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The Effect of Sector Loss on the Internal Structure of Regional Economies

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Abstract:

The basic purpose of this study is to provide a useful framework in order to examine the various kinds of "hypothetical extraction" measures. In other words the purpose is to quantify how much the region's output would change if a particular sector was not present. In accordance to the literature below sited a measure of the relative importance of any particular sector in a regional economy is found by extracting this sector. The impacts of these "extractions" on the sector multipliers, which represent the basic structure of the regional economy, were measured. The conclusion of the empirical implementation indicated that the change is significant. This should be crucial to the regional analyst when is called to use the extraction model.

***Key Words*:** *Extraction Method, Structure of Economy, Significant Difference*

JEL Classification : *R10, R11*

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1. Introduction

Input – Output models are being employed quite widely in the analysis of economic growth. Generally these models assume that certain forces will remain relatively unchanged as others act upon the economy, but this is never actually the case. It should be useful, therefore, to examine the impact upon the structure of the model of selected changes under conditions where all other forces are held constant. So, the main goal of this paper will be the investigation of the impact upon the internal structure of the regional economies of the complete loss of an industrial sector. This impact will be isolated by simply pulling the row and column representing each of the several sectors from the matrix and reinvested to develop new multipliers. Starting with a summary of the earlier extraction methods we will apply it to the case of regionalized Greek economy. Next we will provide a statistical analysis of the results. Finally some conclusions will be proffered.

2. Review of Literature

This study provides a useful framework to examine various kinds of possible "hypothetical extraction" linkages measures. The idea was to try to quantify how much an economy's total output would change if a particular sector was loss. The method of extraction originally conceived by Paelinck, de Caevel, end Degueldre (1965) and later employed by Strassert (1968), Schultz (1976, 1977), Meller and Marfan (1981), Milana (1985), and Hemler (1991). A complete recapitulation for extraction methods as well as their properties and their economic interpretation, can be found in Miller and Lahr (2001). In accordance to the literature a measure of the relative importance of any particular sector in an economy is found by extracting that sector.

3. Methodology

The basic balance equation of Leontief's model is, $x = (I - A)^{-1} y$ so, it may be assumed that one sector is extracted from the economy. Extraction of the jth sector for example, means that the jth row column of input matrix A are deleted (not replaced by zero).
Thus the equation can be rewritten as:

$$\bar{x}(j) = [I - \bar{A}(j)]^{-1} \bar{y}(j) \qquad (1)$$

Where $\bar{A}(j)$ is a (n-1) input matrix by deleting jth sector from A, also $\bar{x}(j)$ and $\bar{y}(j)$ are (n-1) dimensions vectors corresponding to output vector x and final demand vector y, respectively.

If y and $\bar{y}(j)$ is given, the results $\bar{x}(j)$ should be less than x, $\bar{x}(j) < x_i$

Thus, the sum of the differential between the output vector x excluding jth element and $\bar{x}(k)$ can measure linkage effect of the extracted sector j on total output.
Cella (1984) decomposed the matrix A and defined a total linkage effect of each sector and then identified into backward linkage and forward linkage.

Accordingly, the basic balance equation of Leontief's model, X = A x+y, may be rewritten as:

$$\begin{matrix} x_1 \\ x_2 \end{matrix} = \begin{matrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{matrix} \begin{matrix} x_1 \\ x_2 \end{matrix} + \begin{matrix} y_1 \\ y_2 \end{matrix} \qquad (2)$$

The sectors of the economy can be divided into one category that consists of the sectors that are to be extracted from the economy and category two that encompasses all the other sectors of the economy.
If the extracted sectors do not sell or buy any intermediate products to or from the other sectors of the economy (A_{11} and A_{21} are equal to zero), then the above equation can be rewritten as:

$$\begin{matrix} x_1 \\ x_2 \end{matrix} = \begin{matrix} A_{11} & 0 \\ 0 & A_{22} \end{matrix} \begin{matrix} x_1 \\ x_2 \end{matrix} + \begin{matrix} y_1 \\ y_2 \end{matrix} \qquad (3)$$

