XVII International Input-Output Conference

Sao Paulo Brazil - 2009

Economic model of business simulation. Application to a company of the tourist sector in the Canary Islands*.

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Preliminary Version. July 2008

Abstract

In this paper we have made a business Input-Output framework, and specifically for a company that belongs to the tourist sector. These tables show the interdependences that exist in the company productive structure and give us the possibility to set out, under some hypothesis, economic models of business simulation. We will show the great potential of these models in the taking of microeconomic decisions. In our study, first of all we make a demand analysis of the company. We break down that demand according to nationalities and groups of clients, studying which part of that demand provides the largest profit to the company. Subsequently, we make some simulations, from which we study the effects produced in the gross operating surplus of the different departments of the company, which are derived from a final demand increase of the company services.

(*): We would like to thank Mur group, especially Mr. Mario Mur, Mr. Antonio López and Mr. Juan Santana for their invaluable collaboration, giving us the required information to write this paper. This research has been partially financed by the Spanish Government and FEDER (project ECO2008-05589)

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INTRODUCTION

In this research, our aim is to create an economic model of tourist business simulation from an input-output accounting scheme. This scheme is a descriptive instrument that shows the interdependences or accounting relations that exist in the production of a country, sector or company. By adding some hypothesis to these relations, an economic model of business simulation is obtained.

The input-output analysis was introduced by Leontief in 1636. Traditionally, the input-output models have been used almost exclusively in the macroeconomic analysis. As it was required to have high capacity computers and a lot of data to make this kind of analysis, the potential of these models in the taking of economic decisions did not have an important effect. Nevertheless, nowadays we do not have these restrictions any more. In 1986, Custer showed how these models can be developed by computers, using the VisiCalc spreadsheet and without need of computer specialists.

In the seventies and eighties, just a few authors contributed to the development of the business input-output modelling. In fact, just two papers describe business models. In 1980 Harding et al. described how the input-output technique can be used in the optimization of price transfer decisions. In 1969 David Stone proved that input-output models could be used in the taking of strategic decisions of multi-product companies that are vertically integrated.

In the nineties, the application of input-output techniques in business is a reintroduced theme by some authors. In 1998, Lin and Polenske submitted a revision of the main contributions in the field of models and input-output accounting schemes in business. These authors pointed out that such studies had been made, mainly, in Belgium, Italy, in the former Yugoslavia and in the Republic of China.

In China, several authors have contributed to the development of input-output microeconomic models. In fact, there are three interesting contributions. The authors are Li (1991), Rencheng (1991) and Zhang et al. (1991) and their papers can be found in the book published by Polenske and Chen in 1991.

In this paper, we work with business input-output tables for a company that belongs to the tourist sector in the Canary Islands. From these tables, we show how it is possible to apply economic models of business simulation, which are essential in the taking of strategic decisions in the company.

INPUT-OUTPUT FRAMEWORK AS A TOOL OF ECONOMIC ANALYSIS.

Input-output tables (IOT) integrate the relations that define the productive structure in a relatively simple accounting scheme. Thus, the economists can analyse the present and the future projection of an economy. However, the validity and usefulness of this tool of economic analysis depend, principally, on the quality of the information and on the hypothesis that appear on the tables.

With the introduction of SEC-95 (Eurostat, 1994), the IOT started to be known as input-output framework, formed by a group of interrelated tables. These tables are divided into three groups:

- Origin and destination tables.
- Tables that relate origin and destination tables to the sectors accounts.
- Symmetric input-output tables.

We are now in a position to define just the origin and destination tables, because they are the ones analysed in this paper.

Origin table

The SEC-95 input-output framework includes a table known as origin table (OT), that shows the domestic or imported origin of the goods and services available in the economy to meet the demand. The core of the OT is a rectangular matrix (mxn). This matrix is formed by the domestic production entries of the (m) goods and services made by the (n) branches in which is divided the total of the economy. Some entries of this matrix are null, indicating that the branch does not produce the respective good or service.

