A MULTISCALE ANALYSIS OF BUCHAREST'S GDP ON A NUTS 3 LEVEL

SECĂREANU GEORGE[1]

Abstract

This article's main purpose is to prove the impact the GVA has over the GDP on three different spatial directions. The first scale is represented by the importance of Bucharest in the European Union, where the capital of Romania is analyzed and compared with the other administrative units. The second scale emphasizes the importance of Bucharest in the states which formerly had a centralized economy and which are nowadays part of the European Union. The last scale is represented by Romania itself, thus, in this article, some of the economic disparities and discontinuities were briefly explained.

Given the fact that the GDP is an important economic indicator, the study aims to consider both the amplitude and the impact that the added value has in the economy. Based on the results, the national administration can observe the differences between these scales of analysis, while the European Union can design sound economic policies that are adjusted to different regions so as to reduce the discrepancies from the inside.

The data are taken from INSSE's, ATISPLUS' and ESPON's websites and are processed through ArcMap 10.2.2, with which it has been possible to standardize and calculate the closest 30 neighbours of the administrative units.

Keywords: Geographically Weighted Regression,Ordinary Least Squares, PIB, GVA, analysis of Bucharest.

Introduction

Multiscalarity in a geographical context is the property of a system which, through some territorial phenomena, revolves around a set of interconnected processes that appear on different scales but most of all on different intervals of time, having certain cyclicality. At the center of this system there will always be an important subject so that the whole process of multiscalarity can develop around it. An eloquent example is the parallel between an ecosystem and an urban crowd (Prosperi, Morgado, 2011).

Scheling makes the multiscalarity easier to understand in his thesis from 1978 "Micromotives and Macrobehavior". The main idea this thesis will debate

[1] PhD. Student, Universitatea din București – Scoala Doctorală "Simion Mehedinți", Bd. Nicolae Bălcescu, nr. 1, 010041, București, e-mail:secareanugeorge@yahoo.com

is that individual circumstances can and will lead to a self-organizing system, to macrobehavioral models . The main example the academician gives is a strictly social one, of living with someone with characteristics that are completely oposed to ours. Throughout time, these individual preferences resulted in spatially segregated social structures. (Schelling, 1978).

Thinking on a multiscale level is determined through the debate in which the way the resilience, the biodiversity and the scale are blended These ones must suggest an interconnecting scale model in order to evaluate such characteristics as the resilience. (Peterson, Holling, 1998).

On the other hand, we need to consider the difference between innovation and scale. Innovation is brought into our atention by the human intelligence, which is transmitted beyond strcitly technical aspects and which have as a purpose the measurement and the association of formal activities, of innovative national studies, but, above all, the social aspects and the historical progress.In Joseph A. Schumpeter 's opinion, innovation represents any modification of products based on processes and organization forms. Most of the times, innovation can be identified with the science people or with the antrepreneurs, because they are in a continuous search of innovations (Schumpeter, 1975). On the other side, the notion of scale is based on the geographical literature, where the explored notions led to a functionality of the numerous levels such as the level of the communities, the urban level, the regional one, the worlwide level. (Bunnell, Coe, 2001).

Similarly, Sommerville uses multiscalarity to explain what the governance of neighborhoods could mean. The author differentiates the hierarchical autogovernance from the joint governance. He underlines the existence of a multiscale governance where governance is a dynamic of (1) the community's associates and residents who resist in front of the governmental forces on a neighborhood scale through hierarchical division and argumentations and (2) the asymetry in the organizations' ruling condition on higher levels of the hierarchy. Thus, governance is transcalar and, in the author's opinion, more efficient in what concerns the results for the top-down vertical coordination rather than for an ascending type. (Prosperi, Morgado, 2011).

As for the problems that appeared in the field of planning, Sheppard and McMaster launch two main hypotheses. The first one is based on the fact that important planning problems, such as for example governance, are often better designed and also well-structured in what concerns the multiscale interractions between members of different "layers" of a hierarchical system. The second hypothesis refers to the fact that different layers have different dynamics. In such a dynamic we find two different situations. The first one is when the whole can be stable while the parts can be unstable, and the second situation is when the whole is unstable while the parts can be stable. These possibilities form a

framework for this analysis having a dual perspective of evaluation and planning (Sheppard, McMaster, 2004).

