Social Accounting Matrices: An Introduction

"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." (Stone, 1962 ,p v).

"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." (Pyatt, 1987, p 330)

.

1. Introduction

At the heart of all quantitative analyses of economic systems, be it a modern macroeconomic model and/or some other form of whole economy model, will be found estimates of national accounts. Indeed, so central are national accounts to the work of economists it is easy to forget how short is the history of (formal/institutionalised) national accounting, especially since the 'wealth of a nation' appears to be a concept that has lain at the very root of economic analyses for more than two centuries (Stone, 1978, provides a brief historical review). But despite the importance of national accounts it is surprising to find how ill-informed many economists are about the issues and problems faced by national account statisticians; with the gap between economists and statisticians seeming to grow with the increasing 'sophistication' of modern economics. This is arguably a source of substantial concern. It suggests that economists are forgetting that the development of national accounts was inspired directly by developments in macroeconomics, especially the Keynesian revolution, and with it the attendant need to understand and quantify how economic systems operate.

This is not just of historical interest. Throughout the development of national accounts there has been a strong history of dialogue between the compilers and the users of national accounts; this dialogue has had important consequences in that it has ensured that conventions for the compiling of national accounts have incorporated considerations about the use of national accounts in economic analyses. Indeed, this is one of the enduring legacies of Richard Stone's contribution to economics.[1] This has meant that national accounts, if compiled in line with SNA guidelines, adopt definitions and conventions that ensure they can be used meaningfully as a basis for economic analyses and not solely as a mechanical accounting exercise that describes an economy at a point in time. Consequently, it is disappointing that so many economists fail to recognise the difficulties confronted by national account statisticians and the extent to which the task of compiling national accounts is often as much art as science.

A social accounting matrix, or SAM, is a single-entry transactions matrix where the core data record the values of income and expenditure transactions between different agents.

[1] "The fact that others have not had to reinvent the architecture of the national accounts in particular is perhaps the most telling measure of the importance of Richard Stone's contributions and their enduring significance." (Pyatt, 2005).

A SAM serves two major purposes: a framework within which transactions data can be organised and the statistical basis for the creation of economic models. As a system for organising information it is a powerful tool whereby the economic and social structure of a country, region, city, village etc., can be described in a complete and consistent way. A SAM provides a unifying structure within which the statistical authorities of a state can compile and present national accounts. In some respects, this is the task to which SAMs were first applied. Under the leadership of Stone a series of SAMs for the UK were constructed during the late 1950s and early 1960s as extensions and developments of national accounts. More recently the potential benefits of SAMs have been recognised in the United Nations' 1993 and 2008 revisions of the System of National Accounts (see Keuning, 1994, and UN, 1993 and 2009). As an organisational framework, SAMs are not limited to transactions data. SAMs have been extended by adding satellite accounts that encompass quantitative data about social, demographic and environmental interactions within economic systems; these extensions are particularly useful for economic models that include issues of ever wider scope, e.g., environmental sustainability and climate change.

A SAM is a **not** an economic model. A SAM can only provide the statistical basis upon which an empirical model can be built. By definition an economic model requires the specification of a series of behavioural economic relationships, e.g., production and consumption functions, and an institutional structure within which these economic relationships are played out. The relationships specified may be linear functions, e.g., as in simple input-output and SAM multiplier models, or they may be complex non-linear functions, e.g., nested CES or translog functions, while the institutional arrangements can range from command to market economies. The choice of model will depend critically upon the nature of the economic system and the policy issues and variables analysts wish to analyse, e.g., trade or taxation policies, and the outcomes analysts wish to emphasise, e.g., income distribution, government budgets, foreign exchange availability, etc., and the economic/social events that will drive the model, e.g., global trade negotiations and climate change policies. Hence a single SAM can provide the data used to calibrate many different models.

The detail of any SAM constructed therefore depends not only on the economic system for which it is developed, and the wealth of data about that system which is available, but also on the purposes for which the SAM will be used. This generates a potentially disconcerting

feature about SAMs: while SAMs as a class have a general structure, the specific structure of each SAM tends to differ. Thus this introduction uses two SAMs to illustrate the concepts covered in the first part of the document. The first is macro (aggregated) SAM for Botswana; the second is a SAM for Africa that is used later in the course.

This document is intended to provide information about SAMs that will be of use to many different users; as such the document is designed as a reference source. A general overview of the structure of SAMs is provided in section 2. Section three demonstrates how the single-entry bookkeeping method in a SAM represents the data presented in conventional presentations of national accounts. The system of prices in a SAM is explained in section 4, while section 5 explains the price system in a SAM and how this relates to the treatment of inter-industry transactions. The issue of the SNA's production boundary is discussed with respect to both its importance and limitations in section 6. The final section uses an aggregated SAM for Botswana to introduce the interpretation of the information in a SAM. This section also provides guidance on how interpreting a SAM may proceed.

As is so often the case with multisector models/data systems, they are best understood/appreciated by combining theory and practice. For many people an imbalance between the two will usually result in confusion. Consequently, the reader of this document is urged, and in fact needs, to explore the information contents of the SAMs used in this document by posing questions about the economies described by the SAMs.

2. An Introduction to Social Accounting Matrices

This section demonstrates how a SAM is distinct from input-output tables (IOT) and supply and use tables (SUT), and that this difference is critical since it captures the full circular flow of an economy. The guiding principles of a SAM are the concept of the circular flow and the requirements of double entry bookkeeping.

2.1 The Circular Flow

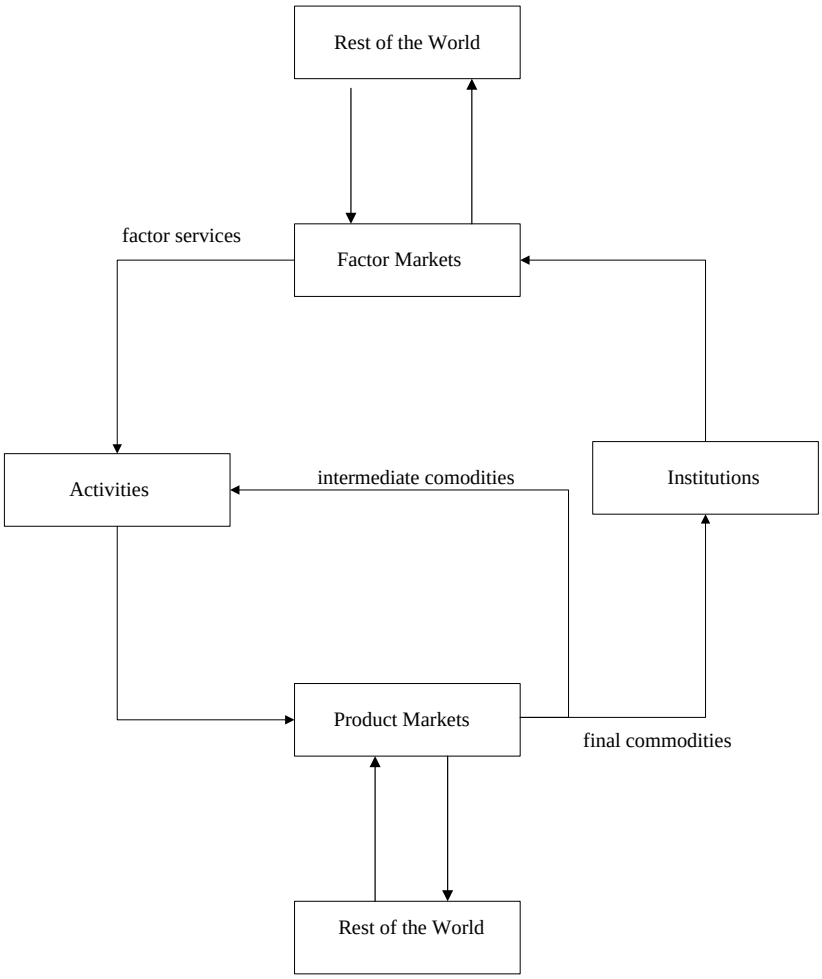
The concept of a circular flow represents a vision of economic systems. Going one way around the circular flows involves tracing out the flow of goods and services while going the other way around traces out the flows of funds (see Figure 2.1): the arrow heads in Figure 2.1 indicate the direction of physical flows with associated flows of funds going in the opposite directions. Assume initially that the economy is closed and hence the Rest of the World agents/accounts can be ignored. Institutions (a term that encompasses households, non-profit organizations, government, investment, etc.,) sell the factor services they own in factor markets where activities (producers, industries, firms, etc.,) are the purchasers. This generates flows of funds, incomes, to the institutions, which can be used to fund purchasers of final commodities (goods and services) by the institutions on product markets. The activities realise part of their incomes from the sale of final commodities; the remainder of their incomes are realised from the sale to other activities of intermediate commodities on the product markets. Hence, a circular flow is generated between the institutions and activities that are linked via factor and product markets.

