DOCUMENTS DE TREBALL
DE LA FACULTAT DE CIÈNCIES
ECONÒMIQUES I EMPRESARIALS

Col·lecció d'Economia

Building a Social Accounting Matrix within the ESA95 Framework: Obtaining a Dataset for Applied General Equilibrium Modelling♦

Abel Lucena
Mònica Serrano

University of Barcelona

Adreça correspondència:
Departament de Teoria Econòmica, i CREB
Facultat de Ciències Econòmiques i Empresarials
Universitat de Barcelona
Av. Diagonal 690
08034 Barcelona (Spain)
Tfn. +34 934034539, +34 9340219 41

♦ The authors are grateful for the comments received from Antonio Manresa, Samuel Calonge, and one anonymous referee, as well as those received from participants at 15th International Input-Output Conference, and participants at the I Jornadas de Análisis Input-Output. Likewise, we are grateful to Alejandro Cardenete and to Ferran Sancho for their help with the data in the Spanish 1994 input-output table.

Abstract: This research provides a description of the process followed in order to assemble a "Social Accounting Matrix" for Spain corresponding to the year 2000 (SAMSP00). As argued in the paper, this process attempts to reconcile ESA95 conventions with requirements of applied general equilibrium modelling. Particularly, problems related to the level of aggregation of net taxation data, and to the valuation system used for expressing the monetary value of input-output transactions have deserved special attention. Since the adoption of ESA95 conventions, input-output transactions have been preferably valued at basic prices, which impose additional difficulties on modellers interested in computing applied general equilibrium models. This paper addresses these difficulties by developing a procedure that allows SAM-builders to change the valuation system of input-output transactions conveniently. In addition, this procedure produces new data related to net taxation information.
Key words: social accounting matrix, applied general equilibrium analysis, valuation system, ESA95 conventions, input-output transactions, net taxation on products

JEL classification: C68, C81, D57, D58

Resumen: En este trabajo se describe un procedimiento que permite calcular una "Matriz de Contabilidad Social" para España correspondiente al año 2000. Dicho procedimiento se caracteriza, fundamentalmente, por intentar adaptar las recomendaciones incluidas en el SEC95 a los requerimientos impuestos por los modelos de equilibrio general aplicados. Específicamente, se ha dedicado una especial atención a los problemas de agregación referidos a los impuestos netos sobre los productos, así como también aquellos vinculados con el sistema de valoración de las transacciones del marco input-output. Después de la adopción del SEC95, las transacciones referidas al marco input-output han sido preferiblemente expresadas en términos de los llamados precios básicos. Este hecho genera dificultades a la hora de calibrar modelos de equilibrio general aplicados. En este sentido, este trabajo pretende resolver dichas dificultades a través de un método que transforma convenientemente el sistema de valoración de las transacciones de la tabla input-output. Adicionalmente, se muestra cómo este procedimiento puede ser aplicado para generar información útil a la hora de desagregar los datos referidos a los impuestos netos sobre los productos.

1. Introduction

Researchers interested in computing applied general equilibrium models for appraising policy changes in Europe have to take as their reference point the set of accounting rules established by the European system of national and regional accounts (ESA95). In general, these rules provide useful recommendations for arranging the accounting data required to calibrate these models. We can mention several advantages for building a Social Accounting Matrix (SAM) within the ESA95 framework. For instance, implementing these rules makes it possible to break down the information referring to the set of institutions that comprise the whole economy. Specifically, the role played by corporations to explain the process of income formation is described properly after considering ESA95 conventions. In comparison with older versions, the ESA95 framework enables the establishment of links between income distribution operations and the kind of institutions directly responsible for them. Much more information is now available to account for the whole process of disposable income formation, enabling researchers to improve the modelling of the set of budget restrictions of the agents typically included in applied general equilibrium models. Another important feature of ESA95 conventions is the composition of its input-output framework, which includes not only the symmetric input-output table, but also two additional matrices, namely, the use and supply tables. Consequently, a more complete description of the supply part of the economy is provided by the use of ESA95 rules.

Despite the advantages mentioned so far, adoption of the ESA95 guidelines for building a SAM also obliges modellers to resolve other challenging issues. In particular, SAM builders still face problems of information aggregation fundamentally related to net taxation on products[1]. As will be discussed later, this is one of the most important consequences of valuating input-output tables at basic prices. After ESA95 conventions, it has been established that use tables should be preferably valued at purchasers' prices while symmetric input-output tables should be valued at basic prices. As a result, figures in input-output tables are deployed in such a way that consumption taxation, i.e. value added tax, is not always easily differentiated from the rest of indirect taxation figures. Modellers thus face some informational shortcomings when calibrating models for appraising, for instance, tax policy changes. Likewise, taxation on domestic production and on imports is often aggregated when presenting input-output tables at basic prices. Consequently, implementing the Armington specification (1968) for modelling prices under the establishment of imperfect substitution patterns between domestic and imported production may add difficulties to those usually encountered in the process of model calibration.

This paper considers how to deal with problems of tax data limitations by explicitly adopting a modeller's viewpoint. That is, bearing in mind that the information on the input-output transactions is commonly valued at basic prices[2], a modeller will have to carry out transformations in order to obtain a SAM that is totally consistent with the requirements of applied general equilibrium analysis. We shall argue for a procedure in which the valuation

[1] Net taxation on products includes all the indirect taxes as well as the subsidies on both consumption and production activities.

[2] This valuation system was already defined by the 1968 SNA. It was established that input-output transactions could be expressed following three conventions: basic prices, producer prices and purchasers' prices. However, since the development of the ESA95 the debate on which system is better for valuing input-output transactions has been reopened. Pyatt (1991) presents an interesting review of the origins of basic price conventions and explains why such conventions were adopted by the 1968 SNA. See also the revision of Ward (2004) who compares the evolution of the 1968 SNA and some of its more important methodological issues. The author comments on the valuation system adopted in this framework as well as its theoretical foundation.

system of the input-output transactions is transformed to facilitate tax information disaggregation. After doing so, values of tax parameters appearing in applied general equilibrium models can be properly calibrated. More specifically, we suggest that turning input-output transactions into producer prices is a suitable strategy when the final goal of modellers is to compute applied general equilibrium models. As we shall see later, this is so because producer prices allow SAM-builders to recover net taxation data in such a way that consumption taxation can be clearly distinguished from production taxation; this is particularly useful for modelling taxes appropriately. At the same time, we shall see that producer prices are better suited than other valuation alternatives to treatment of trade and transport margins. This implies a reduction in the modelling tasks for the specification of relative prices in applied general equilibrium models.

To illustrate how the change valuation actually works, we shall describe the process of assembling a SAM for Spain corresponding to the year 2000 (henceforth SAMSP00). In general, the SAMSP00 can be thought of as a micro-consistent dataset that characterises the circular income flow of economic agents interacting in the Spanish economy. The SAMSP00 is regarded as a micro dataset because it contains disaggregated information on the set of transactions typically established among economic agents for the period mentioned. Special emphasis has been placed on providing detailed information on elements that determine the valuation system used for expressing the monetary value of such transactions. Furthermore, the SAMSP00 is regarded as a consistent dataset because its design allows for computational methods that enable the reconciliation of information provided by alternative statistical sources. Specifically, algorithms for balancing matrices such as the RAS method have been used to avoid data inconsistencies. Gravity model specification has been also helpful when arranging data on some of the income distribution operations included in the SAMSP00.

Apart from the valuation change issue, we should stress some of the most important methodological features about the compilation of SAMSP00. Firstly, this dataset incorporates the approach developed by Pyatt (1988). That is, by assuming that every economic model has its corresponding accounting framework, and that every such framework can be arranged as a SAM, it follows that every economic model has a corresponding SAM. By using this principle, it can be argued that the data assembly of the SAMSP00 is mainly sustained by applied general equilibrium analysis. Thus, the SAMSP00 is regarded as a way of organising information on market transactions occurring in the economy and on which any modelling process should be based. By doing so, we avoid to build a SAM exclusively on accounting conventions, which in many cases impose additional difficulties on the process of model calibration.

Another important feature of the SAMSP00 is the empirical approach applied in its construction. Specifically, we consider the guidelines established by the pioneering work of St-Hilaire and Whalley (1983). The SAMSP00 is regarded as benchmark equilibrium, and consequently, the process of data arrangement must fulfil the requirements of applied general equilibrium analysis. The valuation system used for defining input-output transactions, and the way of organising net taxation data were examined in depth. Similarly, the Spanish 1980 SAM assembled by Kehoe *et al.* (1988) was carefully reviewed. This work provides a useful discussion of how to treat Spanish datasets for building a SAM that fully considers applied general equilibrium modelling. Finally, the approach followed by Kehoe (1998) and Manresa (1996) has been considered in detail so as to analyse the recognised relationships between applied general equilibrium modelling and the process of SAM building.

