise, corresponding to a first-order queen contiguity matrix). Moran's *I* ranges from −1 (perfect dissimilarity among neighbours) to +1 (perfect similarity), while the null value corresponds to random spatial distribution of values. A permutation test is going to be further applied to validate the statistic significance of the results (Anselin and Rey, 1991).

As recommended in the literature, if spatial dependence is confirmed, we are going to correct it using the appropriate spatial model (Anselin, 2005; LeSage and Pace, 2009). To this aim two main types of spatial models are going to be tested: the spatial lag model and the spatial error model.

The spatial lag (autoregressive) model includes a lag of the dependent variable ($\rho \sum_j w_{ij} EXP\_rate_j$) in the classic model specification illustrated in equation (2), resulting:

$$EXP\_rate_i = a + b \cdot \ln EXP\_initial + \sum_k c_k \ln X_{ki} + \rho \sum_j w_{ij} EXP\_rate_j + \varepsilon_i \qquad (4)$$

while the spatial error model accounts for spatial dependence in the error term, as follows:

$$EXP\_rate_i = a + b \cdot \ln EXP\_initial + \sum_k c_k \ln X_{ki} + (\lambda \sum_j w_{ij} \varepsilon_j + v_i), \qquad (5)$$

where $\sum_j w_{ij} \varepsilon_j$ are the spatially autoregressive errors and v_i represents the new uncorrelated errors of the model.

We will finally choose the appropriate model for our data according to the value of Lagrange multiplier test for both spatial error and spatial lag. If we reject the null hypothesis of spatial randomness, we should use a spatial instead of classical OLS regression.

The selection of the variables for our models was based on theoretical considerations and previous studies, while limited by data availability. Official regional data is not very extensive in Romania, therefore the list of additional explanatory variables in the conditional beta convergence models was limited to GDP, import and FDIs (Table 1).

Based on the literature, we expect both GDP and FDIs to exert a positive influence on the regional export growth (Majeed and Ahmad, 2006; Pelinescu and Radulescu, 2009). Romania benefited from large inflows of FDIs in economic sectors that had a significant contribution to economic growth (Rădulescu et al., 2016) and, at least in theory, this should lead to enhanced exports. Previous research regarding the influence of FDIs on exports yielded mixed results, some authors supporting positive effects (e.g. Dumitriu and Hunya, 2002), while others failed to validate them (e.g. Marinescu, 2007). One reason for the lack of correlation between FDIs and exports might be the fact that in Romania, as in other CEE countries, FDIs went to sectors with little or no revealed comparative advantage (Hoekman and Djankov, 1998). Imports, as means of improving the quality of the manufactured goods, can lead to export growth (Hoekman and Djankov, 1998), therefore we expect a positive influence of this variable as well.

Table 1. The variables in the beta convergence models

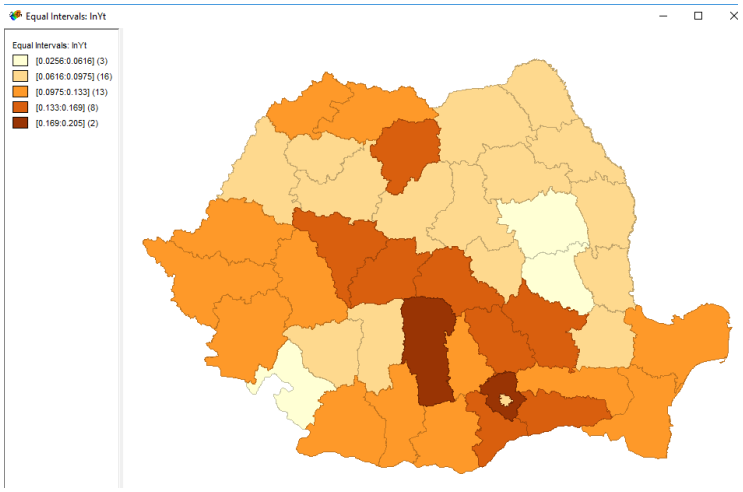
Variable name	Description	Data source
EXP_rate	Annual average growth rate of export per capita over the period of interest.	National Institute of Statistics and own computations
EXP/cap_initial	Export per capita (euro) at the beginning of the period of interest.	National Institute of Statistics and own computations
IMP/cap	Import per capita (euro).	National Institute of Statistics and own computations
FDI/cap	The foreign direct investments stock per capita (Euro)	The National Trade Register Office and own computations
GDP/cap	Gross Domestic Product per inhabitant(Euro)	Eurostat database

We are going to include these variables in the framework of conditional beta convergence model for two time intervals (2001-2007 and 2008-2014), testing both the classic regression specification in equation (2) and the spatial regression models in (4) and (5).