Opening the economy to the Rest of the World is then a simple extension of the system. Institutions can sell their factor services to domestic or foreign activities, while activities can source factor services from domestic or foreign institutions. Similarly, domestic institutions can source final commodities from domestic or foreign activities, while domestic activities can source intermediate commodities from domestic or foreign activities.

The circular flow is somewhat more complicated, although the principles remain simple. Figure 2.1 (deliberately) does not illustrate certain transactions. There are usually multiple transactions between institutions; these include savings (transactions between the investment account and other institutions), direct taxes (transactions between government and other institutions) and transfers (transactions between institutions and between domestic and

foreign institutions). Also excluded are representations of various taxes levied on commodities and activities. Whilst such transactions are important, and are often the instruments through which policies are implemented, none alter the basic principles of the circular flow.

Figure 2.1 A Simple Circular Flow



An important distinction exists between inter-industry tables, which record the costs incurred in the production of commodities (goods and services) by activities\industries, the expenditures on factors by activities and the purchases of commodities by domestic and foreign institutions, and SAMs. This can be intuitively explained by reference to the illustration of the circular flow in Figure 2.1. A SAM captures the full circular flow whereas inter-industry tables only capture part of the circular flow. Specifically, inter-industry tables do not record details of the interactions in factor markets - there are no links between factors and institutions. Consequently, inter-industry tables do not provide information about how

institutions generate the incomes, through interactions on factor markets, that enable them to fund expenditures on product markets. In addition, inter-industry tables do not record the transactions between the various institutions in an economic system, or between the various components of an economic system and the rest of the world except for commodity transactions. These differences and their importance will become clearer in due course.

2.2 Overview of Social Accounting Matrices

A SAM is an extension of an inter-industry table; it extends the information about inter-industry transactions to include more detailed information on institutions and factor markets. A SAM records details of transactions during the period for which it is constructed – current account transactions – and does not record details of the historical transactions that determine the stocks of factors etc., - capital account transactions.

The development of fully articulated SAMs was largely undertaken by the Cambridge Growth Project and, in the context of developing countries, by Graham Pyatt and associates. The first modern SAM for a developed economy was produced by Stone (1962), then in 1972 the first SAM for a developing country was produced for Iran by Graham Pyatt; subsequently Pyatt and various associates produced SAMs for Sri Lanka (Pyatt *et al*., 1977) and several other developing countries, e.g., the country studies in Pyatt and Round (1985).

While the revised 1968 SNA established the integration of macroeconomic and inter-industry data, SAMs did not become an integral part of the SNA until the 1993 revision (United Nation, 1993). As is made clear in the SNA, a SAM provides a comprehensive synthesis of the (real) accounts of the whole economy, supply and use data and inter-institutional transactions for an economy; hence it is the most comprehensive method for presenting data about the real economy at an aggregate level. In most SAMs the focus is however still on the production structure, at the expense of details about the distribution of factor payments to households and inter institutional transactions; this appears to be largely a reflection of data collection, estimation and reconciliation problems rather than a deliberate decision by national account statisticians. It is not an inherent limitation of the SNA.[2]

[2] If a SAM only has a single household account the ability to use that SAM to calibrate models that will provide useful information about the implications of different distributions of income or the impacts on income distribution are limited (see Defourney and Thorbecke, 1984, for an elegant demonstration of the potential importance of income distribution in policy analyses).

A SAM is a square matrix in which each agent/account has both a row and a column. The expenditures/payments/out-goings for each account are recorded as column entries while the incomes/receipts/in-comings for each account are recorded as row entries. As such a SAM is a form of single entry bookkeeping where each entry is a transaction, i.e., each entry has both price and quantity dimensions, which identifies both the source and destination of the transaction. The prices for each and every entry in a row must be identical. Accordingly, the total expenditures by each account must be exactly equal to the total receipts for each account: hence the respective row and column sums for a SAM must equate Moreover, it will provide that information in a manner that is consistent with the aggregate accounts for the system. Thus, in the context of an entire economy, a SAM will contain not only the information provided by the aggregate national accounts but also further details on the transactions between various groups of agents within the system. A SAM is an efficient and, ultimately, simple way to record economic transactions.

Formally, a SAM is a system of single entry book keeping presented in the form of a square matrix wherein each account is represented by a row and a column. The entries in the SAM are transaction values, i.e., prices multiplied by quantities: the row entries represent incomes to the accounts and the column entries represent 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 every expenditure by an agent has a matching and corresponding income for another agent. Hence, a consequence of being complete and consistent is that 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.

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 homogenous (undifferentiated) and can measured in commensurate units; 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

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

Since the transactions in each row refer to items that are homogenous, the prices do not differ by reference to the purchasing agent. This characteristic is a consequence of the 'law of one price' (LOOP) that applies to any SAM and is important for an understanding of a SAM and its use to calibrate any model and its underlying system of prices.

The LOOP is critical to the understanding of the price system in a SAM and the strictures placed upon the price system in any model calibrated with a SAM. Indeed, the price system embedded within a SAM defines the price system that must be applied in any model calibrated with that SAM; if not there will be a fundamental tension between the data and the model's behavioural relationships.[3] Moreover, an understanding of LOOP and the price system in a SAM is critical to an understanding of the behavioural relationships in ALL whole economy models, since the databases for all whole economy models can be presented in the form of SAMs.

[3] For instance, all CGE models that use CET functions violate the LOOP.

3 Structure of a SAM

An illustration of the structure of an archetypal SAM is provided in Table 2.1; however, it needs to be recognised that the concepts underpinning a SAM are extremely flexible and can support a plethora of structures.