In building a SAM for Spain using ESA95 conventions to some extent, researchers have neglected the problem of aggregation of net taxation data. In this regard, the analysis of which valuation system is the best for valuing input-output transactions is another aspect that researchers have ignored. For instance, the Spanish 1995 SAM assembled by Uriel *et al.* (2005) is a good example of data compilation in which ESA95 guidelines were carefully followed. Despite being a very useful dataset in terms of the disaggregated information it provides, this SAM arranges net taxes on products due to intermediate and final demand consumptions in a row-vector integrated into the symmetric input-output table. By doing so, basic prices are entirely adopted for valuating input-output transactions. A similar situation is found in the case of the Spanish SAMs for 1995 and 1998 produced by Morilla *et al.* (2005). Likewise, the Spanish 2000 SAM assembled by Morilla and Diaz (2004) for integrating environmental and social accounting data does not deal with the disaggregation of net taxation figures, in spite of the importance of modelling tax reforms to accomplish environmental policy goals.

In contrast, Cardenete and Sancho (2006) explicitly tackle problems of tax information aggregation, and problems deriving from the valuation of input-output flows at basic prices. By using a methodology based upon a Leontief price model as a starting point, these authors build a SAM for Spain corresponding to the year 1995 in which net taxation on products is disaggregated in some basic categories, and in which input-output flows are valued at purchasers' prices. In general, the building process of this SAM has explicitly followed the modelling guidelines involved in applied general equilibrium analysis. However, in their work the treatment of both trade and transport margins for changing the value of input-output transactions is not totally clear-cut. As we shall see later, if purchasers' prices are used to value input-output transactions, margins have to be reported explicitly because they constitute an important part of the monetary value of any transaction defined in terms of market prices (INE, 2001).

From a more theoretical perspective, the debate about which conventions should be implemented to assemble a SAM is addressed in this paper as follows. Building a SAM that applies the ESA95 framework strictly requires the characterisation of an accounting system greatly based upon a Leontief model perspective. This involves the use of a valuation system (basic prices) which is completely consistent with assumptions like rigidity of technology as well as its independence of relative prices. In contrast, assembling a SAM by using not only some of the guidelines provided by the ESA95, but also the theoretical framework underlying applied general equilibrium analysis enables modellers to obtain an accounting system in which the economic behaviour of agents can be explained by relative prices (Pyatt, 1991). Thus, the re-arrangement of the accounting data by means of changes in the valuation system of ESA95 input-output transactions aims to adapt these data to the process of calibrating a model in which economic agents respond to price changes.

Comparatively speaking, this paper contributes to the literature in the following aspects. A procedure aiming to recover important net taxation data is carefully described. In addition, to illustrate the procedure, the paper accounts for the method followed by assembling a SAM for Spain corresponding to year 2000. The SAMSP00 is built in such a way that it provides useful information for counterfactual general equilibrium analysis involving a basic decomposition of tax data, and in fact represents an important updating of the social accounting data available in Spain. Even though similar accounting systems have been already assembled for Spain, the SAMSP00 constitutes a novel attempt to reconcile ESA95 conventions with the modelling requirements of applied general equilibrium analysis. Finally, the procedure followed by changing the valuation system of the input-output transactions can be easily extended to the rest of countries adopting the ESA95 principles, since most of the information used by this procedure is contained in the ESA95 input-output framework.

The rest of the paper is organised as follows. In section 2, we argue the most important principles to be used to assemble a SAM. The change in the valuation system of input-output transactions is regarded as a part of the set of principles to be considered. Next, section 3 describes the procedure for changing input-output transactions in such a way that net taxation on products can be disaggregated conveniently. In addition, it describes how to arrange income distribution operation data by taking ESA95 conventions as a reference point. Section 4 discusses the way in which data generated by changes in the valuation of input-output transactions can be arranged in a system of accounts, using the case of Spain as a reference. Section 5 then accounts for the input-output framework situation currently prevalent in the European Union (EU). In general, it is suggested that non-survey methods are required in order to face the problem of changes in the valuation system of input-output transactions. Particularly, this is the case of researchers interested in applied general equilibrium analysis. Finally, in section 6 some concluding remarks are made.

2. Main principles to be followed during a SAM building process

Any SAM can be interpreted as a schematic arrangement of the entire market transactions of commodities and primary factors made by the institutions constituting the entire economy. Inside this market-orientated approach, it is assumed that agents earn rents from selling their initial endowments of commodities or primary factors to other agents. At the same time, these agents spend part of their rents when buying commodities and/or primary factors in markets. All of these exchanges occur in such a way that for every income formed there must be a corresponding expenditure. Subsequently, Walras' law turns out to be a useful principle for organising the information arranged in a SAM.

Overall, data compiled in a SAM can be easily regarded as a benchmark equilibrium resulting from solving an applied general equilibrium model (St-Hilaire and Whalley, 1983; Shoven and Whalley, 1992). If this is so, when processing and deploying the data to be compiled in a SAM, the following set of principles has to be fulfilled:

- Demands equal supplies for all commodities.
- Non-positive profits are made in all industries.
- Domestic agents have demands, which fulfil their walrasian budget sets.

Imposing these principles during the process of social accounting data compilation implies to reconcile data coming from alternative statistical sources so as to adjust differences in measurement concepts, as well as to iron out discrepancies caused by the use of different classification system.

Additionally, since it is thought that a SAM contains information about market transactions, it follows that the value of any SAM transaction has to be expressed according to a suitable valuation system[3]. This means that the alternative valuation criteria provided by the ESA95 must be evaluated, and the one that best matches the preconceived theoretical model used for arranging social accounting data, i.e. applied general equilibrium analysis must be chosen (Kehoe *et al.*, 1988; Keuning and Ruuter, 1988; Pyatt, 1991). To this end, it is useful to determine the factors explaining price formation. We find that net taxation on products, as well as total margins, are important elements to be considered. But they are intrinsically different from a modelling perspective. Trade and transport margins arise because of transport and distributive trade activities, and they can be regarded as inputs delivered by certain sectors. Essentially, since margins are part total production costs, they are in consequence a determinant of relative prices. In that way, total margins may be regarded as elements already incorporated in the kind of prices faced by both producers and final consumers. In contrast, indirect taxes and subsides do not affect prices in the same way as total margins do. For instance, value added taxation is charged fundamentally on final consumers while production taxations determine relatives prices faced by producers, and indirectly those faced by consumers. Thus, it can be stated that producers face a price net of value added taxation while consumers face purchasers' prices. Researchers should reflect this fact when modelling relative prices.

Consequently, since the valuation system used for expressing input-output transactions determines to some extent the way in which net taxes and margins are accounted, the choice of a valuation system becomes a non-trivial issue. Subsequently, the valuation system selected to build a SAM should give

[3] Fundamentally, three alternative valuation systems appear in the ESA95 framework: valuation at basic prices, at producer prices and at purchasers' prices (EUROSTAT, 1995).

modellers enough information in order to specify adequately the role played by net taxation and total margins on price formation. Therefore, we have to add a new principle to be followed when building a SAM:

- Transactions included in the SAM have to be valued properly. This means facilitating the modelling process of total margins and net taxation on products. At least, this requires the choice of a valuation system that allows modellers to disaggregate net taxation data in such a way that consumption and production taxation can be distinguished.

As we shall see later, valuing input-output transactions at producer prices ensures to reach this principle. This is so because this valuation criterion allows modellers to account for total margins as production costs, and to divide net taxation on products into some basic components: "net taxation due to domestic production", "net taxation due to imports" and "value added taxation". In that way, the effect of production taxation on relative prices can be distinguished from that of consumption taxation. In an applied general equilibrium context, this fact allows us to define prices faced by consumers as purchasers' prices and at the same time to specify prices faced by producers as net of value added taxation. The impact of tax policy change on agents' behaviour can thus be analysed more fully (Kehoe *et al.*, 1988).

3. Procedures for building a SAM within the ESA95 framework: the case of Spain

In this section, we will describe the methodology implemented in order to assemble a SAM within the ES95, but taking into account the kind of modelling requirements underlying applied general equilibrium analysis. We illustrate the main procedures with the case of Spain as a reference, explaining how to assemble a SAM for Spain corresponding to 2000. We shall focus on explaining the changes relating to the Spanish 2000 input-output framework, discussing how to value the flows arranged in these tables in such a way that the resulting flows are consistent with the valuation system underlying applied general equilibrium modelling. After doing so, we shall deal with the problem of tax information disaggregation, describing the procedure followed in order to compute net value added taxation by product, and explaining how to obtain net taxes on imports by both product/industry and origin categories. Finally, we will outline the procedure implemented to arrange the information concerning with income distribution operations. In this case, the emphasis will be placed on explaining how to estimate the matrix of current transfers established among the set of institutions that make up this economy. We are also going to discuss how to present the rest of the information related to such operations into the SAMSP00.

3.1 Valuation changes of the input-output framework

As mentioned above, we are assuming a user's point of view in our approach to assembling a SAM. It is our experience that, when building a SAM following ESA95 conventions, there may be two alternative scenarios:

- One in which the symmetric input-output is not available. In this case, the input-output framework comprises the use and supply tables, both usually valued at basic prices.
- Another in which the symmetric input-output table valued at basic prices is available. In this scenario, the input-output framework also comprises the use and supply tables respectively valued at basic prices.