Apart from the domestic supply, the imports of goods and equivalent services are also added in an OT. This includes goods and services acquired by resident units and non resident units from the rest of countries of the European Union and the rest of the world. So it gets the total of resources available in the economic system. These imports are valued at CIF price, a concept similar to basic price because it does not include import taxes. The sum of the domestic production at basic prices and CIF imports provides a total supply at basic prices.

Table no.1 presents an example of a simplified origin table

TABLE NO. 1
Simplified origin table

SUPPLY	BRANCH OF ACTIVITY	REST OF THE WORLD	TOTAL
PRODUCTS	Production by product and branch of activity	Imports by product	Total supply by product
TOTAL	Total production by branch of activity	Total of imports	Total supply

Destination table

The destination table (DT) presents the different uses of the available resources from a certain economy until the total of each product in each row consumed. This table also shows the gross added value and its components, known as primary inputs for each branch of activity. The respective columns show its costs structure or production function.

Table no. 2 presents an example of a simplified destination table

TABLE NO. 2
Simplified destination table

USES	BRANCHES OF ACTIVITY	FINAL DEMAND	TOTAL
PRODUCTS	Intermediate consumption by product and branches of activity	Final consumption expenditure + Gross capital formation + Exports	Total of uses by product
COMPONENTS OF ADDED VALUE	Added value by component and branch of activity		
TOTAL	Total of inputs by branch of activity		

Business origin and destination tables

Business origin and destination tables show the interdependencies or accounting relations that exist in the productive structure of a company. In this document we have made business origin and destination tables for the financial year 2006 of a tourist company.

In these tables, products are classified into “third-party goods and services” and in “own goods and services”. On the one hand, the “third-party goods and services” are products whose origin is external of the company. These products are bought by the company from its suppliers or creditors. On the other hand, the “own goods and services” have an internal origin; they are goods and services produced by the company itself. These products are invoiced directly by the company to its clients. The “own goods and services” are accommodation services, menus, beverages, tennis court rental, etc. However, “third-party goods and services” could be, for example, the foodstuff needed to prepare menus, or repairs, advertising, etc. In business origin and destination tables, the branches of activity are known as departments.

The business origin table presents, in rows, the supply of the company by products, which is the part of the goods and services production provided to the clients. In columns, this table shows us the production in the different departments of the company and the external purchases made through the company warehouse. This vector carries out a function that is very similar to the imports in an origin table made for the economy of a country. It can be clearly seen in the origin table that the company departments offer its clients just “own goods and services” and never “third-party goods and services”, that are products acquired by the company from the outside. Table no. 3 presents a business table made for the respective tourist company.

TABLE NO. 3

Business origin table

Origin table	Departments	Warehouse	TOTAL
Third-party goods and services		Purchases made from outside	TOTAL OF SUPPLY OF THIRD-PARTY GOODS AND SERVICES
Own Goods and Services	Production by own goods and services departments		TOTAL OF OWN GOODS AND SERVICES SUPPLY
TOTAL	TOTAL OF PRODUCTION	TOTAL OF PURCHASES FROM OUTSIDE	TOTAL OF RESOURCES

The business destination table shows, in rows, the business demand, intermediate or final, of the different goods and services. In columns, it shows us the intermediate consumptions required by the departments to get its production and the added value obtained by these departments. What it is showed in columns is the costs structure of the different company departments.

As we can see, the intermediate consumptions required by the company departments are always "third-party goods and services". They are acquired through the company warehouse and required by the different departments to obtain its "own goods and services" production. So the final consumption or the clients consumption is always of "own goods and services".

