DEMAND- AND SUPPLY-ORIENTED INPUT-OUTPUT MODELS: A LINKAGE ANALYSIS FOR PORTUGAL

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ABSTRACT

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The dissertation addresses several issues related to the input-output framework. Emphasis is given to both demand and supply sides of the input-output model. The linkage framework and consequently the determination of the key sectors of the structure of the economy is the main subject of Chapter 2. The use of the supply side approach is introduced, and extensions of the linkage model to employment and income considerations are made. Different versions of the traditional linkage indicators are also proposed.

Chapters 3 and 4 consist of an empirical analysis of the Portuguese economy at two different aggregation levels, using the framework proposed in Chapter 2. Linkages and key sectors are obtained for that country. Reference is also made to the balanced-unbalanced growth discussion.

Chapter 5 presents a new set of indicators obtained from the manipulation of the complete input-output model. Finally, Chapter 6, presents the overall conclusions.

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INTRODUCTION

1.1 Purpose of the Study. The Input-Output Systems Framework.

Input-output systems are nowadays among the most powerful operational tools for forecasting and planning. The more generalized conception of the model gives a well faceted description of the structural relationships governing the production process of the economy. Owing to its open, static character, the model considers primary inputs as the "starting point" of the production process and final use as its "end point". This accounting framework describes with conceptual simplicity the system of intersectoral relations between the starting and the end point.

Problems with definitions, conventions, data gathering, intertemporal and international compatability still exist. Yet input-output models are now available worldwide for a wide range of nations and regions. Recognizing the growing importance of input-output techniques, the United Nations published a series of input-output bibliographies, in a joint effort of the statistical office of the U.N. and the Harvard Economic Research Project of Harvard University.[1]

This dissertation addresses several issues related to the input-output framework. Emphasis is given to both demand and supply sides of the input-output model. The supply side version is increasingly used nowadays in input-output stability and energy related issues.

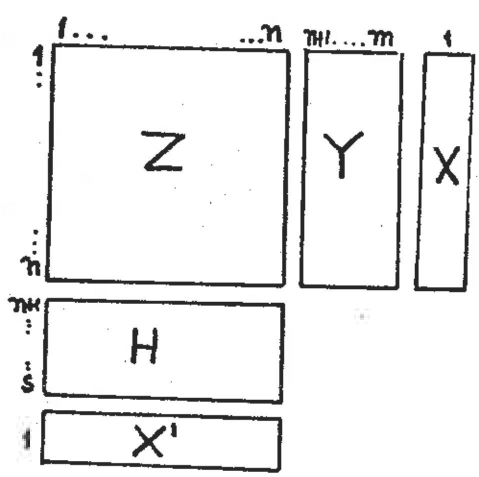
The linkage framework and consequently the determination of the key sectors of the structure of the economy is the main subject of Chapter 2. The use of the supply side approach is introduced, and extensions of the linkage model to employment and income considerations are made. Different versions of the traditional linkage indicators are also proposed.

Chapters 3 and 4 consist of an empirical analysis of the Portuguese economy at two different aggregation levels, using the framework proposed in Chapter 2. Linkages and key sectors are obtained for that country. Reference is also made to the balanced-unbalanced growth discussion.

Chapter 5 presents a new set of indicators obtained from the manipulation of the complete input-output model. Finally, Chapter 6, presents the overall conclusions.

The following pages will present the basic conceptual input-output system framework with the formulas and notation that will be used systematically in this work.[2]

The input-output system is basically as follows:



Z (n x n) = intermediate inputs into n productive sectors

Y (n x m) = final use for m final purposes

H (s x n) = s kinds of primary inputs (value added)

X (n x 1) = total output

The following additional notation will also be used:

I (n x n) = identity matrix

$1 = \begin{bmatrix} 1 \\ 1 \\ \cdot \\ \cdot \\ \cdot \\ 1 \end{bmatrix}$ its order equal to the number of columns in the matrix to be post-multiplied by it.

$\langle \ \rangle$ = diagonal matrix, its components being the components of the vector inscribed.

The use of subscripts to indicate the order of the matrices will be avoided. The above system describes the utilization of the gross social product (rows) as well as the inputs necessary for its creation (columns). The consistency of the system is ensured by the accounting identities (Augustinovics, [1968])

$$Z\,1 + Y\,1 = X \tag{1.1}$$

and

$$1'\,Z + 1'\,H = X' \tag{1.2}$$

The input-output table described so far is a neutral image of an economy, emphasizing neither supply nor demand forces but rather recording equilibrium values at one point in time. However, the system described above contains two aspects of the relationships among participants in the production process. One question is "who receives from whom?" and the other is "who gives to whom?". To deal with both questions, two different approaches are developed. One examines how much is needed of the output of preceding, vertical stages or of the primary inputs for some purpose - either for final use or for a unit output of some industry. This is the input approach from the demand perspective.[3] The second approach examines what will come out of something - either of primary inputs or the unit output of some industry - in successive stages or in final use. This is the output approach or the supply perspective.[4]

These two perspectives describe the flows of products and values in two opposite directions. One of these asks "where do they come from?" the other "where do they go?". The first looks backward in time, the other forward. Either of these two approaches can be transformed into the other with the use of some identities.
In the first approach

$$z_{ij} = a_{ij}^{\downarrow} x_j \qquad i,j = 1,\ldots,n \qquad (1.3)$$

And in the second approach,

$$z_{ij} = \vec{a}_{ij} x_i \qquad i,j = 1,\ldots,n \qquad (1.4)$$ [5]

where

z_{ij} is the ij^{th} element of the Z matrix,

$a_{ij}^{\downarrow}$ is the ij^{th} element of the $A^{\downarrow}$ matrix,

x_i and x_j are the i^{th} and j^{th} elements of the X vector,

$\vec{a}_{ij}$ is the ijth element of the $\vec{A}$ matrix ,

$A\downarrow$ is the technical coefficient matrix of "vertical" coefficients, and

$\vec{A}$ is the technical coefficient matrix of "horizontal" coefficients.

$A_d\downarrow$, $\vec{A}_d$ and A_d will be used to identify the domestic matrix, in contrast with $A\downarrow$, $\vec{A}$ and A which are used in what follows to identify the interindustry matrix. We can obtain input and output coefficient matrices for the above system as shown below:

$$A\downarrow = Z \langle X \rangle^{-1} \qquad (1.5)$$

$$\vec{A} = \langle X \rangle^{-1} Z \qquad (1.6)$$

Also:

$$Y\downarrow = Y \langle 1'Y \rangle^{-1} \qquad (1.7)$$

$$\vec{Y} = \langle X \rangle^{-1} Y \qquad (1.8)$$

$$H\downarrow = H \langle X \rangle^{-1} \qquad (1.9)$$

$$\vec{H} = \langle H\ 1 \rangle^{-1} H \qquad (1.10)$$

A vertical arrow means input (columnwise) coefficient matrices or the so-called vertical coefficients. A horizontal arrow means output (rowwise) coefficients or the so-called horizontal coefficients.

Rewriting the accounting identities of the system gives the following form:

$$A\downarrow X + Y\ 1 = X \qquad (1.11)$$

$$X'\ \vec{A} + 1'\ H = X' \qquad (1.12)$$

and, therefore,

$$(I-A\downarrow)^{-1} Y 1 = X \tag{1.13}$$

$$1' H (I-\vec{A})^{-1} = X' \tag{1.14}$$

We may define

$$Q\downarrow = (I-A\downarrow)^{-1} \tag{1.15}$$

and

$$\vec{Q} = (I-\vec{A})^{-1} \tag{1.16}$$

where $Q\downarrow$ is the familiar Leontief inverse matrix, or "input inverse" where each element $q_{ij}\downarrow$ (or simply α_{ij}) is total production of sector i necessary to deliver a unit of final product of sector j. $\vec{Q}$ is the "output inverse" where each element $\vec{q}_{ij}$ (or β_{ij}) measures the total value of production that comes about in sector j per unit of primary input in sector i.[6] Thus, "the usual $Q\downarrow$ relates gross production to the final product, to a unit of production leaving the interindustry system at the end of the process. The matrix $\vec{Q}$ of the output approach relates gross production to the primary inputs, to the unit of value entering the interindustry system at the beginning of the process" (Augustinovics [1968, p. 252]). Using (1.15) and (1.16), we can rewrite equations (1.13) and (1.14) as:

$$Q\downarrow Y 1 = X \tag{1.17}$$

$$1' H \vec{Q} = X' \tag{1.18}$$

So matrix $Q\downarrow$ describes the final use of the gross social product. Matrix $H\vec{Q}$, on the other hand, describes the value composition of the gross social product.

Following Augustinovics, the structural (i.e., per unit) analysis may, of course, be extended to final use and primary inputs as well.

$$Q{\downarrow}\,Y{\downarrow} = Q{\downarrow}\,Y\ \langle 1'Y\rangle^{-1} \tag{1.19}$$

$$\vec{H}\,\vec{Q} = \langle H\ 1\rangle^{-1} H\ \vec{Q} \tag{1.20}$$

$Q{\downarrow}\,Y{\downarrow}$ and $\vec{H}\,\vec{Q}$ are the complex coefficient matrices.[7]

Let us look at (1.19) in a 3 x 3 framework, and with Y (3 x 2) and H (2 x 3).

$$Y = \begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \\ y_{31} & y_{32} \end{bmatrix} \quad (1.21) \qquad H = \begin{bmatrix} h_{11} & h_{12} & h_{13} \\ h_{21} & h_{22} & h_{23} \end{bmatrix} \quad (1.22)$$

So 1' Y is a (1 x 2) matrix,

$$\underset{(1\ \times\ 3)}{[1\ 1\ 1]}\ \underset{(3\ \times\ 2)}{\begin{bmatrix} y_{11} & y_{12} \\ y_{21} & y_{22} \\ y_{31} & y_{32} \end{bmatrix}} = [(y_{11} + y_{21} + y_{31})(y_{12} + y_{22} + y_{32})] \tag{1.23}$$

Rewriting 1'Y as $[Y_1, Y_2]$, $\langle 1'Y\rangle$ is a 2 x 2 diagonal matrix; $\langle 1'Y\rangle^{-1}$ is its inverse, also a 2 x 2 matrix.

Writing $\langle 1'Y\rangle{-1}$ as

$$\begin{bmatrix} Y'_{11} & 0 \\ 0 & Y'_{22} \end{bmatrix} \tag{1.24}$$

where Y'_{ij} is the jj^{th} element of $\langle 1'Y\rangle^{-1}$, then

$Q{\downarrow}\, Y \langle 1'Y\rangle^{-1}$ from (1.19) will be:

$$\begin{bmatrix} 1-\frac{Z_{11}}{X_1} & -\frac{Z_{12}}{X_2} & -\frac{Z_{13}}{X_3} \\ -\frac{Z_{21}}{X_1} & 1-\frac{Z_{22}}{X_2} & -\frac{Z_{23}}{X_3} \\ -\frac{Z_{31}}{X_1} & -\frac{Z_{32}}{X_2} & 1-\frac{Z_{33}}{X_3} \end{bmatrix}^{-1}_{(3 \times 3)} \begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \\ Y_{31} & Y_{32} \end{bmatrix}_{(3 \times 2)} \begin{bmatrix} Y'_{11} & 0 \\ 0 & Y'_{22} \end{bmatrix}_{(2 \times 2)} \quad (1.25)$$

So $Q{\downarrow}\, Y{\downarrow}$ will be a matrix of size 3 x 2. We could, using the same framework, derive $\vec{H}\, \vec{Q}$. But the above presentation is only an illustration of the compatibility of the system.

$Q{\downarrow}Y{\downarrow}$ represents the gross production necessary for a unit of specific final use, and $\vec{H}\, \vec{Q}$ represents gross production originating from a unit of specific kinds of primary inputs, both by supplying sectors.

However, the relation of production to final use or to primary inputs is not necessarily connected with the input or the output approach. Both approaches are suited to describing both relationships. To show this, we reverse the procedure followed above.

Using (1.1) and (1.2) and expressing these in terms of input and output coefficients, respectively, we have:

$$1'\, A{\downarrow} \langle X\rangle + 1'\, H{\downarrow} \langle X\rangle = X' \quad (1.26)$$

$$\langle X\rangle \vec{A}\, 1 + \langle X\rangle \vec{Y}\, 1 = X \tag{1.27}$$

from which we obtain:

$$1'\ H{\downarrow}\,(I-A{\downarrow})^{-1} = 1' \tag{1.28}$$

$$(I-\vec{A})^{-1}\ \vec{Y}\, 1 = 1 \tag{1.29}$$

or

$$1'\ H{\downarrow}\,Q{\downarrow} = 1' \tag{1.30}$$

$$\vec{Q}\,\vec{Y}\, 1 = 1 \tag{1.31}$$

The complex coefficient matrix $H{\downarrow}\,Q{\downarrow}$ of the "input approach" divides the unit of final value into its original value components while the complex coefficient matrix $\vec{Q}\,\vec{Y}$ of the "output approach" indicates the distribution of the unit of primary input among final uses.

The starting and end points of the production process, the primary inputs and final utilization, are connected by the equation:

$$H{\downarrow}\,Q{\downarrow}\,Y = H\,\vec{Q}\,\vec{Y} \tag{1.32}$$

This describes the volume of specific primary inputs giving the specific final uses.

Also from (1.5,6,7,8,9 and 10), (1.17,18) and (1.30,31):

$$H{\downarrow}\,Q{\downarrow}\,Y\, 1 = H\,\vec{Q}\,\vec{Y}\, 1 = H\ 1 \tag{1.33}$$

and

$$1'\ H{\downarrow}\,Q{\downarrow}\,Y = 1'\ H\,\vec{Q}\,\vec{Y} = 1'Y \tag{1.34}$$

Summing the rows of $H{\downarrow}\,Q{\downarrow}\,Y$ we obtain the total quantities of the specific primary inputs. Summing the columns we obtain the total values of the bills of goods used for the specific components of final demand. Thus the matrix yields a full and unequivocal allocation.

It is interesting to see the final allocation of the primary inputs in terms of all the coefficient matrices. This is done by using the "final structure matrices"

$$H{\downarrow}\, Q{\downarrow}\, Y{\downarrow} = H{\downarrow}\, Q{\downarrow}\, Y \, \langle 1' H{\downarrow}\, Q{\downarrow}\, Y \rangle^{-1} \tag{1.35}$$

and

$$\vec{H}\,\vec{Q}\,\vec{Y} = \langle H\,\vec{Q}\,\vec{Y}\,1 \rangle^{-1}\, H\,\vec{Q}\,\vec{Y} \tag{1.36}$$

Matrix $H{\downarrow}\, Q{\downarrow}\, Y{\downarrow}$ is called the primary input structure of final uses, and matrix $\vec{H}\,\vec{Q}\,\vec{Y}$ the final allocation structure of primary inputs.

The following identities link the two approaches:

$$A{\downarrow} = \langle X \rangle\, \vec{A}\, \langle X \rangle^{-1} \qquad \vec{A} = \langle X \rangle^{-1} A{\downarrow}\, \langle X \rangle$$

$$Y{\downarrow} = \langle X \rangle\, \vec{Y}\, \langle 1'Y \rangle^{-1} \qquad \vec{Y} = \langle X \rangle^{-1}\, Y{\downarrow}\, \langle 1'Y \rangle$$

$$H{\downarrow} = \langle H1 \rangle\, \vec{H}\, \langle X \rangle^{-1} \qquad \vec{H} = \langle H1 \rangle^{-1}\, H{\downarrow}\, \langle X \rangle$$

$$Q{\downarrow} = \langle X \rangle\, \vec{Q}\, \langle X \rangle^{-1} \qquad \vec{Q} = \langle X \rangle^{-1}\, Q{\downarrow}\, \langle X \rangle$$

$$Q{\downarrow}Y = \langle X \rangle\, \vec{Q}\,\vec{Y} \qquad \vec{Q}\,\vec{Y} = \langle X \rangle^{-1}\, Q{\downarrow}Y$$

$$Q{\downarrow}\, Y{\downarrow} = \langle X \rangle\, \vec{Q}\,\vec{Y}\, \langle 1'Y \rangle^{-1} \qquad \vec{Q}\,\vec{Y} = \langle X \rangle^{-1}\, Q{\downarrow}\, Y{\downarrow}\, \langle 1'Y \rangle$$

$$H\downarrow Q\downarrow = H\,\vec{Q}\,\langle X\rangle^{-1} \qquad H\,\vec{Q} = H\downarrow Q\downarrow \langle X\rangle$$

$$H\downarrow Q\downarrow = \langle H\ 1\rangle\,\vec{H}\,\vec{Q}\,\langle X\rangle^{-1} \qquad \vec{H}\,\vec{Q} = \langle H\ 1\rangle^{-1}\,H\downarrow Q\downarrow \langle X\rangle$$

$$H\downarrow Q\downarrow Y = H\,\vec{Q}\,\vec{Y} \qquad H\,\vec{Q}\,\vec{Y} = H\downarrow Q\downarrow Y$$

$$H\downarrow Q\downarrow Y\downarrow = \langle H\ 1\rangle\,\vec{H}\,\vec{Q}\,\vec{Y}\,\langle 1'Y\rangle^{-1} \qquad \vec{H}\,\vec{Q}\,\vec{Y} = \langle H\ 1\rangle^{-1}\,H\downarrow Q\downarrow Y\downarrow \langle 1'Y\rangle$$

This is the conception of the open static input output model that will be used in the following chapters. "It yields a fuller, more comprehensive and less ambiguous picture of the structure of the entire productive process." (Augustinovics [1968, p. 255].)

1.2 Input-Output Tables in Constant versus Current Prices

Leontief's [1951] original input-output model for the United States was expressed in terms of physical units. However to construct such a model, especially in a western society, is troublesome, given that the information is in general expressed in value terms. Then Leontief suggested that to measure the impact of physical inputs on output, prices should be held constant.

Klein [1952-53] had a different perspective. He argued that product mix and aggregation with the addition of "technological production, price speculation, wage bargaining, monetary policy, consumer choice and a large variety of other phenomena" are important factors to consider in deciding which is the best unit system to use

(Klein [1953,p. 208]). Klein concludes that there are no reasons to believe that constant dollar coefficients would be in any way more stable over time than the ones expressed in current dollars.

Empirical studies were developed to test these hypotheses. Tilanus and Rey [1964] tested for the Dutch economy, by comparing current and constant forecasts for 1948 to 1957 and backcasts for 1957 to 1947, they concluded that current value input-output coefficients were more stable than constant ones.

Vaccara [1969] tested for the USA in the 1947 to 1958 period. She got mixed results. Both the current and constant value versions presented a similar grade of stability.

Sarma [1972], who also used USA tables, found current value models more stable than constant ones. Humphrey [1973], again testing for the USA case, used 1947 and 1958 tables and found little statistical significance for price and induced substitution among intermediate inputs. Bezdek and Wendling [1976], for the USA, used deflated and reconciled U.S. Department of Commerce input-output data in the years 1947, 1958, 1961, 1963 and 1967. They found in general that constant value forecasts were more accurate in the long run and, in the short run, current value forecasts were about as good as constant value ones. Finally Harmston and Chow [1980], for Missouri, used data for 1958, 1963, 1967 and 1972 and concluded that "there is little evidence to support Leontief's claim of superior forecasting power for constant values. Rather, Klein's hypothesis of no significant difference seems to be upheld." (Harmston and Chow [1980, p. 130])

The lack of constant value data for our empirical model, the Portuguese input-output systems for 1959, 1964, 1970 and 1974, lead us to the use of the current value version in all the empirical work throughout this dissertation.

1.3 The Input Output Systems for the Portuguese Economy

The first major input-output studies made in Portugal were conducted by the Instituto Nacional de Investigacao Industrial (National Institute for Industrial Research). The work was begun in March, 1961. The Institute collaborated with the Centro de Estudos de Economia Aplicada (Economic Applied Studies Center) from the Associacao Industrial Portuguesa (Portuguese Industrial Association). This was considered an important tool for the study of the national economic structure for national planning purposes, giving a better understanding and knowledge about the structural interdependences of the economy and contributing decisively to the elaboration of national economic plans, particularly those related to the industrial areas.[8]

Initially, a provisory input-output study for 1959 was made. The aggregation adopted in this study, 40x40, was in conformity with disposable sectoral data obtained from several sources such as: the 1959 National Industry Survey, national statistical data, and foreign trade surveys.

The 40 sectors of the original input-output table were divided into 27 industrial sectors (including mining, manufacturing, and construction). In this version, given the great importance of agriculture as a part of the Gross National Product, the primary sector was subdivided into seven sectors, with four of them for crops, one for livestock, one for fisheries and one for forestries. Services sectors received a very superficial treatment, as a consequence of lack of information and data and the non-existence of strong relationships between the manufacturing and the foreign trade group of sectors which constituted, according to the authors, the main interest of the project.

As noted, there was a special interest in the analysis of foreign trade. This led to the creation, as separate economic sectors, of such export activities as wine, canned fish, cotton textiles, cork and pulp paper. On the import side they differentiated imports supplied by the overseas Portuguese territories at that time, and imports coming from other foreign countries.

The 1959 Portuguese input-output table is square, at the 40x40 disaggregation level, calculated at buyers' prices. The year chosen was basically determined by the fact that an industrial survey was made by the National Bureau of Statistics and was available for that year. Also, other sources of information, such as foreign trade, agriculture, industry, business statistical data and national accounts statistics were used. Some surveys of public and private enterprises were also conducted.

The same institution that produced the input-output table for 1959 continued its work, with a new version for 1964. Again, the year was chosen because of the availability of an Industrial Survey, despite the fact that 1963 was the base year for the constant price index used in Portuguese statistical data and in macroeconometric projections. Again, the table was constructed in buyers' prices for two main reasons: First, the system was used in 1959, and second, constructing an input-output table for 1959, at producer's prices, remained an unsolved problem.

The 1964 input-output system is disaggregated to 67x67 sectors, with two versions: a domestic and a technological one.[9] The 1964 version (as in the 1959 case) does not include in the sectors of the national economic structure such important service activities as banks, insurance companies and government activities. This fact contributed to the impossibility of finding a higher disaggregation level for comparing these two versions (1959 and especially 1964) with later ones.

Following the publication in 1964 of the 1959 input-output table, and in 1971 of the 1964 input-output system, a new effort began in 1971 to construct an input-output system for 1970. Using the experience gained in the construction of the previous input-output tables, and also the experience obtained from other countries, a new orientation was possible, with the following goals:[10]

a) An increasing amount of statistical information in input-output form, constructing not only a table but a system of interdependent tables.

b) Organizing on a permanent basis a group of researchers for that purpose, which could permit the gradual improvement and the periodic organization of the input-output systems, covering more deeply all the areas of economic activity, some of them not yet assessed.

c) Connecting the input-output tables system with a study of the economic structure of the Portuguese economy and its development perspectives, using for that purpose input-output methods of analysis and programming models, making the best use possible of the information and data at hand.

These were the major reasons for changing the traditional methods for construction of the input-output tables, using alternatively a computer processing system, with the collaboration and the know-how from the IFO Institute of Munich, directed by Professor Gerhard Gehrig. The new department in charge of the project, the Grupo de Estudos Basicos do Ministerio da Industria (Basic Studies Department of the Ministry of Industry), published a 60x60 input-output system which included eleven different tables, two inverse matrices, four technical coefficient matrices, all of them obtained from a initial rectangular matrix with 2700 rows and 60 columns. This represented an extremely important improvement in the quality of data published. The national accounts system, was more accurate, allowing for errors to be detected. The new system facilitated identification of possibilities for systematic improvement and organization of new matrices.

Meanwhile, attention was given to the construction of a new input-output model for 1973 and also for the analysis of tables for some more complex and condensed groups of sectors. The department in charge of the input-output table construction in conjunction with the Gabinete de Planeamento do Ministerio da Agricultura e Pescas (Planning Department of the Ministry of Agriculture and Fisheries) were at that time also constructing a sectorial matrix for the agricultural industries group, and a matrix for the chemicals group of sectors was also organized.

The most recent system of input-output tables published thus far, in 1978, in its definitive version, was for 1974, Portugal's revolutionary year, which implied a major change in the government economic policies.[11]

That political change forced the policy makers to urge the construction of an input-output table for 1974, using a simpler methodology, given the lack of time to replicate the 1970 input-output methods. The computerized system, implemented for 1970, allowed a much more rapid process of calculation.

Given the earlier experience, some significant improvements were, in some areas, achieved in comparison with the 1970 input-output table. However some difficulties have persisted, given the almost total absence of data concerned with domestic final demand and primary inputs for some sectors. Also, the urgency to come up with results quickly had costs in the poor accuracy of some figures for 1974. This was particularly so in the case of sectors where long and specific surveys would be necessary.

At this moment, Portugal is working on the 1977 input-output system, and also on its first multiregional model. Also, some more specific tables for some more complex and specific groups of sectors are currently under study.

Two groups of tables will be used in this work. One is a compatible set of input-output tables, at the 20 x 20 disaggregation level, in two versions, domestic and interindustry, made by the Grupo de Estudos Basicos do Ministerio da Industria (Basic Studies Department of the Ministry of Industry), in producer's prices. The second set is based on the 60 x 60 tables for 1970 and 1974, also in two versions, domestic and interindustry, in producer's prices, and also made and published by the same department. These are the major sources of data used in this work. Other data and information, such as employment, and rates of growth by industry, were obtained from a variety of sources; these will be cited as used.

FOOTNOTES

Chapter 1

[1] United Nations, [1964], [1967] and [1972]. For an earlier bibliography, see Taskier [1961].

[2] We basically follow the framework proposed by Augustinovics [1968], where a rigorous conceptual definition of the output approach, or horizontal coefficients was made.

[3] See also Giarratani [1976].

[4] This approach was discussed by Ghosh [1958], demonstrating that a model may be formulated to relate total output to supply factors. Later works were Dadajan and Kossov [1962], Ganczer [1962], and especially Augustinovics [1968] who generalized this framework into a rigorous comparison of the input and output approach.

[5] Giarratani presents some criticism about the behavioral assumptions in equations (1.3) and (1.4). That is the possibility of factor substitution and the non-existence of fixed production relationships in the long run. Also Ghosh [1958] pointed out that under monopolistic market conditions in which resources are scarce the allocation function defined in (1.4) will be dominant.

[6] Hoover [1971, pp. 235-237] defines the elements of Q_{ij} as supply multipliers relating unit changes in primary inputs to changes in gross output. Giarratani [1975, pp. 91-92] presents the following explanation: "changes in the level of primary factors available to a given sector permit changes in its level of output as well as in the levels of output of sectors requiring its product for intermediate use. This first round effect and all subsequent rounds of industrial activity are embodied in the supplier multiplier $\vec{Q}_{ij}$." Row sums of the matrix $\vec{Q} = \sum_j \vec{Q}_{ij}$ are multipliers describing the total output permitted in the economy by that unit increase.

[7] Augusticovics [1968, p. 253] pointed out that "the compositions of the different bills of goods serving specific final uses ($Y\downarrow$) and the sectoral distribution of specific kinds of primary inputs ($\vec{H}$) are considered 'given' or 'fixed' in the same sense as is usual for matrices $A\downarrow$ or $\vec{A}$."

[8] These paragraphs were based on Cruzeiro [1963], in a volume where the provisional results of the first Portuguese input-output matrix (1959) were presented.

[9] Information relating to the 1964 input-output system comes from Instituto Nacional de Investigacao Industrial [1971].

[10] The paragraphs relating to the 1970 input-output system are based on Grupo de Estudos Basicos do Ministerio da Industria, [1975] and [n.d.].

[11] Information relating to the 1974 input-output systems comes from Grupo de Estudos Basicos do Ministerio da Industria (GEBEI) [1978].

CHAPTER 2

LINKAGES, KEY SECTORS, BALANCED UNBALANCED GROWTH

2.1 A Brief Introduction

Since the appearance of the Hirschman's Strategies of Economic Development [1958], the concept of "linkages" has attracted considerable interest, as a means of identifying "key sectors" in a strategy of industrial development. Although the discussion of linkages usually relates to developing countries, the idea has also been taken up by regional economists, because this framework provides a way of identifying industries or sectors on which we should concentrate our attention and efforts for obtaining a more efficient way to develop a regional or national industrial development program. In general it is considered, not without some criticism, that if we can concentrate capital and entrepreneurial skills on the predefined key sectors, output and employment in the region or country will grow more rapidly than if those resources were allocated in some alternative way.[1]

The relation between output, employment and income as a result of linkage policy will be discussed later in this chapter. It is the purpose of this chapter to summarize the work done on the development of the concepts, to present some criticism and limitations of some of them and also present a new, modified approach.

This chapter will be divided into two main sections. The first will cover the survey of literature on the linkage framework and key sector definition, from direct linkages concepts to those associated with the Leontief inverse. We comment on the weak points of the standard definition. This justifies the introduction, in Section 2.2, of the proposed new framework. To be discussed are the advantages of the indirect over the direct linkages, the use of interindustry versus domestic matrices, and the use of several proposed weights to attach to the absolute linkages. The final section deals with the balanced-unbalanced growth controversy, usually associated with the linkage issue.

We think that it is important to take into account the linkage effects in terms of income and employment, in addition to the usual formulation in terms of output. In Section 2.2 an extension of the traditional linkage framework to income and employment terms is presented. The supply side approach, related the "horizontal coefficients" version of the input-output system, is also considered. Other extensions, such as net and weighted indicators, will also be introduced. Discussions on interindustry versus domestic and absolute versus relative versions of the tables and their advantages are emphasized. Finally, in Section 2.3, a summary of results in the chapter is presented.

2.1.1 Direct Linkages: Backward and Forward

The work done thus far in this field considers in general only output linkages, which are divided in two fundamental groups: forward and backward linkages.

Hirschman [1958, p. 100] described these linkages as

1) "the input provision, derived demand, or backward linkage effects, i.e., every non-primary economic activity, will induce attempts to supply through domestic production the inputs needed in that activity."

2) "the output utilization or forward linkage effects, i.e., every activity that does not by its nature cater exclusively to final demands, will induce attempts to utilize its outputs as inputs in some new activities."[2]

Hirschman also raised the question of taking into account the minimum economic size (in terms of annual productive capacity) of the firms in consideration, competitive imports, locational advantages and disadvantages for some industries, infant industry protection, and comparative cost analysis as issues to take into consideration, when we define a industrial development policy based on the linkage framework.

The linkages were first devised by Rasmussen [1956], and initially they were simply regarded as useful measures of the structural interdependence of an economy. Also other authors, such as Chenery and Watanabe [1958], provided operational definitions of the linkage effects.

They define:

a) Backward Linkage, U (the usual letter used), indicates to what extent the economic sectors have been specializing. These coefficients are high if the sectors observed are drawing heavily on the system of industries, or vice-versa, if the value added by use of primary inputs is relatively small. That is:

$$U_j^a = \frac{\sum_i Z_{ij}}{X_j} = \frac{\text{column sum of intermediate inputs of sector j}}{\text{gross output of sector j}} \tag{2.1a}$$

where the "a" superscript is used only to differentiate it from other linkage versions presented below.

b) Forward Linkage, W, which is generally weaker, since the output produced is not necessarily met by adequate demand, gives an indication of the direction of supply: high coefficients will typically be found in those sectors producing mainly not for final demand but rather for intermediate demand of other sectors. The words "high" and "low" are used interchangeably for the phrases "values above the average" and "values below (or equal to) the average", respectively.

$$W_i^a = \frac{\sum_i Z_{ij}}{X_i} = \frac{\text{column sum of intermediate inputs of sector i}}{\text{gross output of sector i}} \tag{2.1b}$$

These are the definitions of the so-called direct linkage effects (or index) currently in use for intertemporal and international comparison of the production structures. Examples of their use can be found in, among others, Rasmussen [1956], Chenery and Watanabe [1958], Cao-Pinna [1958], Rasul [1964], Simpson and Tsukui [1965], Long [1970], Santhaman and Patil [1972], Syed [1975], Hazari [1970], and Song [1977]. Also, for regional purposes, Streit [1969], among others. More sophisticated versions of these concepts have also been formulated, with the objective of using these linkage measures to answer to other types of questions, as explained later, referring for example to weights, to include the relative importance of each sector. As an example, we introduce here some suggestions presented by Shultz [1974].

c) Direct Linkages (Backward and Forward), "weighted" by the sum of the intermediate inputs or output per sector.

$$U_j^b = \left(\frac{\sum_i Z_{ij}}{X_j}\right) \left(\sum_j Z_{ij}\right) \tag{2.2a}$$

$$W_i^b = \left(\frac{\sum_i Z_{ij}}{X_i}\right) \left(\sum_i Z_{ij}\right) \tag{2.2b}$$

d) Direct Linkages (Backward and Forward), "weighted" by the share of the sectoral gross output in the output of the entire economy:

$$U_j^c = \left(\frac{\sum_i Z_{ij}}{X_j}\right) \left(\frac{X_j}{\sum_j X_j}\right) \tag{2.3a}$$

$$W_i^c = \left(\frac{\sum_j Z_{ij}}{X_i}\right) \left(\frac{X_i}{\sum_i X_i}\right) \tag{2.3b}$$

e) Direct Linkages (Backward and Forward), obtained by deducting the intrasectoral transactions before computing the linkages:

$$U_j^d = \frac{\sum_i Z_{ij} - Z_{jj}}{X_j} \tag{2.4a}$$

$$W_i^d = \frac{\sum_j Z_{ij} - Z_{ii}}{X_i} \qquad (2.4b)$$

f) <u>Direct Linkages</u> (Backward and Forward), obtaining deducting the intrasectoral transactions, "weighted" by the sum of intermediate inputs or outputs per sector.

$$U_j^e = \left(\frac{\sum_i Z_{ij} - Z_{jj}}{X_j}\right) \left(\sum_i Z_{ij}\right) \qquad (2.5a)$$

$$W_i^e = \left(\frac{\sum_j Z_{ij} - Z_{ii}}{X_i}\right) \left(\sum_j Z_{ij}\right) \qquad (2.5b)$$

g) <u>Direct Linkages</u> (Backward and Forward), obtained deducting the intrasectoral transactions "weighted" by the share of the sectoral gross output in the output of the entire economy.

$$U_j^f = \left(\frac{\sum_i Z_{ij} - Z_{jj}}{X_j}\right) \left(\frac{X_j}{\sum_j X_j}\right) \qquad (2.6a)$$

$$W_i^f = \left(\frac{\sum_j Z_{ij} - Z_{ii}}{X_i}\right) \left(\frac{X_i}{\sum_i X_i}\right) \qquad (2.6b)$$

The use of these ratios for intertemporal and international comparison raises the question of how imports should be treated. For developing countries and even for developed ones (Western Europe, for example) imports play, in general, a very important role in the input structure of the production process. We should raise the question of whether domestic input-output versions (where imports are not considered in the intermediate input structures, as happens in the interindustry table, but as a primary input component), are better than the inter-industry ones for our purposes.

We will consider this issue later in this chapter. Now we present some modified linkage measures to deal with imports, using Z^d_{ij} as flow elements of the domestic table. Following Schultz [1974], and using $|m_i|$ = imports of sector i, and presenting only the forward linkage case:

$$W^a_i = \frac{\sum_j Z_{ij}}{X_i + |m_i|} \tag{2.1c}$$

$$W^b_i = \left(\frac{\sum_j Z_{ij}}{X_i + |m_i|}\right) \left(\sum_j Z_{ij}\right) \tag{2.2c}$$

$$W^c_i = \left(\frac{\sum_j Z_{ij}}{X_i + |m_i|}\right) \left(\frac{X_i}{\sum_i X_i}\right) \tag{2.3c}$$

$$W^d_i = \left(\frac{\sum_j Z_{ij} - Z_{ii}}{X_i + |m_i|}\right) \left(\sum_j Z_{ij}\right) \tag{2.4c}$$

$$W^e_i = \left(\frac{\sum_j Z_{ij} - Z_{ii}}{X_i + |m_i|}\right) \left(\frac{X_i}{\sum_i X_i}\right) \tag{2.5c}$$

$$W^f_i = \left(\frac{\sum_j Z_{ij} - Z_{ii}}{X_i + |m_i|}\right) \left(\frac{X_i}{\sum_i X_i}\right) \tag{2.6c}$$

These are the most generalized versions that have been presented for measuring the direct linkage effects, but in most empirical studies, only formulas 2.1a and 2.1b have been used.

2.1.2 Indirect Linkages

The use of the Leontief inverse matrix to capture the direct and indirect effects of linkages is coming into more general use. Some authors have presented the familiar output multiplier as a total linkage index, arguing that this multiplier captures the direct and indirect effects of both the backward and forward linkages.[3]

The total linkage effect for sector j (O_j) is defined as the effect of both direct and indirect linkages. That is

$$O_j = \sum_{i=1}^{n} \alpha_{ij} \tag{2.7a}$$

where the α_{ij}'s are elements of $(I-A)^{-1}$. In fact this represents nothing but the backward linkage index; it captures only the backward effects in direct and indirect terms.

The simplicity of calculating the direct linkages is that it allows an immediate ranking of sectors.[4] However this procedure addresses itself only to direct production effects as they are expressed in the transaction elements. As we will see in the next pages, other ways of classifying the sectors could be used, using the new inverse indicators. They guarantee the inclusion of direct and indirect effects of a variation in the final demand or primary input vectors on sectoral production levels.

In the literature there have also been several proposals for weighting and normalizing the linkage indexes; all of these are based on Rasmussen [1956]:[5]

$$P_j = \frac{(1/n) \sum_{i=1}^{n} \alpha_{ij}}{(1/n^2) \sum_{j=1}^{n} \sum_{i=1}^{n} \alpha_{ij}} \tag{2.7b}$$

This vector P_j standardizes the column totals (for the purpose of intertemporal and international comparison) in terms of the average of all elements of the inverse. This indicator expresses the power of dispersion of the observed sector in the entire economy, and it was named by Rasmussen the "Index of Power of Dispersion." This formula was introduced by Rasmussen [1956] and was considered a better indicator than the direct linkages themselves by several authors like Syed [1975], Laumas [1976], Boucher [1976], McGilvray [1977] and others.

P_j is presented as a measure of the effects of increased input in one sector relative to all sectors. If $P_j < 1$, sector j produces only weak output stimuli for the economy; a value of $P_j > 1$, however, would signal that this sector is transmitting above-average impulses to other sectors through its intermediate input requirements.

Formula (2.7b) is not a weighted version of the index of backward linkage; however it is considered as such by several authors. Laumas [1976, p. 309], for example, argues: "There are three main reasons for using Rasmussen's indices: (a) by using the inverse of an I-O matrix, these indices take into account the direct as well as the indirect effects of an increase in autonomous expenditure; (b) they are properly weighted and, therefore, more correctly depict the importance of strategic sectors of the economy; (c) it is possible to make interindustry comparisons between different countries." Also Rasmussen considered (2.7b) as a weighted measure, but the denominator of (2.7b) is simply a constant scalar, so no weight is possible using that formula. We now present what is used as an index for capturing direct and indirect forward linkages. Define

$$O_i = \sum_{j=1}^{n} \alpha_{ij} \tag{2.8a}$$

which, following authors like Laumas [1976], measures the output which would be generated in sector i if final demand in each sector were to increase by one unit. Again, this measure could be normalized as

$$Q_i = \frac{(1/n) \sum_{j=1}^{n} \alpha_{ij}}{(1/n^2) \sum_{i=1}^{n} \sum_{j=1}^{n} \alpha_{ij}} \tag{2.8b}$$

This is a normalized version of the index of forward linkage. Values of $Q_i > 1$ indicate high forward linkage, in the sense that those sectors display above-average dependence on the output of other sectors. Again, this was referred to by Rasmussen as an "Index of Sensitivity of Dispersion."

Linkage measures are used in the identification of so-called "key" sectors in an economy. McGilvray [1977, p. 51], defines "key sectors as those in which both P_j and Q_i exceed unity." A key sector is therefore a sector which generates above-average input requirements from other sectors, and whose output is widely used by other sectors.

Key, lead or propulsive industries or sectors, were studied previously. Campbell [1972, p. 79], states: "Perroux's concept of a propulsive industry (as well as the related idea of a key industry) invokes interindustry linkages - when an industry defined as a propulsive industry expands its output it induces major expansions in the outputs of other industries. In other words, the propulsive or key industry possesses a strong linkage pattern, vis-a-vis the other industries in the industrial system." These concepts are present in the works of Boudeville [1966] and Perroux [1969] associated with the Growth Pole theory. The use of the input-output framework gives a decisive operational contribution to these concepts.

Observation of the basic structure of the input-output tables suggests that key sectors would be found to occupy an intermediate position in the hierarchy of sectors from primary to final. Once identified, it is suggested that these key sectors be given priority in investment allocation and in industrial promotion strategy.

McGilvray also cautions that measures of output linkage should not be confused with sectoral income or employment multipliers. "Sectoral multipliers are designed to measure the impact of an increase in final demand on income or employment. Measures of linkage are designed to measure the impact of an increase in final demands on gross outputs" [1977, p. 51]. We do not see in the literature any explicit use of any income or employment indicators for the purpose of defining linkages and, as a consequence, key sectors.[6] However, it is this writer's view that they should have an important role in the definition of a development strategy. So, it should be important to bring those concepts into this framework, and to try to examine their behavior in several countries with several levels of economic development. Thus, we should develop employment linkages and income linkages in a manner similar to the output linkages.

Turning again to the forward linkages, let us examine more carefully the definition contained in (2.8a and b). The $(I-A)^{-1}$ matrix is represented in the 3 x 3 case:

$$\begin{bmatrix} 1 - \frac{Z_{11}}{X_1} & - \frac{Z_{12}}{X_2} & - \frac{Z_{13}}{X_3} \\ - \frac{Z_{21}}{X_1} & 1 - \frac{Z_{22}}{X_2} & - \frac{Z_{23}}{X_3} \\ - \frac{Z_{31}}{X_1} & - \frac{Z_{32}}{X_2} & 1 - \frac{Z_{33}}{X_3} \end{bmatrix}^{-1}$$

Note that the elements of the 1st row,

$$1 - \frac{Z_{11}}{X_1}, \ - \frac{Z_{12}}{X_2}, \ - \frac{Z_{13}}{X_3}$$

do not have the same denominator. When calculating the direct forward linkages, we used the formula:

$$W_i = \frac{\sum_i Z_{ij}}{X_i} \tag{2.1b}$$

In this formula, the denominator is always the same, when we sum the intermediate inputs along a row. This discrepancy, between the direct and indirect way of calculation of the forward indexes, led us to another framework, where we will use the horizontal coefficients approach. The technical coefficients in this approach, as noted in Chapter 1, are calculated as:

$$\overset{*}{a}_{ij} = \frac{Z_{ij}}{X_i}$$

We will come to this point later in the next section. This was the main reason for the introduction on the linkage framework of the output approach, as in Jones [1976].[7] Using the horizontal coefficient version we get, for $(I-\overset{*}{A})^{-1}$

$$\begin{bmatrix} 1 - \frac{Z_{11}}{X_1} & - \frac{Z_{12}}{X_1} & - \frac{Z_{13}}{X_1} \\ - \frac{Z_{21}}{X_2} & 1 - \frac{Z_{22}}{X_2} & - \frac{Z_{23}}{X_2} \\ - \frac{Z_{31}}{X_3} & - \frac{Z_{32}}{X_3} & 1 - \frac{Z_{33}}{X_3} \end{bmatrix}^{-1}$$

We will return to this matter and to the presentation of rigorous definitions of linkages in the next section.

Before ending this section, we introduce a definition of a measure of variability represented by both of the following indexes of the coefficient of variation:[8]

$$V_j = \frac{\sqrt{\frac{1}{n-1} \sum_{i=1}^{n} \left(\alpha_{ij} - \frac{1}{n} \sum_{i=1}^{n} \alpha_{ij} \right)^2}}{\frac{1}{n} \sum_{i=1}^{n} \alpha_{ij}} \tag{2.9a}$$

$$V_i = \frac{\sqrt{\frac{1}{n-1} \sum_{j=1}^{n} \left(\beta_{ij} - \frac{1}{n} \sum_{j=1}^{n} \beta_{ij} \right)^2}}{\frac{1}{n} \sum_{j=1}^{n} \beta_{ij}} \tag{2.9b}$$

These measures, (2.9), represent a "variance" measure of the linkage indexes, in oposition to (2.7a) and (2.7b) which represent an "average" measure of them. We know that average measures can be influenced by extreme values; thus it may be a good idea to measure the linkage impact also by such a "variance" measure. The use of variance measures will give us information about the spread throughout the sectors of the linkage indicators. That is, a low variance measure, V_j, will indicate that an industry draws relatively evenly from the other sectors, and a high value of V_j will mean that the industry draws unilaterally on the system of industries.

However, limitations to this approach should be mentioned. We are not interested in determining the dispersion of sales or aquisitions across industries but rather in their existence and importance. The problem, as pointed out by Jones [1976, p. 326] "is not the dispersion of sales across industries but the existence of sales that are a large share of a small industry. Thus a unitary V_i, indicating identical sales to all industries, could still give distorted row sums if those sales represented a large share of inputs into small industries."

Another limitation is based on the fact that what has been found invariant in international comparisons was "mean" linkage values, not the individual components (and thus their variance), which could be slightly different from country to country. So international comparison of variance measures could be misleading. However, in our case we are dealing with intertemporal comparisons; we are analysing the evolution of one economy and therefore that limitation does not hold in this case.

Yolopoulos and Nugent [1976, p. 341], argued that "mean" measures and "variance" measures are strongly and negatively correlated in both the DC's and LDC's of their sample. They concluded that variance measures are substitutes rather than complements. We will come to this point later in Chapters 3 and 4 in analyzing the Portuguese data.

2.1.3 The Import Issue

After this general overview of the standard linkage definitions, we now consider the question of whether to use domestic or inter-industry (including imports) matrices in the linkage measures. It is important to distinguish between measures of linkage based on the existing technology of a country or a region (the structure of production) and measures of linkage based on the existing interdependence of only the domestic or intraregional sectors of production. In the latter case, backward and forward linkage indexes measure the impact of a unit increase in final demand (primary inputs) on domestically supplied inputs and outputs, and the appropriate matrix for calculating linkages is $(I-A_d)^{-1}$, where A_d is the matrix of domestic coefficients. In the former case, we should use the technological matrix $(I-A)^{-1}$, where A is the matrix of total (domestic plus imported) coefficients.

Assuming that all countries would have the same technological structure, measures of linkage based on the input-output framework would lead to unique ranking of sectors. However if we use the domestic flow matrix, different sectoral values of linkages would reflect different structures of imports for the different economies.

Thus, use of either of the two matrices depends exclusively on one's research or policy purposes, and the specific characteristics of the countries or regions under consideration (natural resources, labor quantity and cost, availability of technology, etc.). As an example, if a developing country wants to develop an import substitution program, it is obvious that one should use measures of linkage based on the domestic matrix, A_d. But if one country is interested in developing an industrialization program without import restriction policies, the technological matrix, A, should be used.

Using input-output tables for Taiwan, 1969 (both domestic and interindustry), Riedel [1976, p. 320] found a correlation of 0.53 between the forward linkage indexes calculated using (2.8a). He concludes that this indicates "significant sectoral rank reversals between the two indices, especially for some sectors." He suggested, also, that low indexes of backward linkages, as he observed in the Taiwan case, was one explanation for the success of that country. The reason was that exports in Taiwan were based on relatively labor intensive consumer goods and so were less capital intensive than intermediate good industries. So low backward linkage indexes should be considered a natural phenomenon in this case.[9]

He argues that in case of a small country in terms of either population or domestic resources "economies-of-scale considerations may recommend concentration on a relatively few, self-contained, 'foot-loose' industries". And he concludes by saying that "'foot-loose' industries had flourished in small, export-oriented countries in which the structure of production conforms rather well to existing factor endowments." Once more this example helps to clarify the idea that high or low values of the indexes, based on the domestic tables or on the technological ones, by themselves do not signify a great deal. We have to interpret them according to the specific characteristics of the country under consideration, also taking into account our particular policy purposes.

For some cases, the use of a more sophisticated matrix would be useful. For example, if we are measuring potential long-run linkages ex-ante, one should utilize a flow matrix incorporating domestic elements plus those imported intermediates that are domestically producible. However, domestically producible does not necessarily mean economically producible, in terms of comparative advantage, particularly when we are concerned with natural-resource-based industries. So this kind of hybrid matrix, that includes only potentially economically replaceable imports, could also be useful. But the actual construction of such a matrix is very difficult, and is not realistic at present.

2.1.4 The Balanced-Unbalanced Growth Controversy

Conflicts between balance and imbalance have been the sources of lively controversy at least since Aesop's tortoise won his famous race against the hare.[10] Also, there is a certain amount of ambiguity in the concept, and this does not help to clarify the controversy.[11]

Referring to the balanced growth arguments, Nurkse stated that the low income elasticity of demand for most exports of underdeveloped countries combined with the very low level of domestic demand are the chief obstacles to successful investment and development. So he suggests simultaneous investment in several or many mutually interdependent consumer goods industries along the lines dictated by demand elasticities.

Hirschman's point of view, however, embodied the unbalanced growth approach, based on the sectors that had higher linkages. It was at this point that the linkages framework was used to help answer the question of balanced or unbalanced growth in national/regional economic development.12

For Hirschman (unbalanced growth theory) countries that have alloted high priority to high linkage industries would have a historical record of higher rates of growth than would countries that have alloted low priority to high linkage industries. In a tetrapartite classification, first and last priority were assigned to sectors that have high backward-high forward and low backward-low forward linkages, respectively. Second and third priority were assigned the sectors that have, respectively, high backward-low forward and low backward-high forward linkages. This rank ordering of the economic sectors in terms of potential linkage generation, presented by Chenery and Watanabe [1958], constituted an important step in formulating Hirschman's strategy empirically.[13]

It is important here to make some references to the Hirschman argument. The first is that he considers that in most developing economies there are imperfections in factor and product markets,[14] and the second is that there is a shortage of entrepreneurial talent. In his considerations it is also implied that resources are not centrally allocated but depend largely upon the atomistic responses of entrepreneurs. In these circumstances, Hirschman considers that investment opportunities will be missed and increases in demand will probably be met by a rise in imports.

To overcome this scenario, Hirschman suggested a form of disequilibrium or unbalanced development strategy in which the economy would experience a sequence of severe shortages and/or excessive supply in particular markets. These will be the strong market signals that would induce the local entrepreneurs to invest.

The chosen or key sectors will be the disequilibrium ones, the ones that indicate investment opportunities. Looking to the backward linkages, key sectors will generate above-average input requirements from other sectors, and therefore (it is argued) there is a greater probability of induced investment in the supplying sectors (to expand existing plant and/or to replace imports). Analyzing the forward linkage, it raises the probability of investment in sectors where the key sector's product is a major input. And, he concludes, the rapid growth of the key sectors provides a greater prospect of generating a sequence of induced investment decisions and an active growth process in conditions of scarce entrepreneurical talents.[15] The Hirschman arguments led to the prescription of unbalancing the economy in favor of high-linkage sectors.

However, we should observe that the end result of a strategy of unbalanced growth may well be characterized as balanced growth. Streeten [1959] argues "it is possible to formulate the choice between balance over periods of varying lengths." Hirschman [1958] also said that, "it is the experience of unbalanced growth in the past that produces, at an advanced stage of economic development, the possibility of balanced growth."

However, Yotopoulos and Nugent [1973, p. 171] criticise the Hirschman conclusions, presenting an empirical test that "does not support the Hirschman hypothesis in its extreme formulation." They present their formulation of a balanced growth version of the linkage hypothesis, and an empirical test of it, using the following methodology: employing the concept of a total linkage index, discussed above (2.7a and b), they formulated the so-called Hirschman-Compliance Index, again, based on the earlier work of Rasmussen [1956].

> Simple and yet adequate Hirschman-Compliance Index (ρH_i) is provided by the country-specific correlation coefficient between the sectoral total linkage indexes (O_j) and a country's sectoral rate of growth (g_{ij}). We thus define: (Yotopoulos and Nugent [1973, p. 165])

$$\rho H_i = \rho(O_j, g_{ij}), \tag{2.10}$$

where i and j denote country and sector, respectively.

Other combinations, using more sophisticated versions, could be used ("weighted" or not, output version for forward version, etc.). Also we can introduce the relative importance of a sector in a country's economy (ω_{ij}).[16]

Yotopoulos and Nugent formulated their test of the Hirschman hypothesis in the following manner: they wanted to see whether countries that complied with the Hirschman prescription, and placed main emphasis on the high-linkage sectors, indeed were able to achieve higher rates of growth than did countries that emphasized low linkage sectors. The null hypothesis would be rejected by significantly positive correlation between the overall country growth rates (G_i) and the Hirschman-compliance index (ρH_i).

In favor of the balanced growth version, Yotopoulos and Nugent argue that there should be a material limit for a sector's growth, no matter how high its linkage is, "without throwing the economy off kilter." The weighting structure of the linkage indicators is considered as one of the major problems that the use of linkages raises. This is discussed extensively by McGilvray [1977, p. 52].

In the first place, using the Bharadwaj [1966] argument "induced investment will depend on the level of demand for inputs (in the case of backward linkage) and the level of supply of outputs (in the case of forward linkage)," McGilvray concludes that the relative importance of each sector in the overall economy should be reflected in the linkage indicators. He next presents the weighting scheme suggested by Hirschman, where for the backward linkage index, the weights are based on the ratio of the demand for each (commodity) input to the output of that commodity at minimum operating capacity.[17]

He interprets the Hirschman idea as

$$V_j' = \frac{\frac{1}{n} \sum_i^n w_{ij} \; \alpha_{ij}}{\frac{1}{n^2} \sum_{ij}^n w_{ij} \; \alpha_{ij}} \qquad (2.11)$$

where the w_{ij} correspond to Hirschman's probability weights. However, McGilvray does not present an operational method for finding the w_{ij}, and criticizes the suggested use of final demands or outputs to calculate the w_{ij}'s. The weights

> ...will reflect the actual or ex-post linkages in the economy (and hence the investment opportunities already available) rather than the ex-ante or potential linkages created by a concentrated development of certain key sectors, and the (ex-ante) market disequilibrium created by this selective expansion. Thus the question of the scale of expansion of the key sectors (and incidentally the

> question of the scale of expansion of the key sectors to be induced) remains unresolved despite the fact that the modified sectoral linkages, and their rank ordering, depend upon the assumed scale of output in the key sectors. (McGilvray [1977, p. 53]).

We agree with McGilvray's point that final demand vectors and primary input vectors (as other authors like Yotopoulos and Nugent [1973] pointed out) are not useful for weighting purposes. One could think of using the sum of the intermediary inputs as a basis for the weighting procedure. However, the sum of the intermediary inputs reflects their import composition. Only the output vector is equal in both (interindustry and domestic) matrices, and this is a good argument in favor of it. In fact, what we really want to express is the real weight of each sector when we compute the index, and as the mathematical analysis of the indicator shows, all sectors in each row (column) will enter on the calculation of each element of the row (column) linkage index. So, we should weight each cell α_{ij} before calculation to provide the real weight of that cell. The best way to weight each cell is to multiply it by the relative importance of each sector's output in the overall output of the economy.

In this way we avoid the criticism of McGilvray against the use of the output vector for the calculation of weights. We present a different approach and clarify our position in Section 2.2.2, below. This problem of weights is not new. Rasmussen [1956] already presented a weighted version of his "Index of Sensitivity to Dispersion" (U_i^w) as follows:

$$U_i^w = \frac{\dfrac{\sum\limits_{j=1}^{n} Z_{ij}\, y_j}{\sum\limits_{j=1}^{n} Y_j}}{\dfrac{1}{n}\sum\limits_{i=1}^{n} \dfrac{\sum\limits_{j=1}^{n} Z_{ij}\, y_j}{\sum\limits_{j=1}^{n} Z_{ij}\, y_j}} \tag{2.12}$$

where y_j = jth element of the final demand vector Y

Z_{ij} = ijth element of the Leontief inverse matrix

We should also mention that formula (2.7b) was considered by some authors (for example, Yotopoulos and Nugent [1973]) as a weighted one. In fact the "Power of Dispersion Index" of Rasmussen is nothing more than a normalized version and a better way to proceed in international or intemporal comparisons. But is is not a "weighted" version of the index as some authors have suggested. The same conclusion applies to the version constructed on the same basis for the forward linkage case. (See, for example, Laumas [1976].) Yotopoulos and Nugent [1976] argued that was one reason for not using the normalized formulas (2.7b and 2.8b) advocated by Boucher [1976], Laumas [1976] and Jones [1976] instead of the absolute ones (2.7a and 2.8a) in their earlier paper. (Yotopoulos and Nugent [1973].) They note that the two sets of indexes (backward linkage versus normalized backward linkage and forward linkage versus normalized forward linkage) are perfectly correlated, which is no surprise, given that the difference between the absolute and the normalized index "is the normalization in the latter by the number of sectors and the double sums are obviously the same for any country, so V_j is simply perfectly correlated with itself after normalization by a constant!"

Turning to the balanced-unbalanced growth controversy, we observe some similarities between the two approaches. Both rely heavily on externalities and dynamic repercussions. Most balanced growth strategies contain some elements of imbalance, and most unbalanced growth strategies contain some elements of balance. Therefore it should not really be so surprising that the linkage hypothesis could be formed both as an unbalanced growth strategy and as a balanced growth stragety. Other authors also contributed to the operational analysis of the balanced-unbalanced growth controversy, in the late 1960's and the beginning of the 1970's.

Swamy [1967, p. 289] (which was the basis of the Yotopoulos and Lau formulations [1970], [1975]) said:

> We postulate the existence of a relationship positive or negative, between overall growth rate and imbalance in sectoral growth rates. To test this relationship, three questions need to be answered: (1) What is the operational meaning of the dependent variable? (2) What is the measure of the degree of "balance" or "unbalance"? (3) What is the operational definition of "sectors" and how many sectors should be considered in order to test the relationship?

That is, for example, what should be the objective funtion to be maximized when performing an empirical test? According to Swamy, Nurske [1961] for example seems to suggest the maximization of "reinvestable" surplus (capital accumulation), inducement to invest, external economies, complementary industries, structural changes, or the growth rate of total output. Hirschman [1958] advocates strategies for the development of decision-makers, external economies (of the vertical type) and the growth rate. Streeten [1959] emphasizes "anabolism" of wants, technological progress, and the growth rate. For Swamy [1967, p. 289], "for purposes of empirical verification, balanced growth is regarded, here, as a means to accelerate the growth rate of aggregate demand, uncorrected for population change." He introduces the following formula: [18]

$$V_b = \frac{\sum_{i=1}^{k} | g_i - g_i^* |}{k} \tag{2.14}$$

where the difference between actual and expected growth rates is regarded as a measure of "imbalance". He also used

$$V_{aie} = \frac{\sqrt{\sum_{i=1}^{k} (g_i - GE_i)^2}}{k} \tag{2.15}$$

$$V_{bie} = \frac{\sum_{i=1}^{k} | g_i - GE_i |}{k} \tag{2.16}$$

where E_i is income elasticity of demand and G is overall rate of growth. These models represent the standard deviation and the mean deviation concepts of variability of Swamy. However the sectoral rates of growth were presented in the so called "expected form", obtained multiplying the sectoral rates by the income elasticities of demand. These were called expected sectoral rates of growth.

The lack of data on income elasticity of demand for many countries meant that the elasticity indicators were the same for all countries. Swamy, uses V_{aie} and V_{bie} and G, for calculating coefficients of correlation for five periods of time (1938-1960), (1938-1948), (1948-1953), (1954-1958) and (1950-1960). He found almost all of them positive and significant at the five percent level. He concludes that "the statistical evidence does not corroborate the balanced growth theory even when it is formulated in its more sophisticated form to incorporate a certain degree of sectoral imbalance warranted by income elasticities of demand." (Swamy [1967, p. 293].) The Swamy formulation does not take into consideration the linkages framework.

These formulas were the starting point for Yotopoulos and Lau [1970], [1975]. They criticize the index of imbalance defined by Swamy because it was based on the absolute deviation terms.

Empirical investigation using the Swamy framework was pursued by Shashua and Goldschmidt [1972] and Demery and Demery [1973] among others. Yotopoulos and Lau [1975] proposed the following measures for sectoral imbalance, which they considered an improvement over earlier ones. Again, the criterion for balance/imbalance is formulated in terms of the degree of dispersion of sectoral growth rates and the overall rate of growth over a certain time period. According to Yotopoulos and Lau [1975, p. 377], "A high degree of dispersion of sectoral growth rates would define a high index of imbalance. In turn, a positive relationship of the index of imbalance with the observed rates of economic growth over the period would constitute rejection of the balanced growth hypothesis." The absolute dispersion of the sectoral growth rates, V_j, is given as

$$V_j = \sqrt{\sum_{i=1}^{m} \frac{(g_{ij} - G_j)^2}{m}} \tag{2.17}$$

and the relative dispersion of the sectoral growth rates, V_j^*, as

$$V_j^* = \frac{1}{G_j} \sqrt{\sum_{i=1}^{m} \frac{(g_{ij} - G_j)^2}{m}} = \frac{V_j}{G_j} \tag{2.18}$$

where G_j is a properly weighted average of g_{ij} over the sectors. They point out that V_j^* should be preferred to V_j for testing the balanced growth controversy, given the fact that it is a relative measure. They argue that the unbalanced growth hypothesis was positively tested by Swamy and others using the absolute measure and not the relative one.

> Consider a country with two sectors, one growing at 50% a year, and the other growing at 45% a year. Contrast this with another country with one sector growing at 5% a year, and the other growing at 0% a year. Do the two countries exhibit the same degree of imbalance? If one uses the index of absolute deviations, they do. (Yotopoulos and Lau [1975, p. 517].)

So, emphasis should be placed on the V_j^* index. For Yotopoulos and Lau, the test of the balanced-unbalanced growth hypothesis consists of examining the sign of the correlation coefficients between the average rate of growth, G_j, on the one hand, and the index of absolute, V_j, or relative, V_j^*, deviation, on the other.

Yotopoulos [1973][19] pursues, also with Nugent, another version for measuring sectoral imbalance: these indices take into consideration the linkages framework, and give a better understanding of the balanced-unbalanced framework.

Using the Yotopoulos and Lau [1970] formulation of sectoral imbalance in terms of the deviation of sectoral growth rates from the overall rate of growth, they consider a maximum degree of imbalance that takes into consideration the linkage framework. That is, a different growth pattern of one sector, relative to others, is due to existing differences in linkages indexes. This was called the "balanced-growth version of the linkage hypothesis". The formula is:

$$VL_i = \frac{1}{G_i}\sqrt{\frac{1}{n}\sum_{i=1}^{n} \tau_{ij}\,(g_{ij} - O_j G_i)^2} \qquad (2.19)$$

where n is the number of sectors, τ_{ij} is the relative importance of sector j in country i (here measured as the sectoral value added over GDP), g_{ij} is the growth rate of sector j in country i, O_j is the linkage index of sector j and G_i is the overall growth rate of country i.

So VL_i is a modified version of Pearson's coefficient of variation. Yotopoulos suggests it because (1) adjustments were made for differences among countries in the overall growth rate, (2) the variance is computed not in terms of the deviations in sectoral growth rates (g_{ij}) from overall growth rate (G_i) but in terms of the deviations in g_{ij} from G_i weighted by the linkage indexes, and (3) the variances in sectoral growth rates from the linkage-weighted growth rates are in turn weighted by the relative importance of the sector (τ_{ij}).

A high VL_i index suggests that a country has deviated from the optimum linkage-weighted growth proportions. Yotopoulos concludes by suggesting that the balanced-growth version of the linkage hypothesis is supported by a negative correlation between the VL_i index and the overall rate of growth. The Yotopoulos and Nugent article was criticized by several authors. McGilvray [1977, pp. 54-55], for example, notes that "the linkage hypothesis does not imply that key sectors will necessarily grow faster than other sectors." Syed [1975] presents the following formulas:

$$V^{*}YLt' = | g_i^{t'} - G^{t'} | \tag{2.20}$$

$$V^{*}YNt' = | g_i^{t'} - C._j G^{t'} | \tag{2.21}$$

where: $g_i^{t'}$ = average sectoral growth rates for the whole period (1961-1970),

$G^{t'}$ = the overall average growth rate of GDP for the whole period (1961-1970), and

$C._j$ = sectoral linkage index, as defined previously.[20]

Equations (2.20) and (2.21) would determine, according to Syed, which industries have grown substantially differently from the overall rate of growth. In Chapter 3, an empirical analysis of these ideas is presented.