In the case of the Spanish 2000 input-output framework, we have to take the first scenario as our starting point. To construct the SAMSP00, a symmetric input-output table has to be estimated from the information provided by the use and supply tables. But, so long as these tables are valued at basic prices, the resulting symmetric input-output table will be also valued in the same way. Consequently, we have to make a decision about the valuation criterion to be used for presenting flows of the symmetric input-output table. As noted above, since we are interested in applied general equilibrium modelling, the valuation criterion selected ought to be consistent with a perspective based upon market prices.

The problem of the estimation of a symmetric input-output table can be conveniently solved by adopting one of the existing methods that combines the use and the supply tables to generate a symmetric input-output table. In our case, we used the method based upon the so-called "industry-technology assumption" (United Nations, 1999; EUROSTAT, 2001). With regard to the valuation issue, the problem is more challenging and requires adopting some additional definitions. Before explaining our approach, we will present a further explanation of why changing valuation of input-output transactions is necessary in our setting.

Figure 1 describes both the use and supply tables valued at basic prices. Valuing transactions of these tables at basic prices implies adopting a particular convention regarding the organisation of the information on both margins and total net taxation. Accordingly, we have that margins and total net taxation on products can be accounted by industries and final demand components in the use table and by products in the supply table. The purpose of doing so is to separate from the monetary value of any transaction the part attributed to trade and transport margins, as well as that attributed to net taxation on products. When an industry or institution purchases a product, then three operations are registered in the input-output framework valued at basic prices:

- One associated with the intrinsic[4] value of the purchased product. Thus, if the buyer is an industry, the purchase will be accounted in the matrix $Z^{BP}_{(nxn)}$. Alternatively, in the case of institutions, the value of the purchase will be accounted in the matrix $F^{BP}_{(nxm)}$.
- One referring to both trade and transport margins incurred by the purchase. When the buyer is an industry, total margins will be registered as an intermediate consumption in the k rows related to trade and transport products, $Z^{BP}_{(kxn)}$. If the buyer is an institution, these margins will be accounted in the k rows corresponding to the expenditures of trade and transport products $F^{BP}_{(kxm)}$.
- Finally, one related to the net taxation caused by the purchase of the product. In the case of an industry, net taxation will be registered at the row-vector $T^{P}_{(1xn)}$, while in the case of institutions the corresponding register will be made at the row-vector $T^{F}_{(1xm)}$.

[4] The term "intrinsic" is used in this context to stress that the value at basic prices is strictly based upon production cost considerations.

FIGURE 1a
The use table valued at basic prices

	Industries (NACE)	Final Demand	Total Uses at basic prices
Products (CPA)	$Z^{BP}_{(n-k\,x\,n)}$	$F^{BP}_{(n-k\,x\,m)}$	$U^{BP}_{(nx1)}$
	Margins $Z^{BP}_{(kxn)}$	**Margins** $F^{BP}_{(kxm)}$	
	Net taxes on products $T^{P}_{(1xn)}$	**Net taxes on products** $T^{F}_{(1xm)}$	
	Value added $V_{(1xn)}$		
	Domestic Supply at basic prices $DS^{BP}_{(1xn)}$		

FIGURE 1b
The supply table valued at basic prices, including information for changing valuation from basic to purchasers' prices

	Industries (NACE)	Domestic Supply at basic prices	Imports	Total Supply at basic prices	Total Margins	Total Net product taxation	Total Supply at purchasers' prices
Products (CPA)	$X_{(nxn)}$	$DS^{BP}_{(nx1)}$	$I_{(nx1)}$	$S^{BP}_{(nx1)}$	$M_{(nx1)}$	$T_{(nx1)}$	$S^{PP}_{(nx1)}$

We will now mention some of the most important consequences of implementing this valuation system. Firstly, the row-vector $T^{P}_{(1xn)}$ in Figure 1a contains only net taxation data derived from intermediate consumption activities. Data about net taxation on products associated with the value of final output, which is arranged by product, is accounted separately in the supply table (see the column-vector $T_{(nx1)}$ in Figure 1b). To model the impact of net taxation on the kind of prices faced by producers, we need the information concerning net taxation on products attributed to final output not that exclusively linked to intermediate consumption. A parallel situation is found in the case of net taxation on imports. Finally, value added taxation is fundamentally accounted in the row-vector $T^F_{(1xm)}$ in Figure 1a. As a result, this taxation is classified according to the kind of final demand component responsible for final consumption not by products. This imposes limitations on the modelling process of prices typically faced by final consumers, in which value added taxation classified by product is required.

The shortcomings mentioned can be partially resolved by using the information gathered by the supply table. As indicated in Figure 1b, margins and total net taxation are deployed by products in this table. That is, for each product i this table provides the amount of both margins and total net taxation caused by the entire purchases of i made in the entire economy. In that way, it is possible to value the total supply of i by using alternative valuation criteria. For instance, when adding to total supply at basic prices the amount referred to total net taxation, the resulting supply will be valued at producer prices. Likewise, adding both the amount referred to total net taxation and that referred to total margins to total supply at basic prices ensures that the resulting supply is valued at purchasers' prices.

Nevertheless, the supply table does not provide explicit information for changing the value of the whole transactions registered by the use table. To do so, supplementary matrices[5] would be needed with the same dimensions as those of the use table, containing the amount of margins and net taxations caused by any transaction accounted in the use table. Although the ESA95 guidelines encourage National Statistics Offices to complement their input-output frameworks with such matrices, researchers interested in applied modelling rarely get access to this kind of information.

[5] For instance, valuation matrices.

By considering these limitations, the following sub-section will describe a procedure that aims to change the valuation of flows registered by the use table. As will be argued later, by changing the valuation of these flows, we can reach two underlying goals:

- Estimation of a symmetric input-output table valued conveniently.
- Generation of additional information to disaggregate tax information. Specifically, we shall show how to compute net value added taxation from a use table valued at purchasers' prices.

3.1.1 Procedure for changing the value of input-output transactions

Our first step will be to define the kind of transactions arranged in the use table, bearing in mind that this table accounts for the entire purchases of products made both by industries and by institutions that make up the economy. Thus, let t_{ij}^{v} be the monetary value of any transaction in which the buyer j purchases commodity i. In this case, the supra-index stands for the kind of valuation used for expressing t_{ij}^{v}. Specifically, the index v refers to the following alternatives:

- Valuation at basic prices, BP.
- Valuation at producer prices, PRP.
- Valuation at purchasers' prices, PP.

In addition, as suggested by Figure 1a, it is established that t_{ij}^{v} is registered at Z when j is an industry, while t_{ij}^{v} is registered at F when j is an institution. Hence, it follows that $j \in \{i, h\}$, where i is the index referring to the set of the n industries included in the matrix of intermediate consumptions, while h is the index denoting to the set of the m institutions comprising the matrix of final demand consumptions. As a whole, two alternative valuation changes can be established when the starting point is a transaction valued at basic prices, t_{ij}^{BP}. Consider the following definitions:

Definition 1: *A transaction is valued at producer prices,* PRP*, when the net tax rate on products,* τ_i*, is charged on the monetary value of this transaction valued at basic prices,* t_{ij}^{BP}*. Then, we have that:*

$$t_{ij}^{PRP} = \left(1+\tau_i\right)t_{ij}^{BP}; \quad \forall i = 1,2, \ldots n \;\wedge\; \forall j \in \{i,h\} \qquad (1)$$

Similarly, let us consider the following definition:

Definition 2: *A transaction is valued at purchasers' prices,* PP*, in those cases in which, besides the net tax rate on product,* τ_i*, the margin rate,* η_i*, is charged on the monetary value of the transaction at basic prices,* t_{ij}^{BP}*. As a result, we have that:*

$$t_{ij}^{PP} = \left(1+\eta_i\right)\left(1+\tau_i\right)t_{ij}^{BP}; \quad \forall i = 1,2, \ldots n \wedge \forall j \in \{i,h\} \qquad (2)$$

By following these definitions, we can change transactions contained by the use table at basic prices conveniently. To do so, we have to calibrate the value of parameters included in equations (1) and (2), by drawing on the information about total margins and total net taxation contained in the supply table of the Spanish 2000 input-output framework (INE, 2005a). See also the schedule in Figure 1b.

Specifically, these parameters can be calibrated as follows:

$$\tau_i = \frac{t_i}{s_i^{BP}}; \quad \forall i = 1,2, \ldots n \tag{3}$$

$$\eta_i = \frac{m_i}{s_i^{PRP}}; \quad \forall i = 1,2, \ldots n \tag{4}$$

Where:

- t_i is the amount corresponding to the net taxation on products caused by total purchases of the product i made in this economy. We have that t_i is registered at the column-vector $T_{(nx1)}$ contained in the supply table.
- s_i^{BP} is total supply of product i valued at basic prices. We find s_i^{BP} in the column-vector $S_{(nx1)}^{BP}$ appearing in the supply table.
- m_i is the amount of total margins caused by the whole purchases of product i made in this economy. Each m_i is registered in the column-vector $M_{(nx1)}$ contained in the supply table.
- s_i^{PRP} is the value of total supply of product i valued at producer prices. In consequence, we have that $s_i^{PRP} = s_i^{BP} + t_i$.