Typically, a SAM is constructed with 6 types of account and each type may contain numerous accounts:

- Commodity (or product) accounts
- Activity (or production/industry) accounts
- Factor accounts
- Institutional accounts
- Capital accounts and
- Rest of the World accounts.

The SAM in Table 3.1 identifies 3 categories of domestic institutional accounts; private households, (incorporated) enterprises and government. Each of these can have numerous sub accounts as can the other types of account. Also, note that while Table 2.1 follows a common ordering of types of account the actual ordering is irrelevant to the information content.[4]

Ultimately the ability to understand the information content of a SAM is a product of experience, and a description of the structure of a SAM can only serve as a starting point. Thus, while Table 3.1 is a reasonable illustration of SAMs used to calibrate economic models it is not an exhaustive illustration. In part this reflects the fact that there is no deterministic structure for a SAM, although all SAMs must conform to a series of principles. This explains why it can be difficult to interpret some SAMs; the structure chosen for a SAM may be one with which the reader is not familiar.[5] Hence while the structure illustrated in Table 3.1 has been chosen to provide an introduction SAMs, those interested in using SAMs as databases will need to spend time learning how to interpret the information content.

[4] Arguably the reason for starting with the commodity accounts stems from the notion of 'consumer sovereignty', which implies that production activities supply outputs in response to consumption choices. But given the circular flow the ordering of arguments has little or no meaning. For instance, many SAMs originating in the USA, or derived by practitioners inspired by US practice, start with activity accounts.

[5] Indeed, the SAM structure in Table 2.1 relates back to the structure implicit to the SNA of 1968 and departs from the structure advocated by the SNA of 1993. One way to simplify the process of understanding a SAM with an unfamiliar structure is to re-order the accounts into a structure with which the reader is familiar.

Table 3.1 Structure of a SAM

	Commodities	**Activities**	**Factors**	**Households**	**Enterprises**	**Government**	**Capital**	**Rest of World**	**Account Total**
Commodities	Marketing Margins	(Combined) USE Matrix	0	Household Consumption		Government Expenditure	Investment Expenditure	Exports of Goods & Services	Commodity Demand
Activities	Production	0	0	0	0	0	0		Production
Factors	0	Remuneration of Factors	0	0	0	0	0	Factor Income from RoW	Incomes to Factors
Households	**0**	0	Distribution of Factor Incomes	Inter Household Transfers	Distribution of Enterprise Income	Transfers to Households	0	Remittances from RoW	Household Income
Enterprises	0	0	Distribution of Factor Incomes			Transfers to Enterprises	0	Enterprise Income from RoW	Enterprise Income
Government	Commodity Taxes	Production Taxes	Factor Taxes	H'hold Income Tax & Other payments to Government	Ent'prise Income Tax & Distributed Enterprise Income		0	Transfers from RoW	Government Income
Capital	0		Depreciation	Household Savings	Enterprise Savings	Government Savings	Stock Changes	Capital Account Balance	Savings
Rest of World	Imports of Goods & Services	0	Factor Payments to RoW	Remittances to RoW	Enterprise Payments to RoW	Current transfers to RoW		0	Imports of G&S from, and Transfers to RoW
Totals	Commodity Supply	Cost of Production	Expenditure on Factors	Household Expenditure	Enterprise Expenditure	Government Expenditure	Investment Expenditure	Exports of G&S to and Transfers ,from RoW	

The description of the SAM in Table 2.1 proceeds in the order of the accounts. The cells that include a '0' entry are those for which such an entry rarely, if ever, makes economic sense, whereas those left blanks may have entries but they are not included in this description.

3.1 Commodity accounts

The commodity accounts are easily understood by starting with the row accounts. The row entries identify the purchases (transactions) by the agents in the columns on commodities (in the rows); note that entries are transactions and therefore record values and not quantities. Thus, the row entries quantify the distribution of commodity demands between intermediate and final demand where final demands are disaggregated across different institutions, the capital account and the Rest of the World (exports). Notice how the Rest of the World (RoW) is simply another account, i.e., exports are incomes to the RoW. Total incomes to the commodity accounts are therefore given by the row sums that quantify the total value of demand for commodities in the system. Transactions in the commodity account rows are valued at purchaser prices (see section 4 for details on the system of prices).

Ex post the total demand for commodities must equal the total supply of commodities, i.e., the row and column totals equate. But for any period the total demand for and totally supply of commodities may not equate due to the drawing down or increasing of stocks; this accommodated by including an account for stock changes as a sub account in the capital account.[6]

The total supply of commodities in value terms includes domestic production (part of the Supply matrix and valued at basic prices), imports (valued at basic prices, i.e., carriage, insurance and freight (*cif*) paid), duties paid on imports and any other taxes on commodities paid by domestic agents, e.g., General Sales Taxes (GST), VAT,[7] excise duties plus the trade and transport costs associated with the domestic marketing of commodities. The commodity accounts therefore trace out the sources of commodities supplied to the system and the destinations of commodities once they are in the economic system.

[6] Note that a SAM does not contain information that allows the user to track the evolution of stocks. If an entry for stock changes is negative it indicates that a stock has been drawn down, and if it is positive that a stock has been added to. But, the transactions provide no information on the size of the stocks. A zero entry does not imply that there are no stocks.

[7] NB: VAT is a tax on (final demand) commodities and NOT a tax on value added.

A complication exists with the entry for (domestic) marketing margins in the commodity:commodity sub matrix. This sub matrix records the trade (wholesale and retail) and transport costs associated with transferring commodities from producers to purchasers within the economy. Thus, trade and transport margins, commonly referred to as marketing services, are part of the costs of supplying commodities to the system, i.e., entries in the column accounts, but also part of the demand for commodities, i.e., commodities of used to produce the services and are therefore entries in the row accounts. The sum of the entries in this sub matrix must be zero, which indicates that at least one entry will be negative, i.e., a demand. The negative entry, or entries, arise because the supply of marketing margins must be matched by demands (expenditures equal incomes) for marketing services, which are recorded as negative expenditures in the columns for the commodities that make up marketing services. While the convention of entering marketing services in this sub matrix is parsimonious, in the use of space, it can be a bit confusing. An alternative representation includes accounts for marketing services with the expenditures as entries in the commodity columns and the demands as incomes in the commodity rows (see below when the alternative treatments of interindustry transactions are discussed).[8]

Note that exports, and export taxes, are treated as commodity accounts. The treatment of export taxes as an expenditure by the commodity account is sensible since *de facto* the taxes are paid by domestic agents with the RoW paying free on board (*fob*) prices, which are inclusive of export taxes, for exports. Note how the inclusion of export taxes, and export subsidies, is necessary since they are expenditures (taxes) or incomes (subsidies) to the commodity accounts that ultimately pass down to the activities responsible for their production.[9] In an alternative SAM representation exports, and export subsidies, are recorded within the activity accounts, e.g., Dervis *et al*., (1985). The commodity accounts then emphasise domestic production for the domestic market, and require the SUPPLY sub matrix only has entries on the principal diagonal. This alternative is a reduced form of the SAM represented in Table 2.1. It has historical and current relevance in the computable general equilibrium (CGE) literature since it was the formulation used by the early CGE models and is a layout that could be adopted for many current CGE models, e.g., the GTAP model and any model calibrated using standard GTAP data.

---

8 This exploits the fact that if an entry is transposed and the sign is changed the SAM remains balanced and the information content is preserved – a negative income is an expenditure, etc.

