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The spatial distribution of economic base multipliers: A GIS and spatial statistics-based cluster analysis

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Abstract:
Empirical studies on the economic base multiplier concept have been highly limited in their spatial scope. The aim of this research is to provide new insights into the study of base multipliers by examining their spatial distribution over space. Base multipliers pertaining to the 923 districts in Turkey, varying between 1,268 and 807,934 in population, are estimated for the year 2000 using aggregate level data. The minimum requirements method is applied following the altering samples approach. The base multiplier estimates are normally distributed and vary between 1.229 and 4.883, with a mean of 2.269. In order to assess whether the districts with similar base multipliers form clusters, two widely used tools of spatial autocorrelation is applied: (1) Moran's I index and (2) Getis and Ord analysis. The results show that the base multipliers form clusters of high and low values. They are neither randomly nor uniformly distributed over space, and the results are statistically significant at the 0.05 level. The results confirm that high base multipliers cluster in and around higher order central places

Keywords: *Economic base theory, economic base multiplier, minimum requirements, spatial autocorrelation.*

Introduction

The economic base theory is one of the oldest and most durable theories of regional growth with roots dating back to the 1900's (Krikelas, 1992). The economic base concept has appeared as a potential theory in the early 1920's to explain regional growth. By 1950, the quantitative techniques derived from the economic base theory have become the primary tools for regional planning (Krikelas, 1992), and have remained as a standard tool in regional research, because of its simple logic and easily obtainable data requirements (Gibson and Worden, 1981).

The economic base theory has two central assertions. The first assertion is that the total regional or urban economic activity can be partitioned into two distinct components, basic and non-basic (Lee, 1973; Ayeni, 1979; Oppenheim, 1980; Foot, 1981; Klosterman, 1990; Kaiser et. al., 1995; Krikelas, 1992). A portion of the economic activity in a city is generated and supported by non-local demand. However, the local population supported by this non-local demand also needs goods and services (Alexander, 1954). This dual structure of the economic activities is first observed by Werner Sombart, a German sociologist (Krumme, 1968; Krikelas, 1992). According to Sombart (1916), there are two positions or occupations in the city, primary and secondary. In another early work, Aurousseau (1921) states that the primary occupations are the ones that are concerned directly with the functions of the city; whereas, the secondary occupations supply the local needs of people engaged in these primary occupations. The conventional terms in the literature for these two type of economic activities are basic (or export), b, and non-basic (or local), n, and the total employment in a city or region, e, is:

$$e = b + n \ . \qquad (1)$$

The basic sectors are export-oriented and dependent on factors external to the local economy. Whereas, the non-basic economic sectors include goods and services consumed by locally within the region. These sectors are highly dependent on the local economic conditions (Lee, 1973; Foot, 1981; Klosterman, 1990; Wang and vom Hofe, 2007).

The second assertion of the economic base theory is that the economic growth is generated by the basic sectors. Krikelas (1992) points out that this assertion is based on the early work of Weimer and Hoyt (1939), *Principles of Urban Real Estate*. Weimer and Hoyt (1939) distinguish between urban growth and service industries and claim that a region's growth potential is dependent on its growth industries. Tiebout (1956) states that the export activities are necessary and sufficient for economic growth. However, without the ability to develop local activities parallel to the developments in the basic sectors, the economic growth would be limited by the increasing costs (Tiebout, 1956). Weiss and Gooding (1968) are the first to introduce a multisectoral base model arguing that there can be more than one basic industry in a region.

The economic base multiplier is the quantitative measure of this second assertion and denotes the number of total employment generated by one basic employment. According to Lane (1966), the concept of base multiplier is first developed by Kahn (1931) as an analytical tool in economics, as the ratio of total employment to basic employment. The base multiplier, by definition, includes the basic employment that generates the total employment. For example, in a settlement with base multiplier of 2.36, suggests that an additional basic employment will generate 1.36 non-basic, or local, employment adding up to a total employment of 2.36. The economic base multiplier, β, is simply:

$$\beta = \frac{e}{b} \ . \qquad (2)$$

The base multiplier, by definition, includes the basic employment that generates the total employment. For example, a settlement with a base multiplier of 2.36 suggests that an additional basic employment will generate 1.36 non-basic, or local, employment adding up to a total employment of 2.36. An alternative measure to the base multiplier is the basic and non-basic ratio (*b/n*), indicating the ratio of basic employment to non-basic employment (Alexander, 1954), and by definition:

$$b / n = \beta - 1. \qquad (3)$$

Krugman (1991) points out that *space* occupies a very small part in standard economic analysis, and suggests incorporation of traditional models and techniques derived from theoretical industrial organization with economic geography. Applied research on the economic base multiplier concept is no exemption. The empirical studies have been highly limited in their spatial scope. Richardson and Gordon (1978) point out that regional multipliers have lost their popularity because of their lack of spatial dimension.