After calibrating both margin and net tax rates, we can convert the value of the use table transactions into the valuation that interest us. As mentioned above, in order to assemble the SAMSP00, we suggest estimating the symmetric input-output table valued at producer prices. Furthermore, the use table valued at purchasers' prices turns out to be helpful to estimate net value added taxation.

First, we perform the valuation change for the estimation of the symmetric input-output table at producer prices. To do so, we have to transform transactions recorded in the use table valued at basic prices as follows:

$$Z^{PRP} = \hat{T} Z^{BP} \quad (5)$$

$$F^{PRP} = \hat{T} F^{BP} \quad (6)$$

Where:

- $\hat{T}$ is a nxn diagonal matrix with elements $(1 + \tau_i)$ on the main diagonal.
- Z^{BP} and F^{BP} stand for the intermediate and final consumption matrices respectively, both valued at basic prices.

The structure of the use table valued at producer prices is almost identical to that depicted by Figure 1a. Instead of a use table valued at basic prices, one valued at producer prices does not arrange net taxes on products in a row-vector. This is so because net taxation on products appearing in the row-vector in Figure 1a is fully incorporated into the monetary value of each transaction. As indicated by equations (5) and (6), pre-multiplying intermediate and final consumption matrices by $\hat{T}$ reallocates net taxes on products to each element compounding these matrices. This requires imputing net taxation to each transaction accounted in such matrices.

After computing Z^{PRP} and F^{PRP}, the symmetric input-output table valued at producer prices is estimated by using the method based upon the "industry-technology assumption". This involves re-arranging columns of Z^{PRP} assuming homogeneous production technology. Figure 2 describes the symmetric input-output tables resulting from implementing the "industry-technology hypothesis" in two alternative situations. In the case of Figure 2a, we find the corresponding table when producer price valuation is considered. As can be noted, so long as total uses are valued at producer prices, $U^{PRP}_{(nx1)}$, we need to add to the row-vector of total supply at basic prices, $S^{BP}_{(1xn)}$, the related net taxes on products, $T'_{(1xn)}$, which is the transpose of the column-vector appearing in the supply table in Figure 1b. By doing so, the system is fully balanced. In this situation, it is said that net taxation on products is the residual element that ensures that the valuation of total demand and supply of the economy are matched. Notice that even after performing changes on the valuation system of the input-output transactions, total supply is always valued at basic prices. That is to say: $\sum_i sz_{ij} + sv_j + im_j = s^{BP}_j ;\forall j = 1,2, \ldots n$, sz's being the elements of the matrix $SZ_{(nxn)}$, vs's the elements corresponding to the row-vector $SV_{(1xn)}$ while im's are those corresponding to the elements of the row-vector $I_{(1xn)}$. So to achieve the equilibrium of demand and supply, it is necessary to consider the set of residual elements establishing differences among the alternative valuation criteria.

Alternatively, we could have opted for building the symmetric input-output table valued at purchasers' prices. This would have involved valuing total uses at purchasers' prices, $U^{PP}_{(nx1)}$, as is indicated in the Figure 2b. As a result, in order to re-establish the equilibrium in terms of demand and supply, it would be essential to add to the row-vector of total supply at basic prices, $S^{BP}_{(1xn)}$, not only the corresponding net taxes on products, $T'_{(1xn)}$, but also the related total margins involved by $M'_{(1xn)}$, both arranged in the supply table (see Figure 1b). In this case, margins as well as net taxation on products are the residual elements required to reach the equilibrium of the system.

Comparatively speaking, it may be more helpful to value input-output transactions at producer prices because it does not require modelling margin rates as additional parameters to be included at price equations. In contrast, if purchasers' prices are adopted, then applied general equilibrium models will have to include additional parameters explaining the contribution of margins to the process of price formation. Conversely, under the valuation system in terms of producer prices, total margins are treated rather as elements making up the cost structure of each industry and then they appear as an intermediate consumption, $SZ^{PRP}_{(kxn)}$ (see Figure 2a). For all these reasons, we suggest that input-output transactions should be valued at producer prices. The procedure discussed in this paper does not ignore the role played by total margins as determinant of relative prices. But it is established that margins are easily treated as costs caused by intermediate consumptions rather than as parameters appearing in price equations as occurs in the case of net taxation rates.

FIGURE 2
Charts for symmetric tables valued at producer and purchasers' prices respectively

(2a)

	Industries	**Final Demand**	
Products CPA	$SZ^{PRP}_{(n-kxn)}$ $SZ^{PRP}_{(kxn)}$	$F^{PRP}_{(n-kxn)}$ $F^{PRP}_{(kxn)}$	$U^{PRP}_{(nx1)}$
	Value added $SV_{(1xn)}$		
	Imports $I'_{(1xn)}$		
	Total supply BP $S^{BP}_{(1xn)}$		
	Net taxes on products $T'_{(1xn)}$		
	Total supply PRP $S^{PRP}_{(1xn)}$		

(2b)

	Industries	**Final Demand**	
Products CPA	$SZ^{PP}_{(nxn)}$	$F^{PP}_{(nxn)}$	$U^{PP}_{(nx1)}$
	Value added $SV_{(1xn)}$		
	Imports $I'_{(1xn)}$		
	Net taxes on products $T'_{(1xn)}$		
	Total margins $M'_{(1xn)}$		
	Total supply $S^{BP}_{(1xn)}$		
	Total supply PP $S^{PP}_{(1xn)}$		

3.2 Net value added estimation

If the use table valued at purchasers' prices can be regarded as a collection of the whole transactions occurring in markets, it contains information about the value added taxation involved in purchases of products made in the entire economy. Therefore, a new valuation change is required in order to prepare the use table and to estimate the value added taxation. By applying *Definition 2*, we can express the value of the use table transactions at purchasers' prices. Then, we have that:

$$Z^{PP} = \hat{M} Z^{BP} \qquad (7)$$

$$F^{PP} = \hat{M} Z^{BP} \qquad (8)$$

Where:

- $\hat{M}$ is a nxn diagonal matrix with elements $(1 + m_i)$ on the main diagonal.

The resulting use table valued at purchasers’ prices is similar to that depicted in Figure 1a, but neither rows containing margins nor the row-vector accounting for net taxation on products are required because each transaction incorporates these amounts as a part of its monetary value.

Once the use table is valued at purchasers’ prices, we can estimate the value-added tax on products (VAT). To do so, we consider the ESA95 conventions adopted by recording this tax. To be precise, what it is recorded in the input-output framework is the net VAT, defined as the difference between total invoiced VAT and total deductible VAT. The former is the amount of tax charged by sellers when they trade product i in markets. Generally, sellers collect the tax and then register it by means of invoices, but they do not pay the total amount invoiced because they can usually deduce from it the value corresponding to purchased inputs and capital goods. Thus, the invoiced VAT generated in any transaction is estimated alongside the corresponding deductions and net VAT on products is defined as the differences between them.

The first step now is to determine the VAT invoice. If we knew the VAT tax rate charged on each transaction, it would be possible to estimate the value of any transaction before VAT application. Then, we have that the difference between the transaction valued at purchasers’ prices and the value of this transaction before VAT application is equal to the corresponding invoiced VAT. As a result, invoiced VAT can be estimated by means of the following proposition:

***Proposition 1**: let t_{ij}^{PP} be the monetary value of product i that is paid by buyer j when such transaction is valued at purchasers' prices. Likewise, let t_{ij}^{BVAT} be the value of the referred transaction before VAT application. Then, it is asserted that the invoiced VAT associated with this purchase is determined as follows:*

$$t_{ij}^{BVAT} = \frac{t_{ij}^{PP}}{\left(1+\tau_i^{VAT}\right)}; \quad \forall i=1,2, \ \dots \ n \quad \wedge \quad \forall j \in \{i,h\} \qquad (9)$$

Where:

$$vat_{ij}^{IN} = t_{ij}^{PP} - t_{ij}^{BVAT}; \quad \forall i=1,2, \ \dots \ n \quad \wedge \quad \forall j \in \{i,h\} \qquad (10)$$

In our setting, τ_i^{VAT} is the VAT rate charged on product i whenever it is sold in markets. Consequently, to compute invoiced VAT according to equation (9), it is necessary to determine the value of each t_{ij}^{BVAT}, which in turn involves calibrating the VAT rate, τ_i^{VAT}, appearing in (10). To do so, we can use the information included in the BADESPE[6] database (IEF, 2006), which records the evolution of VAT rates by CPA products in Spain for the period 1993-2002. The advantage of using this dataset is that it classifies VAT rates according to the same criterion as in the case of the use table. Furthermore, VAT rates are classified by using alterative level of disaggregation, which gives us some flexibility for choosing the level of aggregation to be used for building the

[6] BADESPE is a database of the Spanish public sector produced by the Instituto de Estudios Fiscales (IEF), which is run by the Spanish Ministry of Treasury.