Where $\bar{x}_1$ and $\bar{x}_2$ are the output vectors after extraction. So, the solution equations of the extracted outputs may be obtained as:

$$\begin{matrix} \bar{x}_1 \\ \bar{x}_2 \end{matrix} = \begin{matrix} (I - A_{11})^{-1} & 0 \\ 0 & (I - A_{22})^{-1} \end{matrix} \begin{matrix} y_1 \\ y_2 \end{matrix} \qquad (4)$$

The total linkage effect (TL) can be defined as:

$$TL = e^{/}(x - \bar{x}) \qquad (5)$$

Where $\bar{x}$ demotes the output column vector of all sectors after the sector loss, e is a column summation vector (that is $e_i = 1$ for all i).

4. Results

The hypothesis to be tested in this study was that the loss of a sector from a regional economy will have a significant effect upon the internal structure of that economy. This hypothesis was accomplished by pulling first the Agriculture and then the Manufacturing sectors from the model and reinserted to obtain new multipliers.
Multipliers are numerical expressions aimed at capturing the impacts of a change in final demand on gross output in the economy, household income and employment.
The comparison was made on the basis of sixteen sector multipliers (observations) for three selected regions, region 1, Anatoliki Makedonia, Thraki, region 2, Thessalia and region 10, Attiki.

The relationship between the original multipliers and the multipliers after the sector loss has been explored. Tables 1 through 6 (Appendix) figure out this relationship. Column 1 carries the original multipliers. Column 2 carries the multipliers with Agriculture or Manufacturing excluded. To determine the significance of change, a rank correlation analysis was made to determine whether or not a significant difference occurred between multipliers in the original matrix and each of the new ones.

Region 1: Anatoliki Makedonia, Thraki

Without Agricultural sector
The examination regarding the correlation of multipliers with and without Agriculture, showing that Spearman's rank correlation coefficient is (0.996). The correlation is very strong and positive. The difference is statistical significant.
Without manufacturing sector
Spearman's rank correlation coefficient is (0.811). So, the correlation is strong and positive. The difference is statistical significant.

Region 4: Thessalia

Without Agricultural sector
Spearman's rank correlation coefficient is (0.996). The correlation is very strong and positive. The difference is statistical significant
Without manufacturing sector
Spearman's rank correlation coefficient is (0.718). The correlation is relative strong and positive. The difference is statistical significant.

Region 10: Attiki

Without Agricultural sector
Spearman's correlation coefficient is (0.998). The correlation is very strong and positive. The difference is statistical significant.
Without manufacturing sector
Spearman's correlation coefficient is (0.732). The correlation is relative strong. The difference is statistical significant.

Since a part of the impact consists of payments made to the sectors, so some further impact in the economy is due to the input relationship to the sectors involved.
In this section, this relationship will be explored, (Appendix, Tables 7 through 12.
In Region 1, Anatoliki Makedonia, Thraki, the relationship between the size of Manufacturing input ratio per sector and the sector multipliers for manufacturing it was found that 60 per cent of the variance in manufacturing multiplier for each sector can be attributed to inputs.

In Region 4, Thessalia, the size of Agriculture input ratio per sector and the sector multiplier for Agriculture was explored and it was found that 82 per cent of variance in Agriculture multiplier for each sector can be attributed to inputs. Region 10, Attiki, the relationship between the size of Agriculture input ratio and sector multiplier for Agriculture, indicated that 90 per cent of variance in Agriculture multiplier for each sector can be attributed to inputs.

5. Conclusion

A first important outcome of our investigation is that output multipliers throughout the economy in the absence of Agriculture or Manufacturing would decrease. The size of multipliers is important to the analysis of impact of the industry. The importance of this industry to the economy then depends upon the factors which create its multiplier effect.