2.1.5 Limitations and Criticisms of These Tools

Several limitations have been discussed — related to the linkage framework. One of the problems is connected with the "velocity of growth" of each sector. "If the strategy is successful, the fastest growing sectors may be those which are most closely linked to the key sectors, not the key sectors themselves. These sectors may have relatively low indexes. Hence correlating sectoral growth rates with sectoral indexes of linkages is not an adequate measure of compliance with the Hirschman strategy" (McGilvray [1977, p. 55]). On the other hand, the economies of the developing countries show different rates of growth for the international and national sectors. However this does not mean that they are experiencing unbalanced growth strategy since their growth rates are a result of their economic dependence. That is, it is not clear where the balanced and unbalanced growth strategy begins and ends, given that countries must pay attention to comparative advantage in international trade. So a major criticism is related to the fact that "there is no necessary connection between this form of unbalanced growth and that implied by Hirschman-style linkage-based development, and it is therefore, incorrect to assume that variations in sectoral growth rates demonstrate a linkage-based development strategy" (McGilvray [1977, p. 55]).

The linkage approach does not say anything about comparative advantage, and yet we know the importance of such considerations in a neoclassical context, given that the majority of developing countries are small and highly trade dependent, and so investment decisions can not ignore comparative cost criteria.

And other criticism could be raised regarding the fact that, according to Hirschman, the creation of bottlenecks in the economy induces entrepreneurs to come forward. But in underdeveloped countries experience in most cases shows that the creation of bottlenecks has other consequences that most profoundly inhibit the supply of entrepreneurship. Moreover, if we consider the intricate and innovative ways in which people of developing countries deal with adversity (black markets, etc.), it is apparent that decision-making ability is not altogether lacking (Boucher [1976]).

Maybe what is lacking is the incentive to apply this ability to productive entreprise. So the lack of incentives could be a result of government policy, rather than bottlenecks in the economy. The existence of linkages is not enough to guarantee a generated investment process. Other problems could be noted. The degree of expansion of the key sectors (and how to induce them) in an unbalanced strategy formulation remains unresolved. Also, what is the best time interval for testing the balanced-unbalanced growth formulation? In the following sections attention will be paid to some of these problems.

2.2 Framework of Analysis: A Proposal

We now introduce the use of the linkages framework to the analysis of the Portuguese economy, the object of our empirical study. Our framework presents some new extensions of previous studies in the field, using basically the input-output operational tool as a way to guide the formulation of the best strategy for national economic development.

However, we can not recommend the use of the same rigid operational tools for all study cases under consideration. The basic reason is that strategies should differ from country to country, according to the specific conditions of each. So, we are going to present here the indicators that seem of most interest for a broad spectrum of cases. It is not our purpose to exhaust all possible indicators that can be obtained from the input-output tables.

All the indicators presented in Section 2.1 try to answer only the question of what are the best indicators to measure the greatest increases in output terms. But based on the same assumptions we can also derive linkages in terms of increases of employment and also of increases in income.

We divide our presentation into three parts: the output linkages, the employment linkages and the income linkages. The advantages of this procedure are clear. As we observed before, high output linkages do not necessarily mean high increases in employment or income, as some authors seem to have thought. We will test this hypothesis empirically. And for some countries, for example, with high unemployment rates, or very high levels of emigration, the first priority might be given to the employment issue. Similarly, one can also imagine cases where the increase in income should occupy the first place in the government's policy priorities. Thus we introduce this more general formulation of the linkages framework.

2.2.1 Output Linkages

From among the indicators presented earlier, we choose several that seem more in accordance with our objectives, and we will make some comments about our choices. The option between direct and direct plus indirect indexes deserves some consideration.

In the literature only Jones [1976] raises the question of the importance of using the output inverse for calculating the indirect forward linkages, in view of the fact that the row sums of the input inverse do not represent a consistent indirect forward linkage measure. Using a 3x3 matrix case for illustration, we will try to show what each of these indexes really represents.

The direct linkage is the row sum of the flow matrix, divided by the gross output vector. That is (forward case), for sector j,

$$\frac{Z_{j1} + Z_{j2} + Z_{j3}}{X_j} \text{ or } \frac{Z_{j1}}{X_j} + \frac{Z_{j2}}{X_j} + \frac{Z_{j3}}{X_j} \qquad (2.22a)$$

which gives us the sales to the other industries, originated by the production of one unit of X_j. For the backward case, summing along the column we have:

$$\frac{Z_{1j} + Z_{2j} + Z_{3j}}{X_j} \text{ or } \frac{Z_{1j}}{X_j} + \frac{Z_{2j}}{X_j} + \frac{Z_{3j}}{X_j} \qquad (2.22b)$$

That is, we get the requirements from other industries for production of one unit of X_j. So we can speak unambiguously of direct linkages, because we get direct interindustry requirements from (and sales to) other industries. If we sum the rows or the columns of the A matrix,21 we will get, for the row sum (forward case)

$$\frac{Z_{j1}}{X_1} + \frac{Z_{j2}}{X_2} + \frac{Z_{j3}}{X_3} \qquad (2.23a)$$

and, for the column sum (backward case)

$$\frac{z_{1j}}{X_j} + \frac{z_{2j}}{X_j} + \frac{z_{3j}}{X_j} \tag{2.23b}$$

Thus, using the A matrix, only for the backward case do we really capture the direct effect. Most writers agree on this point. But when we consider the indirect forward linkage, as the row sum of the Leontief inverse, we are summing the inverse of (I-A), and, as we saw above, row sums of A do not represent a direct forward linkage measure.

Turning now to the indirect cases, we sum along the rows, for forward linkages, of the inverse of the (I-A) matrix:

$$\begin{bmatrix} 1 - \frac{z_{11}}{X_1} & -\frac{z_{12}}{X_2} & -\frac{z_{13}}{X_3} \\ -\frac{z_{21}}{X_1} & 1 - \frac{z_{22}}{X_2} & -\frac{z_{23}}{X_3} \\ -\frac{z_{31}}{X_1} & -\frac{z_{32}}{X_2} & 1 - \frac{z_{33}}{X_3} \end{bmatrix}^{-1} \tag{2.24a}$$

where each element of the input inverse is the total production of sector i necessary to deliver a unit of final product of sector j. For backward linkages, we sum down the columns. Jones [1976] suggests that, to obtain the indirect forward linkage we should use the inverse of the matrix obtained from[22]

$$\begin{bmatrix} 1-\frac{Z_{11}}{X_1} & -\frac{Z_{12}}{X_1} & -\frac{Z_{13}}{X_1} \\ -\frac{Z_{21}}{X_2} & 1-\frac{Z_{22}}{X_2} & -\frac{Z_{23}}{X_2} \\ -\frac{Z_{31}}{X_3} & -\frac{Z_{32}}{X_3} & 1-\frac{Z_{33}}{X_3} \end{bmatrix}^{-1} \tag{2.24b}$$

where each element of the output inverse measures the total value of production that comes about in sector j per unit of primary input of sector i. Summing along the rows, we are adding values that are always divided by the same number, as is true for backward linkages using the input inverse. So the inverse of the matrix of "vertical" coefficients gives us the indirect backward linkages and the inverse of the matrix of "horizontal" coefficients gives us the indirect forward linkages. The column sums of the input-inverse and the row sums of the output-inverse are of no interest to us.

Jones [1976, p. 329], pointed out that "each industry's backward linkage is equivalent to a weighted sum of the forward linkages of supplier industries, while each forward linkage is a weighted sum of users' backward linkages. Then total forward linkages equal backward linkages when both are weighted by the value of output ($X' L^F = L^B X$)."[23]

From this equality we derive the "coefficient of interdependence" ($X' L^F \div X'1$)[24] which could give us a standard for separating "high" and "low" linkage industries, much as Chenery and Watanabe used when they dealt with direct coefficients. In order to demonstrate with empirical data from the Portuguese economy some of the misleading results that can be obtained using the input inverse approach for the concept of forward linkage, we present for Sector 1 (Agriculture, Forestry and Fisheries) and Sector 9 (Basic Metals), as an example, and also for the average of all sectors, the following comparison between the values for the index calculated (1) on the basis of the input inverse approach, (2) on the basis of the output inverse approach (Table 2.1).

A rank ordering to classify the four different years considered for each domestic or interindustry indicator has been used. These rank orderings appear in Table 2.1 in parentheses and are read across the rows. For example the rank ordering in the domestic direct linkage for industry 1 shows that the year 1970 exhibited the highest value of (1) followed by years 1974 with (2), 1964 with (3) and 1959 with (4).

For sector 1, the rank ordering classifications observed in the direct linkage case and the indirect linkage case obtained using the input inverse are not the same. Only the indirect linkage indicator obtained using the output inverse maintained the same rank ordering in both domestic and interindustry versions. For some years, like 1959, the corresponding value obtained for the indirect linkage using the input approach is in the first position of the rank order, where in the direct and in the indirect linkage case based on the output approach is in the fourth position.

TABLE 2.1
Input Versus Output Approach
Forward Linkage Indexes
Portugal 16 x 16

		DOMESTIC				INTERINDUSTRY			
		1959	1964	1970	1974	1959	1964	1970	1974
Industry 1	Direct Linkage	.427 (4)	.442 (3)	.490 (1)	.487 (2)	.558 (4)	.622 (3)	.654 (2)	.721 (1)
	Indirect Linkage (input approach)	2.519 (1)	2.315 (3)	2.386 (2)	2.276 (4)	3.331 (1)	2.968 (4)	3.099 (3)	3.116 (2)
	Indirect Linkage (output approach)	1.581 (4)	1.650 (3)	1.773 (1)	1.697 (2)	1.877 (4)	1.998 (3)	2.201 (2)	2.217 (1)
Industry 9	Direct Linkage	.917 (3)	.911 (4)	.923 (2)	1.044 (1)	2.597 (1)	1.526 (4)	1.651 (3)	2.273 (2)
	Indirect Linkage (input approach)	1.394 (4)	1.644 (2)	1.874 (1)	1.471 (3)	2.444 (3)	2.214 (4)	3.040 (1)	2.910 (2)
	Indirect Linkage (output approach)	2.315 (4)	2.390 (3)	2.767 (1)	2.480 (2)	6.336 (2)	3.971 (4)	6.116 (3)	6.949 (1)
Average	Direct Linkage	.379 (4)	.406 (3)	.452 (1)	.423 (2)	.649 (3)	.588 (4)	.701 (2)	.901 (1)
	Indirect Linkage (input approach)	1.339 (4)	1.470 (3)	1.589 (1)	1.471 (2)	1.709 (4)	1.733 (3)	1.955 (1)	1.896 (2)
	Indirect Linkage (output approach)	1.525 (4)	1.610 (3)	1.740 (1)	1.618 (2)	2.230 (3)	2.137 (4)	2.647 (2)	3.119 (1)
Ratio $\frac{\text{Indirect}}{\text{Direct}}$	Input Approach	3.533 (2)	3.621 (1)	3.516 (3)	3.478 (4)	2.633 (3)	2.947 (1)	2.789 (2)	2.104 (4)
	Output Approach	4.024 (1)	3.966 (2)	3.850 (3)	3.825 (4)	3.436 (4)	3.634 (2)	3.776 (1)	3.462 (3)

Industry 9 illustrates another type of misleading result that the use of the input inverse can produce. The high values observed in the interindustry matrix for the direct linkage are a result of the high value of imported inputs. That is, each intermediate input cell includes the imports, so their sum is greater than the gross output, where imports (not nationally produced) are not included. However when we look at the indirect index values using the input inverse we observe great instability from year to year. For 1959 the indirect linkage is even smaller than the direct one. These results are not surprising when we recall that the inverse of the vertical coefficient matrix that gives the input linkage approach is not the matrix from which the direct forward linkages have been deduced.

Analysis of the average values produces the same type of conclusions. The ratios of indirect over direct linkage (average values) for the interindustry tables are presented at the bottom of Table 2.1.

These ratios show that, on the average, using the output approach, we observe a growing path from 1959 to 1970, and a decreasing path from 1970 to 1974. This kind of result is exactly the same as observed for other indicators (in average values) as we will show later, in contrast with the average input-version values, which are not observable in the future.[25] Other sectors could be observed, but these two seem to be enough to illustrate the misleading use of the input inverse approach for forward linkages indicators.

We consider that the concept of linkages in a version where the elements of the main diagonal are netted out has some considerable advantages, as we will explain, and they should be included in our basic framework.[26]

We will use a more sophisticated example of formulas 2.4a and b, as presented in 2.30, 2.32, etc. This indicator gives the direct and indirect effects produced by one sector on the other sectors of the economy, excluding itself.

An analysis of the values obtained for the linkage indicators for the two extreme years (1959 and 1974) in the interindustry case provides an illustration that can be confirmed by looking at other tables or indicator versions (see Tables 2.2 and 2.3).

In the backward linkage case the decline in the output linkage effect is extremely high, and also the rank ordering of the sectors is affected, being for some sectors very sensitive. For the 1959 table, sector 4 falls six places, sector 5 falls four, sector 9 falls five, and sectors 13 and 15 rise five places for backward linkage rank ordering when we compare the backward index with the net backward index. For the 1974 table, sector 4 falls five places, sector 9 falls nine places and sector 13 rises six places also.

The analysis of forward cases shows much more homogeneity, and for 1974 only for sector 4, falling six places, do we find a significant change in rank ordering. For 1959, decreases for sector 3 (four places), 4 (six places), 5 (four places) and a increase for 14 (four places) are found relevant. This greater homogeneity of these forward linkages is demonstrated by calculating the correlation between the indexes for tables and years treated in Tables 2.2 and

TABLE 2.2

Some Linkage Indexes for 1959: Interindustry Matrix
Portugal 16x16

	Backward Index		Backward Net Index		Forward Index		Forward Net Index	
Sectors	Value	Rank Order	Value	Rank Order	Value	Rank Order	Value	Rank Order
1	1.348	13	.207	13	1.877	7	.735	7
2	1.380	12	.340	12	6.173	2	5.134	1
3	2.196	1	.972	1	1.268	12	.044	16
4	2.121	2	.626	8	1.620	8	.124	14
5	2.078	3	.633	7	1.588	9	.143	13
6	1.826	9	.592	9	2.505	3	1.271	4
7	2.019	5	.670	6	2.505	4	1.156	5
8	1.545	11	.513	10	1.915	6	.883	6
9	1.981	6	.457	11	6.336	1	4.813	2
10	2.063	4	.851	3	1.444	10	.233	9
11	1.854	8	.747	4	1.417	11	.310	8
12	1.072	16	.068	16	2.329	5	1.324	3
13	1.883	7	.883	2	1.056	16	.056	15
14	1.083	15	.078	15	1.202	15	.197	11
15	1.688	10	.679	5	1.238	13	.229	10
16	1.202	14	.146	14	1.211	14	.155	12

Formulas for these indicators are given below in (2.29), (2.30), (2.39) and (2.40).

TABLE 2.3

Some Linkage Indexes for 1974: Interindustry Matrix
Portugal 16x16

	Backward Index		Backward Net Index		Forward Index		Forward Net Index	
Sectors	Value	Rank Order	Value	Rank Order	Value	Rank Order	Value	Rank Order
1	1.616	11	.443	14	2.217	6	1.045	5
2	1.524	14	.475	13	18.096	1	17.048	1
3	2.439	2	1.176	1	1.494	12	.230	13
4	2.279	4	.728	9	1.668	9	.117	15
5	2.091	6	.915	4	1.535	11	.358	10
6	2.223	5	.830	6	2.406	5	1.012	6
7	2.383	3	1.030	2	2.693	3	1.341	4
8	1.816	10	.744	8	1.928	7	.855	7
9	2.499	1	.690	10	6.949	2	5.140	2
10	1.927	8	.773	7	1.437	13	.283	12
11	1.981	7	.903	5	1.709	8	.631	8
12	1.612	12	.498	12	2.521	4	1.407	3
13	1.918	9	.916	3	1.058	16	.057	16
14	1.141	16	.129	16	1.565	10	.553	9
15	1.607	13	.592	11	1.216	15	.201	14
16	1.273	15	.201	15	1.407	14	.335	11

Formulas for these indicators are given below in (2.29), (2.30), (2.39) and (2.40).

2.3. As can be seen in Table 2.4, the correlation is almost one for the forward cases, and it is smaller but still very high for the backward case.[27]

Table 2.4

Correlation Values Between Net and Unnetted Indexes
Portugal 16 x 16

	Backward Case	Forward Case
1959	.889	.994
1974	.854	.999

In Section 2.1.3 we already discussed the significance of the use of the interindustry or domestic version of the input-output presentation. As we said, both are extremely useful, according to one's special economic interests. So, we should include both in our framework. The importance of using a weighted version is clear, as was pointed out in Section 2.1.4. However, we have to choose among the different proposed weights (final output, final demand, value added) and also different formulas already generally presented in that section.

As we are concerned now with output linkages, we believe that a good weighted indicator for this special type of linkage should include the relative importance of each sector, also in terms of output. So we suggest:

$$W_j = \frac{X_j}{\sum_j X_j} \qquad (2.25)$$

where X_j is our familiar notation for an element in the gross output vector, and W_j the relative importance of each sector (in percentage terms). But a fact that seems in general misunderstood by several authors is that the way in which that vector is multiplied by the inverse matrix is extremely important. So we suggest that a pre-multiplication be used for backward linkages, and a post-multiplication be used for forward linkages. Define α_{ij} as the ij element of $(I-A^*)^{-1}$, and β_{ij} as the ij element of the $(I-\overset{*}{A})^{-1}$ matrix. Using the familiar 3x3 case, and $W_i = [W_1\ W_2\ W_3]$, as a vector of weights, calculated on the basis of (2.25), we obtain, by pre-multiplying α by W, a row vector where:

$$[W_1\ W_2\ W_3] \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \end{bmatrix} =$$

$$[\underbrace{(W_1\ \alpha_{11} + W_2\ \alpha_{21} + W_3\ \alpha_{31})}_{\text{Sector 1}} \quad \underbrace{(W_1\ \alpha_{12} + W_2\ \alpha_{22} + W_3\ \alpha_{32})}_{\text{Sector 2}}$$

$$\underbrace{(W_1\ \alpha_{13} + W_2\ \alpha_{23} + W_3\ \alpha_{33})}_{\text{Sector 3}}\ ] \qquad (2.26)$$

That is, each element of each column of the input inverse is multiplied by the relative importance of its gross output. For forward linkages, and using now the output inverse approach,

$$\begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} \\ \beta_{21} & \beta_{22} & \beta_{23} \\ \beta_{31} & \beta_{32} & \beta_{33} \end{bmatrix} \qquad \begin{bmatrix} W_1 \\ W_2 \\ W_3 \end{bmatrix} =$$

$$[(\beta_{11}W_1 + \beta_{12}W_2 + \beta_{13}W_3) \qquad (\beta_{21}W_1 + \beta_{22}W_2 + \beta_{23}W_3)$$
$$(\beta_{31}W_1 + \beta_{32}W_2 + \beta_{33}W_3)\ ] \qquad (2.27)$$

That is, each element of each row of the output inverse is multiplied by the relative importance of its gross output.

2.2.1.1. The Output Linkages Methodology

For the study of the output linkages of an economy and eventually to derive the notion of "key sectors" we have chosen the following indicators.

Backward Linkages

From the input approach (vertical coefficients), the interindustry linkages are:

$U_j = \dfrac{\sum_i Z_{ij}}{X_j}$	Direct backward inter-industry linkage	(2.28)
$B_j = \sum_i \alpha_{ij}$	Backward interindustry index	(2.29)
$B_j^n = \sum_i \alpha_{ij} - \alpha_{ii}$	Backward net inter-industry index	(2.30)

$$P_j = \frac{\sum_i w_j \alpha_{ij}}{\frac{1}{n} \sum_j \sum_i w_j \alpha_{ij}}$$ Backward weighted interindustry index (2.31)

$$P^n_j = \frac{\sum_i w_{ij} (\alpha_{ij} - \alpha_{ii})}{\frac{1}{n} \sum_j \sum_i w_{ij} (\alpha_{ij} - \alpha_{ii})}$$ Backward net weighted interindustry index (2.32)

<u>The Domestic Linkages</u>

$$U^d_j = \frac{\sum_i {}_{d}Z_{ij}}{X_j}$$ Direct backward domestic linkage (2.33)

$$B^d_j = \sum_i {}_{d}\alpha_{ij}$$ Backward domestic index (2.34)

$$B^{nd}_j = \sum_i {}_{d}\alpha_{ij} - {}_{d}\alpha_{ii}$$ Backward net domestic index (2.35)

$$P^d_j = \frac{\sum_i w_j \, {}_{d}\alpha_{ij}}{\frac{1}{n} \sum_j \sum_i w_j \, {}_{d}\alpha_{ij}}$$ Backward weighted domestic index (2.36)

$$P^{nd}_j = \frac{\sum_i w_i ({}_{d}\alpha_{ij} - {}_{d}\alpha_{ii})}{\frac{1}{n} \sum_j \sum_i w_j ({}_{d}\alpha_{ij} - {}_{d}\alpha_{ii})}$$ Backward net weighted domestic index (2.37)

Forward Linkages

From the output approach (horizontal coefficients) the interindustry linkages are:

$$W_i = \frac{\sum_i Z_{ij}}{X_j}$$

Direct forward interindustry linkage (2.38)

$$F_i = \Sigma_j \; \beta_{ij}$$

Forward interindustry index (2.39)

$$F_i^n = \sum_j \beta_{ij} - \beta_{ii}$$

Forward net interindustry index (2.40)

$$Q_i = \frac{\sum_j \beta_{ij} \, w_i}{\frac{1}{n} \sum_i \sum_j \beta_{ij} \, w_i}$$

Forward weighted interindustry index (2.41)

$$Q_i^n = \frac{\sum_j (\beta_{ij} - \beta_{ii}) w_i}{\frac{1}{n} \sum_i \sum_j (\beta_{ij} - \beta_{ii}) w_i}$$

Forward net weighted interindustry index (2.42)

The Domestic Linkages

$$W_i^d = \frac{\sum_j Z_{d\,ij}}{X_j}$$

Direct forward domestic linkage (2.43)

$$F_i^d = \sum_j \beta_{d\,ij}$$

Forward domestic index (2.44)

$$F_i^{nd} = \sum_j {}_d\beta_{ij} - {}_d\beta_{ii}$$ Forward net domestic index (2.45)

$$Q_i^d = \frac{\sum_j {}_d\beta_{ij} w_i}{\frac{1}{n} \sum_i \sum_j {}_d\beta_{ij} w_i}$$ Forward weighted domestic index (2.46)

$$Q_i^{nd} = \frac{\sum_j ({}_d\beta_{ij} - {}_d\beta_{ii}) w_i}{\frac{1}{n} \sum_i \sum_j ({}_d\beta_{ij} - {}_d\beta_{ii}) w_i}$$ Forward net weighted domestic index (2.47)

2.2.2 Income Linkages

The linkage framework was based on the multiplier concept as we saw for the backward index. However the income and employment multipliers have not been used for linkage purposes. As already noted, the existence of output linkages does not mean that we will also find for those sectors high values for employment or income multipliers, as some authors seem to infer. For that reason, we think that the concepts of income and employment multipliers should be introduced in the linkage framework.

The output coefficients approach will be explored to give us some new insights. The use of domestic or technological matrices for the calculation of the income multiplier as for the output linkages case deserves some considerations. When we estimate income multipliers on the basis of a technological matrix, we obtain an overestimation, that rises with the increase of imports in the structural composition of the economy. It is clear that imports do not require the use of domestic labor directly. So the income multipliers should be obtained from the domestic tables. However, attention should also be paid to the technological matrices which give us the potential income, that is, the maximum income that could be generated in the country if all imported inputs were produced domestically.

The usual output-income effect is presented as

$$O_j = \sum_i a_{0i} \; \alpha_{ij} \tag{2.48}$$

where α_{ij} is the ij^{th} element of the input-inverse, and a_{0i} is the i^{th} element of the labor vector. That is, using our 3x3 familiar representation:

$$\begin{bmatrix} \frac{Z_{01}}{X_1} & \frac{Z_{02}}{X_2} & \frac{Z_{03}}{X_3} \end{bmatrix} \begin{bmatrix} 1 - \frac{Z_{11}}{X_1} & - \frac{Z_{12}}{X_2} & - \frac{Z_{13}}{X_3} \\ - \frac{Z_{21}}{X_1} & 1 - \frac{Z_{22}}{X_2} & - \frac{Z_{23}}{X_3} \\ - \frac{Z_{31}}{X_1} & - \frac{Z_{32}}{X_2} & 1 - \frac{Z_{33}}{X_3} \end{bmatrix}^{-1} \tag{2.49}$$

For sector 1, for example:

$$\frac{Z_{01}}{X_1} \alpha_{11} + \frac{Z_{02}}{X_2} \alpha_{21} + \frac{Z_{03}}{X_1} \alpha_{31} \tag{2.50}$$

that is, each element of the input-inverse is the total production of sector i necessary to deliver a unit of final product of sector j.

Thus, pre-multiplication by the labor row of the input inverse gives us a row vector where each element represents the income generated in all sectors, to deliver a unit of final product of any given sector.

We should try to introduce some weighting procedure, as we have done with the output linkages. And, as before, we explore the question of what is the best weight to use. As we are measuring the effect of a unit increase in final demand, one might argue that we should use the final demand vector as a consistent weight. In fact, final demand could have a small percentage share in the supply composition of the sector and even in that case the sector could have a large gross output share in the total output composition. So, as we are measuring income generated by total production, the share of the sector's gross output vector is the one to be chosen as weight.

We propose the following: first multiply the household row by the weight, obtained as $W_i = \frac{X_i}{\Sigma X_i}$. Next, multiply[28] that vector by the input inverse matrix, as (using a 3x3 matrix case):

$$[a_{01}W_1 \quad a_{02}W_2 \quad a_{03}W_3] \quad \begin{bmatrix} \alpha_{11} & \alpha_{12} & \alpha_{13} \\ \alpha_{21} & \alpha_{22} & \alpha_{23} \\ \alpha_{31} & \alpha_{32} & \alpha_{33} \end{bmatrix} \qquad (2.51)$$

and so, we get, for sector 1:

$$a_{01}\,W_1\,\alpha_{11} + a_{02}\,W_2\,\alpha_{21} + a_{03}\,W_3\,\alpha_{31} \qquad (2.52)$$

Thus the general formula will be:

$$O_j^w = \sum_i (a_{0i}\ w_i)\ \alpha_{ij} \qquad (2.53)$$

If we first multiply the weight vector by the input inverse we will get instead of (2.54) the following:

$$a_{01}\ (W_1\ \alpha_{11} + W_2\ \alpha_{21} + W_3\ \alpha_{31}) \qquad (2.55)$$

that is, only the first element of the household row will be multiplied, which changes the whole idea of the unweighted multiplier. However, for international or intertemporal comparisons, it will be useful to standardize the above formula, so we will use:

$$O_j^w = \frac{\frac{1}{n} \sum_i (a_{0i}\ w_i)\ \alpha_{ij}}{\frac{1}{n} \sum_j\ \sum_i (a_{0i}\ w_i)\ \alpha_{ij}} \qquad (2.56)$$

We can introduce here a net measure of the output-income effect as we have done with the output linkages. Then, the net output-income effect, is

$$O_j^n = \sum_i a_{0i}\ (\alpha_{ij} - \alpha_{ii}) \qquad (2.57)$$

and the weighted version, is

$$O_j^{nw} = \frac{\frac{1}{n} \sum_i (a_{0i}\ w_i)\ (\alpha_{ij} - \alpha_{ii})}{\frac{1}{n^2} \sum_j\ \sum_i (a_{0i}\ w_i)\ (\alpha_{ij} - \alpha_{ii})} \qquad (2.58)$$

Again the relevance of using O_j^n instead of O_j consists in obtaining the income generated in all sectors, with the exclusion of itself, to deliver a unit of final product of any given sector. O_j^{nw} will represent the weighted version of O_j^n .

As pointed out before[29] we can imagine a situation where one sector generates a great many interconnections with other sectors, but where the majority of the effect is on itself. That means that O_j could give us an erroneous idea about the indirect connections because of the small contribution to the other sectors. If we analyse O_j^n and obtain a very high value it is then clear that indirect interconnections are very strong.

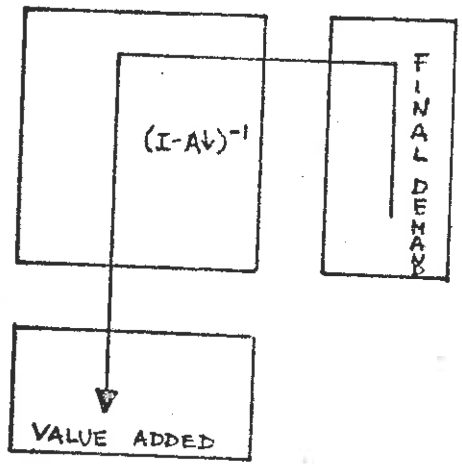
If we use

$$(O_j - O_j^n) \qquad (2.59)$$

this gives us the income generated by the sector's interaction on itself. That could be useful information, as well. However, (2.59) is not considered in our framework, because a complete exhaustion of all possible indicators is not our purpose.

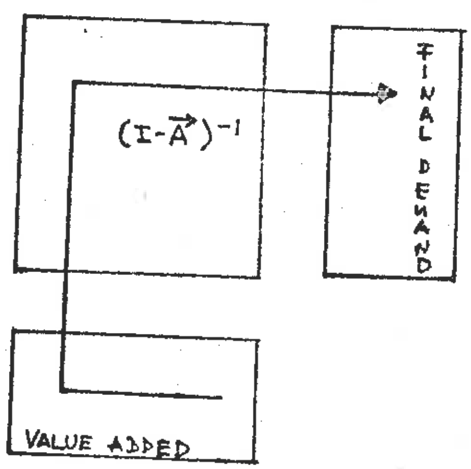
We should mention here that the application of the concept of the output inverse is not relevant here. The output inverse is related to production that comes about in all sectors per unit of primary input of one sector. Thus, what we obtain from the output inverse is a multiplier for the final demand side. That is, in the input inverse we obtain the consequences of a unit increase in final demand in income or employment terms. Figure 2.1 illustrates.

FIGURE 2.1
Input Inverse Approach



In the output inverse, we obtain the consequences of a unit increase in primary inputs on the final demand side. Figure 2.2 illustrates.

FIGURE 2.2
Output Inverse Approach



Thus, the multipliers will be presented in their familiar formulation. They also contribute to the determination of the key sectors of an economy.

The familiar type I income multiplier is:

$$M_j^I = \frac{\sum_i^n a_{0i} \ \alpha_{ij}}{a_{0j}} \qquad (2.60)$$

which is the ratio of the direct plus indirect income change to the direct income change resulting from a unit increase in final demand for any given sector. The direct income change for each sector is given by the household row entry of the input-output table. For Sector 1 in the 3x3 framework, the above indicator will be:

$$\frac{a_{01} \ \alpha_{11} + a_{02} \ \alpha_{21} + a_{03} \ \alpha_{31}}{a_{01}} \qquad (2.61)$$

Also the weighted version of the type I income multiplier will be:

$$M_j^{wI^*} = \frac{\sum_i (a_{0i} \ w_i) \ \alpha_{ij}}{a_{0i} \ w_i} \qquad (2.62)$$

That is, for sector 1 (again using a 3x3 matrix):

$$\frac{a_{01} \ w_1 \ \alpha_{11} + a_{02} \ w_2 \ \alpha_{21} + a_{03} \ w_3 \ \alpha_{31}}{a_{01} \ w_1} \qquad (2.63)$$

and using the standard formula, we get:

$$M_j^{wI} = \frac{\dfrac{\sum_i (a_{0i}\, w_i)\ \alpha_{ij}}{a_{0i}\, w_i}}{\dfrac{1}{n} \sum_j \dfrac{\sum_i (a_{0i}\, w_i)\ \alpha_{ij}}{a_{0i}\, w_i}} \tag{2.64}$$

As was pointed out before, the standard procedure gives us only an ordering, not a cardinal measure.

Again, the net definitions are:

$$M_j^{In} = \frac{\sum_i^n a_{0i}\ (\alpha_{ij} - \alpha_{ii})}{a_{0j}} \tag{2.65}$$

$$M_j^{wIn} = \frac{\dfrac{\sum_i (a_{0i}\, w_i)\ (\alpha_{ij} - \alpha_{ii})}{a_{0i}\, w_i}}{\dfrac{1}{n} \sum_j \dfrac{\sum_i (a_{0i}\, w_i)\ (\alpha_{ij} - \alpha_{ii})}{a_{0i}\, w_i}} \tag{2.66}$$

The type II income multiplier is presented as

$$M_j^{II} = \frac{\bar{\alpha}_{0j}}{a_{0j}} = \left[\frac{j^{th}\ \text{element in the household row of the inverted matrix (closed model)}}{j^{th}\ \text{element in the household row of the technical coefficient matrix (open model)}}\right] \tag{2.67}$$

This indicator represents the ratio of the direct plus indirect income change to the direct income change resulting from a unit increase in final demand.

A weighted version will be:

$$M_j^{wII*} = w_j \frac{\bar{\alpha}_{0j}}{\alpha_{0j}} \tag{2.68}$$

and a standardized weighted version, will be:

$$M_j^{IIw} = \frac{\frac{1}{n} \; w_j \frac{\bar{\alpha}_{0j}}{a_{0j}}}{\frac{1}{n^2} \sum_j w_j \frac{\bar{\alpha}_{0j}}{a_{0j}}} \tag{2.69}$$

Sandoval [1967] and Bradley and Gander [1969], showed that the values of the type II income multipliers are a constant multiple of the values of the type I income multipliers for a particular set of input-output coefficients. Our empirical observation for the 1974 input-output tables (domestic and interindustry versions) verify this. Correlation values between type I and type II multipliers are equal to one for both tables. Since we are interested in direct, indirect and induced effects, type II multipliers will always be preferred.

Some of the possible income indicators were calculated for 1974. Results are presented in Tables 2.5, 2.6 and 2.7. Correlation values among those twenty indicators are presented in Table 2.8. However in our framework only type II income multipliers and net type I income multipliers will be used.

Type II income multipliers have advantages over all the others because they capture direct, indirect and induced effects. For the definition of a key sector we are interested in obtaining all

TABLE 2.5

Some Income Indexes for 1974: Domestic Matrix

Portugal 16x16

Sectors	Output Income Effect		Weighted Output Income Effect		Type One Multiplier		Weighted Type One Multiplier	
		Net		Net		Net		Net
1	.294	.060	1.353	.705	1.418	.288	.545	.153
2	.452	.082	.337	.925	1.225	.222	2.117	3.118
3	.260	.160	1.087	2.300	2.959	1.816	1.234	1.402
4	.358	.077	1.299	.904	1.756	.377	.708	.265
5	.433	.134	.837	1.815	1.669	.515	1.303	1.518
6	.296	.134	.585	1.631	2.372	1.076	2.929	4.381
7	.212	.075	.622	.893	1.728	.611	.789	.608
8	.397	.113	.507	.948	1.491	.424	.967	.971
9	.215	.067	.236	.510	1.679	.525	1.293	1.501
10	.366	.074	1.555	.770	1.311	.264	.500	.133
11	.470	.069	.635	.724	1.212	.178	.635	.389
12	.391	.073	.440	.788	1.364	.254	.959	.923
13	.494	.154	1.428	1.233	1.454	.452	.548	.254
14	.309	.034	1.418	.340	1.136	.125	.444	.057
15	.571	.098	1.285	1.247	1.219	.210	.577	.301
16	.598	.036	2.375	.265	1.139	.070	.452	.027

TABLE 2.6

Some Income Indexes for 1974: Interindustry Matrix
Portugal 16x16

Sectors	Output Income Effect		Weighted Output Income Effect		Type One Multiplier		Weighted Type One Multiplier	
		Net		Net		Net		Net
1	.336	.092	1.222	.589	1.619	.446	.448	.131
2	.498	.112	.353	.781	1.352	.303	2.018	2.710
3	.378	.267	1.282	2.374	4.302	3.039	1.322	1.488
4	.487	.171	1.462	1.280	2.392	.841	.724	.385
5	.516	.211	.899	1.689	1.988	.811	1.273	1.452
6	.366	.193	.600	1.332	2.940	1.547	2.730	3.679
7	.480	.314	.826	1.215	3.915	2.562	.954	.852
8	.465	.179	.511	.839	1.745	.673	.885	.883
9	.439	.207	.404	.768	3.424	1.615	2.015	2.324
10	.486	.164	1.522	.765	1.740	.586	.445	.136
11	.612	.194	.754	1.013	1.579	.500	.685	.560
12	.441	.121	.438	.692	1.536	.422	.867	.833
13	.566	.225	1.325	1.131	1.665	.663	.462	.240
14	.316	.041	1.203	.247	1.163	.151	.342	.043
15	.630	.155	1.173	1.047	1.345	.330	.479	.260
16	.617	.055	2.025	.239	1.176	.104	.350	.025

TABLE 2.7

Some Income Indexes for 1974
Type II Income Multiplier

Portugal 16x16

Sectors	Domestic		Interindustry	
		Weighted		Weighted
1	2.974	1.824	3.011	1.564
2	2.569	.057	2.514	.047
3	6.205	3.185	8.003	3.479
4	3.682	1.700	4.450	1.740
5	3.501	.444	3.697	.397
6	4.975	.409	5.470	.381
7	3.624	1.192	7.282	2.030
8	3.127	.316	3.246	.277
9	3.521	.257	6.370	.393
10	2.748	1.568	3.237	1.565
11	2.542	.336	2.936	.329
12	2.860	.234	2.858	.198
13	3.048	1.197	3.097	1.030
14	2.383	1.433	2.163	1.102
15	2.556	.623	2.503	.516
16	2.389	1.226	2.187	.951

Table 2.8

Correlation Values for 1974
Income Multipliers
Portugal 16 x 16

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Domestic	1		-.02	.44	-.12	-.55	-.51	-.25	-.23	-.55	-.29	.80	-.39	.34	-.25	-.73	-.68	-.39	-.34	-.73	-.43
	2			-.23	.91	.67	.70	.42	.42	.67	.14	.01	.64	-.15	.82	.40	.47	.36	.38	.40	.18
	3				-.20	-.22	-.22	-.58	-.58	-.22	.55	.22	-.42	.97	-.25	-.35	-.32	-.67	-.67	-.35	.37
	4					.78	.81	.46	.45	.78	.28	-.10	.60	-.10	.93	.50	.57	.40	.41	.50	.34
	5						.98	.50	.47	.1	.48	-.43	.61	-.08	.83	.84	.85	.53	.51	.84	.58
	6							.47	.45	.98	.50	-.40	.62	-.09	.83	.82	.86	.50	.49	.82	.60
	7								.998	.50	-.35	-.30	.19	-.59	.33	.33	.31	.95	.97	.33	-.28
	8									.47	-.37	-.78	.18	-.60	.32	.31	.29	.95	.97	.31	-.30
	9										.48	-.43	.61	-.08	.83	.84	.85	.53	.51	.84	.58
	10											-.33	.13	.67	.37	.38	.43	-.35	-.38	.38	.95
Interindustry	11												.10	.23	-.04	-.34	-.32	-.30	-.28	-.34	-.31
	12													-.24	.77	.78	.81	.31	.28	.78	.36
	13														-.08	-.18	-.15	-.65	-.66	-.18	.53
	14															.68	.73	.35	.34	.68	.49
	15																.98	.49	.44	1	.58
	16																	.43	.40	.98	.64
	17																		1	.49	-.24
	18																			.44	-.27
	19																				.58
	20																				

1 and 11 – Output income effect
2 and 12 – Net output income effect
3 and 13 – Weighted output income effect
4 and 14 – Net weighted output income effect
5 and 15 – Type I multiplier
6 and 16 – Net Type I multiplier
7 and 17 – Weighted Type I multiplier
8 and 18 – Net weighted Type I multiplier
9 and 19 – Type II multiplier
10 and 20 – Weighted Type II multiplier

possible effects on the economy. Net type I multipliers were chosen because they are useful to differentiate between the income generated by the sector in itself and the income generated in the other sectors. As pointed out before, some sectors could generate high/low indirect effects on the other sectors and extremely low/high effects in itself. Those multipliers could generate that kind of information.

2.2.2.1 The Income Linkages Methodology

For the study of the income linkages of an economy and eventually to derive the notion of "key sectors" we have chosen the following indicators.

The interindustry or "potential" income linkages:

$$M_j^{IN} = \frac{\sum_i a_{0i} \, (\alpha_{ij} - \alpha_{ii})}{a_{0j}} \qquad (2.70)$$

which is a "potential" net type I multiplier;

$$M_j^{INW} = \frac{\dfrac{\sum_i (a_{0i} \, w_i) \, (\alpha_{ij} - \alpha_{ii})}{a_{0i} \, w_i}}{\dfrac{1}{n} \sum_j \dfrac{\sum_i (a_{0i} \, w_i) \, (\alpha_{ij} - \alpha_{ii})}{a_{0i} \, w_i}} \qquad (2.71)$$

which is a "potential" net weighted type I multiplier;

$$M_j^{II} = \frac{\bar{\alpha}_{0j}}{a_{0j}} \tag{2.72}$$

which is a "potential" type II multiplier, and

$$M_j^{IIw} = \frac{w_j \dfrac{\bar{\alpha}_{0j}}{\alpha_{0j}}}{\dfrac{1}{n} \sum\limits_j w_j \dfrac{\bar{\alpha}_{0j}}{\alpha_{0j}}} \tag{2.73}$$

which is a "potential" weighted type II income multiplier.

The domestic or actual income linkages:

$$M_j^{INd} = \frac{\sum\limits_i^n a_{0i}^d \left(\alpha_{ij}^d - \alpha_{ii}^d\right)}{a_{0j}^d} \tag{2.74}$$

which is an "actual" net type I multiplier;

$$M_j^{IMwd} = \frac{\dfrac{\sum\limits_i^n (a_{0i}^d\ w_i)\ \left(\alpha_{ij}^d - \alpha_{ii}^d\right)}{a_{0i}^d\ w_i}}{\dfrac{1}{n} \sum\limits_j^n \dfrac{\sum\limits_i^n (a_{0i}^d\ w_i)\ \left(\alpha_{ij}^d - \alpha_{ii}^d\right)}{a_{0i}^d\ w_i}} \tag{2.75}$$

which is an "actual" net weighted type I multiplier;

$$M_j^{IId} = \frac{\bar{\alpha}_{0j}^{d}}{a_{0j}^{d}} \tag{2.76}$$

which is an "actual" type II multiplier, and

$$M_j^{IIwd} = \frac{w_j \dfrac{\bar{\alpha}_{0j}^{d}}{a_{0j}^{d}}}{\dfrac{1}{n} \sum_j w_j \dfrac{\bar{\alpha}_{0j}^{d}}{a_{0j}^{d}}} \tag{2.77}$$

which is an "actual" weighted type II income multiplier.

2.2.3 Employment Linkages

As was suggested earlier, the information that could be obtained from the employment multipliers is extremely relevant for any linkage analysis. The discussion in Section 2.2.2 on the use of domestic and technological tables for income and now employment purposes remains meaningful.[30] So the use of domestic tables will give us actual employment multipliers and the use of technological tables will give us potential employment multipliers.

The familiar employment effect is:

$$E_j = \sum_{i=1}^{n} \Pi_i \, \alpha_{ij} \; (i = 1, \dots n) \tag{2.78}$$

where $\Pi_i = \dfrac{E_i}{X_i} = \dfrac{\text{Employment in sector } i}{\text{Gross output of sector } i}$.

However, Parikh [1979] suggested another way of calculating the Π_i value presented in (2.78). He suggested

$$\Pi_i' = \frac{E_i}{X_i + X_i^m} \qquad (2.79)$$

where X_i^m represents total imports of sector i; that is, the employment coefficient is expressed in total supply terms. Also, one could use

$$\Pi_i'' = \frac{E_i}{X_i + X_i^m - Y_i^m} \qquad (2.80)$$

where Y_i^m represents imports entering in final demand for sector i; that is employment is expressed as a proportion of gross output (including intermediate imports).

We can pre-multiply Π_i' or Π_i'' by $(I-A)^{-1}$, where A is the technological matrix

$$E_j^d = \sum_{i=1}^{n} \Pi_i \, \alpha_{ij}^d \qquad (2.81)$$

where α_{ij}^d is the ijth element in the inverse of the domestic matrix and $\Pi_i = \frac{E_i}{X_i}$. This will give us the total labor requirements in the domestic economy. Alternatively

$$E_j = \sum_{i=1}^{n} \Pi_i \, \alpha_{ij} \qquad (2.82)$$

where α_{ij} is the ijth element of the technological matrix. This formula will overestimate the total employment requirements of the domestic economy, but will give us the potential employment that we could expect if all imports were produced domestically.

Also,

$$E_j' = \sum_{i=1}^{n} \Pi_i' \ \alpha_{ij} \tag{2.83}$$

where $\Pi_i' = \dfrac{E_i}{X_i + X_i^m}$. That is, the labor coefficient is expressed in total supply terms. Then $\Pi_i' < \Pi_i$ and so $E_j' < E_j$.

$$E_j'' = \sum_{i=1}^{n} \Pi_i'' \ \alpha_{ij} \tag{2.84}$$

where $\Pi_i'' = \dfrac{E_i}{X_i + X_i^m - Y_i^m}$ and where Y_i^m represents imports entering final demand for sector i. So labor requirements are expressed as a proportion of gross output, including intermediate imports. We would expect that $E_j' < E_j'' < E_j$, given that $\Pi_i' < \Pi_i'' < \Pi_i$.

The Parikh version, however, leads to some underestimation of the coefficients. When we use $\Pi_i = \frac{E}{X}$, E and X are values from the domestic economies, imports excluded. When we use $\Pi_i' = \frac{E}{X + X^m}$, E continues to be the physical amount related only with the domestic economy, but X + Xm is now total supply, that is, gross domestic output plus imports. Then the numerator should also be expanded by the $E(X^m)$ necessary to produce X^m. That is, we should use

$$\Pi_i^* = \frac{E + E^{(X^m)}}{X + X^m}$$

However, a more precise measure of Π_i to be multiplied by the technological matrix would be

$$\Pi_i^{**} = \frac{E + E^{(X^m - Y^n)}}{X + X^m - Y^m}$$

because imported final demands are taken out of the calculation of the denominator, and in the numerator we add $E^{(X^m - Y^m)}$ to E, that is we add employment at the technological level of the imports, that is necessary to obtain the $(X^m - Y^m)$ physical amount of imported goods.

To obtain an acceptable evaluation of $E^{(X^m - Y^m)}$ is not easily done in empirical terms. Imports come from various countries with different technological levels of production, which makes such calculations dificult. Thus, formulas (2.83) and (2.84) proposed by Parikh do not solve the problem of employment multiplier estimation from the technological matrix. Then, we continue to use (2.82) as the better approximation.

The direct plus indirect employment change for sector j consists of the E/X coefficient for each i, multiplied by the total direct and indirect requirements from each i for one unit of final demand to j, and summed. (Richardson [1972].)

In the 3x3 notation, for sector j:

$$E_j = \frac{E_1}{X_1} \alpha_{1j} + \frac{E_2}{X_2} \alpha_{2j} + \frac{E_3}{X_3} \alpha_{3j} \quad (2.85)$$

Net and weighted formulas could also be considered.

Since we are measuring employment generated by total production necessary to produce one unit of final demand, the weight chosen again should be total production. Thus

$$E_j^w = \sum_{i=1}^{m} (\Pi_i W_i) \ \alpha_{ij} \quad (2.86)$$

Again, the corresponding weighted version for the 3 x 3 example will be, for sector j:

$$E_j^w = (\Pi_1 W_1) \ \alpha_{1j} + (\Pi_2 W_2) \ \alpha_{2j} + (\Pi_3 W_3) \ \alpha_{3j} \quad (2.87)$$

A standardized version, to facilitate intertemporal comparisons, is

$$E_j^w \frac{\sum_{i=1}^{n} (\Pi_i w_i) \ \alpha_{ij}}{\frac{1}{n} \sum_{j=1}^{n} \sum_{i=1}^{n} (\Pi_i w_i) \ \alpha_{ij}} \quad (2.88)$$

The net weighted formula will be

$$E_j^{nw} = \sum_{i=1}^{n} (\Pi_i w_i) \ (\alpha_{ij} - \alpha_{ii}) \quad (2.89)$$

and, standardized

$$E_j^{uw} = \frac{\sum_i^n (\Pi_i w_i)\ (\alpha_{ij} - \alpha_{ii})}{\frac{1}{n} \sum_j^n \sum_i^n (\Pi_i W_i)\ (\alpha_{ij} - \alpha_{ii})} \qquad (2.90)$$

The type I employment multiplier is the ratio of the direct plus indirect employment change to the direct employment change resulting from a unit increase in final demand for any given sector. That is

$$E_j^I = \frac{\sum_i^n \Pi_i\ \alpha_{ij}}{\Pi_i} \qquad (2.91)$$

Π_i can be obtained in the following ways:

(a) Using a linear regression model (employment production function approach)

$$E_i = a + b\ X_i \qquad (2.92)$$

where E = employment and X = gross output. Richardson [1972, pp. 34-35] claims that this is the most satisfactory technique available for this purpose.[31] He refers the Boulder study (Miernyk [1967]), where "employment-production reltionships were estimated for each local industry with the aid of data obtained from the industrial surveys . . . the functions took the simple form $E_i = a + b\ X_i$. In virtually all cases, the results were reasonably satisfactory. The correlation coefficients were in excess of 0.65 and standard errors were low. Also, the employment production functions were homogeneous, as shown by the fact that the constant terms were small," or

(b) Using for Π_i the ratio $\frac{E}{X}$ for each i, where E is employment and X is output.

Since approach (a) needs disagregated information on employment and output for some chosen establishments[32], and that is not possible in the Portuguese case, approach (b) was chosen.

The corresponding weighted formula, for the type I employment multiplier, is:

$$E_j^{*IW} = \frac{\sum_{i=1}^{n} (\Pi_i w_i) \alpha_{ij}}{\Pi_i w_i} \qquad (2.93)$$

Also the corresponding standardized one is:

$$E_{jW}^{IW} = \frac{\dfrac{\sum_{i=1}^{n} (\Pi_i w_i) \alpha_{ij}}{\Pi_i w_i}}{\dfrac{1}{n} \sum_{j=1}^{n} \dfrac{\sum_{i=1}^{n} (\Pi_i W_i) \alpha_{ij}}{\Pi_i W_i}} \qquad (2.94)$$

The type II employment multiplier measures the ratio of the direct, indirect and induced employment change to the direct employment change:

$$E_j^{II} = \frac{\sum_{i=1}^{n} \Pi_i \bar{\alpha}_{ij}}{\Pi_i} \qquad (2.95)$$

Again, a presentation of a weighted version will be useful:

$$E_j^{*IIw} = \frac{\sum_{i=1}^{n} (\Pi_i W_i) \bar{\alpha}_{ij}}{\Pi_i W_i} \qquad (2.96)$$

and the standardized form is:

$$E_j^{IIw} = \frac{\dfrac{\sum_{i=1}^{n} (\Pi_i W_i) \bar{\alpha}_{ij}}{\Pi_i W_i}}{\dfrac{1}{n} \sum_{j=1}^{n} \dfrac{\sum_{i=1}^{n} (\Pi_i W_i) \bar{\alpha}_{ij}}{\Pi_i W_i}} \qquad (2.97)$$

Again, there is a relationship between type I and type II employment multipliers:

$$E_j^{I} = \frac{\sum_{i=1}^{n} \Pi_i \alpha_{ij}}{\Pi_i} \qquad (2.98)$$

$$E_j^{II} = \frac{\sum_{i=1}^{n} \Pi_i \bar{\alpha}_{ij}}{\Pi_i} \qquad (2.99)$$

as Π_i is the same for both formulas, let us consider only the numerators. Then

$$\sum_{i=1}^{n} \Pi_i \bar{\alpha}_{ij} - \sum_{i=1}^{n} \Pi_i \alpha_{ij} = \Theta \bar{\alpha}_{0j} \qquad (2.100)$$

where $\bar{\alpha}_{0j}$ is the household row of the closed model; and Θ for the

Portuguese case was calculated for 1974 and was equal to 0.00011724.[33]

Myernyk [1967], presents an alternative type II multiplier, which is the type II multiplier divided by the direct employment change in that sector.[34] As noted before, we are not concerned with exhaustion of all possible indicators, so no use will be made of this version.

As we noted at the beginning, the use of the output inverse provides us with results on the final demand side of a unit increase of a primary input. That is, using the output inverse in our 3x3 presentation:

$$\begin{bmatrix} 1-\dfrac{Z_{11}}{X_1} & -\dfrac{Z_{12}}{X_1} & -\dfrac{Z_{13}}{X_1} \\ -\dfrac{Z_{21}}{X_2} & 1-\dfrac{Z_{22}}{X_2} & -\dfrac{Z_{23}}{X_2} \\ -\dfrac{Z_{31}}{X_3} & -\dfrac{Z_{32}}{X_3} & 1-\dfrac{Z_{33}}{X_3} \end{bmatrix}^{-1} \begin{bmatrix} Y_1/X_1 \\ Y_2/X_2 \\ Y_3/X_3 \end{bmatrix} \qquad (2.101)$$

Multiplying the two matrices, for the first sector, we have:

$$\beta_{11}\, y_1 + \beta_{12}\, y_2 + \beta_{13}\, y_3 \qquad (2.102)$$

where y could be the whole set of final demand vectors $(1'y)$ or any one considered in isolation. And the β's are the elements of the $(I-\hat{A})^{-1}$ matrix. But what is the utility of this kind of information?

If y is the private consumption vector, equation (2.102) will show the private consumption change that comes about in all sectors, because of a unit change in primary inputs in sector 1. If y is the export vector, equation (2.102) will show the export change that comes about in all sectors from the same stimulus. And so forth.

However, we know that those final demand vectors are considered exogenous to the model. In that case, has this indicator any meaningful value? Can we define private consumption and export multipliers? Are these meaningful? We think yes, because the same exogenous character, could, in some sense, to be attributed to the primary input matrix when we construct the income and employment multipliers. So, we only generalized the assumption that also the primary inputs are considered fixed in the model.

In Chapter 5 we will present a more comprehensive and disaggregate structure of the primary inputs in terms of final demand, as well as a more comprehensive and disagregated allocation of the final demand in terms of primary inputs. We will follow a slightly more complex framework, based on the "final allocation structure" and the "primary input structure" as presented by Augustinovics [1968].

As with the income linkages presentation, some of the possible employment indicators are given in Tables 2.9, 2.10, 2.11. Correlation values among those twenty indicators are presented in Table 2.12. Using the same reasoning as in the income linkages case, only type II employment multipliers and net type I employment multipliers will be used.

TABLE 2.9

Some Employment Indexes for 1974: Domestic Matrix
Portugal 16x16

Sectors	Direct Employment Effect		Weighted Direct Employment Effect		Type One Multiplier		Weighted Type One Multiplier	
		Net		Net		Net		Net
1	.000016	.000001	3.287	.396	1.200	.070	.260	.015
2	.000009	.000002	.285	.643	1.243	.240	1.224	1.327
3	.000009	.000007	1.708	3.893	5.996	4.853	1.478	1.622
4	.000007	.000002	1.109	.821	1.823	.445	.415	.148
5	.000010	.000005	1.172	2.633	2.310	1.156	1.396	1.510
6	.000006	.000004	.828	2.165	5.092	3.796	5.979	7.527
7	.000003	.000002	.457	.932	3.139	2.021	.954	.936
8	.000007	.000002	.422	.683	1.492	.425	.570	.443
9	.000008	.000001	.294	.322	1.329	.175	.422	.222
10	.000003	.000002	.473	.594	2.426	1.380	.424	.257
11	.000003	.000001	.281	.536	1.741	.708	.747	.686
12	.000004	.000001	.255	.533	1.796	.686	1.028	1.036
13	.000009	.000003	1.093	.730	1.437	.436	.291	.093
14	.000007	.000001	1.283	.242	1.112	.101	.239	.022
15	.000008	.000002	.798	.736	1.264	.254	.334	.148
16	.000013	.000000	2.255	.141	1.108	.038	.241	.007

TABLE 2.10

Some Employment Indexes for 1974: Interindustry Matrix

Portugal 16x16

Sectors	Direct Employment Effect	Net	Weighted Direct Employment Effect	Net	Type One Multiplier	Net	Weighted Type One Multiplier	Net
1	.000017	.000002	2.783	.315	1.285	.112	.204	.013
2	.000010	.000002	.291	.534	1.402	.354	1.158	1.230
3	.000014	.000012	2.099	3.962	9.265	8.002	1.684	1.841
4	.000011	.000005	1.462	1.561	2.895	1.344	.507	.314
5	.000013	.000007	1.253	2.320	2.889	1.712	1.383	1.484
6	.000007	.000006	.795	1.639	6.412	5.018	5.325	6.359
7	.000008	.000007	.670	1.194	8.822	7.469	1.295	1.337
8	.000009	.000003	.418	.596	1.780	.708	.522	.431
9	.000015	.000004	.450	.485	2.382	.573	.597	.373
10	.000006	.000005	.514	.614	4.668	3.514	.427	.296
11	.000006	.000004	.419	.748	3.094	2.016	1.034	1.068
12	.000005	.000002	.263	.460	2.326	1.212	.983	.997
13	.000011	.000004	.972	.652	1.687	.685	.240	.093
14	.000007	.000001	1.048	.172	1.135	.123	.181	.017
15	.000009	.000003	.718	.618	1.441	.425	.279	.139
16	.000014	.000001	1.845	.129	1.134	.062	.183	.007

TABLE 2.11

Some Employment Indexes For 1974. Type II Employment Multiplier
Portugal 16x16

Sectors	Domestic		Interindustry	
		Weighted		Weighted
1	1.761	.096	1.802	.089
2	2.929	2.627	2.906	2.209
3	10.542	.657	14.609	.831
4	4.254	.268	5.572	.322
5	4.884	.982	5.366	.978
6	11.995	4.115	13.329	4.007
7	8.862	.777	19.302	1.281
8	3.617	.787	3.790	.707
9	2.213	.478	3.840	.734
10	9.795	.502	12.577	.513
11	8.239	1.684	9.936	1.733
12	6.885	2.151	6.961	1.846
13	3.468	.233	3.567	.207
14	2.472	.131	2.260	.109
15	3,553	.372	3.483	.317
16	2.396	.139	2.209	.116

TABLE 2.12

Correlation Values for 1974
Employment Multipliers
Portugal 16 x 16

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Domestic	1		.01	.83	.02	-.24	-.24	-.20	-.20	-.62	-.37	.86	-.21	.76	-.04	-.40	-.41	-.25	-.25	-.61	-.42
	2			.05	.98	.83	.83	.49	.49	.56	.24	.15	.89	.23	.94	.65	.66	.53	.53	.47	.29
	3				.10	.01	-.01	-.13	-.14	-.30	-.42	.69	-.09	.96	.08	-.12	-.12	-.17	-.17	-.29	-.43
	4					.85	.85	.51	.50	.57	.25	.17	.88	.29	.96	.68	.68	.55	.55	.49	.30
	5						.99	.68	.68	.84	.41	-.04	.83	.17	.83	.89	.89	.73	.73	.77	.50
	6							.67	.67	.84	.40	-.06	.83	.16	.83	.89	.90	.72	.72	.78	.49
	7								1	.63	.84	-.22	.33	-.10	.37	.46	.45	.99	.99	.44	.87
	8									.63	.84	-.22	.32	-.11	.37	.46	.45	.99	.99	.44	.88
	9										.52	-.40	.65	-.17	.56	.84	.85	.68	.69	.91	.60
	10											-.45	.10	-.43	.13	.24	.24	.84	.84	.31	.98
Interindustry	11												.12	.73	.20	-.09	-.12	-.22	-.23	-.33	-.43
	12													.14	.94	.84	.83	.41	.40	.70	.20
	13														.31	.61	.06	-.12	-.12	-.14	-.42
	14															.72	.72	.44	.44	.53	.19
	15																1	.54	.54	.94	.37
	16																	.53	.53	.95	.36
	17																		1	.52	.89
	18																			.52	.89
	19																				.44
	20																				

1 and 11 Direct employment effect
2 and 12 Direct employment net effect
3 and 13 Weighted direct employment effect
4 and 14 Weighted direct employment net effect
5 and 15 Type I employment multiplier
6 and 16 Type I net employment multiplier
7 and 17 Weighted Type I employment multiplier
8 and 18 Weighted Type I net employment multiplier
9 and 19 Type II employment multiplier
10 and 20 Weighted Type II employment multiplier

2.2.3.1 The Employment Linkages Methodology

For the study of the employment linkages of an economy and to derive the notion of key sectors from an employment point of view, we have chosen the following indicators:

The interindustry or "potential" employment linkages are:

$$E_j^I = \frac{\sum_{i=1}^{n} \Pi_i (\alpha_{ij} - \alpha_{ii})}{\Pi_i} \qquad (2.103)$$

which is a "potential" net type I employment multiplier;

$$E_j^{Iw} = \frac{\dfrac{\sum_{i=1}^{n} (\Pi_i W_i)(\alpha_{ij} - \alpha_{ii})}{\Pi_i w_i}}{\dfrac{1}{n} \sum_{i=1}^{n} \dfrac{\sum_{i=1} (\Pi_i w_i)(\alpha_{ij} - \alpha_{ii})}{\Pi_i w_i}} \qquad (2.104)$$

which is a "potential" net weighted type I employment multiplier;

$$E_j^{II} = \frac{\sum_{i=1}^{n} \Pi_i \bar{\alpha}_{ij}}{\Pi_i} \qquad (2.105)$$

which is a "potential" type II employment multiplier; and

$$E_j^{IIw} = \frac{\dfrac{\sum_{i=1}^{n} (\Pi_i W_i)\ \bar{\alpha}_{ij}}{\Pi_i w_i}}{\dfrac{1}{n} \sum_{j=1}^{n} \dfrac{\frac{1}{n} \sum_{i=1}^{n} (\Pi_i w_i)\ \bar{\alpha}_{ij}}{\Pi_i w_i}} \tag{2.106}$$

which is a "potential" type II weighted employment multiplier.

The domestic or "actual" employment linkages are:

$$E_j^{Id} = \frac{\sum_{i=1}^{n} \Pi_i (\alpha_{ij}^{d} - \alpha_{ii}^{d})}{\Pi_i} \tag{2.107}$$

which is an "actual" net type I employment multiplier;

$$E_j^{Iwd} = \frac{\dfrac{\sum_{i=1}^{n} (\Pi_i W_i)\ (\alpha_{ij}^{d}\ \ \alpha_{ii}^{d})}{\Pi_i w_i}}{\dfrac{1}{n} \sum_{j=1}^{n} \dfrac{\sum_{i=1}^{n} (\Pi_i w_i)\ (\alpha_{ij}^{d} - \alpha_{ii}^{d})}{\Pi_i w_i}} \tag{2.108}$$

which is an "actual" net weighted type I employment multiplier;

$$E_j^{IId} = \frac{\sum_{i=1}^{n} \Pi_i\ \bar{\alpha}_{ij}^{d}}{\Pi_i} \tag{2.109}$$

which is an "actual" type II employment multiplier; and

$$E_j^{IIwd} = \frac{\dfrac{\sum_{i=1}^{n} (\Pi_i W_i) \bar{\alpha}_{ij}^{d}}{\Pi_i w_i}}{\dfrac{1}{n} \sum_{j=1}^{n} \dfrac{\sum_{i=1}^{n} (\Pi_i w_i) \bar{\alpha}_{ij}^{d}}{\Pi_i w_i}} \qquad (2.110)$$

which is an "actual" weighted type II employment multiplier.

2.3 A Brief Conclusion

This chapter has presented the evolution of the operational measures of the linkage framework that Hirschman presented in 1958. Previously, an extensive discussion of the indicators to be used in the key sectors definitions, their advantages and disadvantages, their limitations and criticisms, was made. The balanced-unbalanced growth controversy was also covered.

