Where do Greeks work during the economic crisis?
A quantitative study of the spatial concentration of Greek employees

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Abstract
Economy and its fields of study constitute subject of continuous change. The economic activity and its sectors are extremely volatile following an erratic path; customized according to the social; political and economic trends. At the same time; the economic sectors are also being differentiated spatially. Particularly in Greece; the external conditions’ transformation; alter the balance of employment; especially during this period. The country in the event of deep economic and systemic recession is characterized by high volatility in all sectors. Direct result of the crisis is the deterioration of the dynamics of some economic fields and the change of the economically active population balance in the employment field. This article approaches spatially and captures the employment by branch of economic activity in Greece; through a series of spatial statistical methods. More specifically; using the data of the 2011 census for the employment by sector of economic activity; the Location Quotient is calculated in order to detect the relative position of those employed; as regards the national average. At the same time; the indicator’s values are visualized in the 316 Kallikratis Municipalities of Greece; through the use of thematic cartography. Finally an evaluation of employment regarding its spatial dimension is done and is been detected if each value is independent of the neighboring. In other words it is researched whether employees depend on the position identified in the study area; through the implementation of spatial autocorrelation.

Key Words: spatial statistics; Location Quotient (LQ); spatial autocorrelation; employed by economic activity

1. INTRODUCTION

Along with other countries; Greece is currently going through a period of deep economic depression with consequences that direly affect the country’s populations without exceptions. This climate’s main consequences include poverty; acute economic disparities; the devaluation of minimum wages; unemployment and drastic shifts in the job market structure. The intense need for an advanced; skilled workforce along with the extreme rise of unemployment of young professionals resulted to the immigration of young and skilled workforce to other countries. After 2012; particularly; unemployment rates in Greece escalated; finally reaching a peak in 2014; with the highest rate of 27.1%. During the next two years; unemployment began to slowly de-escalate; dropping to 23.5% in January; 2017 (Greek Statistical Office) [1]. One of the results of these extreme fluctuations was an acute imbalance in economic activities.
Through an examination of the sectoral dimensions of unemployment, we can infer that infrastructure, processing industries, wholesale and retail trade as well as health and social work have been rapidly affected, thus endangering fundamental structures of the economic development model that collapsed during the depression [2]. Other sectors, however, such as education, administrative activities along with housing and accommodation services have been steadily rising in these last two years.

The workforce’s population percentage, an integral part of the general population, dropped rapidly after 2010. The shifts in employed populations are greater, with a distinctive rise of unemployment and a corresponding decrease of employed populations [3]. Although this pattern escalated in 2013, within the next two years the job market became slightly more promising. The employment changes result from changes in exports, imports and domestic demand [4]. The main sectors’ impact on general employment rates changes significantly, as we can observe a balance in the primary sector’s rates with a slight rise at the end of 2015. On the contrary, the secondary sector’s employment rates, such as in industry, energy and infrastructure, are steadily decreasing. The tertiary sector, however, rose in the last years. It is worth noting that while most employed people worked in the primary and secondary sectors in 1981, only one out of four employed individuals (24%) worked in these sectors in 2015.

During the economic crisis, and more importantly during 2009-2013, the workforce in Greece increased at a 1.2%, while the number of employees concurrently dropped and around 904 positions were lost. Prospects for the employed populations’ living conditions are inauspicious, as the workforce’s rapid shrinking leads to both economic and social degradation. Consequently, through a combination of the sectoral and professional dimensions of unemployment, the structure of the sectors in Greece changes based on the following lines of reason: a) the continuous press for the elimination of the need for processing industries and infrastructure in order to open new work positions, b) the decrease of the rate of self-employed groups, c) the press for the need of professions based on trade and support [2].

This article spatially examines and reflects the breakdown of employed people in various economic sectors in Greece through statistical analyses. In addition to this, the article also aims to an illustration of zones that usually attract employment based on specific fields of economic development, since economic activities tend to cluster on specific geographical centers [5].

