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The input-output table for the Alentejo Region in Portugal([1])

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Abstract

Portugal is a not a homogenous territory even though it is a small country. Each region has different characteristics, which makes the country as an evident case for the need of an effective cohesion policy leading to a diminishment of regional disparities.

This paper presents a preliminary version of the input-output table for Alentejo, a Portuguese region through the regionalization of the input-output national table, for the year 2008.

As it is well known the input-output (IO) model is particularly appropriate for the analysis of the effects of demand on supply (possibly in territorial/regional terms). As such, from the descriptive point of view, the IO model is useful for the analysis of explanatory factors of (regional) growth. Moreover, from a decision-

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making point of view it allows to support (regional) policy making in order to change (in the most favorable possible way) the (regional) production structure. This is particularly important for the fragile region of Alentejo, while the largest one, where such instruments are scarce.

Furthermore, the second quadrant, from which demand effects can be considered and extended to third quadrant, where a proper quantification of inter-regional imports is to be considered, complete the table.

From the production perspective, our preliminary results suggest weak inter-sectors relations in the Alentejo region making it susceptible to lose a substantial part of the potential effects, which may spillover to other Portuguese regions. In particular, more than 75% of the indirect effects are below 0.05.

Furthermore, tobacco, food, beverages, crude refineries, fishing & aquaculture, clothing and agriculture sectors have the most relevant type II multipliers. However, only clothing and beverages have higher aggregate indirect effects over all other industries as a result of an increase of one euro on their final demands.

Regarding type I multipliers, our results suggests a different picture. Forestry, tobacco, leather, beverages, among other have important direct and indirect effect.

These results have important policy implications in this fragile region.

There is, however, another possible use of the model, based on the determination of how to alter the production structure, in order to potentiate the effect of drag of all sectors of production, which may have great potential for development of strategies for economic policy.

Keywords: Regional Input-Output Table, Alentejo.

JEL Codes: C67, R12, R15, R58.

1. Introduction

Portugal is made up of very different regional realities, so considering Portugal as a single region may be important when the objective is to make comparisons with other regions, but not the most appropriate when the goal is to solve internal problems, such as regional disparities. Thus, more information is necessary, if possible in spatial terms (Saúde, 1997).

Furthermore, our accession to the European Economic Community (EEC), now the European Union (EU), stressed the need for statistical production at regional level. In the organic structure of the EU Directorate General, having a purpose to reduce regional disparities within the EU, one can consider the current Director General for Regional Policy (DGREGIO), as associated with the privileged use of statistical information (Saúde, 1997).

For all these reasons, and because the Statistical Office of the European Communities (EUROSTAT) main function is to harmonize criteria and establish uniform rules for the production of national statistics, the National Statistics Institute (INE) accommodated these requirements and evolved to the production of regional information. Regional Accounts arise in this context and are a requirement of EUROSTAT. The European System of Integrated Economic Accounts 1995 (ESA - 1995) devotes an entire chapter to the National Accounts and, simultaneously, Eurostat has developed manuals of the Regional Accounts for each specific area, such as those relating to Gross Value Added (GVA) and Gross Fixed Capital Formation (GFCF) by industry, and household accounts (Saúde, 1997).

The goal would be to construct regional accounts, in all similar to the National Accounts, except for the reference space. But this would only be possible if all statistical surveys had representation at the regional level, allowing reliable results. So the ideal would be to calculate the Regional Accounts, and from these, by aggregation, reaching the National Accounts (Saúde, 1997).

At the present moment it is not possible to follow this methodology, so the INE builds Regional Accounts from the National Accounts, by ventilation, and not vice versa, i.e., in practice, apply mixed pseudo-ascending methods. As approximation methods, these are pseudo-ascending consisting on collecting data for the base units (local activity economic units or households, for example), obtaining, by addition, regional values for the variables. When there is no data for base units and we have to provide estimates to the values of regional variables, it is said that we are applying methods pseudo-ancestors (Saúde, 1997).

The paucity of information with regional representation, in fact, inhibits deeper economic analysis and may represent an obstacle to the establishment and / or evaluation of regional and / or sectorial policies, therefore affecting regions of different forms of the Portuguese territory.