Table no. 4 presents a business destination table made for the respective tourist company

TABLE NO. 4
Business destination table

Destination table	Departments	Final demand		TOTAL
		Final Consumption	FCE*	
Third-party goods and services	Intermediate consumption by departments and by third-party goods and services		FCE of third-party goods and services	TOTAL OF USES THIRD-PARTY GOODS AND SERVICES
Own Goods and Services		Sales of own goods and services		TOTAL OF USES OF OWN GOODS AND SERVICES
Added Value	Added value by departments			
TOTAL	TOTAL OF INPUTS BY DEPARTMENTS			

* Final Consumption Expenditure

Implicit accounting relations in origin and destination table

There are two types of identities between origin and destination tables as long as the flows are valued under the same criterion; an identity by products and another identity by branches of activity.

If the system is in equilibrium, the total by products (rows) in origin and destination table should be identical, because they present the total supply and the total demand by products. This means that the production and the imports should coincide with the sum of intermediate demand and final demand (identity by product).

Production + Imports = Intermediate Consumptions + Exports + Consumption + FCE

On the other hand, there is a second identity (identity by branch of activity). According to this identity, the totals by branches of activity (columns) in origin and destination table should coincide, showing that the production by branches of activity equals the intermediate consumptions required by those branches plus the gross added value generated by each branch.

Production by branch = Intermediate Consumptions + Gross Added Value (GAV)

DEMAND ANALYSIS AND SIMULATIONS MADE FROM THE BUSINESS ORIGIN AND DESTINATION TABLES. RESULTS OBTAINED.

Demand analysis. Results obtained.

Our aim is to make a demand analysis, observing the effects that a variation in that demand would have on the sales and, therefore, on the gross operating surplus of the company. We intend to obtain this operating surplus for each department of the company. Thus, we can know which departments bring more profit to the company and also if any of them has losses. First of all, we need to obtain the sales made by each department and, secondly, the intermediate consumptions required by these departments to obtain its productions or sales, which coincide in this case. We get the operating surplus by the difference between sales and the departments' intermediate consumptions. On the other hand, apart from sales and intermediate consumptions by departments, we intend to obtain this data by types of clients. By means of the database provided by the tourist company, we have classified the clients according to their nationality and also according to the number of adults and/or children included in the reservations made to the tourist company.

The two client classification criteria are shown in chart no. 5. Combining both criteria, 20 types of clients are obtained. However, our client classification includes a total of 21 types of clients. Apart from the 20 groups mentioned above, a new type of client -called "ND" (non defined) - has been added. This group is called "ND" because the nationality and the group of the clients are not known. Although this group is not defined, it is not possible to exclude it from our study because this group represents 25% of total sales of the company. These clients have not made a reservation and therefore they do not appear in the database. This kind of sales is very common in New Year's Eve, for instance, because the clients go to the parties arranged by the company, but they do not stay in the hotel.

TABLE NO. 5
Client classification criteria

Nationality	Notation
Germany	DE
Spain	ES
Great Britain	GB
Other countries	OT

Groups	Definition
1	1 adult without children or babies
2	1 adult with children and/or babies
3	2 or more adults without children or babies
4	2 or more adults with children and/or babies
5	Children and/or babies without adults

The company databases provide information about the number of people by reservation and the number of days that these people have stayed in the hotel. From the product of the two variables, a new variable called people-days has been created. This new variable includes the total number of days that a certain type of client has stayed at the hotel.

In chart no. 6, we show the vector people-days classified by types of clients:

TABLE NO. 6
People-days by types of clients

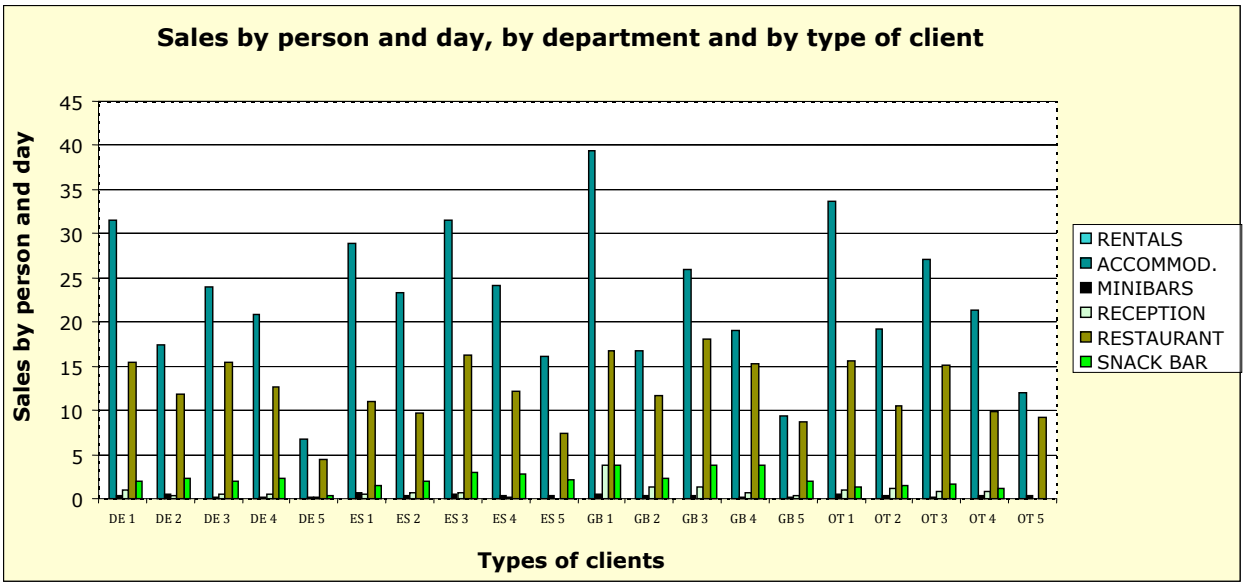
DE 1	DE 2	DE 3	DE 4	DE 5	ES 1	ES 2	ES 3	ES 4	ES 5	GB 1	GB 2	GB 3	GB 4	GB 5	OT 1	OT 2	OT 3	OT 4	OT 5
9.293	458	66.026	3.397	1.043	1.158	364	4.113	2.096	463	955	201	8.983	893	506	700	360	6.991	962	68

Analysing the vector people-days by nationalities, we can see that this variable achieves its highest value for German clients (sum of the first five cells), with a total of 80,217 people-days. This difference is very significant in relation to English clients (11,538 people-days), which represent the second nationality according to its importance. Taking into account the groups of clients, this variable obtains the highest value for group 3, which are the reservations of two or more adults without children, with a total of 86,113 people-days.

In view of the breakdown of the demand that has been presented, we are now in a position to study the sales. The sales appear in the final consumption matrix, which is one of the matrices that make up the business destination table. This matrix is classified by own goods and services (rows) and by types of clients (columns). However, our aim is to obtain the sales of the company classified by departments and types of clients. This does not mean any problem since all the own goods and services are sold only by a department. Thus, by associating each own good and service to the department which produces or invoices it, a new sales matrix classified by departments and types of clients is obtained. This new matrix is called Vdptc. The daily income that a certain type of client brings to the department is obtained if the total sales made by the department to a type of client are divided by the value that the variable people-days has for this type of client.

In graph no. 1, the total sales of the company, classified by people-days, are shown. That is, the daily incomes classified by departments and types of client.

GRAPH NO. 1



As it can be seen, the department "accommodation" obtains the highest daily incomes by person and day (39.35 euros per day for the English clients belonging to group 1). It is followed by the department "restaurant" (18 euros per day for the English clients belonging to group 3). However, the daily incomes of the departments "rentals" and "minibars" are completely imperceptible.