In his extensive review of literature on base multipliers, Richardson (1985) states that multipliers are regarded to be occurring in a spaceless economy; however, multipliers are not uniformly distributed over the space. Alexander (1954) outlines the probable areas of further research on the concept of basic and non-basic employment. He concludes that whether the base multipliers vary with the location of settlement is one of the remaining questions to further the understanding of cities. The spatial distribution of base multipliers has since been largely neglected in recent studies as well.

The goal of this research is to provide new insights into the study of base multipliers by examining their spatial distribution over space. More specifically, do the settlements with similar base multipliers form clusters or are they uniformly distributed over space? The remainder of the paper is organized as follows. Section 2 consists of a literature review. Section 3 presents methodology. Data sources and processing are described in Section 4. The results are presented in Section 5, and Section 6 concludes the paper.

Literature review

A review of literature on the empirical study of economic base multipliers reveal that the estimates vary in size and range, depending on the method and the level of aggregation of the data used. The first reported empirical study pertaining to the economic theory is Sombart's analysis of Berlin published in 1927. Using 1907 data and relying on personal judgment, Sompart estimates basic and non-basic employment in Berlin and the reported economic base multiplier as 2.07 (Krumme, 1968; Krikelas, 1992). Hartshorne's (1936) work is another early attempt to quantify the basic and non-basic components in urban economies. He argues that 10% of the total population employed in manufacturing in the U.S. cities, is non-basic, which is equal to a base multiplier of 1.11. Another notable early empirical analysis is held and published by Fortune Magazine in 1938. Using data on the circulation of money into, through, and out of Oskaloosa, Iowa, U.S., the estimated multiplier is 2.54 (Alexander, 1954). Similarly, Moore (1975) reports trade multipliers using the amount local income resulting from one unit of income generated by regional exports, instead of employment data.

Gibson and Worden (1981) review estimation methods and estimate the base multipliers for 20 Arizona, U.S., communities ranging in population from 1,838 to 15,000 between1976 and1978. They report that the economic base multiplier estimates vary between 1.13 and 1.68 using the benchmark complete survey method; 1.46 and 11.59 for the location quotient method; and 1.20 to 1.69 for the minimum requirements method. Bloomquist (1988) estimates base multiplier for 315 metropolitan statistical areas in the U.S.

The estimates using location quotient method and 1982 data vary between 1.30 and 4.48; and between 1.80 and 4.42 using Moore's (1975) minimum requirements regression method and 1980 data. Mulligan and Gibson (1984) use 1975 and 1982 data for 21 southwestern U.S. communities, and estimate base multipliers using regression-based methods. The estimates vary between 1.00 and 2.2, as a function of population.

The base multiplier estimations in the literature vary not only by method, but also by the level of aggregation of the data used. Using location quotient with modifications, Isserman (1977) show that the base multiplier estimates increase with increasing level of aggregation. He argues that less exports and less basic employment can be identified with more aggregate data. For example, the reported estimate for Georgia, U.S., is 19.01 using division level data, and 4.84 using four-digit SIC code level data (Isserman, 1977).

Despite the studies varying in method and level of aggregation of the data used, the spatial dimension of the base multiplier has long been neglected in empirical studies on economic base multipliers. A limited number of studies including Parr et. al. (1975), Horn and Prescott (1978), Mulligan (1979), Suares-Villa (1980), and Thompson (1982) propose models integrating elements of economic base theory and central place theory. The empirical results support that the aggregate economic base multipliers are higher for higher order central places (Parr et. al., 1975; Prescott, 1978; Mulligan, 1979; Suares-Villa, 1980). However, using disaggregated data, Thompson (1982) reports no significant difference between multipliers of various order centers.

Methodology

There are at least six widely used methods to measure economic base: (1) assignment or assumption, (2) survey based methods, (3) location quotient method, (4) minimum requirements method, (5) regression using time-series data, and (6) regression using export share data (Richardson, 1985). Gibson and Worden (1981) suggest that the complete census survey method based on survey-derived employment and revenue data is the most satisfying method to estimate base multipliers. However, it is time-consuming and expensive (Gibson and Worden, 1981). Location quotient method and minimum requirements method are the two extensively applied techniques in the absence of survey data or trade flow data (Richardson 1985). Due to data limitations, these two indirect estimation techniques are considered in this study.

