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REGIONAL MULTIPLIERS, INEQUALITIES AND PLANNING IN GREECE

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Abstract
In this paper we employ input – output analysis in order to estimate the size of regional multipliers for the Greek prefectures (NUTS III). Then we attempt to analyse and evaluate the observed differences amongst the multipliers and to uncover likely correlations between the multipliers on the one hand, and selective economic indicators on the other hand. The analysis suggests that the most important indicators are "prosperity level", "level of development", "population potential" and "geographic distances". Drawing from the analysis on regional multipliers we construct a mathematical model that includes variables describing the distribution of the public and private investment targeted at achieving economic convergence. The study concludes by offering some general comments on the results of the preceding analysis.

JEL Classification: R10, R15, Q10, Q18
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1. Introduction

In spite of the considerable improvement in the overall performance of the world economy in the decades following the Second World War, the issue of regional inequalities still constitutes a major theoretical and practical consideration not only for the academic community but also for governments, policymakers and experts in the field of economics. A large number of regions seem to have failed to keep up within the international circuit of economic competition. Although the average level of economic development has increased, the so-called "regional problem" remains in place, calling for serious intervention if some real progress is to be made.

In the first three post-war decades, regional inequalities in Greece were intensified. Empirical investigations are relatively few and therefore, there are still significant gaps and great uncertainties concerning the characteristics of the phenomenon and its relation to the geographical features of the particular regions. There is also an incomplete picture regarding the underlying causes of the key changes in the regional economic productive structure, the unfolding of these changes over time as well as the pragmatic effect of the spatial policies implemented (Petrakos and Saratsis 2000).

Public investment has always been one of the most important instruments for pursuing macroeconomic policy objectives. This kind of investment mainly includes spending relevant to the functioning of public services and utility sector, spending on the creation of new or the improvement of existing infrastructure as well as subsidies to certain types of private investment. Therefore, public and private investment can be an important source of income generation for regional economies - not least by creating new employment. These investments also have a positive effect on the level of infrastructure in the non-urban areas and create favorable conditions for economic development (Polyzos 2005). Consequently, investment increases not only local demand and income levels, but also the levels of local supply due to improvements in productivity.

Present and past evidence suggests that, so far, the effectiveness of most of the applied developmental strategies and regional policies of public and private investments has not met the initial expectations. The actual increase in regional income has remained low and the overall positive contribution of investment to the improvement of regional economy has been limited. Even in cases where investments tend to have a positive effect on the local economy of the less developed regions, it is by no means certain that the final increase in the regional product is of some benefit to everybody or to the majority of the people. This is because it is extremely difficult to known *a priori* the scale of economic effects on each region brought about by some kind of investment. A potential useful way of estimating the likely increase in the level of production in each region and consequently, the actual effectiveness of an investment program, is the application of regional multipliers. In particular, the

estimation of regional multipliers regarding both short-term and long-term effects allows prediction of the changes that will possibly take place in the individual regional economies. Therefore, through the application of regional multipliers it may be possible to achieve a more informed distribution of public investments, that pursues more effectively the regional planning objectives.

In closed economies, the estimation of regional multipliers is attainable through the Keynesian model. According to this model, changes in the regional income brought about by increases in state spending are connected to the multiplier of state spending, or to the marginal tendency of the economy for consumption (Olfert and Stabler 1994). However, in the case of an open multiregional economy, it is essential to construct a multiregional econometric model that embodies the marginal tendency for consumption in each region (or the total investments in each region) and the marginal tendency for imports or exports per region. Therefore, the required data for such a study include income levels, consumption, investments, and the patterns of exchange amongst the different regions of the country.

This study argues that a fruitful, alternative way of estimating regional multipliers is by using an input – output modelling approach. This modelling approach is particularly appropriate for supplying information about the relationships amongst the different economic sectors. Hence, in input-output modelling approach, any changes in demand of a productive sector also change the level of production of this particular sector and the level of production of the other sectors as well. This is because there are in place relationships of interdependence (RIMS II 1981, Miller and Blair 1985, Ciobanu *et al*. 2004, Polyzos 2005). Despite some well-documented drawbacks, the input – output modelling approach is widely regarded as an important instrument for analysing regional economies and setting relevant policy objectives. This approach provides certain advantages for adequately presenting the complicated inter-sectoral associations within a national economy as well as the interregional relationships. At the sectoral level this modelling technique outperforms alternative techniques in the field of regional economics. Therefore, the input – output modelling approach could be used as a planning instrument for the economy at both the national and the regional level. Moreover, the multipliers of the input – output model not only correspond to those of the Keynesian model but also they are more accurate and flexible. Additionally, the usual estimations of an input – output model are free from analysis-related problems inherent to the Keynesian model estimations.

However, an important drawback of the use of I-O methodology in empirical studies is that, most of the time, there are not enough statistical data concerning the variables of the model. The problem becomes even more acute when analysing past periods where data shortage is usually the case. Therefore, it is quite difficult to reliably estimate the technical coefficients and to construct the corresponding I-O table. Technically speaking, it is even more difficult to construct an interregional I-O ta-

ble because it requires rare statistical information regarding the structure of regional economy as well as interregional trade flows (Miller and Blair 1985). For this reason, some researchers and experts in the field have been using a number of non-surveys techniques for updating the I-O coefficients and acquiring their regional estimations. The above techniques encompass several versions of location quotients (LQ's).

The remainder of this article is organized as follows. In the next section we estimate the multipliers for the 51 Greek prefectures by using the LQ's technique and the vectors of investment and consumption. Then, we evaluate the estimated multipliers by comparing them to the multipliers of other relevant studies. In the third section, the values of the multipliers with some actual economically important (in terms of their size) data for each prefecture are correlated and the results are commented upon. In the fourth section, we experiment with the distribution of a hypothetical investments program. We apply the earlier estimated multipliers in an attempt to achieve even regional development patterns. The article concludes by drawing some general remarks.

2. Regional multipliers for the Greek prefectures: estimation and evaluation

Input - Output (I/O) analysis is a powerful tool used by economists to estimate the magnitude of transactions that occur between different sectors of an economy. This methodology provides a useful overview of the structure of an economy. Several I/O techniques have been developed and are widely used worldwide for measuring diverse elements and entities such as gross regional product, household consumption and employment generation. Other analytical techniques such as shift-share and location quotient analyses have also been developed for measuring relevant regional economic aspects. These tools provide useful insights into the structure of regional economies and their trajectories of change over time. The various analytical techniques rely heavily upon quantitative methods. However, the use of quantitative techniques for analysing regional economies has certain limitations. It is not easy to measure a large number of important non-quantifiable factors – the "statistical residual" that can significantly influence regional development and competitiveness (Roberts and Stimson 1998).