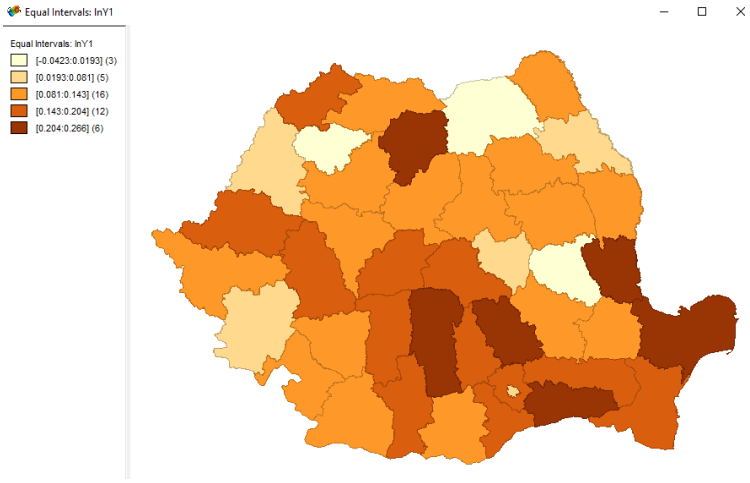
4.Results and discussion

The spatial distribution of the per capita values of the average annual growth of counties' exports over different time intervals shows big inequalities (Figure 1). The regional picture of exports growth illustrated by the maps displayed in Figure 1 is highly unbalanced and the changes from one period to another are quite big.

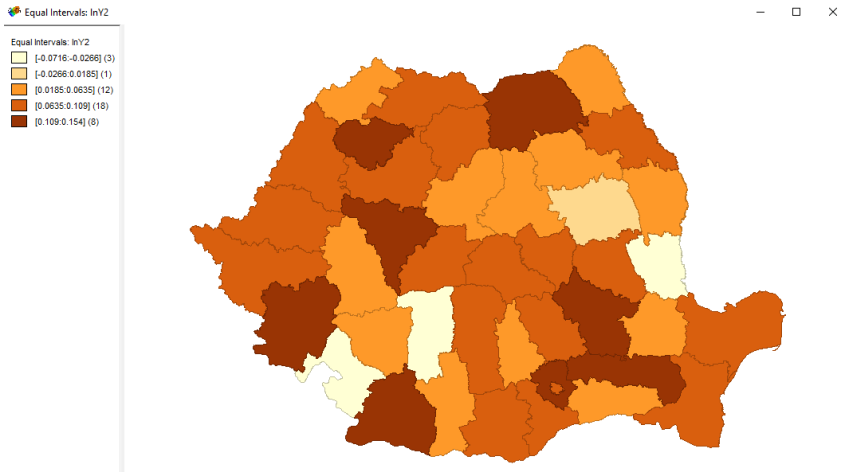
Figure 1. Spatial distribution of the average annual growth of counties' exports, different time intervals



2001-2014



2001-2007



2008-2014

Source: own processing in Geoda 1.7

The maps in Figure 1 suggest that counties sharing similar export trends (i.e. higher or lower annual growth rates) tend to cluster. These clusters of counties with common export dynamics are not stable in time, their locations on the maps changing from the pre-accession to the post-accession period.

In order to address properly the territorial dimension of the phenomenon under investigation and to confirm the spatial dependence suggested by the maps, we further conducted a specific spatial analysis using Moran's *I* scatter-plots for per capita exports in different years (Appendix 1), the LISA cluster maps and significance tests for exports average growth over the interval 2001-2014, with different variants of weighting matrices (Appendix 2), as well as Moran's *I* statistic and permutations test for exports average growth over different time spans (Table 2).

The results point to possible positive spatial autocorrelation, except for the post-accession period 2008-2014. For the other two time intervals the test rejected the null hypothesis of spatial randomness at a significance level of 5%, confirming significant spatial dependence, meaning that the speed of export growth in a county is linked with the export growth of its neighbours. This implies the need to use in our analysis of beta convergence spatial regression models that include a spatial variable, either as spatial lag or spatial error (Anselin, 2005).

