CENTRE OF PLANNING AND ECONOMIC RESEARCH

Structural Changes in the Greek Economy: Intertemporal Analysis in an Input - Output Framework

by TH. SKOUNTZOS

ATHENS 1980

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INTERTEMPORAL ANALYSIS IN AN INPUT-OUTPUT FRAMEWORK

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ACKNOWLEDGEMENTS

The author wishes to express his sincere thanks to the anonymous referees who, with their comments and suggestions, contributed to the improvement of an earlier draft of the study.

Many thanks are also due to Mr G. Mattheos, research associate of the Centre of Planning and Economic Research, for his valuable assistance at the various stages of the study, and to Mrs. Frosso Panaretou, for her computational assistance. Naturally the author undertakes the whole responsibility for the errors that may exist in the study.

THEODOROS A. SKOUNTZOS

May 1980

PREFACE

The high rate of growth in the Greek economy during the 60's was accompanied by significant changes in its structure as well. The subject of Professor Skountzos' present study is the measurement of the structural changes in and the estimation of their effects on the economy.

The analysis of structural changes is carried out within the framework of the static input-output model, by utilizing the two original input-output tables existing for the years 1958 and 1970 respectively.

The main findings gotten out of the estimated various indices of structural changes are that, between 1958 and 1970, significant changes took place in the input-output coefficients, in the degree of interdependence of the production sectors, and in fixed capital and labour requirements per unit of output.

The main conclusions to be drawn from the author's analysis, as regards the effects of structural changes, are as follows: (a) The effect of the changes in input-output coefficients on the sectoral gross outputs was of much smaller importance than the effect of the changes in the level and composition of final demand. (b) The changes in fixed capital requirements were caused mainly by changes in capital and labour coefficients and to a lesser extent by changes in input-output coefficients.

Despite the fact that the structural changes dealt with in this study refer to the decade of the 60's, the empirical findings do not have historical value only but, as future developments depend to a large extent on past

events, they also provide an indication of the future trends in the structure of the economy.

I am sure that the readers of Professor Skountzos' study will agree with me that this makes a significant contribution to input-output analyses in Greece, as well as to the systematic measurement of structural changes in the economy and the estimation of their effects on it.

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May 1980

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INTRODUCTION

Economic development is accompanied by changes in the structure of the economy. In Greece, the period 1958-1970 is characterized by a high rate of growth of real Gross National Product. This rapid increase in real product was not uniform (percentagewise) in all production sectors of the economy. Consequently, the structure of the economy in 1970 was considerably different from that in 1958. The object of this study is to explain and measure the structural changes occurred between 1958 and 1970.

A proper way of analysing structural changes over time is the use of input-output analysis. To this end, use is made of the input-output tables of Greece for 1958 and 1970. In section A of the study, a brief account is given of the main determinants of structural changes. In Section B, various indices of structural changes are estimated, and in Section C, the impact of structural changes on production, labour and capital is examined. The procedures, followed in this study, for measuring the effects of structural changes, trace back to W. Leontief, A.P. Carter and others.[1]

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1. See Bibliography.

A. DETERMINANTS OF STRUCTURAL CHANGES

The structural changes in the Greek economy, as reflected in the changes of input-output coefficients, have been caused by many factors, the most important of which are:

a. Changes in technology: The rate and extent of technological changes in the modern world is one of the main factors accounting for the changes in input-output coefficients over time.[1] The changes in technology take, in the first instance, the form of a change in input quality, as a result of technological changes taking place in other sectors. The input quality improvement increases the productivity in the sectors using this particular input. In the second place, the use of modern fixed capital equipment incorporating the latest technological advancements increases the production efficiency in the sector using the equipment in question. Finally, the adoption of up-to-date organization methods increases the efficiency of production methods or the productivity of a particular input in the sector. All the above forms of technological changes grew more intense in the Greek economy, in the period 1958-1970.

b. Changes in the composition of production: If the quantities of products produced through different technologies by a sector do not change at the same rate, the input structure of the sector will change.

c. Changes in input prices: A change in the relative input prices may result in substitution among inputs.

1. Among the most important aspects of modern technical changes are the intensification of the use of synthetic raw materials in place of natural products, the automation of production processes, the gradual substitution of coal by oil and/or electricity, etc.

An indirect substitution among the same kinds of inputs is likely to occur, as, for example, in the case of reducing the use of an intermediate input due to an increased utilization of labour or better use of the technical equipment processing the input in question.[1] In a large number of cases there is strong interdepedence between the changes in technology and those in input prices, and it is difficult to distinguish between their respective effects on the input structure of the various production sectors.

d. Changes in the scale of operations: The existence of increasing or decreasing returns to scale causes a differentiation in the technical relationships between two periods of time when the scale of operations or the degree of capital utilization changes.[2]

e. Creation of new industries: The setting up of new industries, with an entirely different input structure from that of existing industries, is another factor in the structural changes in the Greek economy.

f. Random factors: Differences in input-output coefficients between two periods of time may well have been created by random factors, such as differences in the sources of data and the statistical methods used in estimating the technical relationships.

Since the above factors operate simultaneously, their separation is not clear and unambiguous, and

1. Changes in the relative prices of capital and labour inputs will affect the prices of different products by different amounts and such changes in the relative prices of product inputs can cause changes in coefficients.

2. Although small changes in the scale of operations within one or two years since an input-output table was drawn up may exert a comparatively unimportant influence on input coefficients, it may well be that, over longer periods, when larger output changes occur, inputs are no longer changing in direct proportion to output changes.

identification through empirical data of their separate effects on input-output coefficients is very difficult when high correlations between all these factors exist. In the case of Greece the above difficulties are accentuated by the fact that only two original tables have been constructed. A time series of input-output tables would greatly facilitate the analysis of the effects of each factor separately. For these reasons, this study deals with the impact of structural changes rather than the sorting out of those factors which caused the coefficient changes.

B. MEASURES OF STRUCTURAL CHANGES

1. Changes in Technical Input-Output Coefficients

An expedient way of measuring changes in input-output coefficients is comparing the columns of input-output matrices at two different points of time and computing the weighted average changes in the input coefficients of the various sectors. This can be done by considering the weighted indices.[1]

$$T \cdot j = \frac{1}{\frac{1}{2}\sum_{i=1}^{n}(X_{ij}^{70} + X_{ij}^{58})} \cdot \sum_{i=1}^{n}\left[\frac{A_{ij}^{70} - A_{ij}^{58}}{A_{ij}^{70} + A_{ij}^{58}} \cdot (X_{ij}^{70} + X_{ij}^{58})\right] \tag{1}$$

where

A_{ij}^{70} = matrix of input-output coefficients for 1970

A_{ij}^{58} = matrix of input-output coefficients for 1958

X_{ij}^{70} = matrix of interindustry transactions in 1970

X_{ij}^{58} = matrix of interindustry transactions in 1958, at constant 1970 prices.

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1. See P. Rasmussen, *Studies in Intersectoral Relations*, 1957, p. 131.

This index measures the overall input changes in each of the n production sectors and is called the Rasmussen index of structural change. Column (1) of Table 1 shows the individual Rasmussen indices of structural change for the period 1958-1970 concerning the 35 production sectors into which the Greek economy has been distinguished.

From column (1) the following observations can be made:

i. The Rasmussen index of structural change is small as regards agriculture and the manufacturing sector. On the other hand, services as a whole seem to constitute the leading sector of structural changes.

ii. There are some subsectors within the manufacturing sector which have undergone substantial structural changes betwen 1958 and 1970. These are: (a) the sectors of transport equipment, glass and glassware, miscellaneous manufacturing, basic metal industries, petroleum and coal products, and (b) the sectors of footwear, beverages, electrical machinery, machinery and appliances (apart from electrical and transport equipment), paper and paper products, clothing, printing and publishing, and chemicals. These latter sectors have experienced important structural changes but to a lesser degree as compared to sectors under (a).

iii. With the exception of housing, all service subsectors show substantial changes in their intermediate input structures.

iv. All of the non-manufacturing industrial sectors, namely, mining and quarrying, construction, and electricity have experienced much bigger structural changes than the sectors of agriculture, manufacturing as a whole and services as a whole.

TABLE 1

Indices of Structural Change between 1958 and 1970

Sector \ Index	Rasmussen Index (1)	Alternative Index (2)
1. Agriculture	−0.02977	0.51909
2. Mining	−0.38725	0.60058
3. Food	−0.08939	0.20144
4. Beverages	−0.19900	0.55965
5. Tobacco	−0.03873	0.66723
6. Textiles	−0.07212	0.26815
7. Footwear	0.27704	0.54369
8. Clothing	0.14873	0.36571
9. Wood and Cork	−0.07369	0.35557
10. Furniture	−0.05012	0.42390
11. Paper and paper products	0.15241	0.37779
12. Printing-Publishing etc.	0.13077	0.50662
13. Leather and leather products	0.08952	0.74378
14. Rubber products	0.07643	0.45346
15. Plastic products	0.05033	0.38199
16. Chemicals	−0.13586	0.43505
17. Petroleum and Coal products	0.56968	0.75220
18. Cement	−0.04604	0.70750
19. Glass and Glassware	0.99532	1.07870
20. Non metallic mineral products	0.01909	0.59898
21. Basic Metal Industries	0.59259	0.82979
22. Metal products	−0.06089	0.39430
23. Machinery and Appliances	0.17795	0.40959
24. Electrical Machinery	−0.18437	0.98242
25. Transport equipment	1.08117	1.18933
26. Miscellaneous Manufacturing	0.72358	0.91690
27. Construction	−0.20642	0.43910
28. Electricity-Water-Gas	−0.62663	0.73084
29. Transportation-Storage	−0.34941	0.64893
30. Communications	−0.67964	0.87497
31. Trade	−0.41475	0.69730
32. Banking, other Financial Instit. and Insurance	0.22189	0.69128
33. Other services	−0.17393	0.92704
34. Housing	−0.07789	0.11485
35. Public Services	–	–
3-26 Total Manufacturing	0.05423	0.41928
29-35 Total Services	−0.24103	0.67628

Note: Column (1) has been calculated according to formula (1). Column (2) has been calculated by the same formula with the difference that the numerator $(A_{ij}^{70} - A_{ij}^{58})$ has been replaced by the absolute values $|A_{ij}^{70} - A_{ij}^{58}|$.

At this point, it should be pointed out that the Rasmussen index used so far measures the net changes in the intermediate input structure of the different production sectors. However, within a given production sector, the changes in some coefficients may be negative while those in others may be positive, resulting in a lower absolute value in the Rasmussen index of structural change. For instance, the agricultural sector used fewer inputs per unit of output in 1970 than in 1958, whereas it increased its input coefficients for industrial inputs, between 1958 and 1970, and thus this sector shows negligible change in its input structure. Opposite changes in the input coefficients have occurred in all sectors of the Greek economy.

For the purpose of providing a better measure of the dynamism of the various sectors of the Greek economy, an alternative index has been computed. The difference between this new index and that of Rasmussen is that the signs (negative) in the differences between the input coefficients of two periods of time have been ignored. More specifically, the alternative index is computed according to formula (1), with $|A_{ij}^{70} - A_{ij}^{58}|$ replacing $(A_{ij}^{70} - A_{ij}^{58})$ in the numerator. This alternative index is presented in column (2) of Table 1. Comparing columns (1) and (2) of Table 1 we can make the following observations:

i. The extent of change according to the alternative index is much bigger than in the case of the Rasmussen index.[1] All sectors of the Greek economy have undergone substantial changes in their input structure. This is consistent with the rate of industrialization of the coun-

1. The alternative index for a given sector would be the same in absolute value as the Rasmussen one, only when all changes within the sector were in the same direction (whether negative or positive).

try during the time under examination. Many sectors which, according to the first index, showed small structural changes, now show substantial ones. This means that in all sectors changes in input coefficients occurred in opposite directions, as a result of input substitutions and/or the use of new inputs by each sector.

ii. The sector of services as a whole seems to be the leading sector of structural changes as compared to agriculture and the manufacturing sector as a whole.