The impacts of these "shocks" on sector multipliers, which represent the basic structure of the regional economy, were measured. The statistical results lead us to conclude that the loss of a sector from a regional economy will have indeed a significant effect upon the internal structure. This should be of importance to regional analyst who is called utilize the model in measuring the possible effect of loss of an industry.

Moreover, the relationship between the size of Agriculture or Manufacturing input ratio and the sector multiplier was explored.

APPENDIX

Table 1. Sector Multipliers Resulting from Loss of Agriculture of Region's 1 Economy, Compared to the Original Sectors Multipliers

Code		Without A	difference
A	1.3130	-	-
B	1.1870	1.1671	0.0199
C	1.4437	1.4087	0.035
D	2.1572	1.8676	0.2896
E	1.4504	1.4279	0.0225
F	1.7228	1.6428	0.08
G	1.2704	1.2547	0.0157
H	1.6727	1.5850	0.0877
I	1.4189	1.3935	0.0254
J	2.1990	2.1827	0.0163
K	1.1334	1.1265	0.0069
L	1.0998	1.0890	0.0108
M	1.1260	1.1197	0.0063
N	1.2780	1.2488	0.0292
O	1.4034	1.3872	0.0162
P	1.0000	1.0000	0.0000

Table 2. Sector Multipliers Resulting from Loss of Manufacturing of Region's 1 Economy, Compared to the Original Sector Multipliers

Code		Without D	difference
A	1.3130	1.1589	0.1541
B	1.1870	1.0555	0.1315
C	1.4437	1.1839	0.2598
D	2.1572	-	-
E	1.4504	1.2829	0.1675
F	1.7228	1.1282	0.5946
G	1.2704	1.1665	0.1039
H	1.6727	1.2833	0.3894
I	1.4189	1.2340	0.1849
J	2.1990	2.0818	0.1172
K	1.3334	1.0827	0.2507
L	1.0998	1.0226	0.0772
M	1.1260	1.0791	0.0469
N	1.2780	1.0774	0.2006
O	1.4034	1.2997	0.1037
P	1.0000	1.0000	0.0000

Table 3. Sector Multipliers, Resulting from Loss of Agriculture of Region's 4 Economy, Compared to the Original Sector Multipliers

Code		Without A	difference
A	1.3387	-	-
B	1.3634	1.3263	0.0371
C	1.5366	1.4960	0.0406
D	2.1387	1.8681	0.2706
E	1.4660	1.4426	0.0234
F	1.7661	1.6860	0.0801
G	1.6235	1.5627	0.0668
H	1.6471	1.5644	0.0827
I	1.3764	1.3511	0.0253
J	2.3130	2.2957	0.0173
K	1.1319	1.1252	0.0067
L	1.6381	1.5681	0.07
M	1.0958	1.0912	0.0046
N	1.3007	1.2706	0.0301
O	1.2807	1.2696	0.0111
P	1.0000	1.0000	0.0000

Table 4. Sector Multipliers, Resulting from Loss of Manufacturing of Region's 4 Economy, Compared to the Original Sector Multipliers

Code		Without D	Difference
A	1.3387	1.1736	0.1651
B	1.3634	1.1111	0.2523
C	1.5366	1.2266	0.31
D	2.1387	-	-
E	1.4660	1.2915	0.1745
F	1.7661	1.1456	0.6205
G	1.6295	1.3962	0.2333
H	1.6471	1.2764	0.3707
I	1.3764	1.1917	0.1847
J	2.3130	2.1864	0.1266
K	1.1319	1.0817	0.0502
L	1.6381	1.1144	0.5237
M	1.0958	1.0603	0.0355
N	1.3007	1.0856	0.2151
O	1.2807	1.2085	0.0722
P	1.0000	1.0000	0.0000

Table 5. Sector Multipliers Resulting from Loss of Agriculture of Region's 10 Economy, Compared to the Original Sectors Multipliers