Table 2. Moran's *I* test for spatial autocorrelation in the dependent variable

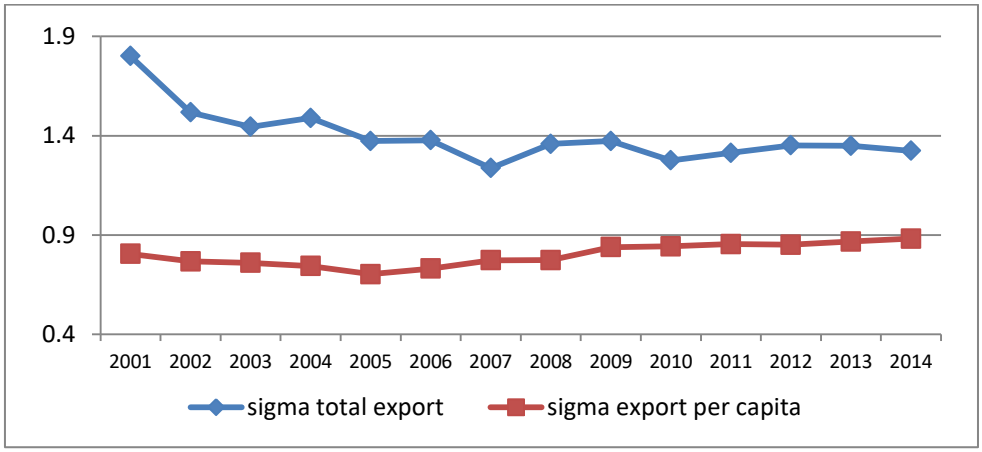
Variable	**Moran's *I* statistic**	**Pseudo p-value***
Export/cap average growth 2001-2014	0.240156	0.0050
Export/cap average growth 2001-2007	0.202875	0.0140
Export/cap average growth 2008-2014	-0.065478	0.3506

Note: * At 999 permutations

Source: own processing in Geoda 1.7

Firstly, we tested the sigma convergence for export based on county data (NUTS3) and found a rather stable long run trend in the territorial dispersion of per capita exports, although the total exports showed less decreasing variation among Romanian counties in the same period – 2001-2014 (Figure 2).

Figure 2. Sigma convergence for export based on county data (NUTS3)



Source: own processing

This means that the hypothesis of sigma convergence in per capita exports does not hold for Romanian counties over 2001-2014.

Given the lack of sigma export convergence among Romanian counties, we further focused on beta convergence as a necessary (but not sufficient) first step towards it. The absolute beta convergence does not hold either (unreported results), but if we account for additional explanatory factors that capture a better image of the regional economies and the differences among them, we are able to find a long run process of real convergence in per capita exports among Romanian counties, over 2001 to 2014 (Table 3) and also over the two sub-intervals that we have investigated, corresponding pre- and post-accession period (Tables 3 and 4).

As expected, the logarithm from the variable "initial export per capita" is significant and has a negative sign, indicating a process of beta convergence among the Romanian counties. With different levels of statistical significance, this result holds for all model specifications and time intervals (Tables 3 and 4). It confirms that the prerequisites for real convergence in Romanian exports are met and sigma convergence might appear in the future.

The results show that the factors leading to this export convergence vary from one period to another, in close relation with the phases of the economic cycle. Thus, during a period of sustained economic growth, supported (among others) by rich inflows of foreign capital, we found the variables "FDI stock per capita" and "imports per capita" to be positive and highly significant, while GDP per capita had to be dropped from the model as statistically insignificant.

On the opposite, during the global economic and financial crisis and in the following period of economic recovery, both FDIs and imports ceased to support convergence and GDP per capita emerged as the new factor leading to export convergence.