Since the spatial aspect of employment is a pervasive factor, the diverse dimensions of employment have become a broad field of investigation that calls for renewed attention. The job marker shifts economically, socially and geographically. In Greece, the workforce has been fractured along the lines of “Central Core-Region”. The first component of this phrase subsequently prevails, as employment in the regional areas is mainly characterized by usually illegal or informal types of employment with low wages [6]. Space, then, is not simply a passive aggregate, unresponsive to different stimuli; rather, space actively expresses the ways it works [7], and since it encompasses complex social and professional processes, it defines the economic activities that are developed within it.

2. DATA

The data regarding the employment of Greeks are made available from the Greek Statistical Office (ELSTAT) and stem from the results of the Greek population consensus in 2011. Data were classified according to specific economic activity codes. The most recent statistical classification of the economic fields was in 2008 (STAKOD 08) and is based on the classification of economic activities NACE rev. 2 of the European Union [8]. The statistical
classification (STAKOD) provides us with a context, at a national level at least, for the collection, tabulation, illustration and analysis of data according to each economic field. The use of statistical classification results in a uniform illustration and comparison of collected evidence from various fields and has become the most fruitful way of classifying statistical units based on economic field. In the context of the present analysis, a number of economic activities will be examined, in which employment has been affected from the economic crisis. The following table contains the fields that will be included in this study.

**Table 2.1:** Description of the economic fields to be analysed

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
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<tbody>
<tr>
<td>stakod1</td>
<td>Agriculture, Forestry and Fishing</td>
</tr>
<tr>
<td>stakod2</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>stakod3</td>
<td>Wholesale and Retail trade; repair of motor vehicles and motorcycles</td>
</tr>
<tr>
<td>stakod4</td>
<td>Accommodation and food service activities</td>
</tr>
<tr>
<td>stakod5</td>
<td>Administrative and Support Service Activities</td>
</tr>
<tr>
<td>stakod6</td>
<td>Public Administration and Defense; compulsory social security</td>
</tr>
<tr>
<td>stakod7</td>
<td>Education</td>
</tr>
<tr>
<td>stakod8</td>
<td>Human health and social work activities</td>
</tr>
</tbody>
</table>

The spatial context that this analysis reflects pertains to the administrative division of Greece in prefectures based on the Kallikratis Programme. This administrative reform was implemented in 2011 and re-defined the territorial boundaries of self-governing units, their way of electing administrative officials and their duties. Since acquiring information for the current administrative reform is much easier as compared to the previous Greek administrative division (Kapodistrias Plan), the approach of this study is strengthened by the availability of data when it comes to current prefectures. Further, the new ‘Kallikratian’ prefectures are not subjected to further divisions within the current plan, something that enables their more accurate study both at an administrative and a geographical level.

3. **METHODOLOGY**

The data analyzed on a spatial axis stem from interrelated observations. This is the result of a systematic shift of a phenomenon that is known as spatial relation. The first law of geography indicates that everything is space is related; however, things that are more proximate to each other are more closely related than things that are not closely connected [9]. This lack of “autonomy” of things observed in space can lead to serious technical problems, especially when data are used in methods of traditional statistics [10]. However, the understanding of a variable’s spatial identity provides more complete and qualitatively better methodological approaches. The methodology used in this article includes a method of calculating spatial disparities regarding employment while elucidating zones that attract specific fields of economic activity through an Exploratory Data Analysis.