9 The inclusion of exports in the commodity rows does raise several issues relating to the prices in the commodity rows of the SAM. These are discussed further below.

3.2 Activity (or production) accounts

Activity accounts record the input (production) and output structures of activities. The column entries record purchases that include intermediate inputs, both domestic and imported, and value added, where value added is broken down into payments to different factors, broadly or narrowly defined, and taxes/subsidies paid by activities on production, e.g., output taxes, and/or the use of factors, e.g., employer contribution to factor 'insurance' taxes, taxes on value added (NOT VAT). Hence the column entries detail the costs incurred during production by activities and the column sums record the total inputs to productive activities. Entries across the activity rows identify the commodities 'made' by each activity - part of the SUPPLY matrix.

The major concern with the activity accounts is the detailing of the cost structures in production and payments to factors. This is reflected in the relatively common practice of only recording incomes to the activity accounts from the sale of commodities.

Note how government subsidies paid directly to activities are recorded as negative input costs despite the arguable case that they represent incomes to activities. It would be equally defensible to enter such subsidies in Activity:Government sub-matrix, i.e., as income to activities, although it is common practice to treat them as negative taxes. This reflects a useful feature of a SAM. Entries can be transposed and the sign reversed without affecting the information content of the SAM. It does change the row (income) and column (expenditure) totals but the requisite accounting identities are preserved. The choice of method largely depends upon the preferences of the agency constructing the SAM. If users have different preferences then reorganising a SAM does not change the information content and is therefore legitimate.

The activity accounts record all the productive activities of an economic system, i.e., the generation of value added: the Factor:Activity submatrix should record the domestic employment of all factors within the system. The definition of a productive activity is important. Productive activities are defined as all those processes within an economy that can and/or do use factors to produce commodities, i.e., goods and services. This is relatively straightforward, and intuitive, when referring to industries, e.g., farming, manufacturing and services, but in some instances the definition is less transparent where a non-activity agent apparently employs factors. For instance, the government final demand account should not

include direct payments to factors, but rather there should be one or more activity accounts, e.g., education, defence, etc., that employ factors and sell their output to the government. Thus, the government can be classified as both an agent and one or more activities through which it employs factors and produces outputs – services, defence, etc. But, for instance, defence could be classified as an activity whose output is purchased by the government's final demand account; such a choice of classification would be particularly useful if the defence system is part of the analyses or a large part of the economy.

Even less transparent may be what to do about home production for home consumption (HPHC); in such cases the household is simultaneously an activity and an institution and therefore each household would have a related activity account since only that household can produce output for home consumption. In a similar manner, the leisure consumed by each household can only be produced by that household; one method for recording leisure in the system is through having a leisure activity for each household whose output is only consumed by the paired household.[10]

3.3 Factor accounts

The row entries for factor accounts are incomes paid to factor accounts for productive services. The sum of these payments, plus incomes from factor sales abroad are GNP at factor cost. Detailed information about factor income is important if SAM data are used to analyse policy issues relating to the operation of factor markets and/or income distribution. Thus, some SAMs report detailed information about the demand for labour of different types, e.g., skilled, unskilled, clerical, manual, professional, etc., and other factors, e.g., building and machine capital, arable and pasture land, etc., by different activities. The determination of those characteristics that should be used to segment each broad factor type depends upon both the economy and the policy issues being addressed: this is particularly the case for labour accounts where distinguishing characteristics that are relevant to income distribution issues are often country specific, e.g., in South Africa it may be appropriate to distinguish between labour types on the basis of race, while in some economies gender may be a particularly important characteristic. But it is important to note that disaggregating factor types will only provide useful information on the transmission of employment changes, e.g., on income

[10] Note, in passing, that the examples here all relate to activities within the SNA's production boundary. The complications, and hence limits, imposed by the production boundary are discussed below.

distribution, if there is a 'matching' disaggregation of the institutional accounts, especially by household types (see below).

The expenditures by the factor accounts are recorded in the columns. Factor incomes are distributed between different types of households as labour income and distributed profits, to (incorporated business) enterprises as non-distributed profits, to government as the payment of taxes etc., and profits from government owned enterprises. Note also payments to overseas factors.

It is the functional distribution of factor incomes implicit in the expenditures by the factor accounts that makes it so important to ensure that the degrees of detail with respect to factor types and domestic institutions are compatible.[11] For instance if there are multiple factor types but only one household type then changes in the incomes of different factors are not reflected in changes in the incomes of different households and hence changes in factor incomes do not feed down into changes in demand associated with differences in preferences across households.[12]

The SAM in Table 3 records depreciation as being expenditures by the factor accounts. Given this representation the payment to factors that depreciate, typically capital factors, by activities are defined as gross of depreciation, e.g., gross operating surplus, and therefore contains the implicit presumption that depreciation is an expenditure by a factor account and not by activity accounts. Alternatively, depreciation could be recorded by each activity, which recognises that deprecation rates may differ across activities, and then payments to relevant factors in the activity account columns are net of depreciation, e.g., net operating surplus.[13] Clearly the information contents of the different representations differ as do the data requirements to compile the SAM.

3.4 Institutional accounts

These accounts include different household types (Representative Household Groups – RHG), incorporated business enterprises, other domestic institutions, e.g., non-profit organisations, and government. Incomes to institutions are recorded as row entries and expenditures as

11 See Pyatt (1991).

12 The importance of differences in preferences and the functional distribution of income has been well illustrated by Defourney and Thorbecke (1984).

13 Gross operating surplus is defined as net operating surplus plus (activity specific) depreciation, which ensures that the total costs for activities are unchanged.

column entries. Note how the government realises different forms of tax revenue: VAT on commodities, tariffs on imports, direct and profit taxes on institutions, etc.

The distinction between incorporated and unincorporated business enterprises is important. The firms that make up activities can be owned directly by households, unincorporated business enterprises, or by incorporated business enterprises; in which case households are the owners of incorporated business enterprises, and hence indirectly own firms. Typically, this distinct is relevant for the capital and, sometimes, the land factors, since ownership of firms is typically defined by reference to the ownership of capital.

Household Accounts

Households primarily receive incomes from factor sales on domestic or foreign markets. Income received directly from the factor accounts are dominated by payments for labour services, with payments for capital and land services being those associated with the incomes to those factors earned by unincorporated business enterprises, e.g., self-employed business and farmers[14]. Since self-employed incomes are (typically) relatively more important in less developed economies the proportions of household incomes that come directly from the factor accounts are likely to be proportionally larger.

Household incomes from enterprise accounts are dominated by the distributed profits of enterprises, although they would also include any transfers directly from enterprises to households. Similarly, payments to households from government will be dominated by transfers – social security transfers made directly to households. Finally, there are factor incomes from abroad. Again, these will typically be dominated by payments for labour services since payments for capital services will most often be received by the enterprise accounts.

Household expenditures are dominated by consumption expenditures – demand for final commodities: these are valued inclusive of any commodity taxes due on consumption by domestic households[15] and trade and transport (margin) costs, i.e., at purchaser prices. Households engage in transfers with other domestic institutions, principally other households, and with non-domestic institutions – mostly as some form of remittance. Households must

[14] The difficulties of allocating factor incomes between labour, capital and land services means that incomes from self-employment activities is often treated as 'mixed' income; this must be resolved if the SAM is to be used to calibrate a CGE model.