A special instrument in the definition and evaluation of economic policy is the input-output analysis (Leontief model), or in the language of National Accounts, Input-Output tables.

It is in this context that the present project arises, our goal being the construction of an Input-Output Table for the Alentejo region, with reference to the year 2008.

The literature on the construction of regional input-output matrices is relatively vast, being influential the works of Moses (1955), Hewings (1969), Schaffer & Chu (1969), Morrison & Smith (1974) and Round (1978). More recently, some work on non-survey methods (Chelli & Bonfiglio, 2008), hybrid methods (Lahr, 1993; West, 1990) and methods based on location quotients (Flegg *et al.*, 1995; Flegg & Webber, 1997) are of relevance (see also Ralston *et al.*, 1986, and Oosterhaven, 2005).

Although this is an innovative project in this region,[2] similar projects for other regions of Portugal were developed. As such, in the following section a brief reference to the methodology followed in these previous projects is presented.

[2] To the best of our knowledge, there is no other of this kind.

After that the statistical sources, the methodologies used in this project and some results are presented.

2. Theoretical background

The input-output model assumes a multi-sector perspective of the economy. Given the characteristics of the input-output methodology, it is one of the most appropriate to determine the economic impacts of demand changes, through a multiplier mechanism that results from three kinds of effects: direct, indirect and induced ones.

To put it clearer, let us consider X to be the vector of output, **A** the matrix of (constant) technical coefficients a_{ij}, which represent the consumption by sector *j* of intermediate goods produced by sector *i* in order to obtain one unity of production X_j, i.e. $\mathbf{A} = \left[a_{ij} \equiv \frac{x_{ij}}{X_j} \right]$, and Y the vector of final demand (constituted by private/public consumption, investment and exports).

If so, it is possible to estimate the direct and indirect effects on output resulting from a change in final demand ΔY as: [3]

$$\Delta X = (\mathbf{I} - \mathbf{A})^{-1} \Delta Y \qquad (3.1)$$

Those effects, in turn, -- the so-called induced effect -- propagate to the use of primary factors such as wages, taxes and imports and, when appropriate, the creation of new jobs. Being V the vector of primary factors, and **v** the diagonal matrix of primary factors coefficients, it is possible to extend the changes in production, given by (1), to ΔV as shown below:

$$\Delta V = \mathbf{v}\, \Delta X = \mathbf{v}\, (\mathbf{I} - \mathbf{A})^{-1} \Delta Y \qquad (3.2)$$

In particular, a regional version of the input-output model has the virtue of making it possible to take into account the way those three kinds of effects are

[3] **I** represent the identity matrix.

propagated through the territory, which is a crucial aspect for social/territorial cohesion policies. Plainly, for that being possible it is required the existence of regional input-output tables.

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3. Comparative Analysis of Methodologies used

The preparation of regional matrices described in the previous section highlights some points in common, but we note that differences will be important to explore, which can possibly be justified by their own economic and social characteristics of each territory (regions) in the analysis. Therefore, it will be useful to conduct a comparative analysis of methodologies adopted in each of these projects.

Base year and date of publication

Speaking globally it is found that, in most of the projects under review, the reference year of input-output matrix is located in the 90's, but has only been published in the year 2000 and beyond.

Sources of Information

Regarding the data used for the construction of regional input-output matrices it is clear that the official source of privileged information is the National Statistics Institute (INE), where we can find most of the information necessary for the construction of such instruments. Note also the importance of additional

information made available by some regional entities, allowing a better description of economic activities in each territory.

Targets

In general, with regional matrices building is intended to seek a planning tool that is critical for the analysis, studies and ex-ante assessment of investment projects in any sector of economic activity in the region. In addition, the regional input-output matrices must be assumed as an important source of information for economic agents to the extent that highlight the economic potential of the territories, describing the inter relationships. Therefore represent an instrument of territorial information of high importance and is likely to update.

Type of table used

In the works under review, it was decided to construct a matrix of total flows. In the case of input-output table of the Beira Interior region, it is broken down into three sub-arrays: table of flows of origin (within and outside of Beira Interior) at purchaser base prices (including trade margins and transport); table flows of origin in Beira Interior at market prices; flow table at producer prices (goods and services produced in the region, excluding the value of trade margins and transport).