The general equation of the I-O analysis for n productive sectors of an economy is the following (Miller and Blair 1985):

$$X = (I\text{-}A)\text{-}1f \qquad (1)$$

where: f is the final demand of economy, X is the total output of economy, A is the technological coefficients that determine the amounts of input required from the various sectors of the economy, in order for a monetary unit to be produced from the output of the productive sector under review. The analytical form of the matrix $(I\text{-}A)^{-1}$ - which is the inverse of (I-A) - in the case of n sectors is:

$$(\text{I-A})\text{-}1 = \begin{bmatrix} m_{11} & m_{12} & . & m_{1n} \\ m_{21} & m_{22} & . & m_{2n} \\ . & m_{ij} & . & . \\ m_{n1} & m_{n2} & . & m_{nn} \end{bmatrix} \quad (2)$$

where m_{ij} are the elements of the inverse matrix. Each coefficient m_{ij} shows the necessary level of increase in the production of sector i, when the final demand of sector j increases by one unit. The coefficients of the inverse matrix are also called "*total input-output coefficients*", because they show the direct and the indirect impacts on the production of sector i caused by an one-unit increase in final demand of sector j.

Alternatively, the elements of matrix can be provided by the relevant partial derivatives $\frac{\partial X_1}{\partial f_1}=m_{11}$, $\frac{\partial X_2}{\partial f_2}=m_{22}$, etc.

Because of the widely adopted assumption in economics that the data of table (2) remain constant for a time period of 5 – 10 years, the output X of the economy depends on the vector of demand *f*. In most economies, usually, the demand is classified into two categories (a) the demand for consumption and (b) the demand for investments. Using ΔX and Δf to represent changes in output and in final demand respectively, we come to the following function $\Delta X=M(\Delta f)$. Consequently, the multiplier matrix M shows the total effects upon output ΔX caused by a change in demand Δf. Then, the analytical form of the matrix $(\text{I-A})^{-1}f$, is:

$$\begin{bmatrix} m_{11} & m_{12} & . & m_{1n} \\ m_{21} & m_{22} & . & m_{2n} \\ . & . & . & . \\ m_{n1} & m_{n2} & . & m_{nn} \end{bmatrix} \begin{bmatrix} f_1 \\ f_2 \\ . \\ f_n \end{bmatrix}$$

The cross - product $(\text{I-A})^{-1}f$ results in a matrix with dimensions (nx1), which has the following form:

$$\begin{bmatrix} \sum_{i=1}^{n} m_{1i} f_i \\ \sum_{i=1}^{n} m_{2i} f_i \\ . \\ \sum_{i=1}^{n} m_{ni} f_i \end{bmatrix} \quad (3)$$

This when $Y_r = \begin{bmatrix} 1 \\ 1 \\ . \\ 1 \end{bmatrix}$ becomes: $\begin{bmatrix} M_1 \\ M_2 \\ \dots \\ . \\ M_n \end{bmatrix} = \begin{bmatrix} \sum_{i=1}^{n} m_{1i} \\ \sum_{i=1}^{n} m_{2i} \\ . \\ \sum_{i=1}^{n} m_{ni} \end{bmatrix}$

The above matrices give the output multipliers M_n of n sector. In a synoptic form they can be written as:

$$M = \sum_{i=1}^{n} \sum_{j=1}^{n} m_{ij} \tag{4}$$

The relatively high cost involved in collecting the required statistical data is usually the most serious difficulty in the construction of regional I-O tables. The conventional approaches to the construction of regional I–O tables range from methods that include a considerable survey element to methods based completely on published data. The terms "survey" and "non- survey" suggest the existence of two well-defined and mutually exclusive groups, but in practice virtually almost all I–O tables are "hybrid" ones, constructed by semi-survey techniques and employing primary and secondary sources to a greater or a lesser extent.

Where survey-based information on regional sales and purchases is unavailable, the regional modeller often has to use employment or GDP-based *location quotients* (LQs) to derive estimates of regional input output coefficients from national tables. The common practice for constructing regional I-O tables is based on the use of simple location quotients (SLQ's) provided that the required information is available (RIMS II 1981, Harrigan 1982, McCann and Dewhurst 1988, Flegg *et al.* 1995, Thomo 2004). According to Harris and Liu, (1998) the necessary assumptions for an LQ approach to be accurate are:

- The productivity per employee should be identical in each region so that a region's share of national employment represents accurately its share of national production.
- The consumption per employee of the products of sector i in the region and the nation, should be identical.
- There should be no "cross-hauling" between regions of the products belonging to the same industrial category, so if a region is an exporter of i, its consumption of i is entirely from the region's production.
- The nation is neither a net exporter nor an importer of i, so that the entire nation's production and consumption balance.

Location quotients represent the level of sectoral dominance in regional economies and are sensitive to issues of economic diversity, size, and economic scale. They are used as a proxy for spatial, or locational dependency of a given economic sector. The location quotient represents an index that places the percent of local output in a given sector as a ratio to the percent of national output in same sector. Also, it represents a useful proxy for identifying the extent to which export-based activity exists within the regions (Bowe and Marcouiller. 2007). A simple location quotient for each regional economic sector can be expressed by the following equation:

$$SLQ_i = \frac{Q_i^r / T^r}{Q_i^N / T^N} \tag{5}$$

where: Q^r_i is a measure of the output of sector *i* in region r, Q^N_i is a measure of the output of sector *i* in nation, T^r is a measure of the aggregate economic activity in region r, Q^r_i is a measure of the economic activity in the nation as a whole.