The second part presented this study's own formulation, emphasizing why the proposed indicators were chosen, and the advantages of using domestic or interindustry, absolute or relative, weighted or unweighted, netted or unnetted concepts.

In the following chapters empirical work is pursued and the problems of when to use these indicators, according to the particular circumstances of the economy, are investigated.

The advantages of the inclusion of the income and employment indicators in the linkage framework becomes clear in the empirical work. It will show that key sectors based only on output linkage indicators are not necessarily the key sectors in terms of income or employment.

Footnotes

Chapter 2

[1] See McGilvray [1977].

[2] Hirschman [1958, pp. 100-101] continues by noting that a "total effect" index could be mentioned, measured by the sum of the products of two elements. One would be the "potential importance of the linkage effect in terms of, say, the net output of the new industries that might be called forth; or we may mean the strength of the effect, i.e. the probability that these industries will actually come into being."

[3] In fact Yotopoulos and Nugent [1973, p. 161], argue that "since our total linkage index is measured by the inverse of the Leontief matrix, it might be more conventional to refer to it as direct plus indirect backward linkage. However it should be emphasized that as such it does also capture something in the way of forward linkage effects. Recall that

$$[I-A]^{-1} = I + A + A^2 + A^3 + \dots .$$

The multiplication of A matrices to obtain A^2, A^3, . . . etc., in this formula, involves forward linkage to the extent that going backward ad infinitum in a closed system also captures forward aspects."

Jones [1976] criticizes this statement saying that "the 'extent' of capture is zero as can readily be seen from an English translation of the mathematical notation."

[4] Chenery and Watanabe [1958] presented a tetrapartite classification referred to on page 39.

[5] We use P_j instead of U_j as Rasmussen did, in order to avoid confusion with the direct linkages. This has also been used by other authors.

[6] McGilvray writes: "It is obvious that a high value of P_j and Q_i does not imply a correspondly high value for the income or employment multiplier, a point overlooked by some writers who seem to assume that high linkages mean a high domestic value-added content." [1977, p. 51]

[7] The output approach appears rigorously defined in Augustinovics [1968]. Former developments in a more or less advanced form are found in the works of several authors like Ghosh [1958], Dadajan and Kossov [1962] and Ganczer [1962].

[8] Used by Rasmussen [1956], Shultz [1974], Yotopoulos and Nugent [1973], Boucher [1976], Jones [1976], among others.

[9] Riedel [1976, p. 320] continues: "Thus resource allocation considerations deriving from neoclassical principles of comparative advantage may well dictate against the development of backward linkages in a labor-abundant LDC. Moreover, economies-of-scale considerations might also mitigate the appropriateness of the linkage hypothesis in a particular developing country."

[10] Suttcliffe [1964] reviewed the pre-1964 literature. According to him, balanced growth has been associated particularly with Nurkse [1953], [1961] and Rosenstein-Rodan [1943]. Another balanced growth proponent was Lewis [1955]. On the other side, defending unbalanced growth, are Hirschman [1958] and Streeten [1959].

[11] Several authors, such as Kindleberger [1958] and Singer [1958], were referred to by Stucliffe as dealing with the problem of ambiguity.

For a definition of balanced growth as noted by Swamy [1967], from Solow and Samuelson [1953],: . . . "state of affairs in which the output of each commodity increases or decreases by a constant percentage per unit of time, the mutual proportions in which commodities are produced remaining constant. The economy changes only in scale, but not in composition." See also Champernowne [1946].

[12] For empirical investigation of this issue see, among others, Swamy [1967], Gerschenkron [1952], Rostow [1956], Ohlin [1959], and Williamson [1965], for spatial inequality purposes.

[13] This rank ordering was based on the direct forward and backward linkages. As we will use the indirect version (based on the inverse input-output matrices), we will propose a new classification.

14 Lipton [1962] pointed out, for example, that balanced or unbalanced views have a basic defect: their concentration on inducements and the consequent neglect of physical scarcities.

15 For the analysis of the Hirschman hypothesis, the inter-industry matrix should be used, because no import restrictions were considered in his analysis.

16 Then formula (2.10) will be $\rho H_i = \rho(0_j, g_{ij} \cdot \omega_{ij})$ (2.10a). Yotopoulos and Nugent [1976] note later that the formula (2.10a) in fact is the only one that weights the linkage indexes by the relative importance of the sector ω_{ij}.

17 From McGilvray [1977, p. 52]: "these ratios are taken to approximate to probabilities (and are thus constrained to be < 1); the higher the ratio the greater the probability that the induced expansion will be forthcoming. Thus derived demand for steel would have to be quite substantial to induce investment in a steel mill, whereas a quite modest demand for protective clothing might justify investment in a protective clothing factory."

18 The variance, or the measure of variability, defined as

$$V_a = \frac{\sqrt{\sum_{i=1}^{k} (g_i - g_i^*)^2}}{k} \qquad (2.13)$$

where k = number of sectors

g_i = sectoral rate of growth of sector i

g_i^* = expected sectoral rate of growth of sector i

was not used, based on the fact that by squaring the differences we may be making our index unnecessarily sensitive to a few extreme deviations in sectoral growth rates.

19 Formula (2.19) is presented by Yotopoulos as a unique formula based on the total linkage index definition, that is, as we already explained, it is nothing but the indirect backward linkage. Yotopoulos and Nugent [1973] states that according to (2.19) "a country's growth is linkage-balanced when each sectoral growth rate varies in proportion to that sector's total linkage index. However, since it is likely that the country's sectoral growth pattern will deviate from this proportionality rate to a different degree in

different sectors, (2.19) appropriately weights these deviations by the relative importance of the sector."

20 Refer to the backward and forward linkage indexes.

21

Here, $$A = \begin{bmatrix} \frac{Z_{11}}{X_1} & \frac{Z_{12}}{X_2} & \frac{Z_{13}}{X_3} \\ \frac{Z_{21}}{X_1} & \frac{Z_{22}}{X_2} & \frac{Z_{23}}{X_3} \\ \frac{Z_{31}}{X_1} & \frac{Z_{32}}{X_2} & \frac{Z_{33}}{X_3} \end{bmatrix}$$

22 As we mentioned before, Jones' presentation was based on Augustinovics' [1968] work, which is the main rigorous presentation of the use of the output inverse approach.

23 L^F = column vector of forward linkages, L^B = row vector of backward linkages, X = column vector of gross output, and 1 = unity column vector.

24 Note that $X'L^F$ is a scalar, as is $X'1$, so the result is also a scalar.

25 Is interesting to note that the same kind of path was observed by this author using the USA data for 1947, 1958, 1961, 1963 and 1967 in Silva [1980]. A increasing path was observed until 1963, and a smaller value was obtained for 1967.

26 Shultz [1974], without discussing the theoretical advantages of such a procedure, present the formula. Syed [1975] used it in his empirical work.

27 We examine this issue further in Section 2.2.2, Table 2.8.

28 As we saw in the output linkages presentation (page 64), post-multiplication leads to misleading results.

29 See page 60.

30 Parikh [1979, p. 150] writes: "The rank correlation between employment estimates based on the domestic input coefficients matrix and total input coefficients matrix is very high for most of the large sized nations, while one would expect the rank correlation to be low for small sized countries as their import requirements tend to be higher."

31 This approach was first introduced by Moore and Petersen [1955], using data for several industries for each sector.

32 Miernyk [1967, p. 118].

33 For details, see Bradley and Gander [1967].

34 For details, see Miernyk [1967].

CHAPTER 3

APPLICATIONS TO THE PORTUGUESE ECONOMY. THE 16x16 LEVEL OF AGGREGATION

This chapter makes an empirical analysis of the Portuguese Economy using the framework proposed in the previous chapter. The data used are the compatible versions of the four input-output tables for Portugal in the years of 1959, 1964, 1970 and 1974.

Following the direct linkage analysis in the first section, output, income and employment linkages will be calculated for the four different years, and key sectors will be defined. An overall and detailed sectoral analysis will be done in Section 3.5. Section 3.6 discusses the balanced-unbalanced controversy using the Portuguese data case. The last section presents the conclusions.

3.1 Direct Linkage Analysis

As we saw in Section 2.2.1.1, we utilize three kinds of indicators in our framework:

(1) the direct linkages (2.28, 33, 38, 43)

(2) the absolute indexes (2.29, 30, 34, 35, 39, 40, 44, 45)

(3) the relative indexes (2.31, 32, 36, 37, 41, 42, 46, 47)

The first group constitutes linkages calculated in the traditional manner. Information provided by these measures is useful because, in addition to the linkage contribution itself, they give us some insights into the constancy of the intermediate input matrix of the input-output table over time. That is the main reason why we proceed with the direct linkages here and especially with the graphical analysis. In the 16-sector tables, the sectors are:

1 - Agriculture, Forestry and Fisheries

2 - Mining and Quarrying

3 - Food Processing, Beverages and Tobacco

4 - Textiles, Apparel, Leather and Shoes

5 - Wood, Cork and Furniture

6 - Paper Pulp and Paper

7 - Chemicals, Petroleum and Coal Products

8 - Non Metallic Mineral Products

9 - Basic Metals

10 - Machinery, Transport Equipment, Naval Construction and Repair

11 - Other Manufacturing

12 - Electricity, Water and Gas

13 - Public and Private Construction

14 - Trade

15 - Transport and Communications

16 - Other Services.

An analysis of Figures 3.1-3.4 shows the following pattern with respect to backward and forward linkages. There is a greater degree of stability over time for backward linkages when we deal with the interindustry tables. The same is true with respect to the forward linkages, but it is not as evident.

TABLE 3.1

Direct Backward Linkage: Domestic Matrix
Portugal 16x16

Years	1959	1964	1970	1974
1	.187	.233	.332	.285
2	.205	.102	.210	.241
3	.620	.687	.657	.570
4	.344	.351	.505	.437
5	.578	.586	.568	.490
6	.383	.506	.545	.560
7	.339	.386	.442	.290
8	.275	.269	.276	.392
9	.316	.405	.461	.286
10	.259	.263	.372	.271
11	.226	.239	.344	.231
12	.006	.160	.245	.298
13	.434	.430	.500	.416
14	.054	.121	.107	.082
15	.307	.193	.274	.271
16	.123	.164	.159	.113
Average	.291	.318	.375	.327

TABLE 3.2

Direct Backward Linkage: Interindustry Matrix
Portugal 16x16

Years	1959	1964	1970	1974
1	.211	.256	.366	.309
2	.239	.119	.245	.279
3	.750	.791	.738	.807
4	.630	.574	.644	.632
5	.619	.634	.655	.610
6	.496	.587	.625	.626
7	.621	.651	.716	.769
8	.369	.333	.336	.433
9	.550	.534	.690	.683
10	.555	.510	.612	.468
11	.476	.412	.527	.477
12	.038	.163	.258	.327
13	.523	.485	.553	.480
14	.054	.121	.116	.085
15	.409	.354	.327	.327
16	.134	.171	.174	.166
Average	.417	.418	.477	.467

TABLE 3.3

Direct Forward Linkage: Domestic Matrix
Portugal 16x16

Years	1959	1964	1970	1974
1	.427	.442	.490	.487
2	.488	.703	.454	.712
3	.150	.253	.282	.197
4	.296	.252	.386	.301
5	.385	.431	.440	.364
6	.767	.628	.635	.578
7	.454	.600	.624	.496
8	.731	.566	.762	.697
9	.917	.911	.923	1.044
10	.172	.204	.306	.174
11	.176	.196	.432	.319
12	.645	.680	.700	.704
13	.046	.054	.035	.033
14	.121	.300	.373	.311
15	.112	.186	.156	.116
16	.173	.098	.238	.173
Average	.379	.406	.452	.419

TABLE 3.4

Direct Forward Linkage: Interindustry Matrix
Portugal 16x16

Years	1959	1964	1970	1974
1	.558	.622	.654	.721
2	2.057	1.961	2.658	5.971
3	.201	.273	.332	.276
4	.371	.301	.440	.389
5	.396	.440	.458	.386
6	.957	.750	.766	.709
7	.770	.923	.886	.791
8	.789	.610	.818	.762
9	2.597	1.526	1.651	2.273
10	.307	.358	.473	.296
11	.282	.248	.532	.443
12	.645	.681	.701	.704
13	.046	.054	.035	.033
14	.119	.306	.373	.311
15	.112	.262	.205	.121
16	.173	.098	.239	.230
Average	.649	.588	.701	.901

FIGURE 3.1

Direct Forward Linkage: Domestic Matrix
Portugal 16x16

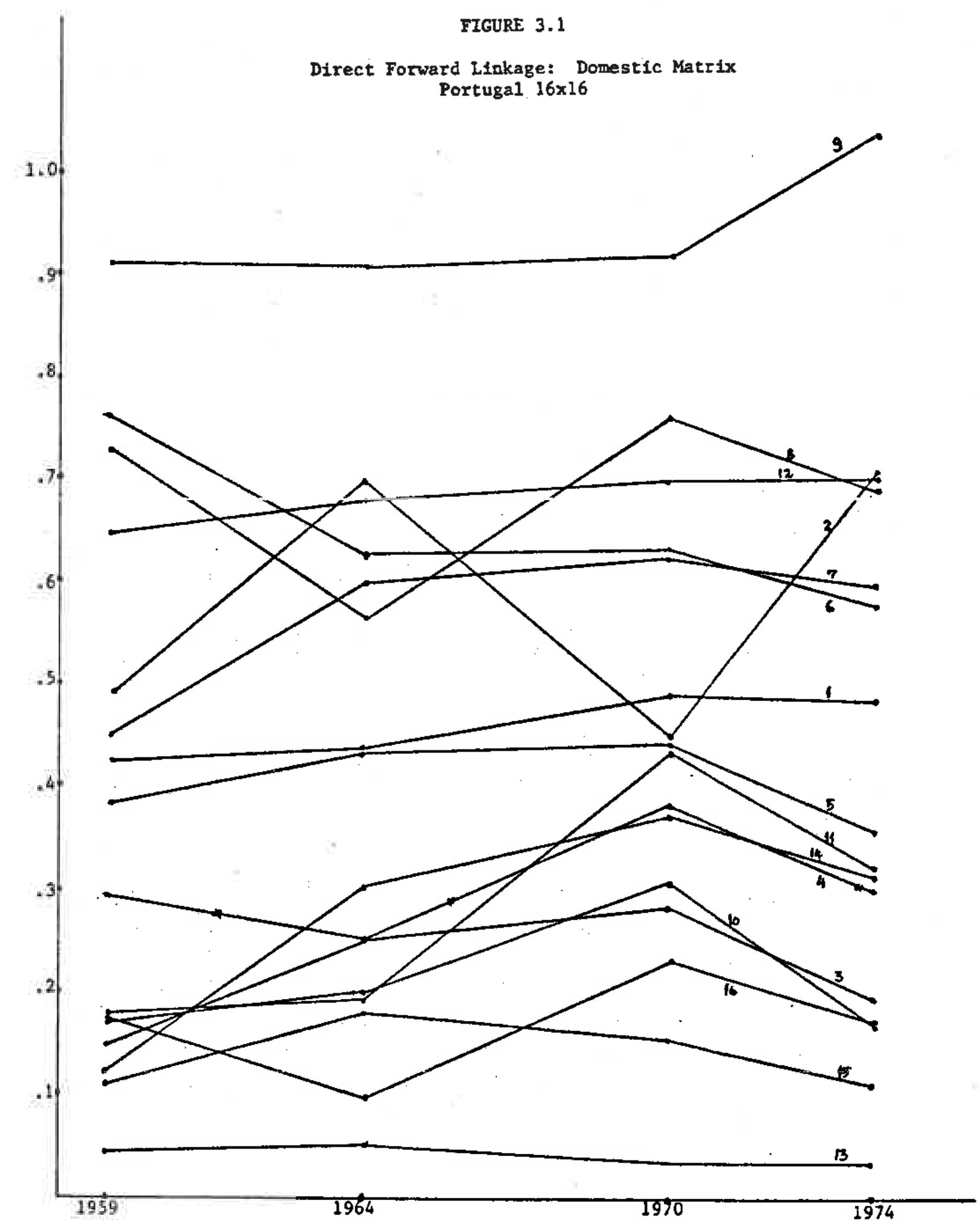


FIGURE 3.2

Direct Backward Linkage: Interindustry Matrix
Portugal 16x16

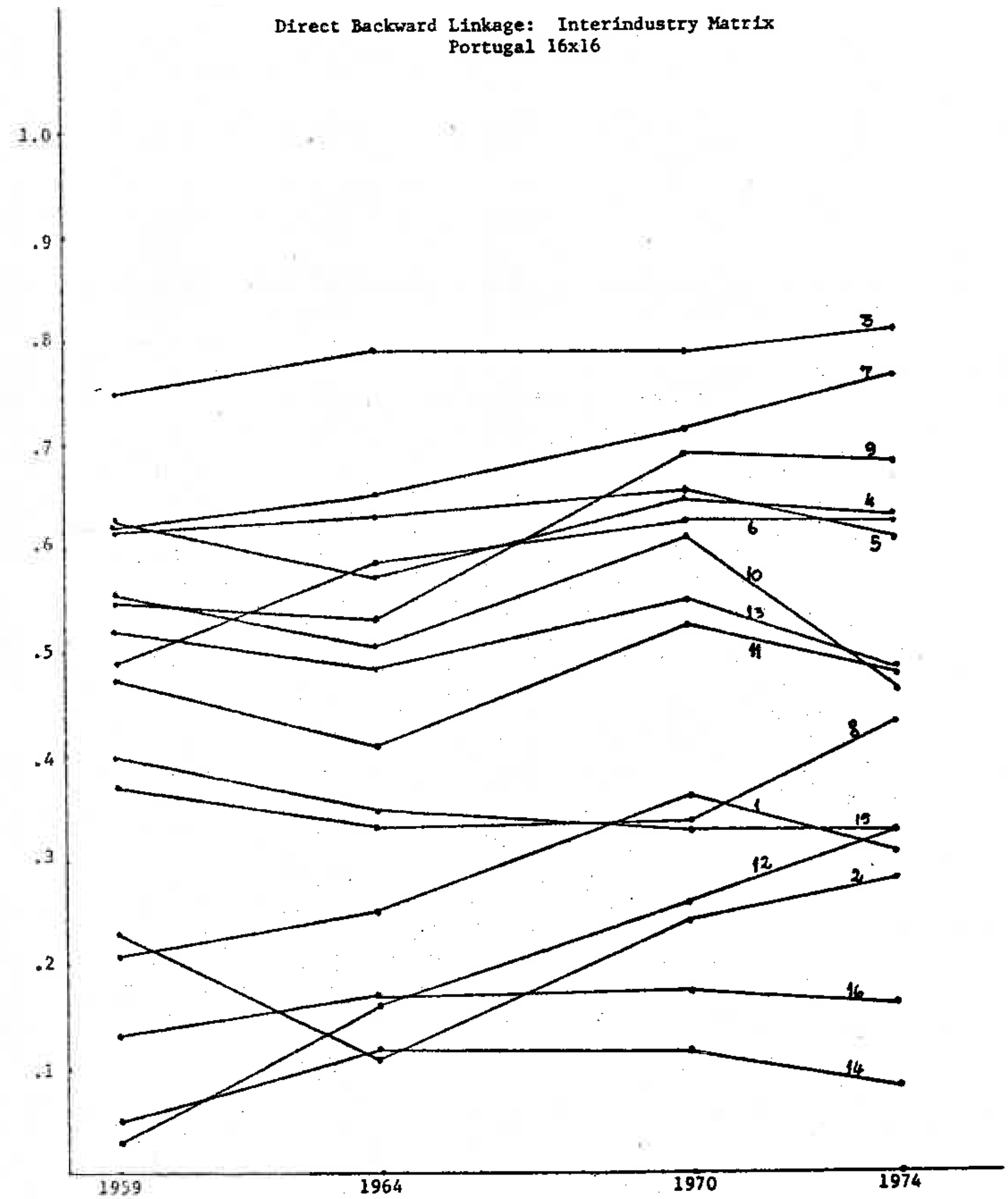


FIGURE 3.3

Direct Backward Linkage: Domestic Matrix
Portugal 16x16

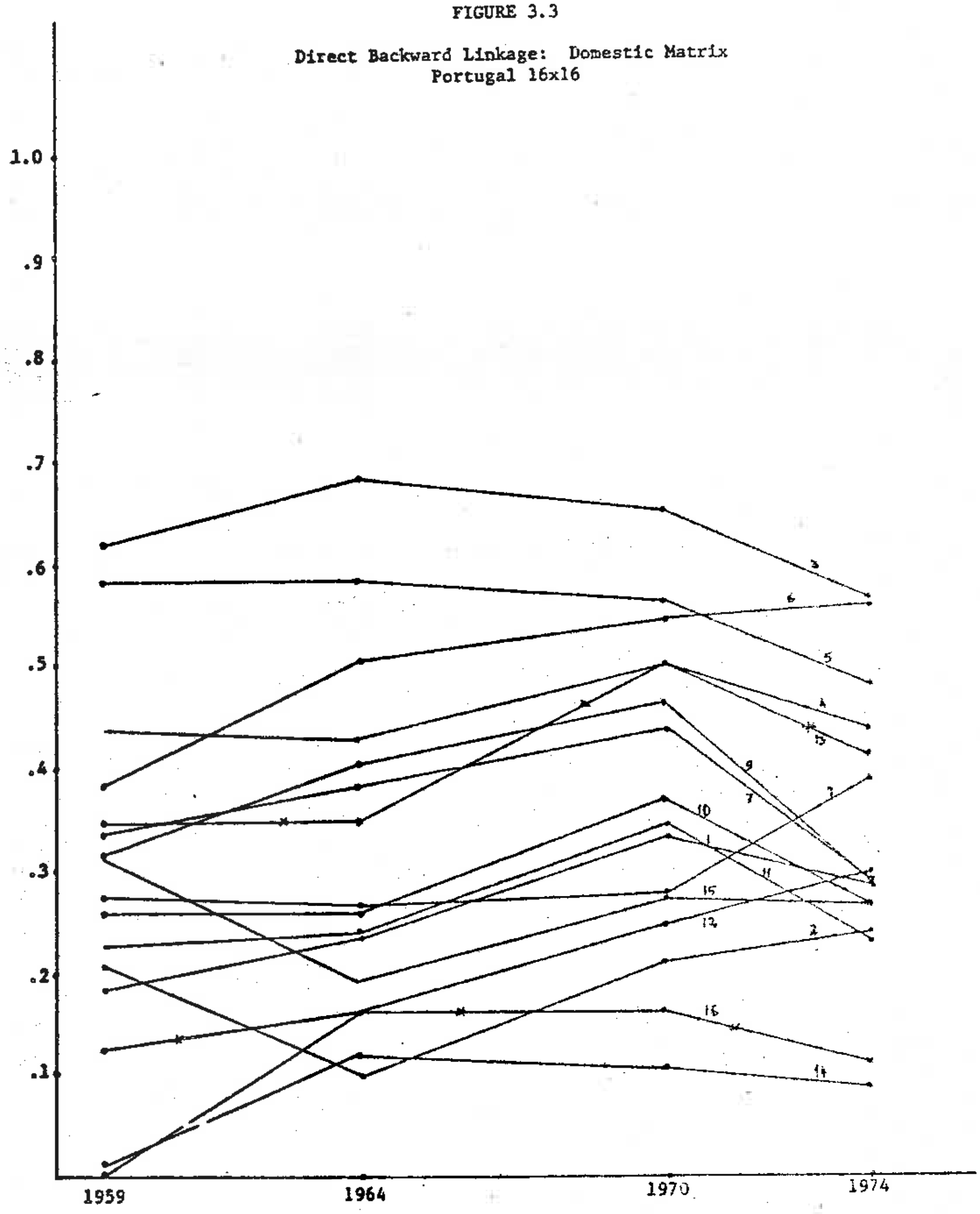
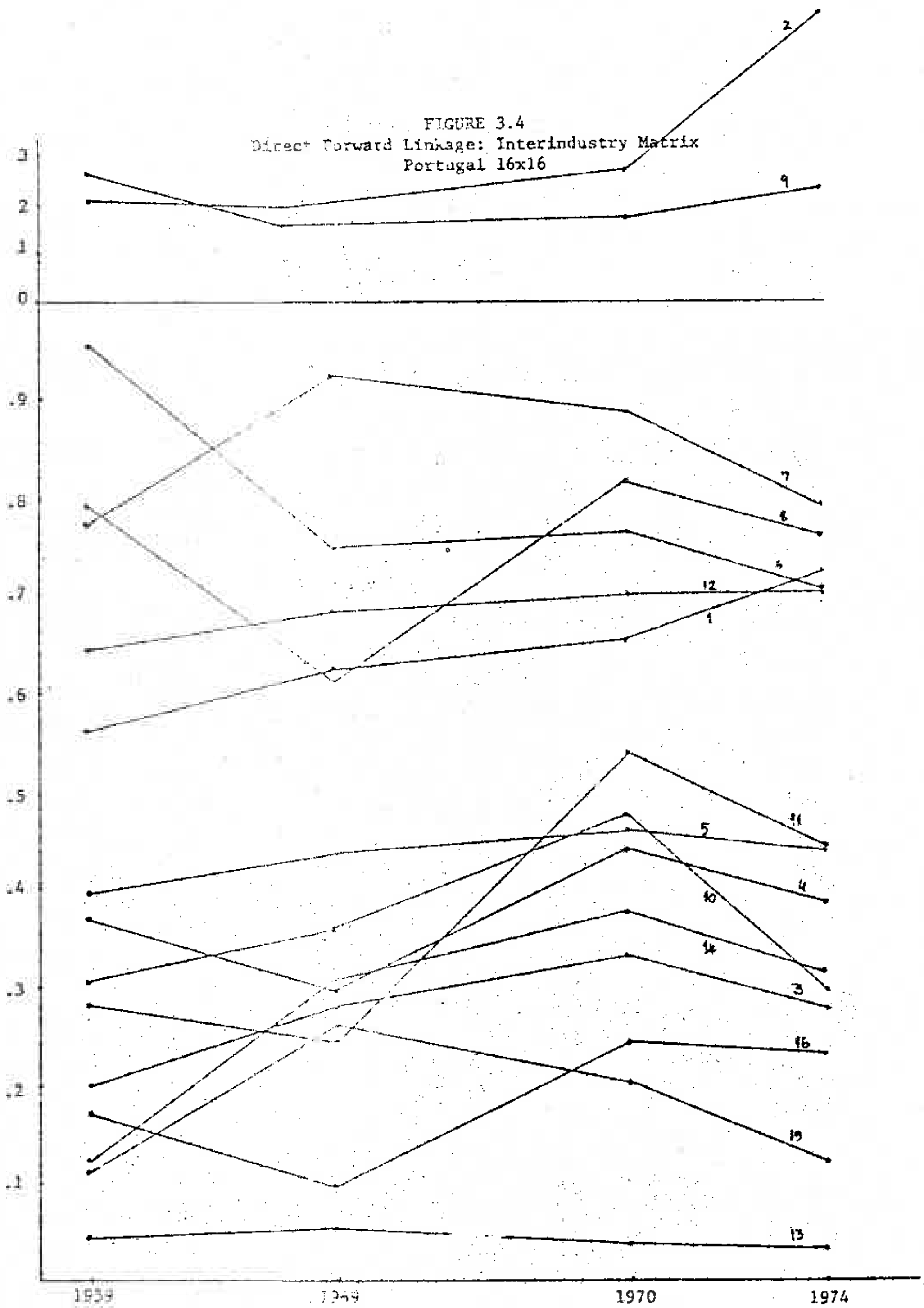


FIGURE 3.4
Direct Forward Linkage: Interindustry Matrix
Portugal 16x16



Backward linkages translate summations along columns, that is, the demand side composition of each sector. So the greater homogeneity for interindustry tables shows that the technological structure changes extremely slowly,[1] and that imports compensate for some input demand needs, when domestic industries can not satisfy them.

With respect to forward linkages, the indicator reflects the structures of the supply side of each sector in the economy. Imports are a negative component of the final demand vector, and in some cases they are the main component for the interindustry tables.[2] Also the other final demand components (especially private consumption, investment and stocks variation) have different values for the different tables. So imports that are included in the sum of the intermediate inputs are also (with the opposite sign) included in the final demand. This helps to compensate for the heterogeneity of some of the domestic tables for this specific indicator. As we see in Table 3.5, interindustry correlations among the direct linkage indicators are higher than in the domestic ones for the backward linkage case. And for the interindustry case, the one with no bias (caused by imports in the domestic case), greater similarity is observed between the two closest years (59/64, 64/70, 70/74); correlation values decrease when we compare (59/70 and 64/74) and the lowest correlation values were observed for the comparison of (59/74).

The general pattern of the graphs of the linkage indexes shows that in general we do not find an increasing pattern or a decreasing pattern over time. In most cases for an increase (decrease) in the second year (1964) there is a corresponding decrease (increase) in

TABLE 3.5

Correlation Values
Direct Linkages

Portugal 16x16

	Backward Linkage		Forward Linkage	
	Domestic	Interindustry	Domestic	Interindustry
59/64	.91	.95	.92	.94
59/70	.89	.94	.93	.90
59/74	.80	.90	.93	.79
64/70	.95	.97	.90	.97
64/74	.85	.94	.96	.90
70/74	.88	.96	.94	.96

the third (1970) or fourth year (1974). This constancy over time of the row and column sums was also observed by this writer for USA using five different years (1947 to 1967). The empirical evidence of this constancy may be useful for certain RAS procedures.[3]

3.2 Key Sectors from an Output Linkage Viewpoint

As already mentioned, Chenery and Watanabe presented the first classification of key sectors. This classification however dealt with direct backward and forward linkage, and we believe that indirect indexes are much more appropriate.

Hazari [1970] presented the following framework for empirical identification of the key sectors of the Indian economy. Using the Rasmussen indexes, (2.7b) and (2.8b), and also the measures of variability presented in (2.9a) and (2.9b), he defines a key sector as one in which (a) both U_j and U_i (normalized backward and forward linkages based on the input inverse) are greater than one, and (b) both V_j and V_i are relatively low. That was the framework of the first method. Hazari also introduces a second method. For Index I, using Z_i and Z_j for our O_i and O_j, he employs formulas (2.7a) and (2.8a); for Index II, he weights each element of those vectors in (2.7a) and (2.8a) by each element's proportion of the total final demand.

That is

$$\lambda_j = O_j w_i \tag{3.1}$$

$$\lambda_i = O_i w_i \tag{3.2}$$

where $w_i = \dfrac{Y_i}{\sum_{i=1}^{m} Y_i}$, and Y is the final demand vector. Hazari [1970, p. 303] concludes that "sectors in which λ_j and λ_i are high can be defined as key sectors from the point of view of (a) the targets of the planner implicit in the final demand vector and (b) the importance of each sector in the economy as a contributor to final demand."

The Hazari framework of analysis was used also by Syed [1975] for the Canadian economy. These methods are based on formulas discussed in the previous sections. We believe that our framework is more rigorous, and we turn now to it. We have information for four different years for each indicator. Instead of using only one of them for our analysis, we have chosen to use the information obtained for the four different years.

As seen in the last section, the fifteen year period considered in the direct linkage analysis is not enough for radical transformations in the economic structure. Therefore the relative positions of the generality of the linkage concepts remains stable. Conway [1976, p. 185] analysed in great detail the causes of instability of the different multipliers over time. He argued: "the question of the stability of multipliers in practice is a relative matter in more than one way of speaking. First, the question of the degree of change, and thus the error from using base year multipliers, depend upon the problem at hand; and in some instances, substantial variations in the values of the multipliers can be tolerated."

So in this study an average value of the four different years ranking positions was used. First the rank ordering position for each year was calculated and after that an average of the four rank orderings was obtained.

Jones [1976, p. 336] mentioned that "the output weighted average of either backward or forward linkages might then be termed the 'coefficient of interdependence' and used in time-series or cross-section comparisons of the 'depth' of industrial structure. The coefficient of interdependence also provides a standard for separating 'high' and 'low' linkage industries."

This coefficient of interdependence should be preferred to the Hazari and Syed procedures. If we compare the distribution of sectors according to that coefficient with the classification obtained using our procedure, the results are practically the same.

In fact, that coefficient divides the sectors in two groups with approximately the same number of sectors in each.

When only one year is considered (cross-section data), the use of the coefficient interdependence should be preferred. However as we are working with time series data, we prefer our procedure. In Table 3.6 the value of the coefficient of interdependence is presented, for our tables.

TABLE 3.6

Coefficient of Interdependence[4]
Portugal

	16X16				60X60	
	1959	1964	1970	1974	1970	1974
Domestic	1.384	1.472	1.593	1.444	1.348	1.437
Net Domestic	0.268	0.349	0.404	0.338	0.271	0.391
Interindustry	1.655	1.722	1.945	1.833	1.906	1.964
Net Inter Industry	0.479	0.545	0.672	0.650	0.745	0.877

The main indicators for the analysis of the output linkages are, in our view, the backward and forward weighted indexes. They were weighted, normalized and should be used initially when we try to find the "key sector structure." Also, the interindustry table should be used and only later should we introduce considerations about the consequences of imports for the analysis. These indexes are shown in Tables 3.7 through 3.10.

In these tables, summing the value corresponding to the rank ordering of a sector over the four years, and dividing it by the number of years, we obtain the last column. That column contains the

TABLE 3.7

Backward Weighted Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	2.129	2	1.758	3	1.625	3	1.494	3	2.75
2	.301	15	.180	16	.263	16	.310	16	15.75
3	2.529	1	2.535	1	2.226	1	2.101	1	1.00
4	1.898	3	1.846	2	1.960	2	1.736	2	2.25
5	1.339	5	1.204	5	1.013	7	.956	9	6.50
6	.623	10	.640	10	.733	11	.761	11	10.50
7	1.326	6	1.171	6	1.211	5	1.176	5	5.50
8	.411	13	.403	14	.366	14	.524	13	13.50
9	.358	14	.537	12	.584	13	.492	14	13.25
10	.887	7	1.073	7	1.393	4	1.396	4	5.50
11	.585	11	.519	13	.622	12	.679	12	12.00
12	.139	16	.284	15	.339	15	.414	15	15.25
13	.726	9	.950	8	.939	8	1.079	7	8.00
14	1.407	4	1.492	4	.932	9	1.089	6	5.75
15	.848	8	.786	9	.741	10	.777	10	9.25
16	.493	12	.631	11	1.053	6	1.016	8	9.25
Average	1		1		1		1		

TABLE 3.8

Forward Weighted Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	2.041	3	1.804	2	1.396	3	1.061	3	2.75
2	2.681	1	2.410	1	3.091	1	5.509	1	1.00
3	.982	6	1.193	6	.963	6	.692	7	6.25
4	.971	7	1.000	7	1.057	5	.686	8	6.75
5	.445	12	.532	12	.334	16	.282	16	14.00
6	.708	9	.620	10	.648	11	.457	11	10.25
7	1.463	4	1.551	3	1.294	4	.871	4	3.75
8	.389	14	.489	13	.468	13	.413	12	13.00
9	2.210	2	1.455	4	2.057	2	2.312	2	2.50
10	.614	10	.807	8	.886	8	.693	6	8.00
11	.346	15	.340	16	.559	12	.388	13	14.00
12	.729	8	.793	9	.738	10	.572	10	9.25
13	.308	16	.488	14	.357	15	.378	14	14.75
14	1.203	5	1.433	5	.906	7	.760	5	5.50
15	.468	11	.599	11	.429	14	.304	15	12.75
16	.442	13	.485	15	.817	9	.621	9	11.50
Average	1		1		1		1		

TABLE 3.9

Backward Net Weighted Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	.308	13	.622	11	.780	10	.717	11	11.25
2	.574	11	.324	14	.580	12	.686	12	12.25
3	3.318	1	3.024	1	2.600	1	2.552	1	1.00
4	1.950	3	1.638	3	1.278	4	1.343	4	3.50
5	2.058	2	2.119	2	1.931	2	1.784	2	2.00
6	1.343	4	1.208	4	1.433	3	1.438	3	3.50
7	1.293	5	1.158	5	1.204	5	1.079	6	5.25
8	.683	10	.607	12	.545	13	.864	9	11.00
9	.555	12	.762	10	.789	9	.683	13	11.00
10	.698	9	.862	9	.935	8	.728	10	9.00
11	.946	7	.993	6	1.124	7	1.111	5	6.25
12	.075	15	.358	13	.411	14	.659	14	14.00
13	.896	8	.956	7	1.166	6	1.054	7	7.00
14	.067	16	.199	16	.228	15	.164	16	15.75
15	1.097	6	.869	8	.776	11	.912	8	8.25
16	.142	14	.300	15	.217	16	.227	15	15.00
Average	1		1		1		1		

TABLE 3.10

Forward Net Weighted Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	.847	6	1.163	5	.853	6	.610	5	5.50
2	4.972	1	4.583	1	5.208	1	8.119	1	1.00
3	.085	15	.233	13	.251	13	.158	12	13.25
4	.176	13	.083	15	.117	15	.059	15	14.50
5	.088	14	.454	11	.277	11	.218	10	11.50
6	1.224	4	.945	6	.907	5	.524	6	5.25
7	1.565	3	1.898	3	1.348	3	.695	4	3.25
8	.536	7	.691	7	.621	8	.466	7	7.25
9	3.982	2	2.451	2	3.179	2	3.245	2	2.00
10	.253	10	.432	12	.325	10	.146	13	11.25
11	.354	8	.458	10	.744	7	.385	8	8.25
12	1.217	5	1.313	4	1.048	4	.725	3	4.00
13	.039	16	.059	16	.054	16	.034	16	16.00
14	.201	11	.614	8	.569	9	.312	9	9.25
15	.281	9	.473	9	.227	14	.120	14	11.50
16	.181	12	.150	14	.273	12	.184	11	12.25
Average	1		1		1		1		

average rank ordering for the four years, and is reported in Table 3.15 and 3.16. Table 3.17 presents the key sector classification.

Consider the first eight sectors with highest rank ordering. We will obtain for the backward weighted case: 1 - Agriculture, Forestry and Fisheries, 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 5 - Wood, Cork and Furniture, 7 - Chemicals, Petroleum and Coal products, 10 - Machinery, Transport Equipment, Naval Construction and Repair, 13 - Public and Private Construction and 14 - Trade. For the forward weighted case the chosen sectors are: 1 - Agriculture, Forestry and Fisheries, 2 - Mining and Quarrying, 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 7 - Chemicals, Petroleum and Coal Products, 9 - Basic Metals, 10 - Machinery, Transport Equipment, Naval Construction and Repair and 14 - Trade.

Based on both backward and forward weighed indexes, the key sectors will be: 1 - Agriculture, Forestry and Fisheries, 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 7 - Chemicals, Petroleum and Coal Products, 10 - Machinery, Transport Equipment, Naval Construction and Repair, and 14 - Trade.

Consider now the first eight sectors with highest rank ordering from the net weighted case. We have, for the backward index: 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 5 - Wood, Cork and Furniture, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, 11 - Other Manufacturing, 13 - Public and Private Construction, and 15 - Transport and Communications.

For the forward case, the eight chosen sectors are: 1 - Agriculture, Forestry and Fisheries, 2 - Mining and Quarrying, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, 8 - Non Metallic Mineral Products, 9 - Basic Metals, 11 - Other Manufacturing, and 12 - Electricity, Water and Gas.

Based on the net weighted backward and forward indexes, key sectors will be: 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, and 11 - Other Manufacturing.

As we observe, key sectors chosen on the basis of the weighted and net weighted indicators used so far do not coincide, as we would expect. Sectors 1 - Agriculture, Forestry and Fisheries, 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 10 - Machinery, Transport Equipment, Naval Construction and Repair, and 14 - Trade loose their key sector position when we do not consider intrasectoral linkages. Only sector 7 - Chemicals, Petroleum and Coal Products, remained when intrasectoral linkages are removed. Sectors 6 - Paper Pulp and Paper and 11 - Other Manufacturing, with exclusion of the intrasectoral linkages connection, became included in the key sectors group.

Sector 14 - Trade could be a good example of the relevance of the use of net indicator measures. Trade, excluding the intrasectoral linkages, looses its designation as a key sector. In fact, it does not seem likely that one country will include internal trade as an economic development strategy. However, the use of unnetted indicators will include it in the key sector group. As stated before, each indicator has its particular relevance and provides different kinds of information about the same problem. So we will continue to use all of them.

Thus far we have been observing relative values of the measures, given that all the elements of the vectors are weighted by their relative contributions to the gross output. Therefore, we want also to look at absolute value figures, to see which industries, in fact, independently of their relative importance, contribute more toward the determination of key sectors. Tables 3.11 through 3.14 refer to the absolute interindustry indicators.

Consider again the first eight sectors with highest rank ordering of the unnetted indicators. Now for the backward case we have: 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 5 - Wood, Cork and Furniture, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, 9 - Basic Metals, 10 - Machinery, Transport Equipment, Naval Construction and Repair, and 13 - Public and Private Construction. For the forward case we have: 1 - Agriculture, Forestry and Fisheries, 2 - Mining and Quarrying, 4 - Textiles, Apparel, Leather and Shoes, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, 8 - Non Metallic Mineral Products, 9 - Basic Metals and 12 - Electricity, Water and Gas. On the basis of these absolute indicators, the key sectors will be: 4 - Textiles, Apparel, Leather and Shoes, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, and 9 - Basic Metals.

Analysis of the net indicators, Tables 3.13 and 3.14, will show, using the same procedure, the following sectors: Backward case,

TABLE 3.11

Backward Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	1.348	13	1.454	12	1.737	10	1.616	11	11.50
2	1.380	12	1.201	15	1.444	13	1.524	14	13.50
3	2.196	1	2.303	1	2.545	2	2.439	2	1.50
4	2.121	2	2.033	5	2.389	4	2.279	4	3.75
5	2.078	3	2.076	4	2.279	6	2.091	6	4.75
6	1.826	9	2.134	2	2.222	7	2.223	5	5.75
7	2.019	5	2.119	3	2.444	3	2.383	3	3.50
8	1.545	11	1.508	11	1.556	12	1.816	10	11.00
9	1.981	6	1.962	6	2.692	1	2.499	1	3.50
10	2.063	4	1.930	7	2.321	5	1.927	8	6.00
11	1.854	8	1.792	9	2.050	9	1.981	7	8.25
12	1.072	16	1.283	13	1.431	14	1.612	12	13.75
13	1.883	7	1.834	8	2.075	8	1.918	9	8.00
14	1.083	15	1.201	16	1.196	16	1.141	16	15.75
15	1.688	10	1.620	10	1.614	11	1.607	13	11.00
16	1.202	14	1.274	14	1.286	15	1.273	15	14.50
Average	1.709		1.733		1.955		1.896		

TABLE 3.12

Forward Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	1.877	7	1.998	6	2.201	6	2.217	6	6.25
2	6.173	2	6.008	1	9.137	1	18.096	1	1.25
3	1.268	12	1.424	12	1.602	13	1.494	12	12.25
4	1.620	8	1.459	11	1.810	10	1.668	9	9.50
5	1.588	9	1.646	8	1.677	12	1.535	11	10.00
6	2.505	3	2.533	4	2.629	4	2.406	5	4.00
7	2.505	4	3.012	3	3.217	3	2.693	3	3.25
8	1.915	6	1.761	7	2.046	7	1.928	7	6.75
9	6.336	1	3.971	2	6.116	2	6.949	2	1.75
10	1.444	10	1.561	9	1.818	9	1.437	13	10.25
11	1.417	11	1.396	14	1.943	8	1.709	8	10.25
12	2.329	5	2.289	5	2.576	5	2.521	4	4.75
13	1.056	16	1.081	16	1.063	16	1.058	16	16.00
14	1.202	15	1.525	10	1.737	11	1.565	10	11.50
15	1.230	13	1.401	13	1.347	15	1.216	15	14.00
16	1.211	14	1.132	15	1.437	14	1.407	14	14.25
Average	2.230		2.137		2.647		3.119		

TABLE 3.13

Backward Net Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	.207	13	.333	12	.504	11	.443	14	12.50
2	.340	12	.187	15	.414	13	.475	13	13.25
3	.972	1	1.026	1	1.191	1	1.176	1	1.00
4	.626	8	.654	6	.730	8	.728	9	7.75
5	.633	7	.809	3	1.007	3	.915	4	4.25
6	.592	9	.562	8	.850	7	.830	6	7.50
7	.670	6	.653	7	.870	6	1.030	2	5.25
8	.513	10	.469	11	.492	12	.744	8	10.25
9	.457	11	.507	10	.644	9	.690	10	10.00
10	.851	3	.705	5	.967	4	.773	7	4.75
11	.747	4	.774	4	.962	5	.903	5	4.50
12	.068	16	.261	13	.319	14	.498	12	13.75
13	.883	2	.832	2	1.073	2	.916	3	2.25
14	.078	15	.182	16	.177	16	.129	16	15.75
15	.679	5	.521	9	.532	10	.592	11	8.75
16	.146	14	.233	14	.208	15	.201	15	14.50
Average	.529		.544		.684		.690		

TABLE 3.14

Forward Net Interindustry Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	.735	7	.876	6	.968	7	1.045	5	6.25
2	5.134	1	4.993	1	8.107	1	17.048	1	1.00
3	.044	16	.146	13	.248	14	.230	13	14.00
4	.124	14	.080	15	.150	15	.117	15	14.75
5	.143	13	.378	9	.404	11	.358	10	10.75
6	1.271	4	.960	5	1.257	5	1.012	6	5.00
7	1.156	5	1.546	3	1.643	3	1.341	4	3.75
8	.883	6	.722	7	.982	6	.855	7	6.50
9	4.813	2	2.516	2	4.067	2	5.140	2	2.00
10	.233	9	.336	11	.464	10	.283	12	10.50
11	.310	8	.377	10	.855	8	.631	8	8.50
12	1.324	3	1.267	4	1.464	4	1.407	3	3.50
13	.056	15	.079	16	.061	16	.057	16	15.75
14	.197	11	.506	8	.717	9	.553	9	9.25
15	.229	10	.302	12	.265	13	.201	14	12.25
16	.155	12	.090	14	.360	12	.335	11	12.25
Average	1.050		.948		1.375		1.913		

TABLE 3.15

Output Indexes: Interindustry Tables
Rank Ordering Average Positions

Portugal 16x16

Sectors	Table 3.7	Table 3.8	Table 3.9	Table 3.10	Table 3.11	Table 3.12	Table 3.13	Table 3.14
1	2.75	2.75	11.25	5.50	11.50	6.25	12.50	6.25
2	15.75	1.00	12.25	1.00	13.50	1.25	13.25	1.00
3	1.00	6.25	1.00	13.25	1.50	12.25	1.00	14.00
4	2.25	6.75	3.50	14.50	3.75	9.50	7.75	14.75
5	6.50	14.00	2.00	11.50	4.75	10.00	4.25	10.75
6	10.50	10.25	3.50	5.25	5.75	4.00	7.50	5.00
7	5.50	3.75	5.25	3.25	3.50	3.25	5.25	3.75
8	13.50	13.00	11.00	7.25	11.00	6.75	10.25	6.50
9	13.25	2.50	11.00	2.00	3.50	1.75	10.00	2.00
10	5.50	8.00	9.00	11.25	6.00	10.25	4.75	10.50
11	12.00	14.00	6.25	8.25	8.25	10.25	4.50	8.50
12	15.25	9.25	14.00	4.00	13.75	4.75	13.75	3.50
13	8.00	14.75	7.00	16.00	8.00	16.00	2.25	15.75
14	5.75	5.50	15.75	9.25	15.75	11.50	15.75	9.25
15	9.25	12.75	8.25	11.50	11.00	14.00	8.75	12.25
16	9.25	11.50	15.00	12.25	14.50	14.25	14.50	12.25

TABLE 3.16

Sectors With Highest Output Indexes
Interindustry Tables
Portugal 16x16

	Backward Weighted Case	Forward Weighted Case	Key Sectors Based on (1) and (2)	Backward Net Weighted Case	Forward Net Weighted Case	Key Sectors Based on (4) and (5)	Backward Case	Forward Case	Key Sectors Based on (7) and (8)	Backward Net Case	Forward Net Case	Key Sectors Based on (10) and (11)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	*	*	ǒ		*			*			*	
2		*			*			*			*	
3	*	*	ǒ	*			*			*		
4	*	*	ǒ	*			*	*	ǒ	*		
5	*			*			*			*		
6				*	*	ǒ	*	*	ǒ	*	*	ǒ
7	*	*	ǒ	*	*	ǒ	*	*	ǒ	*	*	ǒ
8					*			*			*	
9		*			*		*	*	ǒ		*	
10	*	*	ǒ				*			*		
11				*	*	ǒ				*	*	ǒ
12					*			*			*	
13	*			*			*			*		
14	*	*	ǒ									
15				*								
16												

ǒ = Key sectors based on both backward and forward indicators.

Source: Table 3.15

TABLE 3.17

Key Sectors Based on Output Indexes
Interindustry Tables

Portugal 16 x 16

Sectors	Key Sectors Based on (3)	Key Sectors Based on (6)	Key Sectors Based on (9)	Key Sectors Based on (12)
1. Agriculture Forestry and Fisheries	*			
3. Food Processing, Beverages & Tobacco	*			
4. Textiles, Apparel Leather & Shoes	*		*	
6. Paper Pulp and Paper		*	*	*
7. Chemicals, Petroleum & Coal Products	*	*	*	*
9. Basic Metals			*	
10. Machinery, Transport Equipment, Naval Construction and Repair	*			
11. Other Manufacturing		*		*
14. Trade	*			

sectors 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 5 - Wood, Cork and Furniture, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, 10 - Machinery, Transport Equipment, Naval Construction and Repair, 11 - Other Manufacturing and 13 - Public and Private Construction. For the forward case, sectors 1 - Agriculture, Forestry and Fisheries, 2 - Mining and Quarrying, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, 8 - Non Metallic Mineral Products, 9 - Basic Metals, 11 - Other Manufacturing, 12 - Electricity, Water and Gas.

According to these net indicators, key sectors will be: 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, and 11 - Other Manufacturing. It is evident that, in absolute terms, we gain no new information through the use of the net indicators. However this does not mean that the two vectors provide the same type of information. In fact, the rank ordering of each sector in the two vectors varies significantly.[5] We present in the following table the correlation for all indexes and years between the unnetted and the net version.

TABLE 3.18
Correlation for Interindustry Tables
Output Indexes

Portugal 16 x 16

Years	Backward Index	Backward Weighted Index	Forward Index	Forward Weighted Index
1959	.889	.618	.994	.823
1964	.876	.669	.989	.777
1970	.823	.579	.990	.916
1974	.854	.488	.999	.987

Table 3.18 shows that correlation values for the backward index are around 0.85 and for the backward weighted index around 0.58. In the forward index case, correlation values are almost one, showing a strongly correlation pattern, and in the forward weighted case the correlation is smaller but still very high.

The difference between the patterns of the backward and forward case show that intrasectoral demands are more relevant than intra-sectoral supplies. The main conclusion that emerges from comparison of relative versus absolute indexes is the fact that Sector 7 in all (four) classification procedures is designated as a key sector, as could be observed looking again at Table 3.17.

Sector 1 - Agriculture, Forestry and Fisheries is in relative terms or in weighted terms a key sector. In fact agriculture has the strongest share of the Portuguese Gross Output. That is why, in absolute terms, this sector is not a key one. Also, when we look at the net indicators this sector is not considered a key one. In fact, agriculture, in the Portuguese case has increased at a minimal annual rate of growth, with very low productivity levels, having strong intraconnections but very weak interconnections with other sectors.

Sector 3 - Food Processing, Beverages and Tobacco, has very low forward indicator values, and that was the reason for its exclusion from all but the first key sector classification. Almost all the supplies of the sector went directly to final demand.

Sector 4 - Textiles, Apparel, Leather and Shoes is a key sector based on weighted or unweighted indicators, when we consider only the unnetted case. The net forward indicators are low, showing that supplies are very low. Here again, supplies went mainly to the final demand vector.

Sector 6 - Paper Pulp and Paper, only in the unnetted weighted case, was not considered a key sector. The relative importance of its gross output share is, then, the main obstacle. This means that despite its relatively low gross output share in the overall economy, it should be considered as a key sector.

Sector 7 - Chemicals, Petroleum and Coal Products is considered a key sector according to all classification procedures, as already noted. The importance of energy and the economic dependence of all sectors on it, is the main reason for the result, as we should expect.

Sector 9 - Basic Metals, is a key sector only in absolute and unnetted terms. The main reason is the lack of backward linkages, that is the absence of interconnections from the demand side, and also the minor importance of its gross output, in relative terms.

Sector 10 - Machinery, Transport Equipment, Naval Construction and Repair, like sector 1, is a key sector in relative and unnetted terms.

Sector 11 - Other Manufacturing, is a key sector on net terms in the absolute and relative cases. It shows that interconnections excluding the intrasectoral ones are significant.

Sector 14 - Trade, only in weighted terms, and in unnetted terms is a key sector. Its relative gross output importance and the intrasectoral connections are the main reasons. So, as noted before, should not be considered a key sector.

Thus far, we did not utilize the domestic tables. We repeat here the same ranking procedure for the four sets of tables for the domestic cases. Based on Tables 3.19 through 3.22, (weighted indexes) and Tables 3.23 through 3.26 (unweighted indexes), Tables 3.27, 3.28 and 3.29 were constructed.

Conclusions from the four key sector classifications procedures are very similar. So, instead of a detailed analysis of all domestic tables, we will concentrate on the differences.

The first classification procedure is based on the weighted, unnetted indicators. The key sectors chosen according to this procedure are: 1 - Agriculture, Forestry and Fisheries, 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 7 - Chemicals, Petroleum and Coal Products, 10 - Machinery, Transport Equipment, Naval Construction and Repair, and 14 - Trade. Comparing with the already available information, obtained using the same classification procedure for the interindustry tables, no new information is added.

However, using the three other procedures, changes in the chosen sectors do occur. Using the second classification, based on the net weighted indicators, the key sectors will be: 1 - Agriculture, Forestry and Fisheries, 6 - Paper Pulp and Paper and 7 - Chemicals, Petroleum and Coal Products. Making a comparison with the inter-industry case, sector 1 appears now as a key sector, and at the same time sector 11 - Other Manufacturing lost its position. Sector 1 has now a high value in the backward net weighted indicator, showing that excluding imports from the transactions table cells, inputs from the

TABLE 3.19

Backward Weighted Domestic Index

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	2.500	2	1.982	2	1.826	3	1.711	2	2.25
2	.281	14	.174	16	.231	16	.284	16	15.50
3	2.658	1	2.671	1	2.269	1	1.992	1	1.00
4	1.395	5	1.575	4	1.892	2	1.584	3	3.50
5	1.475	4	1.274	5	.978	8	.898	9	6.50
6	.582	10	.606	11	.722	11	.774	11	10.75
7	1.202	6	1.042	6	1.060	7	1.020	8	6.75
8	.399	13	.406	13	.368	14	.523	12	13.00
9	.262	15	.456	12	.389	13	.314	15	13.75
10	.812	8	.971	8	1.292	4	1.453	4	6.00
11	.408	12	.381	14	.504	12	.494	13	12.75
12	.135	16	.309	15	.366	15	.415	14	15.00
13	.780	9	1.023	7	.972	9	1.171	7	8.00
14	1.706	3	1.724	3	1.106	6	1.329	5	4.25
15	.827	7	.692	10	.781	10	.823	10	9.25
16	.577	11	.715	9	1.243	5	1.216	6	7.75
Average	1		1		1		1		

TABLE 3.20

Forward Weighted Domestic Index
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	2.792	1	2.117	1	1.842	1	1.726	1	1.00
2	.563	13	.676	11	.446	16	.690	12	13.00
3	1.387	4	1.559	3	1.386	3	1.235	4	3.50
4	1.297	5	1.262	5	1.521	2	1.214	6	4.50
5	.659	11	.698	10	.490	15	.533	16	13.00
6	.833	7	.648	14	.766	10	.678	13	11.00
7	1.492	3	1.371	4	1.321	5	1.164	8	5.00
8	.531	14	.600	15	.652	12	.748	11	13.00
9	.859	6	.945	6	1.076	8	1.282	3	5.75
10	.779	9	.903	8	1.123	7	1.225	5	7.25
11	.421	16	.382	16	.684	11	.595	14	14.25
12	.826	8	.907	7	.944	9	.895	9	8.25
13	.464	15	.660	12	.561	14	.765	10	12.75
14	1.791	2	1.884	2	1.336	4	1.458	2	2.50
15	.645	12	.732	9	.605	13	.586	15	12.25
16	.662	10	.655	13	1.247	6	1.208	7	9.00
Average	1		1		1		1		

TABLE 3.21

Backward Net Weighted Domestic Index
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	.358	13	.771	7	.929	7	.893	7	8.50
2	.640	8	.355	14	.604	11	.787	10	10.75
3	4.153	1	3.497	1	2.866	1	2.557	1	1.00
4	.590	9	.779	6	.842	9	.865	8	8.00
5	2.775	2	2.646	2	2.156	2	1.963	2	2.00
6	1.583	3	1.346	3	1.706	3	1.826	3	3.00
7	1.181	4	1.058	5	1.033	5	.847	9	5.75
8	.762	7	.673	10	.591	12	.991	6	8.75
9	.434	12	.638	12	.442	14	.459	14	13.00
10	.541	11	.732	8	.788	10	.702	12	10.25
11	.578	10	.725	9	.935	6	.695	13	9.50
12	.009	16	.441	13	.485	13	.749	11	13.25
13	1.081	6	1.094	4	1.247	4	1.169	4	4.50
14	.083	15	.237	16	.275	15	.219	16	15.50
15	1.084	5	.659	11	.870	8	1.032	5	7.25
16	.148	14	.350	15	.230	16	.247	15	15.00
Average	1		1		1		1		

TABLE 3.22

Forward Net Weighted Domestic Index
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	1.351	6	1.400	5	1.225	7	1.175	7	6.25
2	1.494	5	1.662	4	1.050	9	1.701	3	5.25
3	.163	15	.332	13	.431	13	.406	12	13.25
4	.323	13	.113	15	.192	15	.107	15	14.50
5	.199	14	.800	9	.570	10	.689	10	10.75
6	2.313	1	1.298	6	1.538	4	1.263	6	4.25
7	2.076	4	1.937	2	1.710	3	1.275	5	3.50
8	1.153	7	1.135	7	1.256	6	1.441	4	6.00
9	2.270	2	1.910	3	2.186	1	2.956	1	1.75
10	.451	10	.602	12	.498	12	.328	14	12.00
11	.611	8	.652	11	1.273	5	.900	8	8.00
12	2.149	3	2.016	1	1.930	2	1.907	2	2.00
13	.095	16	.104	16	.114	16	.105	16	16.00
14	.415	12	.995	8	1.103	8	.885	9	9.25
15	.509	9	.774	10	.395	14	.349	13	11.50
16	.427	11	.271	14	.530	11	.514	11	11.75
Avearge	1		1		1		1		

TABLE 3.23

Backward Domestic Index
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	1.251	13	1.348	11	1.546	9	1.429	7	10.00
2	1.263	12	1.139	16	1.294	14	1.313	14	14.00
3	1.854	2	2.041	1	2.102	1	1.840	2	1.50
4	1.480	5	1.510	7	1.879	4	1.672	4	5.00
5	1.924	1	1.895	2	1.935	2	1.722	3	2.00
6	1.517	4	1.829	3	1.884	3	1.883	1	2.75
7	1.447	6	1.544	6	1.685	7	1.395	9	7.00
8	1.339	10	1.360	10	1.385	12	1.543	6	9.50
9	1.414	7	1.590	5	1.770	5	1.387	10	6.75
10	1.350	9	1.373	8	1.548	8	1.352	12	9.25
11	1.311	11	1.370	9	1.536	10	1.334	13	10.75
12	1.007	16	1.235	13	1.340	13	1.404	8	12.50
13	1.611	3	1.627	4	1.759	6	1.601	5	4.50
14	1.070	15	1.166	15	1.151	16	1.111	16	15.50
15	1.392	8	1.271	12	1.396	11	1.353	11	10.50
16	1.161	14	1.228	14	1.221	15	1.198	15	14.50
Average	1.399		1.470		1.590		1.471		

TABLE 3.24

Forward Domestic Index
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	1.581	7	1.650	7	1.773	7	1.697	7	7.00
2	1.815	4	2.149	2	1.892	6	2.191	2	3.50
3	1.186	13	1.359	10	1.439	12	1.297	13	12.00
4	1.430	9	1.348	11	1.629	9	1.435	11	10.00
5	1.558	8	1.606	8	1.605	10	1.467	8	8.50
6	2.010	2	2.100	3	2.130	3	1.951	4	3.00
7	1.686	6	1.993	5	2.120	4	1.784	6	5.25
8	1.812	5	1.660	6	1.908	5	1.802	5	5.25
9	2.315	1	2.390	1	2.767	1	2.480	1	1.00
10	1.214	11	1.286	12	1.434	13	1.218	14	12.50
11	1.234	10	1.276	13	1.666	8	1.441	9	10.00
12	1.965	3	2.046	4	2.234	2	2.138	3	3.00
13	1.056	16	1.076	16	1.055	16	1.049	16	16.00
14	1.167	14	1.439	9	1.594	11	1.439	10	11.00
15	1.161	15	1.268	14	1.233	15	1.168	15	14.75
16	1.203	12	1.126	15	1.366	14	1.324	12	13.25
Average	1.525		1.611		1.740		1.618		

TABLE 3.25

Backward Net Domestic Index
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	.134	13	.254	11	.361	8	.299	10	10.50
2	.246	10	.137	16	.279	12	.310	7	11.25
3	.700	1	.784	1	.829	1	.697	1	1.00
4	.136	12	.218	12	.349	10	.294	11	11.25
5	.500	3	.641	2	.683	3	.567	4	3.00
6	.401	4	.385	4	.626	4	.587	3	3.75
7	.297	7	.317	8	.389	7	.278	13	8.75
8	.319	6	.330	6	.326	11	.476	5	7.00
9	.231	11	.270	9	.218	14	.233	14	12.00
10	.291	8	.327	7	.409	6	.306	8	7.25
11	.283	9	.364	5	.478	5	.300	9	7.00
12	.003	16	.214	13	.231	13	.294	12	13.50
13	.611	2	.625	3	.757	2	.599	2	2.25
14	.065	15	.150	15	.134	16	.100	16	15.50
15	.388	5	.258	10	.355	9	.344	6	7.50
16	.105	14	.187	14	.145	15	.128	15	14.50
Average	.294		.341		.411		.363		

TABLE 3.26

Forward Net Domestic Index
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank O. (Mean)
1	.465	7	.556	7	.588	8	.567	7	7.25
2	.797	4	1.146	1	.876	3	1.188	2	2.50
3	.031	16	.102	13	.166	14	.154	14	14.25
4	.086	14	.056	16	.099	15	.056	15	15.00
5	.134	13	.352	9	.353	10	.313	10	10.50
6	.893	3	.656	5	.872	4	.655	6	4.50
7	.536	6	.765	4	.824	6	.666	5	5.25
8	.792	5	.630	6	.849	5	.735	4	5.00
9	1.132	1	1.070	2	1.215	1	1.326	1	1.25
10	.155	11	.240	12	.295	11	.172	12	11.50
11	.207	8	.270	10	.608	7	.407	9	8.50
12	.962	2	1.025	3	1.125	2	1.028	3	2.50
13	.056	15	.074	15	.053	16	.048	16	15.50
14	.162	9	.423	8	.577	9	.428	8	8.50
15	.157	10	.255	11	.192	13	.159	13	11.75
16	.147	12	.084	14	.291	12	.254	11	12.25
Average	.420		.482		.561		.510		

TABLE 3.27

Output Indexes: Domestic Tables
Rank Ordering Average Positions

Portugal 16x16

Sectors	Table 3.19	Table 3.20	Table 3.21	Table 3.22	Table 3.23	Table 3.24	Table 3.25	Table 3.26
1	2.25	1.00	8.50	6.25	10.00	7.00	10.50	7.25
2	15.50	13.00	10.75	5.25	14.00	3.50	11.25	2.50
3	1.00	3.50	1.00	13.25	1.50	12.00	1.00	14.25
4	3.50	4.50	8.00	14.50	5.00	10.00	11.25	15.00
5	6.50	13.00	2.00	10.75	2.00	8.50	3.00	10.50
6	10.75	11.00	3.00	4.25	2.75	3.00	3.75	4.50
7	6.75	5.00	5.75	3.50	7.00	5.25	8.75	5.25
8	13.00	13.00	8.75	6.00	9.50	5.25	7.00	5.00
9	13.75	5.75	13.00	1.75	6.75	1.00	12.00	1.25
10	6.00	7.25	10.25	12.00	9.25	12.50	7.25	11.50
11	12.75	14.25	9.50	8.00	10.75	10.00	7.00	8.50
12	15.00	8.25	13.25	2.00	12.50	3.00	13.50	2.50
13	8.00	12.75	4.50	16.00	4.50	16.00	2.25	15.50
14	4.25	2.50	15.50	9.25	15.50	11.00	15.50	8.50
15	9.25	12.25	7.25	11.50	10.50	14.75	7.50	11.75
16	7.75	9.00	15.00	11.75	14.50	13.25	14.50	12.25

TABLE 3.28

Sectors With Highest Output Indexes
Domestic Tables
Portugal 16x16

	Backward Weighted Case (1)	Forward Weighted Case (2)	Key Sectors Based on (1) and (2) (3)	Backward Net Weighted Case (4)	Forward Net Weighted Case (5)	Key Sectors Based on (4) and (5) (6)	Backward Case (7)	Forward Case (8)	Key Sectors Based on (7) and (8) (9)	Backward Net Case (10)	Forward Net Case (11)	Key Sectors Based on (10) and (11) (12)
1	*	*	θ	*	*	θ		*			*	
2					*			*			*	
3	*	*	θ	*			*			*		
4	*	*	θ	*			*					
5	*			*			*	*	θ	*		
6				*	*	θ	*	*	θ	*	*	θ
7	*	*	θ	*	*	θ	*	*	θ		*	
8					*			*		*	*	θ
9		*			*		*	*	θ		*	
10	*	*	θ				*			*		
11					*					*	*a	θ
12		*			*			*			*	
13				*			*			*		
14	*	*	θ								*a	
15				*						*		
16	*											

θ = key sectors based on both backward and forward indicators.
a = both sectors occupy the eighth position.