SAMSP00. Having assigned the corresponding VAT rate, τ_i^{VAT}, to each purchased product appearing in the use table, we can apply equation (10) to determine the value of t_{ij}^{BVAT}. After that, the matrices of invoiced VAT corresponding to every transaction gathered in the use table can be defined as follows:

$$VAT_Z^{IN} = Z^{PP} - \left(\hat{VAT}\right)^{-1} Z^{PP} \qquad (11)$$

$$VAT_F^{IN} = F^{PP} - \left(\hat{VAT}\right)^{-1} F^{PP} \qquad (12)$$

Where:

- VAT_Z^{IN} and VAT_F^{IN} are the matrices collecting invoiced VAT in the case of intermediate and final demand consumptions respectively.
- $\hat{VAT}$ is a *nxn* diagonal matrix with elements $\left(1+\tau_i^{VAT}\right)$ on the main diagonal.
- Z^{PP} and F^{PP} are the intermediate and final consumption transactions valued at purchasers' prices.

Equation (11) determines VAT invoice generated by purchases associated with the intermediate consumption while equation (12) is the matrix recording VAT invoice charged on final expenditures due to households, the government, the gross capital formation sector and exports.

Nevertheless, to obtain the net VAT on products, we have to consider deductions associated with intermediate consumption items. As long as VAT is charged mostly on total final consumption, industries can usually obtain deductions associated with their intermediate consumption. However, these deductions are not allowed when industries are considered as exempt sectors. In this case, the final incidence of the tax is absorbed by the exempt industries, which are then thought as final consumers.

In order to determine deductions, we must define which industries and which products are considered as exempt. This task is conditioned largely by EU directresses as well as by the kind of fiscal policy prevailing in each country. In our setting, we have used the BADESPE dataset, which provides information on VAT deductions in Spain. We then considered the following products and industries as exempt:

TABLE 1
Non applicable VAT regime in Spain by products and industries

Products (CPA)	Industries (NACE)
- Electrical energy - Insurance and pension funding - Public Administration services - Non market R&D activities - Non market education services - Non market sanitation services - Non market health and social work services - Membership association, n.e.c. - Recreational, cultural and sporting services - Others services - Private household with employed people	- Electricity production - Insurance and pension funding services - Public administration services - Non market education services - Non market sanitation services, NPISH - Non market health and social work services, NPISH. - Recreational, cultural services and sporting services, NPISH - Private household with employed people

Source: own elaborated from the BADESPE dataset (IEF, 2006).

Using the information on deductions in Table 1, we have built a matrix containing deductions related to intermediate consumptions, per sector and per product. Hence, we have the following equation:

$$VAT_Z^{DED} = \left[vat_{i\,j}^{DED} \right]; \quad \forall\, i\, j = 1,2, \ldots \; n \qquad (13)$$

Where:

$$\begin{cases} vat_{ij}^{DED} = vat_{ij}^{IN}, & \text{if } i\text{=non-exempt product and } j\text{=non-exempt industry} \\ vat_{ij}^{DED} = 0, & \text{if } i\text{=exempt product and } j\text{=exempt industry} \end{cases}$$

As a result, a deduction, vat_{ij}^{DED}, is equal to the invoiced VAT, vat_{ij}^{IN}, only when both product i and the industry j are classified as non-exempt.

A similar analysis should be conducted in the case of the final demand consumption. Thus, we have assumed the following scenarios:

- Households and government are not allowed to make any deductions.
- Gross capital formation and changes in inventories are allowed to make deductions following the regime applied in the case of intermediate consumption.
- Exports are charged at “zero” rate, which implies to applied a complete deduction.

As in the previous case, we can build a deduction matrix specifying the deductions applied on final demand consumptions. Then, we have that:

$$VAT_F^{DED} = \left[vat_{ik}^{DED} \right]; \quad \forall i = 1,2, \ldots n \quad \forall k \in \{h\} \qquad (14)$$

Where:

$$\begin{cases} vat_{ik}^{DED} = vat_{ik}^{IN}, & \textit{if i=non-exempt product and k=gross capital formation, exports} \\ vat_{ik}^{DED} = 0, & \textit{if k=households, the government} \end{cases}$$

Finally, we are ready to estimate matrices containing total net VAT caused by each transaction recorded in the use table value at purchasers' prices:

$$VAT_Z^{NET} = VAT_Z^{IN} - VAT_Z^{DED} \quad (15)$$

$$VAT_F^{NET} = VAT_F^{IN} - VAT_F^{DED} \quad (16)$$

Since we are interested in the total net VAT on products, we can compute it as follows:

$$VAT^{NET} = \left(VAT_Z^{NET}\right) i_{(nx1)} + \left(VAT_F^{NET}\right) l_{(nx1)} = \left[vat_i^{NET} \right]_{nx1} \quad (17)$$

Where i and l are both column-vectors of "ones" enabling the addition of total net VAT on products generated by intermediate and final demand consumption respectively.

3.3 Tax information disaggregation

Once the net VAT on products is estimated, the next step is to present a basic disaggregation about the information of net taxation provided by Spanish 2000 input-output framework. To do so, we have used net taxation data registered in the supply table as our starting point, because the column-vector

$T_{(nx1)}$ arranged in Figure 1b gathers information about net taxes on products, including net VAT as well as net taxation on imports. By taking advantage of this fact, we can break down the information of $T_{(nx1)}$ into the following three categories:

- Net taxes on products due to domestic production, excluding net VAT.
- Net taxes on imports, classified by product and origin.
- Net VAT on products.

The first category can be estimated if both net VAT on products and net taxes on imports are effectively extracted from $T_{(nx1)}$. Provided the data about net VAT on products is contained in column-vector VAT^{NET}, we only need information about net taxes on imports in order to estimate a vector containing net taxes on products due to domestic production. The Spanish 2000 input-output framework (INE, 2005a) provides partial information on net import taxes. For instance, the 2000 use table for imported commodities accounts for net taxes on imports caused by intermediate consumption. However, the Spanish 2000 input-output framework does not provide information on net taxes on imports classified by products. This involves adopting a method for estimating net taxes on imports classified not only by products, but also by origin. To do this, we have updated the information about net taxes on imports collected in the Spanish 1994 input-output table (INE, 2005b). This is the most recent statistical source available in Spain in which import taxation is registered by product/industry[7] as well as by origin. The so-called modified RAS method updates this information (United Nations, 1999). The reason for using this method is that, in addition to

[7] While net taxes on imports are arranged in an input-output table, it can be said that they are deployed by homogeneous economic sectors, which implies a single correspondence between industry and product categories. In consequence, net taxes on imports arranged in any input-output table can be regarded as an arrangement by product as well as by industry.

the data provided by the Spanish 1994 input-output table, we have strongly based information about some cells in the matrix of net taxes to be estimated. That is, for the year 2000, partial information is available on the amount of net taxes on imports corresponding to some product categories. Table 2 summarises the procedure used to disaggregate the block of account related to net tax information.

TABLE 2
Procedure followed for obtaining a basic disaggregation of information on net taxation on products

Block of account in the SAMSP00	Taxes categories	Sources
Net Taxation Matrix	Net taxes on products (domestic production)	From the column-vector $T_{(nx1)}$ excluding Net VAT on products, $VAT^{NET}_{(nx1)}$, and net imports taxation.
	Net taxes imports (EU)	From updating the net tax on imports row-vector, EU, from 1994 input-output table.
	Net taxes imports (RW)	From updating the net tax on imports row-vector, RW, from 1994 input-output table.
	Net VAT on products	By means of the procedure illustrated in Section 3.2.

Source: own elaborated.

3.4 Arrangement of income distribution operations

As mentioned above, an important novelty of the SAMSP00 is the way in which income distribution operations are arranged. In SAMs built for Spain adopting ESA95 conventions, income distribution operations have been usually aggregated and then registered as current transactions between institutions (Uriel *et al.*, 2005; Morilla *et al.*, 2005). From an applied general equilibrium perspective, this presentation is slightly inconvenient because each income distribution operation may play a different role in order to model institutions' decisions on resource allocation. For instance, "other transfers" and "income taxation” exert different effects on households’ walrasian budget set because the former are often regarded as lump-sum transfers, while the latter has an important influence on, for example, households’ allocation of time.

To avoid the aggregation of income distribution operations, we have arranged the information about them in separate accounts. The purpose of doing so is to permit the process of calibration underlying applied general equilibrium models. Nonetheless, we have estimated a matrix of current transfers made by institutions including only rents referred to “property income”. Overall, the same procedure could have been applied in order to present the information of other income distribution operations. But we think that the kind of operations involved by “property income” transfers are better characterised as inter-institutional transactions than other income distribution operations. For instance, “social transfers” fundamentally take place between households and the government, while categories such as revenues and payments due to financial assets may be better specified as current transfers occurring among institutions.

