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## Economic Effects Of The Indirect Taxes In A Regional Economy

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## Economic Effects of the Indirect Taxes in a Regional Economy

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### *ABSTRACT*

The goal of this paper is to use a regional social accounting matrix (SAM) to empirically study the price burden of indirect taxes in the regional economy of Andalusia. The methodology we use is that of the well-known input-output subset of a SAM model. Adopting this approach we are able to capture the existent structural interdependence among productive sectors and we are able to evaluate the implicit weights and price-elasticities of the different indirect taxes, as well as indicators of consumer's welfare variations. The database used in the analysis is the SAMAND95 (Social Accounting Matrix of Andalusia, Spain, for 1995) developed by the authors.

**Keywords:** Social accounting matrix, SAM interdependence, indirect taxes, regional economy.

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## **1. Introduction.**

Regional governments in Spain have seen the scope of their responsibilities, both political and economic, enlarged in the last twenty years. The political process of reform of a largely rigid and centralised government structure has shifted to the regional governments many of the formerly centralised decision making process. At the same time that regional governments have assume greater levels of responsibility in the design of regional development plans, the move towards globalisation within the industrialised european countries has added new constraints but also new possibilities for emergent local economies (Curbelo, 1998). The increasing availability of microeconomic regional data makes it feasible to study the impact on the regional economy of policies designed and carried out from within (the regional government) or from above (the higher levels of government, either national or supranational).

The ability to assess policies gains importance in the context of developing regions (as Andalucia can be considered within the Spanish or European framework). It may provide detailed information to be taken into account when ordering priorities and may yield insights for complementary regional public policies beyond those conventional policies aiming at income redistribution.

The work presented here is an attempt to evaluate the impact on prices and consumers' welfare of the tax system, specifically the subset of indirect taxes, on the regional economy of Andalusia. We aim therefore at obtaining an indicator of total indirect tax weight. Such an indicator could be interesting to assess the distortions on relative prices exerted by the different indirect tax figures. It would also allow us to measure the quantitative weight of the indirect taxes on the prices, yielding a measure of the inflationary cost-push of each tax.

A convenient methodological setup for this analysis is that of the Social Accounting Matrix (SAM) since a SAM captures, for a given period and disaggregation, the complete flow of incomes in the economy containing an input-output table as a submatrix. The SAM of Andalusia yields a compact, disaggregated representation of all value transactions taking place in the base period. We have used a recent update to 1995 of the SAM (SAMAND95) laid out in Cardenete (1998). The extracted input-output data subset is used to implement a

linear production model that captures the existent interdependence among productive sectors and it leads to a natural evaluation of the tax burden, both in absolute levels and elasticities, of the different indirect taxes. Needless to say, the interpretation of the results, their validity, and their actuality depend, on the one hand, upon the well-known limitations of the methodology and, on the other hand, upon the quality and date of the data base. Although techniques to update SAMs and input-output tables do exist, one has to balance the trade-off between having a data base with reliable micro data and an update that, having a more recent aggregate macro figures, has been subject to transformations and adaptations that do alter the initial available microdata. In this sense, the SAMAND95 has been constructed using the latest available input-output data.

The paper will be divided in four parts. Section 2 briefly presents some of the main antecedents of the used model. In Section 3 we present the methodology; after introducing the base economy and its technology we lay out the rules governing price formation. We go onto obtaining the different features and price and welfare indicators calculated from the data in the SAMAND95. In Section 4 we outline and discuss the empirical results. We close the paper with a section that summarizes the results and limitations of the analysis.

## **2. Brief literature review.**

In the empirical applications of the theory of general equilibrium we can distinguish between Walrasian models (whose numerical implementations are known as computable general equilibrium models, or CGEs) and SAM type models.

A distinguishing trait of computable general equilibrium models is that they allow for substitution between factors in response to changes in relative factor prices, or shifts in households' demand again in reaction to changes in consumption prices. Demands and supplies (for goods, services, and factors) are coherently integrated in a system that matches them thanks to the balancing role of relative prices. Prices and quantities are endogenous variables in the model, and an algorithmic equilibrium is achieved through an iteration process between prices and quantities.