Table 3. Estimation results for the whole period -2001-2014 and for the pre-crisis period – 2001-2007 (dependent variable – annual growth rate of export per capita)

	2001-2014 - Classic model		**2001-2007 - Classic model**	
Variables	**Coefficient**	**Prob**	**Coefficient**	**Prob**
CONSTANT	0.1433	0.0012	0.2209	0.0074
lnEXP/cap initial	-0.0483	0.0011	-0.0362	0.0406
lnFDI/cap	0.0154	0.0174	0.0251	0.0262
lnIMP/cap	0.0287	0.0637		
Statistics	**Value**	**Prob**	**Value**	**Prob**
R-squared	0.34012		0.1340	
Log likelihood	85.2287		55.5549	
F-statistic	6.529	0.0011	4.0183	0.0403
Breusch-Pagan test	5.8737	0.1179	0.1931	0.9079
Koenker-Bassett test	7.4260	0.0605	0.2496	0.8827
White test	9.8347	0.3640	2.4913	0.7778
Moran'I (error)	2.0303	0.0423	0.0914	0.1794

The presence of spatial dependency, as previously tested and discussed, has been acknowledged by testing the spatial lag model in equation (4) and the spatial error model in equation (5), using the maximum likelihood estimation method. We presented in Table 4 only the results of a spatial lag model for the beta convergence for 2008-2014, as the two other periods investigated failed to yield statistically significant estimations in favour of spatial regressions and classic OLS regression is more appropriate for our data (Table 3).

The diagnostics for spatial dependence, particularly the Lagrange Multiplier tests, provide information about whether spatial dependence exists, and, if so, whether a lag or error model is more appropriate. Based on this test we decided that the spatial lag model is adequate for the period 2008-2014 (Table 4). This suggests that the per capita exports of Romanian counties are interconnected and positive spatial interactions go beyond county borders.

Table 4. Estimation results for 2008-2014, based on classic and spatial models (dependent variable – annual growth rate of export per capita)

	2008-2014 - Classic model*		**2008-2014 - Spatial lag model****	
Variables	**Coefficient**	**Prob**	**Coefficient**	**Prob**
CONSTANT	-0.2395	0.0636	-0.1421	0.1831
W_EXP_growth			-0.0936	0.0002
lnEXP/cap initial	-0.0206	0.0510	-0.0202	0.0174
lnGDP/cap	0.0744	0.0050	0.0696	0.0008
Statistics	**Value**	**Prob**	**Value**	**Prob**
R-squared	0.1875		0.4027	
Log likelihood	71.8341		76.1757	
F-statistic	4.5007			
Breusch-Pagan test	0.2449	0.8847	0.5195	0.7712
Koenker-Bassett test	0.1548	0.9255		
White test	2.2266	0.8170		
Likelihood Ratio Test (spatial dependence)			8.6832	0.0032

Note: *OLS estimation

** Maximum likelihood estimation

In sum, the annual growth rate of export per capita during and after the recent crisis tend to be faster in less developed counties, prompting a process of beta convergence, while depending on the export growth of the neighbouring counties.

Our results clearly show that despite insignificant sigma convergence among Romanian counties the prerequisites for real convergence in regional exports are already met, as indicated by the conditional beta convergence models, and sigma convergence can be expected in the future.

Mitigating the negative effects of the regional disparities is a complex and lengthy process that critically depends on local efforts, including adequate support for increased export performance of the counties. Making good use of the local natural and human resources becomes increasingly important for solving and overcoming the challenges of achieving strong and sustainable economic growth, strengthening the regional economies and narrowing the performance gaps.

5.Conclusions

Real economic convergence is largely acknowledged as an appropriate strategy for mitigating territorial inequality. In this paper we explored the main factors that might support the convergence of exports among Romanian counties, based on both traditional and modern statistical investigation tools. We found that sigma convergence has not been achieved yet and therefore we focused on beta convergence as a necessary (but not sufficient) first step towards it. The absolute beta convergence does not hold either, but if we account for additional explanatory factors that capture a better image of the regional economies and the differences among them, we find a long run process of real convergence in per capita exports among Romanian counties.

The results show that the factors leading to this export convergence vary from one period to another, in close relation with the phases of the economic cycle. Thus, during a period of sustained economic growth, supported (among others) by rich inflows of foreign capital, we found the variables “FDI stock per capita” and “imports per capita” to be positive and highly significant, while GDP per capita had to be dropped from the model as statistically insignificant. On the opposite, during the global economic and financial crisis and in the following period of economic recovery, both FDIs and imports ceased to support convergence and GDP per capita emerged as the new factor leading to export convergence.

Since our study was limited by data availability, further research should focus on identifying new data sources and testing additional explanatory variables in the beta convergence models.

