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Prices, Social Accounts and Economic Models

Scott McDonald
University of Sheffield

Abstract

Despite the fact that SAMs are widely used as the databases for CGE models there remains some confusion over the relationship between the two; in particular the implications and meaning of the 'law of one price' appear to be poorly understood. This has two clear, and arguably, worrying implications. First, a deficiency in understanding the accounting relationships in a SAM means that when compiling a SAM it is likel that the structural relationships in the economy may be misrepresented. And second, any misunderstanding of the behavioural relationships in a CGE model, which can be defined as theory with numbers, is highly likely to lead to flawed interpretations of the results from such models. The discussion in this paper revisits the issues of the role of a price system in social accounts and then demonstrates how the resultant price definitions require that all whole economy models that satisfy the conditions of being both complete and consistent MUST obey the 'law of one price'. The relevance of the 'law' to the characteristics of certain features of CGE models is demonstrated as is its relevance to the compilation of SAMs.

1. Introduction

Economists have been known to assert that 'accountants know the price of everything and the value of nothing'. While such an observation may accurately reflect an attitude of many economists towards accountants it raises concerns about the degree of respect offered by economists towards the national account statisticians who compile the databases used in most applied economic models; especially when those models are price driven. More specifically it raises the spectre that economists do not understand the system of prices that underlies national accounts and are given their richest specification in Social Accounting Matrices (SAM).[1] Since it is now accepted that the databases for all empirical whole economy models are accounting systems (Stone, 1962) and that all such databases can be represented as SAMs (Pyatt, 1987)[2] a lack of understanding of the price system that underlies a SAM suggests the possibility of a serious inconsistency between the work of national account statisticians and economic modellers.

Nowadays the potential benefits from representing data for whole economy models in the form of SAMs has been widely appreciated in the literature and is often a preferred option, e.g., Lofgren *et al*., (2001). This decision reflects some of the useful characteristics of SAMs; of these two features stand out. First, a SAM is a 'complete and consistent' representation of (economic) transactions within an economy[3] during a defined period of time: 'complete' in the sense that all transactions are recorded and 'consistent' in the sense that every expenditure by an agent has a matching and corresponding income for another agent: consequently the row and column totals are equal. And second, a SAM is a parsimonious representation of the data that can highlight patterns of interdependence within an economy.

Despite the fact that SAMs are widely used as the databases for CGE models there remains some confusion over the relationship between the two; in particular the implications and meaning of the 'law' of one price appear to be poorly understood, e.g., the SAMs for CGE models with export transformation (CET) functions[4] typically record exports as a column of the same commodity accounts as domestic (intermediate and final) demand, and some users have suggested that this demonstrates that the 'law' of one price does not hold. It

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1 The price system underlying the UN System of National Accounts (SNA) (UN, 1993) is the most widely used but arguments have been made for different systems, e.g., Pyatt (1991, 1994a and 1994b).

2 Stone (1962) demonstrated many years ago " It is perhaps of interest to realise that the framework of any model concerned with the economy as a whole is always an accounting system. This is true whether we work with highly aggregated models such as that underlying Keynes' General Theory, the input-output model of Leontief or the still more complicated variant with which this series [A Programme for Growth] is concerned." (p v). Pyatt (1987) elaborated on this by demonstrating that " Since every economic model has its corresponding accounting framework, and since every such framework can be set out as a SAM, it follows that every economic model has a corresponding SAM." (p 330.]

3 An 'economy' can be defined in numerous different ways to encompass anything from a household to the world via villages and nation states.

4 See for instance the models that follow the lead of Dervis *et al*., (1982).

is easily demonstrated that this represents a serious misunderstanding of both the accounting relationships in a SAM and the behavioural relationships of the CGE model. This has two clear, and arguably, worrying implications. First, a deficiency in understanding the accounting relationships in a SAM means that when compiling a SAM it is likely, with a high degree of probability, that the structural relationships in the economy may be misrepresented. If such a SAM is then used to calibrate a structural, e.g., CGE, model the resultant analyses may well be flawed. And second, any misunderstanding of the behavioural relationships in a CGE model, which can be defined as theory with numbers, is highly likely to lead to flawed interpretations of the results from such models.

The discussion in this paper revisits the issue of the role of a price system in social accounts and then demonstrates, in section 3, how the resultant price definitions require that **all** whole economy models that satisfy the conditions of being both complete and consistent obey the 'law' of one price. The relevance of the 'law' of one price to the characteristics of certain features of CGE models is demonstrated in section 4. In the main this section serves to illustrate that established, and widely used, models all follow the 'law' of one price. However, it also serves to demonstrate that all known CGE models, bar one, with multiple households render the second law of welfare economics null and void; this is especially worrying when CGE models are being used to analyse issues of income distribution. Because the role of the 'law' of one price is central to general equilibrium models it is fundamental to the compilation of SAMs, and in section 5 it is shown that an understanding of the price system underlying a SAM means that it is trivial to understand how a SAM can be extended to encompass aspects of economic relationships that may be regarded as important. This is illustrated by reference to discussions about the relationships between SAMs based on Supply and Use and Input-Output tables and the extension of a SAM to include home production for home consumption. The discussion is however limited to cases where transactions take place within the SNA's production boundary.[5] These discussions, in section 6, raise an interesting empirical issue; to what extent does a failure to understand the determination of the price system underlying a SAM compromise the results from CGE models.[6] An empirical example is developed to demonstrate the importance of (structural) detail in economic models. The final section, 7, offers some concluding comments; these include a call for economists to reengage with national account statisticians so as to ensure the maintenance of an economically consistent price system within national accounts data, and to demonstrate greater respect for the product of their labours. The paper starts with a description of a SAM; this is based on the SAM that is used throughout the analyses.

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5 A discussion of some of the problems associated with compiling SAMs that include transactions out with the SNA production boundary is provided by McDonald (2006).

6 This is arguably not an issue on a theoretical level since the previous sections have shown that a misunderstanding of the price system has non trivial theoretical implications.

2. Social Accounting Matrices

The development of national accounts and SAMs were both largely inspired by Sir Richard Stone.[7] In essence a SAM is a combination of the information contained in aggregate national accounts data; the input-output schema devised by Leontief and disaggregated institutional (social) data, in such a manner as to ensure the full circular flow of an economy is captured. An important dimension of a SAM is the emphasis upon the disaggregation of the institutional accounts, and hence it is common to find that SAMs contain multiple representative household groups (RHG). The emphasis on the social dimensions of economic systems is a distinctive feature of SAMs, and is a partial explanation of why they have proved so popular to the study of developing economies where issues of welfare, poverty and income distribution are considered most important.