In a world of continuous change based on the fast developing process of industrialization, the method of transcalarity highlights, through its cartograms, the alternative changes from a given territory, and so it grants certain accuracy to the development of those areas and also a chance to better understand the scenery.

Throughout time, different socio-economic indicators could be obtained from the whole world, so that the statisticians could accomplish their mission of comparing the discrepancies that might have occurred on different work scales.

Data and methods

This study is to be based on different statistical methods such as the OLS (Ordinary Least Squares) or the GWR (Geographically Weighted Regression), which will portray an economic perspective on three different scales, on a NUTS 3 level. The first studied scale is Romania and here we will analyze the GVA based on the GDP per capita, the main objective being the analysis of Bucharest based on the other administrative units from Romania. Another scale is the one comprising the states which formerly had a centralized economy and which are now part of the EU, where Bucharest will be analyzed in comparison with the other capitals, in order to demonstrate its progress in comparison with the other ones, and this progress should be appreciated as the other states had a better developed economy in the early 90s. And last but not least we will analyze the European Union as a whole, where Bucharest will be compared again with the other capitals.

Nowadays, when the world is constantly changing due to the accelerated process of technologization, the method of transcalarity offers a picture of the alternative changes from a certain territory, through different cartograms. Thus, it offers those evolutions a useful accuracy and also the chance of having a better understanding of the scenary.

For the multiscale analysis we have used the representation program ArcMap 10.2.2 through which the models of creating the spatial relationships could be used, such as OLS and GWR.

The first method used, the OLS, is meant to describe the relationship between two variables through a technical line from the area of statistics that tries to identify the function which better approximates the data, resulting in a global relationship. Basically, we address a model fitting the observed data. In a more common language, the representation can be explained as being a straight line formed by a set of points of data, so that the sum of the squared vertical distances also known as residuals, can be reduced to a minimum.

The second geographically weighted regression model (GWR) represents an exploration technique indicating where the non-stationarity appears on the map, when the local weighted regression coefficients go farther away from the average values. This model cannot represent the possible small variations. In this case, other implementations of local regression are to be made.

Fig. 1. GWR is a local regression model. Coefficients are allowed to vary
Sursa : www.arcgis.com with modification

The article's main purpose is an economic analysis where the GDP will be a dependent variable and the GVA an explanatory variable, both of them being based on the year of 2005.

Results and discussion

Figure 1, the one representing the OLS and the GWR on a nuts 3 level in the EU, includes the most complete analysis, incorporating many administrative units and being also the hardest to corelate. The created relationship indicates a series of explanatory variables and of resulted tests after the implementation of the model. One of these is the Coefficient, this being of 0.336682, in the OLS this one reflects both the power and the type of relationship the explanatory variable has over the dependent variable. The resulted coefficient shows that the higher the GVA gets the higher the GDP is, this also being the expected change in the dependent variable for each small unitary change in the associate explanatory variable.

The convenience of using standardized coefficients is that of comparing the effect of the explanatory has when being so different, given the fact that the higher standardized coeficcient after removing the +/- signs has the biggest effect over the dependent variable. The standard errors can represent the probability of obtaining the same coefficients were it possible to prove the data are correct infinitely. The highest standard errors for a coefficient indicate the fact that the process could result in a greater variety of values, while the lowest standard errors indicate a more consistent coefficient.

In the current context, the standard deviation for the predicted values are different from one administrative unit to another. The areas with positive

standard deviation values (the red ones) are the ones where the GDP has higher values, the blue areas being the ones with values that are lower than initially predicted; therefore the areas with the overpredictions and underpredictions can already be shaped. The fact that there are some clusters in the bigger picture shows us the reason on which the GVA's independency is based.

Therefore, the initial hypothesis was based on the fact that the GVA explains the GDP and now what we want to know is how the future of the GDP will look like. On a nuts 3 level we cannot predict the future variations of the GDP basing our assumptions on a single indicator, however this particular indicator can show us the current situation of the dependency between these two economic indicators. In order for us to predict the future varions of the GDP, we have to consider several indicators, which could result in a multiple regression and not in a simple one as it is in the current case.