Developed by Weimer and Hoyt (1939), the location quotient method compares of the concentration of economic activity at the city level to the one at the country level to distinguish basic and non-basic activities. Initiated by Ullman and Dacey (1960), the minimum requirements technique estimates the exports as the amount of regions economic activity that exceeds the minimum amount required to supply local needs. The minimum amount required to supply local needs is defined as the smallest proportion of the total activity in other settlements of similar size (Greytak, 1969).

A number of studies have compared these two most widely used techniques. Greytak (1969) evaluates the magnitude of estimation error associated with these two techniques. Using 1963 data for 7 regions in the U.S., Greytak (1969) reports lower root mean square errors for the estimates of the minimum requirements technique compared to those of the location quotient technique. Gibson and Worden (1981) argue that the location quotient technique fails to generate viable estimates for base multipliers. Using data for 20 Arizona, U.S. communities pertaining to 1976-1978, they report much higher multiplier estimates than multipliers produced by other methods. Isserman (1980) and Krikelas (1992) argue that the location technique tend to underestimate the level of basic employment causing an upward bias in base multiplier estimates. Mulligan (2008) reports that the base multipliers estimate for the 200 non-metropolitan southwestern U.S. communities, using data for 1980-2000 and minimum requirements technique, are more accurate, compared to the location quotient estimates. Gibson and Worden (1981) conclude that the minimum requirements technique is far more satisfactory in estimating base multipliers compared to the location quotient. They argue that the poor location quotient results stem from the use of highly aggregated census data (Gibson and Worden, 1981). The available employment data used in this study is highly aggregated and the minimum requirements technique is thus selected to derive economic base multipliers. As stated by Moore (1975), this method is inexpensive, fast and reasonably accurate.

In the minimum requirements method, the amount of employment greater than the minimum percentage of employment required in different sectors to maintain the viability of a settlement is defined as the excess employment. This excess employment in each sector approximates the basic employment (Ullman and Dacey, 1960). There have been different approaches in empirical estimation of the Ullman and Dacey's original model (Klosterman, 1990). In the original model by Ullman and Dacey (1960) and followed by Moore (1975), cities are first grouped with respect to their population. The minimum shares of employment are then calculated within these constant groups, where the benchmark cities for each sector are identified for each sector in each group. However, this approach results in a very limited variation in the magnitudes of base multipliers (Mulligan, 2008). A second approach utilizes the minimum shares equation introduced by Ullman and Dacey (1960) and Moore (1975) and further developed by Moore and Jacobsen (1984).

A third approach to the minimum requirements method, which is chosen in this study, follows Ullman and Dacey (1960). However, this approach uses an altering sample of cities for each city under consideration, instead of a constant group. The minimum shares for each sector are identified within these samples separately for each city (Klosterman, 1990). The altering samples of cities are generated for each settlement using cities that are similar in size and structure to the city in question. This approach is well consistent with Ullman and Dacey's (1960) main idea that suggests the comparison of cities with similar size and structure to derive excess employment. Although computationally more intensive, this approach allows a more direct comparison between the settlement under question and the reference settlements as the benchmark economies are dynamic and unique for each settlement. It thus produces a plausible degree of variation in the base multipliers, which is required for spatial analysis.

The minimum share of employment in sector *i*, s_i, considering settlements 1, 2, …,*n*, in a sample of *n* number of similar-sized settlements can be written as:

$$s_i = \min\left\{\frac{e_{1,i}}{e}, \frac{e_{2,i}}{e}, \cdots, \frac{e_{n,i}}{e}\right\}, \qquad (4)$$

where, the number of basic employment in sector *i* is by definition (Ullman and Dacey, 1960):

$$b_i = \left[\frac{e_i}{e} - s_i \right] * e. \qquad (5)$$

The number of total basic employment, *b*, in a urban area with *k* number of sectors is then:

$$b = \sum_{i=1}^{k} b_i. \qquad (6)$$

The base multipliers are then derived using Equation 2. In order to examine the spatial distribution of these multipliers over space, and assess whether the settlements with similar base multipliers form clusters or they are uniformly or randomly distributed over space, two widely used tools of spatial autocorrelation is applied: (1) Moran's I index and (2) Getis and Ord analysis.