2. Changes in Inverse Coefficients

In the preceding section structural change was measured by comparing the matrices of input-output coefficients A_{ij}^{70} and A_{ij}^{58}. Denoting by R_{ij}^{70} and R_{ij}^{58} the inverse matrices for 1970 and 1958 respectively, we are now going to measure structural changes by considering changes in the elements of the inverse matrix between 1958 and 1970. Two indices which can be used to describe an inverse matrix and in turn changes in its elements are the following:[1]

$$U_j = \frac{\frac{1}{n}\sum_{i=1}^{n} R_{ij}}{\frac{1}{n^2}\sum_{j=1}^{n}\sum_{i=1}^{n} R_{ij}} \qquad (2)$$

and

$$U_i = \frac{\frac{1}{n}\sum_{j=1}^{n} R_{ij}}{\frac{1}{n^2}\sum_{i=1}^{n}\sum_{j=1}^{n} R_{ij}} \qquad (3)$$

1. See Rasmussen, *op. cit.*, pp. 134-135.

In formula (2) the average of each column of the inverse matrix is divided by the overall average of all columns, and in formula (3) the average of each row of the inverse matrix is divided by the same overall average. The indices U_j and U_i have been termed as the "Index of Power of Dispersion" and the "Index of Sensitivity of Dispersion". U_j and U_i are also measures of backward and forward linkages respectively.[1]

A brief analysis of the above two indices is considered advisable. The Index of Power of Dispersion tells us the extent to which a change in the final demand of sector j affects the whole system of sectors. Alternatively, we may say that U_j shows by how much a change in sector j will cause changes in the rest of the system of sectors. When $U_j > 1$, it means that the impact of a unit increase in the final demand of sector j on the system of sectors will be big as compared to the sectors in general. When $U_j < 1$, it means that a unit increase in the final demand in sector j will have relatively small repercussions on the system of sectors as compared to the sectors in general.

A similar interpretation can be given to the meaning of the Index of Sensitivity of Dispersion U_i. This index tells us the extent to which a change in the final demand of the system of sectors will affect sector i. When $U_i > 1$, it means that a unit increase in the final demand of the whole system of sectors will have a bigger impact on sector i than on the system of sectors in general, and vice versa in case $U_i < 1$.

Table 2 presents the indices of Power of Dispersion (backward linkage) U_j for 1958 and 1970 and their changes between these two years. From column (3) of this table the following observations can be made:

1. A. Hirschman, *The Strategy of Economic Development*, 1958.

TABLE 2
Indices of Power of Dispersion (Backward Linkages)

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	2.98531	2.05484	0.68832
2. Mining	1.09941	1.33370	1.21311
3. Food	1.32429	1.15283	0.87053
4. Beverages	0.79006	0.75246	0.95241
5. Tobacco	0.64593	0.69914	1.08238
6. Textiles	1.61953	1.63886	1.01194
7. Footwear	0.64569	0.69606	1.07801
8. Clothing	0.74882	0.66592	0.88929
9. Wood and Cork	1.24582	1.04816	0.84134
10. Furniture	0.66550	0.68008	1.02191
11. Paper and paper products	1.28796	1.39173	1.08057
12. Printing-Publishing etc.	0.72056	0.84420	1.17159
13. Leather and leather products	1.03893	1.18480	1.14040
14. Rubber products	0.80559	0.76781	0.95310
15. Plastic products	0.66181	0.74833	1.13073
16. Chemicals	1.50123	1.44711	0.96395
17. Petroleum and Coal products	1.35092	1.29327	0.95733
18. Cement	0.69524	0.70760	1.01778
19. Glass and Glassware	0.70051	0.72755	1.03860
20. Non metallic mineral products	0.80970	0.77179	0.95318
21. Basic Metal Industries	1.44284	1.42941	0.99069
22. Metal products	1.04648	0.94944	0.90727
23. Machinery and Appliances	0.77370	0.86171	1.11375
24. Electrical Machinery	0.73851	0.87864	1.18975
25. Transport equipment	0.77424	0.91512	1.18191
26. Miscellaneous Manufacturing	0.70537	0.67277	0.95378
27. Construction	0.75645	0.73136	0.96683
28. Electricity-Water-Gas	1.00304	1.03454	1.03140
29. Transportation-Storage	1.08968	1.22552	1.12466
30. Communications	0.75416	0.73938	0.98040
31. Trade	1.32164	1.26727	0.95886
32. Banking, other Financial Instit. and Insurance	1.01025	1.36013	1.34633
33. Other services	0.89417	1.01970	1.14039
34. Housing	0.64569	0.64786	1.00736
35. Public Services	0.70095	0.66091	0.94288

Note: Columns (1) and (2) have been calculated according to formula (2).

i. A substantial reduction has occurred in the backward linkage of the agricultural sector. This means that an expansion in this sector would have affected the other sectors to a considerably lesser extent in 1970 than in 1958. In spite of this reduction, the agricultural sector still continues to be the sector with the strongest backward linkage, as compared to the other sectors.

ii. Among the manufacturing subsectors, those with the biggest increase (over 10%) in backward linkages are printing and publishing, leather and leather products, plastic products, machinery and appliances, electric machinery, and transport equipment. There is only one sector with a big decrease (over 10%) in backward linkage, namely food.

iii. Looking at the non-manufacturing industrial sectors, we notice that only mining and quarrying shows a substantial increase in backward linkage. Construction and electricity do not show any substantial change between 1958 and 1970.

iv. Among the service subsectors, substantial increases have occurred in transportation, banking, and other services.

Table 3 shows the indices of Sensitivity of Dispersion (forward linkages) of the various sectors and their rate of change between 1958 and 1970. As can be seen from column (3) of this table in only few sectors did over 10% changes in forward linkages occur between 1958 and 1970. Over 10% increases in forward linkages occurred in petroleum and coal products, basic metal industries, electrical machinery, transport equip-

TABLE 3
Indices of Sensitivity of Dispersion (Forward Linkages)

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	0.88435	0.91154	1.03075
2. Mining	0.88902	0.78704	0.88529
3. Food	1.40343	1.32261	0.94241
4. Beverages	1.36054	1.20422	0.88510
5. Tobacco	1.06768	1.04643	0.98010
6. Textiles	1.24004	1.17030	0.94376
7. Footwear	1.36182	1.42129	1.04367
8. Clothing	1.42316	1.49818	1.05271
9. Wood and Cork	1.04893	0.99959	0.95296
10. Furniture	1.19701	1.12793	0.94229
11. Paper and paper products	1.06639	1.12283	1.05293
12. Printing-Publishing etc.	1.09289	1.10828	1.01408
13. Leather and leather products	1.49543	1.31268	0.87779
14. Rubber products	0.94623	0.95267	1.00681
15. Plastic products	1.15788	1.08976	0.94117
16. Chemicals	1.01075	0.96720	0.95691
17. Petroleum and Coal products	0.66635	0.85581	1.28433
18. Cement	1.07724	1.06615	0.98971
19. Glass and Glassware	0.84354	0.89427	1.06014
20. Non metallic mineral products	1.02765	1.01835	0.99095
21. Basic Metal Industries	0.83840	0.99504	1.18683
22. Metal products	1.07221	1.09453	1.02082
23. Machinery and Appliances	0.74933	0.76810	1.02505
24. Electrical Machinery	0.87750	1.05448	1.20169
25. Transport equipment	0.72598	0.92249	1.27068
26. Miscellaneous Manufacturing	0.84232	0.83432	0.99050
27. Construction	1.17004	1.16248	0.99354
28. Electricity-Water-Gas	1.00264	0.85637	0.85412
29. Transportation-Storage	0.92354	0.96172	1.04134
30. Communications	0.78852	0.71462	0.90628
31. Trade	0.87709	0.86363	0.98465
32. Banking, other Financial Instit. and Insurance	0.71957	0.79507	1.10492
33. Other services	0.82025	0.76155	0.92844
34. Housing	0.68659	0.69061	1.00586
35. Public Services	0.64569	0.64786	1.00336

Note: Columns (1) and (2) have been calculated according to formula (3).

ment, and banking. This means that the impact of a unit increase in the final demand in the whole system of sectors on each of the above sectors was bigger in 1970 as compared to 1958. The sectors with an over 10% decrease in their forward linkage between 1958 and 1970 are mining and quarrying, beverages, leather and leather products, and electricity.

3. Changes in Employment and Capital Coefficients

Apart from changes in input-output coefficients, structural changes in an economy also take place by way of changes in the coefficients of the primary factors of production, namely labour and capital.

Table 4 presents the direct employment coefficients, Table 5 the direct capital coefficients, and Table 6 the direct capital-labour ratios. From these three tables the following observations can be made:

i. With the exception of the sectors of petroleum and coal products (where the direct employment coefficient increased between 1958 and 1970) and that of transport equipment (where the direct employment coefficient remained almost unchanged), the direct employment coefficients in all other sectors show a decrease between 1958 and 1970. The biggest decrease occurred in mining (72%) and the smallest in transport equipment (1,6%).

TABLE 4
Direct Employment Coefficients

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	47.05917	19.53873	0.41519
2. Mining	9.12517	2.55372	0.27985
3. Food	2.53182	1.75625	0.69367
4. Beverages	2.47831	1.98926	0.80267
5. Tobacco	2.39647	0.94346	0.39369
6. Textiles	8.53318	4.10876	0.48150
7. Footwear	7.76000	4.67618	0.60260
8. Clothing	2.52868	1.53853	0.60843
9. Wood and Cork	3.49565	3.03859	0.86925
10. Furniture	8.09964	4.25232	0.52500
11. Paper and paper products	6.03266	2.82582	0.46842
12. Printing-Publishing etc.	14.45643	5.87247	0.40622
13. Leather and leather products	7.58352	2.64444	0.34871
14. Rubber products	5.49808	3.22613	0.58677
15. Plastic products	20.38492	5.73595	0.28138
16. Chemicals	4.36123	2.14566	0.49199
17. Petroleum and Coal products	0.22857	0.35194	1.53975
18. Cement	5.84818	2.63107	0.44990
19. Glass and Glassware	11.39024	4.16639	0.36579
20. Non metallic mineral products	14.86295	6.06751	0.40823
21. Basic Metal Industries	1.58231	1.06822	0.67510
22. Metal products	6.99725	2.91463	0.41654
23. Machinery and Appliances	3.20639	1.60690	0.50116
24. Electrical Machinery	4.96343	2.40692	0.48493
25. Transport equipment	3.05462	3.00343	0.98324
26. Miscellaneous Manufacturing	3.20019	2.43378	0.76051
27. Construction	6.46287	4.21911	0.65282
28. Electricity-Water-Gas	4.20814	3.33705	0.79300
29. Transportation-Storage	12.26207	6.04391	0.49289
30. Communications	11.24955	4.99684	0.44418
31. Trade	15.30301	7.86832	0.51417
32. Banking, other Financial Instit. and Insurance	20.44086	10.52926	0.51511
33. Other services	20.76942	7.19386	0.34637
34. Housing	–	–	–
35. Public Services	6.58721	3.80244	0.57725

Note: Columns (1) and (2) show the number of workers employed by each sector per million Drachmas of gross sectoral production.