Therefore, in the geographically weighted regression, for the bandwidth method representing the level of smoothness, there have been chosen the parameters of the bandwidth and for the Kernel type the adaptive method was chosen because different spatial units were considered for our analysis, and the distribution of the bandwidth changes depending on the density of the characteristics from the input class. The bandwidth thus becomes a function of the number of the closest indicators taken into account. Thus, for each local determination we have to consider the same number of characteristics. In the current situation, the number of neighbours is chosen to be 30.

The higher or lower the standard deviation is represented, the more or less the GVA (X) impacts the GDP (Y). In our case, the biggest influence of the GVA over the GDP can be found in some areas from London, Copenhagen, Paris, Rome, Helsinky and Stockholm, where there is a gross added value for the industry and for the service sector which have a great contribution in the creation of the GDP.

On the opposite side, we find capitals like Tallin, Sofia, Athens, Dublin, some areas from London, Paris, Berlin , Haga, Lubliana, where we could interpret the result as a logic one, because of the fact that these are areas that are higher than the average regarding the economic development, and here the GVA does not represent a key factor in the development of the GDP. A neutral influence can be found in Bucharest, Warsaw, Riga, Vilnius, Bratislava, Vienna, Lisbona, Madrid, Brussels and Prague. In this situation, Bucharest is the only administrative unit with a value above the average when compared with the other national units that have negative values. One can thus say that the capital of the country is the only region that can be compared with the well-developed parts of Europe.

On a second level (Fig. 2), the resulted coefficient is 0.465942, which makes the relationship between the GVA and the GDP be strongly positive. R-square indicates in this case how much the GVA influences the GDP, the

percentage of this impacto on a scale level being that of 0.61, which in a simple regression with a single explanatory indicator represents a success. This value is also given by the small area where the OLS model is being implemented, and so the analysis obtains the desired accuracy. Another characteristic of the R-square coefficient is represented by the close values found in the analysis, as this "flaw" from the well-developed countries from the Western Europe and from the ones subject to some economic "errors" made the former analysis go through some major imbalances.

The capitals where the GDP has higher values than initially predicted are Talinn, Riga and Bratislava, while the lower values can be found in Warsaw, Bucharest or Sofia, the first two of them having the highest residual standard deviation (above –2.5). Vilnius, Budapest and Prague have average values (–0.5 – 0.5).

If we were to analyze the GWR, we would see that R-square is, in this case, 0.74, which indicates the percentage of the dependent variable's variation, i.e the percentage of the GDP. The capitals where the GVA has a greater impact over the GDP are Talinn (3.38), Bratislava (4) and Riga (1.2), these being the capitals with positive values. On the other hand, the GVA has a lower impact in capitals like Bucharest (–4), Warsaw (–4.7), Sofia (–1) or Prague (–1). The regression thus obtained based on 30 neighbors indicate the fact that the GVA has a negative or a positive indluence depending on the case.In this case, the capital of the country holds a negative value due to the calculation of the index based on the closest 30 neighbours, Greece being excluded and also having to limit the area of expertise.

This particular prediction demonstrates that through the regression there can be made a series of predictions regarding the GDP, based on the value of the GVA.

In our analysis, the highest deviations can be observed in the Czech Republic or Hungary, these economies being direct beneficiaries of the influences some of their well-developed neighbors have (such as Germany or Austria), while some of the lower standard deviations usually appear in Poland or Romania, these being greater economies in what concerns the human capital, and thus they are developing slower.