3.1 **Location Quotient**

Accounting for the different types of spatial unequal distributions and differentiation becomes possible by the use of measurements, which provide us with information about the spatial model of distribution. One of the most commonly used measurements is Location
Coefficient [11]. The location quotient is used for the quantification and estimation of the importance of a parameter in a spatial unit compared to the significance of the same parameter in a broader region, commonly known as point of reference [12]. The location quotient determines the degree in which sub-regions diverge from the median of the broader area that they comprise (e.g. the national median) and points their specific location [13], while it also indicates the power of the activity of the parameters under examination. The location quotient can be understood in the following function:

$$LQ_x = \frac{O_{x,i}}{O_{x,GR}} / \frac{O_i}{O_{GR}}$$

where \(x = \{1,2,3,4,5,6,7,8\}\), \(O_{x,i}\): the total number of employed individuals in \(x\) field of prefectures \(i\), \(O_i\): the total number of employed individuals in the prefecture \(i\), \(O_{x,GR}\): the total number of employed individuals in field \(x\) in Greece, \(O_{GR}\): the total number of employed individuals in every economic field in Greece. Numbers more than a unit reflect high concentrations and numbers below one reflect low concentrations. In the case that \(LQ=1\), the concentrations of a sub-regions are the same with the ones of the broader area [14].

3.2. Spatial Autocorrelation

Spatial Autocorrelation is a method of the Exploratory Spatial Data Analysis (ESDA). Central to this method is the spatial factor that expresses the specific role of parameters. This method statistically controls the concentrations of similar values in space [15]. If similar values of factors are spatially concentrated, spatial autocorrelation can be observed in data analyses. The correlation between values is a result of their spatial proximity [16]. One advantage of this method is the demonstration of centers in neighbouring areas with high or low values of parameters, which are not evident in thematic maps [17]. Spatial data analysis and spatial interdependence are indicated in a table (W) that is comprised from weight functions and depicts the structure of the area of study. Every polygon is connected to a total number of neighbours through a corresponding number of outside elements of the table—elements that can also be read as weight ratios based on geographical distance. The delineation of the number of each polygon’s nearing neighbours is conducted either by calculating the distance between the centroids of each polygon, or by delineating the adjacency. The adjacency can be a) immediate: referring only to the boundaries of polygons (Rook), as well as the common angles of polygons (Queen), b) second degree contiguity: refers to neighbours and the classification of contiguity.

The literature [18] [19] indicates a number of measures regarding spatial autocorrelation that are generally divided into Global (Moran I, Getis and Ord) and Local (Moran’s I, Getis’ and Ord’s G). In order to examine spatial autocorrelation, Moran’s I coefficient [20] will be used. The statistical function of Moran’s general index pertains to analyzed areas in their totality. This coefficient also indicates the linear covariance between the values of variable \(x\) and variable \(W\), that derive from the average weighted numbers of each polygon. Moran’s I coefficient aims to check the spatial autocorrelation, that is, it elucidates whether spatial distribution, shows concentration and did not simply occurred inadvertently in the geographical area. Below we can find the function to calculate Moran’s I coefficient:

$$I = \frac{N}{\sum_i \sum_j W_{ij}} \frac{\sum_i \sum_j W_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_i (x_i - \bar{x})^2}$$
where \( n \) is the number of polygons, \( x_i \) and \( x_j \) the values of the same variable for these two geographical areas \( i \) and \( j \), and finally \( wij \) the spatially weighted averages/medians. If these geographical areas are neighbouring, then \( wij=1 \) and the product of variations is stable; however, if \( wij=0 \), the product is 0.

The coefficient’s value fluctuates in -1 to 1 scale. The positive values represent the positive spatial autocorrelation, which reflects that similar values of the same variable show concentration in the area of study. Locating the positive spatial autocorrelation helps in understanding the broader area, and the fact that areas function with the same intensity. The negative values of the scale represent the negative spatial autocorrelation that shows that high numbers of the variable are neighbouring the lower ones. Pinpointing the negative autocorrelation presents us with regions that disrupt the continuity of a specific phenomenon, based on the values of the intensity, and therefore these regions are either insignificant or overly powerful as compared to the broader area [21]. When the coefficient is 0, no phenomenon of autocorrelation is observed [22].