TABLE 5
Direct Capital Coefficients

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	0.50994	1.12426	2.20469
2. Mining	1.19127	0.90977	0.76370
3. Food	0.13737	0.18183	1.32365
4. Beverages	0.44067	0.22068	0.50078
5. Tobacco	0.25994	0.22406	0.86197
6. Textiles	0.48036	0.42921	0.89352
7. Footwear	0.16000	0.14765	0.92281
8. Clothing	0.04898	0.03073	0.62740
9. Wood and Cork	0.10750	0.22579	2.10037
10. Furniture	0.15273	0.15617	1.02252
11. Paper and paper products	0.96604	0.52370	0.54211
12. Printing-Publishing etc.	0.51682	0.38813	0.75100
13. Leather and leather products	0.31429	0.12465	0.39661
14. Rubber products	0.32981	0.46514	1.41033
15. Plastic products	0.84524	0.80731	0,95513
16. Chemicals	0.06484	0.56010	8.63819
17. Petroleum and Coal products	0.15222	0.09337	0.61339
18. Cement	2.60616	1.22012	0.46817
19. Glass and Glassware	0.09534	0.57213	6.00094
20. Non metallic mineral products	0.39803	0.56916	1.42994
21. Basic Metal Industries	0.39866	0.75977	1.90581
22. Metal products	0.45607	0.26418	0.57925
23. Machinery and Appliances	0.12232	0.07547	0.61699
24. Electrical Machinery	0.22769	0.14866	0.65291
25. Transport equipment	0.17844	0.24317	1.36275
26. Miscellaneous Manufacturing	0.33819	0.10247	0.30300
27. Construction	0.05196	0.08628	1.66051
28. Electricity-Water-Gas	6.25922	7.55069	1.20633
29. Transportation-Storage	2.80076	4.11861	1.47053
30. Communications	1.36347	2.41565	1.77169
31. Trade	1.03931	1.10913	1.06718
32. Banking, other Financial Instit. and Insurance	1.33357	0.90098	0.67562
33. Other services	1.50514	1.09147	0.72516
34. Housing	11.17034	11.73607	1.05065
35. Public Services	0.55155	0.36402	0.65999

Note: Columns (1) and (2) show the units of fixed capital (in Drachmas) required per unit of gross sectoral production (in Drachmas).

TABLE 6
Direct Capital-Labour Ratios

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	10.84	57.54	5.30812
2. Mining	130.55	356.25	2.72884
3. Food	54.26	103.53	1.90804
4. Beverages	177.81	110.93	0.62387
5. Tobacco	108.47	237.48	2.18936
6. Textiles	56.29	104.46	1.85575
7. Footwear	20.62	31.57	1.53104
8. Clothing	19.37	19.98	1.03149
9. Wood and Cork	30.75	74.31	2.41659
10. Furniture	18.86	36.73	1.94751
11. Paper and paper products	160.13	185.33	1.15737
12. Printing-Publishing etc.	35.75	66.09	1.84867
13. Leather and leather products	41.44	47.14	1.13755
14. Rubber products	59.99	144.18	2.40340
15. Plastic products	41.46	140.75	3.39484
16. Chemicals	14.87	261.04	17.55481
17. Petroleum and Coal products	665.95	265.29	0.39836
18. Cement	445.64	463.73	1.04059
19. Glass and Glassware	8.37	137.32	16.40621
20. Non metallic mineral products	26.78	93.80	3.50261
21. Basic Metal Industries	251.95	711.25	2.82298
22. Metal products	65.18	90.64	1.39061
23. Machinery and Appliances	38.15	46.97	1.23119
24. Electrical Machinery	45.87	61.76	1.34641
25. Transport equipment	58.42	80.96	1.38583
26. Miscellaneous Manufacturing	105.68	42.10	0.39837
27. Construction	8.04	20.45	2.54353
28. Electricity-Water-Gas	1487.41	2262.68	1.52122
29. Transportation-Storage	228.41	681.45	2.98345
30. Communications	121.20	483.44	3.98878
31. Trade	67.92	140.96	2.07538
32. Banking, other Financial Instit. and Insurance	65.24	85.57	1.31162
33. Other services	72.47	151.72	2.09356
34. Housing	—	—	—
35. Public Services	83.73	95.73	1.14332

Note: Columns (1) and (2) show the fixed capital (in thousands of Drachmas) directly employed per worker.

ii. Considering the direct capital coefficients in Table 5, we notice that in almost half of the sectors the coefficients have increased and in the rest of them they have decreased. The biggest (over 20%) increases have occurred in agriculture, food, rubber products, chemicals, glass and glassware, non-metallic mineral products, basic metal industries, transport equipment, construction, electricity, transportation and communications. The smallest decreases (less than 20%) in direct capital coefficients have occurred in tobacco, textiles, footwear, plastic products.

iii. The intertemporal differences in the direct employment and capital coefficients, however, do not imply any differences in the degree of economic development of the economy. A measure which would better reflect the degree of development is the capital-labour ratio. The higher the capital intensity (i.e. the capital-labour ratio) the higher the degree of development of the economy. Actually, in the case of the Greek economy, an extensive substitution of capital for labour has taken place, as can be seen from the comparison of the direct capital-labour ratios of 1958 and 1970 presented in Table 6. With the exception of the sectors of beverages, and petroleum and coal products, the capital intensity increased in all sectors of the economy, between 1958 and 1970. The sectors with the most spectacular increases in capital intensity are agriculture, chemicals, plastic products, glass and glassware, and non-metallic mineral products. In these sectors capital intensity more than tripled between 1958 and 1970.

So far we have discussed the changes in the direct employment and capital coefficients. In Tables 7, 8 and 9 we have computed the corresponding total coefficients.[1] As is well known, the total employment coefficient for a particular sector tells us the total (direct plus indirect) labour requirements per unit of final demand of the sector in question. Analogous is the meaning of total capital coefficients.

A comparison between the changes in the direct and total employment coefficients shows that in 21 sectors the changes in direct coefficients are bigger than the corresponding changes in total coefficients. In the remaining sectors the changes in direct coefficients are fewer than or equal to the corresponding changes in total coefficients. The differences between the changes in direct and total employment coefficients vary substantially from sector to sector. Thus, in 8 sectors the differences between the changes in direct and total coefficients are more than 20 percentage points, and in the remaining sectors less than 20 percentage points.

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1. For a particular year let

L_j = row vector of direct employment coefficients

K_j = row vector of direct capital coefficients

$(\frac{K}{L})j$ = row vector of direct capital-labour ratios

then

$L_j \cdot (I-A)^{-1}$ = total employment coefficients

$K_j \cdot (I-A)^{-1}$ = total capital coefficients

$(\frac{K}{L})j \cdot (I-A)^{-1}$ = total capital-labour ratios

TABLE 7
Total (Direct plus Indirect) Employment Coefficients

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	57.83819	23.65448	0.40898
2. Mining	12.90309	3.21413	0.24910
3. Food	38.44431	14.49589	0.37706
4. Beverages	32.56411	9.91941	0.30461
5. Tobacco	27.00578	8.51603	0.31534
6. Textiles	28.07025	10.23683	0.36469
7. Footwear	20.64921	9.91207	0.48002
8. Clothing	20.12346	8.97810	0.44615
9. Wood and Cork	14.79679	7.58216	0.51242
10. Furniture	16.71054	7.78018	0.46559
11. Paper and paper products	11.29429	5.81250	0.51464
12. Printing-Publishing etc.	20.00938	8.80147	0.43987
13. Leather and leather products	26.94993	8.08558	0.30002
14. Rubber products	11.68005	5.60524	0.47990
15. Plastic products	26.97899	8.59465	0.31857
16. Chemicals	11.11036	4.38529	0.39470
17. Petroleum and Coal products	0.46758	1.30192	2.78438
18. Cement	9.55366	5.14715	0.53876
19. Glass and Glassware	13.51444	5.67720	0.42008
20. Non metallic mineral products	21.13072	8.32352	0.39391
21. Basic Metal Industries	2.91886	2.95211	1.01139
22. Metal products	10.34413	4.94712	0.47825
23. Machinery and Appliances	4.28761	2.19491	0.51192
24. Electrical Machinery	7.31632	4.53747	0.62019
25. Transport equipment	3.84341	4.39947	1.14468
26. Miscellaneous Manufacturing	7.91251	3.87751	0.49005
27. Construction	14.76312	7.39141	0.50067
28. Electricity-Water-Gas	8.70117	4.73232	0.54387
29. Transportation-Storage	16.42173	7.77601	0.47352
30. Communications	13.56625	5.46198	0.40262
31. Trade	20.80056	9.45781	0.45469
32. Banking, other Financial Instit. and Insurance	21.58902	12.28853	0.56920
33. Other services	24.21356	7.95081	0.32836
34. Housing	0.61240	0.27869	0.45508
35. Public Services	6.58721	3.80244	0.57725

Note: Columns (1) and (2) show the number of workers employed by each sector per million Drachmas of final demand. They have been calculated according to formula $L_j (I-A)^{-1}$ where L_j the vector of direct employment coefficients and $(I-A)^{-1}$ the inverse matrix.

TABLE 8
Total (Direct plus Indirect) Capital Coefficients

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	0.69946	1.56839	2.24229
2. Mining	1.57198	1.22590	0.77985
3. Food	0.80083	1.24170	1.55052
4. Beverages	1.07819	1.02046	0.94738
5. Tobacco	0.66128	0.86040	1.30111
6. Textiles	1.10246	1.18186	1.07202
7. Footwear	0.72317	0.92992	1.28589
8. Clothing	0.85265	0.96736	1.13453
9. Wood and Cork	0.45978	0.73954	1.60846
10. Furniture	0.63766	0.77347	1.21298
11. Paper and paper products	1.70858	1.25812	0.73635
12. Printing-Publishing etc.	1.28528	1.06414	0.82794
13. Leather and leather products	1.01922	0.85393	0.83783
14. Rubber products	0.67521	0.93860	1.39009
15. Plastic products	1.39925	1.61911	1.15713
16. Chemicals	0.54403	1.12142	2.06132
17. Petroleum and Coal products	0.17294	0.42114	2.43518
18. Cement	3.51709	2.33277	0.66327
19. Glass and Glassware	0.29910	0.97555	3.26162
20. Non metallic mineral products	1.03871	1.31804	1.26892
21. Basic Metal Industries	0.63999	1.46742	2.29288
22. Metal products	0.92364	1.02318	1.10777
23. Machinery and Appliances	0.24853	0.25202	1.01404
24. Electrical Machinery	0.47706	0.67032	1.40511
25. Transport equipment	0.25557	0.54427	2.12963
26. Miscellaneous Manufacturing	0.53719	0.40443	0.75286
27. Construction	0.77424	0.81244	1.04934
28. Electricity-Water-Gas	6.80619	7.90937	1.16209
29. Transportation-Storage	3.10922	4.52544	1.45549
30. Communications	1.73058	2.59992	1.50234
31. Trade	1.45217	1.62063	1.11601
32. Banking, other Financial Instit. and Insurance	1.43361	1.18629	0.82748
33. Other services	1.81876	1.34533	0.73970
34. Housing	11.20483	11.76654	1.05013
35. Public Services	0.55155	0.36402	0.66000

Note: Columns (1) and (2) show the units of fixed capital (in Drachmas) required per unit of final demand. They have been calculated according to formula $K_j (I-A)^{-1}$ where K_j the vector of direct employment coefficients and $(I-A)^{-1}$ the inverse matrix.