2.1 What is a SAM?[8]

A SAM is a system of single entry book keeping presented in the form of a square matrix wherein each account is represented by both a row and a column. The entries in the SAM are transaction values, i.e., prices multiplied by quantities, with the row entries representing incomes to the respective accounts and the columns representing expenditures by the respective accounts. Hence the entry in the i^{th} row and j^{th} column is simultaneously the expenditure by the j^{th} account on the 'product' of the i^{th} account AND the income to the i^{th} account from sales of its product to the j^{th} account. A SAM must be complete and consistent: complete in the sense that it covers all transactions in an economy and 'consistent' in the sense that each expenditure by an agent has a matching and corresponding income for another agent. Hence, as consequence of being complete and consistent, the total income and the total expenditures for every account must equate, i.e.,

$$\sum_i p_{ij}.q_{ij} = \sum_i T_{ij} = \sum_j T_{ij} = \sum_j p_{ij}.q_{ij} \quad \forall i = j$$

where p_{ij} and q_{ij} are the price and quantity of account j used by account i and T_{ij} the transaction (value) between account j and i.

A 'typical' representation of a SAM is presented in Table 1.[9] A typical SAM consists of 6 broad categories of accounts: commodities, activities, factors, institutions (households,

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7 Stone contribution to economic and national accounts has been extensively reviewed. See Pesaran and Harcourt (1991) for a review and comprehensive list of publications.

8 The title of this section is taken from King (1985), which still provides one of the best introductions to SAMs.

9 The representation used here differs from the standard format presented in the SNA (UN, 1993) by collapsing the institutional accounts. This is a simplification that does not affect the subsequent argument but ensures that the representation is consistent with the format typically used in SAMs to calibrate CGE models and thereby eases exposition. It is trivial to demonstrate that all the subsequent arguments in this paper would hold for a SAM with a SNA format.

incorporated business enterprises, government), capital (for investment and savings), and trade.

Consider first the row accounts for commodities; these identify the distribution of commodities between intermediate and final demand where final demands are disaggregated across different institutions and the capital account. These are total demands for commodities.

In equilibrium the total demand for commodities is equal to the total supply of commodities, i.e., the row and column totals equate. By definition the total supply of commodities includes imports and duties paid on imports, i.e., imports are valued in domestic currency units. The commodity accounts therefore trace out the sources and destinations of commodities in the economic system. Two points deserve highlighting; exports, and export taxes, are treated as part of the commodity account, and that export taxes are included as expenditures by the commodity account, and the SUPPLY matrix records total domestic production of commodities by activities, with activities able to produce multiple commodities.[10]

The column entries for activity accounts record the 'use' of inputs by productive activities. These include intermediate inputs, both domestic and imported, and value added, which is broken down so as to include payments to different factors, broadly or narrowly defined, expenditure taxes paid by activities and input subsidies received by activities[11]. The column sums for the production accounts record the total inputs to productive activities. In this example, as is common, the row entries only record the output of commodities by activities.

The activity accounts therefore record the productive activities of an economic system, i.e., the generation of value added. A major concern with the activity accounts is therefore the payments to factors. The row entries for factor accounts are incomes to the labour and capital accounts for productive services; it is a common practice to classify all employers of factors in an economy as activities, e.g., government and private employers of domestic employees. The sum of these plus any factor incomes from abroad are by definition GNP at factor cost.

The expenditures by the factor accounts are recorded in the columns. The factor incomes are distributed between different types of households as labour income and distributed profits, and to firms as non-distributed profits. These distributions take place after the payment of taxes etc., to the government and payments to overseas owned factors. The institutional accounts include different household groups, enterprises, other institutional entities, e.g., non government organisations, and government. Incomes to institutions are recorded as row entries and expenditures as column entries. Note how the government is a recipient of

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10 Some representations of the SUPPLY matrix of SAMs used to calibrate CGE models include only domestic production supplied to the domestic market; these only have entries on the principal diagonal and record exports in the activity accounts (see Dervis *et al*., 1982). This alternative is a reduced form of the SAM represented in Table 1.

11 In the GTAP database input subsidies capture domestic support programmes.

multiple forms of income: tax revenues, e.g., tariffs on imports, direct taxes, profit taxes etc., distributed profits and transfers from abroad, e.g., aid.

The Capital account refers to investment and its funding. Commodities in the capital account column record investments whereas the funding of investment is recorded as savings by institutions and capital account transfers from abroad.

The rest of the world account records the trade accounts. This includes current and capital accounts, and visible and invisible trade. Note that the rest of the world account is important if the policy issues being analysed are trade related.

Table 1 Structure of a SAM

Incomes \ **Expenditures**	**1** Commodities	**2** Activities	**3** Factors: Labour	**3** Factors: Capital	Households	**4** Institutions: Firms	Governme
1 Commodities		Intermediate inputs (Combined USE)			Households consumption		Governme consumpt
2 Activities	Domestic production (SUPPLY)						
3 Factors: Labour		Wages					
3 Factors: Capital		Profits & Rent					
4 Institutions: Households			Labour income	Distributed profits	Intra-household transfers		Transfer
4 Institutions: Firms				Non-distributed profits		Transfers	Transfer
4 Institutions: Government	Tariffs; VAT; Export taxes, Sales taxes	Production taxes	National insurance	Distributed profits; Taxes on profits	Direct taxes	Direct taxes	
5 Capital Account					Household saving	Firms saving	Governme saving
6 Rest of World	Imports (cif)		Factor payments			Current transfers abroad	
7 Total	Total supply	Production	Factor outlay		Households expenditures	Firms expenditures	Governme expenditu

2.2 Prices and Quantities in a SAM

Since a SAM records transactions each entry is, by definition, the product of a price and a quantity. The SAM in Table 2 has 2 commodity, 2 activity, 2 factor, 2 household, 5 tax instruments, 1 government, 1 capital and 1 Rest of the World accounts for which a (stylised) set of transactions are expressed algebraically as prices and quantities. By **definition** the price for any transaction in a row is the same irrespective of the agent/account that makes the purchase. This means that the quantities in any row are measured in commensurate units and hence they can be meaningfully summed so that the row totals are defined as the product of the respective price and the sum of the quantities that are recorded in each transaction in the row;

$$T_{ij} = \sum_j p_i q_{ij} = p_i Q_i \qquad \textit{and} \qquad \sum_j q_{ij} = Q_i$$

by definition therefore the transactions in each row refer to items that are homogenous, i.e., undifferentiated, and do not differ by reference to the purchasing agent.