In order to build a matrix containing inter-institutional flows of “property income” transfers, we applied the method described by Morilla *et al.* (2005) when assembling SAMs for Spain corresponding to 1995 and 1998. We have carefully reviewed the EUROSTAT manual (1995) in order to identify “property income” transactions. By doing so, we attempt to determine the origin and destination of each flow of “property income” transfers between the institutions in the SAMSP00. Since each institution pays and receives rents due to “property income”, we can apply the principle underlying “gravity models” to define these inter-institutional flows. That is, a flow from origin i to destination j can be explained by economic forces at the flow’s origin, economic forces at the flow’s destination or by a combination of both. Traditionally, this principle has been used to predict movement of people, information, or commodities between regions. In particular, the econometric estimation of the gravity equation in trade model is a well-extended application of the gravity theory (Anderson, 1979; Bergstrand, 1985). Applied to our case, the gravity model allows us to determine the origin (the payer) and destination (the recipient) of each “property income” transfer, as well as to define the magnitude of every transfer.

With this purpose in mind, the procedure adopted is as follows:

- By using the information provided by EUROSTAT (1995), to build a square matrix of ones and zeroes identifying inter-institutional flows of “property income” flows. Let $G_{(kxk)}$ denote the matrix of these inter-institutional transactions between the set of k institutions, including both foreign sectors. Thus, when $g_{ij}=1$, institution i receives a net transfer in terms of property income from institution j. Instead, when $g_{ij}=0$, no transaction takes place between i and j.
- From the “Total Economy and its Sub-Sector Accounts” as well as from the “Rest of the World Accounts” (INE, 2006), to determine for each institution both total payments and total revenues attributed to “property income” transfers. Then, we arrange total payments in a $(1xh)$ row-vector and to deploy total perceived revenues in a $(hx1)$ column-vector. These vectors can be regarded as total margins to be fulfilled for any allocation of inter-institutional “property income” rents resulting from applying a matrix balancing method.
- By taking matrix $G_{(hxh)}$ as a starting point, the RAS method is then applied to generate a new matrix that accomplishes the following requirement: the addition by row and by column must be equal to the total margin vectors.

3.5 Other related arrangements

The rest of income distribution operations are completed after reviewing carefully the "Accounting Series" of the Spanish National Accounts (INE, 2006). We have paid particular attention to determining both income distribution operations related to corporations, especially those related to "social transfers" and "social contributions" transfers. With the ESA95 conventions, more information is available about the private system for social security provision. Despite the prevalence of the government as a provider of public social services, corporations are playing an increasingly important role in this regard.

Finally, the information related to net transfers established among domestic and foreign agents is arranged as follows:

- It is considered that net transactions between households and each foreign sector includes net "property income" rents, the balance of purchases made by residents and those made by non-residents, as well as net compensation of employees payments.
- It is assumed that the government receives payments due to adjustments referred to other net taxes as well as to net taxes on products. These adjustments are due to the economic relationships established between Spain and the EU institutions.

4. Integrating the social accounting data in a matrix format

The social accounting data generated in the previous section can be arranged conveniently in a system of inter-related accounts. Table 3 describes the set of accounts included in the SAMSP00. As shown there, six blocks of accounts are incorporated in this SAM. The most disaggregated block is the one related to the intermediate consumption matrix. In the reduced version[8], this matrix arranges the information on the inter-industrial transactions established by eight economic sectors. Next, we have the accounts referring to the production of value added per industry. These accounts show the cost structure involved by the use of two primary factors, labour and capital services. Payroll taxation is also included as a part of the value added accounts. In the next block, we find the set of accounts relating to net taxation on products. After changing the valuation system of the input-output transactions, a finer disaggregation of net taxation on products is then presented. Specifically, the SAMSP00 provides tax information for the following categories:

- Net taxes on products due to the domestic production process.
- Net taxes on imports. In turn, net taxation on imports is differentiated by trade region: EU and the Rest of the World (RW).
- Net value added taxation on product.

The next block of accounts contains the set of income distribution operations prevailing in this economy. In particular, the following operations have been included into this block: payments and revenues due to “social contributions”, “social transfers”, “other transfers”, and “income taxation”. Relatedly, it is assumed that these operations affect the budget restrictions of the following institutions: “households”, “corporations”, and the “government”. Adopting ESA95 conventions makes it possible to establish a match between the bundle of income distributions referred to above and the set of institutions related to them. Thus, to deepen our understanding of the process of disposable income formation, a block of accounts called “institutions” has been used for, which records information not only on the final consumption activities of institutions, but also on the payments and revenues affecting their budget

[8] A more disaggregated version is available upon request from the authors.

restrictions. The set of institutions is completed by assuming the existence of a fictitious agent responsible for gross capital formation. Despite being an institution, this agent does not participate in the process of income disposable formation.

TABLE 3
Accounts corresponding to the reduced version of the SAMSP00:

Block of accounts	Accounts	Row/Column at the SAMSP00	Statistical Source
Intermediate Consumption	Agriculture, hunting, forestry and fishing	1	2000 Input-Output framework (INE, 2005a)
	Industries	2	
	Energy and gas production	3	
	Construction	4	
	Wholesale, retail trade and transportation activities	5	
	Telecommunication services	6	
	Financial and business activities	7	
	Other services	8	
Value Added	Wages	9	2000 Input-Output framework (INE, 2005a)
	Social contributions (employers)	10	
	Other net taxes on production	11	
	Net operating surplus	12	
Taxation	Net taxes on domestic production	13	2000 Input-Output framework (INE, 2005a)
	Net import taxes, European Union	14	1994 Input-Output Table (INE, 2005b)
	Net import taxes, Rest of the World	15	
	VAT on products	16	BADESPE dataset (IEF, 2006)
Income distribution	Social contributions (employees)	17	Accounting Series of the National Accounts,

	Social transfers	18	
	Other transfers	19	
	Income tax	20	
Institutions	Households	21	2000 Input-Output framework (INE, 2005a)
	Corporations	22	
	Government	23	Accounting Series of the National Accounts, 1995 base (INE, 2006)
	Saving / Investment	24	
Foreign sector	European Union	25	Accounting Series of the National Accounts, 1995 base (INE, 2006)
	Rest of the World	26	

Source: own elaborated.

The block of accounts relating to institutions describes domestic operations referring to consumption activities or to income distribution operations. In this respect, the SAMSP00 needs a block for dealing with operations typically established among domestic and foreign agents. With this purpose in mind, we added a block of accounts called "foreign sector". In general, operations described by these accounts are not exclusively related to trade commodity data, but also include the flow of income distribution operations.

In order to include the whole accounts described by Table 3 in the SAMSP00, a square matrix framework has been used. All in all, there is no one generalised schedule to present a SAM. However, there are guidelines for deploying the accounts that usually make up an accounting system like the SAMSP00. Specifically, the SAMSP00 is organised around the Spanish 2000 input-output framework, because this framework contains the most disaggregated block of data in the entire SAMSP00. By following the ESA95 conventions, the SAMSP00 can be thought as a natural extension of the Spanish input-output framework in which income data information is arranged in a schematic matrix-form. In that way, the SAMSP00 gives a complete description of the circular income flow of the set of institutions that make up this economy.

Figure 3 depicts the schedule for assembling the SAMSP00. See Appendix 1 for the numerical version. Starting from the first row and column, we find the information corresponding to the Spanish symmetric input-output table for the year 2000. The table is made up of a set of sub-matrices that include, on one hand, a description of the production cost structure of the Spanish industries, and on the other, the information on the final demand structure of the Spanish economy.

FIGURE 3
A SAM proposed schedule for modelling the Spanish economy for the year 2000

		Industries (1)	Labour (2)	Capital (3)	Net Taxation (4)	Income Distribution Operations (5)	Households (6)	Corporations (7)	Government (8)	Saving-Investment (9)	Foreign Sector (10)	Total
Production	**Industries (1)**	Intermediate consumption					Private consumption		Public consumption	Gross capital formation	Exports per industry and by trade region	**Total Uses**
	Labour (2)	Compensation employees										**Total labour rents**
	Capital (3)	Operating surplus										**Total capital rents**
Income related operations	**Net Taxation (4)**	Net product and import taxation. Net VAT										**Total taxation rents**
	Income Distribution Operations (5)						Payments social contributions Payment income taxation	Payment income taxation	Payment social transfers		Income distribution operation received from foreign agents	**Rents for income distribution operations**
Institutions	**Households (6)**		Labour Wages	Capital rents		Received social transfers	Current transfers among Institutions (Net income property)				Transfers received from foreign agents	**Household Income disposal**
	Corporations (7)			Capital rents								**Corporations total rents**
	Government (8)			Capital rents	Taxation revenues	Rents for income distribution income operations						**Total government rents**
	Investment (9)						Private saving	Private saving	Public saving		Foreign saving	**Total Saving**
Rest of the World	**Foreign Sector (10)**	Imports per industry and by trade region				Income distributions operations received by foreign agents	Transfers received by foreign agents					**Total rents foreign sector**
Total		**Output**	**Labour payments**	**Capital payments**	**Tax payments**	**Payments for income distribution operations**	**Private Expenditures**	**Expenditure Corporations**	**Public Expenditures**	**Total Investment**	**Payments foreign Sector**	

Source: own elaborated from Manresa and Sancho (1997), Llop and Manresa (2003) and Eurostat (2001).