These models have their foundations in modern microeconomic theory and have had a spectacular development starting in the 80's dealing with fiscal and trade issues beyond the size constraints of analytical models. In the first area, Scarf and Shoven (1984), Ballard et al (1985) and Whalley (1985) have collected and expanded the most relevant aspects and applications of this methodology. In the trade area we have Dervis, de Melo and Robinson (1982), Robinson (1987), Decaluwé and Martens (1988), and Roland-Holst and Tocarick (1989) as main contributors. The most general contribution is probably that of Shoven and Whalley (1992).

SAM models, in contrast to CGE models, can be seen as extensions of classical input-output models. The flow of interdependencies encompasses a greater set of structural relations than those of input-output analysis, but adapting behaviour of quantities to changing relative prices is ruled out. An advantage of SAM models is their operational simplicity regarding their Walrasian counterparts. In this paper we will be using this second methodology, that is, the social accounting matrix approach. Many authors that work in this area refer to this kind of models as *linear general equilibrium models* (as opposed to *non linear* or *computable general equilibrium models* proper), but we feel that this terminology does not capture the true sense of this methodology.

### **3. The Model.**

#### **3.1. The economy.**

We consider an economy with 25 production sectors. The technology that characterises the economy is the traditional in input-output analysis, where each sector produces a unique good or service under fixed coefficients and constant returns to scale. Primary factors include "Labour" and "Capital". The "Foreign Sector" supplies a non competitive commodity as an additional input to the total cost of production.

The public sector participates as a tax collection agent. Given the nature of the analysis, we focus on indirect taxation and distinguish four types of taxes: a "Social Security Tax paid by Employers (SSTE)", which represents a fiscal cost assumed by firms when using the labor factor; an "Ad Valorem Excise Tax" that conglomerates different small tributes and subsidies that affect production activities and transactions (licenses, special taxes, etc.);

“Tariffs” collected from imports; and a “Value Added Tax (VAT)” that taxes the additional value at each one of the phases of the production and that it relapses in the last step of the chain, generally the final consumer.

### 3.2. Price formation.

Given the production structure of the economy, production prices follow a standard average cost rule:

$$p_j = (1 + t_j) (\sum_i q_j a_{ij} + (1 + s_j) w l_j + r k_j + (1 + t_j) pm am_j) \quad (1)$$

Final prices are affected by the Value-added tax yielding:

$$q_j = p_j (1 + VAT_j) \quad (2)$$

The notation for the two equations follows:

$p_j$  : production price of sector  $j$ .

$\odot_j$ : "Ad Valorem Excise Tax" of sector  $j$ .

$a_{ij}$  : input-output technical coefficients

$s_j$  : "Social Security Tax paid by Employers" of sector  $j$ .

$w$ : wage rate

$l_j$ : labor technical coefficients of sector  $j$ .

$r$ : capital services rate.

$k_j$ : capital technical coefficients of sector  $j$ .

$t_j$  : “Tariffs” on the imports of sector  $j$ .

$pm$  : price of import goods.

$am_j$  : technical coefficients for foreign goods.

$q_j$  : final price of sector  $j$ .

$VAT_j$  : “Value Added Tax” of sector  $j$ .

Using the information contained in SAMAND95 database we calibrate the technical coefficients  $a_{ij}$ ,  $am_j$ ,  $l_j$ , and  $k_j$ . As an example the input-output coefficients are obtained from:

$$a_{ij} = SAM(i,j) / X_j \quad (3)$$

where  $SAM(i,j)$  and  $X_j$  are total intermediate transactions and total output. Likewise coefficients for the production factors, labor ( $l_j$ ) and capital ( $k_j$ ), have been calculated as,:

$$l_j = SAM(labor,j) / X_j \quad (4)$$

$$k_j = SAM(capital,j) / X_j \quad (5)$$

Finally, the different tax rates are calibrated using the following generic expression:

$$TAX_j = Income_j / Taxable Base_j \quad (6)$$

Theses types are effective and not nominal, that is, they reflect the effective income transfer and taxable base as read from the SAM. Production prices or unitary costs, final prices and wage are endogenous. The wage rate is endogenized using an implicit normalised basket of goods that define weights for final prices similar to those of consumers' price indices. The model is calibrated setting an endogenous initial wage that also works as an indicator for aggregate price variations:

$$w = \sum_j q_j \varkappa_j \quad j = 1, \dots, 25 \quad (7)$$

where  $\varkappa_j$  is the share of the consumption of each good  $j$  over total consumption. A possible justification for incorporating an endogenous wage rate of this kind is that this indicator is an index of reference for unions in wage negotiations (indexing).