Table 2

		$c1$	$c2$	$a2$	$a3$	$f1$	$f1$	$h1$	$h2$	$t1$	$t2$	$t3$	$t4$	$t5$	g	k	w
Commodities	$c1$	0	0	$p_{c1}q_{c1,a1}$	$p_{c1}q_{c1,a2}$	0	0	$p_{c1}q_{c1,h1}$	$p_{c1}q_{c1,h2}$	0	0	0	0	0	$p_{c1}q_{c1,g1}$	$p_{c1}q_{c1,k1}$	$p_{c1}q_{c1,w1}$
	$c2$	0	0	$p_{c2}q_{c2,a1}$	$p_{c2}q_{c2,a2}$	0	0	$p_{c2}q_{c2,h1}$	$p_{c2}q_{c2,h2}$	0	0	0	0	0	$p_{c2}q_{c2,g2}$	$p_{c2}q_{c2,k2}$	$p_{c2}q_{c2,w2}$
Activities	$a1$	$p_{a1}q_{a1,c1}$	$p_{a1}q_{a1,c2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	$a2$	$p_{a2}q_{a2,c1}$	$p_{a2}q_{a2,c2}$	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Factors	$f1$	0	0	$p_{f1}q_{f1,a1}$	$p_{f1}q_{f1,a2}$	0	0	0	0	0	0	0	0	0	0	0	0
	$f2$	0	0	$p_{f2}q_{f2,a1}$	$p_{f2}q_{f2,a2}$	0	0	0	0	0	0	0	0	0	0	0	0
Households	$h1$	0	0	0	0			0	0	0	0	0	0	0	0	0	0
	$h2$	0	0	0	0			0	0	0	0	0	0	0	0	0	0
Tariffs	$t1$			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Export Taxes	$t2$			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sales Taxes	$t3$			0	0	0	0	0	0	0	0	0	0	0	0	0	0
Prodn Taxes	$t4$	0	0			0	0	0	0	0	0	0	0	0	0	0	0
Direct Taxes	$t5$	0	0	0	0	0	0			0	0	0	0	0	0	0	0
Government	g	0	0	0	0			0	0								
Capital	k	0	0	0	0	0	0			0	0	0	0	0			
Rest of World	w									0	0	0	0	0			
Totals	*Total*																

However, by definition the total income to an account, i.e., the row total, is identical to the total expenditure by that account, i.e., the column total, and therefore the column total can also be defined as $p_i Q_i$, but while $\sum_j p_i q_{ij} = p_i Q_i$ is meaningful, because the units (transaction values) are commensurate,

$$\sum_i q_{ij} = Q_j$$

is not meaningful because the transaction quantities are not commensurate.

Consequently the accounting identities require that the transaction quantities in each row are recorded in commensurate units, i.e., the items are homogenous and hence should have, from an economic logic perspective, a common single price.

2.3 Different Prices in a SAM

It is useful at this point to comment briefly of some of the definitions used for different prices in the SNA. In part this is to allow the subsequent use of specific terms, and in part it is necessary to avoid confusion, since there are tendencies for alternative names to be used for these terms or for the teams to be misused.

2.3.1 Basic Prices

Basic prices are defined in the SNA as "the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any tax payable, and plus any subsidy receivable, on that unit as a consequence of its production or sale. It excludes any transport charges invoiced separately by the producer" (UN, 1993, paragraph 205). Consequently transactions in the supply matrix are valued in terms of basic prices, i.e., p_{a1} and p_{a2} are basic prices.

2.3.2 Producers Prices

Producer prices are defined in the SNA as "the amount receivable by the producer from the purchaser for a unit of a good or service produced as output minus any VAT, or similar deductible tax, invoiced to the purchaser. It excludes any transport charges invoiced separately by the producer". (UN, 1993, paragraph 205)

2.3.3 Purchaser Prices

Purchaser prices are defined in the SNA as "the amount paid by the purchaser, excluding any deductible VAT or similar deductible tax, in order to take delivery of a unit of a good or service at the time and place required by the purchaser. The purchaser's price of a good includes any transport charges paid separately by the purchaser to take delivery at the required

time and place" (UN, 1993, paragraph 215). Consequently transactions in the commodity rows are defined in terms of purchaser prices, i.e., p_{c1} and p_{c2} are purchaser prices, which are defined as basic prices plus any relevant commodity taxes and trade and transport margins. These relationships are transparent and straightforward for a closed economy, since there are no imports or exports or tariffs or export taxes; they are less obvious for an open economy.

3. Prices and Social Accounts[12]

The description of a SAM in the previous section was couched in terms of transactions and asserted the 'law of one price' as definitional within the context of national accounts. However while this was a satisfactory accounting definition, that accords with economic logic, it was to some extent a convenient abstraction from an economic theoretic perspective. The fundamental issue that was avoided was the economic rationale for the accounting definition; it seems to be have been forgotten that it was economic theoretic reasoning rather than accounting that underlay the development of the price system.[13] The rationale derives not from some set of bookkeeping/accounting conventions but rather from a series of economic relationships; since these are fundamental behavioural relationships that underpin a large proportion of 'modern' economics they are central to economic models calibrated from SAMs.

3.1 Price Definitions and Accounting Identities

Consider the entries in the primary commodity row of the SAM in Table 2, although the same logic applies to all rows, and where the quantity units in the row are commensurate. The row total is the total value of income to the primary commodity account, or the total expenditure on that commodity by agents in the economy, i.e., the total value of demand, and this is equal to the column total for the primary commodity, i.e., the total value of supply. This satisfies the equilibrium condition whereby total supply and total demand equate. Hence the price, p(c1), is the average revenue received for that commodity. But this raises a question as to the interpretation of p(c1) in the context of the column total; in this context p(c1) is the average cost and therefore the accounting identity requires that average revenues are defined as identical to average costs, which is consistent, in economic theoretic terms, since costs and prices are co determined.

This applies to all rows and columns and means that in all CGE models all prices are derived from accounting identities, whether or not the data are presented as a SAM since the

12 The discussion in this section derives largely from Pyatt (1987).

13 Among the major reasons for the development of national accounts was a desire to give empirical content to the Keynesian economic model.

databases for all (consistent) CGE models can be represented as SAMs. Some examples will serve to illustrate how this works.

3.1.1 Domestic Price of Imports

Define the domestic price of imports (PM_c) as the world price, *cif*, of imports in domestic currency units plus any import duties. The value of imports at domestic prices is therefore

$$PM_c * QM_c = SAM("row", c) + SAM("imptax", c) \tag{1}$$

where QM_c is the quantity of imports, which is a simple accounting identity derived from the SAM. Expressing each SAM transaction as a price multiplied by quantity, assuming import duties are defined *ad valorem* and simplifying produces

$$\begin{aligned} PM_c * QM_c &= (pwm_c * ER * QM_c) + (pwm_c * ER * QM_c * tm_c) \\ PM_c &= pwm_c * (1 + tm_c) * ER \end{aligned} \tag{2}$$

where pwm_c is the world price of imports in foreign currency units, ER the exchange rate and tm_c the *ad valorem* import duty rate. Note how PM_c is average 'revenue' that is determined by the cost components and therefore is the 'basic' price of imports.