The interpretation of this measure is as follows: The numerator in eq. (5) represents the proportion of region's *r* total output contributed by sector *i*. The denominator in eq. (5) represents the proportion of total national output that is contributed by sector *i* nationally. When $SLQ_i^r > 1$, then the sector *i* is more localized or concentrated in region *r* than in the nation as a whole. Conversely, if $SLQ_i^r < 1$ then the sector *i* is less localized or less concentrated in region *r* than in the nation as a whole (Miller and Blair 1985). The SLQ_i^r has been viewed as a measure of the ability of regional sector *i* to meet the demands placed upon it by other sectors in the region and by regional final demand. In cases where $SLQ_i^r < 1$, sector *i* is viewed as less capable of satisfying regional demand for its output and its regional direct input coefficients a_{ij}^r are estimated by multiplying them by SLQ_i^r. However, if sector *i* is more highly concentrated in the region than in the nation ($SLQ_i^r > 1$), then it is assumed that the national coefficients a_{ij}^N will apply to the region and the regional "surplus" produced by *i* will be exported to the rest of the nation. This can be expressed by the:

$$a_{ij}^r = SLQ_i a_j^N \tag{6}$$

Where:

a_{ij}^r = The proportion of the total output of regional sector j that is accounted for by the purchases of inputs from regional industry i.

a_{ij}^N = The national direct requirements coefficient.

SLQ'i = SLQi, if SLQ<1, 1.0 if SLQ≥1.

There is therefore a kind of asymmetry in this approach. When a sector is import oriented ($SLQ_i^r < 1$) the modification of the national coefficients varies with the strength of the import orientation, while if a sector is export oriented ($SLQ_i^r > 1$) the strength of this orientation is not reflected in the modification.

Thus it has become obvious that along with the national product multipliers the regional ones can also be constructed and used for evaluating the observed inter-regional inequalities. Following the aforementioned procedure, we try to estimate the regional multipliers for the 51 Greek prefectures for the year 1998. We choose this particular time period because it corresponds to the existing national I-O tables (NSSG 2002).

In order to estimate the regional technological coefficients and subsequently the regional multipliers, we first use the Gross Domestic Product (GDP) for estimating the LQ's from equation (5). For this reason we divide the whole national economy into 12 productive sectors. In addition, we chose the shortened I-O tables (i.e. with dimensions 12x12) for achieving the relevant correspondence. The technological coefficients for national level are shown in table 1. Furthermore, we use the national vectors of demand for consumption and investments of the aforementioned year because it has similar distribution of the demand among the sectors expressed in percentage terms (NSSG 2002). We also assume that the distribution of demand in each prefecture is similar to the national vector and that the sum of all elements in each vector of demand is equal to unit. Then, we calculate the change in the produced output in each prefecture. This change derives from changes in the demand for consumption or investments in each prefecture and equals the unit. The results of the estimations are presented in table 2. An overview of these results leads us to the conclusion that there are important differences in multipliers amongst the prefectures. There are also significant differences between the two categories of multipliers for the same prefectures. The prefectures with the highest values are Viotia, Evia and Korinthia, while the prefectures with the lowest values are Lakonia, Lefkada, Grevena, Karditsa, Dodekanisos and Lasithi.

Table 1. The national technological coefficients (12x12)

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
1. Agriculture, hunting, forestry, fishing	0,161	0	0,182	0	0	0	0	0	0	0,011	0,002	0,047
2. Mining, quarrying, fuels and lubricants	0,03	0,018	0,087	0,228	0,032	0,089	0,012	0,01	0	0,013	0,011	0,002
3. Industrial and chemical products	0,1	0,042	0,393	0,053	0,477	0,078	0,095	0,032	0,017	0,209	0,089	0,222
4.Electricity, gas and water supply	0,009	0,012	0,027	0,015	0,002	0,007	0,005	0,008	0,001	0,013	0,013	0,017
5. Constructions	0,003	0,002	0	0,01	0,007	0,002	0,006	0,006	0,061	0,018	0,008	0,005
6. Transports, communications	0,005	0,004	0,007	0,009	0,003	0,047	0,099	0,02	0	0,027	0,01	0,017
7. Trade	0	0	0,011	0,001	0,003	0,021	0,011	0	0	0,001	0,001	0,009
8. Banks, real estate	0,003	0,003	0,012	0,006	0,004	0,004	0,006	0,646	0	0,011	0,001	0,001
9. Residences	0	0,003	0,002	0,007	0,003	0,01	0,079	0,014	0,002	0,017	0,028	0,034
10. Public administration, defense	0	0	0	0,001	0	0,014	0,01	0,003	0	0,001	0,003	0,002
11. Health, education	0	0	0	0	0	0	0	0,004	0	0,011	0,003	0,001
12. Various services	0,001	0,015	0,027	0,007	0,024	0,032	0,02	0,07	0,012	0,026	0,018	0,045

Table 2. The multipliers for the prefectures of Greece for year 1998

	Prefectures	Multipliers estimated by using consumption vector	Multipliers estimated by using investment vector		Prefectures	Multipliers estimated by using consumption vector	Multipliers estimated by using investment vector
1	Attiki	139.72	164.75	27	Thessaloniki	141.28	169.95
2	Aitoloakarnania	150.91	182.62	28	Kavala	152.11	186.63
3	Viotia	140.97	174.21	29	Kastoria	135.42	151.67
4	Evia	149.64	186.42	30	Kilkis	143.47	176.68
5	Evritania	124.48	125.93	31	Kozani	123.53	130.21
6	Fthiotida	146.09	178.83	32	Pella	147.73	181.80
7	Fokida	127.57	128.68	33	Pieria	128.43	132.44
8	Argolida	133.87	145.25	34	Serres	133.31	146.51
9	Arkadia	134.73	151.43	35	Florina	126.14	129.69
10	Achaia	148.67	182.85	36	Chalkidiki	130.15	140.32
11	Ilia	131.41	141.04	37	Evros	134.21	154.10
12	Korinthia	145.10	179.29	38	Xanthi	139.84	173.00
13	Lakonia	126.68	128.68	39	Rodopi	130.76	143.74
14	Messinia	126.15	127.97	40	Zakinthos	125.00	123.91
15	Lefkada	120.47	120.44	41	Kerkyra	129.67	129.60
16	Arta	130.35	138.12	42	Kefallinia	128.50	130.67
17	Thesprotia	123.95	122.55	43	Dodekanisos	121.18	122.84
18	Ioannina	138.60	163.27	44	Kyklades	130.14	135.41
19	Preveza	136.57	151.98	45	Lesvos	126.50	126.57
20	Karditsa	123.73	126.03	46	Samos	130.80	134.47
21	Larisa	146.00	179.89	47	Chios	126.35	125.48
22	Magnisia	147.69	184.44	48	Irakleio	129.81	136.40
23	Trikala	134.14	148.16	49	Lasithi	125.79	128.72
24	Grevena	125.51	131.13	50	Rethymno	127.46	133.28
25	Drama	143.49	167.84	51	Chania	128.49	131.46
26	Imathia	149.57	182.54				

It is apparent that the prefectures with the highest values are those that are the economic "satellites" of the Attiki region. These prefectures exhibit significant economic development and, in fact, represent the geographical space over which Attiki develops its economy. At this point, it is worth mentioning that there are certain legal restrictions on developing secondary sector activities within the boundaries of the Attiki area. On the other hand, the prefectures with low values (except Dodekanisos prefecture) belong to the economically-weak prefectures and they are ranked in the lowest positions of developmental scale in the case of Greece. The remaining prefectures are placed in middle positions with the island prefectures presenting the lowest values.