On the other hand, we intend to obtain the intermediate consumption matrix, classified by departments and types of clients. In the business destination table, it can be seen that the intermediate consumption matrix is classified by third-party goods and services (rows) and by departments (columns). This matrix will be called intermediate consumption matrix Xbsdp. Now, we will explain the steps taken to obtain the intermediate consumption matrix by departments and types of clients, which will be called Xdptc.

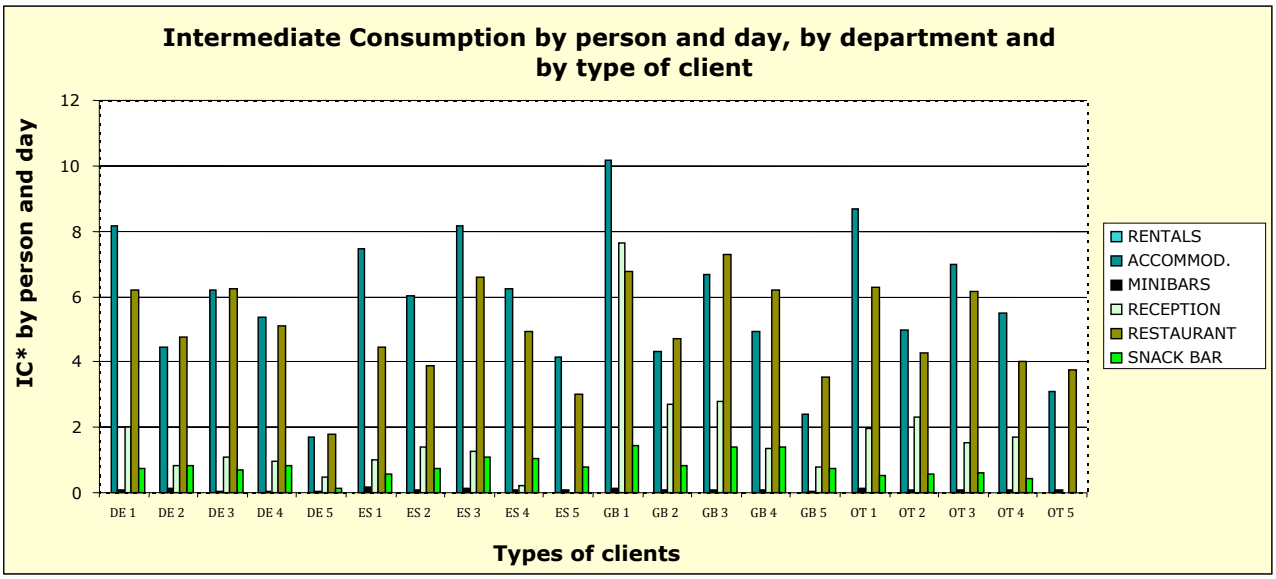
The sum of the intermediate consumption matrix by columns –that is, by departments– will be called xdp. From the sales matrix Vdptc, which –as it was explained– is classified by departments and types of clients, we can obtain its coefficient matrix by departments (rows). This new matrix is obtained from the relation of the elements of that matrix and the totals by row of that matrix. The elements of this coefficient matrix, which will be called Av, indicate the proportion of the department sales to a certain type of client to the total sales of this department to all the types of clients. So, if the coefficient matrix Av is multiplied by the vector sum of intermediate consumptions by departments xdp, the matrix of intermediate consumptions by departments and types of clients Xdptc is obtained. If the intermediate consumptions needed by a department of the company to obtain its sales to a type of client are divided by the value that the variable people-days has for this type of client, the daily expenditure that this client brings to the department is obtained.

In short, we suppose that each unit sold by a department requires the same amount of all the intermediate goods for its production. These quantities can be interpreted as fixed

requirements of intermediate goods by sale units. As we know the amount of goods of each department which is sold to each type of client, we can distribute the intermediate goods required by the department among the different clients. In order to do that, the intermediate goods required to produce the amount sold to each type of client is calculated, using the fixed requirements of intermediate goods mentioned above.