The Global Moran I index results from the values of local autocorrelation indexes [23]. The use of the local autocorrelation index benefits the finding of spatial entities that carry different values in their peripheries. In this process, a limited amount of statistically significant entities is observed. The need to calculate spatial autocorrelations in smaller areas led to this “local” adaption of Moran’s I Index, which is illustrated below:

\[
I_i = \frac{(x_i - \bar{x})}{\sigma^2} \sum_j w_{ij} \left( x_j - \bar{x} \right)
\]  (3)

Where \( \bar{x} \) is the average value of the entities in the area of study, \( w_{ij} \) the weight of every neighbour, \( (x_i - \bar{x}) \) the difference of the average value from the neighbouring entities, \( (x_i - \bar{x}) \) as the difference of the average value in terms of the picture of the variable under examination, an finally \( \sigma \) the variation.

The analysis of local spatial correlation is conducted through the use of the Moran Scatterplot and the Local Indicators of Spatial Association, (“LISA”). The Moran Scatterplot depicts the calculated variable’s levels in relation to the variable under examination. The scattering of variable values depicts the existence and the type of the possible local spatial correlation. Each quadrant represents the relation between a geographical entity and its neighbours (Table 1) [24].

<table>
<thead>
<tr>
<th><strong>Table 3.1</strong>: Types of Local Spatial Associations</th>
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<tbody>
<tr>
<td><strong>High-High</strong></td>
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<tr>
<td><strong>Low-High</strong></td>
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<tr>
<td><strong>Low-Low</strong></td>
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<td><strong>High-Low</strong></td>
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4. RESULTS
The anatomy of employment in Greek municipalities under the Kallikratis programme is integral for the understanding not only of the spatial concentration and the specialization of employment, but also helps understand the particularities of the job market. It also indicates the geographical disparities that the Greek municipal regions reflect regarding the division of employed individuals, while it also reflects the impact of the financial crisis on various economic sectors.

**Maps 4.1-4.8:** Thematic maps locating employed individuals based on economic field

Map 4.1: Agriculture, Forestry and Fishing

Map 4.2: Manufacturing

Map 4.3: Wholesale and Retail trade

Map 4.4: Accommodation and food service activities
Spatial disparities in terms of employment within the Kallikratian municipalities are evident in thematic maps, see Maps 4.1-4.8. A clear turn to agriculture is evident despite the dire difficulties that this field have suffered. The majority of the Kallikratian municipalities are highly attracted towards the primary sector, with an exception of the centers of these regional entities that have a more acute urban identity (cities such as Thessaloniki, Athens, Larisa, Volos, Alexandroupolis, Kavala, Chalkida, Chania, Heraklion). The significant drop in the field of infrastructure is represented by the decrease of employed workforce.
Municipalities that reflect a slightly stronger concentration of employment are usually islands, touristic coastal and mountain areas. Mapping employment that is related to trade (wholesale and retail) reflects a sharp decline of this field, especially in mountainous and less conspicuous areas. Employed persons in wholesale and retail represent the 17.5% of all employed individuals in Greece and there is a large concentration of employment around the capital and Thessaloniki’s urban network, while regional urban areas fluctuate around the same numbers close to the national average. In terms of accommodations and housing services, the expected spatial concentration of employed persons in islands, coastal and other touristic areas is depicted. Tourism and its strong prevalence in Greece entails a definitive factor of the progress of the country’s economy. Administrative services, although they only account for a 3% of the employed population, are proportionately scattered. The majority of municipalities has in their workforce employees who are involved in these fields. Employment in public service and defense, especially, shows a high concentration in frontier zones, including the islands near Turkey. Regarding the field of education, thematic maps affirm that the concentration of employees is higher in municipalities that have access to higher education. On a different note, municipalities that are hard to reach or are close to mountain areas and thus with limited demographic dynamic, lack the concentration of educational activities. Finally, health services, in which 6.5% of the employed population works, depicts a spatial concentration in areas that hospital infrastructure is developed in conjunction with housing and hospitality services, social activities for the elderly and young children. The concentration of employed persons in these fields is located in urban centers or municipalities with large populations. The representation of the location quotient in thematic maps affirms the existence of spatial disparities as well as the intense impact of the financial crisis on the economy in Greece. The conclusions made are supported by the statistical control that Moran’s I provides through the testing of many simulations (Monte Carlo Simulation) [23].