Spatial autocorrelation is concerned with the degree to which points are similar to neighboring points in terms of a given attribute. Developed by Moran (1948, 1950), Moran's I index, has been one of the most popular indices for measuring spatial autocorrelation. It integrates the two measures for attribute similarity and locational proximity into a single index (Lee and Wong, 2005):

$$I = \frac{\sum_{i=1}^{n}\sum_{j=1}^{n} c_{ij} w_{ij}}{s^2 \sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}}, \qquad (7)$$

where, c_{ij} is a measure of attribute similarity between points *i* and *j*; w_{ij} is a measure of proximity between points *i* and *j*; s^2 is the sample variance; and *n* is the number of points in the sample with:

$$c_{ij} = (x_i - \bar{x})(x_j - \bar{x}), \qquad (8)$$

$$w_{ij} = \frac{1}{d_{ij}{}^{\alpha}} \qquad (w_{ii} = 0), \qquad (9)$$

and

$$s^2 = \frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n}, \qquad (10)$$

where, x_i is the value of attribute for point *i*; $\bar{x}$ is the attribute sample mean; d_{ij} is the distance between points *i* and *j*; and α is the distance-decay parameter. For statistical inference, Moran's I index is compared to an expected value, *E(I)*:

$$E(I) = (-1)/(n-1), \qquad (11)$$

where, $I > E(I)$ indicates a clustered pattern with high attribute similarity; $I < E(I)$ indicates a uniform or dispersed pattern with low attribute similarity; and $I \approx E(I)$ indicates a random pattern (Lee ve Wong, 2005). For hypothesis testing, the z-test is applied under the null hypothesis of no spatial autocorrelation or no clustering of similar values. A positive z-statistics over the critical value indicates cluster formation with similar attribute values, and negative z-statistics over the critical value indicates a uniform or dispersed pattern (Fingleton, 2007). However, Moran's I index does not detect the presence of multiple clusters or give any information on the location of these clusters.

Getis-Ord local statistics, introduced in Getis and Ord (1992) and further developed in Ord and Getis (1995), are used to test the presence of clusters with high or low values of base multipliers. The standardized statistic for point i, $G_i^*(d)$, is:

$$G_i^*(d) = \frac{\sum_{j=1}^{n} w_{ij}(d)x_j - W_i^* \bar{x}}{s\sqrt{(nS_{1i}^*) - W_i^{*2})/(n-1)}}, \quad \text{all } j, \qquad (12)$$

where,

$$W_i^* = \sum_{j=1}^{n} w_{ij}(d), \qquad (13)$$

and

$$S_{1i}^* = \sum_{j=1}^{n} w_{ij}^2, \qquad (14)$$

where, $w_{ij}(d)$ is a symmetric zero/one spatial weight matrix with ones for points that are within a threshold distance of d (including w_{ii} = 1), and zeros otherwise; x_j is the value of attribute for point j; $\bar{x}$ is the attribute sample mean; and s^2 is the attribute sample variance (Ord and Getis, 1995). Statistical inference is straightforward as the $G_i^*(d)$ statistics is a z-statistic.

Data sources and processing

The data used in the study pertain to 923 districts in Turkey by the year 2000. The employment data is drawn from the 2000 Census of Population, conducted and published by the Turkish Statistical Institute, Turkstat. The 2000 Population Census was carried out in one day by application of a curfew, and the questionnaires are completed through face-to-face interviews (TURKSTAT, 2003). The employment data at the district is available for 10 major sectors. Table 1 presents these sectors and the descriptive statistics for them and urban population for the 923 districts in the sample.

Table 1. Descriptive statistics for employment and urban population (n = 923)

	Min.	Max.	Mean	Std. Dev
Sector				
Agriculture, hunting, forestry, and fishing	6	6,335	507	641
Mining and quarrying	0	4,949	55	243
Manufacturing industry	2	99,512	2,930	9,296
Electricity, gas, and water	0	2,729	84	219
Construction	2	16,823	932	2,115
Wholesale and retail trade, restaurants, and hotels	7	54,359	2,291	6,070
Transport, communication, and storage	4	16,600	738	1,978
Finance, insurance, real estate, and business services	0	42,753	781	2,961
Community, social, and personal services	93	139,814	3,000	9,576
Other	0	1,843	28	89
Total Employment	188	279,573	12,347	30,168
Urban Population	1,268	807,934	48,417	106,22

The districts in the sample vary between 1,268 and 807,934 in population, with a mean of 48,417. The total employment varies between 188 and 279,573 with a mean of 12,347 (Table 1).

The available data at the district level, which is appropriate for spatial analysis offering a larger spatial sample compared to the city level data, is highly aggregated. Thus, following Gibson and Worden (1981), the base multipliers are computed using the minimum requirements approach. As mentioned in the methodology section, there are various approaches in applying this technique. The approach chosen here is based on the altering samples of cities, instead of constant groups. Although this approach is computationally more intensive, it produces a plausible degree of variation in the base multipliers.