It should be pointed out that the estimations of regional multipliers by using the method described above have a kind of asymmetry. Generally speaking, non-survey or partial-survey technique should be expected to generate a table of input output coefficients that is a perfect copy of what could be obtained if a complete survey were undertaken (Miller and Blair 1985). On the other hand, errors and compromises of many sorts enter into the production of even the best survey-based table, so it can be argued that even in survey-based tables we do not have a completely accurate snapshot of an economy. It has been shown empirically that of the various quotient techniques, the SLQ is generally as good as or even better than other more complicated methods.(Harrigan 1982, Flegg *et al*. 1995, Thomo 2004). Therefore, we maintain that the calculations depict in a satisfactory degree the actual magnitude of regional economic inequalities among the Greek prefectures as well as the developmental capacity of each prefecture. Hence, these estimated multipliers could function as contributors to the rationalization of the applied regional economic policy in the context of achieving more balanced developmental patterns.

Comparing the values of the estimated multipliers (table 2) and considering the ranking of the prefectures in two other relevant studies (Polyzos 2005, Polyzos 2006), several important spatial differences can be uncovered. The multipliers of the aforementioned studies were estimated by using the recorded trade flows among the prefectures. The observed differences between the multipliers are shown in diagrams 1 and 2.

Diagram 1. Differences between the multipliers estimated by using LQ's and interregional trade

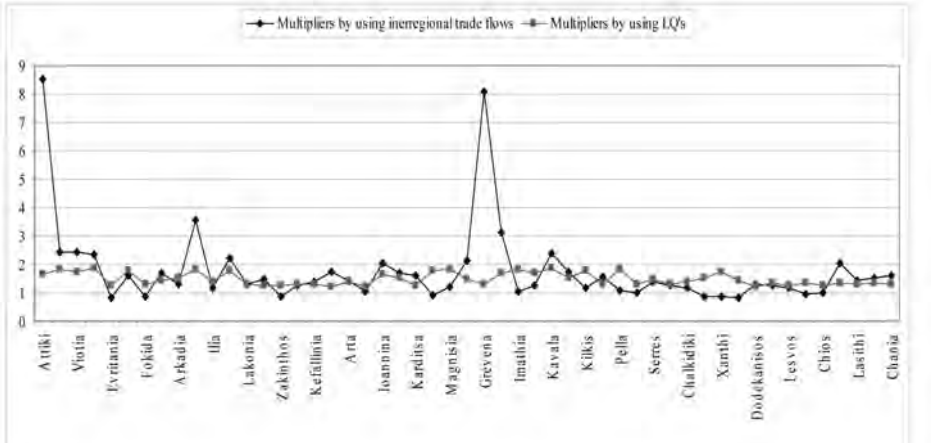
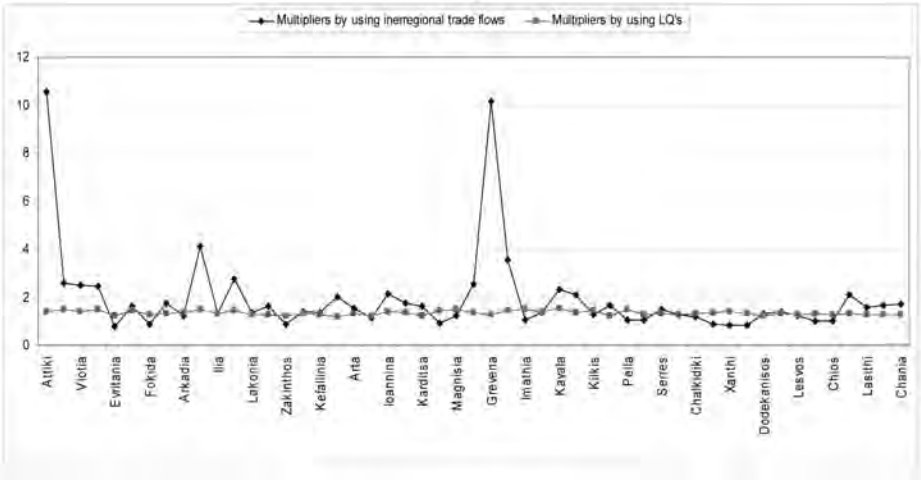


Diagram 2. Differences between the multipliers estimated by using LQ's and interregional trade



The diagrams clearly show that the differences between the multipliers of the prefectures are lower when the multipliers are estimated by LQ's method than when they are estimated by using the interregional trade flows. In the second case, the prefectures with large population sizes (i.e. Attiki, Thessaloniki, Achaia, etc.) have very high values compared to the other prefectures. By contrast, in the first case, the prefectures with large population sizes have regional multipliers relatively similar (small differ-

ences) to the rest of the prefectures. As regards the multipliers as a whole, in the first case, for the investment vector the sum of the multipliers is equal to 75.90 and for the consumption vector is 68.42. In the second case, the sum of the multipliers for the investment vector is 90.32 and for the consumption vector is 99.48. Namely, in the second case, the multiplicative effects of spending on investments or consumption on the national level are greater than in the first case. This leads to the conclusion that the estimations deriving from the first method hold less information, possibly owing to the way that the LQ's are calculated as well as the assumptions of the method.

3. Further analysis

In this section we try to expand the analysis in order to interpret the differences in the size of multipliers. We also examine whether the values of multipliers are correlated with any other important economic indicators that characterize regional economic and development identity as well as the observed size of regional inequalities. For this reason, the indicators and features that we introduce into the analysis are classified into three categories. In the first category, we include factors that depict the structure of the economy. The second category consists of factors that describe welfare and finally, the third category contains social and economic factors for each prefecture.

In particular, the first category of factors that concern the composition of the economy of each prefecture includes the percentage contribution to the GDP of the primary, secondary and tertiary sectors and economic productivity (product per employee) for each prefecture. The statistical data for the structure of production in regional level (NUTS III) have been taken from NSSG (2005) and Epilogi 2006. By using these indicators we can ascertain whether the structure of the economy affects the magnitude of multipliers and if this structure can improve the likely development level of each prefecture. The results of estimations are presented in table 3.