TABLE 9
Total (Direct plus Indirect) Capital-Labour Ratios

Sector \ Year	1958 (1)	1970 (2)	(2):(1) (3)
1. Agriculture	12.09	66.30	5.48397
2. Mining	121.83	350.30	2.87532
3. Food	20.83	85.66	4.11234
4. Beverages	33.11	102.88	3.10722
5. Tobacco	24.49	101.03	4.12536
6. Textiles	39.28	115.45	2.93915
7. Footwear	35.02	93.82	2.67904
8. Clothing	42.37	107.75	2.54307
9. Wood and Cork	31.07	97.54	3.13936
10. Furniture	38.16	99.42	2.60535
11. Paper and paper products	151.28	216.45	1.43079
12. Printing-Publishing etc.	64.23	120.90	1.88230
13. Leather and leather products	37.82	105.61	2.79244
14. Rubber products	57.81	167.45	2.89656
15. Plastic products	51.86	188.39	3.63267
16. Chemicals	48.97	255.72	5.22197
17. Petroleum and Coal products	369.86	323.48	0.87460
18. Cement	368.14	453.22	1.23111
19. Glass and Glassware	22.13	171.84	7.76502
20. Non metallic mineral products	49.11	158.35	3.22439
21. Basic Metal Industries	219.26	497.07	2.26704
22. Metal products	89.29	206.82	2.31627
23. Machinery and Appliances	57.96	114.82	1.98102
24. Electrical Machinery	65.20	147.73	2.26580
25. Transport equipment	66.50	123.71	1.86030
26. Miscellaneous Manufacturing	67.89	104.30	1.53631
27. Construction	52.44	109.92	2.09611
28. Electricity-Water-Gas	782.21	1671.35	2.13670
29. Transportation-Storage	189.34	581.97	3.07368
30. Communications	127.57	476.00	3.73129
31. Trade	69.81	171.35	2.45452
32. Banking, other Financial Instit. and Insurance	66.40	96.54	1.45392
33. Other services	75.11	169.21	2.25283
34. Housing	18296.58	42220.89	2.30758
35. Public Services	83.73	95.73	1.14332

Note: Columns (1) and (2) show the fixed capital (in thousands of Drachmas) directly and indirectly employed per worker.

The comparison between the changes in the direct and total capital coefficients reveals that in the majority of sectors the changes in direct capital coefficients were, contrary to the changes in direct labour coefficients, smaller than the changes in the corresponding total capital coefficients. The number of sectors in which the differences between the changes in direct and total capital coefficients are more than 20 percentage points is much larger than the corresponding number of sectors which show more than 20 percentage points differences in the changes of employment coefficients. Furthermore, the differences in the changes between direct and total capital coefficients are much larger than the differences in the changes between direct and total employment coefficients. Thus, in three sectors (chemicals, petroleum and coal products, glass and glassware) the differences between the changes in the two kinds of capital coefficients are larger than 180 percentage points, in 4 sectors (clothing, electrical machinery, transport equipment, construction) they are larger than 50 but less than 100 percentage points, and in 10 sectors larger than 20 but less than 50 percentage points. In the remaining sectors the differences are less than 20 percentage points.

Finally, the comparison of the changes in direct with the changes in total capital-labour ratios shows that in most of the sectors the changes in direct coefficients are smaller than the changes in the corresponding total coefficients. Furthermore, the differences between the changes in the two kinds of ratios exceed, with very few exceptions, the 20 percentage points. Thus, in 5 sectors (i.e. food, beverages, chemicals, glass and glassware, housing) the differences between the changes in direct and total capital-labour

ratios are larger than 200 percentage points, in 6 sectors (i.e. tobacco, textiles, footwear, clothing, printing and publishing, miscellaneous manufacturing) they are larger than 100 but smaller than 200 percentage points, in 7 sectors (i.e. wood and cork, furniture, rubber products, basic metal industries, metal products, machinery and appliances, electrical machinery, electricity) they are smaller than 100 but larger than 50 percentage points, in 8 sectors they are between 20 and 50 percentage points and in the remaining sectors less than 20 percentage points.

C. IMPACT OF STRUCTURAL CHANGES

1. Changes in Gross Output Requirements

The sectoral differences in the growth of real product between 1958 and 1970 may be explained in terms of two factors: (a) changes in input-output coefficients[1] and (b) changes in final demand. The procedure followed for the separation of the two causes of total change in sectoral gross production is described below.

Let f^{58} and f^{70} be the total final demand vectors for 1958 and 1970 respectively, at constant 1970 prices and R_{ij}^{58} and R_{ij}^{70} the corresponding inverse matrices for these years. The total change in actual gross production between 1958 and 1970 is $(R_{ij}^{70} \cdot f^{70} - R_{ij}^{58} \cdot f^{58})$. This total change can be broken down into the part due to changes in input-output coefficients $(R_{ij}^{70} \cdot f^{70} - R_{ij}^{58} \cdot f^{70})$, and the part due to changes in final demand $(R_{ij}^{58} \cdot f^{70} - R_{ij}^{58} \cdot f^{58})$. In columns (1) and (2) of Table 10 are shown the actual sectoral gross outputs for 1958 and 1970 respectively, i.e. $R_{ij}^{58} \cdot f^{58}$ and $R_{ij}^{70} \cdot f^{70}$. Column (3) of the table shows the gross output required to deliver the 1970 final demand with the input-output relationships prevailing in 1958, i.e. $R_{ij}^{58} \cdot f^{70}$. Column (4) of the table shows the changes in actual gross outputs as percentage of the 1958 levels, i.e.

$$\frac{R_{ij}^{70} \cdot f^{70} - R_{ij}^{58} \cdot f^{58}}{R_{ij}^{58} \cdot f^{58}} \times 100$$

1. As mentioned in section A, the changes in input-output coefficients are caused by various factors among which are changes in technology, in product mix, etc.

TABLE 10
Causes of Change in Gross Production Requirements
(In mil. Drachmas at 1970 prices)

Sector	Actual gross production 1958 (1)	Actual gross production 1970 (2)
1. Agriculture	43.015	66.853
2. Mining	2.269	8.423
3. Food	29.089	46.044
4. Beverages	3.826	7.545
5. Tobacco	7.017	10.542
6. Textiles	12.703	23.705
7. Footwear	1.250	2.804
8. Clothing	7.269	15.521
9. Wood and Cork	2.986	5.235
10. Furniture	1.375	3.015
11. Paper and paper products	1.531	5.191
12. Printing-Publishing etc.	1.159	3.067
13. Leather and leather products	0.910	3.209
14. Rubber products	1.040	1.707
15. Plastic products	0.252	2.242
16. Chemicals	5.999	14.684
17. Petroleum and Coal products	4.060	13.098
18. Cement	0.909	2.903
19. Glass and Glassware	0.451	1.219
20. Non metallic mineral products	1.525	4.844
21. Basic Metal Industries	2.837	13.516
22. Metal products	4.006	12.522
23. Machinery and Appliances	3.818	12.268
24. Electrical Machinery	2.051	12.801
25. Transport equipment	6.170	12.552
26. Miscellaneous Manufacturing	1.029	2.469
27. Construction	17.802	53.580
28. Electricity-Water-Gas	2.604	7.260
29. Transportation-Storage	9.757	29.331
30. Communications	1.106	4.742
31. Trade	18.775	43.911
32. Banking, other Financial Instit. and Insurance	2.824	9.483
33. Other services	11.484	33.999
34. Housing	11.448	22.248
35. Public Services	14.327	30.214
Total	238.675	542.747

Computed gross production 1970	Percentage change in gross production 1958-1970		
	Total $\frac{(2)-(1)}{(1)} \cdot 100$	Due to coefficient change $\frac{(2)-(3)}{(1)} \cdot 100$	Due to final demand change $\frac{(3)-(1)}{(1)} \cdot 100$
(3)	(4)	(5)	(6)
83.177	55.42	−37.95	93.37
6.352	271.24	91.28	179.96
47.050	58.28	−3.46	61.74
7.941	97.20	−10.34	107.54
9.773	50.24	10.97	39.27
22.187	86.61	11.95	74.66
2.609	124.34	15.62	108.72
16.189	113.52	−9.19	122.71
8.690	75.32	−115.72	191.04
3.043	119.23	−2.00	121.23
4.338	239.05	55.73	183.32
1.954	164.62	95.99	68.63
2.811	252.241	43.65	208.76
2.121	64.09	−39.78	103.87
0.735	788.77	597.46	191.31
14.904	144.77	−3.66	148.43
11.398	222.59	41.88	180.71
2.752	219.27	16.60	202.67
1.128	170.55	20.32	150.23
5.235	217.71	−25.60	243.31
12.844	376.43	23.68	352.75
12.567	212.60	−1.11	213.71
11.645	221.32	16.33	204.99
8.847	524.10	192.76	331.34
9.896	103.45	43.05	60.40
2.879	139.90	−39.77	179.67
53.514	200.98	0.38	200.60
6.311	178.84	36.46	142.38
28.655	200.64	6.93	193.71
4.916	328.64	−15.77	344.41
45.617	133.88	−9.09	142.97
7.680	235.79	63.84	171.95
33.403	196.06	5.19	190.87
22.248	94.34	–	94.34
31.300	110.88	−7.58	118.46
546.707	127.40	−1.66	129.06

Column (5) shows the changes in gross outputs due to changes in input-output coefficients as percentage of the 1958 actual gross output levels, i.e.

$$\frac{R_{ij}^{70} \cdot f^{70} - R_{ij}^{58} \cdot f^{70}}{R_{ij}^{58} \cdot f^{58}} \times 100$$

Finally, column (6) shows the changes in gross outputs due to changes in final demand as percentage of the 1958 gross output, i.e.

$$\frac{R_{ij}^{58} \cdot f^{70} - R_{ij}^{58} \cdot f^{58}}{R_{ij}^{58} \cdot f^{58}} \times 100$$

1.1. Impact of Changes in Input-Output Coefficients on Gross Output Requirements

Column (5) of Table 10 shows that part of the percentage change in real gross sectoral output between 1958 and 1970, which is attributed solely to the changes in technical input-output coefficients.

Although the total gross production of the economy as a whole which would have been needed to satisfy the 1970 final demand, had the 1958 input-output relationships prevailed in the economy of 1970, is larger than actual 1970 gross production by only 1.66% of the 1958 gross production[1], there is a wide range of sectoral output changes both negative and positive. A negative change shows that the gross output which a sector would have needed to produce in order to satisfy the 1970 vector of final demand would have been smaller if the 1970 rather than the 1958 technical input-output relationship had been prevailing in both years. A positive change, on the other hand, shows that the

1. If we ignore signs, the change in total gross production due to coefficient changes comes out to be about 20% of the 1958 total gross production.

gross output requirements of the sector in question, needed to satisfy the 1970 vector of final demand would have been bigger if the 1970 rather than the 1958 technical input-output relationship had been prevailing in both years.

A close examination of column (5) of Table 10 shows that in the majority of sectors the change in technical input-output relationships alone resulted in increases in their output requirements for delivering the same 1970 set of final demands.[1]

The largest positive impact of changing coefficients on gross production requirements is observed in plastic products, electrical machinery, printing and publishing, mining, banking etc., paper and paper products, leather and leather products, transport equipment, petroleum and coal products, electricity, basic metal industries, glass and glassware. In all the above sectors the increase in their gross output requirements between 1958 and 1970, as a result of the changed input-output relationships alone, ranged between 20% for glass and glassware to 597% for plastic products. In the remaining sectors which show increase in gross output requirements, the changes were below 20%. The largest decreases (over 20%) in output requirements occur in agriculture, wood and cork, rubber products, non-metallic mineral products, and miscellaneous manufacturing.

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1. It is generally to be expected that industries that sell primarily to final demand will show smaller percentage changes over time in gross output requirements than sectors that sell primarily to other producing sectors. The most extreme case is housing (sector 34) which sells its entire output directly to final demand. As is to be expected, the gross output requirements for this sector, for delivering the 1970 final demand, are the same, no matter which year's input-output relationships are used.

The reduction in output requirements in these sectors (as well as in a few others exhibiting negative change) can be interpreted as the result of technological progress which has made it possible to deliver the same 1970 final demand with less gross production in 1970 than in 1958.

The changes presented in column (5) of Table 10 can be broken down into many components, representing changes in gross output requirements for delivering the various elements of final demand. For some items of final demand a sector's gross output requirements may be increasing while for some others they may be decreasing. In order to see whether the net shifts, appearing in column (5) of Table 10, represent very strong tendencies in certain basic areas or not, the 35-order final demand vector of 1970 has been subdivided into five major subvectors, namely, private consumption, public consumption, fixed investment, change in stocks, and exports. The 1958 and 1970 inverse matrices were multiplied by each subvector of final demand and in this way the total sectoral output requirements for each subvector of final demand and for each year were estimated.

