Intersectoral Relationships Between the Wood Production and Processing Sectors in Western Thessaly

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Abstract

This paper deals with the construction, description and analysis of an input-output model related to the wood-processing sector in primary and secondary production in the region of western Thessaly. An analysis of the emerging intersectoral relationships will constitute a useful tool, since it can function as a guide for wood-related businesses as regards their investment decisions, as well as decisions related to resource allocation. The term "intersectoral relationships" refers to the flow of products from one production sector to another. The use of this intersectoral model will lead to planning for the development of regional resources and to the evaluation of the interdependence between the various production sectors that are active in a specific economic context and use wood as a raw material.

Résumé

Le but de ce travail est de présenter la création, la description et l' analyse d' un modèle d' entrées et sorties concernant le secteur du traitement du bois dans la production primaire et secondaire de la région de Thessalie occidentale. Une analyse des relations intersectorielles émergentes peut constituer un outil utile, étant donné qu'il va servir de guide pour les entreprises de traitement du bois sur le plan des décisions d' investissement et des décisions relatives à l' affectation des ressources (Midmore, 1991). Le terme 'relations intersectorielles' se réfère à l' écoulement des produits d' un secteur de production à l'autre. L' application de ce modèle intersectoriel va contribuer à la planification pour le développement des ressources régionales et à l' évaluation de l' interdépendance entre les divers secteurs de production qui s'inscrivent dans un contexte économique spécifique et utilisent le bois comme matière première.

1. Introduction

The various forest resources of a region are one of the basic preconditions for the development of its economy. That is why attention is usually focused on how these resources can be improved, mobilized and evaluated.

The study of social, economic and cultural issues is an object of regional analysis, the latter proving more effective through the use of modern analytical means, for example through econometric models, which, however, quite often do not sufficiently display the various ways in which the forest contributes to regional areas.

Such models are essential to any effort aiming to mobilize and develop all resources thus leading to regional growth.

The contribution of a forest to a region could be examined both from an economic and a social perspective, taking into account all the products and services the former offers to the region.

It is well known that various exogenous factors, such as an increase in exports, or endogenous factors, such as an increase in domestic demand, can affect the equilibrium of a region. This may result in changes to the conditions of employment and income distribution in a region as compared to the existing situation prior to the alteration of the above-mentioned parameters, mainly due to the shift in the mobility of the production coefficients (Ronald, 2000).

The objective of this paper is a systematic classification of the productional relations that develop between the sectors of wood production and processing in the region of western Thessaly. It also aims to study the cross-sectoral relations that exist between the two and determine the required increase in the production of the wood processing sectors through an assessment of the final demand.

The first effort to depict and explain the interdependence between the production sectors of the economy began in 1758 by F. Quesnay, the doctor of Louis XIV of France. Later, a more significant and complete study was published in 1877 by the French economist L. Walras (Raftis, 1999).

Furthermore, this effort was greatly promoted by Leontief who established the input-output models and introduced them into the economic analysis (Loukakis, 1997). The input-output tables were later used to analyze the economies of other countries as well, such as the Federal Republic of Germany (initially in 1953) according to Helmstädter et al (1983).

Use of input-output analysis has also spread to the agricultural sector in recent years. Such surveys determine the role of the agricultural sector within the national economy, the degree of interdependence between the various sectors of an economy and the qualitative and quantitative impact on the economy from changes in the agricultural field (Douglas and Reilly, 1978; Rabinowicz, 1982).

Anderson and Manning (1983) used input-output analysis in order to study the way in which developmental projects affect a region's economy. Through the use of input - output tables, Mattas et al. (1984) examined the impact of various policy measures on a country's rural and national economy. Mattas and Shrestha (1991) recommended the use of input-output elasticities in order to assess the most important sec-

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tors of the economy. They used the elasticities of production, employment and income to determine the key-sectors of the Greek economy. Robinson (1997) made use of the input-output model in his analysis of rural areas, and also cited a particular application in central Idaho, U.S.A.

During the last few years, there have also been significant applications of input-output analysis in the environmental field. In Australia, Lenzen and Foran (2001) used input-output analysis to study the effects that the population increase and the increase in water usage per capita had on water consumption.

Loizou (2001) established a regional input-output model in order to carry out a quantitative evaluation of the environmental impact of production processes in the region of Central Macedonia and also calculated the environmental multipliers for the region in question.

The basic methods used for the study and analysis of regional problems can be summarized as follows (Midmore, Harrison-Mayfield, 1996):

i) The regional income and product accounts

ii) The system of cross - sectoral input-output, through which information on the productive structure of regions is organized

iii) The measures and indexes often used to describe regional inequalities or structural characteristics.