3.1.2 Basic and Purchaser Prices of Composite Commodities

A common specification in a CGE model is the use of the composite commodity concept whereby domestically produced and imported commodities are aggregated. Hence the basic price of the composite commodity (PQS_c) can be specified, using (1) and (2), as

$$\begin{aligned} PQS_c * QQ_c &= SAM(a, c_d) + SAM("imptax", c) + SAM("row", c) \\ &= (PD_c * QD_c) + (pwm_c * ER * QM_c) + (pwm_c * ER * QM_c * tm_c) \\ &= (PD_c * QD_c) + (PM_c * QM_c) \end{aligned} \tag{3}$$

which can then be written as

$$PQS_c = \left(PD_c * {QD_c}/{QQ_c}\right) + \left(PM_c * {QM_c}/{QQ_c}\right) \tag{4}$$

where QQ_c the quantity of the composite commodity, PD_c and QD_c the basic price and quantity of the domestically produced commodity. Hence the basic price of the composite commodity is the weighted average of the basic prices of its components, i.e., costs.

In this simple example, assuming a simple *ad valorem* (general) sales tax, purchaser prices (PQD_c) are then defined as

$$\begin{aligned} PQD_c * QQ_c &= PQS_c * QQ_c + SAM("saltax", c) \\ &= PQS_c * QQ_c + (PQS_c * QQ_c * ts_c) \\ PQD_c &= PQS_c + (1 + ts_c) \end{aligned} \tag{5}$$

where ts_c is the *ad valorem* sales tax rate, i.e., basic prices plus an ad valorem sales tax rate. In inclusion of trade and transport margins is a simple extension of the same logic.[14]

3.1.3 Purchaser Price of Commodities with VAT

The existence of VAT adds an interesting complication. In an idealised situation all VAT on intermediate inputs is rebated and hence VAT is only levied on final demand commodities. Therefore the price paid varies by agent, which requires different price definitions for intermediate and final demand commodities. Assume the row labeled '*saltax*' is in fact an *ad valorem* VAT, then there are two price definitions for the purchaser prices of the composite commodity, i.e.,

$$\begin{aligned} PQD_c^a &= PQS_c \\ PQD_c^i &= PQS_c + (1 + tv_c) \end{aligned} \tag{6}$$

where PQD_c^a and PQD_c^i are respectively the intermediate and final demand purchaser prices and tv_c the *ad valorem* VAT rate. Note how the price definitions preserve the economic logic of the 'law' since there is a unique price formation for both purchaser prices even though the SAM representation suggests only a single price; this ambiguity would of course be removed by segmenting the commodity accounts between intermediate and final demand, in which case the SAM transaction representing the VAT revenue by commodity would have appeared in the column for the commodity sold into final demand. The key point is clearly NOT the SAM presentation but the knowledge that the '*saltax*' row in fact refers to a VAT that only applies to final demand, i.e., that the price determination processes were different.

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14 Defining an account called 'marg' to carry the trade and transport transactions costs, this can be written as

$$\begin{aligned} PQD_c * QQ_c &= PQS_c * QQ_c + SAM("saltax", c) + SAM("marg", c) \\ &= PQS_c * QQ_c + (PQS_c * QQ_c * ts_c) + (PQS_c * QQ_c * mm_c) \\ &= PQS_c + (PQS_c * ts_c) + (PQS_c * mm_c) \\ PQD_c &= PQS_c * (1 + ts_c + mm_c) \end{aligned}$$

where mm_c is the *ad valorem* margin rate.

Table 3 A SAM (extract) for VAT System

Incomes	**Expenditures**	**1a**	**1b**	**2**	**3** Factors		**4** Institutions			**5**	**6**	**7**
		Final Commodities	Intermediate Commodities	Activities	Labour	Capital	Households	Firms	Government	Capital Account	Rest of World	Tota
1a	Final Commodities	0	0	0	0	0	Households consumption	0	Government consumption	Investment	Exports (fob)	Tota dema
1b	Intermediate Commodities			Intermediate inputs	0	0	0	0	0	0	0	
2	Activities	Domestic production	Domestic production	0	0	0	0	0	0	0	0	Produc
3	Factors											
	Labour			Wages							Factor Incomes from abroad	GNP factor
	Capital			Profits & Rent							Factor Incomes from abroad	
4	Institutions											
	Households				Labour income	Distributed profits	Intra-household transfers		Transfers		Transfers from abroad	Housel incor
	Firms					Non-distributed profits		Transfers	Transfers		Transfers from abroad	Firm incor
	Government	Tariffs; VAT; Export taxes, Sales taxes		Production taxes	National insurance	Distributed profits; Taxes on profits	Direct taxes	Direct taxes			Transfers from abroad	Govern t inco
5	Capital Account						Household saving	Firms saving	Government saving		Capital transfers	Tota savin
6	Rest of World	Imports (cif)			Factor payments			Current transfers abroad				Impo
7	Total	Total supply		Production	Factor outlay		Households expenditures	Firms expenditures	Government expenditures	Total investment	Foreign earnings	

3.2 Prices and Interdependence

The relationship between average cost and average revenue also contains another fundamental implication for structural whole economy models that are price driven. Namely, interdependencies within the economic model are determined by the structural information contained within the columns of the SAM since it is these structural relationships that determine the average costs and hence prices. Consequently it is the relative magnitudes of the entries in the columns of a SAM, i.e., the supply side, that determine the structure of interdependencies and therefore have a fundamental influence upon model performance irrespective of the specific functional forms used in a model.

This has an important implication for the compilation of a SAM, and by analogy any data structure used for a CGE model; the relevant structural information is contained in the column entries i.e., the Leontief style[15] column coefficients. Thus, when compiling a SAM, it is imperative that an emphasis is placed upon the preservation of the information content of EXPENDITURES by accounts.[16]

4. The 'Law of One Price' and Computable General Equilibrium Models

The relationship between costs and prices also provides the economic theoretic reason why the 'law' of one price holds in all consistent CGE models. Each set of cost structures can only provide one price; hence each column of the SAM can only provide the information content for one price and hence the price for any row of SAM must be unique. Therefore all CGE models must adhere to the 'law of one price'; if it is advocated that a model does not adhere to this 'law' then either the advocate does not understand the model or the model is not consistent, because the 'law' is simply a statement of the requirement that each price in the model is uniquely determined. If any price is not uniquely determined there is the implication that the model contains redundant equations.