The result of these calculations was a set of 5 35-order gross output vectors for each year. By comparing the corresponding actual and computed gross output subvectors for 1970 we can see how the total gross outputs (direct plus indirect) required to deliver the 1970 final demand subvectors changed as a result of the changed coefficients. In Table 11 we present separately the changes in gross output (as percentage of the 1958 gross output) which would have been needed to satisfy each subvector of final demand of 1970 if the 1958

technical input-output relationships had been prevailing in the economy in 1970.[1]

From Table 11 we can see that the changes in technical input-output coefficients have affected in different degrees the output requirements for producing each vector of final demand. More specifically:

a. Private consumption: For mining, textiles, paper and paper products, printing and publishing, leather and leather products, plastic products, petroleum and coal products, electrical machinery, transport equipment, electricity, banking, etc., the gross outputs needed for producing the private consumption respectively have increased by more than 20%, with the biggest increases occurring in mining (154%), plastic products (242%) and transport equipment (188%). For agriculture, wood and cork, non-metallic mineral products, metal products, miscellaneous manufacturing, communications, and public services we observe decreases in output requirements by more than 20%, with the biggest decreases occurring in wood and cork (64%), and metal products (65%). In the majority of the remaining sectors the changes (negative or positive) in output requirements are below 10%.

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1. Each column of Table 11 has been calculated as follows:

Let f_{im}^{58} and f_{im}^{70} be the subvector of the m^{th} final demand component for 1958 and 1970 respectively. Then the percentage changes in gross output requirements for delivering the 1970 subvector by using the 1958 input-output relationships are

$$\frac{R_{ij}^{70} \cdot f_{im}^{70} - R_{ij}^{58} \cdot f_{im}^{70}}{R_{ij}^{58} \cdot f_{im}^{58}} \times 100$$

It is in an analogous way that the percentage changes in gross output requirements for the other subvectors of final demand have been estimated.

TABLE II

Percentage Change in Gross Production Requirements for Final Demand due to Changes in Input-Output Coefficients 1958-70

Sector	Private consumption (1)	Public consumption (2)
1. Agriculture	−31.62	−28.33
2. Mining	153.97	92.51
3. Food	−2.41	−2.95
4. Beverages	−8.49	−2.04
5. Tobacco	16.98	−656.08
6. Textiles	20.71	3.84
7. Footwear	15.21	4.84
8. Clothing	−6.16	−8.28
9. Wood and Cork	−63.94	−65.32
10. Furniture	−7.92	−3.77
11. Paper and paper products	46.05	1.75
12. Printing-Publishing etc.	70.18	36.12
13. Leather and leather products	33.69	7.02
14. Rubber products	−9.44	−31.75
15. Plastic products	241.93	236.93
16. Chemicals	−7.42	−1.20
17. Petroleum and Coal products	69.53	−1.60
18. Cement	−18.81	2.37
19. Glass and Glassware	−2.64	8.89
20. Non metallic mineral products	−24.15	−6.03
21. Basic Metal Industries	2.16	11.37
22. Metal products	−65.17	11.73
23. Machinery and Appliances	−3.75	163.68
24. Electrical Machinery	101.34	77.92
25. Transport equipment	188.46	103.75
26. Miscellaneous Manufacturing	−68.27	−9.22
27. Construction	10.89	−1.31
28. Electricity-Water-Gas	22.60	13.02
29. Transportation-Storage	16.11	−1.79
30. Communications	−31.98	−6.96
31. Trade	−5.48	−8.89
32. Banking, other Financial Instit. and Insurance	61.08	155.31
33. Other services	8.36	13.43
34. Housing	0	0
35. Public Services	−37.10	−0.28
Net total changes	−2.51	2.06
Absolute total changes	19.77	7.42

Fixed investment	Changes in stocks	Exports	Total demand
(3)	(4)	(5)	(6)
−179.60	−236.27	−42.13	−37.95
50.09	31.95	51.73	91.28
−58.41	115.91	−6.46	−3.46
201.61	15.50	−7.32	−10.34
−295.92	11.29	5.99	10.97
−125.91	0.00	−9.13	11.95
0.00	−11.32	0.00	15.62
−202.89	−60.99	−125.15	−9.19
−146.64	−246.43	−152.55	−115.72
51.88	31.68	−228.88	−2.00
156.90	1018.24	41.09	55.73
435.47	1807.97	284.10	95.99
−228.44	1195.12	117.98	43.65
−177.67	−453.03	−53.97	−39.78
19013.79	1201.42	11173.16	597.46
111.96	−19.47	−18.00	−3.66
−26.40	−83.89	52.92	41.88
21.79	−119.93	16.40	16.60
50.10	−41.83	37.14	20.32
−20.84	−5.35	−56.67	−25.60
29.53	−41.11	−11.21	23.68
79.49	−274.81	−49.19	−1.11
18.33	−36.55	46.83	16.33
313.10	125.39	680.32	192.76
10.64	−12980.36	248.15	43.05
0.83	116.31	−59.25	−39.77
0.00	8.68	19.31	0.38
124.83	216.41	115.47	36.46
−47.50	−1.04	9.78	6.93
146.25	109.46	−31.83	−15.77
−38.87	−31.69	1.72	−9.09
−11.27	496.56	127.47	63.84
−124.58	284.86	275.88	5.19
0	0	0	0
−292.24	−7140.90	−229.67	−7.58
3.06	−41.74	−3.98	−1.66
38.48	111.83	28.84	20.40

b. Public consumption: The biggest increases (over 30%) in output requirements are observed in mining, printing and publishing, machinery and appliances, electrical machinery, transport equipment, and plastic products, which exhibit, as in the case of private consumption, the largest positive change (237%). The largest decreases in output requirements (over 28%) occur in agriculture, wood and cork, rubber products, and tobacco, which exhibits the largest decrease (656%). For most of the remaining sectors the changes (positive or negative) do not exceed 10%.

c. Fixed investment: The gross output requirements of most of the sectors for producing fixed investment items have been substantially affected by changes in input-output coefficients. Some sectors show over 100% positive changes. These are beverages, paper and paper products, printing and publishing, chemicals, electric machinery, electricity, communications, and plastic products which show the largest positive (and absolute) percentage change (19014%) of all sectors. On the other hand, agriculture, tobacco, textiles, clothing, wood and cork, leather and leather products, rubber products, and other services show decreases in their gross outputs which are more than 100% of their 1958 output requirements.

d. Exports: The gross output requirements for the production of the export subvector of final demand show the largest percentage increases (over 100%) in printing and publishing, leather and leather products, plastic products, electrical machinery, transport equipment, electricity, banking etc., and other services. The largest (over 100%) decreases in gross output require-

ments are observed in clothing, wood and cork, furniture, and public services.

As can be observed from Table 11, for each subvector of final demand, the gross output requirements in some sectors increase while in others they decrease. In order to have an index of the total change for each subvector of final demand, we have calculated the absolute total changes in gross output requirements (ignoring the signs) and taken them as percentage of the 1958 actual magnitudes. These figures are shown in the last line of Table 11. In the line before the last of this table are presented the percentage net total changes.[1] A comparison of these two lines shows that the impact of the changed input-output coefficients on the gross output requirements for producing each subvector of final demand was much bigger than net total changes show.

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1. In the case of the m^{th} final demand component the percentage net total change would be

$$\frac{\sum_{i=1}^{35} (R_{ij}^{70} \cdot f_{im}^{70} - R_{ij}^{58} \cdot f_{im}^{70})}{\sum_{i=1}^{35} R_{ij}^{58} \cdot f_{im}^{58}} \cdot 100$$

and the absolute total change,

$$\frac{\sum_{i=1}^{35} \left| R_{ij}^{70} \cdot f_{im}^{70} - R_{ij}^{58} \cdot f_{im}^{70} \right|}{\sum_{i=1}^{35} R_{ij}^{58} \cdot f_{im}^{58}} \cdot 100$$

Thus, while the net total percentage changes in private consumption, fixed investment and exports did not exceed 4%, the percentage absolute total changes are 20%, 38% and 29% respectively.

1.2. Impact of Final Demand Changes on Gross Output Requirements

Between 1958 and 1970 total final demand increased by 133.98%. This increase in total final demand did not affect all sectors of the economy to the same degree. This can be easily observed in column (6) of Table 10. This column shows the percentage change in sectoral gross output attributed to the changes in final demand only.

As can be seen from column (6) of Table 10, in 22 out of 35 sectors, the increases in gross output due to final demand only were above the average increase in total gross production. Tobacco is the sector with the smallest increase (39%) in gross production due to final demand change only and the basic metal industry is the sector with the biggest increase (353%). From columns (4) and (6) of Table 10 it becomes obvious that the gross production in 13 sectors would have increased more than it actually did if final demand only had changed between 1958 and 1970 (the coefficients remaining constant). For example, the increase in gross agricultural production would have been 93.37% instead of 55.42% shown in column (4). On the other hand, the remaining sectors (excluding housing, which shows the same percentage change) show lower final demand change than total change.

A comparison (sector by sector) of the percentage changes (ignoring signs) due to final demand with those

due to changes in technical input-output coefficients, shows that only in the sector of plastic products was the percentage change in gross production due to changes in technical coefficients bigger than that due to final demand change. In all other sectors the impact of final demand (percentagewise) on gross production was larger than that of the changed technical input-output coefficients.

So far, in analysing the impact of final demand on gross production no distinction has been made between the influences due to the change in final demand structure and those due to the change in the total amount of final demand. The decomposition of the impact of final demand changes on gross production into the part due to changes in the final demand structure and the part due to changes in the total amount of final demand may be computed by

$$R_{ij}^{58} \cdot f^{70} - R_{ij}^{58} \cdot f^{58} = (R_{ij}^{58} \cdot f^{70} - R_{ij}^{58} \cdot f^{58,70}) + (R_{ij}^{58} \cdot f^{58,70} - R_{ij}^{58} \cdot f^{58})$$

where $f^{58,70}$ is a 35×1 vector whose elements have been calculated by allocating the 1970 actual total amount of final demand (and its components) according to the 1958 percentage distribution of final demand. The left-hand side of the above formula shows the change in gross output requirements which is attributed to the change in both the total amount and the structure of final demand. It is this composite change in gross output requirements we have already talked about. The magnitude in the first parenthesis (i.e. $R_{ij}^{58} \cdot f^{70} - R_{ij}^{58} \cdot f^{58,70}$) on the right-hand side of the formula shows the part of the change in gross output requirements which

is attributed solely to the change in the structure of final demand between 1958 and 1970. The magnitude in the second parenthesis (i.e. $R_{ij}^{58} \cdot f^{58,70} - R_{ij}^{58} \cdot f^{58}$) shows the change in gross output requirements which is attributed solely to the change in the total amount of final demand between 1958 and 1970. Column (6) of Table 12 has been calculated by expressing ($R_{ij}^{58} \cdot f^{70} - R_{ij}^{58} \cdot f^{58,70}$) as percentage of $R_{ij}^{58} \cdot f^{58}$. Columns (1) through (5) of the same table have been calculated by

$$\frac{R_{ij}^{58} \cdot f_{im}^{70} - R_{ij}^{58} \cdot f_{im}^{58,70}}{R_{ij}^{58} \cdot f_{im}^{58}} \cdot 100$$

Column (6) of Table 12 shows the percentage changes in gross outputs due solely to the changes in the structure of total final demand between 1958 and 1970. Although total gross production of the economy in 1970 reduced by 4.93% as a result of the changed structure of total final demand, a wide range of changes is observed among sectoral gross outputs. In 13 sectors the changed structure of final demand resulted in decreases in their gross output requirements while in the remaining sectors it resulted in increases. In agriculture, food, beverages, tobacco, footwear, printing and publishing, rubber products, transport equipment, and housing the changed structure of final demand resulted in over 25% decreases in their gross output requirements, with the largest decrease occurring in transport equipment (73%). On the other hand, in the sectors whose gross output is increased because of the changed structure of final demand, there is a bigger variation in

gross output changes. More specifically, among the 17 sectors which show a more than 45% increase in their gross output, the smallest percentage increases (45%) occur in mining and miscellaneous manufacturing and the largest ones in basic metal industries (219%) and communications (210%).