Considering the results of the estimations in table 3, we can say that the multipliers have relatively high correlation with the productivity of the economy. They are also statistically significant at a satisfactory confidence level.. The multipliers have somewhat lower correlation with the secondary sector and much lower as well as negative correlation with the tertiary sector. On the other hand, there is a relatively low, negative and statistically insignificant correlation between the multipliers and the primary sector. These results lead us to the conclusion that the prefectures with high productivity also have high multipliers. Hence, the benefits for each prefecture that derive from any public or private economic activity will be greater for those prefectures.

The results of the correlation between the multipliers and the economic sectors are also interesting. I–O multipliers measure the response of the economy to an exogenous change in final demand and they are conceived as indicators of the importance

of particular sectors and measure the interdependence of the sectoral structure. The positive relation with the secondary sector and the negative relation with the other two basic sectors show that the existence of industries and enterprises of the secondary sector or else the specialization of a region in the secondary sector generates the necessary condition for increase in GDP and for regional economic development.

Table 3.Correlation coefficients between multipliers and the sectors of the economy

	Primary sector	Secondary sector	Tertiary sector	Productivity
Multipliers estimated using consumption vector	-0.107 *(0.455)*	**0.420*** *(0.012)*	**-0.268*** *(0.057)*	**0.405**** *(0.003)*
Multipliers estimated using investment vector	-0.127 *(0.375)*	**0.450**** *(0.008)*	**-0.315*** *(0.051)*	**0.466**** *(0.002)*

Notes: N=51, values of significant of t in the parentheses, **correlation is significant at the 0.01 level (2-tailed), *correlation is significant at the 0.05 level (2-tailed).

In the second category we include data of prosperity for each prefecture, in order to examine whether the high values of the multipliers are related to the level of people's prosperity. In order to improve the validity of the survey we use three indicators instead of one. In particular, we use (a) the purchasing power of the population, (b) the per capita income, (c) the prosperity indicator which is formed by merging the per capita GDP for each prefecture with the per capita electricity consumption of the household, the private cars per 1000 residents and the per capita deposits, and finally, (d) the composite indicator of prosperity that encompass even more prosperity information. This indicator is taken from a study by Petrakos and Polyzos (2005) and it has been modified in a way that includes almost every aspect of the developmental identity of every prefecture. Bearing in mind that high multipliers ensure corresponding level of economic development and prosperity, we expect positive correlation values. The results of the estimations are presented in table 4.

In this table we can see that the multipliers have positive correlation values with the prosperity indicators but the statistical significance of the results is non-satisfactory. These results lead us to the conclusion that the prefectures with high levels of prosperity also have high multipliers. This result is reasonable and to be expected if we assume that high multipliers reflect the economic and developmental profile of the prefectures of the country. However, the relation between the multipliers and the indicators of prosperity is rather "weak" because of the level of statistical significance of the results.

Table 4. Correlation coefficients between multipliers and indicators of prosperity

	Purchasing power (/1000)	Per capita income	Prosperity	Synthetic indicator of prosperity
Multipliers estimated using consumption vector	0.063 *(0.662)*	0.067 *(0.643)*	0.055 *(0.702)*	0.055 *(0.703)*
Multipliers estimated using investment vector	0.124 *(0.387)*	0.126 *(0.380)*	0.102 *(0.475)*	0.061 *(0.669)*

Notes: N=51, values of significant of t in the parentheses, **correlation is significant at the 0.01 level (2-tailed), *correlation is significant at the 0.05 level (2-tailed).

In the third category we include the population potential of each prefecture, the percentage of urban population to the total population of the prefecture, the productive capacity of the prefecture and an indicator that depicts the "quality" of the population of each prefecture. The population potential shows the accessibility of each prefecture in relation to large urban concentration. The total population potential P_r of a region *r* is a function of the interregional distances d_{rs} (r, s regions) and of the size of populations Ms of the regions, and is calculated by the following equation: (Polyzos 2001) $P_r = \frac{M_r}{D_r} + \sum_s^n \frac{M_s}{D_s}$. The productive capacity is obtained by factoring in the total evolution of the product, the progress of employment and the productive structure of the economy for each prefecture during the last decade (Polyzos and Petrakos 2000). Finally, for estimating population "quality" we use an indicator that includes the percentages of graduates in each prefecture in relation to three educational levels. The indicator also incorporates the level of training and education of the population (NSSG 2003, Petrakos and Polyzos 2004).

We perform this correlation with the aforementioned variables in order to examine whether a) the relative accessibility of the prefectures to large urban concentrations, and b) the efficiency and educational level of the people in each prefecture, affect their developmental profile. The results of the estimations are presented in table 5.

From table 5 it is obvious that the values of Pearson coefficients of correlation between the multipliers on the one hand and the population potential, the indicator of productive capacity and the indicator of the population "quality" on the other hand, are relatively high and statistically significant. On the other hand, the correlation with the rate of urban population is low and statistically insignificant. These results lead us to a reasonable and expected conclusion, that high values of population potential, high productive capacity and high educational level are all related to the developmental profile of each prefecture.

Table 5. Correlation coefficients between indicators of productive capacity and population "quality"

	Population potential	Urban population	Productive capacity	Population "quality"
Consumption multipliers	**0.438*** *(0.018)*	0.137 *(0.336)*	**0.510*** *(0.144)*	**0.429*** *(0.106)*
Investment multipliers	**0.458*** *(0.010)*	0.156 *(0.274)*	**0.526*** *(0.096)*	**0.437*** *(0.093)*

Notes: N=51, values of significant of t in the parentheses, **correlation is significant at the 0.01 level (2-tailed), *correlation is significant at the 0.05 level (2-tailed).

Subsequently, we make an attempt to link the estimated multipliers with the geographical distances and to investigate their relationship in the light of the concepts of "*new economic geography" (NOG)*. The NOG models, especially those put forward by Krugman, Fujita and Venables (Fujita 1993, Krugman 1991, Krugman 1993, Venables 1996), are general equilibrium models. They assume that in a state of monopolistic competition the size of a city is determined by the action of centripetal and centrifugal forces. The interregional or spatial inequalities in income are explained as a possible consequence of trade costs and market size, plus either labour mobility or input-output linkages. Krugman's primary contribution is to incorporate external scale economies and increasing returns into traditional models of interregional trade. The industries which are characterised by increasing returns to scale concentrate in the larger initial market, while the periphery specialises in other industries.