Valuations of Table

All matrices analysed are valued at purchase prices. In all matrices, adopt the criteria CIF (Cost, Insurance and Freight) on the value of imports and FOB (Free on Board) on the value of exports.

Level of Nomenclature of National Accounts

All regional headquarters in the analysis present the results of the first level, according to the classification of national accounts (NCN) to 49 branches (NCN49), and in some cases present more detailed data on 2nd level. The table of the Central

Region presents the results of second-level breakdown of the 49 branches into sub-branches, creating a 291x276 table. In the case of the Algarve region, in addition to presenting results for intermediate consumption and GVA according to NCN315 also break up the branch 34 of NCN49 into three sub-sectors - restaurants, hotels and other traditional means of accommodation - given the expertise production in the region in tourism.

Methodology Used

The matrices of the Norte, Centro and Algarve regions were prepared using a partially indirect method (mixed method), i.e., it uses information from national accounts and, through information available to the productive activity of each region (via the statistical operations INE), are estimated, indirectly, the values of flows for each region.

In general, this method corresponds to calculating a given flow x in the region R (X_{ij}^{R}) as follows: [4]

$$X_{ij}^{R} = \frac{X_{ij}^{P}}{\sum_{i\ (or\ j)} X_{ij}^{P}} \sum_{i\ (or\ j)} \hat{X}_{ij}^{r} \qquad (4.1)$$

Where the superscript r indicates that it is the estimated value for the region through methods upward (bottom-up), or from direct collection of information in the territory, and the exponent P refers the value for the same variable in the accounts national. Thereby are combined the two types of information, information on a territorial basis and reference information for the construction of regional matrices (i.e., the information in Tables of Resources-Employment or frames of inputs and outputs of national accounts), which corresponds the application of methods pseudo-up or mixed. The indices i and j refer, respectively, the row and column of the table.

As for inputs, the table of the Norte region are estimated from national values with the use of expressions like (4.1), although with exceptions for some branches as mentioned below, while at the table of the Centro, in a general way it was

[4] In this example, the sum is used online, but we can use the sum column depending on the variable in the estimation.

decided by RAS method due to lack of data on the second level, and in the table of Algarve region was used a more specific methodology, branch to branch, as also described below.

RAS is a well-known method of updating the (input-output) matrix of technical coefficients. In its simplest form, it consists on an iterative adjustment of the rows and columns of the first quadrant of an input-output table given the knowledge of the column and row vectors of total intermediate consumption. This adjustment is made by multiplying each row by a positive constant, so that the total (in row) equals the true total. In general, this operation does not lead to a total (in column) equal to the true total. Hence, in a second iteration, the columns are then be multiplied by a constants in order to make the total equal the true total. This sequence of row and column multiplication continues until the totals of rows and columns converge to the true vectors.

In Vaz *et al.* (2012) we describe the specific treatment of each branch in each of the cases under review, with regard to the first quadrant (inputs) and the third quadrant (clearance of total resources).

Also in the second quadrant of the table (components of final demand) are major differences between the previous input-output tables (Vaz *et al.* (2012)).

Inter-regional trade and balance of the table

With respect to inter-regional trade, in the table of the Norte region was followed the method of balances calculating, for each branch, the difference between total resources and uses in the region and the difference corresponds to the flow of inter-regional imports and exports. As an alternative method can be used the method of location quotients (QL), calibrating the global balance of extra-regional (interregional and international) with the level of specialization assessed by QL's in each branch

In the table of Algarve region was followed a similar method to that adopted in the construction of the table of the Norte.