Code		Without A	difference
A	1.2585	-	-
B	1.4077	1.3708	0.0369
C	1.4341	1.4059	0.0282
D	1.9629	1.7345	0.2284
E	1.5757	1.5520	0.0237
F	1.7380	1.6676	0.0704
G	1.4958	1.4717	0.0241
H	1.5654	1.4996	0.0658
I	1.4367	1.4122	0.0245
J	2.3514	2.3362	0.0152
K	1.1553	1.1486	0.0067
L	1.6470	1.5872	0.0598
M	1.1134	1.1086	0.0048
N	1.3292	1.2997	0.0295
O	1.2668	1.2578	0.009
P	1.0000	1.0000	0.0000

Table 6. Sector Multipliers, Resulting from Loss of Manufacturing of Region's 10 Economy, Compared to the Original Sector Multipliers

Code		Without D	Difference
A	1.2585	1.1377	0.1208
B	1.4077	1.1319	0.2758
C	1.4341	1.1930	0.2411
D	1.9629	-	-
E	1.5757	1.3738	0.2019
F	1.7380	1.1341	0.6039
G	1.4958	1.3145	0.1813
H	1.5654	1.2524	0.313
I	1.4367	1.2309	0.2058
J	2.3514	2.2256	0.1258
K	1.1553	1.0983	0.057
L	1.6470	1.1595	0.4875
M	1.1134	1.0731	0.0403
N	1.3292	1.0994	0.2298
O	1.2668	1.2019	0.0649
P	1.0000	1.0000	0.0000

Table 7. The Relationship Between the Size of Agriculture Input Ratio per Sector and the Sector Multiplier for Agriculture – Region 1. Anatoliki Makedonia, Thraki

Code	Sectors	Sector Multipliers Agriculture	Agriculture Input ratio
A	Agriculture, hunting, forestry	1.1258	0.0975
B	Fishing	0.0171	0.0000
C	Mining and quarrying	0.0300	0.0039
D	Manufacturing	0.2483	0.0615
E	Electricity, gas and water supply	0.0194	0.0079
F	Constructions	0.0686	0.0026
G	Wholesale and Retail trade	0.0135	0.0199
H	Hotel and restaurants	0.0751	0.0000
I	Transport and communication	0.0218	0.0014
J	Financial intermediation	0.0140	0.0011
K	Real estate, renting	0.0059	0.0005
L	Public administration, defense and social security	0.0092	0.0000
M	Education	0.0054	0.0000
N	Health and social work	0.0250	0.0004
O	Other social services	0.0139	0.0000
P	Private households with employed persons	0.0000	0.0000

Table 8. The Relationship Between the Size of Manufacturing Input Ratio per Sector and the Sector Multiplier for Manufacturing – Region 1. Anatoliki Makedonia, Thraki

Code	Sectors	Sector Multiplier Manufacturing	Manufacturing Input ratio
A	Agriculture, hunting, forestry	0.1034	0.1548
B	Fishing	0.0882	0.0003
C	Mining and quarrying	0.1742	0.1024
D	Manufacturing	1.4468	0.2783
E	Electricity, gas and water supply	0.1124	0.0198
F	Constructions	0.3988	0.0004
G	Wholesale and Retail trade	0.0697	0.0535
H	Hotel and restaurants	0.2611	0.0002
I	Transport and communication	0.1240	0.0072
J	Financial intermediation	0.0786	0.0235
K	Real estate, renting	0.0340	0.0393
L	Public administration, defense and social security	0.0518	0.0000
M	Education	0.0315	0.0004
N	Health and social work	0.1345	0.0000
O	Other social services	0.0695	0.0006
P	Private households with employed persons	0.0000	0.0000

Table 9. The Relationship Between the Size of Agriculture Input Ratio per Sector and the Sector Multiplier for Agriculture – Region 4. Thessalia