Capital and foreign goods prices are exogenously given and fixed at unitary levels. With these and the previous conventions we can show that the database reproduces a simple micro-economic balance. Therefore alternative scenarios when indirect tax rates are modified allow us to evaluate the changes in all prices for all commodities following the adaptation of the economic structure to the simulated new fiscal system.

Needles to say the current structure is also fit for studying price behaviour under scenarios other than fiscal ones like changes in the exogenous price of imports or payments to capital services.

### 3.3. Welfare indicator.

In addition to the effects on the prices, we can also obtain an approximation of the influence that each indirect tax category has on the welfare of consumers. The model contemplates a single representative consumer and we can compare expenditure associated to a typical basket of goods before and after the simulation,  $G$  and  $G'$  respectively:

$$G - G' = \sum_j q_j C_j - \sum_j q'_j C_j = \sum_j (q_j - q'_j) C_j \quad j=1, \dots, 25. \quad (8)$$

where for commodity  $j$  we have that  $q_j$  and  $q'_j$  are consumption prices before and after the simulation and  $C_j$  is the standard consumption in the reference basket. If the difference is positive, we have an improving welfare situation, whereas a negative sign would indicate a worsening of the consumer's welfare. The comparison gives us an estimate of the change in consumer's real income when facing a tax change since this will generate a new set of equilibrium prices. It is obvious that this calculation overestimates the standard welfare change since the adaptive reaction of the consumer to the new price set is disregarded. It gives us though a first approximation of the impact of a fiscal policy on consumers' welfare.



#### 4. Empirical results.

The simplest way to ascertain the impact of each indirect tax on prices is to set, for each tax category, the tax rate to zero. This *de facto* elimination of a tax category will clearly have a lowering effect on final prices since we are actually eliminating the fiscal cost from the price equation and, under competitive conditions, this reduction is passed over to final prices.

An alternative way of presenting the influence of each tax category on prices is through the use of a tax-price elasticity. It has the additional advantage of rendering feasible to evaluate the effects of marginal adjustments in tax rates. As an example we will proceed to calculate the elasticity after a 10 percent increment in each tax rate.

We present here the results of the simulation exercises. Table 1 shows the effects induced on prices by eliminating tax rates one at a time. Table 2 summarises the welfare effects on the representative consumers. Finally, Table 3 displays average elasticities of prices vis a vis each of the four tax categories

We can read in Table 1 the effects of the eliminating each tax rate on each one of the productive sectors in Andalusian economy, as well as a aggregate average effect on the price index.

Table 1. Elimination of Taxes: Effects on the final prices.

Recipient sector	(a)	(b)	(c)	(d)	(e)
1. Agriculture	1.046	0.996	0.910	0.965	0.915
2. Cattle & Forestry	1.072	0.993	0.891	0.959	0.909
3. Fishing	1.022	0.995	0.935	0.946	0.899
4. Extractives	1.072	0.941	0.982	0.987	0.976
5. Refineries	1.019	0.975	0.969	0.957	0.921
6. Electricity	1.065	0.989	0.949	0.928	0.925
7. Natural gas	1.141	0.968	0.943	0.896	0.931
8. Water	1.075	0.993	0.830	0.919	0.814
9. Mining, iron & steel ind.	1.030	0.987	0.976	0.988	0.971
10. Building materials	1.032	0.988	0.926	0.966	0.912
11. Chemicals	1.046	0.992	0.978	0.957	0.971
12. Metal products	1.027	0.992	0.955	0.975	0.948
13. Machinery	1.043	0.988	0.983	0.969	0.982
14. Automobiles	1.107	0.988	0.974	0.912	0.971

15. Other transport. equip.	1.077	0.974	0.889	0.953	0.887
16. Food products	1.127	0.978	0.923	0.939	0.953
17. Textiles and Leather	1.108	0.989	0.954	0.914	0.954
18. Wood products	1.044	0.995	0.960	0.960	0.956
19. Other manufactures	1.084	0.991	0.943	0.926	0.937
20. Construction	1.086	0.992	0.861	.0.902	0.836
21. Commerce	1.030	0.995	0.884	0.950	0.860
22. Transportation & Commun.	1.073	0.995	0.901	0.906	0.871
23. Other services	1.032	0.994	0.800	0.931	0.764
24. Commercial services	1.067	0.998	0.941	0.932	0.934
25. Non commercial services	1.029	0.994	0.801	0.951	0.783
Price Index	1.056	0.992	0.903	0.940	0.888

Source: simulation output from database SAMAND95.