The value of regional accounts relates to the fact that they provide essential information for decision-making purposes and also help assessing the reflexive impact from the implementation of national economic policies on a regional level. Richardson (1972) states that regional accounts constitute the basis of regional economic analysis.

In essence, regional accounts can be seen as summarized into two main regional account groups, namely a) regional income and product accounts, and b) regional input-output accounts (Kurz, Dietzenbacher and Lager, 1998).

In the regional income and product account group, economic activity is divided into the three following sectors: a) production, b) consumption, and c) investments.

As regards the measures and indexes used to describe certain regional characteristics, those most frequently utilized are the specialization coefficient, the participation coefficient and the multiplier (Peterson, 1997).

The input-output system, which essentially supplements the income accounts, provides the overall framework for the evaluation of the interdependence between the various production sectors within a specific economic context. The term interdependence refers to the flow of goods and services from one sector (or field) to another, without the existence of which there would be no production.

An analysis by sector on a regional level can be very useful in pinpointing the effect of exogenous variables on the regional economy.

And as we have already mentioned, these accounts are considered to be an extension and modification of the income and product accounts. If we carry out a sectoral analysis of every regional production account, we will arrive at a series of cross-sectoral accounts, indicating the flow of goods and services from one productive sector to the next. Within this cross-sectoral analysis, the total production and consumption are analysed per category of goods.

Just as formal economic models or systems are based on a variety of conditions, similarly input-output systems are based on the basic assumptions formulated within Leontief's general models (1966).

These assumptions are the following:

i) Each commodity is produced by a single production sector or field;

ii) Only one technical method is used for the production of each commodity, and each production sector produces one and only commodity;

iii) The coefficients of the products purchased by each sector are only related to the sector's level of production.

The input-output model that will be created for this specific field of study indicates the flow of goods within its economy, and more specifically that part of the economy which is related to the wood produced and processed in the region during the year 1999. According to Kaiser (1968), such an analysis portrays the way in which forests, and more generally, small and large industries using wood as raw material, contribute to the income and employment level of the local population.

The application of the input-output table, as related to problems that need to be approached through an economic analysis, can be generally split into three main categories (Lazaris, 1974; Lahr and Dietzenbacher, 2001):

i) An analysis of the existing economic structure;

ii) The establishment of sectoral programmes based on the existing structure;

iii) A prediction of the needs by sector through conclusive planning of sectoral requirements according to the final demand.

Mayer (1963) mentions that the methods used to create an input-output table can be subject to criticism, due to the fact that they are based on simplified assumptions. That is why, he hastens to add, that despite the problems and difficulties that may arise, the input-output model has the great advantage of being an empirical adaptable model that provides an organized, consistent framework, in contrast to many other techniques.

Furthermore, he makes the observation following which the fact should be acknowledged that, despite its imperfections and omissions, the input-output model along with economically-based analysis constitute the means which support the compilation of research papers on regional economy.

With this view in mind, the present research was based on an input-output model put together with data we collected from the region that indicate the respective markets for every sector involved in wood processing and others of a

similar nature, as well as the sales from each sector to the others.

The main problem in designing and constructing the model was gathering the necessary data, due to the lack of relevant information. The construction of a regional input-output model presupposes the existence of statistical figures but the process of gathering such figures poses great difficulties (Papastavrou and Oliveira, 1978).

2. Research Area - Methodology

The region of western Thessaly was chosen as the research area, based on geographical, administrative and economic criteria. Points to consider were the rapid economic development of the region and the great number of small and large wood industries in the area combined with its impressive forest resources.

The prefectures of Trikala and Karditsa have the largest stretch of wood-covered areas compared to all other geographical regions of Greece amounting to 29% (Karameris, 1981) and that is the reason that led to the choice of western Thessaly as the study area.

The total expanse of this region is 425,336 ha, with forests covering 192,241 ha (K.E.P.E.., 1976). The total volume of industrial wood is 11,668,284 c.m. and the total volume of wood for sawing is 6,133,000 c.m. (First National Forest Census, 1992). The population in the region according to the census data from 1991 is 265,000 inhabitants, while the percentage distribution of the gross product for the region is the following: primary sector - 30.1%, secondary sector - 24.8% and tertiary sector - 45.1% (EUROSTAT, 1995). The G.D.P. of western Thessaly is 332,304 million GDR and accounts for 32.46% of the total G.D.P. for Thessaly (Region of Thessaly, 1999).

Western Thessaly is characterized by high levels of forested areas (industrial and non-industrial forests). More specifically, in the Trikala Prefecture the forest areas amount to 52,5% of the total extent of the prefecture land area. The industrial forests, areas that produce marketable wood biomass, comprise 40,5% of the total prefecture's land area, while the non-industrial forests, which are mainly used for foraging, the production of firewood and the protection of watershed area from erosion amount to about 12%. In the neighbouring Karditsa Prefecture, the forest areas amounts to 34,2% of the total extent of the prefecture with the industrial forests covering 21% and the non-industrial forests 13,2% of the total area, respectively (Ministry of Agriculture, 1992).