In graph no. 2, we show the intermediate consumptions required by the company by people-days, that is, the daily expenditure classified by departments and types of clients.

GRAPH NO. 2



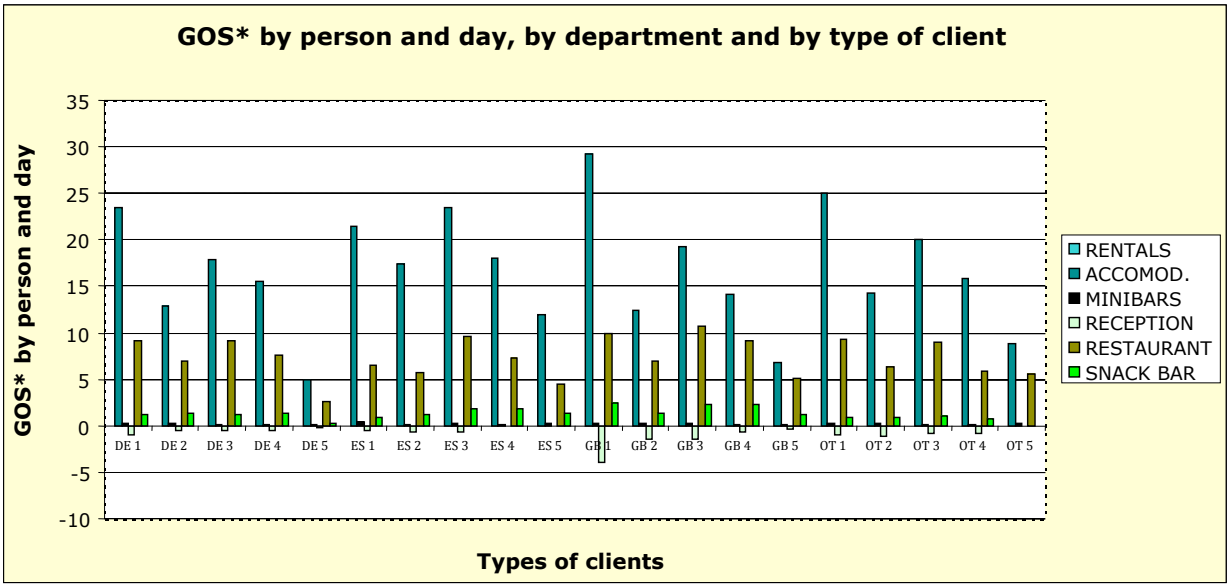
* IC: Intermediate Consumption

Analysing the data of this graph, we can conclude that the departments which need more daily intermediate requirements to carry out their sales are "accommodation" and "restaurant", which are also the departments that bring larger daily profits to the company. It is necessary to observe that the department “reception” needs important daily intermediate requirements and the daily sales of this department represent a short amount, as it can be seen in graph no. 1. This means that the department “reception” produces a negative gross operating surplus to the company.

We are now in a position to obtain the gross operating surplus of the company, EBEdptc, classified by departments and types of clients. It is the difference between the sales matrix Vdptc and the intermediate consumptions matrix Xdptc.

In graph no.3, we can see the gross operating surplus produced by the company classified by people-days. That is, the daily profit or loss classified by departments and by types of clients.

GRAPH NO. 3



*GOS: Gross Operating Surplus

If this graph is analysed by departments, we can see that the most profitable departments for the company are "accommodation", followed by "restaurant". This is quite logical because these departments sell the most important services in a hotel, which are the rooms and the sustenance. In addition to this, it can be observed that the department "reception" produces losses, as we mentioned. The services sold by the reception (telephone, fax, foreign currency exchange…) do not make a large profit and, in contrast, this department has very high employee costs as it needs a large management and administration staff. In an analysis like this, it is not possible to study the benefit that the "reception" brings to the company because its production, which is indirect, is very difficult to be quantified. If the graph by types of clients is analysed and the groups of clients according to its nationality are observed, we conclude that the clients of group 1 and 3 bring the largest profit to the company. Considering the clients by nationality regardless of their group, the Spanish clients bring the largest daily income (132 euros by person and day), followed by the English clients (127 euros by person and day).