As described in Klosterman (1990), the minimum shares for each sector are identified within the samples of a constant size in this approach. Here, the altering samples of districts of size 5 are consecutively formed for each district in question (n=5 in Equation 4). The sample sizes of 7, 9, and 11 are also considered. However, the obtained degree of variation in the base multiplier estimates is not satisfactory. As a result, each sample includes the district in question, with four additional districts that have the closest number of employment. Two of these four districts have higher number of employment and the other two lower. This is achieved by sorting the data with respect to the employment size and calculating the minimum shares, basic employment and base multipliers consecutively for each district in the sample using Equations 4-6 and 2, respectively.

Results

Table 2 presents the descriptive statistics for the estimated base multipliers derived for the 923 districts in the sample. The base multiplier estimates vary between 1.229 and 4.883, with a mean of 2.269.

Table 2: *Descriptive statistics for the base multiplier estimates (n = 923)*

	Min.	Maks.	Mean	Std. Dev.	Skewness	Kurtosis
Base multiplier	1.229	4.883	2.269	0.608	1.212	2.019

The histogram for the base multiplier estimates is presented in Figure 1. The distribution has a slightly longer right tail compared to normal distribution, with a skewness of 1.212 and a kurtosis of 2.019. However, the distortions are not significant (Figure 2), and it is concluded that the base multipliers are normally distributed. Figure 1 shows the histogram for the base multipliers. The spatial distribution of base multiplier estimates are presented in Figure 2.

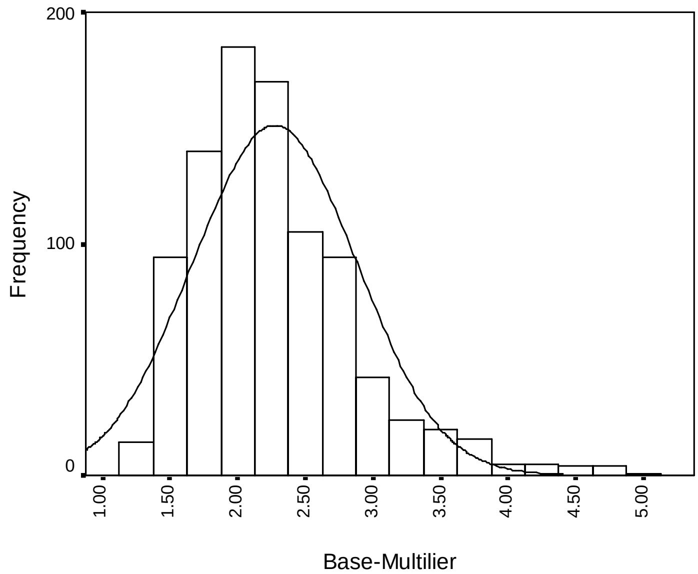

Figure 1. *Histogram for the base multiplier estimates with normal curve* (n=923)