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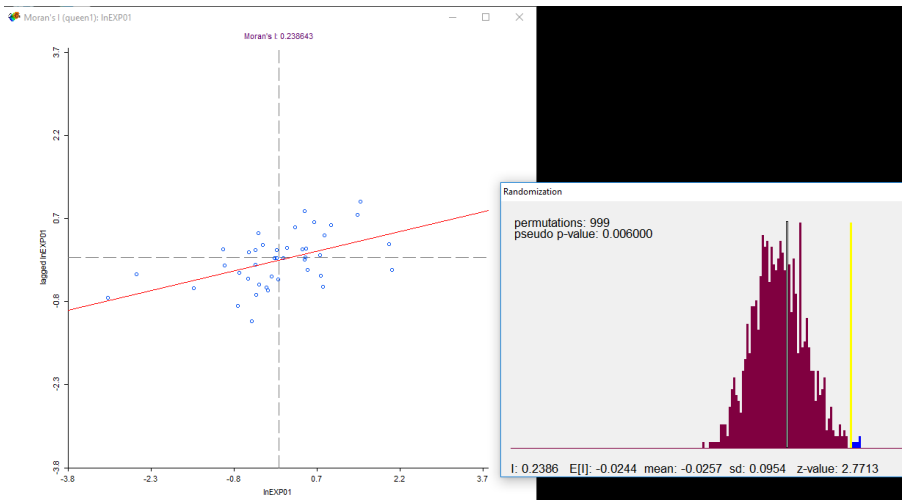
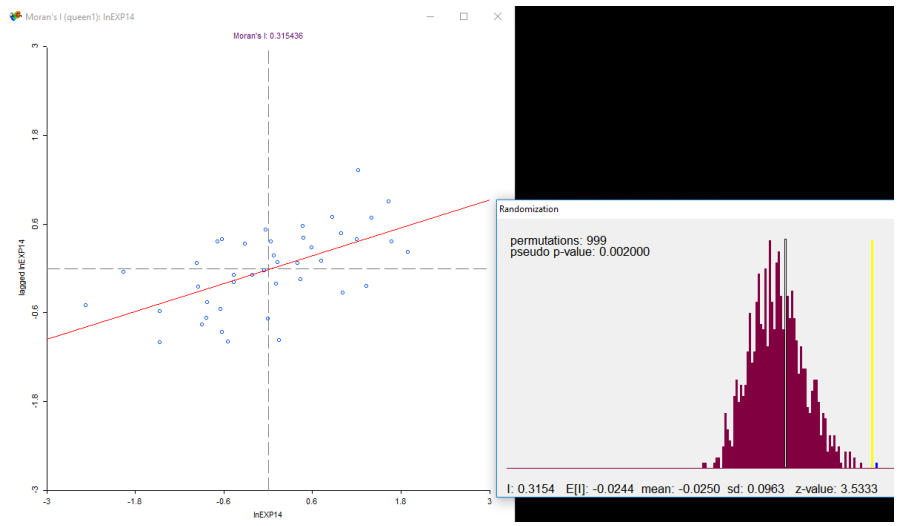
Appendix 1. Moran's I and permutation test for exports per capita, selected years