The utilization of industrial wood in western Thessaly takes place mainly in sawmills, while other wood processing units, i.e., pallets and parquets, as well as units for timber impregnation with water-borne inorganic preservatives. The degree of utilization of the installed equipment (processing raw material/installed capacity * 100) in the particular units amounts to an average of 55%.

A much more serious problem of installed equipment utilization is faced by the other units (pallets and parquets etc), where the degree of utilization is under 10%. The low degree of utilization is closely related to the lack of sufficient and suitable quantity of raw material, the difficulty of production disposal because of increased cost and low quality. The overwhelming majority of units are characterized by small size, low productivity and quality of produced products, lack of standardization and financing problems (Petinarakis, 1992).

The determination and selection of the specific sectors were made using the type of production (product) as a criterion (Hewings et al, 1999). As regards the classification of sectors in the input-output table, the primary wood production sector was placed first, then the primary wood processing sector (manufacturing) and finally all other sectors using wood for the production of various other products, using the final demand for their products as a criterion.

The type and number of businesses selected was based on information from the industrial and SMEs chambers of the prefectures of Trikala and Karditsa, and then the businesses chosen were ranked according to the kind of product their production mainly focuses on (Kaiser, 1968; Peterson, 1997).

The collection of data was carried out according to the census method (Drakatos, 1980).

Based on the research data, the input-output table was constructed (Table 1), which is a matrix of the following form:

$$(1-A)X=Y \qquad (1)$$

usually referred to as Leontief's table. In the present study, this table presents detailed information about the interdependence of various wood processing sectors in the region of western Thessaly.

3. Results - Discussion

In Table 1, the sales sector (output) is represented by lines 1 to 7.

This also includes imports and added value. The purchase sector (input) is represented by columns A to Z. These columns provide information about the amount each sector is purchasing from every sales sector.

Based on the above-mentioned data, the sawmills in this region process domestic round wood valued at 1,046 million GDR and imported round wood valued at 145.5 million GDR, while the added value of this sector is 4,009.5 million GDR.

The small and large industries manufacturing furniture and door/window frames receive timber valued at 1,135.5 million GDR from the sawmills and products valued at 384.1 million GDR from the particle board units, while the added value of this sector is 3,898.5 million GDR. A great disadvantage for the furniture-manufacturing units is the lack of drying kilns. This forces them either to let the timber dry naturally for up to a year (which means that a large amount of circulating capital is tied up) or use the wood

without having allowed it to dry sufficiently, thus running the risk of faulty products. In the case of furniture manufacturing, we see no import data on the table. The reason is that the imported log timber is first sawn into pieces at the local sawmills and then supplied to the industry.

The flooring sector buys round timber amounting to 547 million GDR, while its purchases in sawn timber amount to 65 million GRD. Since there is a lack of flooring products in our country, imports for this sector amount to 828 million GDR. From the wood that is imported, about 80% is tropical timber and 20% is oak. The added value of the flooring sector amounts to 203.8 million GDR.

The wooden crate sector purchases round wood (mainly poplar, pine, fir and beech) amounting to 30.7 million GDR from the domestic production while the imports for this sector are 2.5 million GDR. The sector's added value comes to 28.8 million GDR.

The particle board sector purchases round wood of a small diameter, domestically produced only, at a value of 168 million GDR. A large percentage however of the raw material used in the particle board sector consists of scraps from sawmills, which amount to 112 million GDR. The added value of this sector is 465.9 million GDR.

Finally, the pallet construction sector buys sawn timber at a value of 19.3 million GDR, and its added value amounts to 3.9 million GDR.

From Table 1 we see that the total input per sector is the following:

i) Sawmill sector - 5,201.4 million GDR.

ii) Small and large furniture and frame manufacturing industries - 5,418.1 million GDR.

iii) Flooring sector - 1,643.8 million GDR.

iv) Wooden crate sector - 62.0 million GDR.

v) Particle board sector - 745. million GDR.

vi) Pallet sector - 23.2 million GDR.

An analysis of Table 1 shows that the sectors involved in wood processing contributed an added value of 8,611.4 million GDR to western Thessaly. The main share of this amount is primarily derived from the sawmill sector and, on a secondary level, from the sector of furniture and frame manufacturing.

If we reverse the matrix (1) then we arrive at the general form of the matrix:

$$X = (1\text{-}A)\text{ -}1Y \qquad (2)$$

where (1 - A)-1 is known as Leontief's reverse matrix and the coefficients of this matrix, named technological coefficients, refer to the amount of production per sector required to cover one unit of the final demand of another sector.