[15] VAT is typically levied on all domestic demand and then rebated, at least partially, to all domestic purchasers except for households.

also pay income taxes; in many countries, direct taxes on households and transfers from government to households are both substantial and data limitations can make it difficult to separate out these transactions. Hence they are often treated jointly as net direct tax payments by the households; thus, negative NET income tax rates may be implied, which despite being an appropriate representation of net transactions can cause difficulties for policy experiments. Finally, the *ex post* accounting identity is ensured by the savings of households being a residual category; what is not spent or accounted for elsewhere is recorded as saving/dissaving. This reflects the fact that data on savings by households are often partial and/or difficult to verify, which can result in estimates of savings being derived as a residual.

Incorporated Enterprise Accounts

Incorporated enterprises are in many economies the principal recipients of the profits – returns on capital – from activities. Thus, while incorporated enterprises are ultimately owned by other (domestic) institutions – primarily households but also by government (parastatals and nationalised companies) – they should be included in a SAM, since they are important institutions in terms of their responsibility for a large proportion of domestic savings and in the pathways by which factor incomes are translated into disposable incomes that fund domestic demand.

Incomes to enterprises are dominated by the returns to capital, and to a much lesser extent land, both within the domestic economy and the rest of the world – remitted profits. Expenditures are typically dominated by savings out of retained profits – often among the largest sources of investment funds in developed economies – transfers to households and government, who are the domestic owners of enterprises, or to foreign owners of the enterprises. Finally, enterprises pay direct taxes, e.g., corporation taxes, to the government, which, as with households, may be recorded net of transfers from government to enterprises.

Government Accounts

Tax revenues are the principal source of government incomes in most countries. Although taxes are required to fund legitimate government activities they represent potential policy instruments that can affect/influence economic incentives while being, arguably, the most important single group of policy instruments available to governments. Thus, tax revenues – note that SAMs record transactions (revenues) not rates – are critically important when constructing a SAM.

Ideally tax transactions will be recorded in sufficient detail to identify the major different types of tax instruments applied by a government; although it is very unlikely all separate instruments will be recorded as separate accounts, all tax revenues must be accounted. Taxes on commodities might separately identify import duties, export taxes, VAT, general sales taxes (GST), excise taxes, etc., taxes on activities might include taxes on output and factor use – individually or in aggregate, taxes on factors may include national insurance contributions paid directly by the factor[16] and taxes on institutions will be made up primarily by direct (income) taxes. Clearly the balance will vary by country; typically, it may be expected that indirect taxes, especially trade taxes, are relatively more important the less wealthy is a country while direct taxes will be relatively more important the richer is a country and/or household group. Negative taxes, i.e., subsidies, are also possible and although it might be expected that they are positively correlated with a country's wealth, e.g., domestic agricultural support schemes in the EU and USA, there is ample evidence that subsidies are non-trivial in many less wealthy countries.

Ultimately it is the responsibility of the person(s) compiling a SAM to ensure that the detail on tax accounts included in the SAM provides a reasonable representation of the tax system operating in the country. This can however be difficult since all too often the information on tax revenues is limited, e.g., total revenues by each instrument may be recorded but it is rare to find details about tax payments by different agents. Ultimately the all too common 'habit' of aggregating multiple tax instruments into a catchall category, e.g., only recording import duties and a residual commodity tax, seriously compromises the usefulness of a SAM for policy analyses. Although it may be tempting to accept the limitations imposed by readily available data there are strong arguments for separating out different tax instruments even if the process may involve a substantial degree of '*guesstimation*'; in particular it may be argued that it is 'better' to analyse policy questions using correctly formulated tax instruments even if the recorded initial applied rates are of low reliability.[17] Consider for instance the case of an economy with both GST and VAT systems for which the SAM only records import duties and other commodity taxes. If the VAT component is ignored and the other commodity taxes are modelled as a GST then – for positive VAT rates – the assumed tax rates on households will be underestimated while those on other agents will

[16] Some contributions to such insurance schemes will be paid by the employer, i.e., activity, and are therefore part of the costs of employment incurred by activities.

[17] Initial tax rates and how they are levied, i.e, influence behaviour, are both important.

be overestimated and the impacts of changes in the commodity tax rates will be biased, e.g., if the GST rates are increased rather than the VAT rates to achieve a given revenue target, then production costs (for activities) will be increased while consumption costs (for households) will not increase as much as they would have done with a VAT system.

Other sources of government income include distributed profits from state owned enterprises and payments from abroad; the components of these depend upon the institutional arrangements but in most cases they will be dominated by inter government transfers.[18] A major component of inter government transfers for some countries will be official development assistance (aid) in all its guises; since in some of the least developed countries aid may constitute a substantial part of government income. These transfers are not under a government's (direct) control but it is important to record these transfers accurately, since they will be important components of the Rest of the World account. Similarly, expenditures on aid will need accurate recording; given 'target' rates of aid remittances for OECD countries of between c 0.25 and 1 percent of GDP such expenditures are potentially important.

Other government expenditures can be complicated. In a SAM based on Supply and Use tables government consumption expenditures will cover a very limited range of commodities – this reflects the fact that in such a representation government will be included as an activity, whereas in an input-output framework government will purchase multiple commodities because it will not be treated as an activity. Whichever option is chosen it is likely consumption expenditure will account for most of government expenditure. Other categories of government expenditure include transfers to domestic and foreign institutions and government savings.

Government savings are typically recorded as an expenditure and therefore a negative entry represents the government's borrowings. Since the internal balance is an important government policy target that will often require the government to vary tax rates to ensure its achievement it represents an important entry in any SAM.

[18] Returns on investments abroad by state owned enterprises will most commonly be recorded as income to the enterprise accounts.

3.5 Capital accounts

This 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 the balance on the capital account. The representation in Table 2.1 ensures that a surplus on the capital account (deficit on the current account) is recorded as positive and a deficit (surplus on the current account) is recorded as negative.

In many SAMs it is common to include an account that records stock changes – the column account will record the values of stock changes that will be funded by incomes provided by the main capital account. However, since stock changes can be legitimately negative, while (gross) investments must be positive, the merging of the investment and stock change accounts can generate the seemingly odd situation of apparently negative investments.[19]

3.6 Rest of the World accounts

The rest of the world accounts record trade and other foreign transactions. These include the current and capital accounts, and visible and invisible trade. Imports are implicitly valued carriage insurance and freight (*cif*) paid in Table 2.1, which is a typical approach when constructing a SAM for a single region, while exports are recorded free on board (*fob*). When a SAM is constructed to analyse trade issues that may involve changes in trade costs for imports then it may be appropriate to include multiple trade accounts with imports valued *fob* from the source regions and to include accounts that record trade costs by trade partner.

Visible trade - trade in goods and services – is relatively straightforward but only constitutes part of the current account. Other components of the current account, which have been detailed above, are important. Any transactions missing from the current account are likely to end up either being included in the balance on the capital account, which will then not be reconciled with the national accounts, or as distortions in the estimates of other transactions on the current account. Where other transactions on the current account are relatively small this may not be an issue, but, as noted above, in some countries aid transfers may make up a substantial proportion of government income and household may receive a substantial proportion of their incomes from remittances.

[19] If the two accounts are combined it may be necessary to address this situation in the formulation of the model.