While the universality of the 'law of one price' in CGE models is theoretically self evident it is nevertheless beneficial to demonstrate how it applies in the context of a number of features commonly found in CGE models.

15 Derived using a normalised price vector.

16 This partially explains why using the RAS method to estimate a new SAM can produce such unreliable results, since the RAS method cannot preserve the relative magnitudes of the column entries, see Lynch (1979).

4.1 The Armington 'Insight' vv Homogenous Imports

Consider first the case of a CGE model that uses the concept of a composite commodity[17], e.g., models in the tradition of Dervis *et al*., (1984), and hence a model that is consistent with the SAM data in Table 1. The consumer price (PQD_c) is defined (see above) as

$$PQD_c = PQS_c + \left(1 + ts_c\right) \tag{7}$$

where PQS_c is the weighted average of the domestic supply (basic) price (PD_c) and the import price (PM_c), and the import price is the world price (pwm_c), in domestic currency units, times 1 plus the import duty rate (tm_c). Hence an Armington 'function' operates simply as a cost function over a specific organisation of the entries in the commodity columns of the SAM, and therefore accords fully, and obviously, with the arguments for the 'law of one price'.[18]

Now consider a case where there are separate commodity accounts for the domestically produced commodities and imports.[19] If the demand for commodities by agents is expressed separately for imports and domestically produced commodities then the 'law' of one price clearly holds by definition. However it is pertinent to confirm that the 'law' of one price holds if demand is expressed for composite commodities that are aggregates of differentiated imports and domestically produced commodities, e.g., a case where the arguments of household utility functions are composite commodities. Since this simply amounts to a series of Armington 'functions' that operate as cost functions over paired sets of commodities then this is no more than a generalised version of the composite commodity case dealt with above: it therefore accords fully with the 'law of one price'.

4.2 Export Transformation Functions vv Homogenous Exports

Typically a SAM is presented with export transactions (foreign demand for commodities) appearing in the same (commodity) rows as domestic demand, which suggests that for the 'law of one price' to hold that the export price should be the same as the domestic price. This is the approach in Tables 1 to 3 above, but closer analyses of the behavioural relationships underpinning a model with export transformation (CET) functions for exports, e.g., Dervis *et al*., (1984), demonstrates that this is potentially misleading, if parsimonious, SAM presentation of the data that obscures the behavioural assumptions.

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17 In fact all known CGE models, as does most modern economics, make extensive use aggregator functions that are in fact index number systems. On the relationships between aggregator (utility, production, Armington, etc.,) functions see Diewert (1976).

18 Note the maintained assumption that the sales tax is some form of general sales tax that applies equally to all agents. If the sales tax were some form of value added tax that was rebated - partially or wholly - to activities that purchased the commodities as intermediate inputs, but not final demand, the formulation is more complex but the 'law of one price' still holds (see McDonald, 2007, for a model with a generalised treatment of VAT).

19 The GTAP model is an example of such aa arrangement; see McDonald and Thierfelder(200?) for a SAM representation of the GTAP database. In fact the GTAP uses a generalisation of the composite commodity specification.

The use of an export transformation function involves the explicit assumption that each activity actually produces two variants of the 'single' commodity that are differentiated by destination - export and domestic commodities. The standard behavioural assumption is that each activity produces a composite commodity (QXC_c) using the single technology represented by the activity specific (composite) production function, and then this composite commodity is differentiated according to destination. An alternative interpretation of this behavioural model would be that the activity had two technologies; one for the domestic commodity and another for the export and that the composite production function was some weighted average.[20] Such a characterisation of an economy could be recorded as a SAM with two sets of commodity and activity accounts - one for the domestic commodity and imports and the other for exports, see Table 4. For such an economy the apparent anomaly of the breach of the 'law of one price' in the SAM disappears instantly.

20 This is consistent with the fact that the functional forms, i.e., aggregator functions, used in CGE models are in fact index number systems.

Table 4 A SAM (extract) for Exports

Incomes	**Expenditures**	**1a**	**1b**	**2a**	**2**	**3** Factors		**4** Institutions			**5**	
		Export Commodities	Domestic Commodities	'Export' Activities	'Domestic' Activities	Labour	Capital	Households	Firms	Government	Capital Account	Rest
1a	Export Commodities	0	0	0	0	0	0	0	0	0	0	Exp
1b	Domestic Commodities	0	0	Intermediate inputs	Intermediate inputs	0	0	Households consumption	0	Government consumption	Investment	
2a	'Export' Activities	Export production	0	0	0	0	0	0	0	0	0	
2b	'Domestic' Activities		Domestic production	0	0	0	0	0	0	0	0	
3	Factors										0	
	Labour	0	0	Wages	Wages	0	0	0	0	0	0	Facto fro
	Capital	0	0	Profits & Rent	Profits & Rent	0	0	0	0	0	0	Facto fro
4	Institutions	0	0	0	0	0	0	0	0	0	0	
	Households					Labour income	Distributed profits	Intra-household transfers	0	Transfers	0	Tran a
	Firms	0	0	0	0	0	Non-distributed profits		Transfers	Transfers	0	Tran a
	Government	Export taxes	Tariffs; VAT; Export taxes, Sales taxes	Production taxes	Production taxes	National insurance	Distributed profits; Taxes on profits	Direct taxes	Direct taxes	0	0	Tran a
5	Capital Account	0	0	0	0	0	0	Household saving	Firms saving	Government saving	0	C tr
6	Rest of World	0	Imports (cif)	0	0	Factor payments	0	0	Current transfers abroad	0	0	
7	Total	Export supply	Domestic Supply	'Export' Production	'Domestic' Production	Factor outlay		Households expenditures	Firms expenditures	Government expenditures	Total investment	F ea

The price definitions from the SAM in Table 4 are straightforward. For the export commodity

$$\begin{aligned} SAM\left(ce,"row"\right) &= SAM\left(ae,ce\right) + SAM\left("exptax",ce\right) \\ PE_{ce} * QE_{ce} &= \left(PD_{ce} * QE_{ce}\right) + \left(PE_{ce} * QE_{ce} * te_{ce}\right) \\ PE_{ce} &= PD_{ce} * \left(1 + te_{ce}\right) \end{aligned} \tag{8}$$

and the definition for the 'domestic' commodity is an obvious permutation of the previously derived definition.