Code	Sectors	Sector Multipliers Agriculture	Agriculture Input ratio
A	Agriculture, hunting, forestry	1.1326	0.1025
B	Fishing	0.0314	0.0000
C	Mining and quarrying	0.0344	0.0041
D	Manufacturing	0.2289	0.0647
E	Electricity, gas and water supply	0.0198	0.0084
F	Constructions	0.0678	0.0027
G	Wholesale and Retail trade	0.0565	0.0209
H	Hotel and restaurants	0.0699	0.0000
I	Transport and communication	0.0214	0.0015
J	Financial intermediation	0.0146	0.0011
K	Real estate, renting	0.0057	0.0005
L	Public administration, defense and social security	0.0592	0.0000
M	Education	0.0040	0.0000
N	Health and social work	0.0255	0.0004
O	Other social services	0.0094	0.0000
P	Private households with employed persons	0.0000	0.0000

Table 10. The Relationship Between the Size of Manufacturing Input Ratio per Sector and the Sector Multiplier for Manufacturing – Region 4. Thessalia

Code	Sectors	Sector Multiplier Manufacturing	Manufacturing Input ratio
A	Agriculture, hunting, forestry	0.1111	0.0000
B	Fishing	0.1698	0.0000
C	Mining and quarrying	0.2086	0.0046
D	Manufacturing	1.4393	0.1321
E	Electricity, gas and water supply	0.1174	0.0441
F	Constructions	0.4176	0.0046
G	Wholesale and Retail trade	0.1570	0.0348
H	Hotel and restaurants	0.2494	0.0000
I	Transport and communication	0.1243	0.0146
J	Financial intermediation	0.0852	0.0129
K	Real estate, renting	0.0338	0.0587
L	Public administration, defense and social security	0.3525	0.0000
M	Education	0.0239	0.0000
N	Health and social work	0.1448	0.0009
O	Other social services	0.0486	0.0000
P	Private households with employed persons	0.0000	0.3073

Table 11. The Relationship Between the Size of Agriculture Input Ratio per Sector and the Sector Multiplier for Agriculture – Region 10. Attiki

Code	Sectors	Sector Multipliers Agriculture	Agriculture Input ratio
A	Agriculture, hunting, forestry	1.1037	0.0837
B	Fishing	0.0323	0.0000
C	Mining and quarrying	0.0247	0.0033
D	Manufacturing	0.2003	0.0528
E	Electricity, gas and water supply	0.0207	0.0068
F	Constructions	0.0618	0.0022
G	Wholesale and Retail trade	0.0212	0.0171
H	Hotel and restaurants	0.0577	0.0000
I	Transport and communication	0.0215	0.0012
J	Financial intermediation	0.0133	0.0009
K	Real estate, renting	0.0059	0.0004
L	Public administration, defense and social security	0.0525	0.0000
M	Education	0.0041	0.0000
N	Health and social work	0.0258	0.0003
O	Other social services	0.0079	0.0000
P	Private households with employed persons	0.0000	0.0000
		1.6536	

Table 12. The Relationship Between the Size of Manufacturing Input Ratio per Sector and the Sector Multiplier for Manufacturing – Region 10. Attiki

Code	Sectors	Sector Multiplier Manufacturing	Manufacturing Input ratio
A	Agriculture, hunting, forestry	0.0842	0.1346
B	Fishing	0.1923	0.0003
C	Mining and quarrying	0.1681	0.0886
D	Manufacturing	1.3683	0.2409
E	Electricity, gas and water supply	0.1407	0.0171
F	Constructions	0.4210	0.0003
G	Wholesale and Retail trade	0.1264	0.0463
H	Hotel and restaurants	0.2182	0.0002
I	Transport and communication	0.1434	0.0062
J	Financial intermediation	0.0877	0.0203
K	Real estate, renting	0.0397	0.0340
L	Public administration, defense and social security	0.3398	0.0000
M	Education	0.0280	0.0003
N	Health and social work	0.1602	0.0000
O	Other social services	0.0452	0.0000
P	Private households with employed persons	0.0000	0.0000

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