4. National Accounts and SAMs

This section demonstrates how the single-entry bookkeeping method in a SAM represents the data presented in conventional presentations of disaggregated national accounts. Typically, national accounts are reported as a series of aggregates – GDP, GNI, private consumption (*C*), government consumption (*G*), savings (*S*), investment (*I*), internal balance (government borrowing) and external balance (surplus on the current account). These are the elements of the national accounts commonly encountered when students first study macroeconomics and form the bedrock of the Keynesian income and expenditure model.

In theory, these aggregates should be calculated as totals of the disaggregated underlying data; the (disaggregated) national accounts. It is such disaggregated national accounts that provide the empirical data used to construct a SAM, and are used to form supply and use tables (SUT) that serve to benchmark the aggregate national accounts.

4.1. T-Accounts

The most well-known form for the presentation of detailed national accounts is as a series of T-accounts, which follow standard double entry bookkeeping practice where incomes are recorded in the left hand column and expenditures in the right hand column. Table 4.1 provides an illustrative T-account for the private household account in a stylised economy; income (100) comes from three sources – employment (75), property (15) and transfers (8 + 2 =10) – and there are four forms of expenditure – consumption (63), taxes (12), transfers (4) and savings (21), which are typically defined as residual or balancing item. Logically it would be expected that savings and income taxes by the private household will also be recorded as incomes in the capital (savings and investment)[20] and government accounts respectively. Accordingly, in the capital account for this economy, see Table 4.2, there is an income item for household savings that matches the expenditure item from the household account. In the capital account the stock changes serve as the residual or balancing item.

Consequently there is an implicit T-account for every agent in the economy, including all commodities and activities[21].

[20] The capital account appears with different labels in different representations, e.g., the SNA uses the label Gross Capital Formation for the expenditure side.

[21] For activities/industries the balancing item will be gross or net operating surplus, while for the commodity accounts it will be changes in the stocks of the individual commodities. The requirement for a residual or balancing item is a basic aspect of double entry book keeping.

Table 4.1 Stylised T-Account for Private Household

Incomes		Expenditures	
Income from employment	75	Private consumption	63
Income from property	15		
		Income taxes	12
Transfers from government	8		
Transfers from rest of world	2	Transfers to rest of world	4
		Savings	21
Total	100	**Total**	100

If every T-account is fully reconciled with ALL other T-accounts, i.e., each and every income item has a matching expenditure item in another account, then the accounts will be consistent. Note also how the fundamental *ex-post* accounting identity that total income equals total expenditure is satisfied; if it not satisfied for all the T-accounts then the system of accounts is incomplete. Therefore a set of national accounts can be defined as complete and consistent if every transaction is accounted for – complete – and every expenditure transaction is exactly matched by a counterpart income transaction – consistent. Such a complete and consistent set of national accounts will record the full circular flow of an economy.

Table 4.2 Stylised T-Account for Capital Account

Incomes		Expenditures	
Household Savings	21	Gross Domestic Capital Formation	36
Enterprise Savings	6	Stock Changes	2
Government Savings	4		
Depreciation	5		
Current Account Balance	2		
Total	138	**Total**	38

The familiarity of the T-account representation to economists should not be surprising since it underpins (empirical) macroeconomics and such national accounts were primarily driven by the needs of the (Keynesian) macroeconomics literature and the desire to quantify major macroeconomic aggregates.

4.2 Inter-Industry Transactions and National Accounts

Arguably details about transactions between the agents within each aggregate are substantial omissions from aggregate national accounts. Thus while aggregate national accounts identify payments to labour and capital in the production accounts they often do not provide details about the use of, or payments to, labour and capital by different activities nor do they provide

information about purchases and sales of intermediate inputs. However, in the late 1930's Wassily Leontief produced a data framework that is known today as an input-output table (Leontief, 1953), and whose fundamental objective was to provide data about transactions between industries and between industries and other agents in an economy.

An important development in national accounting was the integration of inter-industry data into national accounts (see Stone, 1961), which was made a central feature of the revised 1968 System of National Accounts (SNA). However, it is important to note that the inter-industry data in the SNA were presented in two or three tables; a make/supply table and one (domestic) or two (domestic and import) absorption/use tables rather than in the form of an archetypal symmetric input-output table (see below).

Table 4.3 Stylised T-Account for an Activity Account

Incomes		Expenditures	
Income from commodity 1	120	Intermediate inputs	65
Income from commodity 2	25		
		Payments to labour	40
		Gross Operating surplus	20
		Taxes on production	5
Total	125	**Total**	125

The T-accounts for activities and commodities are identical, in principle, to that for other agents. The activity T-accounts record the income and expenditure accounts for domestic production activities. In Table 4.3 the activity is recorded as selling two different commodities – principal and secondary commodities – to generate income, while the expenditures are the costs of production – intermediate and primary inputs and taxes levied on production.[22] In the accounting process the balancing item will be gross operating surplus, i.e., the surplus before allowing for depreciation of productive assets. In the process of converting these accounts into a SAM appropriate for a CGE model it will be necessary to allocate GOS between payments for capital services and the labour services of the proprietors.

The T-accounts for commodities are similar (see Table 4.4). Income is realised by sales of commodities to different domestic (intermediate and final demand) and foreign (exports valued free on board (*fob*)) agents, valued at purchaser prices. Expenditures are the payments

[22] Note that corporation taxes are not taxes on production, rather they are the taxes paid by incorporated business enterprises that may own multiple production activities.

to domestic and foreign (imports carriage, insurance and freight (*cif*) paid) producers (valued at basic prices) plus any domestic trade and transport costs associated with transferring the commodity from producer to purchaser and any domestic commodity taxes levied. Note how import duties are separately identified, since the value of imports *cif* plus import duties is the value of imports at basic prices.

Table 4.4 Stylised T-Account for a Commodity Account

Incomes		Expenditures	
Intermediate inputs	60	Purchases from domestic activities	80
Private consumption	45	Purchases of imports (cif)	20
Government consumption	10		
Investment	26	Trade & transport margins	15
Stock changes	-1		
		Import duties	5
Exports (fob)	10	Domestic commodity taxes	30
Total	150	**Total**	150

Details about inter-industry transactions in the commodity and activity accounts are important since they identify the costs and values of production, the purchasers of commodities by different agents and the imports and exports of commodities. These data are important if a model is to accurately represent the supply and demand of commodities in an economy.

5. Price System in a SAM

An understanding of the system of prices in a SAM is important if the data are to be used appropriately in any economic model. So far the discussion has avoided any explanation of how the prices in a SAM are defined; this section addresses that issue and its implications for the treatment of inter-industry transactions in a SAM.

Understanding the price system in a SAM is critical to the development of the price system in any CGE model. This section explains the price system in the System of National Accounts and its implications for the interpretation of a SAM consistent with the price system in the SNA. As part of this explanation it is important to understand the distinction between prices in input-out tables (IOT) and Supply and Use tables (SUT).

5.1 Prices in the SNA

The SNA defines three key prices (see SNA, 2008, 6.49 to 6.69):

1. Purchaser Prices - the prices paid by purchasers, which include transport and distribution margins and any VAT payable.
2. Producer Prices - the price paid to the producer by the purchaser less any VAT or other deductible tax and any transport or distribution charges invoiced separately.
3. Basic Prices - the price paid to the producer by the purchaser less any tax payable plus any subsidy receivable but excluding any transport or distribution charges invoiced separately.