To complete the argument it is critical to consider the prices used to value the supply matrix in Table 1. The correct price is the 'basic' price, which in the above analyses is PXC_c. This is simply a share weighted average of the export (PE_c) and domestic (PD_c) prices, i.e., a price index. However this does raise a non obvious issue associated with the choice of an export transformation function; namely the input cost shares for the export and the domestic commodity are required to be identical if there is only one activity account that produces composite commodities that are aggregates of domestic and export commodities. This sidesteps the requirement for two activity accounts by allowing the use of a single (composite) production function for both the domestic and export commodities, but involves the hidden presumption that although the commodities are differentiated the production functions are identical.

Hence there is a tension in any CGE model that includes a CET formulation for the modelling the assumption that the domestic and export commodities are differentiated. Namely despite the presumption of differentiation the commodities are produced with identical technologies **AND** the input mix of the relevant activities does **NOT** change as the output mix changes.

Finally it is interesting to assess the difference between a model that assumes the export and domestic commodities are differentiated and one in which they are homogenous. The only difference is that the requirement for two 'different' activity accounts is no longer necessary. Since the export and domestic commodities are homogenous they are priced identically ($PE_c \equiv PXC_c \equiv PD_c$) it is only necessary to record two types of commodity account - one for the domestic commodity and imports and the other for exports. The separate export account is required because of the possibility of export and sales taxes means that the export and (composite) domestic purchaser prices might differ despite a common basic price. Thus whether it is assumed that the domestic and export commodity are homogenous or differentiated does not alter the implied requirement for two sets of commodity accounts; one for the domestic commodity and another for exports.

4.3 Sales Taxes and the GTAP Model

A SAM representation of the GTAP database (McDonald and Thierfelder, 2004) at first sight seems to suggest that the 'law of one price' holds in the case of the GTAP model. But closer inspection indicates that the entries in the domestic commodity rows are valued at *basic* prices, which begs the question of the derivation of purchaser prices in the model and hence of consistency with the 'law' of one price.[21] The data in the SAM indicate that *purchaser* prices for domestically produced are defined as basic prices plus sales taxes[22] but that the *ad valorem* sales tax rates are purchasing agent AND commodity specific, i.e., the proportionate markup on basic prices for the same commodity differs by purchasing agent. Thus it appears that the GTAP model does not conform to the 'law' of one price.

In fact the GTAP model conforms fully with the 'law'. In the GTAP model the effective purchaser price of any domestic commodity is defined as

$$PDD^{g}_{c,sac} = PXC^{g}_{c} * \left(1 + ts^{g}_{c,sac}\right) \tag{9}$$

where $PDD^{g}_{c,sac}$ is the GTAP purchaser price for purchasing agent *sac* of the domestically produced commodity *c*, PXC^{g}_{c} is the GTAP basic price of the domestically produced commodity *c* and $ts^{g}_{c,sac}$ is the domestically produced commodity *c* and purchasing agent, *sac*, specific commodity tax. Since the GTAP model assumes export and domestically produced and sold commodities are homogeneous, i.e., $PXC^{g}_{c} \equiv PE^{g}_{c} \equiv PD^{g}_{c}$. Exactly the same logic applies to the treatment of imports and consequently the 'law of one price' holds for all commodities and agents in the GTAP model.

Notice how there is a symmetry in the GTAP model between the treatment of exports and domestically produced commodities sold on the domestic market; the distinction by agents is in effect implemented on the supply side of the model, which ensures conformity with the 'law of one price' as being the supply determination of prices.

The obfuscation of the operation of the 'law' of one price arises from the 'peculiar' format adopted for the SAM representation of the GTAP database, not from the behavioural relationships in the GTAP model. In order to reduce vastly the number of rows and columns in the SAM the commodity rows were valued at *basic* and NOT, as is arguably appropriate, *purchaser* prices. Such a representation is consistent with the GTAP convention of using (symmetric) input-output tables as the data format for inter industry and final demand transactions (see below for a discussion of input-output vv supply and use formats in SAMs). In the same manner the disaggregation the total indirect taxes on commodities paid by agents is consistent and necessary for meaningfully recording the data. However the information

21 The recording of exports in the domestic commodity rows has been dealt with above.

22 Note how the SAM indicates that the purchasing agent makes two payments when purchasing a commodity; one to the producer at basic prices and another to the government via the paired sales tax account.

requirements for such a representation are enormous, which begs the question about data reliability.[23]

4.4 The Second 'Law' of Welfare Economics

General equilibrium economics are intimately related to welfare economics,[24] and a common use a CGE models, following Adelman and Robinson (197?), has been to assess the income distribution and welfare implications of economic policy choices - especially for developing countries. However all bar one known CGE model formulates the 'functional distribution of income' in such a manner that NO second 'law' of welfare economics effects can arise. An understanding of the operation of the 'law' of one prices makes the reason for this transparent.

The concern here is with the behavioural relationships that relate to the household by factor sub matrix of SAM.[25] A typical behavioural assumption, e.g., Lofgren *et al*., (2001),[26] is that fixed value shares of factor incomes are distributed to each household. This appears to be an eminently sensible behavioural assumption that is, under certain circumstances, fully consistent with the 'law of one price'. But under the common factor market clearing assumption that a factor is not fully employed and a perfectly elastic supply is available at the prevailing (real) market factor price, it is arguably flawed.

At first it is not immediately obvious what the correct prices are for the rows in the household by factor sub matrix. However this matrix records the income to households with respect to the factors they own, the services from which are sold to the factor accounts at, assuming the factors are homogenous, a common price. If the unemployed factor is sold at a common price then the value shares are identical to the factor (service) quantity shares. Consequently the assumption of constant value shares means that the quantity shares are assumed to remain constant which requires that any changes in the quantity of that factor employed is drawn from each household in the same ratio as provided in the situation prevailing in the base period of the SAM. Therefore the underlying behavioural assumption is that the distribution of factor ownership is constant and hence there is no scope for changes in the volumes of employment to generate redistributive effects in line with the second law of welfare economics.

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23 Version 6 of the GTAP database contains approximately 600,000 potentially different sales tax rates.

24 Note how it is almost standard practice to use summary welfare measures when analysing results from CGE models.

25 This argument could be applied to the sub matrices relating to the income to ALL domestic and foreign institutions from the domestic factor account, but exposition is eased by concentrating on household incomes only.

26 In fact the same applies to the GTAP model but the existence of one (regional) household renders issues of the second 'law' of welfare economics irrelevant

5. Developing Social Accounting Matrices for Economic Models

It was argued at the start of this paper that not only did all whole economy models conform to the 'law of one price' but that understanding the 'law' was important for the construction of databases to calibrate such models. The previous analyses have concentrated on the application of the 'law' to CGE models; this section uses two examples to demonstrate the importance of understanding the 'law' for compiling databases/SAMs for such models. The first example relates to the seemingly innocuous issue of the appropriate format for recording inter industry and final demand data, while the second deals with the seemingly difficult, but in fact (theoretically) simple, issue of recording home production for home consumption.