4. Methodology applied to the input-output matrix of the Alentejo region

With regard to the first quadrant of the input-output table for the Alentejo region, its determination was done following the footsteps immediately described below:

a) Aggregation of the 2008 Input-Output Table for Portugal, published by the Departamento de Prospectiva e Planeamento (DPP), in order to obtain the A38xA38 sectorial aggregation compatible with the classification of the Gross Value Added (GVA) for the Alentejo region as published by the National Institute of Statistics;

b) Extrapolation of the relationship, at the national level, between the Intermediate Consumption (IC) and the GVA in order to obtain the ICs for the Alentejo region;

c) Considering the national I-O table, as a basis for regionalization, application of the RAS method allowing the determination of the values for the intermediate supplies (IS);

d) The use of other RAS stages makes it possible to update the values of ICs (calculated in step 2) and IS2 (calculated in step 3) for the Alentejo region, being fulfilled the condition that the total of flows in the second quadrant equals the one for the third quadrant.

The application of four steps described above, considering as a basis for regionalization the input-output table (published by DPP), makes it possible to estimate the first quadrant of MIO Alentejo (see, however, Sargento *et al.* (2011) for a discussion of the need / utility of using the IO table rather than the Supply and Use tables).

Obviously, in view of the assumptions made in determining the first quadrant of the MIO Alentejo it essentially matters to point out the results for the output

multipliers from a relative point of view. Having this in mind, the inverse of the Leontief matrix is shown in Figure 1.

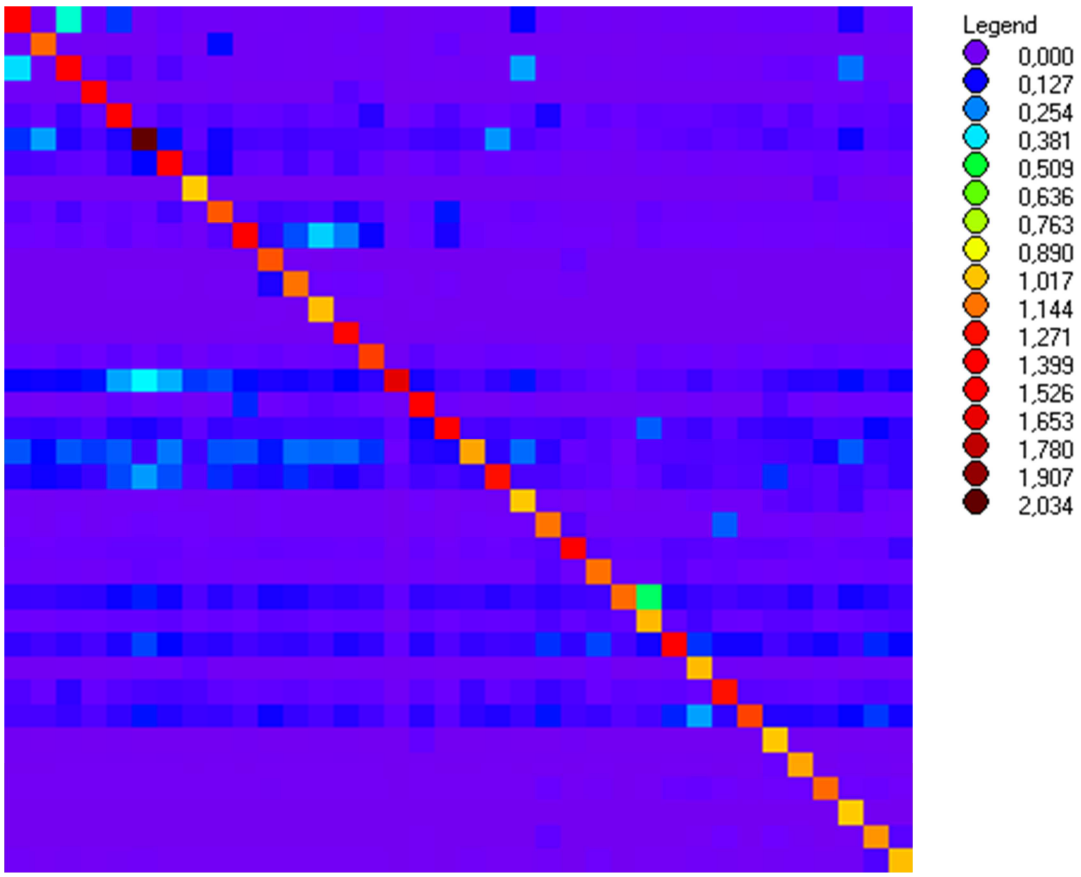

Figure 1: The inverse of the Leontief matrix

In terms of what corresponds to the traditional use of input-output model, the visualization of output multipliers (as presented in Figure 1) allows to determine - based on the verification of the assumptions underlying the model - those sectors of activity engaged in a greater multiplier effect (of demand on supply). From this point of view, it is apparent to highlight the relationships established at the level of the primary sector and some types of industries.