These relationships between these prices can be summarised in a figure (Figure 5.1).

The key prices for a CGE model are the basic and the purchaser prices. Typically, in a SAM, commodities supplied to an economy by domestic activities and the rest of the world will be valued in basic prices, while commodities used by an economy will be valued in purchaser prices. It is useful to see how these prices are recorded in a SAM, but to do so requires examining how inter-industry tables are recorded in a SAM.

Figure 5.1 SNA Price Relationships

Basic prices
+
Taxes on products excluding invoiced VAT
-
Subsidies on products
=
Producers' prices
+
VAT not deductible by the purchaser
+
Separately invoiced transport charges
+
Wholesalers' and retailers' margins
=
Purchasers' prices

Source: SNA (2008), Figure 6.1, p 103.

5.2 Inter-Industry Tables

Inter-industry tables can, typically, be presented either as input-output tables (IOT) or supply and use tables (SUT). The distinction is not trivial and some understanding of the differences is important, especially as the formulation of IOT presented in standard economics texts can be, and usually is, misleading.

In the context of the SNA, when statisticians collect the data for estimating inter-industry transactions they seek answers to two key questions: what did each agent use (absorb/demand) and what did each agent supply (make). The former question provides the data for the USE table and the latter for the SUPPLY table.[23]

In a SUPPLY table the purchasing agents, in the columns, are commodities while selling agents, in the rows, are activities and the rest of the world (see Table 5.1). The SUPPLY table thus contains a subset of the matrices in the SAM illustrated in Table 3.1, and records the supply of commodities to an economy from domestic production, by activities, and imports, from the rest of the world. In the SNA, the prices paid to the producers are basic prices; thus, the prices received by domestic activities and the rest of the world for commodities supplied to the economy are *basic* prices. The basic prices received by domestic producers can be conceived of crudely as 'factory gate' prices, i.e., before any domestic trade

[23] In earlier versions of the SNA these tables were known as MAKE and ABSORPTION.

and transport costs have been incurred or any domestic commodity taxes have been levied. The basic prices by foreign producers can be conceived of crudely as 'dock gate' prices, i.e., after any costs incurred transporting the commodity into the country and any import duties have been paid, but before any domestic trade and transport costs have been incurred or any domestic commodity taxes have been levied.

In a USE table the purchasing agents, in the columns, are activities and institutions while selling agents, in the rows, are commodities and factors (see Table 5.2). The USE table thus contains a subset of the matrices in the SAM illustrated in Table 5.2, and records the use of commodities and factors by activities, institutions and the rest of the world. In the SNA, the prices paid by agents are *purchaser* prices.

The row and column totals for a SAM must be identical; thus, the value of each commodity supplied to the economy (column total) must equal the value of each commodity demand by the economy (row total). The information needed to relate basic and purchaser prices is contained in the SUPPLY table. In simple terms, the difference between basic and purchaser prices are taxes paid and margins, so adding the values of commodity taxes paid and marketing margins incurred to the values, at basic prices, of commodities supplied generates the values, at purchaser prices, of the commodities supplied.

Thus, for the commodity accounts domestic production and imports should be valued in basic prices, while intermediate inputs, domestic final demand (by institutions) and exports should be valued in purchaser prices. This is how they are valued in SNA compliant SUT, and has implications for the price system in a CGE model: the tax and margin rates determine the markup between basic and purchaser prices are assumed identical for all commodities and agents.

Table 5.1 A Supply Table

		1 **Commodities**
1	**Margins**	Marketing Margins
2	**Activities**	Production
6	**Government**	Commodity Taxes
8	**Rest of World**	Imports of Goods & Services
9	**Totals**	Commodity Supply

Table 5.2 A USE Table

		2 **Margins**	 **Activities**	4 **Households**	6 **Government**	7 **Capital**	8 **Rest of World**	9 **Account Total**
1	**Commodities**	Marketing Margins	Intermediate Inputs	Household Consumption	Government Expenditure	Investment Expenditure	Exports of Goods & Services	Commodity Demand
3	**Factors**		Remuneration of Factors					
6	**Government**		Production Taxes					
9	**Totals**		Cost of Production					

5.3 Input-Output and Supply and Use Tables

An inter-industry table is symmetric if the row and column labels and totals are identical, the table is square and each activity (industry) produces a unique commodity (product) and only that product. This is how input-output tables (IOT) are defined and presented, whereas supply and use tables (SUT) are asymmetric in that the row and column labels and totals are not necessarily identical, and therefore the tables are not necessarily square. In supply and use tables the row accounts are for products/commodities and the column accounts are for activities/industries;[24] each column of the supply table therefore identifies the values of different commodities produced by each (multi-product) activity while each column of the use table(s) identifies the values of different inputs used by each activity. The standard (SNA) approach is to collect data in supply and use formats and then to derive an input-output (or analytical) table as a reduced form by decomposing the prices in the use table and then adjusting the (revalued) use matrix/matrices using information from the Supply[25] matrix (see UN, 1999; and Miller and Blair, 1985). Hence, one way an IOT can be defined is as a square Use[26] matrix with identical row and column accounts and for which the associated Supply matrix is also square and only has entries on the principal diagonal. Thus, it would appear that the SAM format discussed above applies for cases where the inter-industry data are present in either IOT or SUT formats.

But, this ignores an important aspect of an IOT. In an IOT, constructed following the standard procedures, the purchases of commodities for intermediate and final demand and exports are valued at *BASIC* prices not *PURCHASER* prices. This means that the accounting data used to derive purchaser prices from basic prices, taxes and trade and transport margins are not immediately available. There are methods by which a SAM can be structured so that purchases of commodities can be recorded at basic prices and the associated taxes and trade

[24] Activities refer to enterprises that engage in productive activities while commodities are the outputs (and intermediate inputs) produced by activities. A standard classification system allocates enterprises to activity groups by the principal commodity produced by an activity; consequently, many supply and use tables contain activities and commodities that have the same name although the interpretations are different. This is not necessarily the case: for instance, agriculture might be an activity that produces multiple commodities, e.g., grains, vegetables, fruit, meat, milk, wool, etc. Similarly, the agricultural activity might be subdivided into crop agriculture and animal agriculture where the former produces grains, vegetables, fruit, meat, etc., and the latter produces grains, meat, milk, wool, etc.: note how crop agriculture produces an animal product and animal agriculture produces a crop product. This reflects the fact that multi-product activities may be multi-dimensional. This become relevant when trying to specify production relationships.

[25] Also known as the MAKE matrix.

[26] Also known as the ABSORPTION matrix.

and transport margins can be explicitly recorded in the SAM. While such a presentation has merits, and may arguably be regarded as ideal, it is not without difficulties; not the least of which are the very large additional data requirements.

For purposes of this course the format of the data will follow that of a SAM with inter-industry data presented using a SUT format, with strictly diagonal domestic production matrices. For this course, domestic trade and transport margins will be ignored to simplify the models; hence although the terms basic and purchaser prices will be used, the precise definitions will depart from those in the SNA. During the online training course, this simplifying assumption will be relaxed.[27]

[27] It should be noted that the GTAP database, even in its SAM representation, violates the SNA'a basic and purchaser price definitions.