The changed structure of total final demand between 1958 and 1970 was apparently the net result of the changed structure of the various final demand components, i.e. private consumption, public consumption, fixed investment, changes in stocks and exports. In columns (1) through (5) of Table 12 are presented the percentage changes in gross output (required to produce each subvector of final demand) which are due solely to the changed structure of the various components of final demand. More specifically:

a. Private consumption: Among the 16 sectors whose gross outpout has been negatively affected by changes in the structure of private consumption, 9 sectors show a greater than 30% percentage negative change, with the largest decreases occurring in non-metallic mineral products (95%) and food (84%), and the smallest ones in agriculture (31%), and wood and cork (33%). On the other hand, among the sectors showing increases in their gross outputs because of changes in the structure of private consumption, 4 show percentage changes over 100%. These are paper and paper products (105%), electrical machinery (137%), communications (270%), and public services (100%).

b. Public consumption: The variation in the gross output percentage changes due to the changed structure of public consumption is considerably larger than in the case of private consumption. Among the 20 sectors which show decreases in their gross outputs, 9 show

decreases over 100%, the largest percentage decreases occurring in housing (196%) and food (173%). On the other hand, out of the 15 sectors with positive changes in their gross outputs, 7 sectors show increases by more than 200%, 2 sectors 100%-200% and the remaining ones less than 100%.

c. Fixed investment: With the exception of clothing, transport equipment and trade, the gross outputs of all other sectors have increased as a result of the changed structure of fixed investment. The largest positive (over 100%) percentage changes have occurred in furniture (472%), leather and leather products (270%), electrical machinery (202%), and miscellaneous manufacturing (127%). The largest negative percentage change has occurred in transport equipment (182%).

d. Changes in stocks: The changes in gross outputs due to the changed structure of stocks show much bigger variations in comparison to the changes due to the changed structure of the other final demand components.

e. Exports: In 22 sectors, gross output has increased as a result of the changed structure of exports. Out of these, 7 sectors show greater than 1000% percentage increases. These are plastic products (5469%), non-metallic mineral products (1230%), basic metal industries (3130%), electrical machinery (1312%), construction (1316%), other services (4891%), and public services (2333%). The percentage decreases (in absolute numbers) are much smaller than the percentage increases. The largest percentage decreases have occurred in agriculture (109%), beverages (132%), tobacco (202%), and miscellaneous manufacturing (127%).

A comparison of the last two lines of Table 12 in which are recorded the net total and the absolute total

percentage changes, shows that the impact of the changed structure of final demand on gross outputs was much bigger than net total changes indicate.[1]

Thus, the net total change in total final demand is 4.93% and the absolute total change is 50.77%. As regards the components of final demand, the largest difference between net total changes and absolute total changes occurred in stocks. Then, the second largest difference occurred in exports followed by public consumption, fixed investment and private consumption.

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1. Net total percentage changes were calculatd by the formula

$$\frac{\sum_{i=1}^{35} (R_{ij}^{58} \cdot f_{im}^{70} - R_{ij}^{58} \cdot f_{im}^{58,70})}{\sum_{i=1}^{35} R_{ij}^{58} \cdot f_{im}^{58}} \cdot 100$$

Absolute total percentage changes were calculated by the formula

$$\frac{\sum_{i=1}^{35} \left| R_{ij}^{58} \cdot f_{im}^{70} - R_{ij}^{58} \cdot f_{im}^{58,70} \right|}{\sum_{i=1}^{35} R_{ij}^{58} \cdot f_{im}^{58}} \cdot 100$$

where $f_{im}^{58,70}$ is a 35×1 vector whose elements were calculated by allocating the 1970 total of the m^{th} final demand component according to the 1958 percentage distribution.

TABLE 12

Percentage Changes in Gross Outputs 1958-1970, due to Changes in the Structure of Final Demand

Sector	Private Consumption (1)	Public Consumption (2)
1. Agriculture	−31.39	−139.57
2. Mining	0.73	−46.37
3. Food	−83.70	−172.94
4. Beverages	−45.58	168.74
5. Tobacco	−0.36	460.57
6. Textiles	−12.96	−128.46
7. Footwear	−10.36	−133.88
8. Clothing	2.91	−106.87
9. Wood and Cork	−33.03	−61.17
10. Furniture	−47.19	−124.38
11. Paper and paper products	105.37	18.21
12. Printing-Publishing etc.	11.84	110.36
13. Leather and leather products	16.64	−147.21
14. Rubber products	−47.13	−76.14
15. Plastic products	94.72	−135.59
16. Chemicals	9.24	−35.01
17. Petroleum and Coal products	99.70	−37.73
18. Cement	−3.02	−76.77
19. Glass and Glassware	−40.80	−95.35
20. Non metallic mineral products	−94.64	−78.35
21. Basic Metal Industries	−0.25	203.81
22. Metal products	−20.61	476.52
23. Machinery and Appliances	−50.80	337.13
24. Electrical Machinery	136.91	−35.70
25. Transport equipment	98.97	432.57
26. Miscellaneous Manufacturing	62.29	−85.78
27. Construction	6.72	−81.05
28. Electricity-Water-Gas	1.41	93.44
29. Transportation-Storage	83.85	47.23
30. Communications	269.57	49.21
31. Trade	13.47	−75.28
32. Banking, other Financial Instit. and Insurance	11.83	696.62
33. Other services	28.48	279.74
34. Housing	−7.48	−195.51
35. Public Services	100.23	2.15
Net total Changes	−10.91	−8.25
Absolute total Changes	39.15	63.39

Fixed investment	Changes in stocks	Exports	Total final demand
(3)	(4)	(5)	(6)
38.84	74.36	−108.74	−40.62
38.89	−821.88	−56.22	45.97
34.11	−5568.40	−48.93	−72.25
39.99	−1222.91	−132.11	−26.45
18.87	−772.67	−201.65	−94.72
63.97	−869.50	−88.24	−59.33
0	−1125.17	0	−25.27
−13.50	395.17	229.03	−11.28
53.57	1204.19	58.10	57.05
472.13	−861.51	289.01	−12.76
7.72	−2461.50	−53.93	49.33
1.62	−23189.32	39.69	−65.37
278.60	7377.85	562.75	74.77
43.06	−333.29	188.23	−30.12
88.61	−1295.57	5468.52	57.32
40.22	−558.33	49.69	14.44
28.53	1143.40	111.35	46.72
41.37	93.97	80.39	68.69
48.30	57.26	72.73	16.24
40.73	−808.34	1229.93	109.32
34.73	−1015.94	3130.03	218.76
45.57	3596.24	475.58	79.73
19.59	2632.94	−43.46	71.00
202.43	−106.12	1312.00	197.35
−182.23	−69893.26	167.47	−73.59
126.90	−10582.84	−127.46	45.68
41.42	7943.89	1315.77	66.61
25.86	−80.69	89.91	8.39
13.16	317.44	−6.73	59.72
13.55	−49.50	170.01	210.42
−8.35	1044.61	170.85	8.98
37.36	−1377.98	−24.28	37.96
35.18	−26.68	4891.34	56.88
0	0	0	−39.65
24.75	13339.31	2332.74	−15.53
13.24	16.11	−22.85	−4.93
59.62	1941.90	161.99	50.77

2. Changes in Intermediate Output and Input Requirements

The analysis in section 1.1, based on the total (direct and indirect) effects of coefficient changes, has helped to summarize the effect which the various changes in input coefficients in all industries had on the production of a given sector. However, it may well happen that the direct and indirect impacts on the output of a given sector offset each other, thus giving a false impression about the effects of coefficient change over time. Also, no knowledge was provided by the previous analysis about the substitutions which took place among the various inputs of a given producing sector.

For these reasons, a better way to summarize the impact of intertemporal changes in the various input coefficients on production, might be to concentrate on changes in intermediate outputs and inputs rather than in total output requirements.

Tables 13 and 14 present the changes in intermediate output and input requirements of individual sectors, based on direct rather than inverse coefficients. To derive these figures, the actual 1970 gross output for each sector was multiplied, in turn, by the 1958 and 1970 direct coefficient matrix. From these multiplications we derive the intermediate outputs and inputs that would have been required from and by each industry in order to produce the actual 1970 output levels with 1958 and 1970 input-output coefficients respectively.[1]

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1. If A_{ij}^{58} and A_{ij}^{70} are the direct input-output coefficient matrices for 1958 and 1970 respectively, and $\hat{X}_j^{70}$ is the diagonal matrix with diagonal elements the 1970 gross outputs and off-diagonal elements equal to zero, then

Column (3) of Table 13 shows the changes in intermediate output sold by each sector to other sectors between 1958 and 1970. As indicated in column (3) of Table 13, fairly high rates of technical change can be observed in the intermediate outputs of certain sectors. More specifically we observe the following:

i. A reduction in the intermediate demand for agricultural products. This reflects, to a great extent,

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$$\sum_{j=1}^{35} A_{ij}^{70} \cdot \hat{X}_j^{70}$$

and

$$\sum_{j=1}^{35} A_{ij}^{58} \cdot \hat{X}_j$$

are the total intermediate output that would be required from industry i if we used 1970 and 1958 technilogies respectively. The ratio

$$\sum_{j=1}^{35} A_{ij}^{70} \cdot \hat{X}_j^{70} / \sum_{j=1}^{35} A_{ij}^{58} \cdot \hat{X}_j^{70}$$

would measure the change in intermediate outputs between 1958 and 1970. Similarly

$$\sum_{i=1}^{35} A_{ij}^{70} \cdot \hat{X}_i^{70} / \sum_{i=1}^{35} A_{ij}^{58} \cdot \hat{X}_i^{70}$$

would measure the change in intermediate input requirements between 1958 and 1970 by sector j.

TABLE 13
Changes in Intermediate Outputs

Sector \ Year	Computed 1970 interme-diate outputs (1)	Actual 1970 interme-diate outputs (2)	(2):(1) (3)
1. Agriculture	48972	35758	0.730172
2. Mining	5640	7660	1.358156
3. Food	10787	10081	0.934551
4. Beverages	1379	1055	0.765047
5. Tobacco	4	773	193.250000
6. Textiles	16126	17700	1.097606
7. Footwear	–	195	–
8. Clothing	1138	433	0.380492
9. Wood and Cork	7255	4426	0.610062
10. Furniture	441	423	0.959184
11. Paper and paper products	3736	4018	1.075482
12. Printing-Publishing etc.	1097	2176	1.983592
13. Leather and leather products	1590	1861	1.170440
14. Rubber products	1722	1259	0.731127
15. Plastic products	75	1559	20.786667
16. Chemicals	8004	7701	0.962144
17. Petroleum and Coal products	9114	10613	1.164472
18. Cement	2600	2749	1.057308
19. Glass and Glassware	971	1046	1.077240
20. Non metallic mineral products	5256	4909	0.933980
21. Basic Metal Industries	10426	10606	1.017266
22. Metal products	7968	7733	0.970507
23. Machinery and Appliances	1587	2236	1.408948
24. Electrical Machinery	2105	5909	2.807126
25. Transport equipment	2498	5070	2.029624
26. Miscellaneous Manufacturing	810	365	0.450617
27. Construction	1690	1743	1.031361
28. Electricity-Water-Gas	3925	4748	1.209682
29. Transportation-Storage	7399	8062	1.089607
30. Communications	1878	1674	0.891374
31. Trade	10014	8185	0.817356
32. Banking, other Financial Instit. and Insurance	5977	7779	1.301489
33. Other services	4783	5309	1.109973
34. Housing	0	0	0
35. Public Services	1366	304	0.222548
Grand total	188333	186120	0.988250
Total manufacturing (3-26)	96689	104896	1.08489
Total services (29-35)	31417	31313	0.99669

Note: Column (1) shows the intermediate outputs which would have been produced by each sector if the 1958 technological matrix had been used to produce the 1970 gross outputs. Column (2) shows the actual 1970 intermediate outputs. The figures in columns (1) and (2) are expressed in millions of Drachmas, at 1970 prices.

the fact that there has taken place a substitution of manufactured products as intermediate inputs for primary agricultural products.

ii. General increase in the demand for total manufactured products as intermediate inputs. However, within the manufacturing sector, we observe changes in opposite directions: in some branches of the manufacturing sector the demand for intermediate products has risen while in others it has declined. This is due to a great extent to the substitutions among the various manufactured inputs.[1] Among the manufacturing sectors the biggest (over 40%) increases in their products as intermediate outputs to other sectors occur in tobacco, footwear, printing and publishing, plastic products, machinery and appliances, electrical machinery, transport equipment. On the other hand, the biggest decreases (over 25%) occur in clothing, wood and cork, rubber products, and miscellaneous manufacturing.

iii. Among the non-manufacturing industrial sectors, mining and electricity show a substantial (over 20%) increase in the demand for their products as intermediate inputs.

iv. The use of inputs from the service sectors, as a whole (30-35) does not show any substantial change, though in banking etc., we notice a significant (over 30%) increase, and in public services a significant decrease (about 80%).