When trade costs are extremely high, manufactured goods are essentially not traded, and firms have to locate their production in the region that they ultimately serve, so that each region produces according to local demand. As trade costs are reduced, the larger core region becomes more attractive, as firms located in the core have larger sales and, because of increasing returns, experience rising profits. The higher profits attract more firms and production to the core, which then becomes a net exporter of manufactured goods to the periphery. At the same time, demand and prices for immobile local factors in the core rise relative to the periphery and, as trade costs fall further, this offsets the attraction of locating in the core.

Generally speaking, the picture of accumulating economic activities operates under the pressures that are generated by a certain mechanism. This mechanism encompasses forces of "affinity" and forces of "repulsion". According to the theory of NOG, the geographic distances in conjunction with the urban or economic concentrations influence the intensity of spatial economic interdependence as well as the size of regional inequalities. These factors determine the size of centripetal and

centrifugal forces. They also configure the spatial distribution of economic activities contributing to regional development. NOG, although not explicitly a model of regional growth per se, does offer static predictions about the forces that lead to the emergence of industry clusters.

In central regions the centripetal forces are related to advantages such as the existence of a large market for distributing production, a diverse as well as sizeable labor market, positive external economies, increasing scale-returns, better diffusion of technology and innovations, linkages between the enterprises, economies of urban scale etc. Contrary to centripetal forces, there are significant centrifugal forces, such as the «immobile» factors of production, land prices, negative economies, environmental problems, problems of urban traffic conjunction, social problems, etc. that push the economic activities to spatial dispersion. In Greece, during the '50s, the major spatial economic forces operated according to the theoretical models of NOG. This process resulted in the creation of two large human concentrations: the capital city of Athens and the city of Thessaloniki. Nowadays, these urban centres are powerful poles of attraction of economic activities and they also sustain the largest part of the country's technical and service infrastructure with national and international significance.

The models used by the NOG, attempt to explain theoretically the mechanism of urban evolution and the geographical location of urban agglomerations by means of emphasizing the determining role of scale returns, externalities and cumulative causation. According to NOG, transportation cost influences the spatial distribution of markets as well as the system of urban structuring. There is a threshold up to which the firms located in certain regions are allowed to act in a monopolistic environment avoiding competition from firms located in remote regions. Criticism of NOG focuses on its theoretical simplifications and on the absence of substantial empirical evidence (Martin 2000, Martin and Sunley 1996).

The relation between transportation cost or else geographical distance and regional development is complex and most of the time blurred, since a number of empirical studies have shown that there are many difficulties in determining such a relation (Polyzos 2001). Transportation cost influences the real exchange of products between regions, determines the degree of accessibility for each region and reveals the regional comparative advantages. At the same time, it configures the level of spatial competition in such a way that a reduction in the transportation cost alters the spatial equilibrium, increases competition and influences the distribution of both people and activities.

In order to investigate the influence of "geographical distance" on the generation of monopolistic situations at the regional level - taking also into account the total accessibility of each region to the competitive markets - we correlate the size of the multiplier in each region with the distances of this region from the two largest, national, economic and population centres, namely from Athens and Thessaloniki. High

values of output multiplier in a region indicate that this region satisfies a significant portion of the demand created within the region. Thus, as regards economic matters this region does not depend significantly on other regions.

It is obvious that according to the NOG, the central and remote regions should have high values of multipliers. In the context of NOG, the explanation for this is likely to depend on two factors: (a) In the case that the region is central as well as developed, it has the potential for satisfying almost any increase in demand with products and services coming from its own firms (b) in the case that the region is remote, because of the geographical distance it has the chance of functioning, to some degree, away from the economic competition of central regions. Thus, a considerable portion of the demand in this region is satisfied by the firms located within the region.

Diagram 3. Depiction of the relationship between multipliers estimated by using the consumption vector and the prefectures' distances from Athens or Thessaloniki

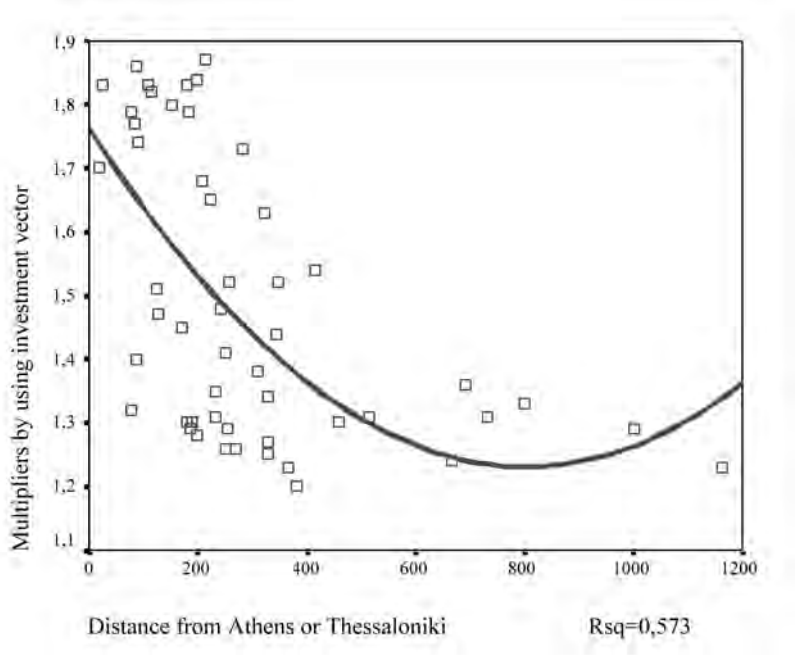
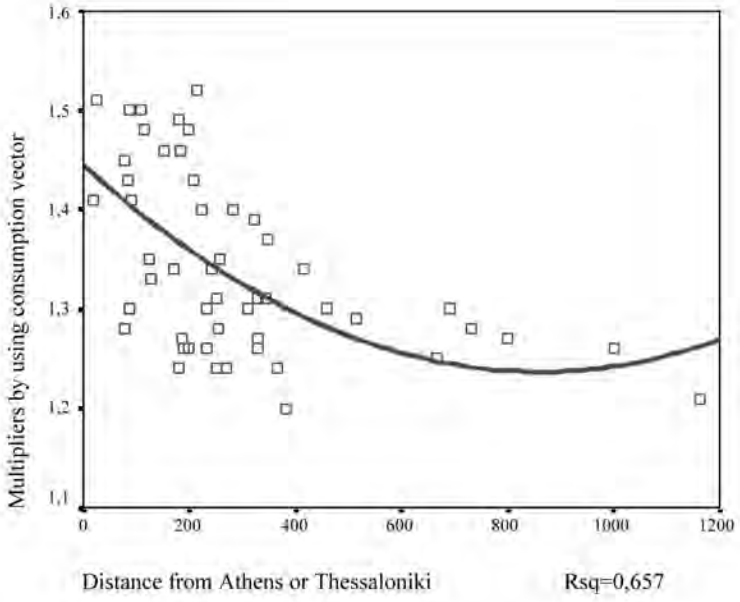