5.1 Input-Output vv Supply and Use Tables

Until now a maintained assumption in the SAM has been that each activity produces a 'single' commodity and each 'single' commodity is produced by only one activity.[27] The advantage of this maintained assumption has been that the issue of input-output versus supply and use format is avoided; the SAM had simultaneously both an input-output and supply and use format. However, input-output tables are almost invariably, and always so if derived in accordance with the SNA (UN, 1993), reduced forms derived from supply and use tables (see Miller and Blair (1985), Armstrong (1975), UN (1999)). The standard approach is to value the SUPPLY table and input-output tables at basic prices and the USE table at purchaser prices, and to generate symmetric input-output tables, valued at basic prices, by using the information in the supply and use tables. In practice to derive such input-output tables it is necessary to

- develop domestic and import use matrices;
- revalue the use matrices in *basic* prices;
- decide whether to use commodity or activity accounts for the inter industry rows and columns of the input-output tables[28]; and
- determine the technology assumptions that will be used to identify the production techniques used for secondary products.[29]

The literature on these processes is now old and the mechanics are well documented and the characteristics of input-output tables are well known, even if they are not well understood by some users of the tables. It is the implications of these processes for economic models, rather than the processes themselves that are of interest here.

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27 This was relaxed when considering the case of the Armington 'insight' and export transformation functions.

28 That is decide whether to form commodity by commodity or industry by industry tables.

29 There is a wide range of such technology assumptions; these range from pure commodity to pure industry assumptions via a spectrum of hybrid and by-product technology assumptions (see Miller and Blair (1985) for an introduction.

The key argument is that any apparent advantages from an input-output format are very unlikely to be achieved because of the restrictive nature of the assumptions required for the linear transformation of the data and the difficulties generated for additional data collection.

5.1.1. Choice of commodity or industry accounts and Additional Data

The choice of commodities or activities as the basis for the row and column accounts of the input-output tables means that the other set of row and column entries must be adjusted to ensure that row and column total equate, e.g., if the activity accounts provide the row and column totals the entries in the commodity rows and columns must be adjusted and hence no longer represent 'natural' commodities. This means that ANY other data must be redefined to maintain definitional consistency, e.g., if the household consumption account is to be disaggregated this is best done BEFORE generating the input-output tables so that the appropriate adjustments can be applied to all RHGs. The same basic argument applies if the commodity accounts provide the row and column totals; the activity accounts no longer represent 'natural' activities. Consequently full consistency in data definitions requires that a disaggregated SAM is developed on the basis of a SUPPLY and USE format PRIOR to converting the SAM to an input-output format.

5.1.2 Technology assumptions and Modelling Production

The application of ANY technology assumption to generate symmetric input-output tables imposes a linear transformation of the data in the SAM so as to remove secondary production, i.e., non principal commodity production, from the SAM. While this achieves a simplification of the modelling of production relationships it does so at the expense of sidestepping potentially important issues in the production process. For instance agriculture is an industry overwhelmingly characterised by multi product firms; the selection of an input-output format explicitly ignores this feature of the industry. In some instances this may not be seem to be an issue, e.g., in the GTAP model where distributional issues are not pertinent due to the use of a 'single' RHG, but this ignores issues about the ability of the agricultural industry to adjust its output structure - this issue is addressed in the OECD's GTAP-EM model. In other cases, e.g., where regional differences in agricultural product structure are an issue (PROVIDE, 2006), or where home production for home consumption is a fundamental characteristic of an economy (McDonald, *et al*., 2007), decisions on product output mix may be of critical importance AND it may be appropriate to have certain factors fixed.[30]

[30] Lofgren *et al*., (2001) is an example of one treatment of multi product firms, but this adopts what is effectively a by-product technology assumption whereby the output mix is fixed. An alternative approach, wherein industries can change product output mix in response to changes in relative prices is used in McDonald and Punt (2007).

5.1.3 Information requirements

The transformation of a supply and use SAM to an input-output format is very data intensive, and moreover the additional data are typically those least readily available.

Imports

The need for both domestic and import USE matrices is a major data requirement. National account statisticians may regard the data underpinning an aggregate use matrix as reasonably reliable, because they are typically based upon surveys that ask about commodity use by agents, but rarely ask how much was imported and how much was domestically produced - if only because purchasers are unlikely to know the answer. Consequently where domestic and imports use matrices exist they are usually less reliable than an aggregated use matrix. So not only is the process of devising symmetric input-output tables data intensive it is also likely to involve the use of less reliable data.[31]

But, even if completely reliable use matrix data are available it is still appropriate to first devise the SAM in a SUPPLY and USE format; at that point it is still questionable what benefits are achieved by converting to an input-output format.

Tax revenues and/or rates[32]

Information on taxes is without question among the most important data for compiling a SAM and any subsequent model. Hence by definition more information is better, provided the data quality does not decline to rapidly. However tax data are not as readily available or reliable as might be wished, and/or governments are reluctant to be explicit about tax revenues. Thus it is not uncommon to find that SUPPLY tables only report the total tax revenue for each commodity, i.e., all commodity taxes (import duties, export taxes, sales taxes, VAT, excise taxes, etc.,) are lumped together as a single vector. Even where the transactions for different tax instruments are explicitly quantified, this is typically done as series of vectors rather than as matrices that are tax instrument and purchasing agent specific. Consequently if input-output tables in basic prices are developed and matrices of tax revenues for each tax instrument are produced from vectors of tax instrument specific revenues the tax rates for each instrument will be invariant across ALL agents. This is an evitable consequence of an embedded assumption of the 'law of one price' in the data organisation and manipulation

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31 Still less appealing is the adoption of a 'naive' assumption; namely that the import/domestic mix in each transaction is in the same proportions as the aggregate import to domestic supply mix for that commodity. The information content of such an assumption is virtually identical to that achieved in a SAM with composite commodity accounts.

32 For a SAM the standard requirement is to collect tax revenue data since the interest is in transaction values, i.e., realised rates rather than published rates. All too often however the gaps between realised and published rates are substantial, which causes some problems. In addition economists sometimes wish to use rates that are equivalent to the effect of multiple interventions, e.g., tariff equivalents, but this raises difficult issues relating to the identification of the rents associated with non tariff barriers.

processes: recognition of this fact is important to the avoidance of claims of spurious accuracy in the all multi sector databases.