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1. For example, the spectacular increase in the intermediate demand for plastic products is certainly due, to a high degree, to the substitution of this raw material for other traditional materials such as wood, rubber, fabrics and various other manufactured raw materials.

Column (3) of Table 14 shows the changes in intermediate input requirements by the various sectors, between 1958 and 1970. In examining this column, the following observations can be made:

i. For the same gross production, the economy as a whole would require slightly fewer raw materials in 1970 compared to 1958. This implies a more efficient use of raw materials in 1970 and a corresponding increase in the value added ratio. Although this increase in efficiency in the use of intermediate inputs is not significant (less than 2%), in some sectors we notice substantial decreases in the intermediate inputs and in others substantial increases.

ii. In manufacturing as a whole we notice only a slight increase in the use of raw materials. This implies that manufacturing as a whole was less efficient in the use of raw materials in 1970 compared to 1958. The pattern of changes in the individual manufacturing sectors does not follow the pattern of manufacturing as a whole. Thus, among the 24 manufacturing sectors, 11 show increase in their intermediate input ratios (and a decrease in the corresponding value added ratios) and the rest show decreases. The biggest (over 20%) increases in the intermediate input ratios occurred in footwear (25%), petroleum and coal products (920%), glass and glassware (20%), basic metal industries (67%), electrical machinery (60%), and transport equipment (226%). The biggest decrease (over 20%) occurred in beverages. In the remaining manufacturing sectors the increases or decreases were less than 20%.

iii. Among the non-manufacturing industrial sectors we notice a substantial efficiency increase in the use of

TABLE 14
Changes in Intermediate Inputs

Sector \ Year	Computed 1970 interme-diate outputs (1)	Actual 1970 interme-diate outputs (2)	(2):(1) (3)
1. Agriculture	17226	18540	1.076280
2. Mining	2278	1340	0.588235
3. Food	34546	30774	0.890812
4. Beverages	5184	4051	0.781443
5. Tobacco	5001	4514	0.902619
6. Textiles	13390	11961	0.893279
7. Footwear	1428	1786	1.250700
8. Clothing	10402	11447	1.100461
9. Wood and Cork	2165	1945	0.898383
10. Furniture	1610	1454	0.903106
11. Paper and paper products	2177	2373	1.090032
12. Printing-Publishing etc.	1344	1363	1.014137
13. Leather and leather products	2125	1790	0.842353
14. Rubber products	513	537	1.046784
15. Plastic products	1181	1048	0.887384
16. Chemicals	5493	4940	0.899326
17. Petroleum and Coal products	327	3336	10.201835
18. Cement	1521	1371	0.901381
19. Glass and Glassware	277	333	1.202166
20. Non metallic mineral products	2043	2022	0.989721
21. Basic Metal Industries	3074	5122	1.666233
22. Metal products	6075	5724	0.942222
23. Machinery and Appliances	1425	1577	1.106667
24. Electrical Machinery	3298	5273	1.598848
25. Transport equipment	1122	3656	3.258467
26. Miscellaneous Manufacturing	558	474	0.849462
27. Construction	29600	27833	0.940270
28. Electricity-Water-Gas	3019	1795	0.594568
29. Transportation-Storage	10350	10386	1.003478
30. Communications	737	336	0.455902
31. Trade	11148	10323	0.925996
32. Banking, other Financial Instit. and Insurance	734	1681	2.290191
33. Other services	6116	4190	0.685088
34. Housing	846	825	0.975177
35. Public Services	—	—	—
Grand total	188333	186120	0.988250
Total manufacturing (3-26)	106279	108871	1.024407
Total services (29-35)	29931	27741	0.926800

Note: Column (1) shows the intermediate inputs which would have been required by each sector if the 1958 technological matrix had been used to produce the 1970 gross outputs. Column (2) shows the actual 1970 intermediate inputs. The figures in columns (1) and (2) are expressed in millions of Drachmas, at 1970 prices.

raw materials for mining and electricity with decreases in their intermediate input ratios around 40% for both sectors.

iv. The use of intermediate inputs by services as a whole shows a less than 10% decline between 1958 and 1970, the implication being that an efficiency increase in the use of intermediate inputs took place. However, we notice a substantial efficiency decrease in banking. The biggest decreases in the intermediate input occurred in communications (54%) and other services (31%).

3. Changes in Primary Input Requirements

The computations presented in this section are designed to show the effects of structural changes on labour and capital requirements.

In Tables 15 and 16 the 1970 set of final demand is used as the basis of all subsequent comparisons.

3.1. Impact of Structural Changes on Labour Requirements

In column (1) of Table 15 we have computed the labour requirements for the production of the 1970 set of final demand by the 1958 input-output structure and the 1958 employment coefficients. The difference between the computed labour requirements and the actual 1970 employment figures shows the total labour saving (or increase in total labour requirements) achieved as a result of the combined effects of changes in both input-output coefficients and employment coefficients.

In the case of the Greek economy, the labour which would have been required for the production of the 1970 set of final demand with the 1958 input-output and employment coefficients is 7,473,727 workers. Given the fact

that 3,135,667 workers were actually employed in 1970, the total labour saving is 7,473,727–3,135,667=4,338,060 workers. This saving has been achieved through changes both in the labour coefficients and the structural input-output matrix.

Depending on the technical progress as affected a particular sector, on the one hand, and the size of that sector as compared with the rest of the economic system, on the other, the sectoral labour savings show substantial variations among themselves. In column (4) of Table 15 we have computed the changes in labour requirements in each sector as a percentage of the 1970 actual sectoral employment. Although for the economy as a whole the labour saving was 138% of the 1970 actual labour employment, there is a big variation in labour saving among sectors. In 31 sectors the labour savings ranged from 16% to 200%. The sectors in which labour saving was more than 100% are agriculture (200%), mining (170%), tobacco (152%), leather and leather products (112%), chemicals (106%), cement (111%), glass and glassware (153%), non-metallic mineral products (165%), metal products (141%), transportation (113%), communications (133%), trade (102%), other services (184%). On the other hand, only in petroleum and coal products, transport equipment and electricity is there an increase in labour requirements in 1970 as compared to 1958.

So far we have talked about the total effects of the 1958-1970 changes in both input-output coefficients and employment coefficients on labour requirements. In order to see the separate effects of the changes in input-output coefficients and those in employment coefficients, a new vector of employment figures has been computed and is presented in column (2) of Table 15.

TABLE 15
Effects of Structural Changes on Labour Requirements

Sector	Computed 1970 labour requirements (1)	Computed 1970 labour requirements (2)
1. Agriculture	3914241	1625173
2. Mining	57963	16221
3. Food	119122	82631
4. Beverages	19680	15797
5. Tobacco	23421	9220
6. Textiles	189326	91161
7. Footwear	20246	12200
8. Clothing	40937	24907
9. Wood and Cork	30377	26405
10. Furniture	24647	12940
11. Paper and paper products	26170	12258
12. Printing-Publishing etc.	28248	11475
13. Leather and leather products	21317	7434
14. Rubber products	11661	6843
15. Plastic products	14983	4216
16. Chemicals	65000	31978
17. Petroleum and Coal products	2605	4011
18. Cement	16094	7241
19. Glass and Glassware	12848	4700
20. Non metallic mineral products	77808	31763
21. Basic Metal Industries	20323	13720
22. Metal products	87934	36628
23. Machinery and Appliances	37342	18714
24. Electrical Machinery	43911	21294
25. Transport equipment	30229	29722
26. Miscellaneous Manufacturing	9213	7007
27. Construction	345854	225781
28. Electricity-Water-Gas	20558	21060
29. Transportation-Storage	351370	173188
30. Communications	55302	24564
31. Trade	698077	358929
32. Banking, other Financial Instit. and Insurance	156986	80865
33. Other services	693761	240297
34. Housing	—	—
35. Public Services	206173	115210
Total	7473727	3405553

Note: Column (1) shows the labour requirements for producing the 1970 final demand with the 1958 input-output matrix and the 1958 employment coefficients. Column (2) shows the labour requirements for producing the 1970 final demand with the 1958 input-output matrix but with the 1970 employment coefficients.

1970 actual employment	Total % changes in labour requirements	% changes in labour requir. due to changes in input-output coefficients	% changes in labour requir. due to changes in employment coefficients
(3)	(4)	(5)	(6)
1306223	199.7	24.4	175.3
21510	169.5	−24.6	194.1
80865	47.3	2.2	45.1
15009	31.1	5.3	25.8
9946	135.5	−7.3	142.8
97394	94.4	−6.4	100.8
13112	54.4	−7.0	61.4
23878	71.4	4.3	67.1
15907	91.0	66.0	25.0
12825	92.2	0.9	91.3
14666	78.4	−16.4	94.8
18005	56.9	−36.3	93.2
8486	151.2	−12.4	163.6
5507	111.7	24.3	87.4
12860	16.5	−67.2	83.7
31509	106.3	1.5	104.8
4610	−43.5	−13.0	−30.5
7638	110.7	−5.2	115.9
5083	152.8	−7.5	160.3
29391	164.7	8.1	156.6
14438	40.8	−5.0	45.8
36497	140.9	0.4	140.5
19715	89.4	−5.1	94.5
30811	42.5	30.9	11.6
37696	−19.8	−21.2	1.4
6009	53.3	16.6	36.7
226060	53.0	0.1	53.1
24227	−15.1	13.1	−28.2
117280	113.3	−2.3	115.6
23695	133.4	3.7	137.1
345506	102.0	3.9	105.9
99849	57.2	−19.0	76.2
244577	183.7	−1.8	185.5
—	—	—	—
114883	79.5	0.3	79.2
3135667	138.3	8.6	129.7

Column (3) shows the actual 1970 employment. In Column (4) the differences between columns (1) and (3) are expressed as percentages of column (3). In column (5) the differences between columns (2) and (3) are expressed as percentages of column (3). Column (6) is the difference between column (4) and column (5).

These figures have been derived in the same way as those entered in column (1) of Table 15 except that here, the 1970 labour coefficients were used throughout. The difference between the figures in column (2) and the actual employment figures in column (3) is the change in labour requirements resulting from changes in input-output coefficients only. Of the total labour saving of 4,338,060 workers, the saving due to changes in input-output coefficients is, for the economy as a whole, 3,405,553 – 3,135,667 = 269,886 workers, i.e. approximately 6% of the total savings or 8.6% of the 1970 actual employment. In column (5) of Table 15 we have computed the changes in labour requirements of the individual sectors, due to changes in input-output coefficients, as a percentage of the 1970 actual employment. Column (6), which is the difference between columns (4) and (5), shows the changes in labour requirements due to changes in employment coefficients only.