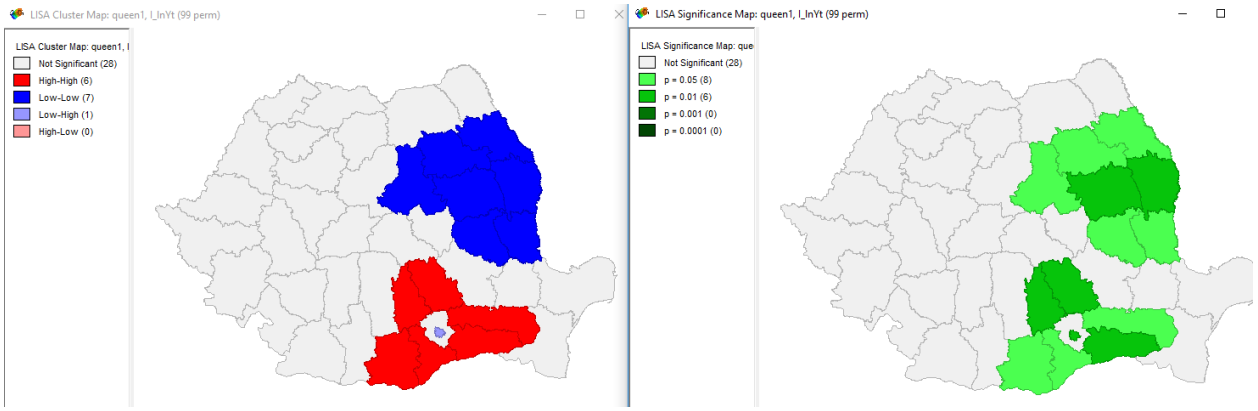
(a) 2001



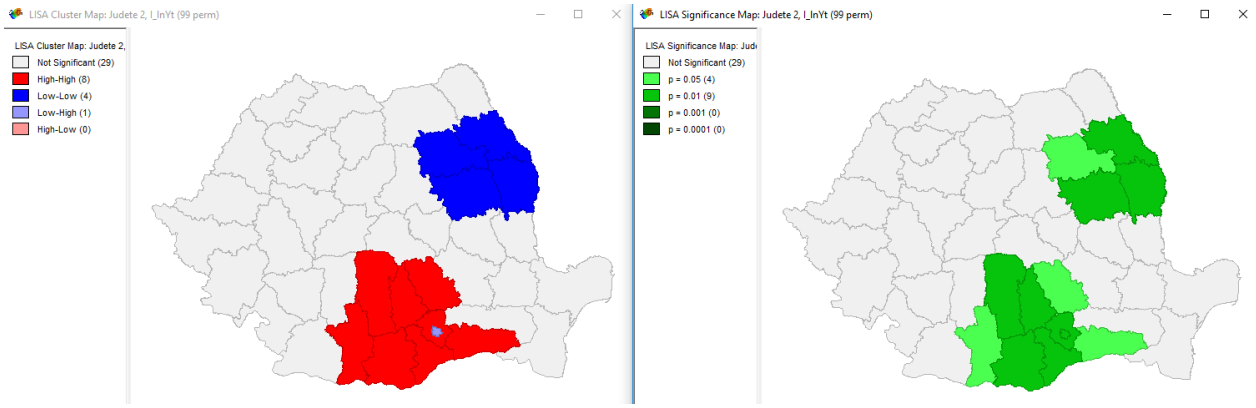
(b) 2014

Source: own processing in Geoda 1.7

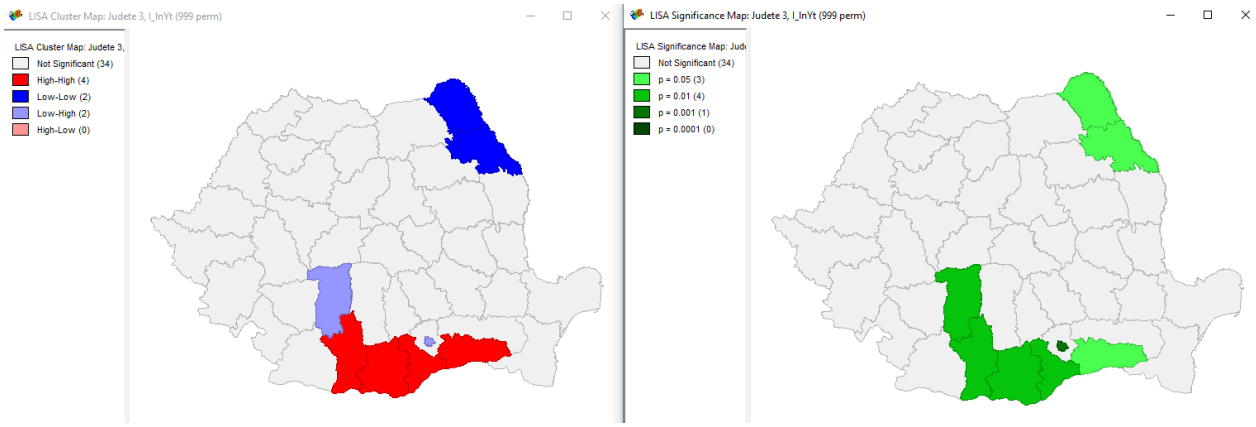
Appendix 2. LISA cluster map and significance test for exports per capita annual average growth over 2001-2014, different weighting matrices



(a) First order contiguity



(b) First and second order contiguity



(c) Up to third order contiguity

Source: own processing in Geoda 1.7