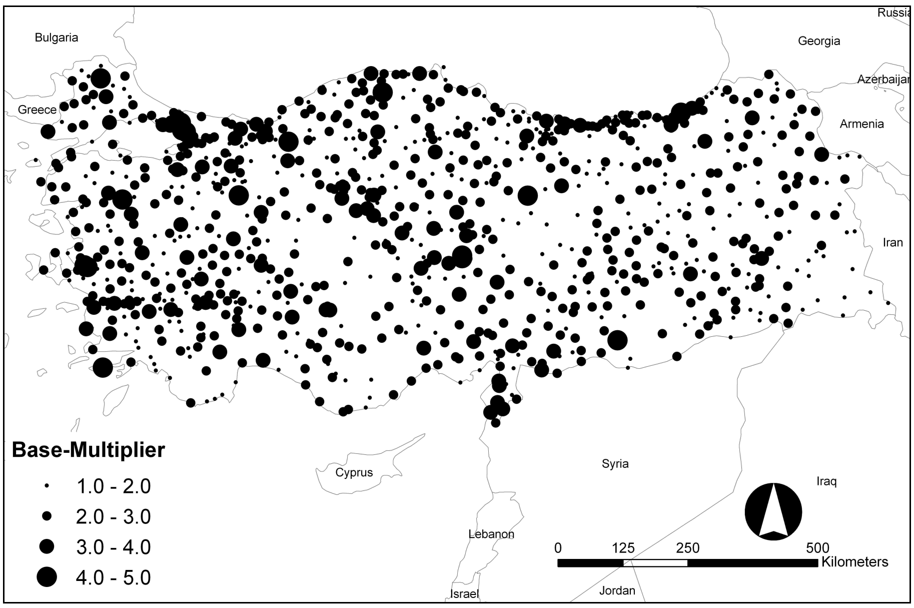

Figure 2. *Spatial distribution of base multiplier estimates (n=923)*

Following Lee and Wong (2005), the distance decay parameter in Equation 9 is set to 1 and Moran's I index is calculated as 0.1679 for the sample, using Equations 7-10. The expected value of the index is -0.0011 (Equation 11), and $I > E(I)$ indicates a clustered pattern of districts with similar base multiplier estimates. The null-hypothesis suggesting that the base multipliers are randomly distributed over space is rejected. This result is statistically significant at the 0.01 level with a z-statistic of 9.513.

In order to detect the locations of clusters with high and low values of base multipliers, the standardized Getis-Ord (1992; 1995) local statistics, $G_i^*(d)$, are derived for each district setting the threshold distance to 100 kilometers, and using equations 12-14, respectively . Table 3 presents the descriptive statistics for the Getis-Ord local statistics for all districts in the sample. The statistics vary between -3.187 and 4.731, with a mean of 0.120. The positive values indicate clusters with high base multipliers and negative values clusters with low base multipliers. The values above 1.95 and below -1.95 are statistically significant at the 0.05 level. In order to visualize the distribution of clusters with high and low values of base multipliers, the point distribution is converted into a triangulated irregular network (TIN) using Getis-Ord local statistics as z-coordinates and spatial interpolation. The resulting map is presented in Figure 3.

Table 3: *Descriptive statistics for Getis-Ord local statistics, $G_i^*(d)$ (n = 923)*

	Min.	Maks.	Mean	Std. Dev.
Getis-Ord local statistics	-3.187	4.731	0.120	1.464

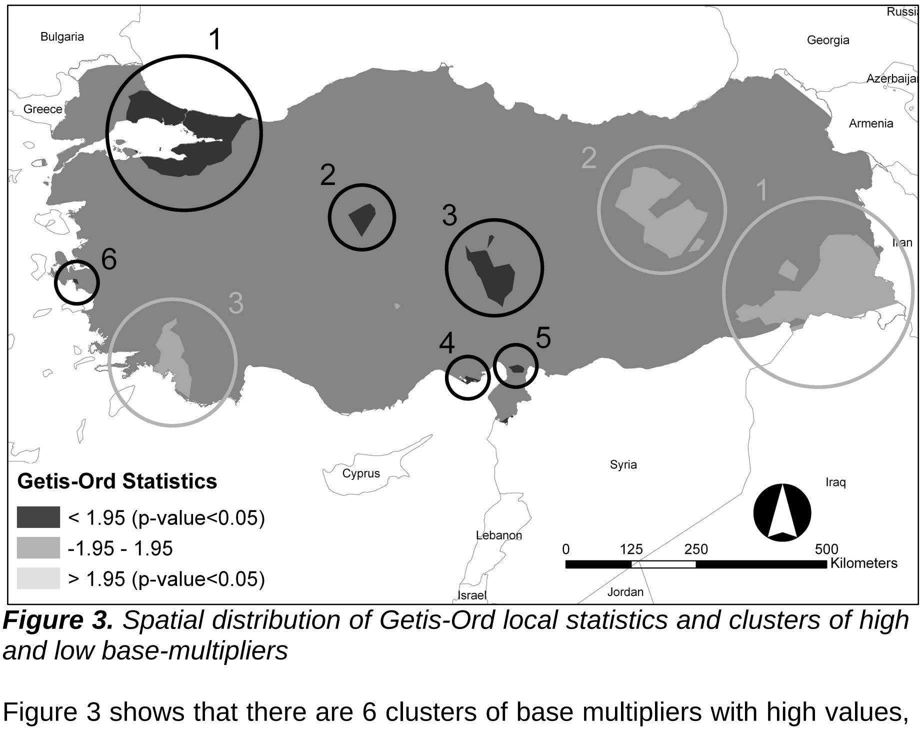

Figure 3. *Spatial distribution of Getis-Ord local statistics and clusters of high and low base-multipliers*

Figure 3 shows that there are 6 clusters of base multipliers with high values, and 3 clusters with low values. A major finding of the study is that the clusters with high base multiplier values emerge in and around higher order central places including Istanbul, Ankara, Izmir, Adana and Bursa, which are the five largest cities in Turkey. The first and the largest cluster of high base multipliers include Istanbul, Bursa, Kocaeli and Sakarya, which are the predominant industrial and finance centers of Turkey. The second cluster is formed around Ankara, the capital and the second largest city of Turkey. The third, forth, and fifth clusters of high base multiplier values are located in Kayseri, Adana and Hatay regions, which have been the economically fastest growing regions in the last two or three decades. The last cluster is Izmir, a major export port and also a major industrial city, which is also the third largest city in Turkey (Figure 3).