5. The input-output framework and the situation of the European Union

From a user is viewpoint, the procedure described here will be useful if we take into account the type of data currently provided by National Statistics Offices in the EU. Table 4 describes the valuation system typically used as well as the structure of the input-output framework compiled by EU members. In general, symmetric input-output tables are valued at basic prices, as are domestic and import use tables. This situation is observed in 13 out of the 25 countries for which input-output frameworks are available. As a result, net taxation data is aggregated in a row-vector inside these tables. A notable exception is found in the case of Poland, in which the symmetric input-output table is valued at purchasers' prices. However, even in this setting, researchers do not have enough information to change the valuation system to suit their interest.

Only three countries, Belgium, Denmark and Finland, provided the kind of information needed to perform valuation system changes properly. That is, in addition to their input-output framework, The National Statistics Offices in these countries make the so-called valuation matrices available to researchers. These are tables containing a record of both total margins and net taxation on products corresponding to each transaction recorded in the input-output tables, which allows researchers to change the valuation system of the input-output transactions as required. Nonetheless, value added taxation is not always distinguished from the rest of indirect taxation in the valuation matrices. Consequently, researchers still face problems of tax data disaggregation.

In the rest of cases, researchers have to use non-survey methods in order to achieve changes in the valuation systems of input-output transactions. In that sense, we think that the procedure described in this paper constitutes a useful alternative for researchers interested in building SAMs for calibrating applied microeconomic models.

TABLE 4
Valuation system and the input-output framework used for the EU members

Members	Valuation system	Available Tables
Austria	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Total Use and Supply Tables for 1995, 97, 99 and 2000-2002 Symmetric, Domestic and Import Use Tables for 1995 and 2000
Belgium	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables PP	Total Use and Supply Tables for 1995, 97, 99 and 2000-2001 Symmetric, Domestic and Import Use Tables for 1995 and 2000 **Valuation matrices for 2000**
Czech Republic	Only at BP	Use and Supply Tables for 2002-2003
Denmark	BP and PP	Annual Use and Supply Tables for 1966-2002 Symmetric Tables for 1995 and 2000 **Valuation matrices for 2000**
Estonia	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	1997 Symmetric, Use and Supply Tables 2000 Use and Supply Tables
Finland	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Annual Total Use and Supply Tables for 1995-2003 Symmetric, Domestic and Import Use Tables for 1995, 2000 and 2002. **Valuation matrices for 2002**
France	BP and PP	Annual Use and Supply Tables for 1978-2004 Symmetric Tables 1995 and 2000
Hungary	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Uses and Supply Tables for 1998-2000 Symmetric Tables for 1998 and 2000
Germany	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Total Use and Supply Tables for 1995, 97, 99 and 2000-2001 Symmetric, Domestic and Import Use Tables for 1995 and 2000
Greece	Only BP	Totals Use and Supply Tables for 1995-1999 Symmetric Tables for 1998 and 1999
Ireland	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Symmetric, Use and Supply Tables for 1998
Italy	Symmetric, Domestic and	Annual Total Use and Supply Tables for

	Imports Use Tables at BP Total Use Tables at PP	1995-2001 Domestic and Import Use Table 2000 Symmetric Tables for 1995 and 2000
Malta	Basic and Purchasers' Prices	Total Use and Supply Table of the year 2000 and 2001
Netherlands	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Annual Use, Supply and Symmetric Tables for the period 1995-2001
Poland	Domestic and Import Use Tables for 2000 at BP Total Use Tables and Symmetric for 2000 at PP	Total Use Tables for 1995-1999 Domestic and Import Use Tables for 2000 Supply Tables for 1995-1999 Symmetric Tables for 1995 and 2000
Portugal	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Annual Total Use and Supply Tables for 1995-1999 Symmetric, Domestic and Import Use Table for 1999
Slovakia	Supply Tables at BP Total Use Tables at PP	Annual Total Use and Supply Tables for 1995-2000
Slovenia	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Symmetric, Use and Supply Tables for 1996, 2000 and 2001
Spain	2000 Use table at BP and PP 1995 Symmetric and Use Tables for the period 1995-1999 at BP	Annual Use and Supply Tables, 1995-2000 Symmetric Table for 1995
Sweden	Supply Tables BP Total Use Tables at PP	Annual Total Use and Supply Tables for 1995-2001. Symmetric, Domestic and Import Use Table for 1995 and 2000.
United Kingdom	Symmetric, Domestic and Imports Use Tables at BP Total Use Tables at PP	Annual Use and Supply Tables for the 1993-2005 Symmetric Table for 1995

Source: own elaboration from available website information from EU members' National Statistic Offices and EUROSTAT.

Notes: (1) BP means basic prices and PP means purchasers' prices.
(2) No information was available for Cyprus, Latvia, Lithuania, and Luxembourg.

6. Concluding remarks

Thus far, we have developed a methodology able to change the monetary value of the input-output transactions included in a SAM. This methodology relies upon the information typically contained in the ESA95 input-output framework. Specifically, the information about margins and net taxes on products is useful for calibrating the parameters used for changing the value of any transaction included in the use table and in the symmetric input-output table.

Changes in input-output transactions have been argued throughout this paper. When building a SAM for computing applied general equilibrium models, it is necessary to express the value of input-output transactions according to the kind of prices perceived by purchasers in markets. Then, when such transactions are valued at basic prices, that is, from a cost production perspective, a change of valuation will be required in order to include all the elements that typically characterise market prices. This requires establishing differences between the kind of prices perceived by final consumers and those faced by producers. As has been argued, net taxation data is a critical element in the modelling of price formation. Changes of valuation concerning input-output transactions also provide additional information for researchers. For instance, this paper shows that a use table valued at purchasers' prices is a reasonable approximation for the VAT tax base. Then, by using additional information, such as VAT rates it is possible to estimate net VAT on products, which in turns allows the construction of the process of tax disaggregation categories.

In spite of its simplicity, the methodology described here produces reliable results. This is confirmed by comparison of the use table at purchasers' prices it provides with the one of the Spanish National Statistics Office (Instituto Nacional de Estadistica, INE). The differences between the two may be explained by changes in the base year used by INE to present the most recent version of the 2000 input-output framework. Systematic differences between our table and the official version are observed in the case of products related to "other service activities". Precisely, after changing the base year (from 1995 to 2000), new criteria for accounting products described as "other service activities” were introduced into the Spanish System of National Accounts, which can explain the differences observed.

In general, the valuation system of input-output transactions is relevant when building an accounting system for analysing the behaviour of agents in response to market prices. Information for expressing the monetary value of input-output transactions according to market prices should be ideally offered alongside the rest of tables included in the input-output framework. However, the evidence indicates that provision of information about valuation issues is insufficient. In addition, the analysis regarding advantages and disadvantages of adopting a particular valuation system has been neglected in many EU countries, suggesting the need to generate non-survey methods for researchers and policy makers interested in applied general equilibrium analysis.

Finally, we should note some limitations and possible extensions of this research. An accounting system like the SAMSP00 permit computation of applied general equilibrium models designed for dealing with policy change appraisal in terms of resource allocation and economic efficiency. Unfortunately, it cannot analyse distributional effects attributed to policy changes, because this dataset does not present any disaggregation of household accounts according to, for example, income groups. The reasons for the absence of any disaggregation of information on households into income groups are the following:

- Despite the existence of surveys of important information about income and expenditure in the case of Spanish households, this information is not integrated in a single dataset. As a result, data must be merged or matched in order to combine information provided by different sources (Alegre *et al.,* 2000). More research is needed to build a unified dataset containing information on expenditure and incomes. For instance, the Spanish Household Panel and Household Budget Continuous Survey for the year 2000 could be complemented by using statistical matching methods.

- The lack of information on the matrix that transforms households' expenditure classified by CPA categories into expenditure classified according to COICOP categories. When decomposing household accounts into income groups, the information provided by this matrix is critical to the proper deployment of data on households' expenditure.

In general, these shortcomings can be regarded as themes to be tackled in future research. A natural extension of the work presented in this paper would be the disaggregation of households' income accounts.

References

Alegre J., Arcarons J., Calonge S., and Manresa A., (2000) "Statistical matching between different datasets: An application to the Spanish household survey (EPF90) and the income tax file (IRPF90)", *Working paper presented in the workshop on fighting poverty and inequality through tax benefit reform: empirical approaches*, Barcelona.

Anderson J.E., (1979) "A theoretical foundation for the gravity equation", *American Economic Review*, 69, 106-16.

Armington P.S., (1968) "A theory of demand for products distinguished by place of production", *International Monetary Fund*, Research Department.

Bergstrand J.H., (1985) "The gravity equation in international trade: Some microeconomic foundations and empirical evidence", *The Review of Economic Statistics*, 67: 474-81.

Cardenete A., and Sancho F., (2006) “Elaboración de una matriz de contabilidad social a través del método de entropía cruzada: España 1995”, *Estadística Española*, 67.

EUROSTAT, (2001) *“EUROSTAT input-output manual”*, Luxembourg: EUROSTAT.