Source: Table 3.27

TABLE 3.29
Key Sectors Based On Output Indexes
Domestic Tables
Portugal 16 x 16

Sectors	Key Sectors Based on (3)	Key Sectors Based on (6)	Key Sectors Based on (9)	Key Sectors Based on (12)
1. Agriculture, Forestry and Fisheries.	*	*		
3. Food Processing, Beverages and Tobacco	*			
4. Textiles, Apparel, Leather and Shoes	*			
5. Wood, Cork and Furniture			*	
6. Paper Pulp and Paper		*	*	*
7. Chemicals, Petroleum & Coal Products	*	*	*	
8. Non Metallic Mineral Products				*
9. Basic Metals			*	
10. Machinery, Transport Equipment, Naval Contruction and Repair	*			
11. Other Manufacturing				*
14. Trade	*			

other sectors to sector 1 are now, relatively speaking, more significant.

In respect to sector 11, low values for both backward and forward net weighted indicators are now found. This means that this sector, Other Manufacturing, has a very heavy import component. When that import component is not included in the transaction table, as in the domestic case, the sector does not play a leading role.

An analysis of the third classification procedure, based on the absolute and unnetted indicators, will also show some changes from the original interindustry analysis. The key sectors will be: 5 - Wood, Cork and Furniture, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, and 9 - Basic Metals. Comparing with the results obtained using the technological matrix, sectors 6, 7 and 9 remain. Sectors 5, now a key sector, with a high value for the forward case, was already in the ninth position in the interindustry case.

Sector 4 lost its key sector position according to this classification procedure. The forward index indicator is now too low, occupying the tenth position. However if we notice its position in the interindustry case, it already occupied the last (eighth) position in the highest group of the forward index indicator.

Finally, the fourth classification procedure, based on the net absolute indicators, shows as key sectors: sector 6 - Paper Pulp and Paper, 8 - Non Metallic Mineral Products, and 11 - Other Manufacturing. Sector 6 and 11 retained their key designations. Sector 8 changes from the eleventh position in the interindustry classification to fifth in the domestic case for the backward net index, and from the seventh position to fifth for the forward net index. Again, the presence of imports in the interindustry table and their absence in the domestic one played the key role. This sector showed that without considering the intrasectoral relations, and in absolute terms, it is a key sector. It shows the independence of this sector from imports for key sector considerations. Sector 7, on the contrary, lost its position. However, a closer observation of Tables 3.27 and 3.15 will show that for the interindustry table, net backward and net forward indicators were in sixth and fourth positions respectively, and in the domestic table they were ninth and sixth. So, in the domestic case, the net backward indicator position of the sector is almost in the high value group. So, again, no new information was added.

Concluding, the domestic tables did not add much relevant information for the determination of key sectors. However, information about the role of imports in the sectors's structure could be analysed comparing the indicators from both tables. A more detailed discussion will be made when the 60x60 level of aggregation of these tables is presented in Chapter 4.

In Section 2.1.2, the variability measures, formulas 2.9a, and 2.9b, were introduced. The operational uses of those measures where presented in Hazari [1970] and Syed [1975]. According to those studies, key sectors will be the ones having high backward and forward indexes and relatively low V_j and V_i (relatively low meaning below the average). The variability measures analyze the variance of each row or each column. Thus, comparison of weighted indicators with these is out of the question. What we can compare, however, is the index of backward linkage with the variability measure based on the input inverse, and the index of forward linkage with the variability measure of the output inverse. And the same procedure could be repeated for the net absolute indicators also. However, for a definition of key sector both high backward and forward values must exist, so both V_i and V_j should also be low for the same sectors.

An analysis for the interindustry and domestic sectors was attempted for each year; four variability indicators were calculated. Two for the unneted matrices (input and output versions) and the other two for the netted ones. For each variability measure, a rank ordering classification for the four different years was calculated, and an average of the rank ordering classifications was obtained. These data are in Tables 3.30 through 3.37. In Table 3.38, the eight sectors with lowest values for each variability measure are presented.

If we define a key sector as one for which we obtain for both measures (along the column and along the row) low variability indexes, we will get the following, as presented in Table 3.39. Adding the information obtained for the absolute indexes measures obtained for the output linkages, for interindustry and domestic tables, to the information in this one, we obtain the results shown in Table 3.40.

TABLE 3.30

Variability Along the Column
Input Inverse Matrix. Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	3.361	13	3.044	12	2.789	11	2.851	13	3.011	13	12.25
2	2.974	11	3.350	15	2.795	12	2.696	11	2.954	11	12.25
3	2.444	5	2.368	3	2.275	4	2.265	4	2.338	3	4.00
4	2.822	10	2.684	7	2.720	10	2.671	10	2.724	10	9.25
5	2.805	9	2.464	4	2.203	3	2.243	3	2.429	5	4.75
6	2.658	8	2.905	10	2.416	6	2.461	8	2.610	9	8.00
7	2.639	7	2.716	9	2.506	7	2.273	5	2.533	7	7.00
8	2.617	6	2.698	8	2.672	9	2.313	6	2.575	8	7.25
9	3.038	12	2.930	11	2.998	13	2.861	14	2.956	12	12.50
10	2.417	4	2.539	5	2.341	5	2.404	7	2.425	4	5.25
11	2.350	3	2.254	2	2.064	2	2.129	2	2.199	2	2.25
12	3.733	16	3.141	13	3.057	14	2.712	12	3.161	14	13.75
13	2.076	1	2.120	1	1.860	1	2.013	1	2.017	1	1.00
14	3.695	15	3.356	16	3.375	16	3.520	16	3.486	16	15.75
15	2.348	2	2.660	6	2.625	8	2.470	9	2.526	6	6.25
16	3.486	14	3.225	14	3.311	15	3.327	15	3.337	15	14.50

TABLE 3.31

Variability Along the Row
Output Inverse Matrix. Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	2.469	6	2.351	5	2.375	9	2.272	6	2.367	6	6.50
2	1.270	1	1.137	1	1.146	1	1.366	1	1.230	1	1.00
3	3.853	16	3.569	13	3.359	14	3.363	14	3.536	14	14.25
4	3.674	14	3.768	16	3.647	15	3.702	15	3.698	15	15.00
5	3.626	13	3.047	10	3.021	12	3.037	11	3.183	11	11.50
6	2.144	5	2.419	6	2.017	5	2.241	5	2.205	5	5.25
7	2.107	4	1.865	4	1.879	3	1.909	4	1.940	4	3.75
8	2.499	7	2.513	7	2.344	8	2.484	8	2.460	7	7.50
9	1.870	3	1.829	3	1.939	4	1.798	3	1.859	3	3.25
10	3.319	11	3.091	11	2.925	10	3.170	12	3.126	10	11.00
11	3.075	8	2.857	9	2.165	6	2.448	7	2.636	8	7.50
12	1.625	2	1.674	2	1.611	2	1.652	2	1.641	2	2.00
13	3.778	15	3.692	15	3.756	16	3.773	16	3.750	16	15.50
14	3.305	10	2.611	8	2.277	7	2.516	9	2.677	9	8.50
15	3.216	9	3.104	12	3.166	13	3.298	13	3.196	12	11.75
16	3.467	12	3.664	14	2.938	11	2.988	10	3.264	13	11.75

TABLE 3.32

Variability Along the Column
Net Input Inverse Matrix. Interindustry Tables
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	2.059	11	1.536	9	1.349	12	1.293	7	1.559	11	9.75
2	1.577	8	1.986	14	1.141	7	1.248	4	1.488	10	8.25
3	2.791	16	2.475	16	2.321	16	2.429	16	2.504	16	16.00
4	2.287	14	1.718	12	1.190	9	1.345	10	1.635	13	11.25
5	2.498	15	2.019	15	1.423	14	1.603	12	1.886	14	14.00
6	1.462	7	1.558	10	1.293	11	1.394	11	1.427	8	9.75
7	1.620	9	1.368	7	1.022	3	1.695	13	1.426	7	8.00
8	1.278	4	1.199	5	1.097	5	1.308	8	1.220	4	5.50
9	1.642	10	1.679	11	1.390	13	1.705	14	1.604	12	12.00
10	2.223	13	1.919	13	1.786	15	1.856	15	1.946	15	14.00
11	1.420	6	1.531	8	1.137	6	1.249	5	1.334	6	6.25
12	2.136	12	1.188	4	1.092	4	1.321	9	1.434	9	7.25
13	1.223	2	1.103	3	.991	2	.983	2	1.075	2	2.25
14	1.233	3	1.005	2	1.180	8	1.088	3	1.126	3	4.00
15	1.375	5	1.321	6	1.230	10	1.253	6	1.295	5	6.75
16	1.160	1	.927	1	.850	1	.862	1	.950	1	1.00

TABLE 3.33

Variability Along the Row
Net Output Inverse Matrix. Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	2.115	9	2.292	15	2.430	15	2.343	14	2.295	14	13.25
2	1.452	7	1.283	8	1.297	10	1.474	11	1.376	9	9.00
3	2.412	13	2.238	14	2.318	13	2.477	15	2.361	15	13.75
4	1.594	8	1.204	7	1.125	9	.992	7	1.229	6	7.75
5	2.984	14	1.814	10	2.291	12	1.923	12	2.253	13	12.00
6	2.201	10	1.133	4	1.034	6	.981	6	1.337	8	6.50
7	1.237	5	.922	2	.949	4	.756	3	.966	2	3.50
8	3.165	15	2.740	16	2.717	16	2.978	16	2.900	16	15.75
9	2.265	11	2.052	12	2.349	14	2.163	13	2.207	12	12.50
10	1.263	6	1.153	5	1.119	8	1.397	9	1.233	7	7.00
11	1.035	4	.976	3	1.004	5	.948	5	.991	3	4.25
12	.759	1	.673	1	.657	1	.650	1	.685	1	1.00
13	3.472	16	1.921	11	1.425	11	1.437	10	2.064	11	12.00
14	.890	2	1.170	6	1.054	7	1.008	8	1.030	4	5.75
15	.970	3	1.772	9	.884	3	.821	4	1.111	5	4.75
16	2.338	12	2.199	13	.761	2	.747	2	1.511	10	7.25

TABLE 3.34

Variability Along the Column
Input Inverse Matrix
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	3.549	12	3.211	10	3.022	9	3.123	10	3.226	11	10.25
2	3.183	10	3.494	16	3.092	11	3.006	7	3.194	10	11.00
3	2.664	2	2.553	2	2.507	2	2.566	2	2.573	2	2.00
4	3.613	13	3.392	14	3.213	12	3.257	13	3.369	13	13.00
5	2.978	5	2.666	3	2.550	3	2.665	3	2.717	3	3.50
6	2.900	4	3.119	7	2.625	4	2.715	5	2.840	4	5.00
7	3.140	9	3.137	8	3.023	10	3.159	12	3.115	9	9.75
8	2.997	6	2.977	5	3.006	8	2.712	4	2.923	5	5.75
9	3.314	11	3.287	12	3.477	14	3.289	14	3.342	12	12.75
10	3.104	7	3.016	6	2.902	6	3.055	9	3.019	8	7.00
11	3.112	8	2.898	4	2.697	5	3.049	8	2.939	6	6.25
12	3.987	16	3.270	11	3.269	13	3.124	11	3.412	14	12.75
13	2.454	1	2.396	1	2.212	1	2.435	1	2.374	1	1.00
14	3.742	15	3.455	15	3.508	16	3.617	16	3.580	16	15.50
15	2.832	3	3.145	9	2.935	7	2.937	6	2.962	7	6.25
16	3.616	14	3.354	13	3.494	15	3.544	15	3.502	15	14.25

TABLE 3.35
Variability Along the Row
Output Inverse Matrix
Domestic Tables

Portugal 16x16

Sec-tors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	2.849	7	2.720	7	2.756	9	2.717	7	2.761	7	7.50
2	2.185	2	1.862	1	2.075	2	1.893	1	2.004	2	1.50
3	3.887	16	3.687	14	3.525	14	3.511	14	3.653	14	14.50
4	3.746	14	3.822	16	3.740	15	3.834	16	3.786	16	15.25
5	3.642	13	3.094	9	3.110	11	3.120	10	3.241	10	10.75
6	2.347	4	2.690	6	2.293	3	2.507	5	2.479	5	4.50
7	2.694	6	2.400	4	2.382	5	2.424	4	2.475	4	4.75
8	2.587	5	2.643	5	2.490	8	2.620	6	2.585	6	6.00
9	2.299	3	2.302	3	2.328	4	2.049	3	2.245	3	3.25
10	3.460	11	3.212	12	3.131	12	3.403	12	3.301	11	11.75
11	3.292	8	3.109	10	2.470	6	2.806	9	2.919	9	8.25
12	1.940	1	1.890	2	1.876	1	1.970	2	1.919	1	1.50
13	3.779	15	3.708	15	3.785	16	3.805	15	3.769	15	15.25
14	3.409	9	2.769	8	2.483	7	2.747	8	2.852	8	8.00
15	3.425	10	3.166	11	3.340	13	3.423	13	3.338	12	11.75
16	3.491	12	3.685	13	3.096	10	3.184	11	3.364	13	11.50

TABLE 3.36

Variability Along the Column
Net Input Inverse Matrix
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	2.105	12	1.614	12	1.454	13	1.501	11	1.669	12	12.00
2	1.531	5	1.839	13	1.234	9	1.237	5	1.460	8	8.00
3	3.131	16	2.538	16	2.443	16	2.525	16	2.659	16	16.00
4	1.834	11	1.600	10	1.162	7	1.260	6	1.464	9	8.50
5	2.754	15	2.248	15	1.627	15	1.870	15	2.125	15	15.00
6	1.527	4	1.601	11	1.427	12	1.616	13	1.543	11	10.00
7	1.533	6	1.383	7	1.058	2	1.215	4	1.297	4	4.75
8	1.158	1	1.115	4	1.131	4	1.313	8	1.179	2	4.25
9	1.591	8	1.534	8	1.146	5	1.305	7	1.394	7	7.00
10	1.813	10	1.869	14	1.562	14	1.623	14	1.717	14	13.00
11	2.142	13	1.592	9	1.218	8	1.091	2	1.511	10	8.00
12	2.698	14	1.322	6	1.161	6	1.553	12	1.683	13	9.50
13	1.575	7	1.101	3	1.111	3	1.095	3	1.221	3	4.00
14	1.424	3	1.087	2	1.407	11	1.343	9	1.315	5	6.25
15	1.268	2	1.297	5	1.358	10	1.411	10	1.333	6	6.75
16	1.645	9	1.037	1	.979	1	.987	1	1.162	1	3.00

TABLE 3.37

Variability Along the Row
Net Output Inverse Matrix
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Average	Rank Order	Rank Order Average
1	2.598	11	2.725	15	2.891	14	2.609	14	2.706	14	13.50
2	1.182	4	1.346	8	1.030	4	1.608	10	1.291	6	6.50
3	2.859	13	2.719	14	2.915	15	3.048	15	2.885	15	14.25
4	1.841	8	1.322	7	1.206	10	.936	5	1.326	7	7.50
5	3.105	14	1.925	9	2.483	13	2.035	12	2.387	13	12.00
6	2.357	9	1.159	3	1.063	7	.984	7	1.391	9	6.50
7	1.638	7	1.133	2	1.152	8	.834	3	1.189	4	5.00
8	3.350	15	3.032	16	3.012	16	3.264	16	3.165	16	15.75
9	2.619	12	2.174	12	2.175	12	2.104	13	2.268	12	12.25
10	1.528	6	1.212	4	1.173	9	1.548	9	1.365	8	7.00
11	1.333	5	1.241	5	1.036	5	.948	6	1.139	3	5.25
12	.726	1	.689	1	.657	1	.659	1	.683	1	1.00
13	3.495	16	2.045	11	1.616	11	1.682	11	2.209	11	12.25
14	.882	2	1.258	6	1.040	6	1.033	8	1.053	2	5.50
15	1.102	3	1.934	10	.915	3	.878	4	1.207	5	5.00
16	2.463	10	2.343	13	.775	2	.800	2	1.595	10	6.75

TABLE 3.38

Sectors With Lowest Average Rank Ordering Classification Based on Variability Measures Portugal 16 x 16

	Interindustry				Domestic			
			Net Case				Net Case	
	Along the Column	Along the Row	Along the Column	Along the Row	Along the Column	Along the Row	Along the Column	Along the Row
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1		*				*		
2		*				*	⊛[a]	⊛
3	*				*			
4								
5	*				*			
6		*		*	⊛	⊛		*
7	⊛	⊛	⊛	⊛		*	⊛	⊛
8	⊛	⊛	*		⊛	⊛	*	
9		*				*	*	
10	*			*	*			
11	⊛	⊛	⊛	⊛	*		⊛[a]	⊛
12		*	⊛	⊛		*		*
13	*		*		*		*	
14			⊛	⊛		*	⊛	⊛
15	*		⊛	⊛	*		⊛	⊛
16			⊛	⊛			⊛	⊛

⊛ – Key sectors based on both backward and forward indicators.
a – both sectors have the same (eight) rank ordering.

TABLE 3.39

Key Sectors Based on the Variability Measures
Portugal 16 x 16

Sectors	(1) (1) and (2)	(2) (3) and (4)	(3) (5) and (6)	(4) (7) and (8)
2				*
6			*	
7	*	*		*
8	*		*	
11	*	*		*
12		*		
14		*		*
15		*		*
16		*		*

Source: Table 3.38

These variability measures, using the arguments presented in Section 2.1.2, while not required in order to determine key sectors, could be used as supplementary information. In this case, we may conclude that sector 7 - Chemicals, Petroleum and Coal Products, determined as a key sector using all classification procedures on the basis of the output linkages, has also a very low value of the variability measures in almost all classifications.[6]

Also sector 11 - Other Manufacturing, which is a key sector for the second and fourth classification procedures, is confirmed by the corresponding variability procedures. And the same can be concluded for sector 6 - Pulp Paper and Paper, from the third classification procedure.

TABLE 3.40

Key Sectors Based on Output Indexes
and Variability Measures
Portugal 16 x 16

Sectors	Interindustry				Domestic			
	Key Sectors of 3.16 (9)	Key Sectors of 3.39 (1)	Key Sectors of 3.16 (12)	Key Sectors of 3.39 (2)	Key Sectors of 3.28 (9)	Key Sectors of 3.39 (3)	Key Sectors of 3.28 (12)	Key Sectors of 3.39 (4)
2. Mining and Quarrying								*
4. Textiles, Apparel Leather & Shoes	*							
5. Wood, Cork & Furniture	*				*			
6. Paper Pulp & Paper	*		*		⊛	⊛	*	
7. Chemicals, Petroleum & Coal Products	⊛	⊛	⊛	⊛	*			*
8. Non Metallic Mineral Mineral Products		*				*	*	
9. Basic Metals					*			
10. Machinery, Transport Equipment, Naval Construction and Repair	*							
11. Other Manufacturing		*	⊛	⊛			⊛	⊛
12. Electricity, Water & Gas				*				
14. Trade				*				*
15. Transport & Communications				*				*
16. Other Services				*				*

Low variability measures, without high linkage values, do not mean a great deal. Thus, if using this variability procedure we obtain information of low values for some sectors, that in itself is not relevant without high linkages classifications, for the key sectors purpose.

3.3 Key Sectors from an Income Linkage Viewpoint

We present two kinds of indicators in our framework:

the absolute indexes: (2.70, 72, 74, 76)

the relative indexes: (2.71, 73, 75, 77)

To each of these indexes corresponds one of the following tables (3.41, 42, 43, 44, 45, 46, 47, and 48). In each, a rank ordering was established for each year (column) and a mean value was calculated for the four years. Summarizing all the rank ordering information in one table, we get Table 3.49. Changes in the income multiplers could also provide a convenient summary measure of the stability of the national/regional structure.[7]

From Table 3.50, the decrease (39 percent) from the 1970 value for the domestic net type I multiplier to 1974 indicates a strong increase in the intrasectoral relations in each sector. This could indicate a strong concentration rather than a dispersal in the industrial relations. In interindustry terms the same indicator also shows a decreasing value of 27 percent. Smaller than the domestic case, this shows that concentration is not so strong for the interindustry case (imports included) than in the domestic one.

TABLE 3.41

Net Type I Income Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.069	13	.111	14	.174	13	.288	9	12.25
2	.138	11	.091	16	.171	14	.222	12	13.25
3	2.335	1	4.313	1	3.951	1	1.816	1	1.00
4	.202	9	.210	11	.473	7	.377	8	8.75
5	.087	12	1.261	2	.865	5	.515	5	6.00
6	.908	3	.985	3	1.787	2	1.076	2	2.50
7	.814	4	.930	4	1.216	3	.611	3	3.50
8	.228	8	.286	7	.301	10	.424	7	8.00
9	.427	6	.688	5	.927	4	.525	4	4.75
10	.916	2	.257	9	.462	8	.264	10	7.25
11	.034	14	.236	10	.458	9	.178	14	11.75
12	.002	16	.276	8	.221	12	.254	11	11.75
13	.429	5	.480	6	.655	6	.452	6	5.75
14	.032	15	.122	13	.156	15	.125	15	14.50
15	.166	10	.158	12	.222	11	.210	13	11.50
16	.233	7	.109	15	.065	16	.070	16	13.50

TABLE 3.42

Weighted Net Type I Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.016	14	.037	15	.052	15	.153	13	14.25
2	.809	4	.759	6	1.590	5	3.118	2	4.25
3	2.120	2	2.552	3	1.993	2	1.402	5	3.00
4	.184	11	.130	13	.176	13	.265	11	12.00
5	.208	10	2.566	2	1.804	3	1.518	3	4.50
6	8.723	1	5.029	1	5.283	1	4.381	1	1.00
7	.808	5	.934	5	.878	6	.608	8	6.00
8	.637	6	.598	8	.505	8	.971	6	7.00
9	1.161	3	1.475	4	1.739	4	1.501	4	3.75
10	.613	7	.179	11	.182	12	.133	14	11.00
11	.083	13	.693	7	.827	7	.389	9	9.00
12	.012	15	.579	9	.414	9	.923	7	10.00
13	.294	8	.236	10	.294	10	.254	12	10.00
14	.005	16	.020	16	.060	14	.057	15	15.25
15	.211	9	.151	12	.189	11	.301	10	10.50
16	.116	12	.061	14	.014	16	.027	16	14.50

TABLE 3.43

Type II Income Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	1.454	10	1.707	12	2.007	11	2.974	9	10.50
2	1.416	12	1.549	16	1.751	14	2.569	12	13.50
3	4.276	1	7.889	1	7.715	1	6.205	1	1.00
4	1.895	6	2.127	6	2.957	6	3.682	3	5.25
5	.107	15	3.562	2	3.126	5	3.501	6	7.00
6	2.481	2	3.441	3	4.497	2	4.975	2	2.25
7	2.407	4	3.056	4	3.710	3	3.624	4	3.75
8	1.530	9	1.864	8	2.009	10	3.127	7	8.50
9	1.973	5	2.844	5	3.661	4	3.521	5	4.75
10	2.421	3	1.846	9	2.364	8	2.748	11	7.75
11	.042	16	1.759	11	2.239	9	2.542	14	12.50
12	1.233	14	1.837	10	1.964	12	2.860	10	11.50
13	1.751	7	2.099	7	2.446	7	3.048	8	7.25
14	1.271	13	1.612	15	1.733	15	2.383	16	14.75
15	1.434	11	1.658	13	1.865	13	2.556	13	12.50
16	1.580	8	1.629	14	1.685	16	2.389	15	13.25

TABLE 3.44

Weighted Type II Income Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	2.706	2	1.621	2	1.514	3	1.824	2	2.25
2	.097	14	.057	16	.042	16	.057	16	15.50
3	4.364	1	5.863	1	4.834	1	3.185	1	1.00
4	1.483	5	1.307	4	1.833	2	1.700	3	3.50
5	.039	15	.739	8	.438	10	.444	10	10.75
6	.163	12	.255	12	.388	11	.409	11	11.50
7	1.513	4	1.052	5	1.226	5	1.192	8	5.50
8	.209	10	.209	13	.201	15	.316	13	12.75
9	.182	11	.327	11	.344	12	.257	14	12.00
10	1.278	6	.780	7	1.263	4	1.568	4	5.25
11	.008	16	.158	15	.260	13	.336	12	14.00
12	.141	13	.182	14	.221	14	.234	15	14.00
13	.670	8	.847	6	.827	8	1.197	7	7.25
14	1.849	3	1.564	3	1.011	7	1.433	5	4.50
15	.605	9	.473	10	.530	9	.623	9	9.25
16	.691	7	.565	9	1.068	6	1.226	6	7.00

TABLE 3.45

Net Type I Income Index
Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.120	12	.145	13	.251	13	.446	11	12.25
2	.168	11	.118	16	.218	14	.303	14	13.75
3	3.143	1	5.516	1	5.514	1	3.039	1	1.00
4	.879	5	.673	6	1.173	6	.841	5	5.50
5	.108	13	1.505	3	1.183	5	.811	6	6.75
6	1.314	4	1.349	4	2.336	3	1.547	4	3.75
7	2.206	3	1.925	2	2.966	2	2.562	2	2.25
8	.389	8	.393	10	.448	10	.673	7	8.75
9	.809	6	1.150	5	2.242	4	1.615	3	4.50
10	2.628	2	.498	8	.898	8	.586	9	6.75
11	.090	14	.496	9	.909	7	.500	10	10.00
12	.043	15	.325	11	.278	12	.422	12	12.50
13	.603	7	.600	7	.864	9	.663	8	7.75
14	.038	16	.143	14	.188	15	.151	15	15.00
15	.311	9	.307	12	.308	11	.330	13	11.25
16	.289	10	.130	15	.090	16	.104	16	14.25

TABLE 3.46

Weighted Net Type I Income Index
Interindustry Tables
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.015	15	.032	15	.046	15	.131	14	14.75
2	.729	6	.721	7	1.419	5	2.710	2	5.00
3	1.861	2	2.402	2	1.901	3	1.488	4	2.75
4	.623	7	.323	10	.338	10	.385	10	9.25
5	.170	11	2.200	3	1.644	4	1.452	5	5.75
6	7.916	1	4.723	1	4.545	1	3.679	1	1.00
7	.996	4	1.126	5	1.071	6	.852	7	5.50
8	.600	8	.554	8	.457	8	.883	6	7.50
9	1.493	3	1.727	4	2.574	2	2.324	3	3.00
10	.809	5	.211	13	.203	12	.136	13	10.75
11	.125	12	.976	6	.957	7	.560	9	8.50
12	.067	14	.503	9	.342	9	.833	8	10.00
13	.263	9	.216	11	.275	11	.240	12	10.75
14	.005	16	.018	16	.047	14	.043	15	15.25
15	.223	10	.212	12	.167	13	.260	11	11.50
16	.107	13	.056	14	.013	16	.025	16	14.75

TABLE 3.47

Type II Income Index
Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	1.627	11	1.952	13	2.521	11	3.011	10	11.25
2	1.557	12	1.745	16	2.120	14	2.514	13	13.75
3	5.631	1	10.470	1	11.662	1	8.003	1	1.00
4	3.061	5	3.162	6	4.810	5	4.450	5	5.25
5	.140	15	4.273	4	4.169	6	3.697	6	7.75
6	3.285	4	4.502	3	6.297	4	5.470	4	3.75
7	4.584	3	5.226	2	7.709	2	7.282	2	2.25
8	1.832	8	2.207	10	2.567	10	3.246	7	8.75
9	3.008	6	4.015	5	7.285	3	6.370	3	4.25
10	4.950	2	2.656	7	3.825	7	3.237	8	6.00
11	.116	16	2.333	9	3.392	8	2.936	11	11.00
12	1.351	13	2.076	12	2.360	13	2.858	12	12.50
13	2.066	7	2.469	8	3.168	9	3.097	9	9.25
14	1.346	14	1.790	15	2.050	15	2.163	16	15.00
15	1.702	10	2.167	11	2.360	12	2.503	14	11.75
16	1.735	9	1.806	14	1.982	16	2.187	15	13.50

TABLE 3.48
Weighted Type II Income Index
Interindustry Tables
Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	2.205	2	1.420	3	1.280	5	1.564	5	3.75
2	.078	14	.049	16	.034	16	.047	16	15.50
3	4.185	1	5.961	1	4.922	1	3.479	1	1.00
4	1.745	5	1.488	2	2.008	2	1.740	3	3.00
5	.038	15	.679	8	.393	11	.397	10	11.00
6	.158	12	.256	12	.366	12	.381	12	12.00
7	2.099	3	1.379	4	1.716	3	2.030	2	3.00
8	.182	11	.189	13	.173	15	.277	14	13.25
9	.202	10	.354	11	.461	9	.393	11	10.25
10	1.904	4	.859	6	1.376	4	1.565	4	4.50
11	.016	16	.161	14	.265	13	.329	13	14.00
12	.112	13	.158	15	.179	14	.198	15	14.25
13	.576	7	.764	7	.721	8	1.030	7	7.25
14	1.426	6	1.330	5	.805	7	1.102	6	6.00
15	.523	9	.473	10	.451	10	.516	9	9.50
16	.553	8	.479	9	.847	6	.951	8	7.75

TABLE 3.49

Sectors With Highest Income Indexes
Portugal 16 x 16

	Interindustry				Domestic			
	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I
1	*				*			
2		*				*		
3	*	*	*	*	*	*	*	*
4	*		*	*	*		*	
5		*	*	*		*	*	*
6		*	*	*		*	*	*
7	*	*	*	*	*	*	*	*
8		*				*		*
9		*	*	*		*	*	*
10	*		*	*	*		*	*
11		*				*		
12								
13	*		*	*	*		*	*
14	*				*			
15								
16	*				*			

TABLE 3.50

Average Income Indexes
Portugal 1959-74
16 x 16

	1959	1964	1970	1974
Domestic Net Type I	.431	.657	.757	.463
Interindustry Net Type I	.809	.955	1.242	.912
Domestic Type II	1.695	2.530	2.858	3.294
Interindustry Type II	2.358	3.303	4.267	3.939

Between 1970 and 1974, the average value for the domestic direct, indirect and induced effects obtained for the economy showed an increase in value of 15.3 percent. This means that, in domestic terms, the overall effects in the economy continue to increase since 1959. However, where imports are included, an 8.6 percent decrease was obtained, showing that a greater part of the domestic generated income left the country through imports.

Changing the usual procedure, let us analyse first the differences between the interindustry and the domestic information provided by the chosen income multipliers.

From Table 3.49, only two sectors exhibit differences from the interindustry to the domestic case. They are sector 4 - Textiles, Apparel, Leather and Shoes for the unweighted net type I multiplier, where in the domestic case it occupies the ninth position and sector

8 - Non Metallic Mineral Products, which is classified in the eighth highest position for the same indicator in the domestic case and is not considered in the interindustry case. However, it occupies the ninth position in the interindustry case, showing that it is only a matter of classification procedure. So, the differences are not so significant. The homogeneity of the results is not so surprising. The a_{0j} vector is the same in both domestic and interindustry calculations, so only the composition of the open and the closed inverse matrices in both cases diverges.

Thus, income analysis can proceed, for key sector purposes, using only the interindustry information. However, the absolute type II indexes in both domestic and interindustry tables are the same.

In terms of absolute direct, indirect and induced effects the key sectors will be: sector 3 - Food Processing, Beverages, and Tobacco, sector 4 - Textiles, Apparel, Leather and Shoes, sector 5 - Wood, Cork and Furniture, sector 6 - Pulp Paper and Paper, sector 7 - Chemicals, Petroleum and Coal Products, sector 9 - Basic Metals, sector 10 - Machinery, Transport Equipment, Naval Construction and Repair, and sector 13 - Public and Private Construction. The same sectors are chosen if we use the absolute net type I multiplier, showing no new added information. However, in weighted terms, the key sector structure will change. In terms of relative direct, indirect and induced effects, the key sectors will be: sector 1 - Agriculture, Forestry and Fisheries, sector 3 - Food Processing, Beverages and Tobacco, sector 4 - Textiles, Apparel, Leather and Shoes, sector 7 - Chemicals, Petroleum and Coal Products, sector

10 - Machinery, Transport Equipment and Naval Construction and Repair, sector 13 - Public and Private Construction and sector 14 - Trade. However, if we look at the direct and indirect effects alone, and excluding the intrasectoral contributions, the key sectors will be: sector 2 - Mining and Quarrying, sector 3 - Food Processing, Beverages and Tobacco, sector 5 - Wood, Cork and Furniture, sector 6 - Pulp Paper and Paper, sector 7 - Chemicals, Petroleum and Coal products, sector 8 - Non Metallic Mineral Products, sector 9 - Basic Metals, and sector 11 - Other Manufacturing.

If we compare the rank ordering obtained from the absolute indexes with the rank ordering obtained from the labor coefficients for those years (Table 3.51) we will observe great ranking differences, as we expected. That shows that a large labor share in the composition of an industry's production does not mean that that sector will have an important income multiplier.

A more comprehensive analysis of the results obtained thus far will be developed in conjunction with the final results of the output, income and employment linkages. This will be the subject matter of Section 3.5.

3.4 Key Sectors from an Employment Linkage Viewpoint

Using the procedures of the previous section, we will now base our analysis on the following indicators:

the "actual" indexes: (2.107, 108, 109, 110)

the "potential" indexes: (2.103, 104, 105, 106)

TABLE 3.51

Labor Coefficients

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.194	6	.316	2	.302	4	.207	11	5.75
2	.306	1	.243	5	.379	2	.369	4	3.00
3	.053	13	.050	16	.056	16	.088	16	15.25
4	.120	8	.208	9	.132	12	.204	12	10.25
5	.000	15	.128	12	.192	9	.259	10	11.50
6	.072	11	.083	13	.081	13	.125	14	12.75
7	.065	12	.079	14	.076	14	.123	15	13.75
8	.229	3	.216	8	.250	5	.266	9	6.25
9	.107	9	.076	15	.064	15	.128	13	13.00
10	.042	14	.191	10	.163	11	.279	7	10.50
11	.000	16	.217	7	.187	10	.388	3	9.00
12	.142	7	.147	11	.246	6	.287	6	7.50
13	.227	5	.229	6	.240	7	.340	5	5.75
14	.228	4	.250	4	.226	8	.272	8	6.00
15	.258	2	.284	3	.337	3	.468	2	2.50
16	.084	10	.318	1	.447	1	.525	1	3.25

Those indexes are calculated for the eight input-output tables for Portugal, and results are presented in Tables 3.52 through 3.59. As usual, for each table, a rank ordering classification was established for each year (column) and a mean value was calculated for the four years.

Table 3.60 summarizes all the information. The information obtained from the domestic or the interindustry data is exactly the same. So in absolute and relative terms, both "potential" and "actual" key sectors, in respect to employment, will be: sector 3 - Food Processing, Beverages and Tobacco, sector 5 - Wood, Cork and Furniture, sector 6 - Paper Pulp and Paper, sector 7 - Chemicals, Petroleum and Coal Products, sector 9 - Basic Metals, and sector 11 - Other Manufacturing. Sector 2 - Mining is, in weighted terms, a key sector. On the contrary, sector 4 - Textiles is a key sector only in absolute terms.

TABLE 3.52

Net Type I Employment Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.014	15	.028	16	.069	15	.070	15	15.25
2	.170	12	.075	14	.136	13	.240	12	12.75
3	9.461	1	12.913	1	8.134	1	4.853	1	1.00
4	.315	10	.437	8	.674	9	.445	8	8.75
5	5.223	4	6.058	2	3.765	3	1.156	5	3.50
6	1.645	5	1.928	4	3.963	2	3.796	2	3.25
7	6.684	3	3.947	3	3.049	4	2.021	3	3.25
8	.344	9	.407	10	.356	10	.425	10	9.75
9	9.201	2	1.906	5	.832	7	.175	13	6.75
10	1.353	6	1.480	6	3.028	5	1.380	4	5.25
11	1.152	7	.478	7	1.004	6	.708	6	6.50
12	.003	16	.423	9	.738	8	.686	7	10.00
13	.207	11	.280	11	.346	11	.436	9	10.50
14	.150	13	.208	12	.114	14	.101	14	13.25
15	.510	8	.137	13	.250	12	.254	11	11.00
16	.030	14	.034	15	.043	16	.038	16	15.25

TABLE 3.53

Net Type I Employment Index
Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.026	16	.038	16	.100	15	.112	15	15.50
2	.205	12	.096	14	.171	13	.354	13	13.00
3	11.953	3	16.618	1	11.231	1	8.002	1	1.50
4	2.067	8	2.055	7	1.918	8	1.344	7	7.50
5	6.133	4	7.001	3	5.002	5	1.712	6	4.50
6	2.226	7	2.527	6	5.042	4	5.018	3	5.00
7	15.711	2	8.684	2	7.888	2	7.469	2	2.00
8	.549	10	.549	9	.556	10	.708	9	9.50
9	18.278	1	3.302	4	2.009	7	.573	11	5.75
10	3.209	5	2.902	5	5.925	3	3.514	4	4.25
11	2.928	6	1.107	8	2.094	6	2.016	5	6.25
12	.040	14	.490	10	.917	9	1.212	8	10.25
13	.269	11	.346	11	.467	11	.685	10	10.75
14	.161	13	.235	13	.137	14	.123	14	13.50
15	.672	9	.270	12	.357	12	.425	12	11.25
16	.034	15	.040	15	.063	16	.062	16	15.50

TABLE 3.54

Net Type I Weighted Employment Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.099	13	.157	14	.009	15	.015	15	14.25
2	.306	9	.358	10	.599	7	1.327	4	7.50
3	1.601	4	2.457	3	1.764	3	1.622	2	3.00
4	.175	10	.267	11	.119	11	.148	12	11.00
5	2.378	3	3.987	1	3.522	2	1.510	3	2.25
6	3.460	2	3.386	2	5.739	1	7.527	1	1.50
7	1.523	5	1.455	4	1.031	4	.936	6	4.75
8	.323	8	.447	8	.285	10	.443	8	8.50
9	4.568	1	1.294	5	.751	6	.222	10	5.50
10	.357	7	.486	7	.539	9	.257	9	8.00
11	.634	6	.616	6	.868	5	.686	7	6.00
12	.092	16	.408	9	.582	8	1.036	5	9.50
13	.122	12	.190	12	.075	13	.093	13	12.50
14	.093	15	.155	15	.020	14	.022	14	14.50
15	.172	11	.184	13	.094	12	.148	11	11.75
16	.096	14	.153	16	.005	16	.007	16	15.50

TABLE 3.55

Weighted Net Type I Employment Index
Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.063	14	.121	14	.151	14	.013	15	14.25
2	.232	10	.319	11	.583	8	1.230	5	8.50
3	1.217	5	2.329	3	1.644	3	1.841	2	3.25
4	.331	8	.462	8	.423	10	.314	10	9.00
5	1.683	3	3.394	1	2.949	2	1.484	3	2.25
6	2.720	2	3.131	2	4.429	1	6.359	1	1.50
7	1.666	4	1.868	4	1.359	4	1.337	4	4.00
8	.245	9	.386	9	.353	11	.431	8	9.25
9	6.138	1	1.634	5	1.180	5	.373	9	5.00
10	.368	7	.559	7	.696	7	.296	11	8.00
11	.941	6	.889	6	1.041	6	1.068	6	6.00
12	.069	13	.343	10	.551	9	.997	7	9.75
13	.081	12	.151	13	.178	13	.093	13	12.75
14	.058	16	.118	15	.133	15	.017	14	15.00
15	.127	11	.178	12	.200	12	.139	12	11.75
16	.060	15	.116	16	.130	16	.007	16	15.75

TABLE 3.56

Type II Employment Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	1.308	15	1.435	15	1.633	16	1.761	16	15.50
2	1.717	12	1.632	14	1.751	13	2.929	12	12.75
3	12.985	2	19.550	1	13.023	1	10.542	2	1.50
4	2.412	8	3.433	7	3.866	8	4.254	8	7.75
5	7.593	4	11.330	2	8.637	3	4.884	7	4.00
6	3.746	6	5.410	6	8.252	4	11.995	1	4.25
7	12.017	3	9.659	3	7.723	5	8.862	4	3.75
8	2.054	10	2.433	10	2.466	10	3.617	9	9.75
9	27.306	1	7.105	5	3.711	9	2.213	15	7.50
10	4.233	5	8.941	4	10.127	2	9.795	3	3.50
11	2.674	7	3.292	8	4.179	7	8.239	5	6.75
12	1.627	13	2.642	9	4.360	6	6.885	6	8.50
13	1.517	14	1.899	13	1.991	12	3.468	11	12.50
14	1.879	11	2.180	11	1.687	15	2.472	13	12.50
15	2.098	9	1.917	12	2.302	11	3.553	10	10.50
16	1.136	16	1.299	16	1.731	14	2.396	14	15.00

TABLE 3.57

Type II Employment Index
Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	1.400	15	1.582	15	1.932	16	1.802	16	15.50
2	1.925	12	1.846	14	2.113	13	2.906	13	13.00
3	16.825	3	26.311	1	19.446	1	14.609	2	1.75
4	4.983	8	6.419	7	6.554	8	5.572	7	7.50
5	9.022	4	13.949	4	12.336	4	5.366	8	5.00
6	4.984	7	7.243	6	11.742	5	13.329	3	5.25
7	26.377	2	19.185	2	18.276	3	19.302	1	2.00
8	2.548	9	2.977	10	3.306	10	3.790	10	9.75
9	49.966	1	11.212	5	7.373	6	3.840	9	5.25
10	8.774	5	15.007	3	19.381	2	12.577	4	3.50
11	5.632	6	4.952	8	7.207	7	9.936	5	6.50
12	1.841	13	3.109	9	5.820	9	6.961	6	9.25
13	1.697	14	2.204	13	2.515	12	3.567	11	12.50
14	2.062	11	2.506	12	1.982	15	2.260	14	13.00
15	2.492	10	2.552	11	3.045	11	3.483	12	11.00
16	1.154	16	1.375	16	2.045	14	2.209	15	15.25

TABLE 3.58

Weighted Type II Employment Index
Domestic Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.040	15	.089	16	.111	16	.096	16	15.75
2	.441	6	.874	8	1.451	3	2.627	2	4.75
3	.679	5	1.494	4	1.018	7	.657	8	6.00
4	.105	12	.255	11	.276	11	.268	12	11.50
5	.970	3	2.780	2	2.595	2	.982	5	3.00
6	1.893	2	2.878	1	3.853	1	4.115	1	1.25
7	.836	4	1.294	5	.947	8	.777	7	6.00
8	.334	8	.626	10	.662	10	.787	6	8.50
9	9.524	1	2.187	3	1.038	6	.478	10	5.00
10	.277	9	.940	7	.793	9	.502	9	8.50
11	.340	7	1.232	6	1.235	5	1.684	4	5.50
12	.266	10	.757	9	1.318	4	2.151	3	6.50
13	.079	13	.161	13	.186	13	.233	13	13.00
14	.055	14	.119	14	.123	14	.131	15	14.25
15	.122	11	.212	12	.272	12	.372	11	11.50
16	.040	16	.102	15	.122	15	.139	14	15.00

TABLE 3.59

Weighted Type II Employment Index
Interindustry Tables

Portugal 16x16

Sectors	1959	Rank Order	1964	Rank Order	1970	Rank Order	1974	Rank Order	Rank Order Average
1	.024	15	.066	16	.081	16	.089	16	15.75
2	.329	8	.786	8	1.327	5	2.209	2	5.75
3	.504	6	1.358	6	.953	8	.831	7	6.75
4	.158	11	.354	11	.302	11	.322	11	11.00
5	.671	4	2.333	3	2.386	2	.978	6	3.75
6	1.508	2	2.709	1	3.490	1	4.007	1	1.25
7	.940	3	1.648	4	1.293	6	1.281	5	4.50
8	.262	9	.567	10	.620	10	.707	9	9.50
9	10.335	1	2.520	2	1.470	3	.734	8	3.50
10	.333	7	1.076	7	.920	9	.513	10	8.25
11	.530	5	1.401	5	1.398	4	1.733	4	4.50
12	.199	10	.669	9	1.179	7	1.846	3	7.25
13	.056	13	.133	13	.158	13	.207	13	13.00
14	.035	14	.092	14	.092	14	.109	15	14.25
15	.092	12	.211	12	.240	12	.317	12	12.00
16	.024	16	.077	15	.091	15	.116	14	15.00

TABLE 3.60

Sectors with Highest Employment Indexes
Portugal 16 x 16

	Interindustry				Domestic			
	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I
1								
2	*	*			*	*		
3	*	*	*	*	*	*	*	*
4			*	*			*	*
5	*	*	*	*	*	*	*	*
6	*	*	*	*	*	*	*	*
7	*	*	*	*	*	*	*	*
8								
9	*	*	*	*	*	*	*	*
10		*	*	*		*	*	*
11	*	*	*	*	*	*	*	*
12	*				*			
13								
14								
15								
16								

The employment data were obtained from various sources, which are referenced below in Table 3.61.

TABLE 3.61

Number Of Employees
Portugal
(Thousands)

Sectors	1959		1964		1970		1974	
1	1,285	(4)	1,215.4	(5)	1004	(3)	1182	(3)
2	24.4	(1)	18.6	(1)	21.9	(2)	16	(2)
3	42.6	(1)	40.2	(1)	62.1	(2)	79.3	(2)
4	102.9	(1)	118.8	(1)	138.6	(2)	183.4	(2)
5	18.1	(1)	17.6	(1)	19.4	(2)	57.6	(2)
6	5.2	(1)	7.7	(1)	8.6	(2)	9.5	(2)
7	10.2	(1)	13.8	(1)	23.0	(2)	32.9	(2)
8	30.0	(1)	33.8	(1)	39.8	(2)	50.9	(2)
9	0.5	(1)	4.8	(1)	13.8	(2)	47.9	(2)
10	12.9	(1)	17.3	(1)	28.8	(2)	76.5	(2)
11	7.1	(1)	14.1	(1)	19.1	(2)	25.8	(2)
12	14	(4)	16.7	(5)	18	(3)	17	(3)
13	213	(4)	234.5	(5)	257	(3)	258	(3)
14	253	(4)	305	(5)	342	(3)	369	(3)
15	116	(4)	130.2	(5)	147	(3)	164	(3)
16	583	(4)	596.2	(5)	650	(3)	643	(3)

Source:
(1) United Nations [1968]

(2) United Nations [1977]

(3) International Labor Office [1976]

(4) OECD [1963]

(5) By extrapolation of data obtained for 1966 (3) and 1960 (4).

In the next section, 3.5, general considerations will be offered.

3.5 Overall Analysis of the Empirical Data

Tables 3.62 and 3.63 represent the four classification procedures used in the output linkage framework, adding to them also information on the eight highest sectors in terms of employment and income. Table 3.62 is for the interindustry information and Table 3.63 for the domestic cases.

We proceed to a detailed analysis of each classification procedure using Table 3.62 (the interindustry case). This table provides information in terms of "potential" key sectors. Procedure 1 is in relative terms, where linkages have been weighted by the output share of the sector in the total output of the economy. In contrast, procedure 3 provides the same information but in absolute terms. Procedures 2 and 4 net out of the calculation the intra-sectoral relations.

We will consider as key sectors those that are in the eight highest places for the three classification procedures in question. Ninth and tenth positions could also be considered, but only for income and employment cases.

As noted before (see Chapter 2), the definition of a key sector should be related to the context of the problems we are dealing with. So, no general and universal classification procedure should exist, but rather the procedures should be defined according to the type of issues we want to solve. Thus, all classifications, including the one we follow here, could be subject to criticism. In relative terms (weighted), and looking at the unnetted information, where we introduce into consideration all the output, income and

TABLE 3.62

Sectors With Highest Output, Income and Employment Indexes
Interindustry Tables
Portugal 16x16

	Weighted			Net Weighted			Unweighted			Net		
	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	*	*										
2			*		*	*						
3	⊛	⊛	⊛		*	*		*	*		*	*
4	*	*					⊛	⊛	⊛		*	*
5			*		*	*		*	*		*	*
6			*	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛
7	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛
8					*							
9			*		*	*	⊛	⊛	⊛		*	*
10	⊛	⊛	⊛[a]			*		*	*		*	*
11			*	⊛	⊛	⊛			*	⊛	⊛[b]	⊛
12			*									
13		*						*			*	
14	*	*										
15												
16		*										

a = the sector occupies the ninth position
b = the sector occupies the tenth position

TABLE 3.63

Sectors With Highest Output, Income, and Employment Indexes
Domestic Tables
Portugal 16x16

	Weighted			Net Weighted			Unnetted			Net		
	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	*	*		*								
2			*		*	*						
3	ő	ő	ő		*	*		*	*		*	*
4	*	*						*	*			*
5			*		*	*	ő	ő	ő		*	*
6			*	ő	ő	ő	ő	ő	ő	ő	ő	ő
7	ő	ő	ő	ő	ő	ő	ő	ő	ő		*	*
8					*					ő	ő	ő[a]
9			*		*	*	ő	ő	ő		*	*
10	ő	ő	ő[a]			*		*	*		*	*
11			*		*	*			*	*		*
12			*									
13		*						*			*	
14	*	*										
15												
16		*										

a = the sector occupies the ninth position employment information, the key sectors will be: Sectors 3 - Food Processing, Beverages and Tobacco, 7 - Chemicals, Petroleum and Coal Products, and 10 - Machinery, Transport Equipment, Naval Construction and Repair. Looking now to the net information (that is, without considering the intrasectoral relations), the key sector will be Sector 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum, and Coal Products, and 11 - Other Manufacturing.

According to this classification, Sector 3 looses its output linkage power here but continues to be a key sector in terms of income and employment. Sector 10 lost its output and income positions, being only a key sector in terms of employment.

Looking now at the absolute indicators, and in unnetted terms, key sectors will be: Sectors 4 - Textiles, Apparel, Leather and Shoes, 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products, and 9 - Basic Metals. Sector 3 again lost its position, due to the absence of output linkages power. Finally if we look at the absolute indexes, in netted terms, key sectors will be: Sectors 6 - Paper Pulp and Paper, 7 - Chemicals, Petroleum and Coal Products and 11 - Other Manufacturing.

The information that we can obtain from Table 3.63, for procedure 1 is the same. For procedure 2, Sector 11, lost its position because of the absence of output linkage power, and in procedure 3, Sector 4 also lost its position for the same reason. On the contrary Sector 5, in procedure 3, becomes a key sector, given the existence for this procedure of output linkage power. For procedure 4, Sector 7 and 11 loose their position and Sector 8, on the contrary, is now a key sector for all the three classification procedures.

In any case, the information in terms of "actual" or in terms of "potential" key sectors in overall terms is rather stable, as it was before in specific terms of output, income and employment. We are now in posession of a wide range of information and indicators which could be used for policy making according to the particular characteristics of the Portuguese economy at this specific time.

3.6 The Balanced-Unbalanced Growth Controversy and the Portuguese Case

A survey of the literature on the balanced-unbalanced growth controversy was presented in Section 2.1.4. From that section, the following group of formulas were obtained. The first group provides us with a scalar measure, which gives an overall idea of the balanced-unbalanced development pattern followed by the economy under consideration. This group contains

$$\rho H_i = \rho(O_j, g_{ij}) \qquad (2.10)$$

$$V_j = \sqrt{\sum_{i=1}^{m} \frac{(g_{ij} - G_j)^2}{m}} \qquad (2.17)$$

and relative ones:

$$\rho H_i = \rho\,(O_j, g_{ij}, w_{ij}) \qquad (2.10b)$$

$$V_j^* = \frac{1}{G_j} \sqrt{\sum_{i=1}^{m} \frac{(g_{ij} - G_j)^2}{m}} = \frac{V_j}{G_j} \qquad (2.18)$$

$$V_{Li} = \frac{1}{G_i} \sqrt{\frac{1}{n} \sum_{i=1}^{n} W_{ij} \left(g_{ij} - O_j G_i\right)^2} \qquad (2.19)$$

Another group provides us with sector-by-sector information about balanced-unbalanced growth of each sector in relation to the overall economy. This group contains the following formulas:

$$V_{YLt'}^* = | g_i^{t'} - G^{t'} | \qquad (2.20)$$

$$V_{YNt'}^* = | g_i^{t'} - C_j G^{t'} | \qquad (2.21)$$

In this section, we will use only the interindustry tables to calculate the different ratios. All the formulas presented above enter into consideration with the sectoral and the overall rates of growth, and these refer to the overall economy and not simply to domestic production. So the use of the domestic tables does not make any sense in this framework. The sectoral and overall rates of growth are presented in Table 3.64.[8]

Formulas 2.10, 2.10b, 2.17, 2.18 and 2.19 were basically used for international comparisons, and they were used to compute correlation values for a set of countries between themselves and the overall rate

TABLE 3.64

Sectoral and Overall Rates of Growth
Portugal 16x16

Sectors (1)	Rate of Growth 60/65 (2)	Rate of Growth 60/70 (3)	Rate of Growth 60/74 (4)	Rate of Growth 65/70 (5)	Rate of Growth 65/74 (6)	Rate of Growth 70/74 (7)
1	2.216	1.270	.933	.333	.227	.094
2	3.750	4.750	6.532	5.760	8.110	11.122
3	5.629	6.252	6.736	6.878	7.356	7.957
4	8.754	8.139	10.282	7.526	11.139	15.827
5	4.985	4.435	4.490	3.888	4.217	4.629
6	9.140	9.381	7.759	9.624	7.000	3.808
7	8.395	10.254	9.413	12.146	9.983	7.338
8	7.806	7.952	8.330	8.097	8.623	9.284
9	31.569	10.942	8.361	-6.451	-2.714	2.167
10	9.780	10.383	9.815	10.990	9.835	8.408
11	8.504	8.105	7.046	7.708	6.244	4.442
12	9.371	9.930	9.712	10.491	9.901	9.169
13	9.896	7.678	8.258	5.505	7.358	9.719
14	5.240	6.292	5.699	7.354	5.955	4.233
15	4.683	7.569	8.251	10.535	10.286	9.976
16	4.665	5.124	5.526	5.584	6.007	6.537
Total Rate of Growth	6.4155	6.3627	6.4547	6.31	6.4766	6.6851

of growth from these countries, and to observe the characteristics of that correlation value, to test the Hirschman hypothesis.

In the absence of values for those formulas for other countries, at the same sectoral disaggregation level, an analysis like that of Yotopoulos and Nugent [1973] can not be made. However, using the backward interindustry index (2.29), BII, and six different time periods for the 1960-1974 period, we have the following results for the above formulas:

TABLE 3.65

Hirschman Compliance Indexes
Portugal 16x16

	60/65		60/70		60/74	
	4.10	4.10B	4.10	4.10B	4.10	4.10B
1959 BII	.31	.31	.34	.28	.34	.32
1964 BII	-	-	-	-	-	-
1970 BII	-	-	-	-	-	-
	65/70		**65/74**		**70/74**	
	4.10	**4.10B**	**4.10**	**4.10B**	**4.10**	**4.10B**
1959 BII	-	-	-	-	-	-
1964 BII	.02	.17	.01	.24	-	-
1970 BII	-	-	-	-	.05	.23

For the Hirschman compliance indexes 2.10 and 2.10b, correlation values are positive but insignificant. No conclusion can be made in the absence of a strong correlation value between the sectoral rates of growth and the backward interindustry index for any of the periods in consideration.

TABLE 3.66

Sectoral "Variance" Measures
Portugal 16x16

Periods	V_j (4.17)	V_j^* (4.18)	V_{ii} (4.19)
60/65	6.7215	1.0477	.70
60/70	2.7366	0.4301	.44
60/74	2.4603	0.3812	.42
65/70	4.4456	0.7045	.33
65/74	3.6215	0.5592	.38
70/74	3.7803	0.5611	.56

Different "variance" measures were presented in 2.17, 2.18 and 2.19. Again, the only conclusion we can make is that the greater the time gap between the years, the smaller are in general those variance values, showing that the response to high linkages is not a short-term one, but rather takes 10 to 15 years to produce effect.

The analysis of the results of 2.20 shows how the different rates of growth of the sectors behave in relation to the overall rate of growth of the economy. We classified those deviations according to the following classification:

more than 5 percent $>$very high

from +1 percent $>$ high $>$+ 5 percent

from −1 percent $>$ normal $>$+1 percent

from −5 percent $>$ low $>$−1 percent

very low $>$−5 percent

TABLE 3.67
Absolute Deviations of the Sectoral Rates of Growth
From the Overall Rates of Growth
Portugal 16 x 16

	1960/65	1960/70	1960/74	1965/70	1965/74	1970/74
1	low	very low	very low	very low	very low	very low
2	low	low	normal	normal	high	high
3	normal	normal	normal	normal	normal	high
4	high	high	high	high	high	very high
5	low	low	low	low	low	low
6	high	high	high	high	normal	low
7	high	high	high	very high	high	normal
8	high	high	high	high	high	high
9	very high	high	high	very low	very low	low
10	high	high	high	high	high	high
11	high	high	normal	high	normal	low
12	high	high	high	high	high	high
13	high	high	high	normal	normal	high
14	low	normal	normal	high	normal	low
15	low	high	high	high	high	high
16	low	low	normal	normal	normal	normal

The analysis of the fourth column (1960-74) in Table 3.67 shows the following percentages for the five different categories:

Very low - 1 sector (1 - Agriculture), 6 percent of the total.

Low - 1 sector (5 - Wood, Cork and Furniture), 6 percent.

Normal - 5 sectors (2 - Mining and Quarrying, 3 - Food Processing, Beverages and Tobacco, 11 - Other Manufacturing, 14 - Trade and 16 - Other Services), 31 percent.

High - 9 sectors (4 - Textiles, Apparel, Leather and Shoes, 6 - Pulp Paper and Paper, 7 - Chemicals, Petroleum and Coal Products, 8 - Non Metallic Mineral Products, 9 - Basic Metals, 10 - Machinery, Transport Equipment, Naval Construction and Repairs, 12 - Electricity, Water and Gas, 13 - Public and Private Construction, and

14 - Transport and Communications), 56 percent.

Very High - no sectors, 0 percent

The results given above are not surprising. The manufacturing sectors, as we would expect, exhibit higher rates of growth than the national average, and Sector 1 - Agriculture, which supplies an important share in the gross output composition, is the only one with a very low rate of growth, as was already expected.

3.7 Brief Conclusions

This chapter presented a detailed empirical analysis of the linkage framework. Key sectors have been defined according to the output, income and employment linkages in their several versions. The extension of the linkage framework to income and employment terms was empirically justified. The tests performed at the 16x16 aggregation level showed that a key sector defined in terms of output may not be a key sector in terms of income or employment.

Also illustrated were the advantages of using several different versions of the linkage definition: absolute versus relative, net versus unnetted, domestic versus interindustry, and weighted versus unweighted. The comparisons give a broad and rigorous picture of each sector. This is very important for policy making considerations. Key sectors were presented and discussed in overall terms in Section 3.5. In the last section, the balanced-unbalanced question was investigated using Portuguese data.

FOOTNOTES

Chapter 3

[1] Carter [1967] already noted this characteristic of the constant technological structure of the economy over time, despite the extraordinary degree of technological progress in the last decades.

[2] That is the reason why Sectors 2 and 9 in Figure 3-4 show values greater than one for the forward linkage indicator.

[3] See Parikh [1979].

[4] For analytical discussion of the coefficient of interdependence, see page 56.

[5] See Section 2.2 page 60, for this discussion.

[6] In fact, Sector 7 does not appear in the eight lowest sectors for the column measure for the domestic case, only because it occupies the ninth position.

[7] See Bourque [1971] and Conway [1975].

[8] The basic source of the data was the United Nations [1977], United Nations [1978], and United Nations [1979].

CHAPTER 4

APPLICATIONS TO THE PORTUGUESE ECONOMY.

THE 60x60 LEVEL OF AGGREGATION.

In Chapter 3, the relatively high level of aggregation did not allow a detailed sectoral analysis. In this chapter, we will use a much more disaggregated set of data, using however the same framework and maintaining the same general structure of the last chapter.

Unfortunately, only two tables (for 1970 and 1974) are available, and so a complete comparison of results of the two different levels of aggregation is not possible. The direct linkage analysis is presented in Section 4.1. In Sections 4.2 through 4.4 output, income and employment linkage versions and key sectors are presented. Section 4.5 contains a detailed overall analysis. In Section 4.6, a brief conclusion is made.

4.1 Direct Linkage Analysis

A graphical analysis of the direct linkages indicators, as presented in the last chapter, is not made here since we have tables for only two different years.

In Table 4.1 correlation values between the linkage indicators are presented. As in the 16x16 disaggregation level, the interindustry indicators show a higher degree of correlation than the domestic ones. Comparing the two levels of disaggregation, higher

TABLE 4.1

Correlation Values
Direct Linkages

Portugal

	Backward Linkage		Forward Linkage	
	Domestic	Interindustry	Domestic	Interindustry
60x60	.78	.89	.93	.90
16x16	.88	.96	.94	.96

correlation is observed on the 16x16 level. The aggregation of tables could be responsible for that behavior. However, for the domestic tables, higher correlation is observed in the 60x60 case, showing that aggregation in this case does not function as an "averaging" process. Domestic tables are more sensitive, especially in countries like Portugal, where in general one-third of the GNP has some import composition. In Tables 4.2, 4.3, 4.4 and 4.5, the direct linkage indicators are presented, as calculated from formulas 2.28, 2.38, 2.33 and 2.43.