Two largest clusters of districts with low base multipliers are located in the East Anatolia and South-east Anatolia, which are known to be the least developed parts of Turkey, economically and educationally. These regions are characterized with high levels of unemployment, to which low base multipliers contribute to the problem. The third cluster is located on the west coast, around Mugla (Figure 3). A plausible explanation to this finding is that this region is characterized with small touristic towns. In these districts, tourism is the only basic sector, which is not capable of generating high levels of local employment.

Conclusions

Although the economic base theory is one of the oldest and widely applied theories of regional studies, the spatial distribution of base multipliers have largely neglected. This study aims to provide new insights into the study of base multipliers by examining their spatial distribution over space using two standard tools of spatial statistics. Base multipliers pertaining to the 923 districts in Turkey are estimated for the year 2000 using the minimum requirements method following the altering samples approach.

The results show that the base multipliers neither randomly nor uniformly distributed over space. Rather they form clusters with high and low values (Figure 3). These results regarding the formation of clusters are statistically significant at the 0.05 level. This finding alone confirms Richardson's (1985) statement that multipliers are not occurring in a spaceless economy. The findings also support the hypothesis that base multipliers are higher for higher order central places, consistent with Christaller's Central Place Theory. Using disaggregate level data, Parr et. al. (1975), Prescott (1978), Mulligan (1979), and Suares-Villa (1980) show that base multipliers are higher for higher order central places. This study confirms that high base multipliers cluster in and around higher order central places using aggregate level employment data as well.

Figure 3 shows the six clusters with high and three clusters with low values of economic base multipliers, which are statistically significant at the 0.05 level. This finding confirms the presence of spatial inequality in employment generation through investment. That is to say, adding one basic employment to the existing economic structure generates much less local employment in some urban areas, and higher in some others. It is clear that the strongest cluster of high values of base multipliers is located in and around Istanbul. Clusters in and around Ankara, Kırıkkale, Nevsehir, Kayseri, Adana, Gaziantep, Hatay, Konya, and Izmir forms the remaining five clusters with high base multipliers (Figure 3). On the other hand, low values of base multipliers form clusters in and around Erzincan, Tunceli, Bingol, Elazıg, Diyarbakir, Batman, Bitlis, Siirt, Mardin, Sırnak and Hakkari, which are predominantly located in the Eastern and Southeastern Anatolia. The only exception is the cluster around Mugla. This finding can be explained by the fact that the economy in this region is heavily dependent on a single sector, tourism, which seems to fail in generating high levels of local employment.

This research has one important drawback. The sample of districts in calculating the minimum shares are selected regarding only the employment size of the district in question. A more sophisticated tool taking into account locational similarity is required for selecting the reference districts. Nonetheless, the present study expands the empirical research on base multipliers by applying standard spatial analysis tools, and concludes that the base multipliers neither randomly nor uniformly distributed over space.

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Temel çarpanı değerlerinin mekansal dağılımı:
CBS ve mekansal istatistik temelli kümeleşme analizi

Ekonomik-temel modeli, kentteki ekonomik aktivitenin temel ve yerel olarak ikiye ayrıldığını varsayar. Modelin en temel varsayımı, kentteki yerel işgücünün varlık nedeninin kentteki temel işgücü olmasıdır. Modelde, kentteki toplam işgücü sayısı ile kentteki temel işgücü sayısı arasındaki ilişki kentteki toplam işgücü sayısının toplam temel işgücü sayısına oranı olan “temel çarpanı” kavramı ile kurulmuştur. Literatürde pek çok çalışma kentlerdeki temel çarpanı değerinin hesaplanmasına ve bu değerlerin karşılaştırmasına odaklanmıştır. Ancak temel çarpanının mekansal dağılımına ilişkin bir çalışma literatürde bulunmamaktadır. Bu çalışmada, Türkiye sınırları içerisindeki 923 ilçe merkezine ait temel çarpanı değerleri hesaplanarak, hesaplanan bu değerlerin mesafe ve büyüklüğe bağlı olarak küme ya da kümeler oluşturup oluşturmadığı mekansal istatistik yöntemleri ile incelenmiş; temel