Another possibility, not to be overlooked, is the use of the model in order to determine how to alter the structure of production, in order to potentiate the multiplier effects. This, in our opinion, more interesting possibility of use of the input-output model, will be developed in future work.

Regarding the second quadrant of the MIO Alentejo the information sources to focus will be:

a) Supply and Use tables for 2008 at current prices
b) Income and Expenditure Survey of Families, INE (previous Household Budget Survey - HBS)
c) Input-Output Tables for 2008 (64x64), INE
d) Regional Accounts, INE

For the third quadrant of input-output table of Alentejo region, the methodology follows two major steps:

a) The using of values published in INE's Regional Accounts, to ensure perfect compatibility between input-output table of Alentejo and Regional Accounts, which means filling the lines related to the wages and GVA by industry (A38);
b) The valuation of other transactions in this quadrant applying the calculation algorithm followed in the National Accounts, to ensure maximum methodological consistency. The main source of information is the Integrated System of Business Accounts (INE, File SCIE).

Table 1 describes the sources of information used in the estimation of the third quadrant of the input-output table of Alentejo region.

Table 1 – Information sources used in the estimation of the 3rd quadrant

Transaction	Information Source
Total intermediate consumption at basic prices by sector	1st quadrant and INE, Regional Accounts
Compensation of employees	INE, Regional Accounts
Other taxes on production minus subsidies	Estimating endogenously
Consumption of fixed capital (depreciation)	Estimating endogenously
Net Operating Surplus	Estimating endogenously
Value added by sector at the cost factors	Estimating endogenously
Production at basic prices by product	INE, Regional Accounts
Total Imports of Goods	Estatísticas do Comércio Internacional e estimação do comércio inter-regional

Imports of total services	Estatísticas do Comércio Internacional e estimação do comércio inter-regional
Imports of Goods and Services Totals	Estimating endogenously
Customs Duties	Calculation algorithm followed in the National Accounts (File SCIE)
Total Commercial Margins	Calculation algorithm followed in the National Accounts (File SCIE)
Total Margins of Transportation	Calculation algorithm followed in the National Accounts (File SCIE)
Non-deductible VAT on products	Calculation algorithm followed in the National Accounts (File SCIE)
Other taxes on products	Calculation algorithm followed in the National Accounts (File SCIE)
Subsidies on products	Calculation algorithm followed in the National Accounts (File SCIE)
Total Supply	Estimating endogenously

The GVA was estimated for comparison with published data on regional accounts to evaluate the consistency of our results with the regional accounts published for all other transactions, by sector.

The inter-regional trade, share of significant importance in the flow of any region in Portugal, can not be determined using the statistics of international trade, since this source, as its name indicates, only gives us information on the flows with outside the country (and not all the territory outside the Alentejo region, national and international). As such, to try to quantify the approximate size of the variable is important to assess the relevance and validity of transport statistics at regional level.

In previous studies, the value of interregional trade was obtained by the method of balances, by which one obtains the regional balance of trade (entry-exit or vice versa) by imposing the assumption of equality between the total resources and the total employment for each branch of economic activity in regional input-output table, not being possible to quantify individually the amount actually exported and imported to and from other regions of Portugal.

With regard to international trade were used International Trade Statistics of the INE, for the year 2008, to obtain the flow of imports and exports carried out by agents who operated in the Alentejo region.

Due to lack of precise information about the statistics used in the total imports, this variable was recorded at *cif* prices and exports were recorded at *fob* prices (in both cases we used the variable "statistical value"). Later it was not possible to perform any procedure *cif/fob*. Because of this the values of imports include a set of services that should not be included in this item (transport and freight to the international border of the region).