Before proceeding to Section 4.2, we introduce the sectors contained in the 60x60 aggregation level:

1 - Agriculture

2 - Forestries

3 - Livestock

TABLE 4.2

Direct Backward Interindustry Linkage

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.254	45	.260	51	48.0	47
2	.050	59	.065	59	59.0	59
3	.414	41	.429	40	40.5	42
4	[illegible]	33	.542	31	32.0	33
5	.250	47	.293	49	48.0	48
6	[illegible]	49	.271	50	49.5	51
7	[illegible]	1	.879	5	3.0	1
8	.622	24	.342	7	15.5	15
9	.667	18	.622	22	20.0	18
10	.892	2	.812	8	5.0	6
11	[illegible]	3	.903	3	3.0	2
12	[illegible]	10	.862	6	8.0	7
13	[illegible]	34	.581	25	29.5	31
14	[illegible]	39	.524	35	37.0	39
15	[illegible]	15	.564	28	21.5	21
16	[illegible]	26	.541	32	29.0	30
17	[illegible]	7	.721	12	9.5	9
18	[illegible]	16	.714	13	14.5	12
19	[illegible]	29	.619	24	26.5	25
20	[illegible]	12	.741	11	11.5	10
21	[illegible]	19	.565	27	23.0	22
22	[illegible]	11	.709	14	12.5	11
23	[illegible]	30	.531	34	32.0	34
24	[illegible]	22	.634	16	19.0	17
25	[illegible]	25	.621	23	24.0	23
26	[illegible]	37	.466	39	38.0	40
27	[illegible]	14	.657	15	14.5	13
28	[illegible]	36	.577	26	31.0	32
29	[illegible]	13	.633	17	15.0	14
30	[illegible]	4	.896	4	4.0	5
31	[illegible]	5	.915	2	3.5	3
32	[illegible]	21	.622	21	21.0	20
33	[illegible]	20	.629	20	20.0	19
34	[illegible]	6	.942	1	3.5	4
35	[illegible]	28	.486	37	32.5	35
36	[illegible]	43	.771	10	26.5	26
37	[illegible]	50	.308	47	48.5	50
38	[illegible]	17	.631	18	17.5	16
39	[illegible]	8	.811	9	8.5	8
40	[illegible]	38	.631	19	28.5	28
41	[illegible]	27	.542	30	28.5	29
42	[illegible]	23	.542	29	26.0	24
43	[illegible]	40	.533	33	36.5	37
44	.777	9	.356	45	27.0	27
45	[illegible]	31	.394	42	36.5	38
46	.553	32	.430	38	35.0	36
47	[illegible]	48	.321	46	47.0	46
48	.175	55	.404	41	48.0	49
49	.336	44	.366	44	44.0	44
50	.115	57	.126	56	56.5	56
51	.299	46	.367	43	44.5	45
52	.518	35	.296	48	41.5	43
53	.385	42	.495	36	39.0	41
54	[illegible]	56	.109	58	57.0	57
55	.211	51	.211	53	52.0	52
56	.199	52	.160	55	53.5	54
57	[illegible]	54	.230	52	53.0	53
58	.173	53	.177	54	53.5	55
59	.114	58	.112	57	57.5	58
60	.000	60	.000	60	60.0	60

TABLE 4.3

Direct Forward Interindustry Linkage

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.643	23	.749	17	20.0	20
2	.933	10	.911	11	10.5	10
3	.744	18	.723	19	18.5	19
4	.306	39	.308	34	36.5	37
5	4.258	1	13.041	1	1.0	1
6	1.307	4	1.498	4	4.0	4
7	.201	44	.169	43	43.5	44
8	.082	51	.060	48	49.5	48
9	.007	56	.120	45	50.5	51
10	.467	30	.861	12	21.0	21
11	1.019	8	.782	15	11.5	11
12	.429	35	.273	37	36.0	36
13	.046	53	.015	55	54.0	56
14	.000	58	.001	58	58.0	58
15	.923	11	1.004	7	9.0	7
16	.736	20	.581	22	21.0	22
17	.472	28	.417	29	28.5	27
18	.056	52	.043	50	51.0	53
19	.100	49	.031	52	50.5	52
20	.738	19	.840	13	16.0	16
21	.688	21	.573	24	22.5	23
22	.474	27	.300	35	31.0	30
23	.044	54	.169	44	49.0	47
24	.302	41	.267	39	40.0	39
25	1.071	6	1.005	6	6.0	6
26	.470	29	.355	32	30.5	29
27	.527	25	.424	27	26.0	26
28	.762	15	.638	21	18.0	18
29	1.296	5	1.441	5	5.0	5
30	.134	47	.025	53	50.0	50
31	.776	14	.918	10	12.0	12
32	.922	12	.997	8	10.0	9
33	.307	38	.415	30	34.0	35
34	1.068	7	.683	20	13.5	13
35	.685	22	.570	25	23.5	24
36	.966	9	.983	9	9.0	8
37	.810	13	.761	16	14.5	14
38	1.529	3	2.202	3	3.0	3
39	2.222	2	2.452	2	2.0	2
40	.755	16	.793	14	15.0	15
41	.433	33	.267	40	36.5	38
42	.465	31	.294	36	33.5	34
43	.419	36	.043	49	42.5	43
44	.305	40	.195	42	41.0	41
45	.447	32	.363	31	31.5	32
46	.035	55	.033	51	53.0	55
47	.750	17	.746	18	17.5	17
48	.210	43	.213	41	42.0	42
49	.432	34	.422	28	31.0	31
50	.373	37	.465	26	31.5	33
51	.126	48	.114	46	47.0	45
52	.156	46	.001	57	51.5	54
53	.168	45	.020	54	49.5	49
54	.496	26	.353	33	29.5	28
55	.096	50	.110	47	48.5	46
56	.002	57	.002	56	56.5	57
57	.000	59	.000	59	59.0	59
58	.257	42	.271	38	40.0	40
59	.590	24	.575	23	23.5	25
60	.000	60	.000	60	60.0	60

TABLE 4.4

Direct Backward Domestic Linkage

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.329	37	.229	45	41.0	44
2	.047	59	.062	59	59.0	59
3	.359	32	.418	18	25.0	25
4	.477	22	.489	13	17.5	16
5	.220	46	.257	41	43.5	46
6	.201	47	.230	43	45.0	47
7	.914	1	.855	2	1.5	1
8	.611	8	.822	3	5.5	4
9	.651	4	.604	7	5.5	5
10	.540	13	.328	28	20.5	21
11	.608	9	.400	21	15.0	12
12	.614	6	.434	14	10.0	8
13	.518	15	.566	9	12.0	9
14	.094	58	.096	58	58.0	58
15	.572	11	.378	23	17.0	15
16	.356	34	.291	35	34.5	33
17	.481	20	.418	17	18.5	18
18	.614	7	.598	8	7.5	7
19	.542	12	.510	12	12.0	10
20	.473	23	.395	22	22.5	22
21	.519	14	.372	24	19.0	19
22	.717	3	.700	5	4.0	3
23	.446	27	.369	26	26.5	26
24	.639	5	.614	6	5.5	6
25	.484	19	.524	10	14.5	11
26	.401	30	.289	37	33.5	32
27	.484	18	.320	30	24.0	24
28	.261	40	.179	51	45.5	49
29	.584	10	.400	20	15.0	13
30	.809	2	.886	1	1.5	2
31	.447	26	.195	48	37.0	38
32	.308	39	.299	34	36.5	36
33	.358	33	.317	32	32.5	31
34	.173	52	.104	57	54.5	54
35	.515	16	.423	16	16.0	14
36	.258	41	.764	4	22.5	23
37	.180	50	.265	40	45.0	48
38	.468	24	.191	50	37.0	39
39	.427	28	.523	11	19.5	20
40	.253	42	.318	31	36.5	37
41	.344	36	.268	39	37.5	40
42	.377	31	.287	38	34.5	34
43	.405	29	.321	29	29.0	27
44	.478	21	.241	42	31.5	30
45	.328	38	.209	46	42.0	45
46	.500	17	.416	19	18.0	17
47	.233	44	.289	36	40.0	43
48	.164	54	.371	25	39.5	42
49	.348	35	.356	27	31.0	29
50	.107	57	.122	54	55.5	55
51	.230	45	.308	33	39.0	41
52	.461	25	.207	47	36.0	35
53	.242	43	.425	15	29.0	28
54	.143	55	.105	56	55.5	56
55	.198	48	.195	49	48.5	51
56	.166	53	.137	53	53.0	53
57	.182	49	.229	44	46.5	50
58	.174	51	.145	52	51.5	52
59	.110	56	.109	55	55.5	57
60	.000	60	.000	60	60.0	60

TABLE 4.5

Direct Forward Domestic Linkage

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (mean)	Rank Order
1	.391	30	.336	29	29.5	31
2	.841	9	.797	8	8.5	8
3	.696	13	.694	14	13.5	13
4	.227	39	.285	32	35.5	34
5	.372	32	.512	20	26.0	24
6	.524	22	.839	6	14.0	15
7	.159	43	.121	42	42.5	42
8	.080	50	.058	48	49.0	49
9	.001	57	.112	44	50.5	50
10	.358	33	.443	23	28.0	29
11	.978	1	.759	10	5.5	5
12	.353	34	.130	41	37.5	37
13	.040	52	.012	53	52.5	54
14	.000	58	.001	57	57.5	58
15	.880	6	.934	4	5.0	4
16	.616	19	.404	26	22.5	21
17	.424	27	.351	28	27.5	27
18	.047	51	.036	50	50.5	51
19	.099	48	.016	54	51.0	52
20	.651	15	.726	12	13.5	14
21	.649	16	.527	19	17.5	18
22	.474	23	.293	31	27.0	26
23	.038	53	.159	38	45.5	46
24	.232	38	.227	36	37.0	35
25	.901	4	.814	7	5.5	6
26	.447	25	.304	30	27.5	28
27	.451	24	.255	35	29.5	32
28	.619	18	.485	21	19.5	20
29	.872	7	.637	15	11.0	9
30	.132	44	.023	52	48.0	48
31	.689	14	.739	9	11.5	11
32	.852	8	.893	5	6.5	7
33	.211	40	.263	34	37.0	36
34	.708	12	.555	18	15.0	16
35	.579	21	.434	24	22.5	22
36	.963	2	.979	3	2.5	1
37	.753	10	.702	13	11.5	12
38	.930	3	.994	2	2.5	2
39	.889	5	1.193	1	3.0	3
40	.625	17	.572	17	17.0	17
41	.288	35	.076	47	41.0	41
42	.194	42	.082	46	44.0	44
43	.418	28	.043	49	38.5	39
44	.107	47	.134	40	43.5	43
45	.275	36	.143	39	37.5	38
46	.035	54	.033	51	52.5	55
47	.749	11	.746	11	11.0	10
48	.210	41	.213	37	39.0	40
49	.432	26	.422	25	25.5	23
50	.373	31	.465	22	26.5	25
51	.126	45	.114	43	44.0	45
52	.114	46	.001	56	51.0	53
53	.034	55	.000	58	56.5	57
54	.409	29	.353	27	28.0	30
55	.096	49	.110	45	47.0	47
56	.002	56	.002	55	55.5	56
57	.000	59	.000	59	59.0	59
58	.255	37	.269	33	35.0	33
59	.591	20	.575	16	18.0	19
60	.000	60	.000	60	60.0	60

4 - Fisheries and Fishery Products

5 - Petroleum, Coal and Metal Mining

6 - Non Metal Mining and Quarrying

7 - Meat and Meat Products

8 - Milk, Butter and Cheese Products

9 - Canned Fruits

10 - Animal and Vegetable Food Oils

11 - Prepared Feed for Animals

12 - Other Food Products

13 - Beverages

14 - Tobacco Manufacturers

15 - Wool and Wool Mixed Textiles

16 - Cotton and Cotton Mixed Textiles

17 - Fiber Textiles

18 - Apparel

19 - Footwear

20 - Leather Tanning and Industrial Leather Products

21 - Wood

22 - Cork

23 - Furniture and Mattress Industry

24 - Paper Pulp

25 - Cardboard and Cardboard Articles

26 - Printing and Publishing

27 - Rubber and Rubber Products

28 - Plastic Materials and Products

29 - Basic Chemical Products

30 - Resins

31 - Non Food Oils

32 - Paints and Allied Products

33 - Other Chemicals

34 - Petroleum and Coal Products

35 - Glass and Glass Products

36 - Cement

37 - Other Non Metal Minerals

38 - Primary Iron and Steel Manufacturing

39 - Primary Non Ferrous Metals Manufacturing

40 - Metal Products

41 - Non Electrical Machinery

42 - Electrical Machinery and Products

43 - Shipbuilding and Repairing

44 - Transportatin Equipment

45 - Miscellaneous Manufacturing

46 - Public and Private Construction

47 - Electricity

48 - Gas

49 - Water and Sanitary Services

50 - Trade

51 - Road and Railroad Transportation

52 - Water Transportation

53 - Air Transportation

54 - Communications

55 - Hotels, Restaurants and Coffeeshops

56 - Medical and Educational Services

57 - Housing Services

58 - Other Services

59 - Finance, Insurance and Real Estate

60 - Government

4.2 Key Sectors from an Output Linkage Viewpoint

In the last chapter, Section 3.2, we analysed the methods proposed thus far to classify the key sectors of an economy. We also explained the particular methodology preferred for analysis of the Portuguese economy. In what follows, we use averages; that is, for each indicator two rank ordering classifications (one for each year) were obtained. Then we calculate their average and obtain a new rank ordering from that average.

Tables 4.6 to 4.21 refer to the different chosen output linkage indicators in domestic and in interindustry terms. The tables were obtained from the following formulas:

Interindustry ones: 2.31, 2.41, 2.32, 2.42, 2.29, 2.39, 2.30, and 2.40

Domestic ones: 2.36, 2.46, 2.37, 2.47, 2.34, 2.44, 2.35, and 2.45.

TABLE 4.6

Backward Weighted Interindustry Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (mean)	Rank Order
1	2.168	4	1.890	5	4.5	4
2	.285	59	.435	55	57.0	56
3	1.573	11	1.596	10	10.5	10
4	.921	25	.786	33	29.0	26
5	.292	58	.315	60	59.0	60
6	.316	54	.404	56	55.0	55
7	2.182	3	2.155	3	3.0	2
8	1.000	24	1.274	16	20.0	20
9	1.304	16	1.139	17	16.5	17
10	1.738	10	1.476	12	11.0	11
11	2.041	5	1.867	7	6.0	6
12	2.824	1	2.371	1	1.0	1
13	1.209	17	1.324	15	16.0	16
14	1.010	23	.955	24	23.5	23
15	1.143	21	.978	23	22.0	22
16	1.805	8	1.705	9	8.5	9
17	1.500	12	1.325	14	13.0	13
18	2.023	6	1.858	8	7.0	8
19	.812	31	.868	28	29.5	27
20	1.367	15	1.345	13	14.0	14
21	.686	38	.671	43	40.5	39
22	.589	47	.672	42	44.5	46
23	.682	39	.612	49	44.0	45
24	.611	44	.642	47	45.5	48
25	.687	37	.764	36	36.5	36
26	.617	42	.654	44	43.0	41
27	1.147	20	.997	22	21.0	21
28	.755	32	.833	30	31.0	31
29	1.393	13	1.102	18	15.5	15
30	.513	51	.654	45	48.0	50
31	1.384	14	1.567	11	12.5	12
32	.875	27	.738	37	32.0	32
33	1.168	19	1.053	19	19.0	18
34	.670	40	1.036	21	30.5	29
35	.724	36	.608	50	43.0	42
36	.303	56	.774	34	45.0	47
37	.403	53	.576	52	52.5	53
38	.865	28	.695	39	33.5	33
39	.539	50	.620	48	49.0	52
40	.895	26	.913	25	25.5	24
41	1.137	22	.864	29	25.5	25
42	1.171	18	1.040	20	19.0	19
43	.610	45	.689	40	42.5	40
44	1.868	7	1.879	6	6.5	7
45	.736	35	.593	51	43.0	43
46	1.745	9	2.314	2	5.5	5
47	.592	46	.689	41	43.5	44
48	.149	60	.361	57	58.5	59
49	.303	57	.345	58	57.5	58
50	2.368	2	2.083	4	3.0	3
51	.738	33	.912	27	30.0	28
52	.613	43	.547	53	48.0	51
53	.559	49	.913	26	37.5	38
54	.304	55	.336	59	57.0	57
55	.457	52	.446	54	53.0	54
56	.653	41	.798	32	36.5	37
57	.570	48	.649	46	47.0	49
58	.837	29	.714	38	33.5	34
59	.737	34	.765	35	34.5	35
60	.834	30	.815	31	30.5	30

TABLE 4.7

Forward Weighted Interindustry Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	2.253	6	1.628	7	6.5	7
2	.797	26	.637	27	26.5	27
3	1.216	16	.960	20	18.0	19
4	.483	41	.329	43	42.0	43
5	7.270	1	16.276	1	1.0	1
6	1.938	7	2.057	4	5.5	5
7	.711	32	.564	32	32.0	32
8	.128	58	.069	59	58.5	59
9	.081	60	.139	55	57.5	58
10	.349	46	.814	21	33.5	34
11	1.408	11	.961	19	15.0	13
12	1.472	10	.690	26	18.0	20
13	.212	53	.215	50	51.5	51
14	.096	59	.064	60	59.5	60
15	1.167	18	.789	22	20.0	21
16	1.496	9	.970	18	13.5	12
17	.487	40	.342	42	41.0	41
18	.876	23	.614	29	26.0	24
19	.182	54	.085	58	56.0	55
20	.325	48	.213	51	49.5	49
21	.793	27	.715	25	26.0	25
22	.414	44	.241	47	45.5	46
23	.171	55	.279	46	50.5	50
24	.542	38	.393	41	39.5	39
25	1.407	12	1.047	14	13.0	10
26	.657	33	.447	37	35.0	36
27	.408	45	.304	45	45.0	45
28	.899	22	.742	23	22.5	23
29	2.995	3	2.046	5	4.0	4
30	.138	56	.088	57	56.5	56
31	.714	31	.723	24	27.5	28
32	.912	21	1.057	13	17.0	18
33	.597	37	.578	31	34.0	35
34	1.649	8	1.077	12	10.0	8
35	.602	36	.443	38	37.0	38
36	1.223	15	1.335	8	11.5	9
37	1.103	20	1.174	10	15.0	14
38	2.508	4	3.235	2	3.0	3
39	3.720	2	2.936	3	2.5	2
40	1.135	19	1.122	11	15.0	15
41	.875	25	.493	35	30.0	29
42	.654	35	.492	36	35.5	37
43	.296	50	.180	53	51.5	52
44	.755	29	1.036	15	22.0	22
45	.431	42	.326	44	43.0	44
46	1.182	17	1.316	9	13.0	11
47	1.301	13	1.009	17	15.0	16
48	.129	57	.089	56	56.5	57
49	.655	34	.598	30	32.0	33
50	2.382	5	1.726	6	5.5	6
51	.538	39	.404	40	39.5	40
52	.293	51	.161	54	52.5	54
53	.213	52	.182	52	52.0	53
54	.785	28	.521	34	31.0	30
55	.317	49	.235	48	48.5	48
56	.418	43	.440	39	41.0	42
57	.339	47	.233	49	48.0	47
58	.896	24	.621	28	26.0	26
59	1.261	14	1.013	16	15.0	17
60	.735	30	.549	33	31.5	31

TABLE 4.8

Backward Net Weighted Interindustry Index
Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.575	39	.410	52	45.5	45
2	.086	58	.131	58	58.0	58
3	1.266	17	1.308	14	15.5	14
4	.782	30	.742	35	32.5	32
5	.430	47	.473	50	48.5	48
6	.456	45	.589	44	44.5	44
7	2.534	3	2.383	4	3.5	3
8	1.501	15	2.072	7	11.0	11
9	2.090	8	1.703	11	9.5	9
10	2.765	2	2.348	5	3.5	4
11	3.172	1	2.714	1	1.0	1
12	2.155	7	2.466	3	5.0	5
13	1.696	11	1.768	10	10.5	10
14	1.552	13	1.503	13	13.0	13
15	1.191	20	1.266	16	18.0	17
16	1.255	18	1.257	17	17.5	16
17	2.251	5	1.892	8	6.5	7
18	1.874	9	1.788	9	9.0	8
19	1.138	21	1.297	15	18.0	18
20	2.193	6	2.232	6	6.0	6
21	.748	32	.678	40	36.0	37
22	.508	43	.635	42	42.5	42
23	.946	25	.831	29	27.0	26
24	.831	28	.840	28	28.0	27
25	.722	35	.743	34	34.5	35
26	.718	36	.701	38	37.0	40
27	1.669	12	1.602	12	12.0	12
28	1.100	22	1.079	22	22.0	21
29	.875	26	.881	25	25.5	24
30	.800	29	.978	23	26.0	25
31	2.286	4	2.675	2	3.0	2
32	1.416	16	1.164	20	18.0	19
33	1.530	14	1.220	18	16.0	15
34	.703	37	.705	37	37.0	41
35	1.048	23	.851	27	25.0	23
36	.362	48	1.192	19	33.5	34
37	.335	49	.484	49	49.0	50
38	.457	44	.456	51	47.5	47
39	.680	38	.768	31	34.5	36
40	.723	34	.858	26	30.0	28
41	.847	27	.755	33	30.0	29
42	1.225	19	.892	24	21.5	20
43	.768	31	.765	32	31.5	31
44	1.870	10	.720	36	23.0	22
45	.988	24	.649	41	32.5	33
46	.746	33	.680	39	36.0	38
47	.307	53	.528	47	50.0	52
48	.240	55	.623	43	49.0	51
49	.438	46	.526	48	47.0	46
50	.110	57	.141	57	57.0	57
51	.514	42	.825	30	36.0	39
52	.518	41	.540	45	43.0	43
53	.545	40	1.123	21	30.5	30
54	.192	56	.148	56	56.0	56
55	.321	50	.332	53	51.5	53
56	.310	52	.259	54	53.0	54
57	.319	51	.529	46	48.5	49
58	.248	54	.224	55	54.5	55
59	.057	59	.060	59	59.0	59
60	.000	60	.000	60	60.0	60

TABLE 4.9

Forward Weighted Interindustry Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.012	18	.709	21	17.5	19
2	.935	21	.554	22	21.5	21
3	.774	25	.547	23	24.0	23
4	.113	47	.121	40	43.5	42
5	11.474	1	22.825	1	1.0	1
6	3.002	5	2.827	4	4.5	5
7	.133	44	.043	47	45.5	47
8	.024	53	.013	52	52.5	52
9	.000	56	.039	48	52.0	51
10	.367	37	1.018	13	25.0	25
11	1.954	7	1.054	11	9.0	7
12	.137	43	.061	45	44.0	44
13	.022	54	.006	53	53.5	53
14	.000	57	.000	56	56.5	57
15	1.220	14	.869	16	15.0	14
16	.870	23	.430	28	25.5	26
17	.502	30	.252	35	32.5	32
18	.114	46	.073	43	44.5	45
19	.077	50	.000	57	53.5	54
20	.384	36	.235	37	36.5	37
21	.906	22	.737	19	20.5	20
22	.246	38	.047	46	42.0	41
23	.085	49	.263	34	41.5	40
24	.673	27	.392	29	28.0	28
25	1.857	8	1.150	10	9.0	8
26	.763	26	.389	30	28.0	29
27	.386	35	.351	31	33.0	34
28	1.262	13	.838	17	15.0	15
29	3.514	3	2.307	5	4.0	4
30	.151	42	.034	49	45.5	48
31	1.052	16	.982	14	15.0	16
32	1.372	12	1.418	7	9.5	9
33	.555	29	.477	27	28.0	30
34	2.250	6	.914	15	10.5	11
35	.795	24	.507	25	24.5	24
36	1.811	9	1.788	6	7.5	6
37	1.459	11	1.366	8	9.5	10
38	3.141	4	4.133	2	3.0	3
39	5.700	2	3.955	3	2.5	2
40	1.136	15	1.177	9	12.0	13
41	.486	31	.284	33	32.0	31
42	.395	34	.175	38	36.0	36
43	.240	39	.015	51	45.0	46
44	.103	48	.067	44	46.0	49
45	.458	32	.249	36	34.0	35
46	.042	51	.026	50	50.5	50
47	1.486	10	1.051	12	11.0	12
48	.190	41	.121	41	41.0	39
49	.971	20	.798	18	19.0	18
50	.560	28	.529	24	26.0	27
51	.240	40	.151	39	39.5	38
52	.028	52	.001	55	53.5	55
53	.000	58	.000	58	58.0	58
54	.977	19	.495	26	22.5	22
55	.124	45	.088	42	43.5	43
56	.003	55	.002	54	54.5	56
57	.000	59	.000	59	59.0	59
58	.453	33	.317	32	32.5	33
59	1.017	17	.730	20	18.5	17
60	.000	60	.000	60	60.0	60

TABLE 4.10

Backward Interindustry Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.692	42	1.492	50	46.0	46
2	1.085	59	1.132	59	59.0	59
3	1.981	35	1.986	32	33.5	35
4	2.104	28	2.096	27	27.5	27
5	1.456	46	1.563	48	47.0	48
6	1.413	48	1.477	51	49.5	50
7	2.990	2	2.816	3	2.5	2
8	2.221	22	2.710	4	13.0	10
9	2.137	27	2.017	30	28.5	29
10	2.742	6	2.369	14	10.0	7
11	2.913	4	2.676	5	4.5	4
12	2.694	7	2.640	6	6.5	5
13	1.847	40	1.878	38	39.0	38
14	1.828	41	1.831	39	40.0	42
15	2.616	8	2.132	24	16.0	17
16	2.071	29	1.935	34	31.5	31
17	2.572	11	2.327	17	14.0	12
18	2.445	15	2.380	13	14.0	13
19	2.344	17	2.482	10	13.5	11
20	2.915	3	2.872	2	2.5	3
21	1.931	39	1.794	40	39.5	41
22	2.254	21	2.129	25	23.0	24
23	2.157	26	2.027	29	27.5	28
24	1.934	38	1.915	36	37.0	37
25	2.203	23	2.284	19	21.0	20
26	2.038	32	2.000	31	31.5	32
27	2.431	16	2.211	21	18.5	19
28	2.180	25	2.269	20	22.5	23
29	2.522	12	2.297	18	15.0	15
30	1.956	36	2.049	28	32.0	33
31	2.771	5	2.495	8	6.5	6
32	2.485	14	2.367	15	14.5	14
33	2.495	13	2.403	12	12.5	8
34	2.260	19	2.476	11	15.0	16
35	2.068	30	1.916	35	32.5	34
36	1.555	44	2.541	7	25.5	25
37	1.365	50	1.595	46	48.0	49
38	2.589	9	2.341	16	12.5	9
39	3.005	1	2.957	1	1.0	1
40	2.183	24	2.494	9	16.5	18
41	2.256	20	2.191	22	21.0	21
42	2.293	18	2.115	26	22.0	22
43	2.062	31	2.156	23	27.0	26
44	2.581	10	1.573	47	28.5	30
45	1.951	37	1.700	41	39.0	39
46	2.009	34	1.966	33	33.5	36
47	1.413	49	1.637	43	46.0	47
48	1.236	56	1.547	49	52.5	52
49	1.520	45	1.623	44	44.5	44
50	1.189	57	1.210	56	56.5	57
51	1.451	47	1.660	42	44.5	45
52	2.034	33	1.611	45	39.0	40
53	1.675	43	1.883	37	40.0	43
54	1.267	54	1.187	57	55.5	56
55	1.350	51	1.381	52	51.5	51
56	1.340	52	1.277	55	53.5	53
57	1.266	55	1.351	53	54.0	55
58	1.321	53	1.290	54	53.5	54
59	1.150	58	1.149	58	58.0	58
60	1.000	60	1.000	60	60.0	60

TABLE 4.11

Forward Interindustry Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	2.276	14	2.361	13	13.5	13
2	2.735	10	2.399	12	11.0	11
3	2.090	20	1.947	22	21.0	22
4	1.526	39	1.551	33	36.0	37
5	16.586	1	39.747	1	1.0	1
6	4.446	5	4.696	5	5.0	5
7	1.410	43	1.255	42	42.5	42
8	1.098	52	1.071	49	50.5	50
9	1.008	56	1.153	46	51.0	51
10	1.912	25	3.098	6	15.5	16
11	3.129	8	2.522	11	9.5	9
12	1.824	31	1.427	37	34.0	33
13	1.061	53	1.021	54	53.5	55
14	1.001	58	1.001	58	58.0	58
15	2.600	11	2.341	14	12.5	12
16	2.107	19	1.825	25	22.0	23
17	1.696	35	1.635	30	32.5	31
18	1.120	51	1.121	48	49.5	49
19	1.129	50	1.032	53	51.5	53
20	1.996	23	2.047	21	22.0	24
21	1.883	27	1.712	29	28.0	27
22	1.832	30	1.423	38	34.0	34
23	1.060	54	1.234	44	49.0	48
24	1.952	24	1.813	26	25.0	25
25	3.155	7	3.045	7	7.0	6
26	1.720	34	1.537	34	34.0	35
27	1.834	29	1.576	32	30.5	29
28	2.427	13	2.166	16	14.5	14
29	5.276	4	5.075	4	4.0	4
30	1.242	46	1.054	51	48.5	47
31	2.448	12	2.751	9	10.5	10
32	2.274	15	2.245	15	15.0	15
33	1.587	38	1.772	28	33.0	32
34	3.510	6	2.558	10	8.0	7
35	2.191	17	1.911	23	20.0	21
36	2.038	22	2.147	17	19.5	19
37	1.903	26	1.828	24	25.0	26
38	5.620	3	7.293	3	3.0	3
39	9.851	2	7.803	2	2.0	2
40	2.218	16	2.084	20	18.0	17
41	1.735	33	1.364	40	36.5	39
42	1.781	32	1.422	39	35.5	36
43	1.521	40	1.056	50	45.0	44
44	1.450	41	1.255	43	42.0	41
45	1.605	37	1.465	35	36.0	38
46	1.056	55	1.053	52	53.5	56
47	2.800	9	2.772	8	8.5	8
48	1.290	44	1.281	41	42.5	43
49	2.068	21	2.145	18	19.5	20
50	1.690	36	1.792	27	31.5	30
51	1.243	45	1.220	45	45.0	45
52	1.185	48	1.002	57	52.5	54
53	1.202	47	1.020	55	51.0	52
54	1.874	28	1.631	31	29.5	28
55	1.135	49	1.153	47	48.0	46
56	1.003	57	1.003	56	56.5	57
57	1.000	59	1.000	59	59.0	59
58	1.433	42	1.437	36	39.0	40
59	2.128	18	2.137	19	18.5	18
60	1.000	60	1.000	60	60.0	60

TABLE 4.12

Backward Net Interindustry Index
Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.519	44	.410	51	47.5	47
2	.081	58	.131	58	58.0	58
3	.928	28	.976	25	26.5	27
4	.733	37	.769	35	36.0	35
5	.439	47	.500	48	47.5	48
6	.386	48	.474	49	48.5	49
7	1.853	2	1.699	2	2.0	1
8	1.142	15	1.660	4	9.5	8
9	1.129	17	.930	27	22.0	21
10	1.490	5	1.216	15	10.0	9
11	1.872	1	1.673	3	2.0	2
12	1.069	20	1.334	13	16.5	15
13	.815	34	.868	31	32.5	32
14	.827	32	.830	34	33.0	33
15	1.071	19	.982	24	21.5	20
16	.724	38	.756	37	37.5	39
17	1.342	9	1.080	20	14.5	14
18	1.437	7	1.369	11	9.0	5
19	1.293	10	1.450	8	9.0	6
20	1.765	3	1.769	1	2.0	3
21	.819	33	.707	39	36.0	36
22	.653	40	.754	38	39.0	42
23	1.156	12	1.027	22	17.0	16
24	.933	27	.913	28	27.5	28
25	.873	30	.878	30	30.0	30
26	1.016	22	.984	23	22.5	22
27	1.140	16	1.159	18	17.0	17
28	1.092	18	1.160	17	17.5	18
29	.706	39	.846	33	36.0	37
30	.956	25	1.049	21	23.0	23
31	1.685	4	1.436	9	6.5	4
32	1.478	6	1.357	12	9.0	7
33	1.434	8	1.314	14	11.0	11
34	1.153	14	1.413	10	12.0	12
35	.784	35	.760	36	35.5	34
36	.537	42	1.541	6	24.0	24
37	.362	49	.584	45	47.0	46
38	.592	41	.635	41	41.0	43
39	.754	36	1.186	16	26.0	26
40	1.154	13	1.478	7	10.0	10
41	1.007	23	1.105	19	21.0	19
42	.937	26	.894	29	27.5	29
43	1.062	21	1.556	5	13.0	13
44	1.253	11	.439	50	30.5	31
45	.841	31	.610	44	37.5	40
46	1.007	24	.964	26	25.0	25
47	.315	52	.538	47	49.5	50
48	.233	56	.544	46	51.0	51
49	.520	43	.622	42	42.5	44
50	.170	57	.192	56	56.5	57
51	.449	46	.657	40	43.0	45
52	.876	29	.611	43	36.0	38
53	.473	45	.862	32	38.5	41
54	.260	55	.181	57	56.0	56
55	.348	50	.379	52	51.0	52
56	.340	51	.277	54	52.5	53
57	.266	54	.351	53	53.5	54
58	.297	53	.277	55	54.0	55
59	.075	59	.075	59	59.0	59
60	.000	60	.000	60	60.0	60

TABLE 4.13

Forward Net Interindustry Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.103	15	1.279	13	14.0	13
2	1.731	9	1.399	12	10.5	11
3	1.030	19	.937	22	20.5	21
4	.155	45	.224	39	42.0	42
5	15.569	1	38.684	1	1.0	1
6	3.419	5	3.693	4	4.5	4
7	.273	40	.139	43	41.5	41
8	.020	54	.021	52	53.0	53
9	.000	56	.066	47	51.5	51
10	.660	30	1.945	6	18.0	18
11	2.080	7	1.520	10	8.5	6
12	.198	44	.120	45	44.5	45
13	.028	52	.011	53	52.5	52
14	.000	57	.000	56	56.5	57
15	1.055	17	1.191	15	16.0	14
16	.760	27	.646	28	27.5	28
17	.465	36	.387	34	35.0	34
18	.112	48	.109	46	47.0	48
19	.077	49	.000	57	53.0	54
20	.946	25	.945	21	23.0	23
21	.771	26	.625	30	28.0	29
22	.232	43	.048	51	47.0	49
23	.059	50	.233	38	44.0	43
24	.951	21	.811	24	22.5	22
25	1.826	8	1.638	9	8.5	7
26	.698	28	.520	32	30.0	31
27	.594	31	.525	31	31.0	32
28	1.330	12	1.057	20	16.0	15
29	3.460	4	3.624	5	4.5	5
30	.242	41	.054	49	45.0	46
31	1.361	11	1.691	7	9.0	9
32	1.266	13	1.234	14	13.5	12
33	.526	32	.682	27	29.5	30
34	2.403	6	1.496	11	8.5	8
35	.907	22	.755	26	24.0	25
36	1.019	20	1.146	16	18.0	19
37	.900	23	.817	23	23.0	24
38	3.623	3	5.597	3	3.0	3
39	7.600	2	6.032	2	2.0	2
40	1.189	14	1.068	18	16.0	16
41	.487	35	.278	36	35.5	35
42	.425	37	.201	41	39.0	38
43	.521	33	.056	48	40.5	39
44	.122	47	.121	44	45.5	47
45	.495	34	.375	35	34.5	33
46	.055	51	.052	50	50.5	50
47	1.702	10	1.674	8	9.0	10
48	.287	39	.278	37	38.0	37
49	1.068	16	1.144	17	16.5	17
50	.672	29	.775	25	27.0	27
51	.241	42	.217	40	41.0	40
52	.027	53	.002	55	54.0	55
53	.000	58	.000	58	58.0	58
54	.967	24	.626	29	26.5	26
55	.134	46	.151	42	44.0	44
56	.003	55	.003	54	54.5	56
57	.000	59	.000	59	59.0	59
58	.409	38	.424	33	35.5	36
59	1.054	18	1.063	19	18.5	20
60	.000	60	.000	60	60.0	60

TABLE 4.14

Backward Weighted Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	2.734	3	2.490	4	3.5	2
2	.364	53	.579	45	49.0	50
3	1.711	9	1.740	8	8.5	8
4	.987	22	.889	23	22.5	20
5	.306	58	.328	58	58.0	59
6	.326	57	.457	53	55.0	56
7	2.434	4	2.535	3	3.5	3
8	1.123	14	1.407	12	13.0	13
9	1.605	11	1.465	11	11.0	10
10	1.040	20	.545	49	34.5	34
11	1.761	7	1.098	15	11.0	11
12	2.905	2	1.834	7	4.5	5
13	1.509	13	1.734	9	11.0	12
14	.235	59	.228	60	59.5	60
15	1.097	15	.831	33	24.0	21
16	1.613	10	1.624	10	10.0	9
17	.957	24	.870	27	25.5	24
18	2.169	5	1.983	6	5.5	6
19	.774	32	.654	40	36.0	38
20	1.010	21	.775	36	28.5	26
21	.765	33	.747	37	35.0	37
22	.743	35	.878	24	29.5	27
23	.636	42	.556	46	44.0	47
24	.736	38	.794	35	36.5	39
25	.721	39	.856	30	34.5	35
26	.625	44	.616	43	43.5	46
27	.843	27	.550	48	37.5	40
28	.486	49	.470	52	50.5	51
29	1.523	12	1.093	16	14.0	14
30	.641	41	.870	28	34.5	36
31	.627	43	.231	59	51.0	52
32	.469	50	.429	56	53.0	53
33	.838	28	.845	32	30.0	28
34	.564	47	1.041	20	33.5	31
35	.828	29	.685	39	34.0	33
36	.334	56	.877	25	40.5	43
37	.464	51	.696	38	44.5	48
38	.803	30	.534	50	40.0	42
39	.352	55	.475	51	53.0	54
40	.880	26	.866	29	27.5	25
41	1.094	16	.821	34	25.0	23
42	1.085	18	1.027	21	19.5	16
43	.610	45	.639	41	43.0	45
44	1.732	8	2.342	5	6.5	7
45	.747	34	.629	42	38.0	41
46	2.143	6	3.024	1	3.5	4
47	.737	36	.852	31	33.5	32
48	.176	60	.451	54	57.0	58
49	.359	54	.394	57	55.5	57
50	3.083	1	2.849	2	1.5	1
51	.894	25	1.120	14	19.5	17
52	.670	40	.582	44	42.0	44
53	.565	46	1.074	17	31.5	29
54	.376	52	.446	55	53.5	55
55	.553	48	.551	47	47.5	49
56	.798	31	1.049	18	24.5	22
57	.737	37	.875	26	31.5	30
58	1.055	19	.933	22	20.5	18
59	.959	23	1.047	19	21.0	19
60	1.094	17	1.124	13	15.0	15

TABLE 4.15

Forward Weighted Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	2.790	2	2.318	4	3.0	2
2	.949	27	.944	27	27.0	27
3	1.689	11	1.690	10	10.5	10
4	.587	41	.530	41	41.0	40
5	.581	42	.834	31	36.5	37
6	.985	26	1.981	6	16.0	16
7	.997	25	.986	26	25.5	26
8	.181	56	.122	59	57.5	57
9	.118	60	.246	55	57.5	58
10	.345	51	.694	37	44.0	44
11	1.902	6	1.669	11	8.5	5
12	1.922	5	1.062	24	14.5	12
13	.304	52	.390	48	50.0	50
14	.142	59	.118	60	59.5	60
15	1.580	14	1.251	20	17.0	18
16	1.939	4	1.509	16	10.0	8
17	.623	38	.494	44	41.0	41
18	1.283	18	1.077	23	20.5	22
19	.265	54	.152	57	55.5	55
20	.376	50	.307	52	51.0	52
21	1.113	21	1.232	21	21.0	24
22	.589	40	.435	45	42.5	43
23	.238	55	.495	43	49.0	48
24	.558	43	.538	40	41.5	42
25	1.658	12	1.488	18	15.0	15
26	.895	30	.755	34	32.0	32
27	.452	46	.277	54	50.0	51
28	.913	29	.930	28	28.5	28
29	2.686	3	1.584	14	8.5	6
30	.174	57	.153	56	56.5	56
31	.829	32	.907	29	30.5	30
32	1.168	20	1.692	9	14.5	13
33	.705	35	.781	33	34.0	33
34	1.358	17	1.496	17	17.0	19
35	.646	36	.511	42	39.0	39
36	1.791	7	2.420	2	4.5	3
37	1.534	15	2.027	5	10.0	9
38	1.711	9	1.745	8	8.5	7
39	1.047	23	1.551	15	19.0	20
40	1.363	16	1.610	13	14.5	14
41	1.034	24	.557	39	31.5	31
42	.624	37	.657	38	37.5	38
43	.419	48	.329	50	49.0	49
44	.870	31	1.771	7	19.0	21
45	.445	47	.376	49	48.0	47
46	1.736	8	2.412	3	5.5	4
47	1.592	13	1.430	19	16.0	17
48	.174	58	.146	58	58.0	59
49	.720	34	.697	36	35.0	35
50	3.402	1	3.038	1	1.0	1
51	.761	33	.703	35	34.0	34
52	.411	49	.296	53	51.0	53
53	.271	53	.329	51	52.0	54
54	.917	28	.865	30	29.0	29
55	.463	45	.427	47	46.0	46
56	.615	39	.808	32	35.5	36
57	.499	44	.429	46	45.0	45
58	1.276	19	1.087	22	20.5	23
59	1.707	10	1.633	12	11.0	11
60	1.082	22	1.009	25	23.5	25

TABLE 4.16

Backward Net Weighted Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.731	34	.545	47	40.5	43
2	.117	58	.191	58	58.0	58
3	1.343	14	1.330	12	13.0	11
4	.880	28	.907	27	27.5	26
5	.530	44	.624	43	43.5	47
6	.547	43	.846	31	37.0	37
7	3.212	1	3.375	1	1.0	1
8	2.018	6	2.973	3	4.5	4
9	3.142	3	2.869	4	3.5	3
10	1.841	10	.840	32	21.0	19
11	3.172	2	1.542	11	6.5	6
12	2.243	5	1.639	8	6.5	7
13	2.569	4	3.016	2	3.0	2
14	.193	56	.224	56	56.0	56
15	1.108	22	1.158	17	19.5	17
16	.608	40	.822	34	37.0	38
17	1.491	11	1.247	14	12.5	10
18	2.002	7	1.941	5	8.0	5
19	1.216	18	1.121	18	18.0	16
20	1.877	9	1.585	10	9.5	8
21	.930	26	.839	33	29.5	31
22	.755	33	1.056	20	26.5	23
23	.977	25	.852	30	27.5	27
24	1.187	19	1.322	13	16.0	14
25	.837	30	.987	25	27.5	28
26	.767	32	.621	44	38.0	40
27	1.291	15	1.107	19	17.0	15
28	.712	36	.427	50	43.0	46
29	1.039	23	1.030	22	22.5	20
30	1.220	17	1.710	7	12.0	9
31	1.172	20	.426	51	35.5	34
32	.845	29	.767	37	33.0	33
33	1.034	24	.887	28	26.0	22
34	1.491	12	.484	48	30.0	32
35	1.435	13	1.204	15	14.0	12
36	.448	47	1.734	6	26.5	24
37	.404	50	.655	42	46.0	50
38	.358	52	.357	52	52.0	52
39	.513	45	.701	39	42.0	45
40	.558	42	.678	40	41.0	44
41	.730	35	.594	45	40.0	42
42	1.259	16	.991	24	20.0	18
43	.834	31	.676	41	36.0	35
44	1.939	8	1.033	21	14.5	13
45	1.148	21	.799	35	28.0	29
46	.894	27	.856	29	28.0	30
47	.415	49	.744	38	43.5	48
48	.344	53	1.027	23	38.0	41
49	.623	38	.770	36	37.0	39
50	.143	57	.212	57	57.0	57
51	.673	37	1.187	16	26.5	25
52	.590	41	.587	46	43.5	49
53	.617	39	1.638	9	24.0	21
54	.262	55	.231	55	55.0	55
55	.417	48	.457	49	48.5	51
56	.377	51	.353	53	52.0	53
57	.490	46	.919	26	36.0	36
58	.312	54	.289	54	54.0	54
59	.078	59	.091	59	59.0	59
60	.000	60	.000	60	60.0	60

TABLE 4.17

Forward Net Weighted Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.893	26	.600	32	29.0	27
2	1.345	20	1.017	24	22.0	22
3	1.305	23	1.313	19	21.0	21
4	.047	52	.171	41	46.5	49
5	1.099	24	1.595	15	19.5	18
6	1.919	12	3.974	2	7.0	8
7	.192	46	.040	50	48.0	50
8	.029	53	.026	52	52.5	52
9	.000	56	.089	47	51.5	51
10	.372	40	1.082	23	31.5	31
11	3.433	3	2.613	7	5.0	3
12	.204	45	.184	44	44.5	44
13	.027	54	.007	53	53.5	55
14	.000	57	.000	56	56.5	57
15	2.118	10	[illegible]	11	10.5	11
16	1.313	22	.756	26	24.0	24
17	.782	30	.481	39	32.0	32
18	.156	47	.103	45	46.0	46
19	.142	48	.000	57	52.5	53
20	.532	34	.461	33	33.5	33
21	1.652	14	1.819	13	13.5	14
22	.433	37	.115	43	40.0	39
23	.138	49	.606	31	40.0	40
24	.805	29	.596	30	29.0	28
25	2.792	4	[illegible]	3	6.0	6
26	1.327	21	.995	25	23.0	23
27	.463	36	.364	35	35.5	34
28	1.600	15	1.875	18	16.5	17
29	3.529	1	2.044	10	5.5	5
30	.231	44	.073	48	46.0	47
31	1.583	16	1.725	14	15.0	15
32	2.296	6	[illegible]	4	5.0	4
33	.791	31	.748	27	29.0	29
34	2.151	9	1.229	16	12.5	12
35	1.041	25	.781	28	26.5	26
36	3.489	2	4.703	1	1.5	1
37	2.640	5	3.379	3	4.0	2
38	2.263	7	2.654	5	6.0	7
39	1.961	11	2.848	6	8.5	9
40	1.573	17	[illegible]	9	13.0	13
41	.614	33	.103	46	39.5	38
42	.292	42	.245	39	40.5	41
43	.431	38	.037	51	44.5	45
44	.135	50	.141	42	46.0	48
45	.508	35	.247	38	36.5	35
46	.720	32	.059	49	40.5	42
47	2.208	8	1.946	12	10.0	10
48	.336	41	.286	37	39.0	37
49	1.379	19	1.310	20	19.5	19
50	.877	27	1.148	21	24.0	25
51	.399	39	.322	36	37.5	36
52	.050	51	.003	55	53.0	54
53	.000	58	.000	58	58.0	58
54	1.394	18	1.130	22	20.0	20
55	.233	43	.224	40	41.5	43
56	.005	55	.006	54	54.5	56
57	.000	59	.000	59	59.0	59
58	.790	29	.730	29	29.0	30
59	[illegible]	13	1.484	17	15.0	16
60	.000	60	[illegible]	60	60.0	60

TABLE 4.18

Backward Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.530	34	1.316	42	38.0	40
2	1.061	59	1.087	59	59.0	59
3	1.703	23	1.620	15	19.0	19
4	1.759	19	1.763	10	14.5	13
5	1.332	43	1.327	41	42.0	43
6	1.269	47	1.287	45	46.0	49
7	2.611	1	2.449	1	1.0	1
8	2.012	8	2.293	2	5.0	3
9	1.949	11	1.829	8	9.5	6
10	1.870	13	1.446	29	21.0	21
11	2.216	2	1.578	20	11.0	11
12	2.105	4	1.608	16	10.0	8
13	1.727	21	1.734	12	16.5	16
14	1.141	57	1.140	55	56.0	57
15	2.093	5	1.550	21	13.0	12
16	1.531	33	1.397	35	34.0	32
17	1.772	18	1.600	17	17.5	18
18	2.005	9	1.853	7	8.0	4
19	1.973	10	1.787	9	9.5	7
20	2.031	6	1.723	14	10.0	9
21	1.646	27	1.453	28	27.5	26
22	2.203	3	2.033	3	3.0	2
23	1.696	26	1.479	25	25.5	24
24	1.799	16	1.733	13	14.5	14
25	1.804	15	1.875	6	10.5	10
26	1.639	29	1.454	27	28.0	27
27	1.750	20	1.425	33	26.5	25
28	1.437	40	1.239	50	45.0	48
29	2.020	7	1.544	22	14.5	15
30	1.881	12	1.978	4	8.0	5
31	1.698	24	1.262	47	35.5	35
32	1.484	37	1.432	31	34.0	33
33	1.558	32	1.487	24	28.0	28
34	1.210	53	1.127	58	55.5	55
35	1.821	14	1.582	19	16.5	17
36	1.348	42	1.951	5	23.5	23
37	1.234	51	1.367	38	44.5	47
38	1.790	17	1.238	51	34.0	34
39	1.633	31	1.759	11	21.0	22
40	1.391	41	1.422	34	37.5	39
41	1.506	36	1.347	40	38.0	41
42	1.529	35	1.395	36	35.5	36
43	1.634	30	1.427	32	31.0	29
44	1.644	28	1.299	44	36.0	37
45	1.438	39	1.280	46	42.5	46
46	1.704	22	1.590	18	20.0	20
47	1.301	45	1.367	39	42.0	44
48	1.197	54	1.438	30	42.0	45
49	1.447	38	1.463	26	32.0	30
50	1.143	56	1.160	54	55.0	54
51	1.299	46	1.374	37	41.5	42
52	1.697	25	1.248	49	37.0	38
53	1.316	44	1.515	23	33.5	31
54	1.190	55	1.140	56	55.5	56
55	1.266	48	1.258	48	48.0	51
56	1.226	52	1.181	53	52.5	53
57	1.243	49	1.306	43	46.0	50
58	1.241	50	1.191	52	51.0	52
59	1.134	58	1.131	57	57.5	58
60	1.000	60	1.000	60	60.0	60

TABLE 4.19

Forward Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.642	26	1.477	29	27.5	26
2	2.387	7	2.097	10	8.5	7
3	1.928	15	1.818	18	16.5	16
4	1.308	41	1.442	32	36.5	36
5	1.916	17	2.343	5	11.0	12
6	1.968	13	2.268	6	9.5	10
7	1.310	40	1.155	42	41.0	40
8	1.092	50	1.065	48	49.0	49
9	1.001	57	1.134	45	51.0	51
10	1.574	32	1.899	15	23.5	22
11	2.886	2	2.379	4	3.0	3
12	1.606	30	1.187	39	34.5	34
13	1.048	53	1.014	53	53.0	55
14	1.001	58	1.001	56	57.0	58
15	2.431	6	2.071	12	9.0	8
16	1.841	20	1.513	27	23.5	23
17	1.568	33	1.461	30	31.5	32
18	1.081	51	1.057	49	50.0	50
19	1.124	49	1.010	54	51.5	52
20	1.834	21	1.822	17	19.0	18
21	1.791	24	1.611	24	24.0	25
22	1.805	23	1.405	33	28.0	27
23	1.040	54	1.217	38	46.0	46
24	1.593	31	1.547	26	28.5	28
25	2.554	5	2.403	3	4.0	4
26	1.625	28	1.453	31	29.5	31
27	1.639	27	1.313	36	31.5	33
28	1.935	14	1.677	21	17.5	17
29	2.972	1	2.091	11	6.0	5
30	1.200	44	1.044	51	47.5	48
31	2.092	10	2.148	8	9.0	9
32	2.060	11	2.023	13	12.0	14
33	1.330	39	1.384	34	36.5	37
34	2.188	9	1.908	14	11.5	13
35	1.867	18	1.596	25	21.5	21
36	2.028	12	2.123	9	10.5	11
37	1.811	22	1.745	19	20.5	20
38	2.865	3	2.438	2	2.5	1
39	2.757	4	2.849	1	2.5	2
40	1.842	19	1.686	20	19.5	19
41	1.424	36	1.093	47	41.5	41
42	1.245	43	1.095	46	44.5	45
43	1.486	35	1.053	50	42.5	42
44	1.131	46	1.158	41	43.5	44
45	1.339	38	1.152	43	40.5	39
46	1.049	52	1.044	52	52.0	53
47	2.362	8	2.235	7	7.5	6
48	1.272	42	1.261	37	39.5	38
49	1.735	25	1.640	22	23.5	24
50	1.551	34	1.628	23	28.5	29
51	1.200	45	1.168	40	42.5	43
52	1.129	47	1.001	57	52.0	54
53	1.036	55	1.000	58	56.5	57
54	1.622	29	1.511	28	28.5	30
55	1.129	48	1.146	44	46.0	47
56	1.003	56	1.003	55	55.5	56
57	1.000	59	1.000	59	59.0	59
58	1.374	37	1.369	35	36.0	35
59	1.925	16	1.848	16	16.0	15
60	1.000	60	1.000	60	60.0	60

TABLE 4.20

Backward Net Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.365	38	.248	47	42.5	44
2	.057	59	.086	58	58.5	58
3	.658	15	.613	12	13.5	12
4	.483	28	.440	25	26.5	24
5	.320	41	.326	37	39.0	40
6	.244	46	.287	42	44.0	48
7	1.496	1	1.348	1	1.0	1
8	.934	5	1.243	2	3.5	2
9	.947	4	.752	7	5.5	4
10	.659	13	.299	40	26.5	25
11	1.180	2	.577	15	8.5	7
12	.652	16	.497	18	17.0	15
13	.697	11	.725	9	10.0	10
14	.140	56	.139	55	55.5	55
15	.599	20	.465	20	20.0	17
16	.266	44	.297	41	42.5	45
17	.555	24	.361	35	29.5	28
18	1.001	3	.848	5	4.0	3
19	.922	6	.777	6	6.0	6
20	.900	7	.665	11	9.0	9
21	.549	27	.381	33	30.0	29
22	.603	19	.671	10	14.5	13
23	.696	12	.479	19	15.5	14
24	.799	9	.732	8	8.5	8
25	.577	23	.583	14	18.5	16
26	.618	18	.441	24	21.0	18
27	.466	30	.382	32	31.0	32
28	.383	35	.177	52	43.5	47
29	.443	32	.405	30	31.0	33
30	.881	8	.978	3	5.5	5
31	.659	14	.252	46	30.0	30
32	.482	29	.430	27	28.0	26
33	.550	26	.460	22	24.0	21
34	.144	55	.115	57	56.0	57
35	.554	25	.445	23	24.0	22
36	.330	39	.950	4	21.5	19
37	.231	48	.356	36	42.0	43
38	.178	54	.157	53	53.5	53
39	.324	40	.533	16	28.0	27
40	.373	37	.420	29	33.0	35
41	.400	34	.320	38	36.0	38
42	.428	33	.395	31	32.0	34
43	.634	17	.427	28	22.5	20
44	.591	22	.238	49	35.5	37
45	.374	36	.269	44	40.0	42
46	.703	10	.589	13	11.5	11
47	.208	51	.274	43	47.0	50
48	.194	52	.435	26	39.0	41
49	.446	31	.462	21	26.0	23
50	.127	57	.145	54	55.5	56
51	.297	42	.373	34	38.0	39
52	.592	21	.248	48	34.5	36
53	.281	43	.515	17	30.0	31
54	.184	53	.135	56	54.5	54
55	.265	45	.257	45	45.0	49
56	.226	49	.181	50	49.5	51
57	.243	47	.306	39	43.0	46
58	.219	50	.179	51	50.5	52
59	.059	58	.058	59	58.5	59
60	.000	60	.000	60	60.0	60

TABLE 4.21

Forward Net Domestic Index

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.476	30	.410	30	30.0	30
2	1.384	4	1.096	10	7.0	5
3	.803	15	.811	15	15.0	15
4	.032	51	.119	40	45.5	48
5	.914	14	1.342	4	9.0	10
6	.943	12	1.268	5	8.5	8
7	.195	42	.054	46	44.0	45
8	.013	54	.015	52	53.0	53
9	.000	56	.057	45	50.5	51
10	.363	31	.752	18	24.5	23
11	1.849	1	1.378	2	1.5	1
12	.153	43	.076	43	43.0	41
13	.019	53	.005	53	53.0	54
14	.000	57	.000	56	56.5	57
15	.936	13	.936	12	12.5	14
16	.576	27	.413	29	28.0	29
17	.356	34	.222	35	34.5	34
18	.077	47	.052	48	47.5	49
19	.073	48	.000	57	52.5	52
20	.702	21	.763	17	19.0	17
21	.694	22	.540	25	23.5	22
22	.204	39	.043	50	44.5	46
23	.040	50	.217	36	43.0	42
24	.593	26	.546	24	25.0	25
25	1.326	5	1.112	9	7.0	6
26	.605	24	.440	28	26.0	27
27	.354	32	.269	33	32.5	31
28	.881	16	.616	22	19.0	18
29	1.395	3	.951	13	8.0	7
30	.200	40	.044	49	44.5	47
31	1.053	10	1.137	7	8.5	9
32	1.059	9	1.020	11	10.0	12
33	.322	35	.357	31	33.0	33
34	1.122	8	.896	14	11.0	13
35	.600	25	.458	27	26.0	28
36	1.010	11	1.123	8	9.5	11
37	.808	19	.734	19	19.0	19
38	1.253	7	1.358	3	5.0	3
39	1.448	2	1.623	1	1.5	2
40	.824	18	.684	20	19.0	20
41	.319	36	.066	44	40.0	39
42	.144	44	.094	42	43.0	43
43	.486	29	.053	47	38.0	36
44	.078	46	.096	41	43.5	44
45	.275	37	.141	39	38.0	37
46	.048	49	.043	51	50.0	50
47	1.268	6	1.143	6	6.0	4
48	.269	38	.258	34	36.0	35
49	.735	20	.639	21	20.5	21
50	.534	28	.612	23	25.5	26
51	.198	41	.166	37	39.0	38
52	.025	52	.001	55	53.5	55
53	.000	58	.000	58	58.0	58
54	.616	23	.506	26	24.5	24
55	.127	45	.144	38	41.5	40
56	.003	55	.003	54	54.5	56
57	.000	59	.000	59	59.0	59
58	.351	33	.357	32	32.5	32
59	.850	17	.774	16	16.5	16
60	.000	60	.000	60	60.0	60

TABLE 4.22
Key Sectors Based on Output Indexes
Interindustry Tables
Portugal 60x60

	Backward Weighted Case	Forward Weighted Case	Key Sectors Based on (1) and (2)	Backward Net Weighted Case	Forward Net Weighted Case	Key Sectors Based on (4) and (5)	Backward Case	Forward Case	Key Sectors Based on (7) and (8)	Backward Net Case	Forward Net Case	Key Sectors Based on (10) and (11)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	*	*	⊛		*			*			*	
2								*			*	
3	*	*	⊛	*								
4												
5		*			*			*			*	
6		*			*			*			*	
7	*			*			*			*		
8	*			*			*			*		
9	*			*								
10	*			*			*	*	⊛	*	*	⊛
11	*	*	⊛	*	*	⊛	*	*	⊛	*	*	⊛
12	*	*	⊛	*			*			*		
13	*			*								
14				*								
15				*	*	⊛	*	*	⊛	*	*	⊛
16	*	*	⊛	*								
17	*			*			*			*		
18	*			*			*			*		
19				*			*			*		
20	*			*			*			*		
21					*							
22												
23										*		
24												
25		*			*		*	*	⊛		*	
26												
27				*			*			*		
28					*			*		*	*	⊛
29	*	*	⊛		*		*	*	⊛		*	
30												

TABLE 4.22
(continued)

	Backward Weighted Case	Forward Weighted Case	Key Sectors Based on (1) and (2)	Backward Net Weighted Case	Forward Net Weighted Case	Key Sectors Based on (4) and (5)	Backward Case	Forward Case	Key Sectors Based on (7) and (8)	Backward Net Case	Forward Net Case	Key Sectors Based on (10) and (11)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
31	*			*	*	⊛	*	*	⊛	*	*	⊛
32		*		*	*	⊛	*	*	⊛	*	*	⊛
33	*			*			*			*		
34		*			*		*	*	⊛	*	*	⊛
35												
36		*			*			*			*	
37		*			*							
38		*			*		*	*	⊛		*	
39		*			*		*	*	⊛		*	
40		*			*		*	*	⊛	*	*	⊛
41										*		
42	*			*								
43										*		
44	*											
45												
46	*	*	⊛									
47		*			*			*			*	
48												
49					*			*			*	
50	*	*	⊛									
51												
52												
53												
54												
55												
56												
57												
58												
59		*			*			*			*	
60												

In interindustry terms, Tables 4.22 and 4.23 summarize all the information contained on those tables concerning the designation of the key sector structure of the economy. Using the same procedures as in Section 3.2, the key sectors will be:

TABLE 4.23

Key Sectors Based on Output Indexes
Interindustry Tables

Portugal 60 x 60

Sectors	(1) Weighted Case	(2) Net Weighted Case	(3) Unweighted Case	(4) Net Unweighted Case
1	high			
3	high			
10			high	high
11	high	high	high	high
12	high			
15		high	high	high
16	high			
25			high	
28				high
29	high		high	
31		high	high	high
32		high	high	high
34			high	high
38			high	
39			high	
40			high	high
46	high			
50	high			
TOTAL	8	4	11	8

Key sectors for each of the four classifications were the ones that are in the twenty highest positions for both backward and forward cases.

In relative terms, eight sectors will be chosen as key ones: Sectors 1 - Agriculture, 3 - Livestock, 11 - Prepared Feed for Animals, 12 - Other Food Products, 16 - Cotton and Cotton Mixed Textiles, 29 - Basic Chemical Products, 46 - Public and Private Construction, and 50 - Trade.

Disregarding their contribution to themselves, only four sectors were chosen: Sectors 11 - Prepared Feed for Animals, 15 - Wool and Wool Mixed Textiles, 31 - Non Food Oils and 32 - Paints and Allied Products.

In absolute terms, eleven sectors will be obtained: Sectors 10 - Animal and Vegetable Food Oils, 11 - Prepared Feed for Animals, 15 - Wool and Wool Mixed Textiles, 25 - Cardboard and Cardboard Articles, 29 - Basic Chemical Products, 31 - Non Food Oils, 32 - Paints and Allied Products, 34 - Petroleum and Coal Products, 38 - Primary Iron and Steel Manufacturing, 39 - Primary Non Ferrous Metals Manufacturing and 40 - Metal Products.

Looking at the absolute indicators without considering their contribution to themselves, we get eight key sectors: Sectors 10 - Animal and Vegetable Food Oils, 11 - Prepared Feed for Animals, 15 - Wool and Wool Mixed Textiles, 28 - Plastic Materials and Products, 31 - Non Food Oils, 32 - Paints and Allied Products, 34 - Petroleum and Coal Products, and 40 - Metal Products.

In domestic terms, Table 4.24, summarizes all the information. The key sector structure is presented in Table 4.25.

Table 4.24
Key Sectors Based on Output Indexes
Domestic Tables
Portugal 60x60

	Backward Weighted Case	Forward Weighted Case	Key Sectors Based on (1) and (2)	Backward Net Weighted Case	Forward Net Weighted Case	Key Sectors Based on (3) and (4)	Backward Case	Forward Case	Key Sectors Based on (7) and (8)	Backward Net Case	Forward Net Case	Key Sectors Based on (10) and (11)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	*	*	δ									
2								*			*	
3	*	*	δ	*			*	*	δ	*	*	δ
4	*						*					
5					*			*			*	
6		*			*			*			*	
7	*			*			*			*		
8	*			*			*			*		
9	*			*			*			*		
10				*								
11	*	*	δ	*	*	δ	*	*	δ	*	*	δ
12	*	*	δ	*			*			*		
13	*			*			*			*		
14												
15		*		*	*	δ	*	*	δ	*	*	δ
16	*	*	δ									
17				*			*					
18	*			*			*			*		
19				*			*			*		
20				*			*	*	δ	*	*	δ
21					*							
22							*			*		
23										*		
24				*			*			*		
25		*			*		*	*	δ	*	*	δ
26										*		
27				*								
28					*			*			*	
29	*	*	δ	*	*	δ	*	*	δ		*	
30				*			*			*		

TABLE 4.24
(continued)

	Backward Weighted Case	Forward Weighted Case	Key Sectors Based on (1) and (2)	Backward Weighted Net Case	Forward Weighted Net Case	Key Sectors Based on (3) and (4)	Backward Weighted Case	Forward Weighted Case	Key Sectors Based on (7) and (8)	Backward Net Case	Forward Net Case	Key Sectors Based on (1) and (2)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
31					*			*			*	
32		*			*			*			*	
33												
34		*			*			*			*	
35				*			*					
36		*			*			*		*	*	•
37		*			*			*			*	
38		*			*			*			*	
39		*			*			*			*	
40		*			*			*			*	
41												
42	*			*								
43										*		
44	*			*								
45												
46	*	*	•				*			*		
47		*			*			*			*	
48												
49					*							
50	*	*	•									
51	*											
52												
53												
54					*							
55												
56												
57												
58	*											
59	*	*	•		*			*			*	
60	*											

TABLE 4.25

Key Sectors Based on Output Indexes
Domestic Tables
Portugal 60 x 60

Sectors	(1) Weighted Case	(2) Net Weighted Case	(3) Unweighted Case	(4) Net Unweighted Case
1	high			
3	high		high	high
11	high	high	high	high
12	high			
15		high	high	high
16	high			
20			high	high
25			high	high
29	high	high	high	
36				high
46	high			
50	high			
59	high			
TOTAL	9	3	6	6

The domestic analysis does not coincide, as we expect, with the interindustry one. In some sectors we gain new insights. Sector 3 - Livestock is now key sector in absolute terms, in three of four classifications. Sector 10 - Animal and Vegetable Food Oils, which was a key sector in interindustry terms, now, with exclusion of imports, loses that position, indicating a very high import dependence. Sector 20 - Leather Tanning and Industrial Leather Products, on the contrary, in domestic and absolute terms now becomes a key sector, showing an independence from imports. Sector 32 - Paints and Allied Products, 34 - Petroleum and Coal Products, 38 - Primary Iron and Steel Manufacturing, 39 - Primary Non Ferrous Metals Manufacturing and 40 - Metal Products, all show a great dependence on imports and therefore they lose their key sector positions in domestic terms.