işgücünün yerel işgücü üretme oranları arasında mekansal bir ilişki olup olmadığı test edilmiştir. Çalışmada, Türkiye İstatistik Kurumu'ndan temin edilen 2000 yılına ait 923 ilçe için 10 ana sektörde çalışan işgücü sayıları (ekonomik faaliyete göre istihdam edilen nüfus) kullanılarak "minimum gereksinmeler" tekniği kullanılarak ilçe düzeyinde temel ve yerel işgücü sayıları ayrıştırılmış ve ilçe düzeyinde temel çarpanları hesaplanmıştır. Minimum gereksinmeler tekniğinin kullanımında her ilçe için toplam işgücü büyüklüğü ilçenin kendi ile birlikte artı ve eksi yönden en yakın 2 ilçe dikkate alınmış ve karşılaştırmalar toplam 5 ilçe kullanılarak yapılmıştır. Temel çarpanı değerlerinin, ortalama 2.269 (standart sapma: 0.608) olmak üzere, 1.229 ile 4.883 arasında değiştiği ve normal dağılım gösterdiği tespit edilmiştir. İlçeler için hesaplanan temel çarpanı değerleri ve ilçe koordinatları kullanılarak, benzer değerdeki temel çarpanı değerlerinin mekansal olarak birbirlerine yakın olup olmadığı, başka bir ifade ile kümeleşme eğiliminde olup olmadıkları, iki popüler mekansal istatistik tekniği kullanılarak analiz edilmiştir: (1) Moran's I Endeksi ve Getis-Ord mekansal analiz yöntemi. Moran's I Endeksi, nokta verinin mekansal otokorelasyonlarını hesaplamada kullanılan en yaygın yöntemlerden birisidir. Hesaplamalarda mesafe etki parametresinin 1 olduğu varsayıldığında, Moran's I Endeksi 0.1679 olarak hesaplanmıştır. Bu değer, veri için beklenen değer (-1/(n*1)) olan 0.0011 değerinden oldukça yüksektir. Bu nedenle ilçe düzeyinde temel çarpanı değerlerinin yüksek derecede kümeleşme oluşturduğu sonucuna varılmıştır. Elde edilen sonuçlar 0.01 düzeyinde istatistiksel açıdan anlamlı bulunmuştur (z-istatistiği: 9.51). Bu sonuç, temel işgücünden yerel işgücü üretme konusunda yüksek değere sahip ilçeler ile düşük değere sahip ilçelerin kendi içlerinde kümeler oluşturduğuna ve ülkesel düzeyde bir eşitsizlik olduğuna işaret etmektedir. Çalışmada son olarak Getis-Ord mekansal analiz yöntemi ile temel çarpanı değerleri açısından kümeleşme eğilimlerinin olduğu alanlar tespit edilmiştir. En yüksek temel çarpanı değerlerine sahip kümeleşmenin İstanbul ve çevresinde oluştuğu gözlemlenmektedir. Ankara, Kırıkkale, Nevşehir, Kayseri, Adana, Gaziantep, Hatay, Konya ve İzmir illerine bağlı ilçe merkezleri izlemektedir. Erzincan, Tunceli, Bingöl, Elazığ, Diyarbakır, Batman, Bitlis, Siirt, Mardin, Şırnak ve Hakkari'de ise düşük temel çarpanı değerlerinin kümeleşme eğilimi gösterdiği anlaşılmaktadır. Bu durum bölgedeki işgücünün sektörel açıdan yeterli farklılaşma düzeyine gelmemiş olması ile açıklanabilir. Benzer bir eğilim kısmen Muğla, Antalya ve İçel'de de gözlemlenmektedir. Bu tespitler ışığında, Türkiye genelinde temel işgücü yatırımından yerel işgücü yaratılması konusunda bölgesel bir eşitsizlik olduğu sonucuna ulaşılabilir. Güneydoğu bölgesinde yaratılacak bir kişilik temel işgücü batı ve iç bölgelere oranla daha az sayıda yerel işgücü yaratabilmektedir. Bu durum ülkenin güneydoğusundaki işsizlik çözümünün daha zor aşılabileceği anlamını taşımaktadır. Elde edilen sonuçlar aynı zamanda Christaller'in Merkezi Yer Teorisi ile de örtüşmektedir. Temel çarpanı değerleri mekansal kademelenmede üst sıralarda olan yüksek nüfuslu ilçelerde ve çevrelerinde kümeleşme eğilimindedir.