The criteria for confidentiality does not allow the consideration of flows of a group of companies, which will lead to more biases results that increase the need for the use of correction methods, also used in other regional input-output tables, and involving the use of correction weights hereinafter explained (see Alves, M. *et al*. (2004)).

The need to reduce the biases generated by the regional statistics of international trade and the need for compatibility with the available data on National Accounts in 2008 (reflected in the Input-Output Table of Portugal in 2008, built and made available by the Departmento de Planeamento e Prospetiva - DPP) leads us to correct regional values found for each branch as a function of distance between the values of the Portuguese trade (imports and exports) in each branch in International Trade Statistics and in National Accounts for the year 2008.

Thus being $X_{i,ECI}^{A}$ the value of exports from the Alentejo region of each branch *i*, in International Trade Statistics, $X_{i,ECI}^{P}$ the value of total exports of Portugal, for each product *i* in International Trade Statistics, and $X_{i,CN}^{P}$ the value of total Portuguese exports, for each branch *i*, in the National Accounts, we can calculate the value of exports of Alentejo Region X_{i}^{A} as follows:

$$X_{i}^{A} = X_{i,ECI}^{A} * \frac{X_{i,CN}^{P}}{X_{i,ECI}^{P}} \qquad (4.1)$$

For the calculation of imports, the methodology will be similar:

$$M_i^A = M_{i,ECI}^A * \frac{M_{i,CN}^P}{M_{i,ECI}^P} \quad (4.2)$$

However this approach cannot be applied to all products / activities for two different reasons:

i. When there is flow in the National Accounts but there is no flow in the International Trade Statistics for Portugal (the T in imports)[5]. In these cases, the flow into the region on Statistics of International Trade is also null;

ii. Flows international services, especially in export,[6] the values are repeatedly zero (in the classes I, JA, JB, JC, L, MA, MB, MC, N, P, QA, R and S), which should not always be justified by the absence of international transactions.

In the first case exports are calculated by using the following expression, where the index j refers to branches which are in this situation:

$$X_i^A = X_{i,CN}^P * \frac{\sum_i X_{i,ECI}^A}{\sum_i X_{i,CN}^P - \sum_j X_{j,CN}^P} \quad (4.3)$$

and imports:

$$M_i^A = M_{i,CN}^P * \frac{\sum_i M_{i,ECI}^A}{\sum_i M_{i,CN}^P - \sum_j X_{j,CN}^P} \quad (4.4)$$

In the second case the ideal is to identify those branches where the data deviate from reality for the more correct with special information.

Given the difficulties in obtaining additional statistical information on services is often used as an assumption that the relationship between exports and production at national level, fully reflected in regional flows, ie the share of exports in production will be equal in the region and the country.

[5] This is also seen in terms of products (sub-branches) 05, 06, 97 and 98 in imports and the products 05, 06 and 39 in exports. However, when we make a correction to the level of aggregation of 38 branches this problem turns out to be "invisible" in the total industry.

[6] There are also null flows in regional imports, in terms of products, which is no longer identifiable in aggregation used in this table.

Conclusion

Throughout this paper the main features of the latest regional input-output for Portugal were analysed. This gave us an overview of the main sources of information, methodology and structure of existing input-output tables.

Although the structure of the territory is very irregular among different regions of the country, it is important to emphasize several points in common, including the main sources of information, which are based on the INE, the structure of tables based on a nomenclature to 49 branches (NCN49) and the fact that, for almost all cases, the data collection process is based on a top-down method, i.e. use national accounts as the primary basis of information, which may lead to a less precise analysis of the territories.

In the matrices analysed a similar structure for the North, Centre and the Algarve regions can be noted, while the Azores region, possibly due to their much more specific territorial characteristics, has shown some differences in the structure of its information. It is also of relevance the fact that the input-output table for Beira Interior region has a differentiated structure, which may be explained by the fact that it is a table published in the early 90s and based on the year 1986.

As it concerns the IO table for the Alentejo region, the results for its first quadrant show a fragile productive structure, i.e. the inexistence of a dense network between the several sectors of production. Plainly, this is reflected on generally low multipliers. From a policy viewpoint this should call the attention that the stimulus via the demand may easily spillover to other regions, unless a change in the territorial structure is to be made.

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