Those are the most significant changes that result from using the domestic tables. Note that the number of key sectors obtained from the domestic tables analysis is considerably smaller than the number obtained from the interindustry case.

Variability measures are presented in Tables 4.26 to 4.33; these are calculated from formulas 2.9a and 2.9b. All information is summarized in Table 4.34. That table presents the sectors with lowest variability measures, using the procedure of choosing the twenty lowest variability values among all sectors. Defining a key sector as one for which we obtain low values for both measures (along the column and along the row) we obtain the results presented in Table 4.35. If we put the information of Table 4.23, 4.25 and 4.35 together, we get Table 4.36.

Some discussion about the usefulness of these measures was presented in Section 3.2. We find that 45 and 66 percent of the sectors in unnetted terms in interindustry and domestic cases have also a low variability measure. Only one sector, Sector 11 - Prepared Feed for Animals, has both variability measures in both domestic and interindustry cases, being also a key sector in output terms. In netted terms however, there is no correspondence among key sectors in output terms and low variability measures. As noted before, low variability mesures, without high linkages, do not mean much. So

TABLE 4.26

Variability Along the Column
Input Inverse Matrix
Interindustry Tables
Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	5.445	41	5.632	51	46.0	46
2	7.161	58	6.843	58	58.0	58
3	4.305	21	4.199	18	19.5	17
4	5.032	36	4.894	39	37.5	40
5	5.446	42	5.299	48	45.0	45
6	5.620	45	5.272	47	46.0	47
7	3.783	8	3.859	12	10.0	10
8	3.994	13	3.333	1	7.0	6
9	4.021	14	4.413	28	21.0	21
10	4.058	15	4.306	24	19.5	18
11	3.223	1	3.572	5	3.0	1
12	4.917	35	4.251	19	27.0	27
13	4.469	25	4.385	27	26.0	25
14	4.591	28	4.573	30	29.0	28
15	4.656	30	4.265	20	25.0	24
16	5.111	37	4.839	36	36.5	38
17	3.881	10	4.265	21	15.5	15
18	3.607	5	3.664	6	5.5	4
19	3.610	6	3.383	2	4.0	3
20	3.498	3	3.402	3	3.0	2
21	4.665	31	4.874	37	34.0	35
22	5.656	46	5.243	46	46.0	48
23	3.638	7	3.855	11	9.0	9
24	4.243	19	4.293	22	20.5	20
25	4.743	33	4.826	35	34.0	36
26	4.129	18	4.090	16	17.0	16
27	4.287	20	3.824	10	15.0	14
28	4.518	27	4.317	25	26.0	26
29	5.576	44	4.918	41	42.5	43
30	4.676	32	4.682	31	31.5	30
31	3.461	2	4.035	15	8.5	8
32	3.822	9	3.680	7	8.0	7
33	3.546	4	3.801	9	6.5	5
34	4.402	23	4.302	23	23.0	23
35	4.875	34	4.718	32	33.0	31
36	5.117	38	3.440	4	21.0	22
37	5.682	47	4.922	42	44.5	44
38	5.983	51	5.691	52	51.5	52
39	5.811	50	4.784	34	42.0	42
40	4.077	16	3.763	8	12.0	11
41	4.389	22	4.090	17	19.5	19
42	4.648	29	4.543	29	29.0	29
43	3.984	12	4.018	14	13.0	13
44	4.121	17	5.614	50	33.5	33
45	4.452	24	4.979	43	33.5	34
46	3.904	11	3.992	13	12.0	12
47	6.016	53	5.241	45	49.0	50
48	6.315	56	5.189	44	50.0	51
49	5.192	39	4.878	38	38.5	41
50	6.623	57	6.503	56	56.5	57
51	5.351	40	4.734	33	36.5	39
52	4.502	26	4.894	40	33.0	32
53	5.562	43	4.328	26	34.5	37
54	6.165	55	6.556	57	56.0	56
55	5.730	48	5.603	49	48.5	49
56	5.763	49	6.045	54	51.5	53
57	6.137	54	5.763	53	53.5	54
58	5.986	52	6.067	55	53.5	55
59	7.232	59	7.232	59	59.0	59
60	7.746	60	7.746	60	60.0	60

TABLE 4.27

Variability Along the Row
Output Inverse Matrix
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	4.165	18	3.741	13	15.5	15
2	3.164	8	3.470	8	8.0	8
3	4.694	23	4.948	26	24.5	23
4	6.955	46	6.625	40	43.0	42
5	1.896	1	2.514	5	3.0	2
6	2.273	2	2.359	1	1.5	1
7	6.253	42	6.885	43	42.5	41
8	7.607	54	[illegible]	52	53.0	53
9	7.744	56	7.300	47	51.5	51
10	5.147	28	[illegible]	10	19.0	18
11	4.050	16	[illegible]	18	17.0	17
12	6.900	45	[illegible]	46	45.5	46
13	7.537	52	[illegible]	53	52.5	52
14	7.746	57	[illegible]	56	56.5	57
15	5.145	27	[illegible]	25	26.0	26
16	5.349	31	[illegible]	32	31.5	31
17	5.476	37	[illegible]	35	36.0	35
18	6.964	[illegible]	[illegible]	44	[illegible]	[illegible]
19	7.217	49	[illegible]	57	53.0	54
20	4.871	25	[illegible]	24	24.5	24
21	4.833	24	[illegible]	28	26.0	27
22	6.760	43	[illegible]	51	47.0	49
23	7.310	[illegible]	[illegible]	38	44.0	44
24	4.243	[illegible]	[illegible]	20	19.5	19
25	3.392	9	[illegible]	12	10.5	9
26	4.595	21	[illegible]	29	25.0	25
27	5.505	34	5.290	30	32.0	32
28	3.483	10	[illegible]	15	12.5	12
29	2.874	[illegible]	2.402	2	3.5	4
30	6.251	41	[illegible]	49	45.0	45
31	3.889	14	[illegible]	9	11.5	10
32	3.922	15	[illegible]	16	15.5	16
33	5.170	29	[illegible]	23	26.0	28
34	2.494	4	[illegible]	7	5.5	5
35	4.546	20	[illegible]	21	20.5	21
36	5.287	30	[illegible]	27	28.5	29
37	5.032	26	[illegible]	31	28.5	30
38	3.117	7	[illegible]	4	5.5	6
39	2.415	3	[illegible]	3	3.0	3
40	3.700	11	[illegible]	17	14.0	14
41	5.575	36	[illegible]	37	36.5	36
42	5.906	38	[illegible]	41	39.5	38
43	5.463	33	7.334	48	40.5	40
44	7.084	48	6.990	45	46.5	48
45	5.394	32	5.794	34	33.0	33
46	7.338	51	7.062	50	50.5	50
47	3.017	6	3.047	6	6.0	7
48	6.049	39	6.091	36	37.5	37
49	3.747	12	[illegible]	11	11.5	11
50	4.645	22	4.380	19	20.5	22
51	6.223	40	[illegible]	39	39.5	39
52	7.566	53	7.734	55	54.0	55
53	7.746	58	7.746	58	58.0	58
54	4.148	17	[illegible]	22	19.5	20
55	6.845	44	6.746	42	43.0	43
56	7.721	55	[illegible]	54	54.5	56
57	7.746	59	7.746	59	59.0	59
58	5.513	35	[illegible]	33	34.0	34
59	3.878	13	[illegible]	14	13.5	13
60	7.746	60	7.746	60	60.0	60

TABLE 4.28

Variability Along the Column
Net Input Inverse
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	3.637	49	2.767	28	38.5	38
2	2.899	30	2.610	20	25.0	23
3	3.097	40	3.291	40	40.0	42
4	1.577	2	1.684	4	3.0	2
5	2.979	36	2.761	26	31.0	31
6	2.054	8	2.321	14	11.0	10
7	3.990	53	4.041	52	52.5	52
8	2.953	33	2.625	21	27.0	27
9	3.458	45	3.462	45	45.0	49
10	3.886	52	4.282	56	54.0	55
11	2.780	28	3.508	46	37.0	37
12	4.245	55	3.902	51	53.0	53
13	2.978	35	3.334	43	39.0	39
14	4.191	54	4.126	53	53.5	54
15	2.720	25	2.425	17	21.0	17
16	[illegible]	41	[illegible]	39	40.0	43
17	2.599	21	2.746	25	23.0	20
18	3.094	39	3.055	34	36.5	36
19	2.201	13	2.142	11	12.0	11
20	3.036	38	2.909	31	34.5	34
21	3.636	48	3.765	50	49.0	50
22	5.053	59	4.831	58	58.5	59
23	1.706	6	1.720	5	5.5	5
24	3.235	44	3.327	42	43.0	45
25	2.680	24	2.632	22	23.0	21
26	3.146	43	2.677	23	33.0	32
27	2.995	37	2.379	15	26.0	24
28	4.877	58	4.291	57	57.5	57
29	2.192	12	2.317	13	12.5	13
30	5.292	60	5.574	60	60.0	60
31	2.960	34	4.242	55	44.5	48
32	3.847	51	3.078	35	43.0	46
33	2.594	20	2.964	32	26.0	25
34	4.592	57	4.941	59	58.0	58
35	2.794	29	2.401	16	22.5	19
36	2.765	27	2.867	30	28.5	29
37	2.083	10	2.078	9	9.5	9
38	2.930	32	3.519	47	39.5	40
39	2.757	26	3.388	44	35.0	35
40	3.690	50	3.652	49	49.5	51
41	2.261	15	3.128	37	26.0	26
42	2.577	18	2.515	18	18.0	16
43	2.918	31	3.606	48	39.5	41
44	2.618	22	3.100	36	29.0	30
45	2.214	14	2.121	10	12.0	12
46	1.824	7	1.899	7	7.0	7
47	2.526	17	2.856	29	23.0	22
48	4.441	56	4.193	54	55.0	56
49	3.484	46	3.156	38	42.0	44
50	2.082	9	1.980	8	8.5	8
51	2.134	11	2.536	19	15.0	14
52	2.663	23	3.023	33	28.0	28
53	2.401	16	2.763	27	21.5	18
54	3.137	42	2.727	24	33.0	33
55	1.607	3	1.678	3	3.0	3
56	1.634	4	1.605	2	3.0	4
57	3.551	47	3.299	41	44.0	47
58	1.657	5	1.811	6	5.5	6
59	2.590	19	2.240	12	15.5	15
60	1.000	1	1.000	1	1.0	1

TABLE 4.29

**Variability Along the Row
Net Output Inverse Matrix
Interindustry Tables**

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	2.860	29	2.549	26	27.5	27
2	2.449	27	2.481	24	25.5	24
3	5.454	52	5.826	57	54.5	54
4	3.014	34	3.363	38	36.0	36
5	1.990	19	2.585	27	23.0	22
6	1.985	18	2.227	20	19.0	18
7	3.247	36	3.172	35	35.5	35
8	6.128	57	5.440	55	56.0	57
9	6.955	59	4.923	51	55.0	55
10	3.190	35	3.634	42	38.5	39
11	4.788	48	4.852	50	49.0	49
12	3.562	41	3.551	40	40.5	41
13	2.867	31	2.777	29	30.0	30
14	.000	1	.000	1	1.0	1
15	5.925	55	6.057	58	56.5	58
16	5.912	54	5.462	56	55.0	56
17	3.698	44	2.967	32	38.0	38
18	2.415	26	1.759	16	21.0	20
19	5.534	53	3.917	46	49.5	50
20	4.897	49	5.294	54	51.5	51
21	4.188	46	4.067	48	47.0	46
22	2.978	32	3.076	34	33.0	32
23	5.122	51	3.763	44	47.5	47
24	3.396	37	3.661	43	40.0	40
25	2.006	20	1.906	19	19.5	19
26	1.566	14	1.597	15	14.5	14
27	3.418	38	2.662	28	33.0	33
28	1.349	11	1.415	13	12.0	12
29	1.932	17	1.585	14	15.5	15
30	3.529	40	3.575	41	40.5	42
31	3.503	39	3.205	36	37.5	37
32	3.635	42	4.043	47	44.5	45
33	1.777	15	1.776	17	16.0	16
34	1.216	8	1.230	8	8.0	8
35	1.784	16	1.792	18	17.0	17
36	7.339	60	6.434	59	59.5	60
37	6.398	58	6.864	60	59.0	59
38	2.503	28	2.369	23	25.5	25
39	2.267	23	2.314	21	22.0	21
40	2.118	21	3.378	39	30.0	31
41	2.295	24	2.940	31	27.5	28
42	2.866	30	2.507	25	27.5	29
43	6.092	56	5.067	52	54.0	53
44	2.185	22	2.874	30	26.0	26
45	2.993	33	3.041	33	33.0	34
46	2.328	25	2.338	22	23.5	23
47	.985	4	.977	4	4.0	4
48	3.696	43	3.763	45	44.0	44
49	1.374	13	1.383	12	12.5	13
50	1.369	12	1.361	11	11.5	11
51	1.103	7	1.069	7	7.0	7
52	3.903	45	3.296	37	41.0	43
53	.000	2	.000	2	2.0	2
54	1.316	9	1.254	9	9.0	9
55	5.089	50	5.094	53	51.5	52
56	4.695	47	4.850	49	48.0	48
57	.000	3	.000	3	3.0	3
58	1.341	10	1.327	10	10.0	10
59	1.013	6	1.036	6	6.0	6
60	1.000	5	1.000	5	5.0	5

TABLE 4.30

Variability Along the Column
Input Inverse Matrix
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	5.937	39	6.283	48	43.5	46
2	7.325	58	7.126	58	58.0	58
3	4.887	15	4.992	13	14.0	13
4	5.606	29	5.801	35	32.0	32
5	5.881	38	5.846	36	37.0	39
6	6.252	45	6.023	40	42.5	45
7	4.161	2	4.323	3	2.5	1
8	4.404	6	3.923	1	3.5	2
9	4.368	5	4.814	8	6.5	5
10	5.092	19	6.135	43	31.0	30
11	3.847	1	4.971	12	6.5	6
12	5.480	27	5.412	19	23.0	21
13	4.761	11	4.735	7	9.0	9
14	6.789	54	6.793	55	54.5	53
15	5.557	28	5.462	25	26.5	22
16	[illegible]	[illegible]	[illegible]	41	45.5	49
17	5.366	24	6.021	39	31.5	31
18	4.219	3	4.453	4	3.5	3
19	4.252	4	4.506	5	4.5	4
20	4.534	7	4.839	10	8.5	8
21	5.293	22	5.764	34	28.0	24
22	5.788	36	5.442	21	28.5	26
23	4.589	10	5.238	15	12.5	12
24	4.540	8	4.722	6	7.0	7
25	5.311	23	5.378	17	20.0	18
26	4.941	16	5.443	22	19.0	16
27	5.736	33	5.673	31	32.0	33
28	5.776	35	6.632	52	43.5	47
29	6.047	41	5.728	33	37.0	40
30	4.834	14	4.834	9	11.5	11
31	4.802	12	6.197	45	28.5	27
32	5.248	21	5.424	20	20.5	19
33	5.015	17	5.349	16	16.5	14
34	6.823	55	6.959	57	56.0	57
35	5.432	25	5.588	28	26.5	23
36	5.863	37	4.271	2	19.5	17
37	6.288	47	5.724	32	39.5	42
38	6.969	57	6.761	53	55.0	55
39	6.210	44	5.453	24	34.0	36
40	5.721	32	5.515	26	29.0	29
41	5.689	31	5.905	37	34.0	37
42	5.610	30	5.581	27	28.5	28
43	4.832	13	5.449	23	18.0	15
44	5.078	18	6.366	49	33.5	34
45	5.755	34	6.120	42	38.0	41
46	4.570	9	4.889	11	10.0	10
47	6.505	51	6.205	46	48.5	50
48	6.528	52	5.588	29	40.5	43
49	5.458	26	5.411	18	22.0	20
50	6.877	56	6.771	54	55.0	56
51	5.971	40	5.667	30	35.0	38
52	5.137	20	6.213	47	33.5	35
53	6.097	42	5.197	14	28.0	25
54	6.546	53	6.825	56	54.5	54
55	6.113	43	6.154	44	43.5	48
56	6.306	48	6.543	50	49.0	51
57	6.252	46	5.966	38	42.0	44
58	6.368	49	6.571	51	50.0	52
59	7.336	59	7.346	59	59.0	59
60	7.746	60	7.746	60	60.0	60

TABLE 4.31

Variability Along the Row
Output Inverse Matrix
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	5.580	29	5.618	29	29.0	29
2	3.542	1	3.909	5	3.0	2
3	4.974	19	5.143	23	21.0	19
4	7.556	51	7.105	42	46.5	47
5	4.108	6	3.604	2	4.0	4
6	4.237	10	4.248	9	9.5	8
7	6.598	41	7.379	48	44.5	45
8	7.655	54	7.633	52	53.0	53
9	7.746	56	7.357	46	51.0	51
10	5.997	33	4.852	17	25.0	26
11	4.224	9	4.359	11	10.0	11
12	7.004	45	7.245	43	44.0	43
13	7.604	53	7.709	53	53.0	54
14	7.746	57	7.746	56	56.5	57
15	5.276	26	5.043	21	23.5	25
16	5.637	30	5.826	32	31.0	31
17	6.045	35	6.574	36	35.[illegible]	3[illegible]
18	7.185	46	7.363	47	46.5	48
19	7.243	48	7.746	57	52.5	52
20	5.175	23	5.032	20	21.5	20
21	5.000	20	5.323	25	22.5	21
22	6.864	43	7.506	51	47.0	49
23	7.449	50	6.381	35	42.5	42
24	5.019	21	5.184	24	22.5	22
25	3.801	5	4.192	8	6.5	6
26	4.857	18	5.390	27	22.5	23
27	6.083	36	6.156	33	34.5	33
28	4.212	8	4.896	18	13.0	14
29	4.316	13	4.328	10	11.5	12
30	6.466	40	7.413	49	44.5	46
31	4.239	11	4.085	6	8.5	7
32	4.196	7	4.371	12	9.5	9
33	5.870	32	5.742	31	31.5	32
34	3.782	4	4.103	7	5.5	5
35	5.249	25	5.518	28	26.5	28
36	5.305	27	4.963	19	23.0	24
37	5.213	24	5.370	26	25.0	27
38	4.473	16	3.706	3	9.5	10
39	3.757	3	3.544	1	2.0	1
40	4.341	14	4.844	16	15.0	16
41	6.005	34	7.271	44	39.0	39
42	6.842	42	7.075	40	41.0	40
43	5.555	28	7.352	45	36.5	36
44	7.207	47	7.096	41	44.0	44
45	6.163	38	6.800	39	38.5	38
46	7.386	49	7.421	50	49.5	50
47	3.562	2	3.758	4	3.0	3
48	6.137	37	6.188	34	35.5	35
49	4.462	15	4.718	14	14.5	15
50	5.055	22	4.816	15	18.5	17
51	6.447	39	6.628	37	38.0	37
52	7.575	52	7.738	55	53.5	55
53	7.746	58	7.746	58	58.0	58
54	4.786	17	5.131	22	19.5	18
55	6.886	44	6.788	38	41.0	41
56	7.723	55	7.722	54	54.5	56
57	7.746	59	7.746	59	59.0	59
58	5.744	31	5.703	30	30.5	30
59	4.295	12	4.474	13	12.5	13
60	7.746	60	7.746	60	60.0	60

TABLE 4.32

**Variability Along the Column
Net Input Inverse
Domestic Tables**

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	3.798	49	2.812	26	37.5	41
2	3.462	41	3.140	35	38.0	42
3	3.441	40	3.920	51	45.5	46
4	1.825	2	1.955	3	2.5	2
5	2.915	24	2.552	17	20.5	17
6	2.571	14	2.757	20	17.0	15
7	4.574	57	4.828	56	56.5	57
8	3.514	42	3.359	40	41.0	44
9	3.982	52	4.106	54	53.0	55
10	3.135	34	2.278	10	22.0	20
11	2.773	21	2.767	22	21.5	19
12	4.420	55	3.370	41	48.0	49
13	3.353	37	3.849	50	43.5	45
14	2.982	28	2.808	25	26.5	24
15	2.969	27	3.081	33	30.0	28
16	2.581	15	2.580	18	1[illegible].5	13
17	[illegible]	31	[illegible]	43	[illegible]	39
18	3.624	46	3.578	47	46.5	48
19	2.678	19	2.953	30	24.5	22
20	3.521	43	2.907	27	35.0	36
21	4.034	54	3.739	48	51.0	53
22	5.472	59	5.368	59	59.0	59
23	2.024	7	2.031	4	5.5	5
24	3.606	45	3.949	52	48.5	50
25	2.911	23	3.018	32	27.5	26
26	3.375	38	3.154	36	37.0	40
27	3.727	47	2.456	13	30.0	29
28	4.534	56	2.544	16	36.0	38
29	2.652	17	2.793	23	20.0	16
30	5.617	60	5.909	60	60.0	60
31	2.673	18	2.538	15	16.5	14
32	2.517	12	2.220	8	10.0	9
33	2.032	8	2.127	7	7.5	7
34	3.867	50	4.514	55	52.5	54
35	3.106	32	2.796	24	28.0	27
36	2.943	25	3.538	46	35.5	37
37	2.475	11	2.275	9	10.0	10
38	2.631	16	3.172	37	26.5	25
39	2.998	29	3.310	39	34.0	34
40	3.728	48	3.477	44	46.0	47
41	2.366	9	2.517	14	11.5	12
42	3.134	33	2.955	31	32.0	30
43	2.969	26	2.679	19	22.5	21
44	3.556	44	4.847	57	50.5	52
45	3.201	36	2.932	29	32.5	32
46	1.999	6	2.054	5	5.5	6
47	2.760	20	3.502	45	32.5	33
48	5.321	58	5.197	58	58.0	58
49	4.007	53	4.054	53	53.0	56
50	2.458	10	2.373	11	10.5	11
51	2.530	13	2.929	28	20.5	18
52	3.400	39	3.251	38	38.5	43
53	2.895	22	3.389	42	32.0	31
54	3.189	35	3.135	34	34.5	35
55	1.950	3	2.077	6	4.5	4
56	1.980	5	1.860	2	3.5	3
57	3.873	51	3.758	49	50.0	51
58	1.968	4	2.448	12	8.0	8
59	3.032	30	2.761	21	25.5	23
60	1.000	1	1.000	1	1.0	1

TABLE 4.33

**Variability Along the Row
Net Output Inverse
Domestic Tables**

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	3.958	43	2.839	27	35.0	35
2	2.695	26	2.781	23	24.5	21
3	6.025	54	6.552	59	56.5	58
4	2.547	24	3.728	34	29.0	29
5	2.051	19	2.777	22	20.5	19
6	3.084	31	4.693	47	39.0	40
7	3.722	36	3.295	28	32.0	33
8	5.898	53	5.239	51	52.0	52
9	.000	1	4.888	48	24.5	22
10	3.872	41	3.693	33	37.0	36
11	5.073	49	5.142	49	49.0	49
12	3.778	37	3.896	37	37.0	37
13	2.845	28	3.318	29	28.5	28
14	.000	2	.000	1	1.5	1
15	6.162	55	6.464	57	56.0	56
16	[illegible]	57	[illegible]	55	56.0	57
17	4.362	46	3.965	38	42.0	44
18	2.973	30	2.666	21	25.5	24
19	5.765	52	5.975	56	54.0	54
20	5.484	51	5.631	54	52.5	53
21	4.458	47	4.480	46	46.5	47
22	3.195	32	3.398	32	32.0	34
23	7.388	60	3.853	36	48.0	48
24	3.805	38	4.200	43	40.5	41
25	2.011	18	1.866	16	17.0	16
26	1.735	15	1.817	15	15.0	14
27	3.262	34	2.820	26	30.0	30
28	1.432	10	1.733	13	11.5	11
29	3.185	33	2.620	20	26.5	27
30	4.019	44	3.994	39	41.5	43
31	3.812	39	3.733	35	37.0	38
32	3.864	40	4.375	44	42.0	45
33	2.532	23	2.269	18	20.5	20
34	1.484	13	1.430	8	10.5	10
35	1.860	16	2.105	17	16.5	15
36	7.387	59	6.500	58	58.5	59
37	6.825	58	7.208	60	59.0	60
38	2.814	27	2.808	25	26.0	25
39	2.004	17	2.451	19	18.0	18
40	2.271	20	4.103	41	30.5	32
41	2.294	21	1.740	14	17.5	17
42	2.861	29	3.387	31	30.0	31
43	6.221	56	5.306	52	54.0	55
44	2.416	22	3.334	30	26.0	26
45	3.290	35	4.167	42	38.5	39
46	2.648	25	2.781	24	24.5	23
47	1.066	6	1.055	5	5.5	5
48	3.907	42	4.013	40	41.0	42
49	1.590	14	1.631	12	13.0	13
50	1.364	9	1.495	10	9.5	8
51	1.185	8	1.173	6	7.0	6
52	4.111	45	4.472	45	45.0	46
53	.000	3	.000	2	2.5	2
54	1.448	11	1.443	9	10.0	9
55	5.344	50	5.334	53	51.5	51
56	4.974	48	5.144	50	49.0	50
57	.000	4	.000	3	3.5	3
58	1.482	12	1.504	11	11.5	12
59	1.138	7	1.203	7	7.0	7
60	1.000	5	1.000	4	4.5	4

TABLE 4.34

Sectors with Lowest Average Rank Ordering Classification
Based on Variability Measures
Portugal 60x60

	Interindustry				Domestic			
			Net Case				Net Case	
	Along Column	Along Row	Along Column	Along Row	Along Column	Along Row	Along Column	Along Row
1		*						
2		*				*		
3	*				⊛	⊛		
4			*				*	
5		*				*	⊛	⊛
6		*	⊛	⊛		*	*	
7	*				*			
8	*				*			
9					*			
10	⊛	⊛					*	
11	⊛	⊛			⊛	⊛	*	
12								
13					*			
14				*				*
15			*					
16							*	
17	*		*					
18	*			*	*			
19	*		*		*			
20	*				⊛	⊛		
21								
22								
23	*		*		*		*	
24	⊛	⊛			*			
25		*		*	⊛	⊛		*
26	*			*	*			*
27	*							
28		*		*		*		*
29		*	⊛	⊛		*	*	
30					*			

TABLE 4.34
(continued)

	Interindustry				Domestic			
			Net Case				Net Case	
	Along Column	Along Row	Along Column	Along Row	Along Column	Along Row	Along Column	Along Row
31	ŏ	ŏ				*	*	
32	ŏ	ŏ			ŏ	ŏ	*	
33	*			*	*		ŏ	ŏ
34		*		*		*		*
35			ŏ	ŏ				*
36					*			
37			*				*	
38		*				*		
39		*				*		*
40	ŏ	ŏ				*		
41	*						ŏ	ŏ
42			*					
43	*				*			
44								
45			*					
46	*		*		*		*	
47		*		*		*		*
48								
49		*		*	ŏ	ŏ		*
50			ŏ	ŏ		*	ŏ	ŏ
51			ŏ	ŏ			ŏ	ŏ
52								
53			ŏ	ŏ				*
54		*		*		*		*
55			*				*	
56			*				*	
57				*				*
58			ŏ	ŏ			ŏ	ŏ
59		*	ŏ	ŏ		*		*
60			ŏ	ŏ			ŏ	ŏ

TABLE 4.35

Key Sectors Based on Low Variability Measures
Portugal 60x60

Sectors	Interindustry Tables (1) Unnetted	Interindustry Tables (2) Net Case	Domestic Tables (3) Unnetted	Domestic Tables (4) Net Case
3			Low	
5				Low
6		Low		
10	Low			
11	Low		Low	
[illegible]			Low	
24	Low			
25			Low	
29		Low		
31	Low			
32	Low		Low	
33				Low
35		Low		
40	Low			
41				Low
49			Low	
50		Low		Low
51		Low		Low
53		Low		
58		Low		Low
59		Low		
60		Low		Low

TABLE 4.36

Key Sectors Based on Output Indexes
And Variability Measures

	Interindustry				Domestic			
Sectors	Key Sectors Table 4.23 (3)	Table 4.35 (1)	Key Sectors Table 4.23 (4)	Table 4.35 (2)	Key Sectors Table 4.25 (3)	Table 4.35 (3)	Key Sectors Table 4.25 (4)	Table 4.35 (4)
3					high	low	high	
5								low
6				low				
10	high	low	high					
11	high	low	high		high	low	high	
15	high		high		high		high	
20					high	low	high	
24		low						
25	high				high	low	high	
28			high					
29	high			low	high			
31	high	low	high					
32	high	low	high			low		
33								low
34	high		high					
35				low				
36							high	
38	high							
39	high							
40	high	low	high					
41								low
49						low		
50				low				low
51				low				low
53				low				
58				low				low
59				low				
60				low				low
Total	11	6	8	9	6	6	6	7
Percentage of cases with coincidence of linkage and variability terms.	45		0		66		0	

this variability information can only be used as a complement to the linkage results, because they could give an idea about the degree of concentration or dispersion of the linkage impact.

4.3 Key Sectors from an Income Linkage Viewpoint

The analysis to be pursued here is based on formulas 2.70, 72, 74, 76 for the absolute indexes and formulas 2.71, 73, 75 and 77 for the relative indexes. The results of the application of those formulas are presented in Tables 3.37 through 3.44. In each table, a rank ordering was established for each year (column) and a mean value was calculated over the two rank order years. Table 4.46 summarizes the information, considering only the sectors which are in the twenty highest positions for each indicator.

As mentioned in Section 3.3, some authors have suggested that changes in income multipliers could also provide a convenient summary measure of the stability of the national/regional structure. Table 4.45 presents the average income multipliers for the two years and for the two aggregation levels.

The percentage changes observed thus far, for the two disaggregation levels, are a result of the different disaggregation levels, and also of the relative importance of each sector in relation to gross output. When we calculate the sectoral averages of the income indicators, the gross output share of each sector to total output was excluded. This accounts for the different percentage increases/decreases between the two disaggregation levels.

TABLE 4.37

Net Type I Income Index
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.229	52	.460	44	48.0	48
2	.723	36	2.838	7	21.5	23
3	.574	39	.792	32	35.5	38
4	.529	42	.598	38	40.0	41
5	.363	45	.334	49	47.0	47
6	.155	54	.346	48	51.0	53
7	62.320	1	9.016	2	1.5	1
8	3.475	8	3.167	6	7.0	6
9	1.402	24	2.182	11	17.5	14
10	24.461	2	4.815	5	3.5	3
11	14.533	3	8.191	3	3.0	2
12	4.311	7	2.757	8	7.5	7
13	1.751	20	1.432	21	20.5	19
14	5.165	5	1.735	16	10.5	9
15	1.241	27	.841	31	29.0	30
16	1.335	25	.901	29	27.0	28
17	2.735	10	1.965	12	11.0	10
18	1.424	23	1.916	14	18.5	16
19	1.328	26	.923	27	26.5	27
20	2.590	11	1.489	18	14.5	12
21	.510	43	.407	45	44.0	44
22	.563	41	.466	43	42.0	43
23	.811	35	.768	33	34.0	34
24	1.807	19	1.186	25	22.0	24
25	1.431	22	1.463	19	20.5	20
26	.589	38	.596	39	38.5	39
27	2.378	13	1.767	15	14.0	11
28	1.073	30	.989	26	28.0	29
29	2.208	15	1.440	20	17.5	15
30	2.963	9	2.673	9	9.0	8
31	7.138	4	5.729	4	4.0	5
32	2.074	17	1.212	24	20.5	21
33	2.185	16	1.222	23	19.5	17
34	5.160	6	16.300	1	3.5	4
35	1.014	31	.630	36	33.5	33
36	1.080	29	2.598	10	19.5	18
37	.256	49	.492	42	45.5	46
38	2.353	14	1.625	17	15.5	13
39	1.164	28	1.960	13	20.5	22
40	.593	37	.917	28	32.5	31
41	.865	32	.609	37	34.5	37
42	1.535	21	.885	30	25.5	26
43	.573	40	.576	40	40.0	42
44	2.551	12	.659	35	23.5	25
45	1.851	18	.319	50	34.0	35
46	.816	34	.712	34	34.0	36
47	.292	48	.564	41	44.5	45
48	.234	51	.363	47	49.0	49
49	.362	46	.261	52	49.0	50
50	.198	53	.158	55	54.0	54
51	.241	50	.294	51	50.5	52
52	.820	33	.374	46	39.5	40
53	.491	44	1.371	22	33.0	32
54	.132	56	.112	58	57.0	57
55	.293	47	.199	53	50.0	51
56	.133	55	.180	54	54.5	55
57	.080	58	.129	57	57.5	58
58	.100	57	.132	56	56.5	56
59	.055	59	.053	59	59.0	59
60	.000	60	.000	60	60.0	60

TABLE 4.38

Type II Income Index
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	2.422	45	2.859	43	44.0	46
2	2.983	38	7.118	8	23.0	23
3	2.810	40	3.342	34	37.0	38
4	3.282	35	3.570	32	33.5	35
5	2.384	47	2.589	47	47.0	47
6	2.041	54	2.502	50	52.0	53
7	109.627	1	18.788	2	1.5	1
8	7.866	8	7.819	6	7.0	6
9	4.162	27	6.061	13	20.0	16
10	44.421	2	11.066	5	3.5	4
11	26.905	3	17.047	3	3.0	2
12	10.255	7	7.535	7	7.0	7
13	4.809	23	4.528	21	22.0	21
14	10.651	6	5.072	19	12.5	10
15	4.812	22	3.691	29	25.5	27
16	4.635	25	3.857	28	26.5	28
17	6.851	11	5.957	14	12.5	11
18	4.201	26	5.427	15	20.5	18
19	4.111	28	3.624	30	29.0	29
20	6.461	14	4.805	20	17.0	15
21	2.800	42	2.771	45	43.5	45
22	3.738	30	3.412	33	31.5	32
23	3.129	37	3.278	37	37.0	39
24	4.851	21	4.057	25	23.0	24
25	4.769	24	5.330	17	20.5	19
26	2.785	43	2.990	41	42.0	42
27	6.337	15	5.227	18	16.5	14
28	3.735	31	3.890	27	29.0	30
29	6.953	10	5.360	16	13.0	13
30	6.846	12	6.811	10	11.0	9
31	14.208	4	12.588	4	4.0	5
32	5.323	18	4.121	24	21.0	20
33	5.608	17	4.286	23	20.0	17
34	10.827	5	32.193	1	3.0	3
35	3.970	29	3.311	36	32.5	33
36	3.624	33	6.672	11	22.0	22
37	2.175	50	2.787	44	47.0	48
38	7.515	9	6.177	12	10.5	8
39	5.901	16	6.918	9	12.5	12
40	2.802	41	3.586	31	36.0	37
41	3.651	32	3.144	39	35.5	36
42	4.995	20	3.906	26	23.0	25
43	2.717	44	2.923	42	43.0	43
44	6.701	13	3.323	35	24.0	26
45	5.115	19	2.613	46	32.5	34
46	3.139	36	3.178	38	37.0	40
47	2.401	46	3.082	40	43.0	44
48	2.138	52	2.532	49	50.5	50
49	2.354	48	2.340	52	50.0	49
50	2.100	53	2.179	55	54.0	54
51	2.148	51	2.403	51	51.0	51
52	3.416	34	2.547	48	41.0	41
53	2.924	39	4.434	22	30.5	31
54	1.969	55	2.072	58	56.5	56
55	2.236	49	2.227	53	51.0	52
56	1.957	56	2.188	54	55.0	55
57	.138	60	.240	60	60.0	60
58	1.942	58	2.122	56	57.0	57
59	1.952	57	2.089	57	57.0	58
60	1.728	59	1.854	59	59.0	59

TABLE 4.39

Net Type I Income Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.161	53	.294	40	46.5	50
2	1.419	10	2.029	5	7.5	6
3	.348	42	.436	27	34.5	34
4	.372	40	.406	30	35.0	36
5	.296	45	.244	45	45.0	46
6	.114	54	.237	46	50.0	52
7	50.572	1	7.065	1	1.0	1
8	2.932	4	2.429	3	3.5	3
9	1.261	14	1.794	6	10.0	9
10	11.074	2	1.537	8	5.0	4
11	8.105	3	2.793	2	2.5	2
12	2.732	5	1.056	12	8.5	7
13	1.591	8	1.238	11	9.5	8
14	.726	26	.380	31	28.5	27
15	.667	29	.415	29	29.0	29
16	.421	37	.380	32	34.5	35
17	1.005	16	.818	18	17.0	16
18	.921	19	1.246	10	14.5	12
19	.954	18	.562	22	20.0	21
20	1.339	13	.630	21	17.0	17
21	.352	41	.265	43	42.0	42
22	.447	34	.371	33	33.5	32
23	.529	33	.370	34	33.5	33
24	1.399	11	.834	17	14.0	11
25	.968	17	.943	13	15.0	13
26	.402	38	.299	38	38.0	37
27	1.062	15	.715	19	17.0	18
28	.436	35	.191	49	42.0	43
29	1.385	12	.637	20	16.0	15
30	2.379	7	2.324	4	5.5	5
31	2.725	6	.941	14	10.0	10
32	.858	22	.442	26	24.0	24
33	.907	20	.443	25	22.5	22
34	.840	23	1.565	7	15.0	14
35	.725	27	.369	35	31.0	31
36	.699	28	1.382	9	18.5	19
37	.182	50	.292	41	45.5	47
38	.878	21	.348	36	28.5	28
39	.553	32	.929	15	23.5	23
40	.224	47	.296	39	43.0	45
41	.429	36	.229	47	41.5	40
42	.830	24	.447	24	24.0	25
43	.374	39	.251	44	41.5	41
44	1.421	9	.417	28	18.5	20
45	.737	25	.159	52	38.5	38
46	.630	30	.465	23	26.5	26
47	.211	49	.267	42	45.5	48
48	.215	48	.314	37	42.5	44
49	.330	43	.200	48	45.5	49
50	.167	52	.130	54	53.0	54
51	.177	51	.177	50	50.5	53
52	.641	31	.174	51	41.0	39
53	.321	44	.875	16	30.0	30
54	.108	55	.094	57	56.0	56
55	.248	46	.154	53	49.5	51
56	.100	56	.127	55	55.5	55
57	.077	58	.119	56	57.0	57
58	.079	57	.092	58	57.5	58
59	.048	59	.044	59	59.0	59
60	.000	60	.000	60	60.0	60

TABLE 4.40

Type II Income Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	2.048	45	2.086	37	41.0	41
2	3.740	13	4.641	5	9.0	7
3	2.150	41	2.210	33	37.0	36
4	2.545	34	2.649	22	28.0	29
5	2.004	47	1.907	47	47.0	50
6	1.759	54	1.895	48	51.0	52
7	79.800	1	12.508	1	1.0	1
8	6.193	5	5.328	3	4.0	3
9	3.493	16	4.398	6	11.0	9
10	18.967	2	4.111	7	4.5	4
11	14.113	3	5.813	2	2.5	2
12	6.461	4	3.320	13	8.5	6
13	4.045	9	3.442	11	10.0	8
14	2.665	30	2.115	35	32.5	33
15	3.337	19	2.297	26	22.5	24
16	2.604	33	2.267	27	30.0	30
17	3.432	17	3.151	15	16.0	13
18	2.972	24	3.449	10	17.0	15
19	3.094	21	2.408	24	22.5	25
20	3.815	12	2.586	23	17.5	17
21	2.237	39	2.047	39	39.0	37
22	3.161	20	2.654	21	20.5	21
23	2.360	37	2.100	36	36.5	35
24	3.705	14	2.811	18	16.0	14
25	3.390	18	3.423	12	15.0	12
26	2.196	40	2.010	41	40.5	39
27	3.622	15	2.693	20	17.5	18
28	2.302	38	1.920	45	41.5	42
29	4.573	8	2.721	19	13.5	11
30	5.216	7	5.092	4	5.5	5
31	5.812	6	2.990	16	11.0	10
32	2.870	28	2.214	32	30.0	31
33	2.956	25	2.251	29	27.0	27
34	2.942	26	3.947	8	17.0	16
35	3.076	22	2.307	25	23.5	26
36	2.651	31	3.649	9	20.0	20
37	1.829	51	1.996	42	46.5	48
38	3.845	10	2.199	34	22.0	23
39	2.873	27	3.301	14	20.5	22
40	1.917	49	1.988	43	46.0	47
41	2.368	36	1.925	44	40.0	38
42	2.981	23	2.218	31	27.0	28
43	2.121	42	1.917	46	44.0	45
44	3.821	11	2.265	28	19.5	19
45	2.780	29	1.793	52	40.5	40
46	2.518	35	2.245	30	32.5	34
47	2.015	46	2.083	38	42.0	44
48	1.881	50	2.017	40	45.0	46
49	2.053	44	1.839	49	46.5	49
50	1.826	52	1.755	54	53.0	54
51	1.821	53	1.806	50	51.5	53
52	2.633	32	1.798	51	41.5	43
53	2.094	43	2.871	17	30.0	32
54	1.720	56	1.684	58	57.0	57
55	1.929	48	1.770	53	50.5	51
56	1.698	58	1.726	55	56.5	56
57	.118	60	.182	60	60.0	60
58	1.701	57	1.690	57	57.0	58
59	1.733	55	1.712	56	55.5	55
60	1.544	59	1.532	59	59.0	59

TABLE 4.41

Weighted Net Type I Income Index
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.006	56	.020	54	55.0	55
2	.121	36	.544	19	27.5	26
3	.050	46	.095	45	45.5	44
4	.069	43	.149	37	40.0	42
5	.326	24	.536	20	22.0	20
6	.141	34	.456	22	28.0	27
7	5.342	3	1.160	12	7.5	7
8	1.499	8	3.033	4	6.0	5
9	1.124	11	1.587	10	10.5	11
10	16.728	1	4.578	3	2.0	2
11	5.197	4	2.782	6	5.0	3
12	.350	23	.428	24	23.5	22
13	.621	14	.584	17	15.5	14
14	3.538	5	1.961	9	7.0	6
15	.192	32	.308	30	31.0	32
16	.116	37	.109	42	39.5	40
17	1.181	10	1.124	13	11.5	12
18	.079	42	.187	34	38.0	37
19	.365	22	.455	23	22.5	21
20	1.612	7	1.974	8	7.5	8
21	.102	40	.129	38	39.0	39
22	.135	35	.163	35	35.0	36
23	.205	31	.322	28	29.5	29
24	.560	17	.549	18	17.5	17
25	.276	26	.405	25	25.5	24
26	.094	41	.125	39	40.0	43
27	1.009	12	2.002	7	9.5	10
28	.389	21	.315	29	25.0	23
29	.189	33	.229	33	33.0	35
30	3.035	6	2.946	5	5.5	4
31	8.667	2	19.040	1	1.5	1
32	1.496	9	1.020	14	11.5	13
33	.398	20	.239	32	26.0	25
34	.470	18	.859	15	16.5	16
35	.570	16	.469	21	18.5	19
36	.292	25	1.235	11	18.0	18
37	.036	48	.095	46	47.0	49
38	.239	29	.264	31	30.0	31
39	.598	15	.804	16	15.5	15
40	.036	49	.097	44	46.5	46
41	.063	45	.078	48	46.5	47
42	.253	28	.159	36	32.0	33
43	.110	38	.110	41	39.5	41
44	.266	27	.059	49	38.0	38
45	.465	19	.119	40	29.5	30
46	.017	53	.018	55	54.0	54
47	.030	50	.105	43	46.5	48
48	.841	13	4.981	2	[illegible]	9
49	.217	30	.330	27	28.5	28
50	.003	58	.004	58	58.0	58
51	.025	51	.053	50	50.5	51
52	.069	44	.085	47	45.5	45
53	.107	39	.388	26	32.5	34
54	.022	52	.026	53	52.5	52
55	.038	47	.043	51	49.0	50
56	.010	54	.016	56	55.0	56
57	.009	55	.034	52	53.5	53
58	.004	57	.010	57	57.0	57
59	.002	59	.004	59	[illegible]	59
60	.000	60	.000	60	[illegible]	60

TABLE 4.42

Weighted Type II Income Index
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.444	9	2.273	7	8.0	9
2	.267	36	1.330	12	24.0	23
3	.842	14	1.456	11	12.5	12
4	.427	24	.505	30	27.0	28
5	.038	58	.056	57	57.5	58
6	.039	57	.086	56	56.5	56
7	26.166	1	6.919	2	1.5	1
8	.358	29	.342	40	34.5	32
9	.144	49	.477	31	40.0	40
10	1.803	5	.663	23	14.0	13
11	1.974	3	2.770	5	4.0	3
12	3.786	2	2.875	4	3.0	2
13	.400	26	.728	20	23.0	22
14	.444	23	.251	48	35.5	33
15	.536	19	.423	33	26.0	26
16	1.411	10	1.675	10	10.0	10
17	.412	25	.600	27	26.0	27
18	1.488	8	2.326	6	7.0	7
19	.227	41	.229	50	45.5	48
20	.203	44	.154	54	49.0	52
21	.242	39	.374	38	38.5	36
22	.262	37	.398	34	35.5	34
23	.159	47	.231	49	48.0	50
24	.246	38	.340	41	39.5	38
25	.367	27	.667	22	24.5	25
26	.208	43	.386	36	39.5	39
27	.334	33	.208	52	42.5	44
28	.153	48	.393	35	41.5	42
29	1.292	11	1.149	13	12.0	11
30	.127	53	.335	42	47.5	49
31	.287	34	.221	51	42.5	45
32	.108	55	.151	55	55.0	55
33	.565	17	.725	21	19.0	17
34	.979	12	9.469	1	6.5	5
35	.136	52	.181	53	52.5	54
36	.126	54	.321	43	48.5	51
37	.172	45	.429	32	38.5	37
38	.861	13	.818	15	14.0	14
39	.144	50	.366	39	44.5	47
40	.494	21	.773	17	19.0	18
41	.719	15	.650	24	19.5	19
42	.646	16	.830	14	15.0	15
43	.170	46	.382	37	41.5	43
44	1.509	7	2.235	8	7.5	8
45	.285	35	.276	46	40.5	41
46	1.569	6	3.173	3	4.5	4
47	.345	32	.563	28	30.0	30
48	.008	60	.006	60	60.0	60
49	.044	56	.053	58	57.0	57
50	1.912	4	2.228	9	6.5	6
51	.359	28	.548	29	28.5	29
52	.352	31	.315	44	37.5	35
53	.225	42	.611	26	34.0	31
54	.143	51	.269	47	49.0	53
55	.231	40	.296	45	42.5	46
56	.353	30	.739	18	24.0	24
57	.020	59	.043	59	59.0	59
58	.501	20	.633	25	22.0	21
59	.437	22	.739	19	20.5	20
60	.550	18	.785	16	17.0	16

TABLE 4.43

Weighted Net Type I Income Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.010	56	.035	54	55.0	55
2	.492	19	1.006	15	17.0	17
3	.058	46	.112	46	46.0	46
4	.093	42	.252	33	37.5	38
5	.521	18	.920	18	18.0	19
6	.214	35	.841	20	27.5	26
7	7.918	2	1.954	9	5.5	6
8	2.380	6	5.329	3	4.5	3
9	2.048	7	3.226	5	6.0	8
10	13.107	1	2.548	6	3.5	2
11	5.462	3	1.991	8	5.5	7
12	.435	24	.371	28	26.0	25
13	1.134	11	1.212	12	11.5	10
14	.451	21	.551	26	23.5	22
15	.202	36	.355	29	32.5	32
16	.053	48	.100	48	48.0	48
17	.782	15	1.164	13	14.0	14
18	.089	43	.263	32	37.5	39
19	.474	20	.589	25	22.5	21
20	1.613	8	1.933	11	9.5	9
21	.160	37	.228	37	37.0	37
22	.231	34	.317	31	32.5	33
23	.264	32	.430	27	29.5	28
24	.936	13	1.027	14	13.5	13
25	.394	25	.670	23	24.0	23
26	.130	40	.154	42	41.0	42
27	.880	14	1.949	10	12.0	11
28	.352	28	.197	38	33.0	34
29	.281	31	.325	30	30.5	29
30	5.351	4	6.153	2	3.0	1
31	5.060	5	4.457	4	4.5	4
32	1.345	10	.991	16	13.0	12
33	.356	27	.236	35	31.0	31
34	.441	23	.808	21	22.0	20
35	.955	12	.846	19	15.5	16
36	.448	22	2.057	7	14.5	15
37	.056	47	.164	41	44.0	44
38	.249	33	.246	34	33.5	36
39	.573	17	.950	17	17.0	18
40	.039	51	.113	45	48.0	49
41	.074	44	.093	50	47.0	47
42	.329	30	.234	36	33.0	35
43	.153	35	.142	43	40.5	41
44	.344	29	.107	47	38.0	40
45	.659	16	.190	39	27.5	27
46	.027	53	.029	55	54.0	54
47	.050	49	.182	40	44.5	45
48	1.511	9	10.150	1	5.0	5
49	.381	26	.604	24	25.0	24
50	.004	58	.007	58	58.0	58
51	.040	50	.098	49	49.5	51
52	.101	41	.132	44	42.5	43
53	.151	39	.712	22	30.5	30
54	.038	52	.052	53	52.5	52
55	.062	45	.079	51	48.0	50
56	.015	55	.028	56	55.5	56
57	.016	54	.071	52	53.0	53
58	.007	57	.017	57	57.0	57
59	.004	59	.007	59	59.0	59
60	.000	60	.000	60	60.0	60

TABLE 4.44

Weighted Type II Income Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.760	5	3.037	4	4.5	4
2	.482	22	1.588	12	17.0	14
3	.929	12	1.764	10	11.0	10
4	.477	23	.686	27	25.0	25
5	.047	58	.076	58	58.0	58
6	.048	57	.120	55	56.0	56
7	27.455	1	8.435	1	1.0	1
8	.406	28	.427	41	34.5	34
9	.174	45	.634	28	36.5	36
10	1.110	11	.451	38	24.5	24
11	1.493	7	1.729	11	9.0	8
12	3.438	2	2.320	7	4.5	5
13	.484	21	1.013	17	19.0	18
14	.160	49	.191	52	50.5	52
15	.536	19	.482	34	26.5	28
16	1.143	10	1.803	9	9.5	9
17	.298	33	.581	29	31.0	30
18	1.517	6	2.707	6	6.0	6
19	.246	38	.279	48	43.0	42
20	.173	46	.152	53	49.5	49
21	.278	35	.506	33	34.0	33
22	.320	32	.566	30	31.0	31
23	.172	47	.271	49	48.0	47
24	.271	37	.431	39	38.0	40
25	.376	31	.784	20	25.5	26
26	.237	39	.475	35	37.0	38
27	.275	36	.196	51	43.5	44
28	.136	52	.355	44	48.0	48
29	1.225	9	1.068	15	12.0	11
30	.139	51	.459	36	43.5	45
31	.169	48	.096	56	52.0	54
32	.084	55	.149	54	54.5	55
33	.429	26	.698	25	25.5	27
34	.383	30	2.239	8	19.0	19
35	.152	50	.231	50	50.0	51
36	.133	53	.321	46	49.5	50
37	.209	42	.562	31	36.5	37
38	.635	15	.531	32	23.5	22
39	.101	54	.320	47	50.5	53
40	.487	20	.784	21	20.5	21
41	.673	14	.729	23	18.5	16
42	.556	18	.915	19	18.5	17
43	.191	43	.458	37	40.0	41
44	1.239	8	2.789	5	6.5	7
45	.224	41	.347	45	43.0	43
46	1.814	4	4.105	2	3.0	2
47	.418	27	.697	26	26.5	29
48	.011	60	.009	60	60.0	60
49	.056	56	.077	57	56.5	57
50	2.271	3	3.286	3	3.0	3
51	.439	25	.754	22	23.5	23
52	.391	29	.407	42	35.5	35
53	.232	40	.725	24	32.0	32
54	.181	44	.400	43	43.5	46
55	.287	34	.431	40	37.0	39
56	.441	24	1.068	16	20.0	20
57	.025	59	.060	59	59.0	59
58	.633	16	.931	18	17.0	15
59	.624	17	1.109	14	15.5	13
60	.708	13	1.188	13	13.0	12

TABLE 4.45

Average Income Multipliers
Portugal 70/74

	16x16 1970	16x16 1974	Percent Change	60x60 1970	60x60 1974	Percent Change
Domestic Net Type I	.757	.463	-39%	1.868	0.745	-60.1%
Interindustry Net Type I	1.242	.912	-27%	2.994	1.652	-44.8%
Domestic Type II	2.858	3.294	+15%	4.569	2.729	-40.3%
Interindustry Type II	4.267	3.939	-9%	7.155	5.074	-29.1%

At the 60x60 level, decreases in all four indicators were observed. The 60.1 percent decrease observed in the Domestic Net Type I indicator, showing more intense intrasectoral relations in the 1970-74 period, was the major decrease observed in the indicators. The decrease of 40.3 percent from 1970 to 1974 in the Domestic type II indicator in contrast with an increase of 15 percent for the 16x16 level, shows that this kind of information can be misleading, if one fails to consider the gross output share of each sector. Again, the decreases observed in the 60x60 level are lower in the interindustry cases than the domestic ones. This could signify a high import dependence for 1974 compared with 1970, which could be a direct result of the oil crisis (and price increase) of 1973.

Referring to Table 4.46, we observe that in the 16x16 disaggregation level, interindustry and the domestic indicators are very similar. Only in 23 percent of the sectors we observe some changes (Sectors 2, 10, 13, 14, 24, 32, 33, 36, 38, 39, 40, 44, 56, and 58), and only in 11 percent of the cases could the changes be called significant, if by significant we meant two or more changes in the four classifications procedures that we have obtained. Those sectors are: Sector 2 - Forestries, now a key sector in all classification procedures, showing a total independence from imports, for key sector considerations. Sector 13 - Beverages, also a key sector in all domestic classifications, when before it was only in net terms, showing now independence from imports and also from itself. Sectors 14 - Tobacco Manufactures, Sector 33 - Other Chemicals and Sector 38 - Primary Iron and Steel Manufacturing, lose their key sector position in domestic terms, showing a high import composition. Sector 24 - Paper Pulp, and Sector 44 - Transportation Equipment, in domestic terms, rose from one to three key positions in the four classification procedures obtained. Again, import independence is responsible.

A comparison of the rank ordering obtained from the absolute indexes with the rank ordering obtained from the labor coefficients for those years is also of interest. Table 4.47 represents those coefficients and the rank orderings. As we observed in the 16x16 case, high labor coefficient values do not mean higher indices. More detailed analysis of the summarized results of Table 4.46 could be pursued. However, more general conclusions will be made in Section 4.5.

TABLE 4.46

Key Sectors Based on Income Indexes
Portugal 60x60

	Interindustry				Domestic			
	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I
1	*				*			
2					*	*	*	*
3	*				*			
4								
5		*				*		
6								
7	*	*	*	*	*	*	*	*
8		*	*	*		*	*	*
9		*	*	*		*	*	*
10	*	*	*	*		*	*	*
11	*	*	*	*	*	*	*	*
12	*		*	*	*		*	*
13		*		*	*	*	*	*
14		*	*	*				
15								
16	*				*			
17		*	*	*		*	*	*
18	*		*	*	*		*	*
19								
20		*	*	*		*	*	*
21								
22								
23								
24		*				*	*	*
25			*	*			*	*
26								
27		*	*	*		*	*	*
28								
29	*		*	*	*		*	*
30		*	*	*		*	*	*

TABLE 4.46
(continued)

	Interindustry				Domestic			
	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I
31		*	*	*		*	*	*
32		*	*			*		
33	*		*	*				
34	*	*	*	*	*	*	*	*
35		*				*		
36		*		*		*	*	*
37								
38	*		*	*				
39		*	*			*		
40	*							
41	*				*			
42	*				*			
43								
44	*				*		*	*
45								
46	*				*			
47								
48		*				*		
49								
50	*				*			
51								
52								
53								
54								
55								
56					*			
57								
58					*			
59	*				*			
60	*				*			

TABLE 4.47

Labor Coefficients

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.356	8	.224	32	20.0	20
2	.027	56	.012	59	57.5	58
3	.285	13	.214	33	23.0	24
4	.284	14	.349	19	16.5	13
5	.223	22	.350	17	19.5	18
6	.511	5	.380	15	10.0	10
7	.007	59	.038	57	58.0	59
8	.074	48	.119	48	48.0	48
9	.212	25	.110	52	38.5	41
10	.017	58	.065	53	55.5	55
11	.027	57	.043	55	56.0	57
12	.068	49	.112	51	50.0	50
13	.116	36	.171	40	38.0	40
14	.044	54	.114	50	52.0	52
15	.153	29	.259	26	27.5	29
16	.133	34	.208	35	34.5	33
17	.104	41	.142	45	43.0	44
18	.177	27	.177	39	33.0	32
19	.152	30	.350	18	24.0	25
20	.108	39	.205	36	37.5	38
21	.214	24	.293	24	24.0	26
22	.125	35	.196	37	36.0	36
23	.248	18	.301	23	20.5	21
24	.067	50	.128	46	48.0	49
25	.089	44	.123	47	45.5	47
26	.266	16	.359	16	16.0	12
27	.089	45	.166	41	43.0	45
28	.143	33	.258	27	30.0	30
29	.076	47	.165	42	44.5	46
30	.034	55	.042	56	55.5	56
31	.051	51	.058	54	52.5	53
32	.104	40	.251	29	34.5	34
33	.101	43	.234	31	37.0	37
34	.049	52	.028	58	55.0	54
35	.146	31	.312	22	26.5	28
36	.110	38	.144	44	41.0	43
37	.356	9	.288	25	17.0	14
38	.046	53	.116	49	51.0	51
39	.146	32	.160	43	37.5	39
40	.253	17	.323	21	19.0	17
41	.174	28	.404	14	21.0	22
42	.102	42	.257	28	35.0	35
43	.271	15	.412	12	13.5	11
44	.088	46	.208	34	40.0	42
45	.113	37	.547	8	22.5	23
46	.240	19	.340	20	19.5	19
47	.229	20	.237	30	25.0	27
48	.346	11	.650	3	7.0	6
49	.352	10	.649	4	7.0	7
50	.226	21	.407	13	17.0	15
51	.394	7	.615	6	6.5	5
52	.220	23	.429	11	17.0	16
53	.201	26	.182	38	32.0	31
54	.513	4	.552	7	5.5	3
55	.325	12	.639	5	8.5	9
56	.607	3	.528	9	6.0	4
57	.000	60	.000	60	60.0	60
58	.663	2	.786	2	2.0	2
59	.423	6	.524	10	8.0	8
60	1.000	1	1.000	1	1.0	1

4.4 Key Sectors from an Employment Linkage Viewpoint

The use of formulas 2.107, 108, 109, 110 for the "actual indexes" and 2.103, 104, 105 and 106 for the "potential indexes" produced tables 4.48 through 4.55. The construction of the tables follows the same procedures as in previous sections. Table 4.56 summarizes the information.

As in the income linkage case, there is a good deal of stability of chosen sectors in interindustry and in domestic terms. In 75 percent of the sectors no changes were observed. From the other 25 percent of the sectors, only 8 percent (5 sectors) change in two or more classification procedures used. Those sectors are: Sector 14 - Tobacco Manufactures, and Sector 17 - Fiber Textiles. They are key sectors in all classifications of the interindustry case. However, in the domestic case, these sectors became the key sectors in only one of the four procedures. This reveals the big influence of imports on the dominance of the sectors. As a matter of fact, almost all the raw materials for those industries (tobacco, synthetic fibers) are imported from other countries. Sectors 25 - Cardboard and Cardboard Articles and Sector 44 - Transportation Equipment, which are not ranked as key sectors in interindustry terms, are key sectors in domestic terms for the absolute value procedures. That means that despite the lesser importance of those sectors in the overall gross output composition, they are independent of imports for key sector considerations from an absolute point of view. Sector 33, on the contrary, shows a heavy dependence on imports, losing two positions when we analyze the domestic data. More general conclusions will be drawn in the next section.