Simulations. Results obtained.

In this section, we reflect the impact of the increase of one day in the length of stay of all types of clients. Thus, we analyse what types of clients have more effect on the sales and on

the intermediate consumptions and, therefore, on the gross operating surplus produced by the company.

In chart no. 7, the eight simulations made are shown:

TABLE NO. 7
Simulations

SIMULATION 1	Increase of one day in the length of stay of German clients (DE)
SIMULATION 2	Increase of one day in the length of stay of Spanish clients (ES)
SIMULATION 3	Increase of one day in the length of stay of British clients (GB)
SIMULATION 4	Increase of one day in the length of stay of clients of group 1 (1 adult without children and babies)
SIMULATION 5	Increase of one day in the length of stay of clients of group 2 (1 adult with children and/or babies)
SIMULATION 6	Increase of one day in the length of stay of clients of group 3 (2 or + adults without children or babies)
SIMULATION 7	Increase of one day in the length of stay of clients of group 4 (2 or + adults with children and babies)
SIMULATION 8	Increase of one day in the length of stay of clients of group 5 (children and/or babies without adults)

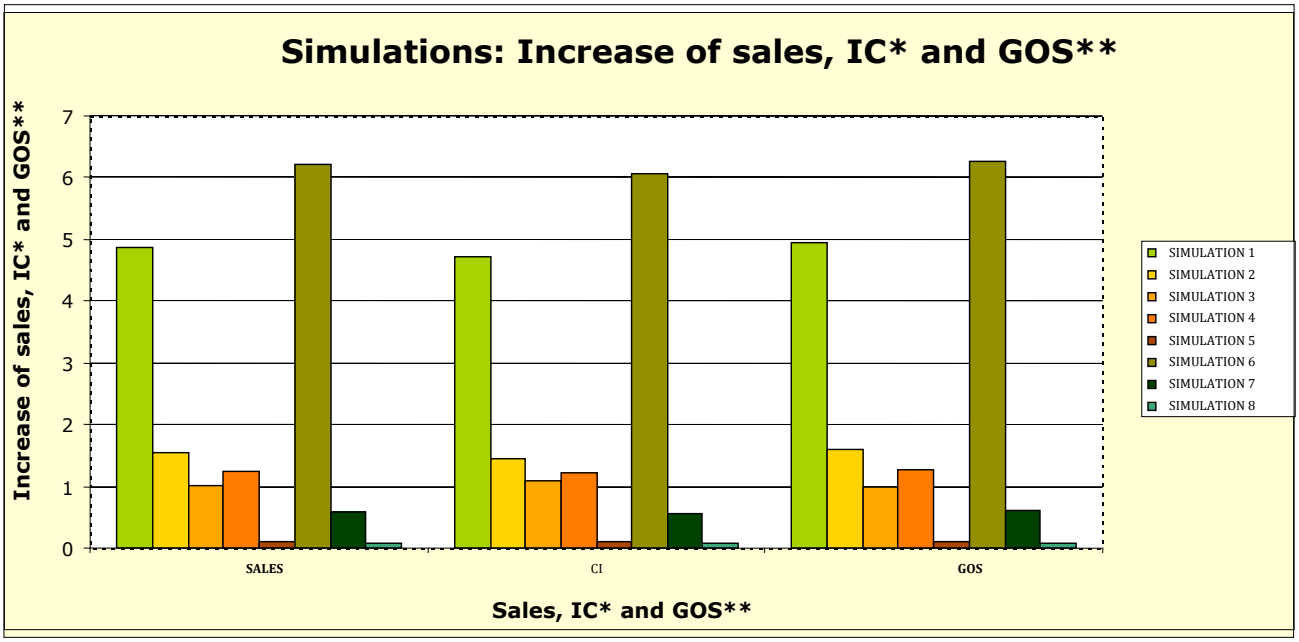
In chart no. 8, we show the people-days vectors, classified by types of clients and by simulations:

TABLE NO. 8
People-days by types of clients and simulations

	DE 1	DE 2	DE 3	DE 4	DE 5	ES 1	ES 2	ES 3	ES 4	ES 5	GB 1	GB 2	GB 3	GB 4	GB 5	OT 1	OT 2	OT 3	OT 4	OT 5
Simulation 1	10.138	514	71.951	3.755	1.138	1.158	364	4.113	2.096	463	955	201	8.983	893	506	700	360	6.991	962	68
Simulation 2	9.293	458	66.026	3.397	1.043	1.702	429	5.164	2.488	538	955	201	8.983	893	506	700	360	6.991	962	68
Simulation 3	9.293	458	66.026	3.397	1.043	1.158	364	4.113	2.096	463	1.074	224	10.010	1.000	561	700	360	6.991	962	68
Simulation 4	10.138	458	66.026	3.397	1.043	1.702	364	4.113	2.096	463	1.074	201	8.983	893	506	816	360	6.991	962	68
Simulation 5	9.293	514	66.026	3.397	1.043	1.158	429	4.113	2.096	463	955	224	8.983	893	506	700	410	6.991	962	68
Simulation 6	9.293	458	71.951	3.397	1.043	1.158	364	5.164	2.096	463	955	201	10.010	893	506	700	360	7.831	962	68
Simulation 7	9.293	458	66.026	3.755	1.043	1.158	364	4.113	2.488	463	955	201	8.983	1.000	506	700	360	6.991	1.087	68
Simulation 8	9.293	458	66.026	3.397	1.138	1.158	364	4.113	2.096	538	955	201	8.983	893	561	700	360	6.991	962	76

If all these people-days vectors by sales, intermediate consumptions and initial gross operating surplus by types of clients are multiplied, the new sales, the intermediate consumption and the gross operating surplus of the company are obtained. In graph no. 4, we can see, for each simulation, the rises in the sales, the intermediate consumptions and the gross operating surplus with respect to the initial values of these variables.

GRAPH NO. 4



*** IC: Intermediate Consumption** **** GOS: Gross Operating Surplus**

The most important effect on the sales, the intermediate consumptions and, therefore, on the company gross operating surplus is that caused by the increase of one day in the length of stay of German clients (simulation 1), which causes a rise of 5% of gross operating surplus. The increase of one day in the length of stay of clients of group 3 (simulation 6), also means a rise of 6.3% of the company gross operating surplus. Considering the nationality of the clients, we can point out that, although Spanish and English bring the highest daily profit, the German clients bring the highest total profit to the company because, as it was shown in the people-days vector, they are by far the most numerous clients of the total clients of the company.

CONCLUSIONS

In this paper, our aim has been to show the great capacity that business origin and destination tables have for economic analysis.

The input-output analysis based on the business origin and destination tables can be a very powerful tool for the decision-making because of its simplicity for the data management and the flexibility of its formulation to achieve different objectives. It is possible to carry out different types of analysis: structural, production processes or environmental analysis, depending on the information we wish to obtain. In this document, basing on a good breakdown of demand, we have known which segments of that demand bring more profit to the company. This is very interesting when presenting new marketing strategies to attract new clients.

Taking the study of this paper as a starter point and considering an enlargement of it, the relation between the input-output tables of the tourist company and the input-output tables of the Canary Islands regional accounts could be studied. This could also be done with the Spanish national accounts, as Polenske did in 1997.

Nowadays, the use of input-output models and techniques for microeconomic analysis is not very common, which is quite surprising because these models are a powerful tool, even unique, to solve a wide variety of business management and organizational problems.

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