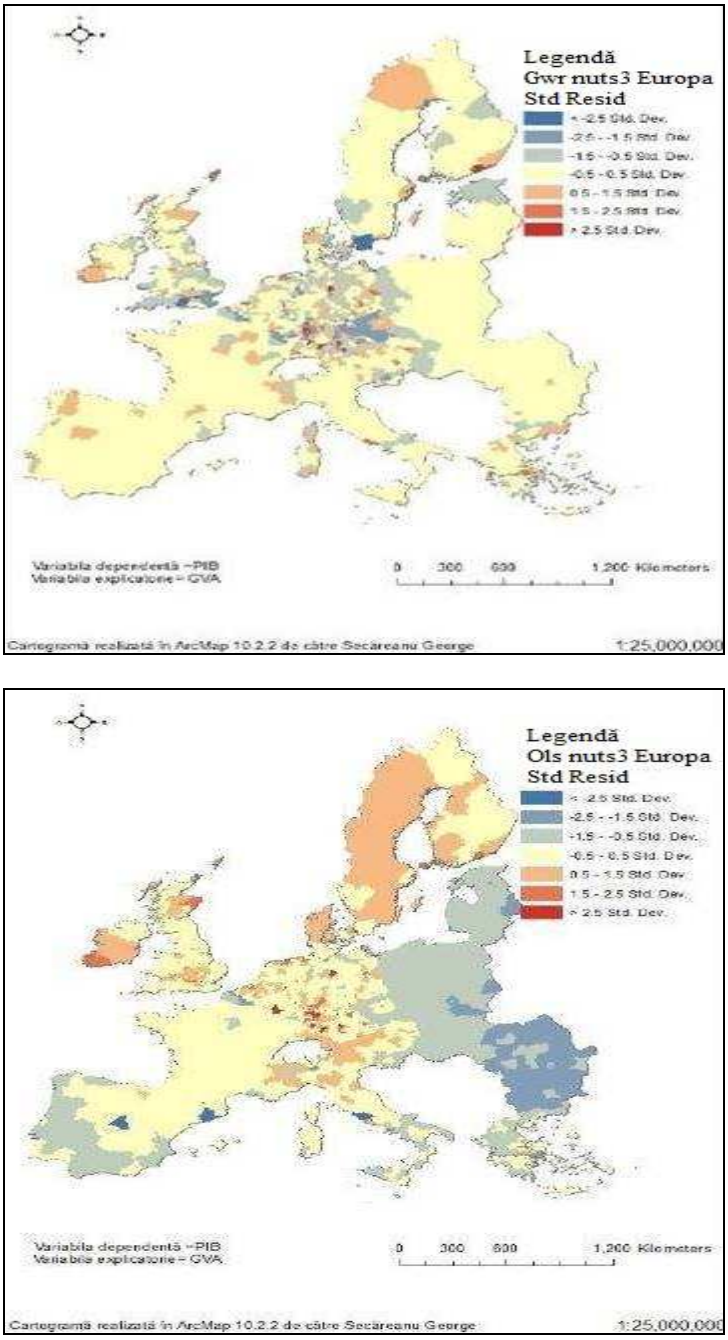

Fig. 2. The distribution of the residuals from the linear regression and from the geographically weighted regression between the GVA and the GDP on a nuts3 level in the EU