TABLE 4.48

Net Type I Employment Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.071	57	.063	57	57.0	58
2	.292	39	.536	28	33.5	32
3	.155	48	.162	48	48.0	48
4	.349	38	.272	39	38.5	40
5	.152	49	.186	46	47.5	47
6	.071	58	.134	51	54.5	54
7	31.271	1	19.920	1	1.0	1
8	5.838	5	4.856	3	4.0	4
9	3.585	7	4.124	6	6.5	5
10	12.483	3	4.280	4	3.5	3
11	20.054	2	7.093	2	2.0	2
12	4.308	6	1.493	11	8.5	9
13	2.739	8	2.787	7	7.5	6
14	.570	27	.603	24	25.5	25
15	.815	22	.574	27	24.5	24
16	.199	43	.377	33	38.0	39
17	.732	25	.777	20	22.5	22
18	1.019	15	.944	18	16.5	17
19	.564	28	.425	29	28.5	28
20	2.659	9	1.060	14	11.5	11
21	.173	47	.194	44	45.5	45
22	.248	41	.286	37	39.0	41
23	.475	32	.255	41	36.5	37
24	1.501	13	1.317	13	13.0	12
25	.945	17	.751	22	19.5	19
26	.415	34	.304	36	35.0	34
27	.837	21	.662	23	22.0	21
28	.210	42	.242	43	42.5	44
29	2.039	11	1.060	15	13.0	13
30	1.799	12	2.187	9	10.5	10
31	6.032	4	1.468	12	8.0	8
32	.701	26	.777	21	23.5	23
33	.964	16	.879	19	17.5	18
34	2.139	10	4.233	5	7.5	7
35	.360	36	.353	34	35.0	35
36	.848	19	2.522	8	13.5	14
37	.136	52	.187	45	48.5	49
38	.777	23	.405	30	26.5	26
39	.759	24	.960	17	20.5	20
40	.183	45	.276	38	41.5	43
41	.492	31	.252	42	36.5	38
42	.555	29	.595	25	27.0	27
43	.445	33	.330	35	34.0	33
44	1.160	14	.992	16	15.0	15
45	.185	44	.180	47	45.5	46
46	.395	35	.405	31	33.0	31
47	.364	37	.583	26	31.5	30
48	.291	40	.379	32	36.0	36
49	.510	30	.140	49	39.5	42
50	.101	55	.097	55	55.0	55
51	.135	53	.136	50	51.5	51
52	.856	18	.264	40	29.0	29
53	.841	20	1.763	10	15.0	16
54	.103	54	.075	56	55.0	56
55	.181	46	.062	58	52.0	52
56	.147	50	.132	52	51.0	50
57	.000	59	.000	59	59.0	59
58	.079	56	.099	54	55.0	57
59	.143	51	.107	53	52.0	53
60	.000	60	.000	60	60.0	60

TABLE 4.49

Weighted Net Type I Employment Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.004	57	.005	57	57.0	57
2	.080	40	.182	34	37.0	37
3	.021	52	.033	50	51.0	52
4	.069	43	.111	42	42.5	43
5	.229	26	.482	21	23.5	25
6	.119	36	.330	25	30.5	29
7	3.334	5	3.336	8	6.5	7
8	3.285	6	6.773	2	4.0	3
9	4.408	4	5.118	4	4.0	4
10	11.758	1	5.345	3	2.0	1
11	9.476	3	3.762	6	4.5	5
12	.509	16	.370	23	19.5	19
13	1.451	10	1.750	11	10.5	10
14	.270	25	.546	19	22.0	21
15	.190	30	.317	26	28.0	27
16	.022	51	.075	45	48.0	48
17	.436	18	.687	17	17.5	17
18	.070	42	.125	40	41.0	42
19	.217	27	.292	29	28.0	28
20	2.205	8	2.064	10	9.0	9
21	.058	45	.106	43	44.0	44
22	.088	39	.149	37	38.0	38
23	.152	32	.191	33	32.5	33
24	.822	13	1.109	15	14.0	13
25	.321	23	.396	22	22.5	22
26	.106	37	.104	44	40.5	41
27	.531	15	1.188	14	14.5	15
28	.143	33	.165	35	34.0	34
29	.338	21	.359	24	22.5	23
30	2.764	7	3.371	7	7.0	8
31	9.488	2	4.906	5	3.5	2
32	.860	12	1.202	13	12.5	12
33	.298	24	.316	27	25.5	26
34	.987	11	1.427	12	11.5	11
35	.413	20	.544	20	20.0	20
36	.424	19	2.126	9	14.0	14
37	.033	47	.068	48	47.5	47
38	.196	29	.202	32	30.5	30
39	.580	14	.636	18	16.0	16
40	.027	48	.074	46	47.0	46
41	.062	44	.069	47	45.5	45
42	.166	31	.205	31	31.0	31
43	.123	35	.119	41	38.0	39
44	.209	28	.156	36	32.0	32
45	.126	34	.138	38	36.0	36
46	.012	54	.015	54	54.0	54
47	.074	41	.266	30	35.5	35
48	1.464	9	7.323	1	5.0	6
49	.446	17	.308	28	22.5	24
50	.002	58	.003	58	58.0	58
51	.025	50	.049	49	49.5	50
52	.099	38	.133	39	38.5	40
53	.322	22	.790	16	19.0	18
54	.027	49	.025	51	50.0	51
55	.035	46	.021	52	49.0	49
56	.016	53	.019	53	53.0	53
57	.000	59	.000	59	59.0	59
58	.005	56	.009	56	56.0	56
59	.010	55	.012	55	55.0	55
60	.000	60	.000	60	60.0	60

TABLE 4.50

Type II Employment Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.713	57	1.400	58	57.5	58
2	1.743	56	2.319	42	49.0	48
3	1.504	59	1.396	59	59.0	59
4	2.754	33	2.616	35	34.0	34
5	1.942	46	2.244	43	44.5	45
6	1.816	52	1.787	54	53.0	54
7	40.952	1	25.734	1	1.0	1
8	9.395	5	7.966	5	5.0	4
9	7.443	7	7.475	6	6.5	6
10	20.524	3	9.535	4	3.5	3
11	29.631	2	11.870	2	2.0	2
12	8.534	6	3.704	21	13.5	14
13	5.987	10	5.785	9	9.5	8
14	2.859	31	3.707	20	25.5	26
15	3.645	22	2.624	34	28.0	29
16	2.174	43	2.384	39	41.0	39
17	3.023	29	3.398	23	26.0	27
18	3.170	28	3.025	29	28.5	30
19	2.257	41	2.196	45	43.0	43
20	5.387	11	3.230	25	18.0	16
21	1.762	55	2.032	48	51.5	50
22	2.638	34	2.685	33	33.5	32
23	2.206	42	1.944	51	46.5	47
24	4.660	13	4.890	12	12.5	13
25	3.954	19	3.747	19	19.0	17
26	2.609	35	2.450	38	36.5	38
27	3.340	26	3.026	28	27.0	28
28	1.922	47	2.589	36	41.5	40
29	6.951	9	4.596	13	11.0	10
30	4.535	14	5.392	10	12.0	11
31	12.059	4	5.031	11	7.5	7
32	2.958	30	4.210	17	23.5	24
33	3.340	27	3.945	18	22.5	23
34	7.370	8	10.734	3	5.5	5
35	2.450	38	2.695	32	35.0	37
36	3.963	17	6.903	7	12.0	12
37	1.878	51	1.918	52	51.5	51
38	4.504	15	3.181	26	20.5	20
39	4.124	16	4.213	16	16.0	15
40	2.032	45	2.382	40	42.5	41
41	2.791	32	2.500	37	34.5	36
42	2.507	36	3.110	27	31.5	31
43	2.493	37	2.708	31	34.0	35
44	3.511	24	4.548	14	19.0	18
45	1.548	58	2.161	46	52.0	52
46	2.060	44	2.367	41	42.5	42
47	3.507	25	4.229	15	20.0	19
48	3.752	21	3.583	22	21.5	21
49	3.639	23	2.198	44	33.5	33
50	1.794	54	1.886	53	53.5	56
51	1.889	50	1.960	50	50.0	49
52	3.963	18	3.002	30	24.0	25
53	5.062	12	5.809	8	10.0	9
54	2.298	40	2.019	49	44.5	46
55	1.903	49	1.450	57	53.0	55
56	2.350	39	2.154	47	43.0	44
57	.000	60	.000	60	60.0	60
58	1.815	53	1.764	55	54.0	57
59	3.856	20	3.259	24	22.0	22
60	1.920	48	1.673	56	52.0	53

TABLE 4.51

Weighted Type II Employment Index
Domestic Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.051	58	.052	59	58.5	58
2	.133	48	.179	43	45.5	46
3	.057	56	.062	57	56.5	56
4	.184	41	.229	39	40.0	40
5	.764	17	1.128	12	14.5	14
6	.574	19	.510	23	21.0	21
7	1.943	8	1.339	11	9.5	8
8	2.160	7	3.076	3	5.0	4
9	3.006	5	2.207	5	5.0	5
10	7.299	3	3.047	4	3.5	3
11	5.637	4	1.670	9	6.5	6
12	.366	27	.218	40	33.5	35
13	1.007	14	.829	19	16.5	16
14	.549	21	1.034	14	17.5	19
15	.287	32	.307	32	32.0	32
16	.082	53	.109	51	52.0	53
17	.460	24	.532	22	23.0	23
18	.106	51	.129	49	50.0	50
19	.280	35	.365	28	31.5	31
20	1.648	10	1.360	10	10.0	9
21	.136	47	.187	42	44.5	43
22	.237	38	.275	35	36.5	37
23	.285	33	.289	33	33.0	34
24	.939	16	.982	17	16.5	17
25	.479	23	.440	24	23.5	24
26	.283	34	.244	37	35.5	36
27	.571	20	1.055	13	16.5	18
28	.304	30	.341	31	30.5	29
29	.431	25	.376	26	25.5	25
30	2.437	6	1.963	7	6.5	7
31	7.326	2	4.372	2	2.0	2
32	1.206	12	1.698	8	10.0	10
33	.330	28	.374	27	27.5	26
34	1.057	13	.832	18	15.5	15
35	.528	22	.643	21	21.5	22
36	.997	15	2.065	6	10.5	11
37	.168	43	.153	48	45.5	47
38	.377	26	.355	29	27.5	27
39	1.381	11	.990	16	13.5	13
40	.107	50	.163	46	48.0	48
41	.142	45	.178	44	44.5	44
42	.194	40	.235	38	39.0	39
43	.303	31	.282	34	32.5	33
44	.200	39	.164	45	42.0	42
45	.159	44	.262	36	40.0	41
46	.056	57	.065	56	56.5	57
47	.253	37	.398	25	31.0	30
48	8.801	1	19.232	1	1.0	1
49	1.690	9	1.032	15	12.0	12
50	.045	59	.058	58	58.5	59
51	.103	52	.126	50	51.0	52
52	.331	29	.355	30	29.5	28
53	.709	18	.715	20	19.0	20
54	.256	36	.189	41	38.5	38
55	.139	46	.104	53	49.5	49
56	.127	49	.106	52	50.5	51
57	.000	60	.000	60	60.0	60
58	.072	54	.087	54	54.0	54
59	.177	42	.161	47	44.5	45
60	.071	55	.072	55	55.0	55

TABLE 4.52

**Net Type I Employment Index
Interindustry Tables**

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.103	58	.099	56	57.0	58
2	.362	44	.772	33	38.5	39
3	.265	46	.331	45	45.5	46
4	.531	38	.444	42	40.0	41
5	.199	51	.266	48	49.5	49
6	.110	56	.203	50	53.0	52
7	36.325	1	23.392	4	2.5	2
8	6.499	8	5.747	7	7.5	7
9	3.842	10	4.541	8	9.0	9
10	30.429	3	22.269	5	4.0	5
11	33.880	2	24.419	2	2.0	1
12	6.742	7	4.363	10	8.5	8
13	2.941	12	3.022	11	11.5	11
14	8.921	6	8.000	6	6.0	6
15	1.724	20	1.315	26	23.0	25
16	1.110	28	1.336	25	26.5	27
17	2.658	13	2.913	13	13.0	12
18	1.707	21	1.677	23	22.0	23
19	.851	31	.804	32	31.5	29
20	4.972	9	2.917	12	10.5	10
21	.238	47	.296	47	47.0	47
22	.280	45	.352	44	44.5	45
23	.706	32	.518	40	36.0	36
24	1.912	19	1.892	22	20.5	20
25	1.440	25	1.209	27	26.0	26
26	.622	34	.596	36	35.0	35
27	2.098	16	2.295	17	16.5	15
28	.545	36	1.134	29	32.5	30
29	3.371	11	2.558	15	13.0	13
30	1.994	18	2.451	16	17.0	17
31	19.473	4	23.775	3	3.5	4
32	1.693	22	2.239	19	20.5	21
33	2.449	14	2.262	18	16.0	14
34	15.777	5	39.429	1	3.0	3
35	.528	39	.596	37	38.0	38
36	1.513	24	4.474	9	16.5	16
37	.201	50	.319	46	48.0	48
38	2.362	15	2.096	20	17.5	18
39	1.639	23	2.016	21	22.0	24
40	.461	41	.825	31	36.0	37
41	.942	30	.648	35	32.5	31
42	.985	29	1.131	30	29.5	28
43	.648	33	.707	34	33.5	34
44	2.043	17	1.471	24	20.5	22
45	.460	42	.370	43	42.5	43
46	.497	40	.585	39	39.5	40
47	.536	37	1.209	28	32.5	32
48	.366	43	.474	41	42.0	42
49	.586	35	.199	51	43.0	44
50	.126	55	.118	55	55.0	55
51	.195	52	.227	49	50.5	50
52	1.208	27	.593	38	32.5	33
53	1.382	26	2.663	14	20.0	19
54	.132	54	.092	57	55.5	57
55	.220	48	.080	58	53.0	53
56	.210	49	.193	52	50.5	51
57	.000	59	.000	59	59.0	59
58	.106	57	.128	53	55.0	56
59	.165	53	.126	54	53.5	54
60	.000	60	.000	60	60.0	60

TABLE 4.53

Weighted Net Type I Employment Index
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.002	57	.002	57	57.0	57
2	.041	44	.050	37	40.5	41
3	.016	50	.016	49	49.5	49
4	.048	41	.041	43	42.0	43
5	.129	31	.148	24	27.5	28
6	.072	36	.094	30	33.0	32
7	1.823	7	.957	10	8.5	8
8	1.699	8	1.909	5	6.5	5
9	2.050	5	1.236	8	6.5	6
10	13.836	2	8.019	2	2.0	2
11	7.591	3	3.177	4	3.5	3
12	.353	18	.249	19	18.5	19
13	.677	14	.420	16	15.0	15
14	4.012	4	3.506	3	3.5	4
15	.176	26	.173	21	23.5	23
16	.067	38	.064	35	36.5	36
17	.761	12	.592	15	13.5	14
18	.061	39	.058	36	37.5	37
19	.158	27	.147	25	26.0	25
20	1.881	6	1.326	7	6.5	7
21	.031	46	.030	45	45.5	46
22	.043	43	.039	44	43.5	44
23	.106	33	.077	32	32.5	31
24	.418	17	.299	17	17.0	16
25	.195	24	.124	28	26.0	26
26	.068	37	.044	39	38.0	39
27	.620	15	1.013	9	12.0	12
28	.136	30	.127	27	28.5	29
29	.195	25	.133	26	25.5	24
30	1.306	9	.811	11	10.0	10
31	16.497	1	29.777	1	1.0	1
32	.833	10	.681	12	11.0	11
33	.315	19	.167	22	20.5	20
34	.819	11	.677	13	12.0	13
35	.209	22	.150	23	22.5	22
36	.243	20	.637	14	17.0	17
37	.018	49	.020	48	48.5	48
38	.158	28	.109	29	28.5	30
39	.526	16	.270	18	17.0	18
40	.020	47	.030	46	46.5	47
41	.044	42	.029	47	44.5	45
42	.109	32	.070	34	33.0	33
43	.076	34	.046	38	36.0	35
44	.138	29	.043	42	35.5	34
45	.075	35	.044	40	37.5	38
46	.006	54	.005	54	54.0	54
47	.038	45	.076	33	39.0	40
48	.759	13	1.902	6	9.5	9
49	.225	21	.089	31	26.0	27
50	.001	58	.001	58	58.0	58
51	.014	51	.013	50	50.5	51
52	.061	40	.044	41	40.5	42
53	.199	23	.217	20	21.5	21
54	.014	52	.007	51	51.5	52
55	.019	48	.006	52	50.0	50
56	.009	53	.006	53	53.0	53
57	.000	59	.000	59	59.0	59
58	.003	56	.003	55	55.5	55
59	.005	55	.003	56	55.5	56
60	.000	60	.000	60	60.0	60

TABLE 4.54

Type II Employment Index
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	1.957	58	1.670	59	58.5	59
2	2.394	47	3.362	42	44.5	44
3	1.799	59	1.795	57	58.0	58
4	3.660	35	3.592	39	37.0	36
5	2.348	48	3.229	45	46.5	47
6	2.146	54	2.348	54	54.0	54
7	51.680	2	33.883	5	3.5	3
8	11.381	8	10.801	8	8.0	7
9	8.961	13	9.778	12	12.5	11
10	51.006	3	38.066	4	3.5	4
11	54.593	1	40.087	2	1.5	1
12	13.687	7	8.974	15	11.0	10
13	7.159	15	7.495	19	17.0	17
14	16.139	6	15.681	6	6.0	6
15	5.595	24	4.519	33	28.5	28
16	3.983	34	4.560	31	32.5	32
17	6.477	17	7.623	18	17.5	18
18	4.675	29	4.932	29	29.0	29
19	2.934	41	3.352	43	42.0	42
20	9.388	10	6.754	23	16.5	16
21	2.092	56	2.758	49	52.5	52
22	3.009	39	3.493	40	39.5	41
23	2.877	44	2.943	47	45.5	45
24	6.328	18	7.801	17	17.5	19
25	5.797	22	6.128	25	23.5	24
26	3.443	36	3.844	38	37.0	37
27	5.964	21	6.742	24	22.5	23
28	2.923	42	5.692	27	34.5	34
29	11.313	9	10.263	9	9.0	8
30	5.747	23	7.358	21	22.0	22
31	35.294	5	38.962	3	4.0	5
32	5.516	25	9.242	14	19.5	20
33	6.646	16	8.494	16	16.0	15
34	35.411	4	99.783	1	2.5	2
35	3.083	38	4.042	37	37.5	38
36	5.994	20	13.660	7	13.5	14
37	2.267	50	2.661	51	50.5	51
38	9.353	11	10.135	10	10.5	9
39	8.995	12	9.414	13	12.5	12
40	2.959	40	4.480	35	37.5	39
41	4.410	32	4.377	36	34.0	33
42	4.064	33	5.807	26	29.5	30
43	3.270	37	4.491	34	35.5	35
44	6.120	19	7.454	20	19.5	21
45	2.235	52	3.322	44	48.0	48
46	2.498	46	3.387	41	43.5	43
47	4.584	30	7.310	22	26.0	25
48	4.744	28	5.137	28	28.0	26
49	4.536	31	2.963	46	38.5	40
50	2.085	57	2.408	53	55.0	55
51	2.269	49	2.678	50	49.5	50
52	5.505	26	4.855	30	28.0	27
53	7.957	14	9.912	11	12.5	13
54	2.784	45	2.629	52	48.5	49
55	2.231	53	1.725	58	55.5	57
56	2.805	43	2.900	48	45.5	46
57	.000	60	.000	60	60.0	60
58	2.113	55	2.229	55	55.0	56
59	4.832	27	4.559	32	29.5	31
60	2.244	51	2.079	56	53.5	53

TABLE 4.55

Weighted Type II Employment Index
Interindustry Tables

Portugal 60x60

Sectors	1970	Rank Order	1974	Rank Order	Rank Order (Mean)	Rank Order
1	.028	58	.020	59	58.5	58
2	.109	46	.094	45	45.5	45
3	.035	56	.029	56	56.0	56
4	.131	41	.123	40	40.5	40
5	.523	21	.663	15	18.0	19
6	.387	22	.278	26	24.0	23
7	1.261	13	.630	16	14.5	14
8	1.353	11	1.510	7	9.0	7
9	1.741	6	.940	12	9.0	8
10	9.598	2	5.368	3	2.5	2
11	5.315	4	2.091	5	4.5	4
12	.285	28	.192	33	30.5	29
13	.581	19	.353	23	21.0	21
14	2.863	5	2.542	4	4.5	5
15	.241	30	.215	31	30.5	30
16	.086	49	.078	49	49.0	49
17	.654	16	.521	19	17.5	17
18	.081	50	.076	50	50.0	50
19	.211	34	.242	29	31.5	31
20	1.570	10	1.199	10	10.0	9
21	.088	47	.097	43	45.0	44
22	.149	40	.138	39	39.5	38
23	.213	33	.184	34	33.5	34
24	.641	17	.543	18	17.5	18
25	.363	25	.264	28	26.5	26
26	.201	35	.150	38	36.5	36
27	.625	18	1.052	11	14.5	15
28	.281	29	.302	24	26.5	27
29	.331	27	.276	27	27.0	28
30	1.575	9	.918	13	11.0	11
31	12.459	1	19.213	1	1.0	1
32	1.292	12	1.418	9	10.5	10
33	.364	24	.295	25	24.5	25
34	1.704	7	1.602	6	6.5	6
35	.355	26	.364	22	24.0	24
36	.763	15	1.441	8	11.5	13
37	.110	45	.081	47	46.0	46
38	.384	23	.392	21	22.0	22
39	1.608	8	.857	14	11.0	12
40	.079	52	.110	42	47.0	48
41	.113	43	.114	41	42.0	42
42	.158	39	.154	36	37.5	37
43	.217	32	.177	35	33.5	35
44	.165	38	.084	46	42.0	43
45	.129	42	.154	37	39.5	39
46	.032	57	.023	57	57.0	57
47	.166	36	.233	30	33.0	33
48	5.854	3	10.570	2	2.5	3
49	1.118	14	.574	17	15.5	16
50	.024	59	.023	58	58.5	59
51	.064	53	.063	51	52.0	53
52	.241	31	.210	32	31.5	32
53	.557	20	.416	20	20.0	20
54	.166	37	.096	44	40.5	41
55	.087	48	.049	53	50.5	51
56	.080	51	.051	52	51.5	52
57	.000	60	.000	60	60.0	60
58	.042	54	.040	54	54.0	54
59	.111	44	.080	48	46.0	47
60	.041	55	.031	55	55.0	55

TABLE 4.56

Key Sectors Based on Employment Linkages
Portugal 60x60

	Interindustry				Domestic			
	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I
1								
2								
3								
4								
5	*				*			
6								
7	*	*	*	*	*	*	*	*
8	*	*	*	*	*	*	*	*
9	*	*	*	*	*	*	*	*
10	*	*	*	*	*	*	*	*
11	*	*	*	*	*	*	*	*
12		*	*	*		*	*	*
13		*	*	*	*	*	*	*
14	*	*	*	*	*			
15								
16								
17	*	*	*	*		*		
18								*
19								
20	*	*	*	*	*	*	*	*
21								
22								
23								
24	*	*	*	*	*	*	*	*
25							*	*
26								
27	*	*		*	*	*		
28								
29			*	*			*	*
30	*	*		*	*	*	*	*

TABLE 4.56
(continued)

	Interindustry				Domestic			
	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I	Weighted Type II	Weighted Net Type I	Unweighted Type II	Unweighted Net Type I
31	*	*	*	*	*	*	*	*
32	*	*	*		*	*		
33		*	*	*				*
34	*	*	*	*	*	*	*	*
35						*		
36	*	*	*	*	*	*	*	*
37								
38			*	*			*	
39	*	*	*		*	*	*	*
40								
41								
42								
43								
44							*	*
45								
46								
47							*	
48	*	*			*	*		
49	*				*			
50								
51								
52								
53	*		*	*	*	*	*	*
54								
55								
56								
57								
58								
59								
60								

4.5 Overall Analysis

All information concerning definition of key sectors that was obtained from the output, income and employment tables is summarized in Tables 4.57 for the interindustry case and 4.58 for the domestic one.

Let us designate three different orders in the key sector structure. Key sectors of the first order will be the ones with simultaneous high values for the output, income and employment cases. Second-order cases will be those with high values for output and for either income or employment. (It should be mentioned that there are no cases where we observe high output and high employment and low income values for all sectors.) And the third and last order contains sectors with high values for both income and employment. Thirty-one sectors will be considered in those three key sectors order groups, and they are presented in Table 4.59.

If we represent the failure to qualify for a key sector position as a fourth order, and if we attribute one point to the first order, two points to the second, three points to the third and four points to the fourth, then summing the "score" for each sector gives the last column of Table 4.59. Grouping the sectors according to the values presented in that column, we get a final rank ordering:

Less than 20 points:

Sector 11 - Prepared Feed for Animals

Sector 29 - Basic Chemicals

TABLE 4.57
Key Sectors Based on Output, Income and Employment Indexes
Interindustry Tables
Portugal 60x60

	Weighted			Net Weighted			Unnetted			Net		
	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	*	*										
2												
3	*	*										
4												
5			*		*							
6												
7		*	*		*	*		*	*		*	*
8			*		*	*		*	*		*	*
9			*		*	*		*	*		*	*
10		*	*		*	*	⊛	⊛	⊛	⊛	⊛	⊛
11	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛
12	*	*				*		*	*		*	*
13					*	*			*		*	*
14			*		*	*		*	*		*	*
15				*			*			*		
16	*	*										
17			*		*	*		*	*		*	*
18		*						*			*	
19												
20			*		*	*		*	*		*	*
21												
22												
23												
24			*		*	*			*			*
25							*	*			*	
26												
27			*		*	*		*			*	*
28										*		
29	*	*					⊛	⊛	⊛		*	*
30			*		*	*		*			*	*

TABLE 4.57
(continued)

	Weighted			Net Weighted			Unnetted			Net		
	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
31			*	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛
32			*	⊛	⊛	⊛	⊛	⊛	⊛	*		
33		*				*		*	*		*	*
34		*	*		*	*	⊛	⊛	⊛	⊛	⊛	⊛
35					*							
36			*		*	*			*		*	*
37												
38		*					⊛	⊛	⊛		*	*
39			*		*	*	⊛	⊛	⊛			
40		*					*			*		
41		*										
42		*										
43												
44		*										
45												
46	*	*										
47												
48			*		*	*						
49			*									
50	*	*										
51												
52												
53			*						*			*
54												
55												
56												
57												
58												
59		*										
60		*										

TABLE 4.58
Key Sectors Based on Output, Income and Employment Indexes
Domestic Tables
Portugal 60x60

	Weighted			Net Weighted			Unnetted			Net		
	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1	*	*										
2		*			*			*			*	
3	*	*					*			*		
4												
5			*		*							
6												
7		*	*		*	*		*	*		*	*
8			*		*	*		*	*		*	*
9			*		*	*		*	*		*	*
10			*		*	*		*	*		*	*
11	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛	⊛
12	*	*				*		*	*		*	*
13		*	*		*	*		*	*		*	*
14			*									
15				*			*			*		
16	*	*										
17					*	*		*			*	
18		*						*			*	*
19												
20			*		*	*	⊛	⊛	⊛	⊛	⊛	⊛
21												
22												
23												
24			*		*	*		*	*		*	*
25							⊛	⊛	⊛	⊛	⊛	⊛
26												
27			*		*	*		*			*	
28												
29	*	*		*			⊛	⊛	⊛		*	*
30			*		*	*		*	*		*	*

TABLE 4.58
(continued)

	Weighted			Net Weighted			Unnetted			Net		
	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment	Output	Income	Employ-ment
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
31			*		*	*		*	*		*	*
32			*		*	*						
33												*
34		*	*		*	*		*	*		*	*
35					*	*						
36			*		*	*		*	*	*	*	*
37												
38									*			
39			*		*	*			*			*
40												
41		*										
42		*										
43												
44		*						*	*		*	*
45												
46	*	*										
47									*			
48			*		*	*						
49			*									
50	*	*										
51												
52												
53			*			*			*			*
54												
55												
56		*										
57												
58		*										
59	*	*										
60		*										

TABLE 4.59

Key Sectors in Overall Terms
Portugal 60x60

	Interindustry				Domestic				
	Weighted (11 sectors)	Net Weighted (18 sectors)	Unnetted (16 sectors)	Net (18 sectors)	Weighted (12 sectors)	Net Weighted (18 sectors)	Unnetted (16 sectors)	Net (17 sectors)	Σ
1	2	4	4	4	2	4	4	4	28
3	2	4	4	4	2	4	4	4	28
7	3	3	3	3	3	3	3	3	24
8	4	3	3	3	4	3	3	3	26
9	4	3	3	3	4	3	3	3	26
10	3	3	1	1	4	3	3	3	21
11	1	1	1	1	1	1	1	1	8
12	2	4	3	3	2	4	3	3	24
13	4	3	4	3	3	3	3	3	26
14	4	3	3	3	4	4	4	4	29
16	2	4	4	4	2	4	4	4	28
17	4	3	3	3	4	3	4	4	28
18	4	4	4	4	4	4	4	3	31
20	4	3	3	3	4	3	1	1	22
24	4	3	4	4	4	3	3	3	29
25	4	4	2	4	4	4	1	1	24
27	4	3	4	3	4	3	4	4	29
29	2	4	1	3	2	4	1	3	12
30	4	3	4	3	4	3	3	3	27
31	4	1	1	1	4	3	3	3	20
32	4	1	1	4	4	3	4	4	29
33	4	4	3	3	3	3	3	3	26
34	3	3	1	1	4	3	4	4	23
36	4	3	4	3	4	3	3	1	25
38	4	4	1	3	4	4	4	4	28
39	4	3	1	4	4	3	4	4	27
44	4	4	4	4	4	4	3	3	30
46	2	4	4	4	2	4	4	4	28
48	4	3	4	4	4	3	4	4	30
50	2	4	4	4	2	4	4	4	28
59	4	4	4	4	2	4	4	4	30

From 20 to 24 points:

Sector 10 - Animal and Vegetable Food Oils

Sector 20 - Leather Tanning and Industrial Leather Products

Sector 31 - Resins

Sector 34 - Petroleum and Coal Products

From 24 to 28 points:

Sectors 7, 8, 9, 12, 13, 25, 30, 32, 33, 36, 38, 39,

From 28 to 32 points:

Sectors 1, 3, 14, 16, 17, 18, 24, 27, 44, 46, 48, 50, 59.

As was recognized from the beginning, no general rank ordering classification can be considered as best for all possible policy purposes that an analyst might have in mind. Nonetheless, the indexes calculated, when analysed together, give us a a multifaceted picture of each sector and its actual and potential importance in the economic structure.

4.6 A Brief Conclusion

Different aggregation levels of input-output tables lead to different quantitative results. This chapter, presented a more detailed sectoral analysis of the economic structure of the Portuguese Economy, in 1970 and 1974.

In Section 4.1, direct linkage analysis was pursued. Sections 4.2, 4.3 and 4.4 presented the key sectors from an output, income and employment linkage viewpoint. Several versions were calculated, corresponding to four different classification procedures. Section 4.5 combined the results of all preceding sections, for a more detailed sector-by-sector analysis.

CHAPTER 5

SECTORAL AND OVERALL ANALYSIS OF THE STRUCTURE OF AN ECONOMY BASED ON A COMPLETE INPUT-OUTPUT MODEL

5.1 A Brief Introduction

Thus far we have been interested in identifying the key sectors of the Portuguese economy in terms of output, income and employment. In this chapter we will conduct a sectoral and an overall analysis that will emphasize the behavior over time of the specific components of the value added and final demand matrices. This intertemporal analysis will be made from 1959 to 1974 at one level of aggregation (16x16). The elements of those matrices that have been widely studied thus far were especially the import and export composition of the economy. Operational measures have been developed concerning import substitution and export diversification policies, or the effects of taxes and subsidies on the competitive supply prices, among other subjects.[1]

In Section 5.2, a brief survey of the literature devoted to the methodologies used thus far on these subjects is conducted. This chapter is organized in two main parts. A proposed method of analysis is theoretically developed in Section 5.3, and a typical illustration case, based on the empirical Portuguese input-output data that we have been using, is presented in Section 5.4.

In Section 5.3, we will present our own methodology based on the vertical and also horizontal coefficients approach, using for this purpose some of the framework presented in a different context by Augustinovics [1968]. Also, some new extensions will be made. Considerable improvement is achieved, in this writer's view, using the proposed methodology. For the first time, consistent information is obtained, considering not only one isolated specific element of the final demand or value added matrices, but taking into consideration the relative importance of each one of them. Also, we present two concepts, based on the final structure matrices, that take into consideration the complete input-output system, that is the intermediate, final demand and value added matrix included all together. Thus, considerable information could be obtained not only for the import or export components but also for other components, all of them taking into account not only the direct but also the indirect effects of the economic sectors of the economy. In Section 5.4, empirical results using the methodological approach presented in Section 5.3 will be obtained for the Portuguese economy, based on the 16x16 input-output tables for 1959, 1964, 1970 and 1974. Section 5.5 will present some concluding remarks.

5.2 A Literature Review (An Historical Introduction and a Summary of the Methodological Approaches)

After the Great Depression, the world economy experienced a broad change in the trade relations between the advanced and the developing economies. The prices of traditional raw materials and goods exported from the "south" followed a trend opposite that of the prices of commodities of the industrial countries, with some relief periods during World War Two and the Korean War. This price movement created balance of payment problems for the developing countries. This situation generated a number of policies designed to alter this economic trend, including devaluation of currencies to increment exports and the creation of protective economic boundaries to avoid competition and stimulate internal industrial growth.

During the 1950's, an attempt was made to change the pattern of economic relations between ADC's and LDC's. The "inward oriented growth" policy, basically an import substitution program, was recognized as an "official ideology" of most developing countries, particularly in Latin America. Criticisms arose, however, when the industrialization process developed under those goals turned out to be, at a more advanced stage, import intensive, and a declining growth pattern was observed in the face of external and internal constraints. Then, a massive distribution program, to use internal demand for internally produced goods, or an export promotion program ("outward-looking strategy") were presented as two possible alternatives. The export diversification and promotion policy proved in some cases that, despite previous inefficiency and also inexperienced nontraditional exports (particularly manufactured ones), rapid expansion rates could occur soon after the programs were initiated.[2]

With this brief historical introduction to the origins of import substitution and export diversification policies, we now present the operational measures usually associated with them. Import substitution is a generalized expression, which is commonly understood by all economists. Precise definition is more difficult.

Pomfret [1976, p. 17] defined import substitution as "Replacement of imports by domestic sources of supply. Thus import substitution has taken place if the amount of imports of a good falls while total availability of the good remains constant." However, there are problems brought about by this definition, because total supply does not remain constant between the beginning and the end of the period. Suppose, for example, that imports increase but by less than total supply. Operationally, the following measure was developed, primarily associated with Chenery [1960],

$$M_1 - \frac{M_0}{S_0} S_1 \qquad (5.1)$$

where M is imports, S is total supply and 0 and 1 refer to the initial and final period. Formula (5.1) compares the final year's imports (M_1) with what imports in that year would have been had import substitution not taken place. When (5.1) is negative, import substitution does occur, when (5.1) is positive, the market composition on the total supply is increased. That is, it is assumed that imports will increase at the same pace as total supply, so any reduction of the ratio of imports to total supply is called import substitution.

From (5.1), we can generate the "contribution" of import substituting production to the growth of domestic production, using the following

$$\frac{M_1 - \frac{M_0}{S_0} S_1}{X_1 - X_0} \qquad (5.2)$$

where X is output[3]. (5.1) and (5.2) were the quantitive basis of most empirical work on import substitution in the 1960's and until the middle of the 1970's.

The main limitations of this framework were the importance of the selected beginning and end periods. Long periods of analysis hide sub-trends in the period considered, where import substitution could change or even occur or not occur from one subperiod to the other. Also, if we choose too short a period, we could get day to day, seasonal or cyclical fluctuations in trade. Other criticism that an input-output analysis could avoid, is that (5.1) and (5.2) only capture direct import requirements of each sector and say nothing about the import requirements for intermediate goods, whose production is necessary for producing the output of any specific sector.

Thus, as noted, the relevance of the export structure, and especially the importance of imports in the export composition, soon came to be analysed. One approach was to examine the relative importance of value added in the export composition, as in Halevi and Klinov-Malul [1968, p. 149],

$$\frac{X_i - M_i}{X_i} \qquad (5.3)$$

where X_i = foreign exchange earned by the sale of the ith good

M_i = foreign exchange spent on producing the exports of the ith good

Another operational tool presented in the literature deals with the export diversification policy and is a measure of concentration of the export composition structure. The Hirschman index [1945, pp. 157-160] was considered sensitive to the shape of the whole distribution of commodities exported and to their number.

$$H = 100 \sqrt{\sum_{i=1}^{n} \frac{x_i^2}{\sum_{i=1}^{n} x_i^2}} \tag{5.4}$$

where n = the number of export goods

x_i = the value of exports of the ith sector.

H will be equal to 100 when only one single sector exports, and $H = 100 / \sqrt{n}$ when all sectors share total exports equally.

Another way to look at export growth (and specifically at the relative quantitative importance of the various factors working on a country's export growth) is via the so-called Constant Market Shares Analysis. References to the method can be found in Tyszynsky [1951][4]. This method is similar to the shift-share technique, used for industrial analysis. Assuming that a country's share of total exports remains unchanged over time, we can divide the changes observed in exports into three effects:

(1) Commodity composition effect

(2) Market distribution effect

(3) Competitiveness effect

Analytically,

$$\sum_i (E_i^1 - E_i^0) - r \sum_i E_i^0 = \sum_i (r_i - r)\ E_i^0 + \sum_i \sum_j (r_{ij} - r_i)\ E_{ij}^0$$

$$+ \sum_i \sum_j (E_{ij}^1 - E_{ij}^0 - r_{ij}\ E_{ij}^0) \qquad (5.5)$$

where 0 and 1 refer to periods 0 and 1,

E = exports receipts,

E_{ij} = the country's exports of commodity i to market j,

r = percentage increase in world exports between period 0 and period 1,

r_i = percentage increase in world exports of commodity i between period 0 and period 1, and

r_{ij} = percentage increase in world exports of commodity i to country j between year 0 and year 1.

The left-hand side of (5.5) represents the change in exports of the analysed country, and the hypothetical change of these exports if they had grown as fast as world trade. The right-hand side is composed of the above-mentioned effects: the commodity composition effect indicates the effect on the country's exports of differences between the growth rates of world trade in its commodities and of total world trade. The market distribution effect shows the corresponding effect with regard to export destination. The competitiveness effect measures the difference between the actual increase in the country's exports and what the increase would have been if the country had maintained a constant share in the market for each commodity at each destination.

There are several limitations to the model. Pomfret [1976, p. 62], summarized them, as follows:

> the model is based on an identity and can thus provide no causal explanation. It has no stochastic basis and is useless for projection purposes, i.e., it provides only an ex-post evaluation of past performance. The model is sensitive to the choice of time period and the level of aggregation of commodities and markets, but provides no guidelines as to the appropriate time period or aggregation levels. Since basic period weights are used, there is an index number problem. Finally, the CMS model implies a normative judgement that retaining a constant share of world markets is the relevant yardstick for judging a country's export performance. In spite of these limitations the CMS model may point to the areas in which an explanation of export performance can be found and is therefore useful provided that the precise values of the estimates obtained from it are not overemphasized.

The input-output framework brought new operational measures to these issues, providing the possibility of pursuing a sectorally disaggregated analysis. Several measures have been based on the input-output model. One, the direct import component of exports, is defined as

$$a_{mj}\ e_j \qquad (5.6)$$

where a_{mj} is the j^{th} element of the import row of the direct coefficient table and e_j is the value of total exports of the j^{th} sector.

A more interesting measure is the total (direct plus indirect) import component of exports, as in Bruno [1962]

$$E = \bar{f}_{pj}\ e_j \qquad (5.7)$$

where $$\bar{f}_{pj} = \sum_i f_{pi} \, r_{ij}$$

where

f_{pi} = primary input row of imports

r_{ij} = ijth element of the Leontief inverse $(I-A\downarrow)^{-1}$

e_j = export vector

and a net measure of the foreign exchange earnings by the country's producers is defined as

$$\sum_j e_j - \sum_j \bar{f}_{pj} \tag{5.8}$$

where $\sum_j e_j$ is the total exports and $\sum_j \bar{f}_{pj}$ is direct and indirect import requirements to produce total exports. More broadly, Blumenthal [1972], presented the following

$$E^* = \langle 1' \; H\downarrow \rangle \; (I-A_d\downarrow)^{-1} E \tag{5.9}$$

where E is the export vector (nxl), $H\downarrow$ is the value added matrix of technical coefficients and $A_d\downarrow$ is the domestic technical coefficient matrix. E* is termed by Pomfret [1976, p. 76] "the vector of redefined exports", which is presented as "the ideal measure of the contribution of the various sectors of the economy to net export earnings."

Tyler [1976, p. 71], presented an amplified export diversification concept, as

$$E^*_T = (I-A\downarrow)^{-1} \; E \tag{5.10}$$

where he argued that he took account of the multiplier effects of exports. Formula (5.10) uses the interindustry table instead of the domestic one and so would appear to overestimate the results. As we shall see, the other approaches, (5.7) or (5.9), have limited analytical usefulness.

The model presented in (5.5) was also developed and amplified using input-output analysis, providing a closer examination of the sources of intermediate domestic demand. Chenery [1979] and [1980], presented the model as:

$$X_i = u_i (W_i + D_i) + E_i \tag{5.11}$$

$$M_i = m_i (W_i + D_i) \tag{5.12}$$

$$W_i = \sum_j a_{ij} X_j \tag{5.13}$$

where u_i is the constant fraction of total domestic demand in each sector, m_i is the proportion of domestic demand supplied by imports ($u_i + m_i = 1$), W_i is intermediate demand, D_i final demand, and E_i exports.

Substituting (5.13) in (5.11), and solving for X_i,

$$X_i^t = \sum_j \bar{r}_{ij}^t (u_j^t D_j^t + E_j^t) \tag{5.14}$$

where $\bar{r}_{ij}$ are the ijth element of the Leontief inverse of the domestic matrix of vertical coefficients and t is a time index.

Based on the last equation, Chenery [1980], decomposes the sources of growth of each sector into four factors, as follows. Consider $\Delta X = X^2 - X^1$ as the increment in output between two time periods:

Substituting ΔX in (5.11)[5]

$$\Delta X_i = u_i^1 \, \Delta D_i + \Delta E_i + u_i^1 \, \Delta W_i + \Delta u_i \, (D_i^2 + W_i^2) \qquad (5.15)$$

Solving as in (5.14) we will get,

$$\begin{aligned} \Delta X_i = {} & \sum_j \bar{r}_{ij}^{\,1} \, u_j^1 \, \Delta D_j + \sum_j \bar{r}_{ij}^{\,1} \, \Delta E_j \\ & + \sum_j \bar{r}_{ij}^{\,1} \, \Delta u_j \, (D_j^2 + W_j^2) \\ & + \sum_j \bar{r}_{ij}^{\,1} \, u_j^1 \sum_k \Delta a_{jk} \, X_k^2 \end{aligned} \qquad (5.16)$$

The right-hand side contains elements that capture:

(a) the expansion of domestic demand in all sectors (DD),

$$\sum_j \bar{r}_{ij}^{\,1} \, u_j^1 \, \Delta D_j \qquad (5.17)$$

(b) the expansion of exports in all sectors (EE),

$$\sum_j \bar{r}_{ij}^{\,1} \, \Delta E_j \qquad (5.18)$$

(c) import substitution in all sectors (IS)

$$\sum_j \bar{r}_{ij}^{\,1} \, \Delta u_j \, (D_j^2 + W_j^2) \qquad (5.19)$$

(d) technological change (TC),

$$\sum_j \bar{r}_{ij}^{\,1}\, u_j^1 \sum_k \Delta a_{jk}\, X_k^2 \tag{5.20}$$

The basis of this formulation is the disaggregation of ΔX into four different parts. It overemphasizes the demand side of the model, because it only registers changes in X as a result of changes on the final demand side. Our approach also emphasizes the supply side of the model, including production that originates from changes in the value added matrix, and is independent of the absolute values in the two years under consideration. The Chenery formulation does not provide per unit analysis and never takes into consideration the value added matrix; thus an overall analysis (such as the one obtained throughout (5.29) or (5.30), as we will present later) is not possible.

The above historical review does not pretend to be exhaustive. Its purpose is only to give an overall view of the frameworks that have been used thus far, for import substitution/export diversification considerations. The Augustinovics generalized conception of an input-output model, already introduced in Chapter 1, provides a more "multi-faceted description" of the structural relationships in an economy. This applies particularly to the import substitution/export diversification discussion. The formulas presented have a common weakness, they fail to take into account the relative importance of different sectors of the economy. For this reason comparisons based on these formulas must be used with great care. Alternative formulas developed in Section 5.3 remedy this deficiency, and may therefore be more useful in making intertemporal and international comparisons.

5.3 A Proposed Framework

We present several concepts that could be obtained from the input-output model, using the generalized framework already introduced in Chapter 1.

$$Q\vec{Y} = (I-A_d)^{-1}Y \qquad (5.21)$$

where the ij^{th} element of $Q\vec{Y}$ will be the total production of sector i allocated to the j^{th} final demand component served by it. That is, we will obtain a matrix, $Q\vec{Y}$, where total production, X_j, of each sector is disagregated by its final demand components.

$$H\vec{Q} = H(I-\vec{A}_d)^{-1} \qquad (5.22)$$

where the ij^{th} element of $H\vec{Q}$, will be the total production of sector j allocated to the i^{th} primary input component from which its value originates. That is, we will obtain a matrix $H\vec{Q}$, where total production, X_j, of each sector is disaggregated by its primary input components.

The above concepts, (5.21) and (5.22), are expressed in absolute terms, as well as the "complex coefficient matrices" (5.23) and (5.24).

$$Q \downarrow Y \downarrow = (I - A_d \downarrow)^{-1} \; Y \; \langle 1'Y \rangle^{-1} \qquad (5.23)$$

where the ij^{th} element of $Q \downarrow Y \downarrow$ will represent the gross production of sector i that is necessary for the production of a unit of the j^{th} final demand component. That is, we obtain a matrix where the common output multiplier concept of each sector is disaggregated by each component of the final demand matrix.

$$\vec{H} \vec{Q} = \langle H1 \rangle^{-1} \; H \; (I - \vec{A}_d)^{-1} \qquad (5.24)$$

where the ij^{th} element of $\vec{H} \vec{Q}$ will represent the gross production of each sector j originating from a unit of the i^{th} primary input component. That is, we obtain a matrix where the supply side output multiplier concept of each sector is disaggregated by each component of the primary input matrix.

The information obtained from the "complex coefficient matrices" is still dependent on gross-production for a specific year. So we propose to redefine the Augustinovics formulas, in relative terms, as:

$$Q \downarrow Y \downarrow \langle 1'Q \downarrow Y \downarrow \rangle^{-1} \qquad (5.25)$$

where the ij^{th} element of $Q \downarrow Y \downarrow \langle 1'Q \downarrow Y \downarrow \rangle^{-1}$ yields the gross production, disaggregated by sector, in proportion terms, necessary for a unit of specific final uses. And,

$$\langle \vec{H}\, \vec{Q}\, 1\rangle^{-1}\, \vec{H}\, \vec{Q} \qquad (5.26)$$

where the ij^{th} element of $\langle \vec{H}\, \vec{Q}\, 1\rangle^{-1}\, \vec{H}\, \vec{Q}$, gives gross production, disaggregated by sector, in proportion terms, originating from a unit of specific kinds of primary inputs. Formulas (5.25) and (5.26) are definitely better for international or intertemporal comparisons because they do not reflect directly the absolute values of a particular year, since they are presented as proportions.

Other concepts could be generated for the same purpose.

$$\vec{Q}\, \vec{Y} = (I-\vec{A}_d)^{-1} \langle X\rangle^{-1}\, Y \qquad (5.27)$$

where the ij^{th} element of $\vec{Q}\, \vec{Y}$ will represent the distribution of the unit of primary input of sector i among the j final uses. And

$$H \downarrow Q \downarrow = H\, \langle X\rangle^{-1}\, (I-A_d \downarrow)^{-1} \qquad (5.28)$$

where the ij^{th} element of $H \downarrow Q \downarrow$ will represent the division of the unit of final value of sector j among the i^{th} primary value components.

Finally in an over-all analysis of the system, we can use the "final structure matrix" concepts,

$$H \downarrow Q \downarrow Y \downarrow = H\, \langle X\rangle^{-1}\, (I-A_d \downarrow)^{-1}\, Y\, \langle 1'Y\rangle^{-1} \qquad (5.29)$$

where the ij^{th} element represents the division of a unit of specific kinds of final value among the primary input components, and

$$\vec{H}\, \vec{Q}\, \vec{Y} = \langle H1\rangle^{-1}\, H\, (I-\vec{A}_d)^{-1}\, \langle X\rangle^{-1} Y \qquad (5.30)$$

where the ij^{th} element represents the division of a unit of specific kinds of primary inputs into their final allocation among the final demand components.

From the concepts presented above, only the rows of $H \downarrow Q \downarrow$ were already used and referred to in the literature as the total content indicators, as noted previously. Thus the concepts presented in (5.25), (5.26), (5.27) and (5.28) for a sectoral analysis, and in (5.29) and (5.30) for an overall analysis, provide the possibility of a much broader and more comprehensive analysis of the structure of the economy, concerning all components of the value added and final demand matrices.

5.4 Empirical Analysis. The 16x16 Aggregation Level

The primary input composition of domestic Portuguese input-output tables is the following:

1. Taxes and subsidies
2. Wages
3. Rents, dividends and profits
4. Imports

The composition of the final demand matrix is:

1. Private consumption
2. Public consumption
3. Investment
4. Stock variation
5. Exports

Based on the methodological approach presented in the previous section, an empirical analysis for 1959, 1964, 1970 and 1974, in sectoral and in over-all terms, is now discussed.

5.4.1 Some Data Problems

The analysis conducted thus far ignored the existence of the 20th sector (government) in the primitive 20x20 transaction flow matrix from which the 16x16 model was derived. The reason was the absence of positive elements in the 20th column and row. Lumping the government sector with another sector will affect the latter's gross output total while leaving its flow totals constant. Consequently, information obtained from the $A\downarrow$, $\vec{A}$, $Q\downarrow$ or $\vec{Q}$ matrices, will be substantially distorted for the last sector and indirectly (in $Q\downarrow$ and $\vec{Q}$) for all others.

However, in this chapter, we have to take into consideration not only the intermediate matrix, but also the remaining data of the input-output model (value added and final demand), and then the 20th sector can not be ignored, because there are positive elements in those matrices that are related to the government sector.

Thus, for calculations pursued in this chapter, sectors 19 and 20 have been aggregated, and as a result, X, the gross output vector, and subsequently the A_d matrix, have changed. Other problems arise with the existence of a residual sector in the intermediate transaction flow matrix for 1959. This sector was also ignored previously, but now, for consistency of the over-all system, it was also aggregated to the last sector.

5.4.2 The Empirical Results

Tables 5.1, 5.2, 5.3 and 5.4 present, for the four different

TABLE 5.1

Gross Production Necessary to Produce One Unit of a Specific Component of Final Demand
(Proportions)

Portugal 1959

Sectors	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports
1	.263	.030	.021	-2.914	.171
2	.003	.007	.015	.127	.022
3	.143	.024	.000	-.960	.092
4	.090	.023	.001	1.870	.111
5	.016	.023	.046	.191	.153
6	.007	.005	.004	-.071	.013
7	.059	.029	.026	2.502	.109
8	.004	.003	.104	.013	.017
9	.006	.015	.027	.027	.015
10	.040	.116	.164	-.018	.048
11	.023	.022	.017	.022	.013
12	.012	.015	.012	.087	.010
13	.002	.010	.433	.000	.001
14	.189	.044	.075	.106	.123
15	.050	.015	.005	.026	.068
16	.093	.619	.050	-.008	.033
Σ	1	1	1	1	1

TABLE 5.2

Gross Production Necessary to Produce One Unit of a Specific Component of Final Demand (Proportions)

Portugal 1964

Sectors	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports
1	.196	.034	.018	.584	.161
2	.002	.004	.015	-.014	.014
3	.180	.022	.001	.107	.048
4	.112	.018	.002	.094	.192
5	.017	.016	.045	.006	.108
6	.010	.011	.005	-.011	.030
7	.054	.040	.030	-.030	.107
8	.009	.017	.057	.034	.020
9	.008	.015	.068	-.058	.024
10	.051	.050	.186	.017	.049
11	.018	.013	.006	.002	.010
12	.017	.027	.011	.004	.013
13	.003	.065	.417	.000	.001
14	.186	.051	.124	.254	.134
15	.050	.015	.011	.008	.085
16	.086	.600	.005	.005	.003
Σ	1	1	1	1	1

TABLE 5.3

Gross Production Necessary to Produce One Unit of a Specific Component of Final Demand (Proportions)

Portugal 1970

Sectors	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports
1	.189	.004	.016	1.380	.128
2	.001	.003	.005	-.049	.014
3	.164	.003	.002	-.070	.077
4	.107	.047	.009	-.575	.235
5	.012	.002	.045	.674	.067
6	.009	.006	.008	-.019	.048
7	.053	.026	.032	-.354	.110
8	.004	.007	.067	-.023	.020
9	.007	.010	.047	-.124	.022
10	.049	.059	.251	-.316	.111
11	.022	.025	.008	-.009	.027
12	.021	.037	.014	-.010	.017
13	.002	.008	.344	.003	.001
14	.125	.034	.116	.450	.052
15	.068	.013	.006	.014	.047
16	.168	.717	.031	.027	.024
Σ	1	1	1	1	1

TABLE 5.4

Gross Production Necessary to Produce One Unit of a Specific Component of Final Demand
(Proportions)

Portugal 1974

Sectors	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports
1	.172	.004	.012	.153	.108
2	.001	.001	.011	-.006	.010
3	.154	.001	.001	.117	.071
4	.072	.003	.005	.157	.251
5	.011	.005	.028	.022	.073
6	.009	.004	.007	.023	.052
7	.059	.025	.036	.156	.109
8	.005	.003	.068	.056	.016
9	.009	.018	.036	-.029	.019
10	.075	.191	.184	.129	.133
11	.032	.029	.009	.020	.026
12	.017	.034	.010	.012	.014
13	.003	.011	.431	.001	.001
14	.141	.040	.141	.165	.050
15	.070	.011	.005	.005	.046
16	.167	.621	.017	.019	.020
Σ	1	1	1	1	1

years, the gross production necessary to produce one unit of a specific component of final demand, in proportional terms. The concept, $Q \downarrow Y \downarrow \langle 1' Q \downarrow Y \downarrow \rangle^{-1}$, was introduced in the last section, in (5.25).

These tables present many possibilities for analysis. We investigate the private consumption and exports columns. The investment column is avoided, given a lack of reliable information for some years. Figures 5.1 and 5.2 present an intertemporal analysis of the exports and private consumption columns in sectoral terms, for the four different years.

The results obtained for the exports analysis show very interesting trends for some sectors. The sectors with major contribution for the required gross production to produce one unit of exports were:

	1959	1974
1 - Agriculture, Forestry and Fisheries	.17	.11
3 - Food, Beverages and Tobacco	.09	.07
4 - Textiles, Apparel, Leather and Shoes	.11	.25
5 - Wood, Cork and Furniture	.15	.07
7 - Chemicals, Petroleum and Coal Products	.11	.11
10 - Machinery, Transport Equipment, Naval Construction and Repair	.05	.13
14 - Trade	.12	.05
15 - Transport and Communications	.07	.05

FIGURE 5.1
Gross Production Necessary to Produce One Unit of Exports
(Proportions)
Portugal 16x16

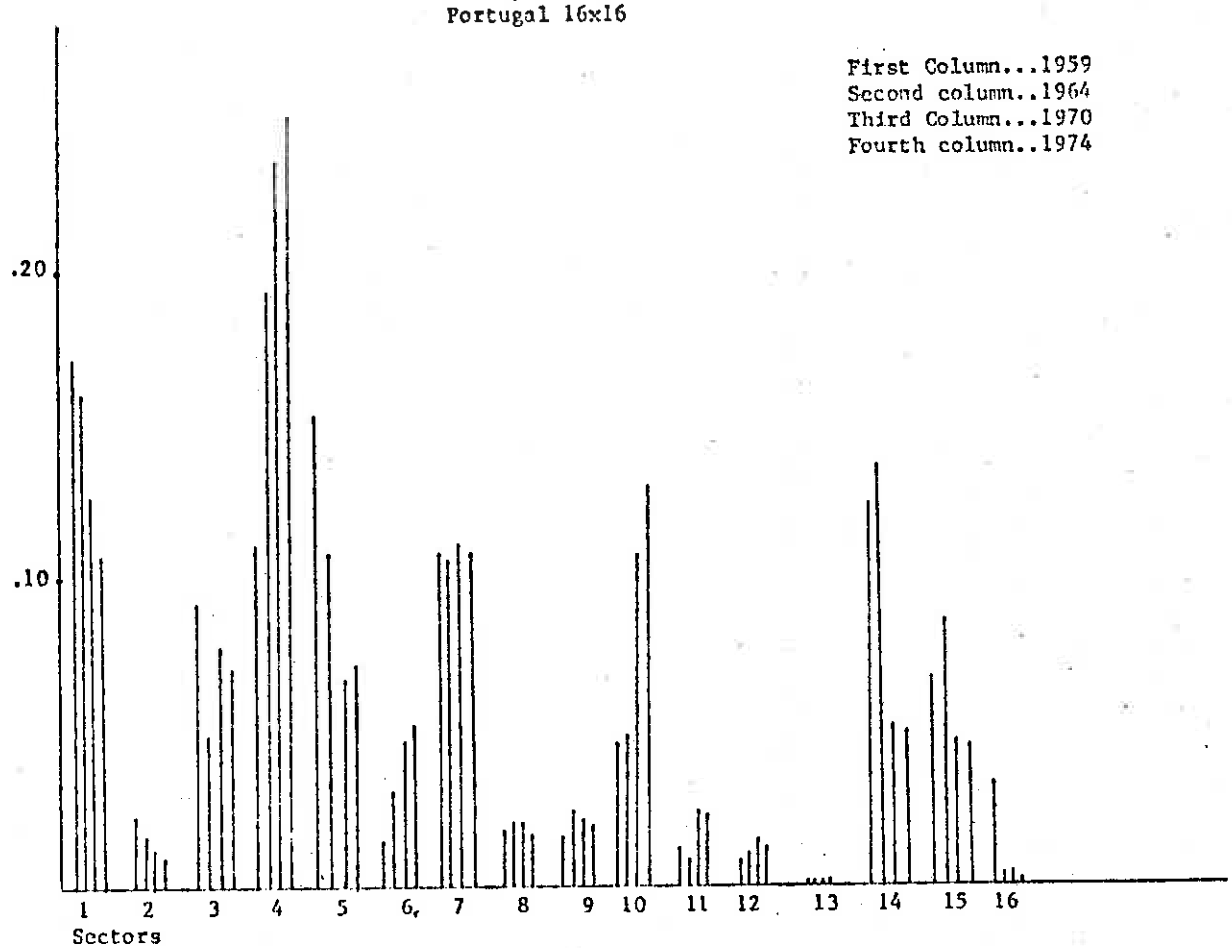
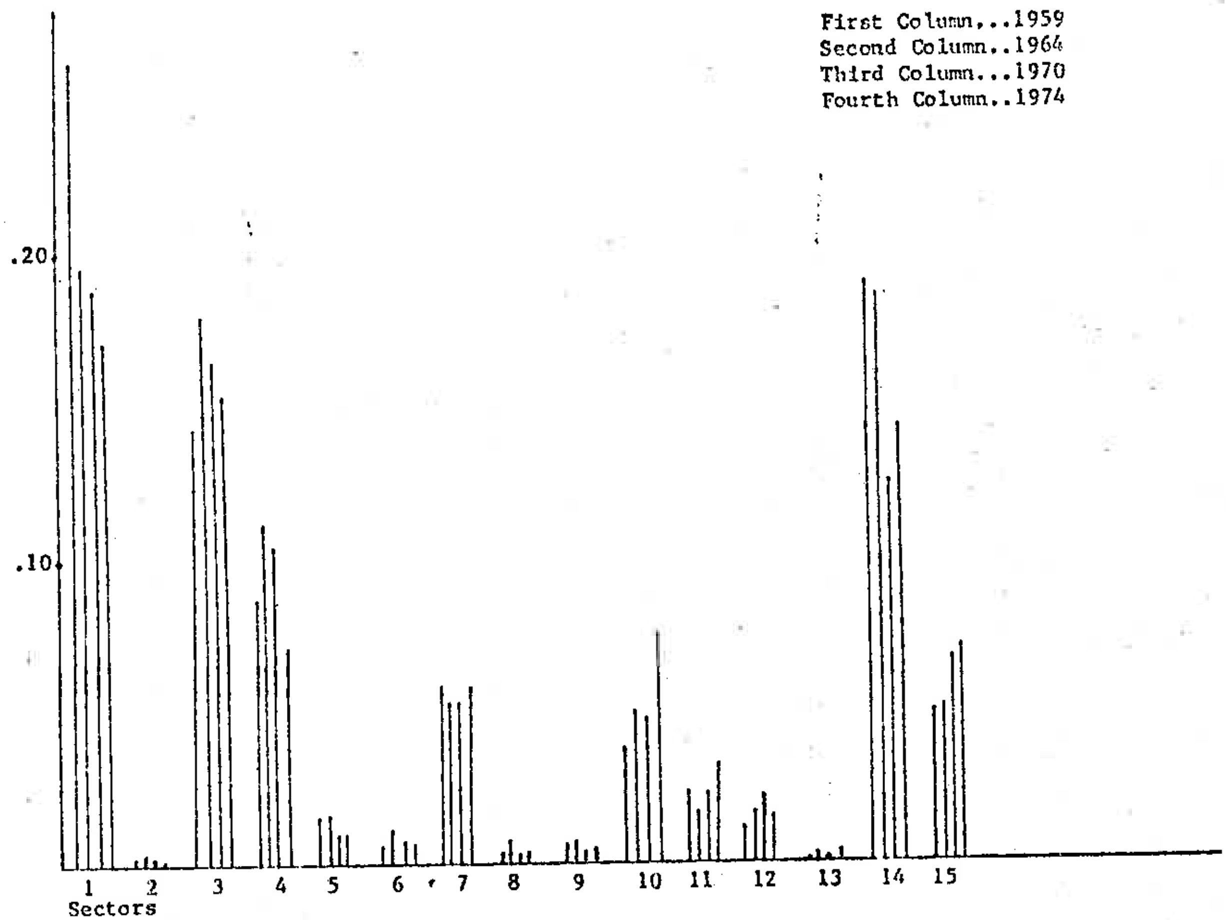


FIGURE 5.2
Gross Production Necessary to Produce One Unit of Private Consumption
(Proportions)
Portugal 16x16



Some sectors, such as 1 - Agriculture, Forestry and Fisheries, 5 - Wood, Cork and Furniture, 14 - Trade, and 15 - Transport and Communications, responsible together for 51.5 percent of total production required for exports in 1959, drop to 27.7 percent of total production required for exports in 1974, some 15 years later. In contrast, sectors like, 4 - Textiles, Apparel, Leather and Shoes, and 10 - Machinery, Transport Equipment, Naval Construction, and Repair, represented 15.9 percent of total production required to export in 1959, and increased to 38.4 percent in the same 15-year period. Some sectors, like 7 - Chemicals, Petroleum and Coal Products, remained constant over the years.

We should emphasize that the value presented for each sector represents not only the percentage of direct gross production of each sector that is required to produce one unit of overall exports but also the indirect production required for the functioning of the overall economy. It is clear that there has been an important shift in the role played by exports in the Portuguese economy over the 1959-1974 period.

The same analysis, made for the private consumption column, also shows some interesting trends. The leading sectors for the required gross production to produce one unit of private consumption were:

	1959	1974
1 - Agriculture, Forestry and Fisheries	.26	.17
3 - Food Processing, Beverages and Tobacco	.14	.15
4 - Textiles, Apparel, Leather and Shoes	.09	.07
7 - Chemicals, Petroleum and Coal Products	.06	.06

	1959	1974
10 - Machinery, Transport Equipipment, Naval Construction and Repair	.04	.03
14 - Trade	.19	.14
15 - Transport and Communications	.05	.07

Consumption patterns, associated with tastes and preferences, change relatively slowly over time. However, traditional sectors like Agriculture and Trade, continue to lose their leading role, from 45.2 percent in 1959, to 31.3 percent in 1974.

As mentioned, the same analysis could be carried out for each of the other specific elements in final demand. The negative values sometimes presented in the vector "variation of stocks" for some sectors were a result of negative variations in the stocks in those years. So, as a result, all concepts for those particular sectors present negative values.

Another useful concept is embodied in $\langle \vec{H}\ \vec{Q}\ 1\rangle^{-1}\ \vec{H}\ \vec{Q}$, presented in (5.26), and shown in Tables 5.5, 5.6, 5.7 and 5.8, for the four different years. These figures represent gross production originating from a unit of specific kinds of primary inputs, in proportional terms.

The rows of the following tables, are: (1) taxes and subsidies, (2) wages, (3) other income (profits, dividends, rents), and (4) imports.

TABLE 5.5

Gross Production Originating From a Unit of Specific Kinds of Primary Inputs in Proportion Terms

Portugal 1959

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
.073	.002	.139	.016	.012	.003	.219	.004	.003	.013	.005	.000	.013	.456	.020	.023
.207	.011	.091	.069	.017	.006	.040	.019	.011	.025	.008	.008	.059	.165	.065	.200
.243	.007	.109	.061	.055	.008	.047	.015	.008	.053	.022	.018	.037	.177	.039	.101
.076	.003	.143	.217	.024	.008	.156	.012	.020	.136	.040	.003	.040	.008	.048	.063

TABLE 5.6

Gross Production Originating From a Unit of Specific Kinds of Primary Inputs in Proportion Terms

Portugal 1964

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
.050	.002	.130	.070	.015	.007	.039	.007	.009	.043	.007	.002	.033	.561	.021	.006
.178	.005	.101	.095	.033	.007	.029	.016	.009	.052	.012	.009	.068	.138	.047	.201
.180	.009	.128	.073	.040	.016	.054	.024	.025	.063	.015	.027	.074	.155	.044	.073
.071	.001	.148	.226	.026	.014	.143	.012	.027	.148	.024	.003	.054	.023	.070	.010

TABLE 5.7

Gross Production Originating From a Unit of Specific
Kinds of Primary Inputs in Proportion Terms

Portugal 1970

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
.031	.002	.110	.116	.021	.010	.051	.009	.009	.111	.017	.006	.043	.413	.028	.024
.151	.005	.090	.092	.028	.010	.031	.017	.007	.069	.016	.018	.066	.076	.060	.263
.160	.005	.116	.102	.023	.021	.053	.024	.018	.079	.021	.030	.061	.110	.053	.123
.080	.002	.156	.174	.026	.015	.143	.010	.039	.193	.032	.005	.054	.013	.034	.022

TABLE 5.8

Gross Production Originating From a Unit of Specific
Kinds of Primary Inputs in Proportion Terms

Portugal 1974

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
-.004	.001	-.021	.067	.010	-.001	.023	-.008	.002	.090	.011	-.017	.026	.804	.007	.009
.091	.005	.067	.083	.028	.012	.035	.020	.008	.105	.031	.016	.097	.094	.070	.238
.206	.005	.121	.075	.024	.024	.039	.027	.011	.104	.015	.025	.072	.111	.039	.100
.062	.002	.172	.149	.026	.014	.192	.015	.038	.156	.041	.009	.063	.009	.031	.020

The analysis of the second row, wages, will give us the gross production, in proportion terms, originating from a unit of overall wages. Figure 5.3, shows the distribution pattern among the sectors. General increases over time are observed in almost all manufactured sectors, accompanied by decreases in the primary ones. In more detail, one unit of wages will generate 37.2 percent of the total production in only two sectors, 1 - Agriculture, Forestry and Fisheries and 14 - Trade, in 1959. In 1974, that percentage value drops to 18.8 percent of the total. In contrast, Sectors 6 - Paper Pulp and Paper, 8 - Non Metallic Mineral Products, 10 - Machinery, Transport Equipment, Naval Construction and Repair, 11 - Other Manufacturing and 13 - Public and Private Construction, increase from 12.7 percent in 1959 to 26.5 percent in 1974.