- a) Consumption prices without "Ad Valorem Excise Tax".
- b) Consumption prices without "Tariffs".
- c) Consumption prices without "Social Security Tax paid by employers"
- d) Consumption prices without "VAT".
- e) Consumption prices without indirect taxes.

We observe that the elimination of the "Ad Valorem Excise Tax" increases the prices of all productive sectors (an average of 1.056 percent). The reason is that this tax category includes different types of subsidies (negative taxes) as recorded in the input-output table of Andalusia. In fact, reading the corresponding row of the SAM, which uses the input-output table as a key constructing element, one concludes that most sectors receive subsidies showing a high component of subsidised economy in the Andalusian region. In numbers, eliminating all excise taxes (positive and negative) the agricultural price would rise by about 4.6 percent, and so on.

In contrast, eliminating the "Social Security Tax paid by employers" would have the greatest impact in reducing sectorial prices. The consumer prices index would fall to 0.903, about a significant 10 percent reduction on prices. A general comment is therefore the substantial impact of this tax on the (lack of) competitiveness of the regional economy. The remaining columns are likewise interpreted and we omit further comments here.

Going to Table 2 we can read the estimated effects of each tax in consumers welfare. A reduction in commodity prices will mean a decrease in the necessary expenditure to

purchase the same consumption bundle (fixed initial utility). Looking at the welfare index we observe that it is positive under the elimination of every tax except the “Ad Valorem Excise Tax” for obvious reasons that have been commented above. Once again the elimination of the “Social Security Tax paid by employers”, other things being kept constant, would increase welfare the most. The monetary benefit is estimated at about 611 thousand millions of pesetas (about 6.15 per cent of andalusian GDP), more than a 60 percent gain over the estimated benefit of a complete elimination of the VAT.

Table 2. Elimination of Taxes: Effects in Welfare of Consumers.

Tax	Welfare Index
Ad Valorem Excise Tax	-350.849 m.m. ptas.
Tariffs	50.080 m.m. ptas.
Social Security paid by employers	611.764 m.m. ptas.
VAT	376.410 m.m. ptas.

Source: Simulation output from SAMAND95 database

To complete the above analysis, we now briefly turn to asses the weight of each tax category using the tax-price elasticity. We define an average elasticity that provides additional information on the response of prices before tax variations. Formally,

$$\epsilon_t = (\partial w / w) / (\partial t / t) \quad t = t_1, \dots, t_{25} \tag{9}$$

where  $w$  is the price index and  $t$  is the tax rate for each tax category. Table 3 shows the numerical results under a 10 percent increase of each tax rate. We confirm once more that “Social Security Tax paid by employers” has the largest impact as measured by its average elasticity (0.109).

Table 3. Tax-price Elasticities as measured by a 10 percent increase in rates.

Tax	Average Elasticity
Ad Valorem Excise Tax	0.070
Tariffs	0.008
Social Security paid by employers	0.109
VAT	0.062

Source: Simulation output from SAMAND95 database.

## 5. Concluding Remarks.

We have developed in this paper a simple linear price model for the Andalusian economy of 1995, extracted from a SAM (SAMAND95). We have analysed the incidence of indirect taxes on aspects such as prices and consumers welfare showing the utility of using a multisectorial model that incorporates economic interdependence and permits to quantify the effects of tax policies.

It is worth remarking that "Social Security Tax paid by employers" is the most inflationary tax in the sense that exerts the largest influence on prices. Moreover this tax significantly affects the welfare of consumers and could provide a possible explanation for the lack of competitiveness of the Andalusian region. This type of result has also been observed in other studies for the whole economy of Spain, as in Sancho (1988) based on a SAM of Spain for 1980.

A necessary extension of this work should go along the lines of using a true general equilibrium model that would account for further and better modeled interdependencies and connections between the production side, the consumption side and the government.

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