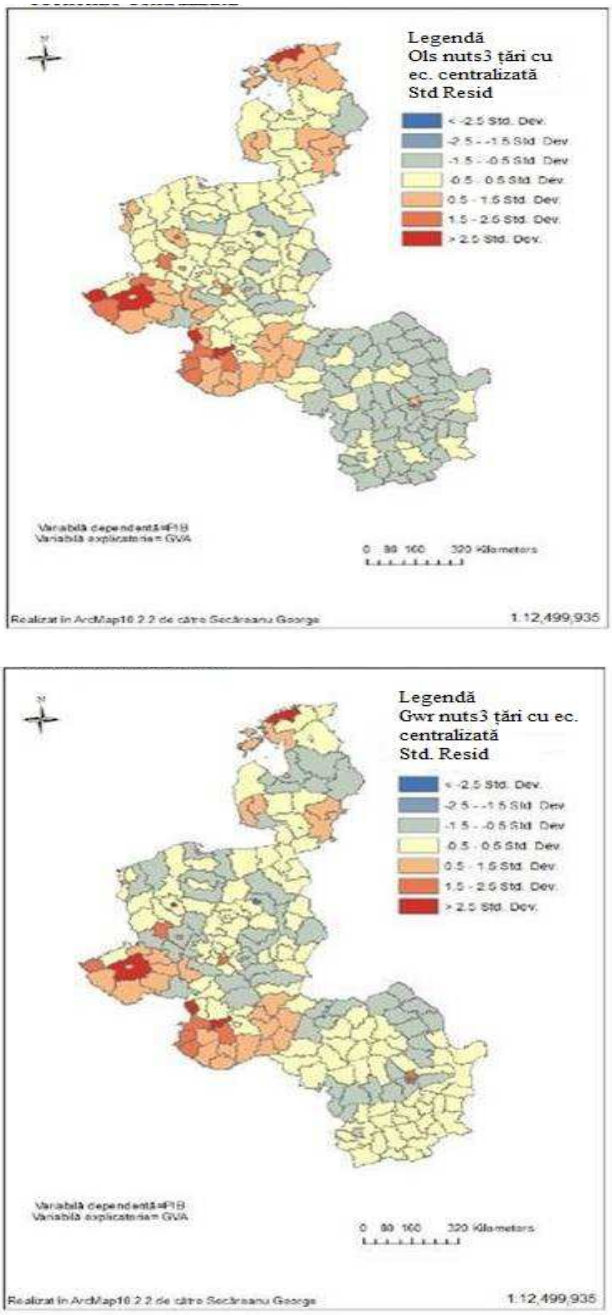

Fig. 3. The distribution of the residuals from the linear regression and the geographically weighted regression between the GDP and the GVA on a nuts 3 level in the states which formerly had a centralized economy

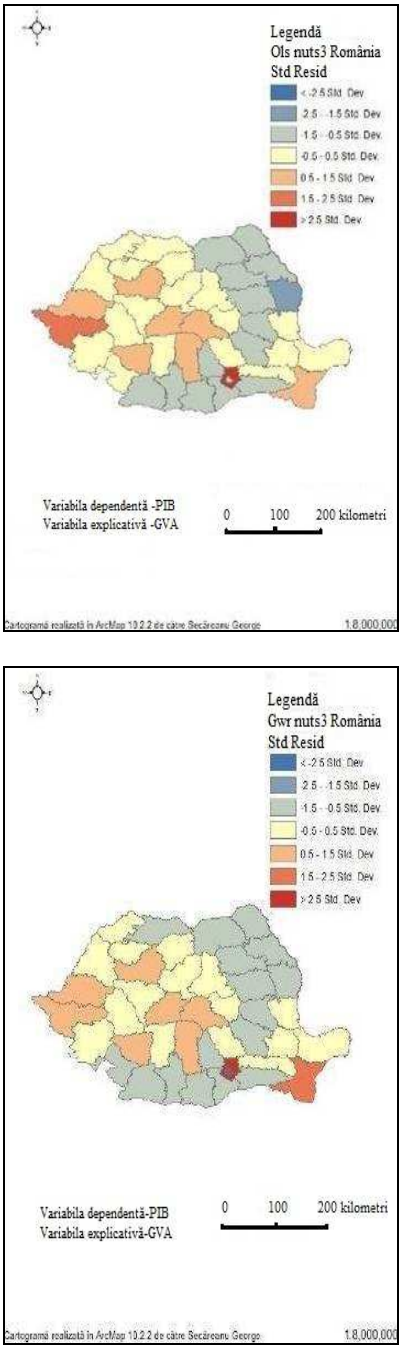

Fig. 4. The distribution of the residuals from the linear regression and from the geogrphically weighted regression between the GDP and the GVA on a nuts 3 level in Romania

The last scale of our discussion is that comprising the counties of Romania, where the coefficient obtained after the OLS is 0.275787, which makes the relationship developed in this administrative plan be strongly positive. R-square is, in this case, 0.64, this justifying the impact the GVA has over the GDP, resulting, again, in a success while explaining the relationship.

The positive standard deviation is encountered in the county of Ilfov (4), this being possible because of its proximity to the Municipality of Bucharest. Thus, the majority of the companies have opened their headquarters there. The following county is Timisoara (1.5). The counties with positive standard deviations are Arad, Cluj, Sibiu, Brasov, Arges, Gorj and Constanta, all of them having well-developed economies (there is Dacia producing vehicles in Arges, there is the harbor in Constanta and there is the IT development in Cluj). On the opposite side, the highest negative standard deviation can be found in the county of Vaslui (–1.5).The polarization that Bucharest exerts have made the country of Ilfov a beneficiary of the investments and thus the majority of the companies have extended their activity or have based their headquarters in that specific county. Another aspect is represented by the lack of space but the advatage is the proximity to the capital of the country.

And not least, we have the analysis of the geographically weighted regression on the level of Romania, where the main indicators from the study have had the following coefficients. For the bandwidth we have chosen in this case too the BANDWIDTH_PARAMETER, but the Kernel type was chosen to be a fixed one, because we are to consider spatial units of the same kind in our case, the counties. The analysis has resulted in an R-square of 67%, which, as in the other cases too, indicates a percentage of the explanation of the GDP through the GVA.