The third row, other income, does not exhibit behavior that is as stable as the wages row. However we can observe from Figure 5.4 that, again, sectors like 1 - Agriculture, Forestry and Fisheries, and 14 - Trade, continue to lose in relation to the other sectors. They drop from 42 percent of the total production to 31.7 percent.

Analysis of the fourth row, imports, is also very interesting. This row gives us the gross production, in proportion terms, originating from a unit of overall imports. Thus we can observe in which sectors imports have a larger impact in the production process. Figure 5.5 represents the intertemporal analysis for each sector. Significant sectors where the imports impact dropped were: 1 - Agriculture, Forestry and Fisheries, 4 - Textiles, Apparel, Leather and Shoes, and 15 - Transport and Communications. For these

FIGURE 5.3
Gross Production Originating from a Unit of Wages
(Proportions)
Portugal 16x16

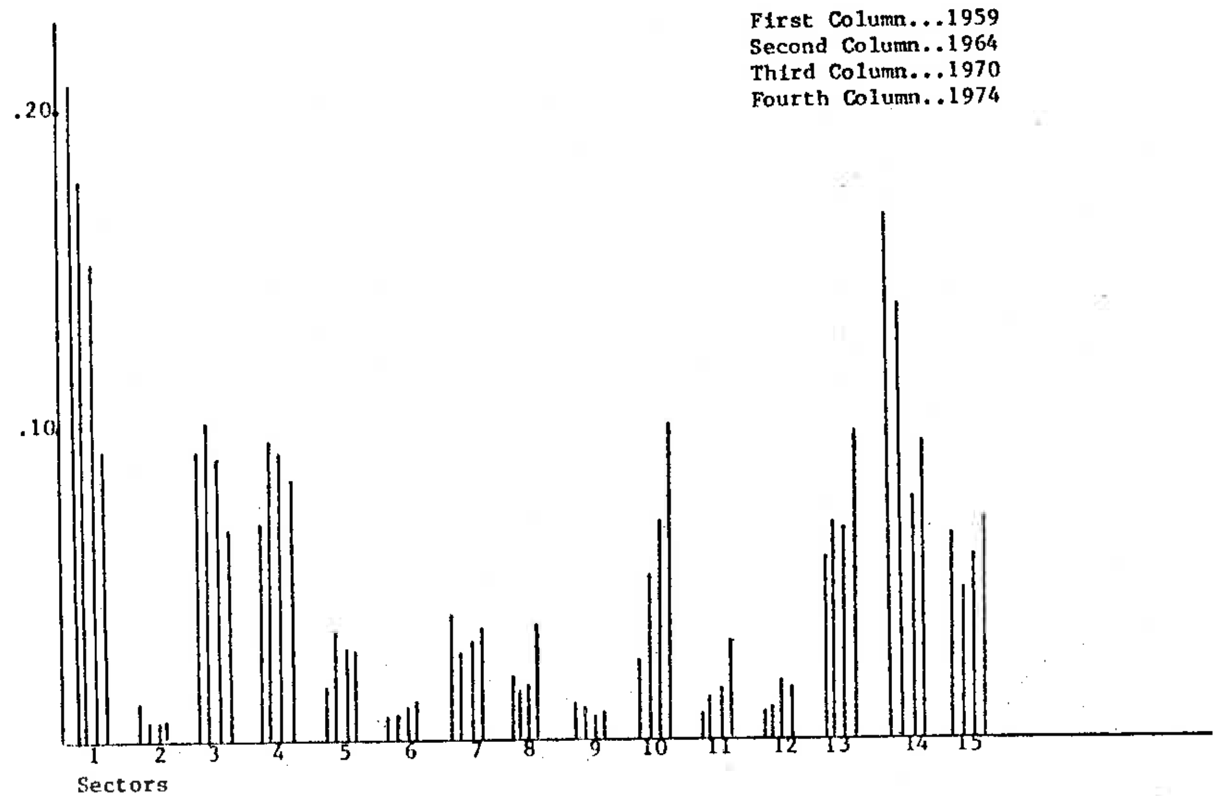


FIGURE 5.4
Gross Production Originating From a Unit of Other Income
(Proportions)
Portugal 16x16

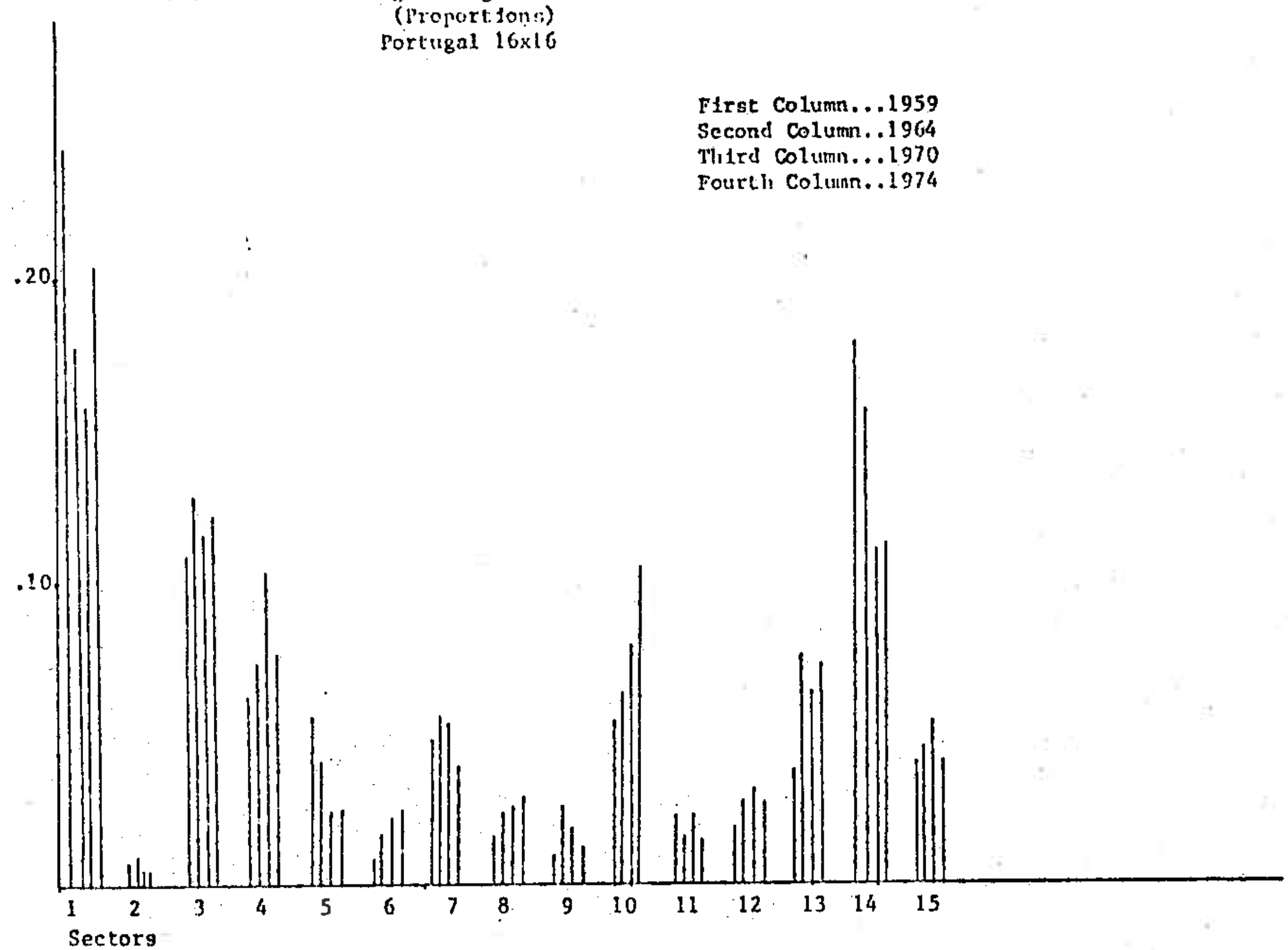
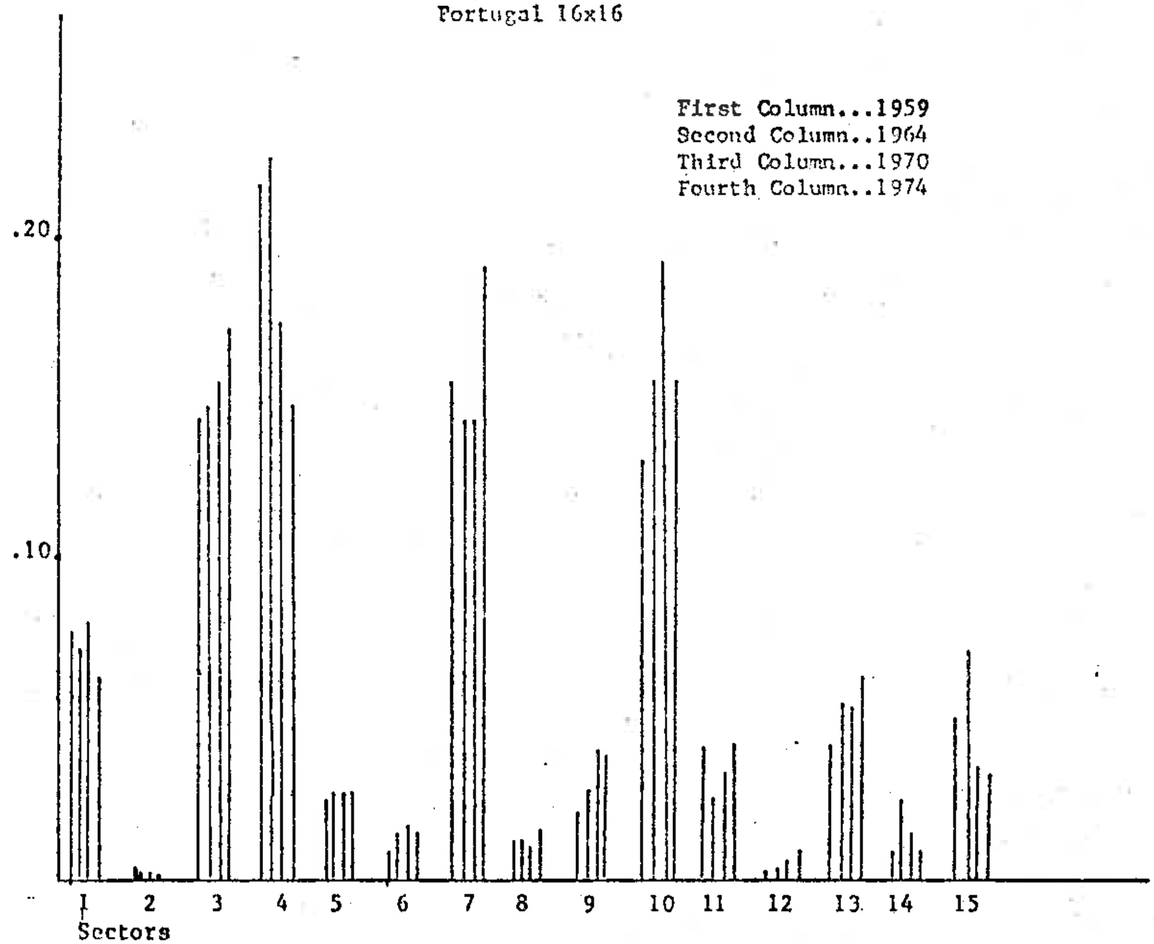


FIGURE 5.5
Gross Production Originating From a Unit of Imports
(Porportions)
Portugal 16x16



sectors, starting with 34.1 percent impact in 1959, the impact dropped to 24.2 percent in 1974. Sectors with an increasing import share were, 3 - Food Processing, Beverages and Tobacco, 7 - Chemicals, Petroleum and Coal Products, 9 - Basic Metals, 10 - Machinery, Transport Equipment, Naval Construction and Repair, and 13 - Public and Private Construction. These sectors went from 49.5 percent in 1959 to 62.1 percent in 1974. Also five sectors were the big (direct and indirect) import consumers, Sector 1 - Agriculture, Forestry and Fisheries, 3 - Food Processing, Beverages and Tobacco, 4 - Textiles, Apparel, Leather and Shoes, 7 - Chemicals, Petroleum and Coal Products and 10 - Machinery, Transport Equipment, Naval Construction and Repair, with 77.8 percent in 1959 and 73.1 percent in 1974.

The former analysis was based on (5.25) and (5.26), and it concerned gross production required (originating) for (from) one unit of specific final uses (one unit of specific kinds of primary inputs). On the other hand, the results in (5.27) and (5.28), to be used next, associate the distribution of primary inputs with their final uses, and division of final uses among primary input components. It is, therefore, not directly associated with gross production, as before. The results in the first set of tables (5.9, 5.10, 5.11 and 5.12) are for $\vec{Q}\ \vec{Y}$.

Each row, representing a sector, indicates the distribution of one unit of primary input among the specific final uses. Analyzing by columns, we can see for each of the final demand components (for example, exports), the sectors from which that final demand takes a large share of the distribution of the value added unit among

TABLE 5.9

Distribution of One Unit of Primary Input
Among Final Uses, By Sector

(Proportions)

Portugal 1959

Sectors	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports	Σ
1	.896	.010	.010	-.040	.125	1
2	.270	.065	.186	.048	.432	1
3	.887	.015	.000	-.024	.123	1
4	.726	.018	.002	.061	.193	1
5	.277	.038	.107	.013	.565	1
6	.662	.045	.047	-.028	.273	1
7	.599	.029	.035	.102	.236	1
8	.170	.014	.644	.003	.170	1
9	.427	.101	.246	.008	.218	1
10	.478	.135	.263	-.001	.124	1
11	.759	.069	.075	.003	.093	1
12	.690	.081	.087	.019	.122	1
13	.026	.017	.955	-.000	.002	1
14	.821	.019	.043	.002	.115	1
15	.747	.021	.010	.002	.220	1
16	.558	.360	.040	-.000	.042	1

TABLE 5.10

Distribution of One unit of Primary Input
Among Final Uses, By Sector

(Proprotions)

Portugal 1964

Sectors	Private Consump-tion	Public Consump-tion	Invest-ment	Variations of Stocks	Exports	Σ
1	.783	.017	.016	.029	.152	1
2	.256	.058	.353	-.019	.350	1
3	.920	.014	.001	.006	.057	1
4	.693	.014	.003	.007	.281	1
5	.305	.036	.187	.001	.469	1
6	.515	.074	.054	-.008	.363	1
7	.590	.056	.076	-.005	.280	1
8	.309	.073	.436	.014	.165	1
9	.266	.062	.506	-.025	.188	1
10	.456	.057	.379	.001	.105	1
11	.772	.070	.055	.000	.101	1
12	.655	.132	.093	.001	.116	1
13	.030	.078	.887	.000	.003	1
14	.727	.025	.109	.012	.025	1
15	.670	.026	.031	.001	.269	1
16	.525	.463	.006	.000	.004	1

TABLE 5.11

Distribution of One Unit of Primary Input
Among Final Uses, By Sector

(Proportions)

Portugal 1970

Sectors	Private Consump- tion	Public Consump- tion	Invest- ment	Variations of Stocks	Exports	Σ
1	.837	.002	.020	-.025	.166	1
2	.160	.040	.209	.028	.563	1
3	.874	.002	.003	.002	.121	1
4	.576	.025	.014	.013	.373	1
5	.283	.006	.307	-.066	.471	1
6	.350	.021	.084	.003	.542	1
7	.540	.026	.092	.015	.328	1
8	.135	.023	.639	.003	.201	1
9	.244	.034	.471	.018	.233	1
10	.307	.036	.446	.008	.203	1
11	.634	.072	.068	.001	.225	1
12	.622	.108	.116	.001	.152	1
13	.023	.008	.966	-.000	.004	1
14	.716	.019	.188	-.011	.087	1
15	.804	.015	.021	-.001	.161	1
16	.660	.278	.035	-.000	.027	1

TABLE 5.12

Distribution of One Unit of Primary Inputs
Among Final Uses, By Sector

(Proportions)

Portugal 1974

Sectors	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports	Σ
1	.775	.002	.018	.047	.159	1
2	.152	.020	.451	-.052	.430	1
3	.829	.000	.002	.043	.126	1
4	.432	.002	.009	.064	.493	1
5	.245	.012	.191	.033	.519	1
6	.287	.015	.076	.051	.571	1
7	.491	.022	.097	.089	.301	1
8	.147	.009	.595	.103	.146	1
9	.333	.071	.429	-.075	.242	1
10	.364	.098	.284	.042	.211	1
11	.672	.063	.058	.029	.178	1
12	.588	.122	.103	.028	.159	1
13	.022	.009	.965	.001	.003	1
14	.648	.020	.206	.051	.075	1
15	.795	.013	.017	.004	.171	1
16	.678	.267	.022	.005	.027	1

final uses. In the exports case, this component share is presented for the four years in Figure 5.6. Also in Figure 5.7, the same presentation is made for private consumption.

An analysis of Figure 5.7 will show that the private consumption share of one unit of value added dropped in all sectors but one, Sector 15 - Transport and Communications. From the eight sectors where private consumption represented more than 60 percent of the total value added unit in 1959, only five remained in 1974.

	1959	1974
1 - Agriculture Forestry and Fisheries	.90	.77
3 - Food Processing, Beverages and Tobacco	.89	.82
4 - Textiles, Apparel, Leather and Shoes	.72	.43
6 - Paper Pulp and Paper	.66	.28
11 - Other Manufacturing	.76	.67
12 - Electricity, Water and Gas	.69	.58
14 - Trade	.82	.64
15 - Transport and Communications	.74	.79

Sectors with minimal private consumption shares (below 30 percent) are:

	1959	1974
2 - Mining and Quarrying	.27	.15
5 - Wood, Cork and Furniture	.28	.25
8 - Non Metallic Mineral Products	.17	.15
13 - Public and Private Construction	.03	.02

In all cases we observe a decrease in the observed values over time. On the contrary, the export share of the value added unit

FIGURE 5.6
Share of Exports in the Distribution
of One Unit of Primary Input among
Specific Final Uses
(Proportions)
Portugal 16x16

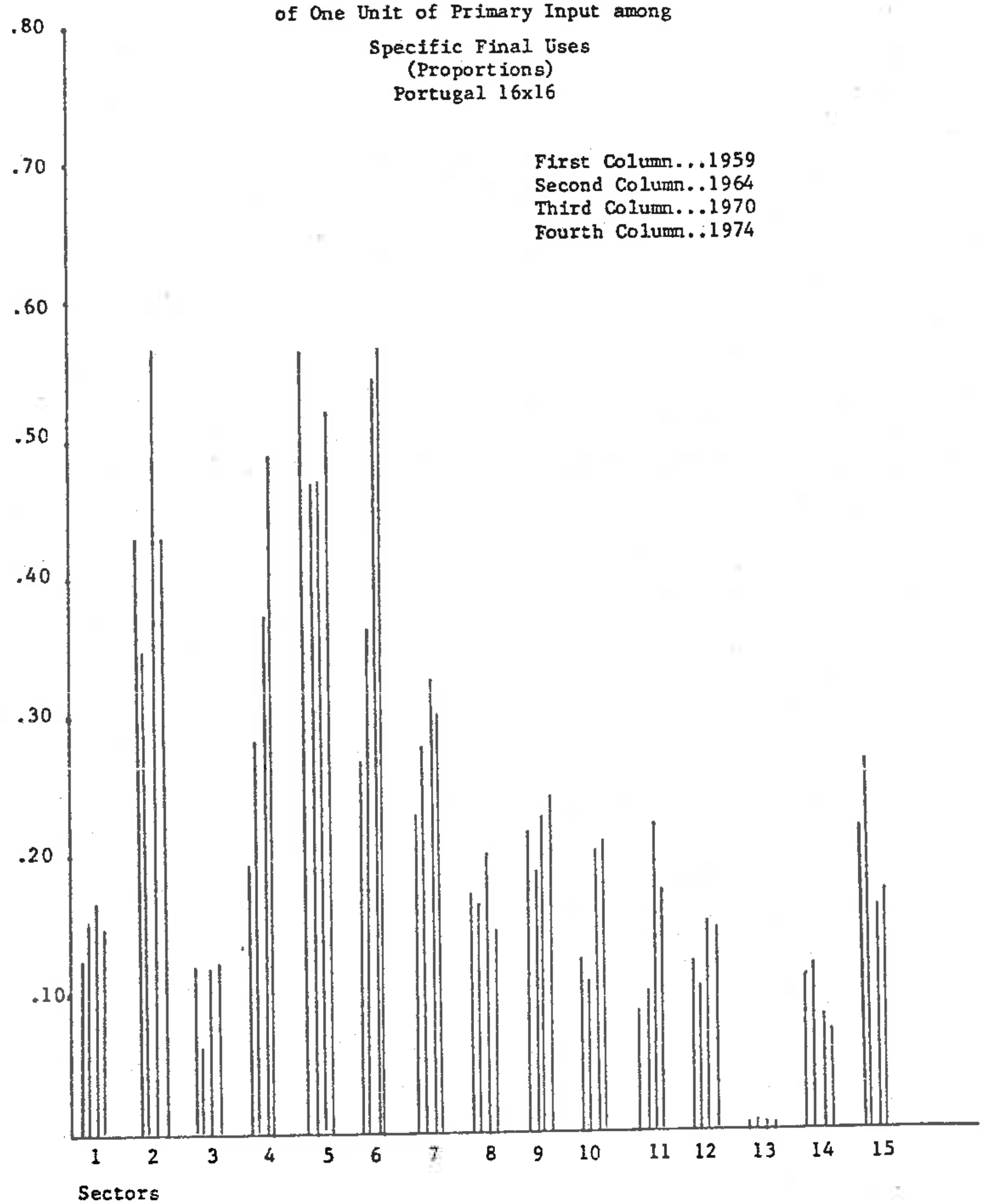
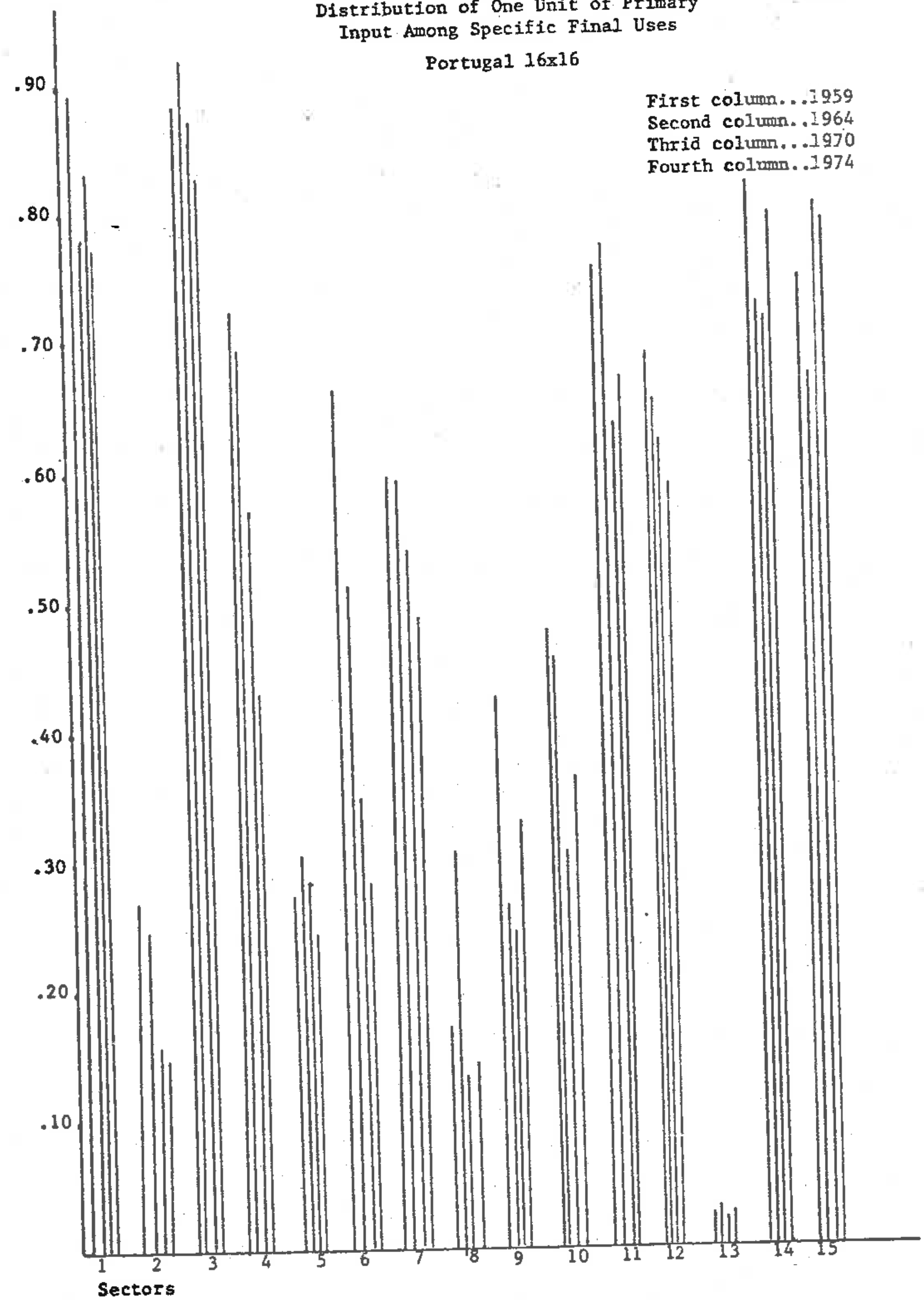


FIGURE 5.7

Share of Private Consumption in the Distribution of One Unit of Primary Input Among Specific Final Uses

Portugal 16x16

First column...1959
Second column..1964
Thrid column...1970
Fourth column..1974



increased over time in almost all sectors, indicating an increase in economic interdependence with the rest of the world.

Sector 4 - Textiles, Apparel, Leather and Shoes, a traditional Portuguese export sector, increased its percentage share significantly over the period, from 19 percent to 49 percent. Sector 6 - Paper Pulp and Paper, also increased, from 27 percent to 57 percent. Leading sectors, with an export share over 30 percent, are

	1959	1974
2 - Mining and Quarrying	.43	.43
4 - Textiles, Apparel, Leather and Shoes	.19	.49
5 - Wood, Cork and Furniture	.57	.52
6 - Paper Pulp and Paper	.27	.57
7 - Chemicals, Petroleum and Coal Products	.24	.30

Results from (5.28), for $H{\downarrow}Q{\downarrow}$, are presented in Tables 5.13, 5.14, 5.15 and 5.16. As noted before, the rows of these tables are: (1) taxes and subsidies, (2) wages, (3) other income (profits, dividends, rents), and (4) imports. The concept, already familiar as the "total content indicators" or "total input coefficients", represents the division of the unit of final value among the value added structure, in sectoral terms.

For the first sector, Agriculture, for example, the first column of these tables shows the share of wages (row 2, as an example) in the final value unit. Therefore from 23.6 percent of the total value unit in 1959, we observe successive increases in 1964 to 38.1 percent in 1970 to 41.4 percent, and finally a drastic drop to 29.6 percent in 1974. An analysis by row (for example, row 4, imports), will show us the distribution pattern of the share that imports has in the final value unit for the different sectors, and looking at all tables, their intertemporal pattern.

In Figure 5.8, the distribution of the wages share in one unit of final demand, across all sectors, is presented. For all sectors there have been increases over time. Sectors with 40 percent or more in 1974 are:

	1959	1974
2 - Mining and Quarrying	.36	.46
5 - Wood, Cork and Furniture	.10	.44
8 - Non Metallic Mineral Products	.29	.40
11 - Other Manufacturing	.09	.47
13 - Public and Private Construction	.33	.50
15 - Transport and Communications	.33	.58

On the contrary the sectors with 25 percent or less are:

	1959	1974
7 - Chemicals, Petroleum and Coal Products	.13	.25
9 - Basic Metals	.21	.22

Figure 5.9 presents the distribution share of imports in one unit of final value for the fifteen different sectors. In general, to produce one unit of final demand, the import composition increased over time for almost all sectors. Exceptions are:

	1959	1974
4 - Textiles, Apparel, Leather and Shoes	.39	.31
6 - Paper Pulp and Paper	.18	.17
10 - Machinery, Transport Equipment, Naval Construction and Repair	.36	.26
11 - Other Manufacturing	.30	.30
15 - Transport and Communications	.16	.12

FIGURE 5.8

Share of Wages in the Division of One Unit of Final Value Among the Primary Value Components

Portugal

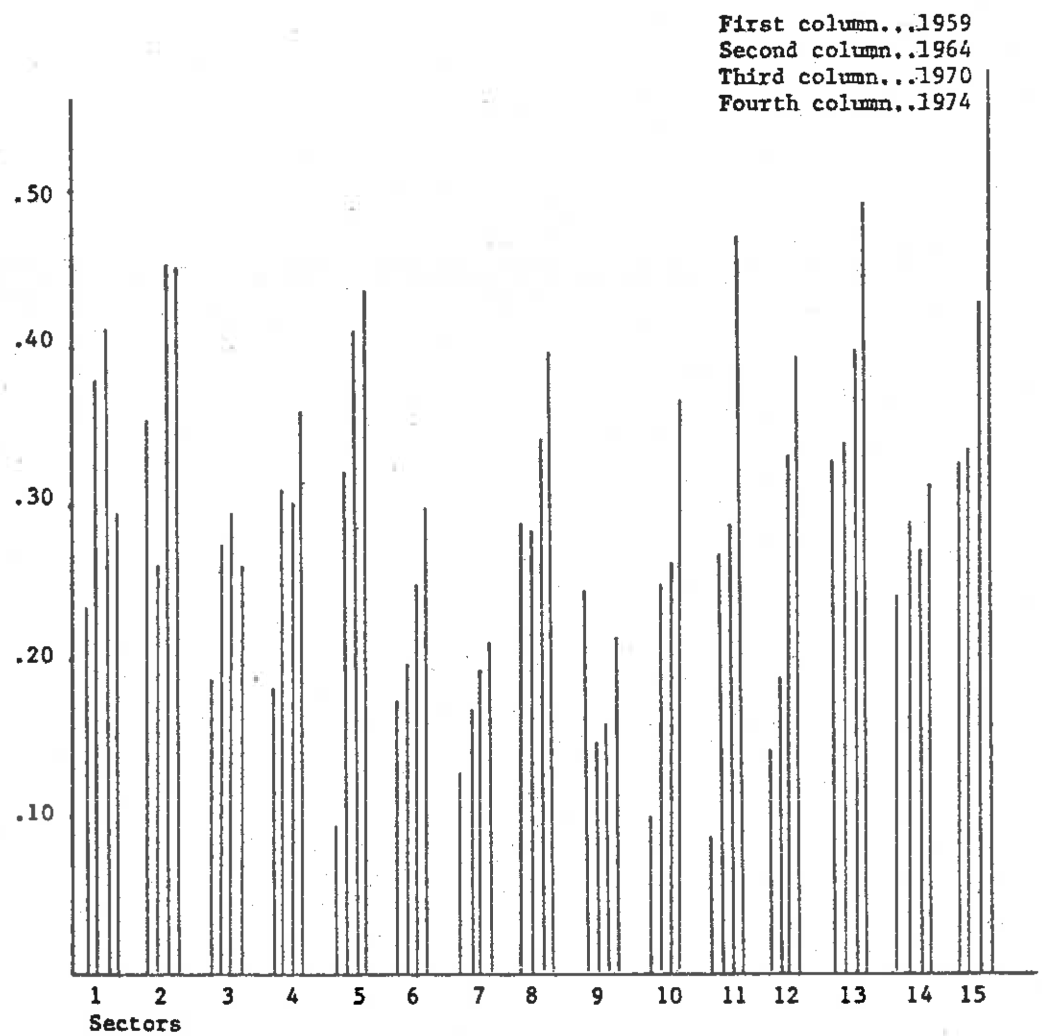


FIGURE 5.9

Share of Inports in the Division of One Unit of Final Value Among the Primary Value Components

Portugal

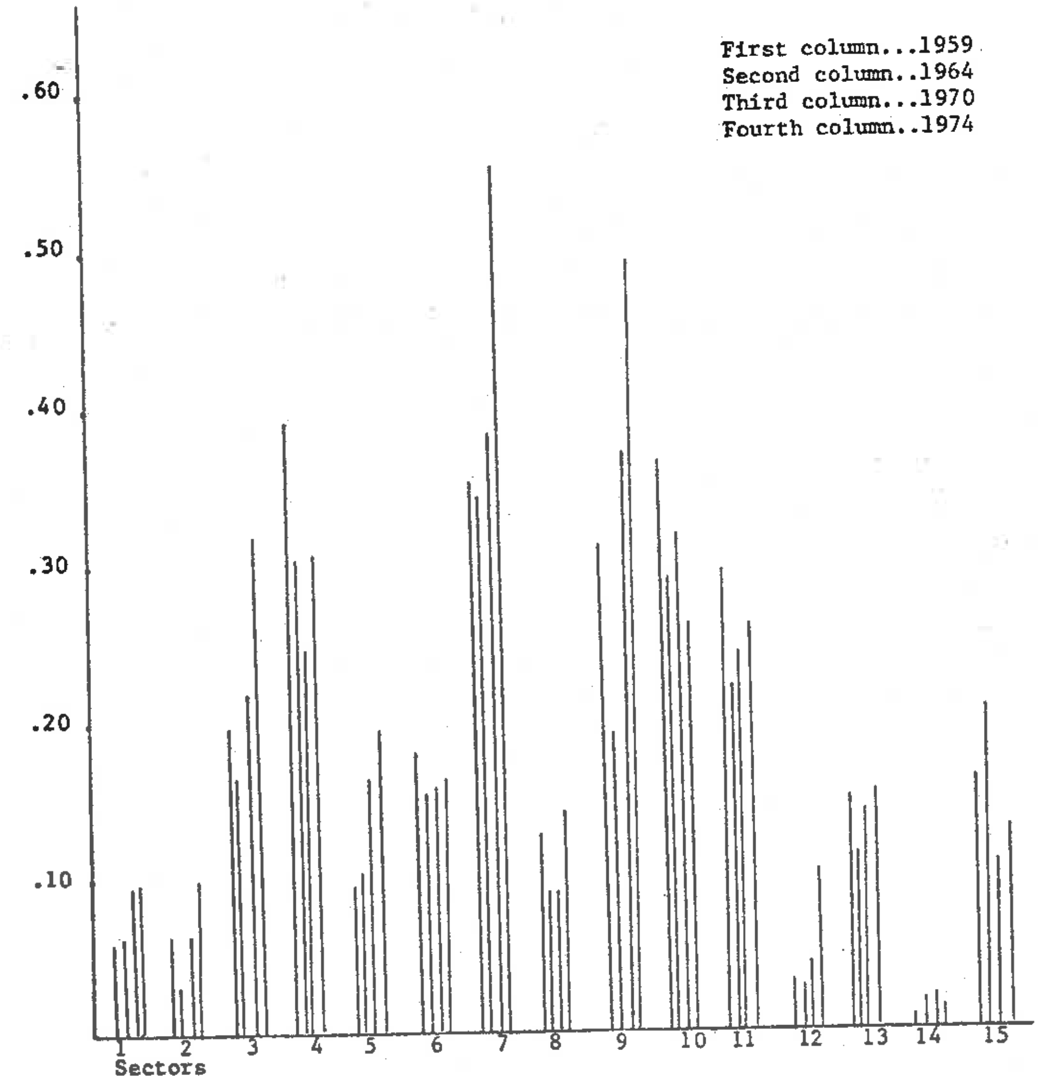


TABLE 5.13

Division of One Unit of Final Value Among
Primary Value Components, By Sector

Portugal 1959

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
.013	.008	.046	.007	.011	.015	.118	.009	.010	.009	.009	.000	.011	.106	.016	.007
.236	.356	.190	.187	.097	.178	.134	.290	.246	.101	.087	.143	.328	.242	.327	.403
.692	.573	.567	.415	.798	.629	.397	.572	.432	.527	.607	.824	.511	.644	.495	.505
.058	.063	.197	.392	.093	.178	.352	.129	.312	.363	.297	.033	.149	.008	.162	.085
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 5.14

Division of One Unit of Final Value Among
Primary Value Components, By Sector

Portugal 1964

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
.022	.018	.072	.047	.030	.038	.047	.025	.034	.042	.031	.008	.033	.239	.030	.004
.381	.266	.277	.313	.323	.201	.171	.285	.154	.250	.269	.191	.341	.290	.335	.655
.536	.682	.487	.337	.543	.607	.440	.600	.621	.420	.484	.774	.515	.452	.434	.329
.061	.033	.164	.304	.103	.154	.342	.091	.192	.289	.216	.027	.111	.019	.201	.013
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 5.15

Division of One Unit of Final Value Among Primary Value Components, By Sector

Portugal 1970

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
.017	.028	.072	.076	.060	.046	.063	.036	.038	.085	.061	.021	.051	.289	.040	.012
.414	.457	.296	.307	.413	.250	.196	.344	.162	.265	.288	.333	.402	.270	.434	.641
.475	.449	.413	.370	.363	.548	.359	.528	.430	.332	.408	.606	.406	.421	.420	.324
.094	.065	.220	.247	.164	.156	.382	.091	.369	.318	.243	.041	.140	.020	.107	.023
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

TABLE 5.16

Division of One Unit of Final Value Among Primary Value Components, By Sector

Portugal 1974

Sectors

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
-.002	.015	-.010	.036	.019	-.002	.017	-.020	.007	.040	.021	-.051	.017	.336	.008	.003
.296	.457	.263	.361	.437	.299	.214	.400	.218	.368	.472	.395	.496	.312	.578	.701
.610	.429	.428	.296	.351	.538	.214	.479	.283	.333	.211	.552	.334	.337	.293	.268
.095	.099	.319	.307	.194	.165	.554	.141	.492	.260	.296	.103	.153	.015	.121	.028
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Sectors where imports play a leading role in the final demand composition (over 30 percent in 1974) are:

	1959	1974
3 - Food Processing, Beverages and Tobacco	.20	.32
4 - Textiles, Apparel, Leather and Shoes	.39	.31
7 - Chemicals, Petroleum and Coal Products	.35	.55
9 - Basic Metals	.31	.49

Finally, an overall analysis is possible using the concepts presented in (5.29) and (5.30). In (5.29), $H{\downarrow}Q{\downarrow}Y{\downarrow}$ represents the overall division of a unit of a specific kind of final value among the primary input components. This is presented for the four different years in Tables 5.17, 5.18, 5.19 and 5.20. This concept, related to an overall analysis of the economy, provides information about the final allocation structure of the final demand components among the value added structure. Figure 5.10 presents a comparison for the 1959-1974 period.

Analysis of the share of wages in the final demand components shows a clear increase over time in all the final demand components.

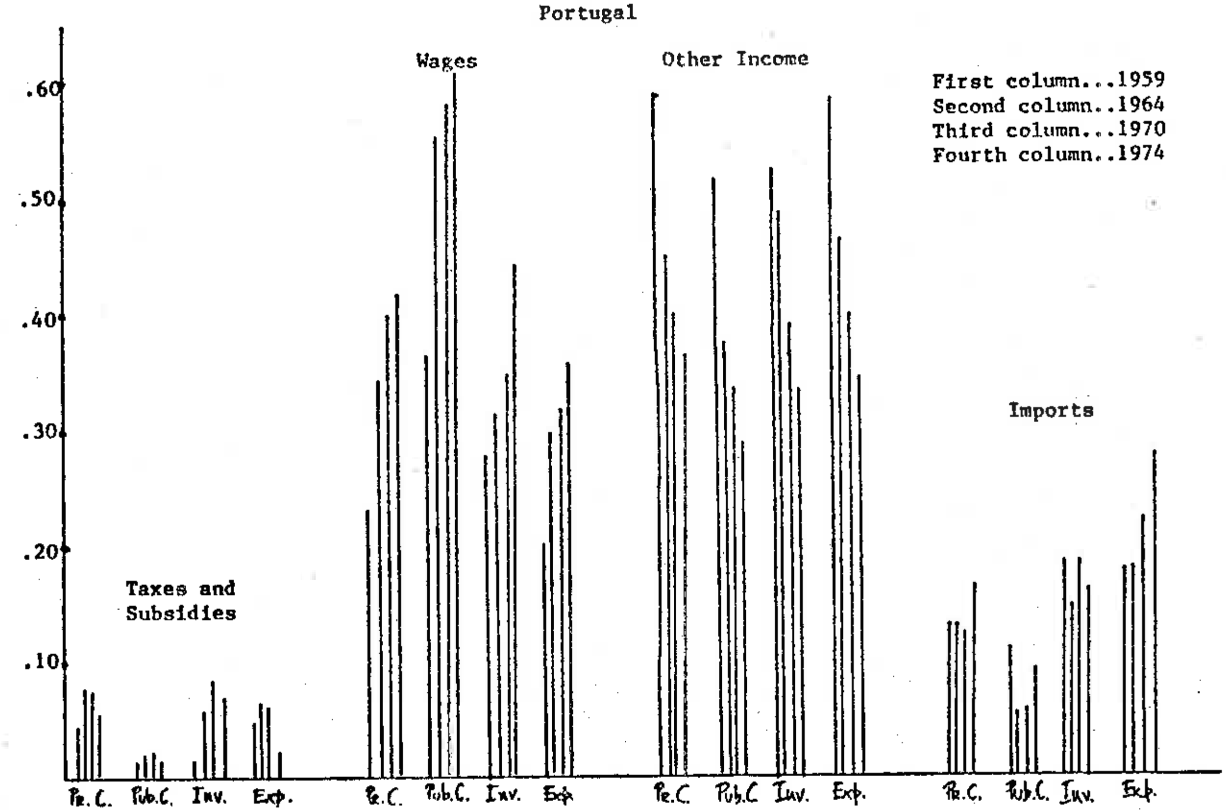
	1959	1974
Private Consumption	.23	.42
Public Consumption	.36	.61
Investment	.28	.32
Exports	.20	.36

The other income components, on the contrary, show an overall decrease over time, as follows:

FIGURE 5.10

Division of One Unit of Specific Kinds of Final Demand Among the Primary Input Components

Portugal



	1959	1974
Private Consumption	.59	.36
Public Consumption	.51	.29
Investment	.52	.33
Exports	.18	.35

The evolution of taxes and subsidies does not show a clear pattern. The main reason is that the impact of subsidies changes considerably over time. Moreover, it could be rather dangerous to make statements based on these four random years, when we do not know much about the overall subsidy policy of the central government.

In relation to imports, the share of this value added conponent also increased considerably in the final demand components. That is,

	1959	1974
Private Consumption	.13	.17
Public Consumption	.11	.09
Investment	.18	.16
Exports	.18	.28

The decrease observed in the investment component also could be attributed to a low investment year; this was undoubtedly the case, if we remember that 1974 was the year of the revolution.

Finally, we analyse $\vec{H}\,\vec{Q}\,\vec{Y}$ as given in (5.30). The results for the 1959-1974 period are presented in Tables 5.21, 5.22, 5.23 and 5.24. Those tables present the division of a unit of specific kinds of primary inputs into their final allocation among final demand

TABLE 5.17

Division of One Unit of Specific Kinds of Final Demand Among the Primary Input Components

(Proportions)

Portugal 1959

	Private Consump- tion	Public Consump- tion	Invest- ment	Variations of Stocks	Exports
Taxes & Subsidies	.043	.014	.016	.411	.041
Wages	.234	.364	.276	-.284	.199
Other Income	.589	.513	.514	-1.140	.583
Imports	.134	.108	.184	2.013	.178
Σ	1	1	1	1	1

TABLE 5.18

Division of One Unit of Specific Kinds of Final Demand Among the Primary Input Components

(Proportions)

Portugal 1964

	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports
Taxes & Subsidies	.078	.020	.057	.087	.063
Wages	.343	.550	.313	.372	.298
Other Income	.448	.374	.484	.491	.462
Imports	.131	.056	.146	.049	.177
Σ	1	1	1	1	1

TABLE 5.19

Division of One Unit of Specific Kinds of Final Demand Among the Primary Input Components

(Proportions)

Portugal 1970

	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports
Taxes & Subsidies	.077	.024	.085	.118	.062
Wages	.396	.581	.349	.577	.318
Other Income	.398	.338	.383	.537	.399
Imports	.128	.056	.182	-.232	.222
Σ	1	1	1	1	1

TABLE 5.20

Division of One Unit of Specific Kinds of Final Demand Among the Primary Input Components

(Proportions)

Portugal 1974

	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports
Taxes & Subsidies	.057	.016	.068	.073	.022
Wages	.415	.606	.440	.320	.356
Other Income	.363	.288	.333	.367	.346
Imports	.166	.091	.158	.240	.276
Σ	1	1	1	1	1

TABLE 5.21

Division of a Unit of Specific Kinds of Primary Inputs Into Their Final Allocation Among Final Demand Components

(Proportions)

Portugal 1959

	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports	Σ
Taxes & Subsidies	.775	.023	.035	.022	.145	1
Wages	.688	.099	.099	-.002	.117	1
Other Income	.724	.058	.078	-.004	.143	1
Imports	.644	.048	.108	.029	.171	1

TABLE 5.22

Division of a Unit of Specific Kinds of Primary Inputs Into Their Final Allocation Among Final Demand Components

(Proportions)

Portugal 1964

	Private Consump-tion	Public Consump-tion	Invest-ment	Variations of Stocks	Exports	Σ
Taxes & Subsidies	.714	.027	.113	.011	.134	1
Wages	.603	.146	.120	.009	.122	1
Other Income	.619	.078	.145	.009	.149	1
Imports	.614	.040	.149	.003	.194	1

TABLE 5.23

Division of a Unit of Specific Kinds of Primary Inputs Into Their Final Allocation Among Final Demand Components

(Proportions)

Portugal 1970

	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports	Σ
Taxes & Subsidies	.652	.025	.192	-.005	.136	1
Wages	.618	.111	.146	-.005	.129	1
Other Income	.619	.065	.159	-.004	.161	1
Imports	.527	.029	.201	.005	.238	1

TABLE 5.24

Division of a Unit of Specific Kinds of Primary Inputs Into Their Final Allocation Among Final Demand Components

(Proportions)

Portugal 1974

	Private Consumption	Public Consumption	Investment	Variations of Stocks	Exports	Σ
Taxes & Subsidies	.630	.021	.227	.052	.070	1
Wages	.554	.100	.178	.028	.141	1
Other Income	.580	.057	.161	.038	.164	1
Imports	.514	.035	.149	.048	.254	1

components. Figure 5.11 presents the patterns observed in that period.

The share of private consumption allocation among the value added matrix components is the largest. However, for all of them we observe a decrease over time.

	1959	1974
Taxes and Subsidies	.78	.63
Wages	.68	.55
Other Income	.72	.58
Imports	.64	.51

The reverse situation is observed in the investment allocation structure.

	1959	1974
Taxes and Subsidies	.04	.23
Wages	.10	.18
Other Income	.08	.16
Imports	.11	.15

A general increase over time is also the general case in the overall export share of the value added components.

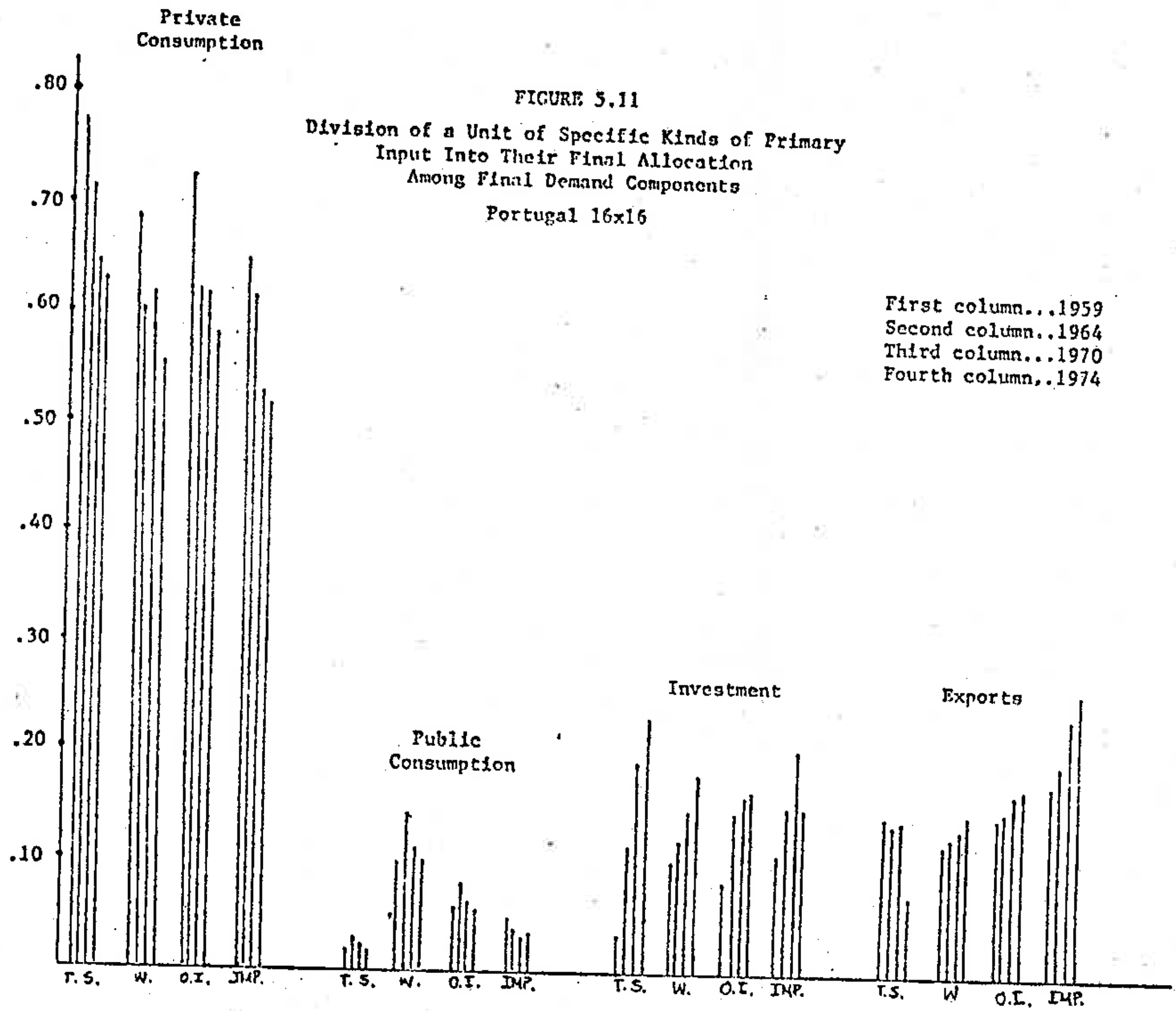
	1959	1974
Taxes and Subsidies	.15	.07
Wages	.12	.14
Other Income	.14	.16
Imports	.17	.25

The exception to the general increase is only observed, for 1974, in the taxes and subsidies component, for reasons already discussed.

FIGURE 5.11

Division of a Unit of Specific Kinds of Primary Input Into Their Final Allocation Among Final Demand Components

Portugal 16x16



Finally, the public consumption pattern shows constant behavior if we analyse the data for the two extreme years. However, within that period, an almost general increase in the public consumption share was observed from 1959 to 1964, followed by a decrease since then to the values observed in 1959.

	1959	1974
Taxes and Subsidies	.02	.02
Wage	.10	.10
Other Income	.06	.06
Imports	.05	.04

5.5 Brief Conclusions

In this chapter we have tried to introduce a more rigorous, comprehensive and broad framework to study the economic structure of an economy, especially in what concerns the relative importance of the specific elements of the final demand and value added matrix.

The literature survey clearly showed an absence of a framework which utilizes all the information contained in the matrix. Thus, the formulas discussed are simply particular cases of the holistic framework that is presented as an alternative. The Chenery model [1980] is only related to the demand side. The final demand components are presented in two vectors, with only exports treated separately from the overall final demand column. The conclusions based on this model will vary with the scale of output. This poses a problem in making intertemporal and international comparisons. The disaggregated analysis presented in Section 5.3, is, in this writer's view, preferable. The framework consisted of six different concepts, three related to the demand side of the model, and other three to the supply side. Formulas 5.25 to 5.28 provide specific information (and 5.29 and 5.30 provide overall information) about each specific element of the final demand and value added matrix. In Section 5.4, a detailed empirical analysis and discussion of the advantages of each concept was made, using the Portuguese case.

Footnotes

Chapter 5

[1]For details, see Atsumi [1981].

[2]For a detailed historical analysis, see Wogart [1978].

[3]As an illustration, the values of the above formulas are presented for some sectors, from Pomfret [1976, p. 20].

Measures of Import Substitution in Israel
1950–1958

Sector	$(\frac{M}{S})_{i,50}$ (Percent)	$(\frac{M}{S})_{i,58}$ (Percent)	Formula (5.1) (I £ 1,000)	Formula (5.2) (Percent)
Chemicals	62.1	25.0	69,630	52.2
Metals and Metal Products	45.2	31.1	36,752	22.6
Leather	33.5	0.8	26,890	33.8
Machinery	71.4	57.8	17,302	37.7
Textiles	19.9	13.0	13,302	9.4

i = sector

[4]For a presentation of the mechanics of calculation, see Leamer, and Stern [1970, Chapter 7]. Also, Pomfret [1976] and Wogart [1978].

[5]Chenery mention that the details of the derivation are discussed in Chenery and Syrquin [1979].

CHAPTER 6

CONCLUSIONS

6.1 General Conclusions

The linkage framework, broadly popularized in the development economics literature, has considerable advantages for defining the different levels of importance of economic sectors in stimulating a national or regional economy. It has been used to define development strategies based on investment allocations in predetermined key sectors, which were selected according to one's particular economic interests.

Criticisms of this approach have been mentioned, emphasizing weaknesses, as already extensively discussed in Chapter 2, and also suggesting alternative formulations.[1] However, empirical studies are published every year, showing that, despite criticisms, there is a broad acceptance and use of these tools by planners and policy makers.[2] This general acceptance of the framework, and its recognized importance as an operational tool nowadays, led to the development of this work.

One of our main assumptions, extensively tested using the Portuguese empirical data, was the relative stability of the linkage measures, and therefore of the key sectors determined by these measures. This relative stability was observed in almost all indicators used over time in this study. This result leads us to conclude that the structure of the Portuguese economy is stable. Structural changes in the Portuguese economy occurred slowly. More than a fifteen-year period is needed to observe slight changes in the production structure.

One of the main criticisms raised against input-output tables deals with this assumption of stability when we are concerned with forecasting or impact analysis. Several authors have analysed in detail the changes that have occurred over time in input-output tables, such as Leontief [1951], Carter [1970] and Syed [1975], at the national level, or Conway [1976] at the regional level.

The linkage analysis developed in Chapters 3 and 4 presented a stable pattern for medium and long-term periods. The more sophisticated the model used, the less sensitive to changes in stability. As an example, changes in the Leontief inverse for the Portuguese case were one-third as pronounced as the corresponding changes using the technical coefficient matrices. Thus the multiplier concepts which use the Leontief inverse in their operational formulation are more stable.

The rather stable pattern observed in the medium-term period of fifteen years for the Portuguese empirical case was the main reason for averaging the specific linkage indicators obtained for each year. The figures presented in Chapter 3, for the direct linkage indicators, clearly corroborate this procedure. Therefore we can say that the key sectors pinpointed in the study will remain key for some period into the future.

Three fundamental developments were introduced in the traditional linkage framework: the use of a supply side approach to the calculation of the forward linkages, their extension to income and employment considerations, and the introduction of several different versions for each indicator.

The advantages of the supply side approach for the linkage framework and also for the multiplier analysis are analysed in detail in Chapter 2. Forward linkages calculated on the basis of the Leontief inverse of vertical coefficients was demonstrated to be wrong and misleading although still widely used.[3] Forward linkages are supply side indicators, and the horizontal version of the input-output tables must be used for their calculation.

The empirical analysis presented in Chapters 3 and 4 shows the relevance of the extension of the linkage framework to income and employment. As predicted, linkage indicators for output considerations do not necessarily coincide with linkages for income or employment. Then, investment decisions for those different purposes should be based on different key sectors, as the different linkage analyses have shown. The summary analysis presented in Section 3.5 is clear about that, and does not support the traditional analysis which fails to differentiate output linkages from the others.

Finally, several different versions were introduced for each indicator. Using the domestic and the interindustry matrices, we can have a sectoral description of the importance of imports for the economy. The more interdependent an economy is, the more interesting is this measure. Using absolute and relative measures, using the value of the share of gross output as the weighting element, we obtain indicators relatively independent from each other in terms of their real absolute weight. Using net and unnetted measures, we can observe and separate the intrasectoral linkages from the intersectoral ones. That is, we can separate the interconnections generated inside each sector from the interconnections generated indirectly on the others.

All of these measures where discussed in detail in Chapter 2. The supporting empirical evidence is presented in Chapters 3 and 4. These concepts contributed a more rigorous (supply side approach), broader (extensions introduced) and more complete (different variants for each indicator) set of information.

The availability of input-output systems has spread so rapidly across the world and the use of computers has become so common, that this operational tool can be used relatively easily in any country. It has an advantage over other models, where the gathering of data to obtain a feasible minimum set of equations is initially impossible, especially where time series or regional data are required.

Finally, a much more rigorous, comprehensive and broad sectoral and overall framework of analysis for interpretation of the structure of the Portuguese economy is introduced.

The relative importance of all the specific elements of the final demand and value added matrices, based not only on direct but also on indirect effects, is examined. This generalized approach to input-output systems is presented in Chapter 5 as a complete framework that deals with all elements that constitute the input-output model.

In general, the more sophisticated models derived from input-output are based on the Leontief inverse of the vertical coefficients version. However, they exclude relevant information that is contained in other parts of the model, as in the final demand and value added components. In some particular cases, indicators have been constructed using some of those elements in conjunction with the Leontief inverse, like income and employment multipliers. However, a framework which contains all specific elements of all sub-matrices of the model has never been proposed before.

Dealing with the demand and supply approach simultaneously, we derived four important concepts which allow a detailed sectoral analysis of the specific elements of the final demand and value added matrices. The first gives the gross production necessary to produce one unit of a specific final demand element in sectoral proportion terms. The second gives gross production originating from a unit of a specific element of the value added matrix, in sectoral porportion terms. The third gives the share of a specific component of final demand in the distribution of one unit of primary input among the specific final uses. Finally, the fourth gives the share of a specific component of the value added matrix in the division of one unit of final value among the primary value components.

Two other concepts, related to the overall sector analysis, give a rigorous picture of the analytical relations linking the two matrices. One gives the division of one unit of specific kinds of final demand among the primary input components. The last one gives the division of a unit of specific kinds of primary inputs into their final allocation among final demand components.

6.2 The Portuguese Empirical Analyses

The study of the Portuguese case, as shown in several of the chapters, presented an opportunity to test the proposed analytical methods, rather than giving a detailed and exhaustive analysis of the country's economic structure.

Fortunately, Portugal had available a set of compatible input-output systems at two different levels of aggregation and one of them for four different years, over a fifteen-year period. However a detailed analysis of the Portuguese economic structure would need a more substantial information data base, in addition to the input-output systems, and historical knowledge of the main characteristics of the economy. The analysis and conclusions are then the results of available data and do not represent an elaborate description of the Portuguese economy of that period.

As mentioned, particular methodologies are used, according to the specific characteristics that we are interested in studying, and the procedures adapted to each particular case study. The conclusions raised from the Portuguese case are not necessarily comparable with other cases.

Availability of data, for one or several years, existence of domestic and interindustry versions, current or constant prices tables, particular purposes of the studies, could lead to different ways of expressing and utilizing the proposed methodology.

In the Portuguese case, lack of information in several rows and columns of the value added and final demand matrices raised several problems. This study avoided an analysis of the "Investment" column or the "Taxes and Subsidies" row, due to lack of accurate data. The Portuguese analysis identified the key sectors of the economy, defined in three different ways: output, income and employment. Chapters 3 and 4 provided a detailed description of each sector and its particular structural composition. Dependence or independence from imports, intrasectoral and intersectoral strength for generating linkages, relative and absolute potentials of each sector, are some of the insights provided from the analysis.

Comparisons of linkage indicators with sectoral and overall rates of growth, as a way to determine balanced and unbalanced paths, were also made, when information was available. Finally, conclusions are made about the Portuguese key sectors, based on all these operational tools.

Concluding, this work has attempted to take a tentative step further in input-output methodology and its implications. It presents a detailed formal description of the proposed frameworks, discussion of their advantages and limitations and the results of an empirical case study as a way to test them. Evidence seems to support the utility of the concepts presented for input-output users.

6.3 Further research topics

The stability question for input-output tables has been widely empirically studied, using several different methods. Changes in cell-by-cell elements, summations over the rows and columns, ratios such as Leontief's "Index of Relative Change" (Leontief [1953]), or the Chenery and Watanabe [1958] "Absolute Column Measure", and others as proposed by Carter [1970] or Syed [1975], could be considered. The stability problem can also be studied through the use of linkage indicators, or the concepts presented in Chapter 5.

Cluster and complex analysis are very much related to this dissertation topic. A great variety of methods has been used,[4] and the linkage framework could find further developments and applications in this area. The "graph theoretic approach", which suggests the identification of the key industries and industry groups based on the structure of interindustry relationships,[5] could also be a potential field of research for further extension and development of the topic.

The division of input-output coefficients into two categories, "large" and "small" (as in Simpson and Tsukui [1965]), and the relative stability of the pattern over time,[6] could be useful in the linkage context. The analysis of the impacts of the large and small coefficients may also be used in linkage analysis.

Linkage indicators have been widely used for investment allocation decisions, but the model could also be oriented in an opposite direction. In a wartime situation one could be interested in determining the sectors whose destruction would cause more direct and indirect damage in the output (or income or employment) of the enemy's economy. The linkage framework, measuring the interconnections among sectors, is in a rather good position to provide such information.

Finally, the construction of a linear programming model, maximizing output from investment allocations on predetermined key sectors, and allowing for the introduction of constraints like sectoral and overall rates of growth, natural resources (availability, operational capacity, etc.), could be explored.

FOOTNOTES

Chapter 6

[1] See, as an example, Taylor [1979, p. 200].

[2] Dowerah and Baruah [1978] for India, Aislabie [1979] for Australia, Malerba [1978] for Italy, Bulmer [1978] for Costa Rica, Diamond [1976] for Singapore, Song [1977] for Korea, and Shultz [1977] for some developing countries, are some examples.

[3] Almost all studies presented in footnote 2 continue to use the vertical approach for forward linkages.

[4] For a summary of cluster and complex analysis see Czamansky and Ablas [1979].

[5] Campbell [1972].

[6] Silva [1980].

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