EUROSTAT, (1995) *“European system of national and regional accounts ESA 1995”*, Brussels: EUROSTAT.

IEF (2006) *“Tipos de IVA según CNPA-96. Evolución y tipos. BADESPE database”*, Madrid: Instituto de Estudios Fiscales and Ministerio de Hacienda, available on line at http://www.estadief.minhac.es/.

INE (2006) *“Accounting series 1995-2003. Spanish national accounts. Base 1995”*, Madrid: Instituto Nacional de Estadística, available on line at http://www.ine.es/en/daco/daco42/cne/dacocne_en.htm.

INE (2005a) *“Framework input-output. Series 1995-2000”*, Madrid: Instituto Nacional de Estadística available on line at http://www.ine.es/en/daco/daco42/cne/dacocneio_en.htm.

INE (2005b) *“Tables input-output 1994. Spanish national accounts. Base 1986”*, Madrid: Instituto Nacional de Estadísitica, available on line at http://www.ine.es/daco/daco42/cne/tablasio.xls.

INE (2001) *“Nota metodológica sobre la tabla simétrica de la economía española para 1995”*, Madrid: Instituto Nacional de Estadística, available on line at http://www.ine.es/daco/daco42/daco4214/cbtc22.pdf.

Kehoe T., Manresa A., Polo C., and Sancho F., (1988) “Una matriz de contabilidad social de la economía española”, *Estadística Española*, 30, 5-33.

Kehoe T., (1998) “Social accounting matrices and applied general equilibrium models”, in I. Begg and S.G.B. Henry (eds.), *Applied Economics and Public Policy*, Cambridge: Cambridge University Press, 59-87.

Keuning S.J., and Ruuter W.A., (1988) “Guidelines to the construction of a social accounting matrix”, *Review of Income and Wealth*, 34, 71-100.

Llop M., and Manresa A., (2003) *“Una propuesta de elaboración de una matriz de contabilidad social para la economía catalana”*, Barcelona: Institut d'Estadistica de Catalunya.

Manresa A., (1996) "Equilibrio general computable: Un instrumento de la economía aplicada", mimeo.

Manresa A., and Sancho F., (1997) *"El análisis medio-ambiental y la tabla input-output: Cálculos energéticos y emisiones de CO2 para la economía de Cataluña"*, Barcelona: Conselleria de Medi Ambient, Ajuntament de Barcelona.

Morilla C.R., Cardenete M.A., and Díaz-Salazar G.L., (2005) "Estimación y actualización anual de matrices de contabilidad social: Aplicación a la economía Española para los años 1995 y 1998", *Estadística Española*, 47, 353-416.

Morilla C.R., and Díaz-Salazar G.L., (2004) "Matriz de contabilidad social y medioambiental: Aplicación a las emisiones de gases efecto invernadero de la economía española del año 2000", *working paper Fedea* (eee175), ISNN 1696-6384, available on line at htpp://www.fedea.es.

Pyatt G., (1991) "SAMs, the SNA and national accounting capabilities", *Review of Income and Wealth*, 37, 177-98.

Pyatt G., (1988) "A SAM approach to modelling", *Journal of Policy Modeling*, 10, 327-52.

Shoven J.B., and Whalley J., (1992) *"Applying general equilibrium"*, Cambridge: Cambridge University Press.

St-Hilaire F., and Whalley J., (1983) "A microconsistent equilibrium data ser for Canada for use in tax policy analysis", *Review of Income and Wealth*, 29, 175-204.

United Nations (1999) *"Handbook of input-output table compilation and analysis"*, New York: United Nations Publications.

Uriel E., Ferri J., and Moltó M., (2005) "Estimación de una matriz de contabilidad social de 1995 para España (MCS-95)", *Estadística Española*, 47, 5-54.

Ward M.P., (2004) "Some reflections on the 1968-93 SNA revision", *Review of Income and Wealth*, 50, 299-313.

APPENDIX 1
Accounting Matrix for Spain for the year 2000
(Millions Euro Social)

	Industries								Value added				Net Taxation on products			
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**	**C11**	**C12**	**C13**	**C14**	**C15**	**C16**
R1	2854.19	21078.85	0.25	449.61	1884.77	3.06	1.74	289.19								
R2	9709.38	174051.50	7820.72	32735.63	35174.43	1668.16	7810.65	14806.12								
R3	720.74	7368.09	2293.04	352.25	3628.21	250.07	1089.50	2519.43								
R4	191.25	957.93	240.52	15580.89	2141.81	162.39	11702.06	1871.20								
R5	2612.14	28056.12	245.61	8062.78	25143.61	870.65	3327.25	3899.89								
R6	78.13	2668.80	196.64	535.46	1963.21	4370.24	3147.11	2775.16								
R7	538.42	23576.62	1312.82	7606.62	19557.46	2493.79	42482.50	11010.42								
R8	278.53	1405.82	85.41	278.12	1347.72	211.91	1919.10	5814.31								
R9	3487.52	52159.74	2327.44	25388.62	48942.47	3773.20	32644.05	71836.96								
R10	458.07	15326.48	813.14	6504.65	12334.23	1721.76	9680.91	18784.76								
R11	-758.98	-492.55	200.76	544.57	375.89	117.61	3330.31	232.40								
R12	15700.70	34268.61	8896.15	15784.10	82142.30	6903.07	55460.11	22546.96								
R13	-2837,78	18579,20	1100,40	5792,90	-2120,62	3807,49	-1107,27	1113,34								
R14	0,11	29,07	0,00	0,26	1,17	0,65	0,00	0,00								
R15	0,83	55,72	0,00	0,00	8,36	5,17	0,00	0,00								
R16	659,95	15980,51	809,49	376,24	7536,60	5770,69	3212,57	604,46								
R17																
R18																
R19																
R20																
R21									240560.00			126450.00				
R22										7492.00		105805.00				
R23										58132.00	3550.00	9447.00	23512.00	31.52	70.48	35491.00
R24																
R25	2793.20	106256.80	116.00	4.00	3154.00	522.00	9230.00	832.00								
R26	3347.90	57851.90	2.20	5.00	2134.00	290.00	5187.00	1218.00								
TOTAL	**39834.30**	**559179.2**	**26460.6**	**120001.7**	**245349.6**	**24801.20**	**196596.3**	**160542.1**	**240560.0**	**65624.00**	**3550.00**	**241702.0**	**23512.00**	**31.52**	**70.48**	**35491.00**

	Income Distribution Operations				Institutions				Foreign Sector		
	C17	**C18**	**C19**	**C20**	**C21**	**C22**	**C23**	**C24**	**C25**	**C26**	**TOTAL**
R1					6070.81		0.00	375.50	5939.17	887.16	**39834.30**
R2					109921.18		4713.50	47910.90	79616.05	33240.97	**559179.20**
R3					1569.12		0.00	1.27	0.00	0.00	**26460.60**
R4					3073.28		0.00	84072.84	2.84	4.70	**120001.70**
R5					149204.39		3340.59	2950.26	11516.44	6119.89	**245349.60**
R6					53661.84		1347.56	20440.91	7680.45	4886.89	**24801.20**
R7					49348.12		98378.35	786.25	326.76	361.70	**196596.30**
R8					5590.52		0.00	0.00	27.04	100.01	**160542.10**
R9											**240560.00**
R10											**65624.00**
R11											**3550.00**
R12											**241702.00**
R13											**23512.00**
R14											**31.52**
R15											**70.48**
R16											**35491.00**
R17					25718.00						**25718.00**
R18											**85361.00**
R19										107.00	**135974.00**
R20					43753.00	20022.00			71.00	10.00	**63856.00**
R21		85312.00	42814.00		2813.30	16672.81	4997.19		25055.73	3859.41	**548534.43**
R22	2690.00		16526.00		8629.13	50742.77	15329.82			639.59	**207854.30**
R23	23028.00		76420.00	63856.00		6478.00			1527.00		**301543.00**
R24					42884.00	74296.00	19106.00		661.00	19666.00	**156613.00**
R25		20.00	214.00			9820.73					**132962.73**
R26		29.00									**70065.00**
TOTAL	**25718.00**	**85361.00**	**135974.00**	**63856.00**	**548534.43**	**207854.30**	**301543.00**	**156613.00**	**132962.73**	**70065.00**	

R1/C1: Agricultures
R2/C2: Industries
R3/C3: Energy and gas production
R4/C4: Construction
R5/C5: Wholesale and retail trade.…
R6/C6: Telecommunication services
R7/C7: Financial & business activities
R8/C8: Other services
R9/C9: Wages and Salaries
R10/C10: Social contributions (employers)
R11/C11: Other net taxes on production
R12/C12: Net operating surplus
R13/C13: Net taxes on domestic production
R14/C14: Net import taxes European Union
R15/C15: Net import taxes rest of the world
R16/C16: VAT on products
R17/C17: Social contributions (employees)
R18/C18: Social transfers
R19/C19: Other transfers
R20/C20: Income tax
R21/C21: Households
R22/C22: Corporations
R23/C23: Government
R24/C24: Saving / Investment
R25/C25: Imports from European Union
R26/C26: Imports from Rest of the World