In the carthographical representation of the geographically weighted regresson, the counties of Ilfov (4.2), Constanta (1.6), Timisoara, Arad, Cluj, Sibiu, Gorj, Arges, Brasov have the highest values. In Bucharest (–3.5), Iasi, Maramures, Suceava, Valsui, Botosani, Bacau, Vrancea, Buzau, Dambovita, Olt etc have positive standard deviations. The values are again clustered, the ones which are mainly positive can be found in the center and in the west of the country, while the negative values can be found in the east and in the south.

Conclusions

The study of Bucharest from a multiscale point of view based on an economic aspect has the standard of living fluctuations in the foreground. That is why there can be noticed how the territorial discrepancies appear on a Nuts 3 level in the EU on a national, on a regional and on an international level. This

can be seen in the field of commerce, in the field of the free movement of goods and also in the free movement of the capital.

Throughout time, different socio-economic indicators have been gathered from all around the world and, thus, statisticians were able to accomplish their mission of comparing the possible discrepancies between different work levels. The actions taken in this case regard censuses with brochures, which, along with the selection of the information, were able to capture the socio-economical reality.

The importance of the study is given by the social aspects that appeared after different strategic and political problems that affected the economy and the standard of living. This kind of problems must be understood better so that the nation can avoid them in the future.

Based on the final results, the national and local administrations are able to observe Bucharest's position on three different scales of analysis, the city being compared not only with the closer regions but also with the farther ones that also belong to the same organism. The European Union can adjust solid economic policies based on the specifics of the studied regions, so as to reduce the discontinuities from the inside. These discontinuities are *"strongly related to the interractions but also to the tendency of automation of some entities...more and more pronounced as the population and the economic structure continue to grow, and this represents the basis of the discontinuities' productions"* (Ianoș I., Heller W., 2006, p. 28).

Therefore, in this study it has been sought to highlight the position of Bucharest on three different scales of analysis. In the European Union, both the capital and the other administrative units record negative values of standard deviation when compared the other regions, to the eastern part of the European Unions and also to other regions in the Iberian Peninsula, in the Italian Peninsula or the Balkan Peninsula. In the second scale of analysis, one can notice the discrepancy between Romania and Bulgaria which have negative values, and the other countries that have been included in the study. In the study field, Romania's economic situation is being highlighted and one can see how this situation coincides in a great measure with the historic regions. Moldavia and Wallachia have negative values, while Transylvania has greater values of standard deviation. This is due to a longer contact with the more civilized Europe and also to the implementation of innovation in all the economic and administrative structures.

These indicators show exactly the level of development of a nation, a region or, why not, the level of a territorial administration. Where we will find a higher added value, we will have an economic structure based on a manufacturing or innovative industry, which will usually create a global trend. Thus, through the implementation of new technologies, the added value will be higher than in other areas which did not have the context nor the „habitat" for such a development. These economic discrepancies, already observed in the

GDP and in the GVA, can be highlighted through some predictabilities which can also be calculated through a simple regression, as they are in our case.

REFERENCE

Bivand, R. (2014), Geographically Weighted Regression.
Bunnell, G., Coe, M. (2001), Spaces and scales of innovation, pp. 569-589.
Heppard, E., McMaster, R.B. (2004), Scale and Geographic Inquiry Blackwell, Oxford, pp.55-236.
Ianoș, I. (2000), Sisteme teritoriale: o abordare geografică, Ed. Tehnică.
Ianoș, I., Heller, W. (2006), Spațiu, economie și sisteme de așezări, Editura Tehnică, București, p. 28.
Peterson, Allen Holling (1998), Ecological Resilence, Biodiversity and Scale, pp. 6-18.
Prosperi, D.C., Morgado, S. (2011), Resilience and Transformation: Can We Have Both?, p. 822.
Schelling, T.C. (1978), Micromotives and Macrobehavior.
Sommerville, P. (2011), Multiscalarity and Neighbourhood Governance. Public Policy and Administration, 26:81-105.
Schumpeter, J.A. (1975), Capitalism, Socialism and Democracy.
http://www-lsr.imag. fr/HyperCarte
http://www.insse.ro/cms/
http://www.etisplus.eu/default.aspx
http://www.espon.eu/main