Diagram 4. Depiction of the relationship between multipliers estimated by using the investment vector and the prefectures' distances from Athens or Thessaloniki



If we assume that in the cases where a large distance between a region and the cities of Athens and Thessaloniki is involved, it is possible to get monopolistic situations, then the regions located at medium geographical distances in relation to the two abovementioned urban centers will present the lowest multipliers. Bearing in mind the earlier reasoning we construct diagrams 3 and 4. These diagrams illustrate the size of the multiplier of each Greek prefecture in relations to the time - distance between each prefecture and Athens or Thessaloniki. These illustrations assume that the two urban centres constitute the major economic competitors of the rest of the prefectures. We think that this assumption is fairly justifiable because if one looks at the direction and the volume of interregional trade flows, they will show that trade is dominated by Attiki and Thessaloniki (MPW 1997, Polyzos 2001).

If we examine the location and the shape of the regression line in diagrams 3 and 4, we can see that the theoretical schema of NOG is valid. The prefectures located close to Attiki and Thessaloniki have high multiplier values. In time - distance at about 700-800 min the regression line has the lowest values while in time – distance over 700 min, the values of the multipliers increase. In other words, this time - distance seems to be the threshold level or a sort of safety distance, between on the one hand the prefectures of Attiki and Thessaloniki (it could be said that these prefectures are economic "rivals" of the rest of the prefectures) and the rest of the prefectures on the other hand.

The remote prefectures of the country (e.g. the prefectures of Crete, Dodekanisa, Messinia, Ioannina, and Evros) are not influenced by Attiki and Thessaloniki as much as the central prefectures are. They seem to have created a monopolistic environment, where the high transportation cost lowers the level of competing pressure coming from the two major urban centres. Thus, these prefectures have high values as regards the above mentioned multipliers.

4. Regional multipliers and regional investments

In this section we investigate potential positive or negative relationships between the multipliers and the per capita level of expenses for private and public investments for the years 1992-1996. It is worth pointing out that according to official statistical data private investments are about 2.7 times higher in size than public investments (Epilogi 2006). Public investments are directly connected to the applied public policy whereas private investments are indirectly connected to this policy through certain developmental incentives given to the enterprises. The observed negative relationship leads us to the conclusion that the applied policy aims at reducing regional inequalities since this can be achieved by increasing the size of financial support for making certain private investments in the prefectures with low multipliers.

The results of the correlation are presented in diagrams 5 and 6. As we can see in these diagrams, neither public nor private investments appear to have a certain identifiable pattern (either a linear one or a non linear one). Instead, there is a wide dispersion as a result of the low values of the coefficient of determination R^2.

In spite of the wide dispersion, a close examination of the diagrams suggests that the largest part of the curve depicting public investments has a negative declination. This may shows that in this case the applied policy aims at reducing regional inequalities. In the case of private investments, the curve has a positive declination in its largest part, a fact that shows that in this case the relevant public policy concerning private investment does not contribute to the reduction of regional inequalities. Instead, it may even exacerbate inequalities.

Subsequently, we attempt to hypothetically redistribute public investments in Greece, in order to influence regional inequalities. We use as a major criterion of redistribution the scale of differences in multipliers amongst the prefectures. We also try to redistribute private investments as well, despite the fact that private investments cannot easily be directed towards specific regions. The distribution is performed by using the following equation (Polyzos 2005):

Diagram 5. Schematic depiction of the relation between multipliers and private investments

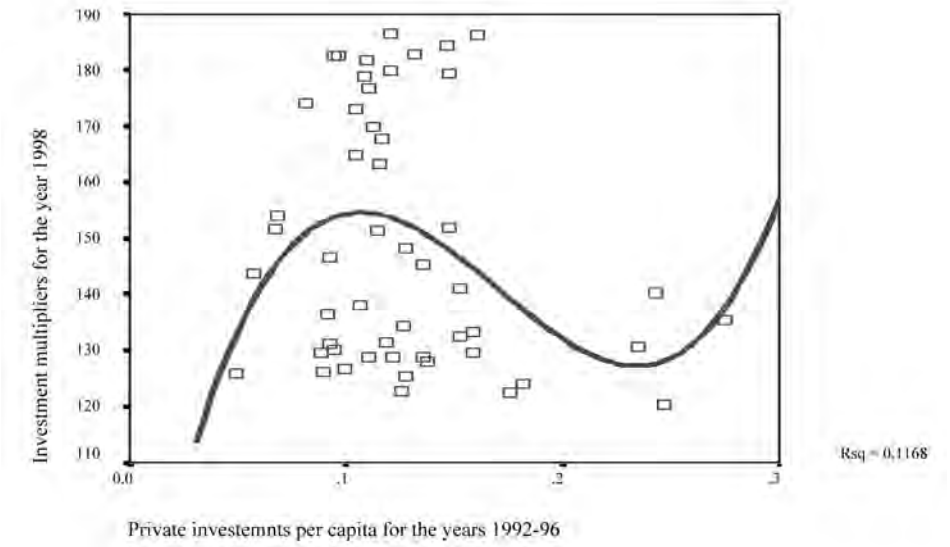
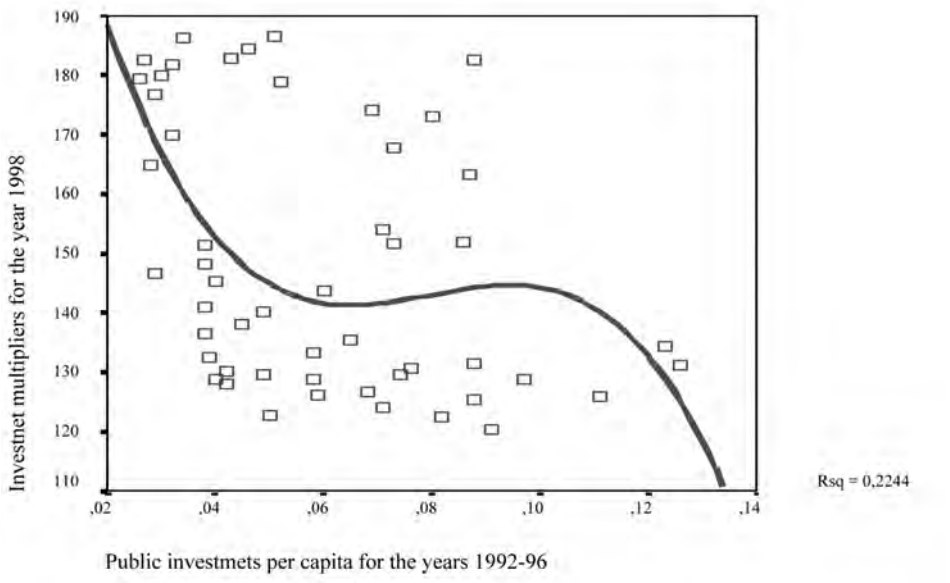