In examining column (5) of Table 15 we observe that in more than half of the production sectors the changes in input-output coefficients alone resulted in labour requirements increases. In mining, printing and publishing, plastic products, and transport equipment increases in labour requirements were more than 20%, with the biggest increases occurring in plastic products (67%). In the remaining sectors whose labour requirements were increased, the percentage changes were less than 20%. The biggest percentage reductions (over 20%) in labour requirements as a result of the changed input-output coefficients alone took place in agriculture (24%), wood and cork (66%), rubber products (24%), and electrical machinery (31%). The net effect of the

above changes was an 8.6% decrease in labour requirements (direct and indirect labour saving).

In examining column (6) of Table 15, we notice that the changes in employment coefficients alone resulted, with the exception of petroleum and coal products, and electricity, in considerable labour savings. Specifically, in 13 sectors labour saving due to changes in employment coefficients was above 100% of the 1970 actual employment, with the biggest labour savings occurring in mining (194%) and other services (185%). In 15 sectors labour saving ranged from 25% to 95%. The net effect of the changes in labour requirements due to changes in employment coefficients only was a labour saving for the economy as a whole of about 130%.

In comparing columns (5) and (6) of Table 15 we notice that the effect of the changed employment coefficients on labour requirements was, with the exception of wood and cork, electrical machinery, and transport equipment, much bigger than the effect of the changed input-output coefficients. Furthermore, while the change in input-output coefficients resulted in increases in labour requirements in 18 sectors, the changes in employment coefficients resulted in considerable labour savings in almost all the sectors of the economy.

As we said earlier in this section, the 1970 set of final demand, if produced on the basis of the 1958 techniques, would have required 4,338,060 workers more than it actually absorbed. The same sectors of the Greek economy actually used, in 1958, 284, 349 workers more than in 1970. Consequently, according to these figures, 4,053,711 (equals 4,338,060 – 284,349) workers should have been employed in 1970 to produce the excess of the 1970 over the 1958 set of final demand.

3.2. Impact of Structural Changes on Fixed Capital Requirements

In Table 16 we present the calculations corresponding to Table 15 with regard to fixed capital stock. Contrary to what happened in the case of labour, the fixed capital which would have been required to produce the 1970 set of final demand with the 1958 technical relationships is smaller than that actually used, and amounts to $709,168 - 615,184 = 93,984$ million drachmas.

As we can see from column (4) of Table 16, although for the economy as a whole a greater amount of fixed capital was actually used in 1970 compared to the capital which would have been required if we had used the 1958 input-output and capital coefficients, in 16 sectors fixed capital saving took place between 1958 and 1970. In 4 out of these sectors the capital saving was more than 100% of the corresponding 1970 actual fixed capital stock, in 7 sectors the capital saving was more than 35% but less than 100%, and in 5 sectors it was less than 20%.

In columns (5) and (6) of Table 16 the total change in capital requirements has been broken down into the part due to changes in input-output coefficients and the part due to changes in capital coefficients, respectively.

In examining column (5) of Table 16 we notice that, although the changes in input-output coefficients had no significant effect on capital requirements of the economy as a whole, the capital requirements of some sectors increased and for others decreased. The biggest decreases in capital requirements (direct and indirect capital saving) occurred in agriculture (24%), wood and cork (66%), and rubber products (24%). On the other

hand, the biggest (over 20%) increases in capital requirements took place in mining (25%), printing and publishing (36%), plastic products (67%), electrical machinery (31%), and transport equipment (21%).

From column (6) of Table 16 we can see that the capital requirements of the economy as a whole due to changes in capital coefficients only increased by about 14% between 1958 and 1970. However, this increase was the net result of opposite changes in the various sectors. Thus, in 13 sectors the changed capital coefficients raised the capital requirements and in 22 sectors reduced them. The biggest (over 20%) increases in capital requirements took place in agriculture (68%), chemicals (90%), glass and glassware (77%), non-metallic mineral products (33%), basic metal industries (45%), transport equipment (21%), construction (40%), transportation (31%), and communications (45%). On the other hand, in 4 sectors the capital saving was more than 100% of the 1970 level of fixed capital stock, in 14 sectors the capital saving was more than 20% but less than 100%, and in 4 sectors less than 20%.

A comparison of columns (5) and (6) of Table 16 shows that in very few sectors was the impact (in absolute numbers) of changed input-output coefficients on fixed capital requirements bigger than the corresponding impact of changed capital coefficients.

TABLE 16
Effects of Structural Changes on Fixed Capital Requirements

Sector	Computed 1970 fixed capital stock requirements (1)	Computed 1970 fixed capital stock requirements (2)
1. Agriculture	42415	93512
2. Mining	7566	5778
3. Food	6463	8555
4. Beverages	3499	1752
5. Tobacco	2540	2189
6. Textiles	10657	9522
7. Footwear	417	385
8. Clothing	792	497
9. Wood and Cork	934	1962
10. Furniture	464	475
11. Paper and paper products	4190	2271
12. Printing-Publishing etc.	1009	758
13. Leather and leather products	883	350
14. Rubber products	699	986
15. Plastic products	621	593
16. Chemicals	966	8347
17. Petroleum and Coal products	1735	1064
18. Cement	7172	3357
19. Glass and Glassware	107	645
20. Non metallic mineral products	2083	2979
21. Basic Metal Industries	5120	9758
22. Metal products	5731	3319
23. Machinery and Appliances	1424	878
24. Electrical Machinery	2014	1315
25. Transport equipment	1765	2406
26. Miscellaneous-Manufacturing	973	295
27. Construction	2780	4617
28. Electricity-Water-Gas	39501	47652
29. Transportation-Storage	80255	118018
30. Communications	6702	11875
31. Trade	47410	50595
32. Banking. other Financial Instit. and Insurance	10241	6919
33. Other services	50276	36458
34. Housing	248518	261104
35. Public Services	17262	11393
Total	615184	712579

Note: Column (1) shows the fixed capital requirements for producing the 1970 final demand with the 1958 input-output matrix and the 1958 capital coefficients. Column (2) shows the fixed capital requirements for producing the 1970 final demand with 1958 input-output matrix but with the 1970 capital coefficients. Column

1970 actual fixed capital stock	Total % changes in fixed capital requirements	% changes in capital requirements due to changes in input-output coefficients	% changes in capital requirements due to changes in capital coefficients
(3)	(4)	(5)	(6)
75160	−43.6	24.4	−68.0
7663	−1.3	−24.6	23.3
8372	−22.8	2.2	25.0
1665	110.2	5.2	105.0
2362	7.5	−7.3	14.8
10174	4.8	−6.4	11.2
414	0.7	−7.0	7.7
477	66.0	4.2	61.8
1182	−21.0	66.0	87.0
471	−1.5	0.9	−2.4
2718	54.2	−16.5	70.7
1190	−15.2	−36.3	21.1
400	120.8	−12.3	133.1
794	−12.0	24.2	36.0
1810	−65.7	−67.2	1.5
8225	−88.3	1.5	−89.8
1223	41.8	−13.0	54.8
3542	102.5	−5.2	107.7
698	−84.7	−7.6	−77.1
2757	−24.5	8.1	−32.6
10269	−50.1	−5.0	−45.1
3308	73.3	0.3	73.0
926	53.8	−5.2	59.0
1903	5.8	−30.9	36.7
3052	−42.2	−21.2	−21.0
253	284.6	16.6	268.0
4623	−39.9	−0.1	−39.8
54818	−27.9	−13.1	−14.8
120807	−33.6	−2.3	−31.3
11455	−41.5	3.7	−45.2
48703	−2.7	3.9	−6.6
8544	19.9	−19.0	38.9
37108	35.5	−1.8	37.3
261104	−4.8	–	−4.8
10998	57.0	3.6	53.4
709168	−13.2	0.5	−13.7

(3) shows the actual 1970 fixed capital stock. In column (4) the differences between columns (1) and (3) are expressed as percentages of column (3). In column (5) the differences between columns (2) and (3) are expressed as percentages of column (3). Column (6) is the differences between column (4) and column (5). The figures in columns (1), (2) and (3) are expressed in millions of Drachmas, at 1970 prices.

D. SUMMARY AND CONLUSIONS

The analysis of the structural characteristics of the Greek economy in 1958 and 1970 revealed many important aspects about the structural changes that took place in the economy between these two years. And as, because of the fundamental continuity of the process of change, future developments are dependent on past developments, our findings do not have historical value only but they can also provide an indication about future developments in the structure of the economy.

Starting from the fact that the causes of structural change are many and interdependent we did not attempt in this study any factoring out of the separate effects of these causes. We instead tried to measure the structural changes and estimate their impact on the economy.

The structural changes in the economy were measured by way of: (a) changes in the direct input-output coefficients, (b) changes in the coefficients of the inverse matrix, and (c) changes in the primary input coefficients (labour and capital).

The analysis on the basis of direct input-output coefficients showed that all sectors of the Greek economy have undergone substantial changes in their intermediate input structure. Also the changes in input-output coefficients moved in opposite directions as a result of input substitutions and/or the use of new inputs by each sector.

The analysis of the inverse coefficients showed that the degree to which various sectors affect the whole system of sectors through the demand for intermediate inputs changed substantially between 1958 and 1970. In some sectors we notice an increase and in others a decrease in their importance as stimulators of output

changes in the whole system of sectors. Analogous observations can be made about the degree to which the activity in the whole system of sectors affects the activity in a particular sector. In this case too, the changes that took place resulted for some sectors in an increase and for others in a decrease in their dependence on the activity of the whole system of sectors.

As regards the changes in the primary input coefficients (labour and fixed capital) we should point out the increase in capital intensity (as this is measured by the capital-labour ratios) in almost all the sectors of the economy, as a result of the extensive substitutions of capital for labour that took place between 1958 and 1970.

The impact of structural changes on the economy was analysed in terms of: (a) the impact on sectoral gross outputs, (b) the impact on intermediate inputs and outputs, and (c) the impact on primary input requirements.

The impact of structural changes on sectoral gross outputs was computed by breaking down the total change into the part due to changes in input-output coefficients and the part due to changes in the level and composition of final demand. The interesting finding about these two causes of total change in sectoral gross outputs is that the changes in the level and composition of final demand were more important in explaining changes in sectoral real products from 1958 to 1970 than were the changes in input-output coefficients.

From the analysis of the impact of structural changes on intermediate output requirements we can draw the conclusion that, between 1958 and 1970 there took place: (a) a reduction in the intermediate demand for agricultural products, as a result of substitutions of

manufactured products as intermediate inputs for agricultural products, and (b) a general increase in the demand for manufactured products as intermediate inputs.

From the analysis of the impact of structural changes on intermediate input requirements we found out that for the same level of gross production, the economy as a whole would have reguired slightly fewer raw materials in 1970 as compared to 1958, the implication being that a more efficient use of raw materials was made in 1970 as compared to 1958. However, in agriculture and manufacturing as a whole we found out slight decreases in efficiency in the use of raw materials.

The total change in primary input requirements was broken down into the part due to changes in input-output coefficients and the part due to changes in the respective primary input coefficients. With regard to labour requirements, we found out significant labour saving as a result of the combined effect of the above factors. This labour saving was caused mostly by changes in labour coefficients rather than changes in input-output coefficients. Finally, contrary to what happened to labour requirements, the total fixed capital requirements were increased between 1958 and 1970. This increase was almost exclusively the result of changes in capital coefficients and not in input-output coefficients.

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Phototypesetting & Printing
by **EPTALOFOS S.A.**
Arditou 12-16, Athens 407
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