**Figure 1. Global Moran’s I in LQ Employment**
Figure 1 indicates that for the eight fields under examination there is Global positive spatial autocorrelation, since in each case significant positive values are statistically observed. Results indicate that the spatial models are clustered and the possibility for this to be a random event is less than 1%, and thus negligible. The positive spatial autocorrelation signifies spatial models in which geographical traits are usually classified in clusters. Consequently, centers with high and low concentrations of employment in these municipalities are expected to become evident. The maps below demonstrate the spatial patterns that derived from the classification of local Moran’s I coefficients.

**Maps 4.9- 4.16: LISA Significance Maps on LQ Employment, based on economic fields**
The spatial patterns reaffirm the disparities that the location quotient indicated for the eight economic fields studied. However, the spatial patterns map depicts more accurately these patterns compared with the thematic maps 4.1 - 4.8.

Centers with high clusters of employment in the primary sector are observed throughout Greece, starting from Thrace (Didimoticho-Orestiada) and Thessalia (Kilee-Sofades) to Peloponisos (Mani-Pilos). Employed persons in construction tend to cluster in the islands and in traditional mountainous areas of Pindos, while centers with low cluster levels are observed in East Thrace. Wholesale and retail also reflect spatial clusters in Attica and Thessaloniki, while employed populations in accommodation and housing services comprise high clusters in the Aegean islands and in the municipalities of Argosaronikos while low clusters are observed in Xanthi and Komotini, not to mention in northeastern municipalities in Attica.
Employed populations in administration and services are grouped spatially due to their low cluster values, particularly in central (Volos, Larisa, Elassona, Farkadona) and western Greece (Preveza, Grevena, Amfiochlia). In central and western Attica, however, high clusters of employed populations are observed. Defense services are concentrated mainly in Evros. By consequence, the spatial pattern of employed populations in Defense tends to cover the municipalities of Evros (Soufi, Didimoticho, Alexnadroupolis, Orestiada), while low spatial zones are formed in the Cyclades and in South Peloponisos (Monemvasia, Mani). Populations employed in education tend to cluster in central Attica and Thessaloniki, while zones with low clusters of employed persons is observed in islands, such as Santorini, Milos, Sifnos, Limnos, and in Easter Chalkidiki (Aristotelis Municipality). In the Aegean islands, further groups of municipalities with low clusters in the health services are observed. The zones with high clusters of employed populations in hospital and health services are typically in Attica and Thessaloniki.

4. CONCLUSIONS

The spatial disparities come along with the additional problem of the disproportionate territories between broader areas. Through the demonstration of employment clusters—specifically based on economic activities—the issue of spatial disparity becomes evident, a problem which takes large dimensions because of the economic depression. Research findings provide extremely useful information for the traits of the economic patterns, in which Greece takes shape during the economic depression. Traditional examinations of employment phenomena through the maps of spatial patterns provided realistically a concrete picture of the spatial disparities regarding employment in Greece. Through the location quotient and spatial autocorrelation, the spatial disparities regarding employment in municipalities under the Kallikratis reform were approached, while the formation of cluster zones based on economic activities was elucidated in this study.

The most dynamic fields during the crisis were fields that substantially contribute to the strengthening of employment with respect to tourism and primary sector examples. Further, although infrastructure dropped significantly, construction still has a significant contribution in the progress of employment, reflecting spatial patterns mainly in islands and traditional mountain regions. On the other hand, however, Thrace, and particularly municipalities in Evros, continue to form zones with extremely low clusters in the field of construction. Spatial disparities are more intense in island and mountain regions, especially when it comes to the field of health and provision. Areas with intense urban identities, on the other hand, are more advanced in fields such as health, education, public administration, as well as wholesale and retail.

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