5.1.4 Multi product activities

By definition input-output tables exclude the possibility of multi product activities whereas the principles underlying SUPPLY and USE tables are that multi product activities are generally the norm. The adoption of a CGE model structure that allows for multi product activities, e.g., Lofgren *et al*., (2001), McDonald and Punt (2007) and Horridge (2003), has the advantages of allowing endogenous price responses while avoiding the adoption of potentially ill defined linear transformations of the underlying data. However there are down sides; the specification of production technologies in the face of changing output mixes are ill defined and typically require the assumption that input combinations – price determination mechanisms – are independent of output mixes.

5.2 Home Production for Home Consumption (HPHC)[33]

In the SNA statisticians are expected to include imputations for HPHC. This is based on a presumption that the definition of HPHC ONLY includes commodities that are produced within the SNA's production boundary (see UN, 1993, paragraphs 6.17 and 6.18), i.e., commodities for which there ARE clearly identifiable marketed equivalent so that unique prices can be assigned to the commodities so produced and consumed[34].

For developed and, many, middle income economies[35] the issue of HPHC is not an issue. But for many developing countries, principally those where semi subsistence agriculture remains an important source of livelihoods, HPHC is a very important form of economic activity.[36] Since the price formation processes for HPHC differ greatly from those for marketed commodities in such economies a decision to ignore HPHC in the data and model formulation is a potentially large source of bias in the results from quantitative analyses. It is

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33 Lofgren *et al*., (2001) and some SAMs configured to work with that model include a component in the model and sub matrix of data designed capture HPHC. The argument developed below questions the approach used in that model and associated SAMs; but it is important to recognise that that model is one ofonly two that are known that seek to encompass HPHC.

34 This means that all domestic services - catering, child rearing, carer services - fall out with the SNA production boundary, and hence are NOT included in measured national product. This is NOT an assertion that such activities are unimportant, rather it is an assertion that the units of measurement are inadequately defined to ensure appropriate measurement (see McDonald, 2006, for a discussion of how activities out with the SNA production boundary can be incorporated into an extended SAM and the associated price definition problems.

35 For the PROVIDE SAM for South Africa it was decided not to separately record home production for home consumption because it represented a very small share of agricultural production and agriculture itself only accounted for some 3 percent of economic activity (PROVIDE, 2006). However detailed data for the former Transkei homeland indicate that for that region HPHC is a substantial contributor to income and welfare (see PROVIDE, 2006b).

36 In Ethiopia some 92 percent of the labour force are either self employed or engaged in 'unpaid family labour', while some 80 percent of the labour force are engaged in some form of semi subsistence agriculture where HPHC accounts for a very large share of the VALUE - note that the prices of commodities that are home produced and consumed are very much lower than similar commodities purchased in the market and therefore the 'volume' share of HPHC is even more pronounced - of consumption by households.

these differences in price formation processes that underpin inclusion of HPHC in a SUPPLY and USE SAM.

Table 5 provides an illustration of a SAM organised to include HPHC. The important points are that

1. home produced and home consumed commodities do not enter the market and hence the price formation processes do not include taxes (or marketing margins); and
2. home produced and home consumed commodities can only be consumed by the households that produce them.

Thus for each household group that engages in HPHC there must be a matching activity account whose HPHC output is consumed solely by that household group, and each commodity that is home produced and home consumed there must be a commodity account that would typically be paired with matching market commodity account. Since the 'law of one price' must hold, each pair of market and HPHC commodities must be characterised by a pair of distinct price formation processes.

Table 5 A SAM with Home Production for Home Consumption

Incomes	Expenditures	1a	1b	2a	2b	3 Factors		4 Institutions			5	
		HPHC Commodities	Market Commodities	HPHC Activities	Activities	Labour	Capital	Households	Firms	Government	Capital Account	Rest
1a	HPHC Commodities							HPH consumption				
1b	Market Commodities			Intermediate inputs	Intermediate inputs			Household consumption		Government consumption	Investment	Exp
2a	HPHC Activities	HPHC production										
2b	Activities		Domestic Production									
3	Factors											
	Labour			Wages	Wages							Facto fro
	Capital			Profits & Rent	Profits & Rent							Facto fro
4	Institutions											
	Households					Labour income	Distributed profits	Intra-household transfers		Transfers		Tran a
	Firms						Non-distributed profits		Transfers	Transfers		Tran a
	Government		Tariffs; VAT; Export taxes, Sales taxes		Production taxes	National insurance	Distributed profits; Taxes on profits	Direct taxes	Direct taxes			Tran a
5	Capital Account							Household saving	Firms saving	Government saving		C tr
6	Rest of World		Imports (cif)			Factor payments			Current transfers abroad			

7	Total	Total HPHC supply	Total Market Supply	HPHC Production	Production	Factor outlay	Households expenditures	Firms expenditures	Government expenditures	Total investment	F ea

6. The Importance of 'Detail' in Economic Models

To illustrate the importance of cost structures to the performance of structural general equilibrium models this section reports on the development of a database for a region using information for another region. The data are derived using data from the GTAP database since the GTAP database can provide a convenient set of SAM with identical account structures.[37]

6.1 Estimating a SAM Using Information from Another Region

The derivation of the database uses data for 2 regions – one a developed economy with the other a less developed economy. It is assumed that for one region full structural information is available, the reference region, while for the other region only a limited set of control totals are known; the structural information from the reference region will be used to estimate the structural relationships for the other region. The developed economy is arbitrarily assigned as the reference economy that provides the structural information, in the form of column coefficients, used in the estimation process while the control totals come for the less developed economy.

6.2 Comparing the Results from a Simple Trade Liberalisation Scenario

The same policy scenario, full unilateral liberalisation of imports, is applied to three models calibrated using data for the less developed and developed economies; the first model uses the SAM for the less developed economy reported in the GTAP database, the second uses the SAM for the less developed country estimated using structural information from the developed economy while the third uses the GTA data for the developed economy.

7. Concluding Comments

The apparent separation of data and model that is implicit to many whole economy models has many useful features, but suffers from several serious potential problems. Not the least of these problems is the inclination to assume that the national accounts data used by these models can be safely left in the hands of national accounts statisticians and neglected by the economists who carry out the modelling exercises. The arguments advanced in this paper suggest that neglect of the national accounting conventions by modellers is a mistake that will compromise both the quality of the data used to calibrate whole economy models and the quality of the whole economy models. It is argued that economic modelers would be well advised to remember that national accounts were originally devised for, among other purposes, the implementation of quantitative economic models and consequently national

37 The use of GTAP data does not carry any implications about the GTAP database.

accounts conventions contain well specified systems of prices. An understanding of these systems is clearly important to an appropriate specification of the price formation processes in price driven economic models. If economic models and national accounts are to remain complementary activities it is argued that economists need to reengage with national account statisticians.

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