By reversing the data in Table 1, we calculate the technological coefficients by converting values to percentages (Table 2), thus portraying the total cost ratio of each sector that is attributed to the other sectors.

We must note here that Table 1 can be read both horizontally and vertically, while Table 2, which presents the technological coefficients, can only be read vertically.

Therefore, if we examine column B in Table 2, we see that for every drachma allocated for the production of sawn timber, the sector pays 0.202 of a drachma to the primary production sector and 0.028 of a drachma to import raw material, while 0.770 of a drachma is the added value of this sector.

In column C of Table 2, we note that for every drachma allocated for the production of furniture and frames, the sector pays 0.209 of a drachma to the sawmill sector and 0.071 of a drachma to the particle board sector, while 0.720 of a drachma is the added value of the sector.

In column D of Table 2, we see that for every drachma allocated to the flooring sector, the sector pays 0.333 of a drachma to the primary production sector, 0.039 of a drachma to the sawmill sector and 0.503 of a drachma to import raw material, while 0.125 of a drachma is the added value of the sector.

In column E of Table 2, we note that for every drachma allocated to crate production, the sector pays 0.490 of a drachma to the primary production sector and 0.050 of a drachma to import raw material, while 0.460 of a drachma is the added value of the sector.

In column F of Table 2, we see that for every drachma allocated to the particle board sector, the sector pays 0.226 of a drachma to the primary production sector and 0.150 of a drachma to the sawmill sector, while 0.624 of a drachma is the added value of the sector.

Finally, in column G of Table 2, we note that for every drachma allocated to the production of pallets, the sector pays 0.831 of a drachma to the sawmill sector, while 0.169 of a drachma is the added value of the sector.

4. Conclusions

The model developed in this paper is highly adaptable, in our opinion, in the sense that it can be used in association with other sectors of production, since the data used for the model's development was selected, combined and processed according to the general principles of economic theory, the principles of regional growth and the techniques of regional development.

The descriptive force of input-output analysis in relation to cross-sectoral relations is very important. It is worth noting that this method is considered one of the most powerful techniques used in relation to analysis on a regional level. An understanding of the basic structure and picture presented by each sector of the region within the framework of its economic activity and social contribution constitutes a sound principle for the planning and further development of the region in question.

The input-output accounts shed light on cross-sectoral transactions, thus allowing us to give an answer to the following vital question: when the final demand for the products of a specific sector increases within a region, to what extent will the changes caused to the cross-sectoral flows affect the other sectors of the said region?

The technological coefficients of the reverse tab (1- A) $^{-1}$ represent the income coefficients (Fisher and Shell, 1998).

Table 1. *Input-output table in million drachmas*

output → / input ↓	A Primary production	B Sawmills	C Furniture-frames	D Flooring	E wooden crates	F Particle boards	G Pallets	Final demand	Total output
1. Primary production		1.046		547	30,7	168		639,2	2.430,9
2. Sawmills			1.135,5	65		112	19,3	3.869,6	5.201,4
3. Furniture-frames								5.418,1	5.418,1
4. Flooring								1.643,8	1.643,8
5. Wooden crates								62	62
6. Particle boards			384,1					745,9	1.130
7. Pallets								23,2	23,2
8. Imports		145,5		828	2,5				976
9. Added value		4.009,9	3.898,5	203,8	28,8	465,9	3,9		8.610,8
10. Total		5.201,4	5.418,1	1.643,8	62,0	745,9	23,2	12.401,8	25.496,2

They are the constants with which the total output of each sector is multiplied in order to determine the level of production needed to cover the required output. After determining future demand, by using the technological coefficients we are able to respectively define the required production increase of the various sectors needed to cover the afore-mentioned demand.

A study of the way forests contribute to a region should include at least a very elementary input-output analysis. A basic output-input table, even when it consists of data, which is not fully satisfactory, can constitute the starting point for an analysis of the forest's contribution to the economic development of a region, an analysis which can otherwise be very hard to achieve.

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Table 2. *Technological coefficients table*

Output → / Input ↓	A Primary production	B Sawmills	C Furniture-frames	D Flooring	E Wooden crates	F Particle Boards	G Pallets
1. Primary production		0,202		0,333	0,490	0,226	
2. Sawmills			0,209	0,039		0,150	0,831
3. Furniture frames							
4. Flooring							
5. Wooden crates							
6. Particle Boards			0,071				
7. Pallets							
8. Imports		0,028		0,503	0,050		
9. Added Value		0,770	0,720	0,125	0,460	0,624	0,169
10. Total		1,000	1,000	1,000	1,000	1,000	1,000

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