Diagram 6. Schematic depiction of the relation between multipliers and public investments



$$I_r = \frac{[a_r + (b)^{\lambda} \frac{M_{\min}}{M_r}]\mathrm{P_r}}{\sum_{r=1}^{51}\left\langle [a_r + (b)^{\lambda} \frac{M_{\min}}{M_r}]\mathrm{P_r} \right\rangle} \quad (7)$$

The variables of equation (7) are the following: (a) I_r is the investment (percentage) allocated to the prefecture r in a public investments program. (b) α_r is a corrective factor, which depicts the interpolative ability of the government to change its general policy in relation to the prevailing political or economic conditions (i=1, 2, .n). Governmental actions can be structural in their intention or merely interposing. (c) M_{min} and M_r are the lower value regional multiplier and the multiplier of prefecture r respectively. (d) $(b)^{\lambda}$ is a variable, that controls the intensity of regional public investments policy, while the exponent λ take values between 0 and 1 ($0 \leq \lambda \leq 1$). In the case where $\lambda=0$ then it will be $(b)^{\lambda}=1$, and therefore it can be dropped. (e) P_r is the population of prefecture r.

The per capita expense of public investment results from equation (7) and it equals the quotient $(I_r)/(P_r)$. Depending on the values assigned to the variables α_r and $(b)^{\lambda}$, it is possible to formulate alternative policies of distributing public investments. These policies will differ in their effectiveness in reducing regional inequalities. Therefore, we can examine four different policies, which derive from assigning alternative values to the variables. These policies are: (a) moderate, (b) proportional, (c) powerful and (d) combined regional policy.

In order to simplify the estimations we assume that $\alpha 0=0$ and $\lambda=0$. By using in equation (7) the multipliers of investments that we estimated earlier and the population of Greek prefectures as it has been recorded in the 2001 census (NSSG 2003), we can form the distribution of an investment program of the hypothetical size of 100,000 € according to the aforementioned conclusions. This is a "retaining" distribution and the results of these estimations are showed in table 6. Considering the results of the estimations in table 6, we can see that there are some spatial differences in distribution, but not of particular importance. Similarly, we can distribute differently a program of public investments applying one of the other aforementioned regional policies.

Table 6. Amount per resident for a theoretical investment program of 100,000 €

	Prefectures	Amount per resident for the theoretical program (€)		Prefectures	Amount per resident for the theoretical program (€)		Prefectures	Amount per resident for the theoretical program (€)
1	Attiki	7.85	18	Ioannina	8.78	35	Florina	11.05
2	Aitoloakarnania	8.70	19	Preveza	9.43	36	Chalkidiki	10.22
3	Viotia	8.23	20	Karditsa	11.38	37	Evros	9.30
4	Evia	7.69	21	Larisa	7.97	38	Xanthi	8.29
5	Evritania	11.38	22	Magnisia	7.77	39	Rodopi	9.97
6	Fthiotida	8.02	23	Trikala	9.68	40	Zakinthos	11.57
7	Fokida	11.14	24	Grevena	10.93	41	Kerkyra	11.06
8	Argolida	9.87	25	Drama	8.54	42	Kefallinia	10.97
9	Arkadia	9.47	26	Imathia	7.85	43	Dodekanisos	11.67
10	Achaia	7.84	27	Thessaloniki	8.43	44	Kyklades	10.59
11	Ilia	10.16	28	Kavala	7.68	45	Lesvos	11.33
12	Korinthia	8.00	29	Kastoria	9.45	46	Samos	10.66
13	Lakonia	11.14	30	Kilkis	8.11	47	Chios	11.43
14	Messinia	11.20	31	Kozani	11.01	48	Irakleio	10.51
15	Lefkada	11.90	32	Pella	7.88	49	Lasithi	11.14
16	Arta	10.38	33	Pieria	10.83	50	Rethymno	10.76
17	Thesprotia	11.70	34	Serres	9.79	51	Chania	10.91

5. Concluding remarks

The aim of this article has been to estimate regional input-output multipliers. In addition, we have estimated the correlation between, on the one hand the multipliers and, on the other hand, some critical regional economic characteristics. The results have all been used for the theoretical distribution of a regional investment program. Our findings indicate that there are differences among the output multipliers of the prefectures due to changes in demand for investments and for consumption.

As mentioned above, the results do not absolutely coincide with the results of a relevant study for Greece (Polyzos 2005). In that study, the author estimated the multipliers through the use of interregional trade flows. We are confident that the estimations of the multipliers through the use of interregional trade flows are more reliable. This is because the LQ method underestimates the exchanges between regions. The differences in the results of the two studies concern mainly the two major prefectures of the country, namely Attiki and Thessaloniki. The differences between the multipliers in the two studies are roughly between 20 and 25%. In some cases, the present study underestimates multipliers and in some other cases it overestimates them. The most important issue that affects the LQ method arises from the fact that the location quotients do not take sufficient account of interregional trade. Comparing the results of the above estimations with the results of another study of a Finnish region (Thomo 2004), we can see that there are no important differences in the sizes of multipliers. In that study, the size of multipliers is 1.1 to 1.9, namely similar to the size determined by this study. Although the accuracy of the estimated interregional inequalities could be low due to poor quality data, we think that the regional multipliers constitute a useful tool for increasing the effectiveness of regional policy.

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