6. The System of National Accounts Production Boundary

It is useful to appreciate the definition of the SNA's production boundary, since this defines what is and what is not included in an SNA compliant SAM.

Most undergraduate macroeconomic textbooks include a brief critique of the definition of GDP by reference to what is and what is not included in GDP. These critiques all relate to what is classified as being within the SNA's production boundary and what is classified as being outwith the production boundary. The SNA defines the production boundary as

> *"In the SNA, production is understood to be a physical process, carried out under the responsibility, control and management of an institutional unit, in which labour and assets are used to transform inputs of goods and services into outputs of other goods and services. All goods and services produced as outputs must be such that they can be sold on markets or at least be capable of being provided by one unit to another, with or without charge. The SNA includes within the production boundary all production actually destined for the market, whether for sale or barter. It also includes all goods or services provided free to individual households or collectively to the community by government units or NPISHs."* (SNA, 2008, para 1.40, p 6)

This definition essentially revolves around the requirement that it must be possible to associate an 'unambiguous' market price to the output of activities if they are to be included within the production boundary.

Consequently, many activities that may be regarded as important are excluded, e.g., childcare by parents, care of the elderly by families, etc. The reason is a problem of valuation and is not hard to understand. Take the case of childcare by parents: the market price of childcare is the price a household would have to pay an activity that provides childcare services, but the value of parental childcare could/should be expressed in terms of the opportunity cost of foregone income. But, the opportunity cost of foregone income differs across households depending upon the wages/salaries that the adult would have realised if they had sold their labour; hence when valued at opportunity cost there is not a unique price, and the value to different households will encompass a range of prices.

This example also serves to identify one of the problems presented by the SNA production boundary. Parental childcare does not contribute to measured economic activity

while childcare provided in a market does contribute. Thus, for instance, assume a government provides universal and compulsory childcare. Measured economic activity will, by the SNA definition, increase because all childcare is now within the production boundary and has recorded value. But does this represent a real increase in welfare?

The issues presented by how the SNA's production boundary is drawn and how models may be adjusted to better represent economic activities are beyond the scope of this course. Some recent research has begun to extend models so that they, arguably, enhance the modelling of such economic activities.

7. Interpreting the Information in a Social Accounting Matrix

The interpretation of the information in a SAM is covered in in the exercises. In this section an aggregate SAM for Botswana is used to illustrate some of the information that can be gleaned from a SAM by simple inspection. But, interpreting SAMs requires practice; the Excel based exercises are designed to help explore the information content of a SAM

Social Accounting Matrices (SAMs) have a disconcerting habit of being heterogeneous. Consequently, it is not possible to develop a 'universal translator' for interpreting the information content of SAMs. Rather it is argued that the best way to appreciate and understand the information contained in SAMs is by the practice gained from interpreting SAMs. This section begins by providing an interpretation of the aggregated SAM for Botswana – chosen because the economy has a number if interesting features. This is followed by some suggestions about how you can simplify the process.

Experience has demonstrated that a simple, and relatively quick, assessment of the information content of a SAM is sufficient to identify potential problems that will arise if the SAM in question is used to calibrate a CGE model; thereby avoiding wasting a lot of time trying to work out why a CGE model generates 'peculiar' simulation results. Thus, it is worthwhile developing the skills needed to interpret a SAM.

7.1 A Macro SAM for Botswana

Table 7.1 reports an aggregate or macro SAM for Botswana that has been derived from the 1992/3 .[28]

The macro SAM for Botswana indicates that the total value of supply of commodities is made up of 18.7% from imports (*cif*), 71.9% from domestic production, 3.7% from domestic trade and transport margins and 5.6% from taxes on commodities. Unfortunately this macro SAM does not separate out import duties from other (domestic) commodity taxes and therefore it is not possible to comment on the distribution of commodity tax burdens across different commodity tax instruments. The largest source of commodity demand is for intermediate inputs but even this only accounts for 29% of total demand, the next biggest category is export demand (21%) followed by household demand (19%), government demand (13%), investment (13%), domestic trade and transport margins (4%) and finally other

[28] The organisation of the accounts differs from those in the published SAM. The change in structure has been made for pedagogic reasons - it makes the data structure consistent with that used elsewhere.

(domestic) institutions (less than 1%). With nearly 30% of domestic production exported and 20% of supply imported this indicates a highly open economy, while the extent of the government's share of domestic demand indicates a substantial degree of government involvement in the economy.

The production structure is apparently not very developed with only a 40% share of inputs being intermediates,[29] a 59% share going to factors (primary inputs). 50% of factor incomes go to other institutions, 6% go directly to the government and the remaining 43% are distributed to households and thereby account for 89% of household incomes. The remainder of household income comes from transfers (7%) and the rest of the world (4%)[30].

Clearly the disaggregated SAM contains a substantial amount of information relating to the transactions taking place between domestic institutions, and indeed this is one of the great strengths of the Botswana SAMs.

[29] In developed economies, the intermediate input share of production costs is typically in the mid-fifties.

[30] The remittances from the rest of the world remain dominated by remittances from migrant workers in South Africa although these are much smaller than they were even 15 years earlier.

Table 6.1 A Macro SAM for Botswana in 1992/3

	Commodities	Activities	Factors	Transfers	Households	Other Institutions	Govt - Taxes on Products	Govt -Taxes on Production	Govt - Subsidies	Govt - Taxes on Income	Other Government	Capital	Rest of World
Commodities	(717)	5,660	0	0	3,599	151	0	0	0	0	2,596	2,545	4,083
Activities	13,922	0	0	0	0	0	0	0	0	0	0	0	0
Factors	0	8,291	0	0	0	0	0	0	0	0	0	0	0
Transfers	0	0	0	0	170	4,649	0	0	0	0	1,067	0	626
Households	0	0	3,583	272	0	0	0	0	0	0	0	0	170
Other Institutions	0	0	4,183	3,070	0	0	0	0	0	0	0	0	1,010
Govt - Taxes on Products	1,087	0	0	0	0	0	0	0	0	0	0	0	0
Govt -Taxes on Production	0	15	0	0	0	0	0	0	0	0	0	0	0
Govt - Subsidies	0	-44	0	0	0	0	0	0	0	0	0	0	0
Govt - Taxes on Income	0	0	0	0	94	1,263	0	0	0	0	0	0	0
Other Government	0	0	525	2,528	0	0	1,087	15	-44	1,356	0	0	0
Capital	0	0	0	0	105	1,190	0	0	0	0	1,731	856	-481
Rest of World	3,625	0	0	641	57	1,012	0	0	0	0	73	0	2,322
Total	19,351	13,922	8,291	6,512	4,025	8,263	1,087	15	-44	1,356	5,467	3,402	7,729

The nature of transactions involving the other institutions account is revealing about the economy of Botswana. Most of the income received by other institutions comes from payments for factor services (50%), but there are also substantial payments from the rest of the world (12%) and large transfers (37%). Payments from the rest of the world are in fact dominated by earnings on foreign investments while the transfers are largely dominated by intra institutional transfers. Some of the extent of this is indicated by the fact that other institutions are responsible for 71% of the income to the transfers account with the government only contributing 16%, the rest of the world 9% and households 3%. The complexity of the intra institutional transactions is further indicated by the expenditures on the transfers account – 46% to government, 37% to other institutions, 8% to the rest of the world and 7% to households. Much of the reason for the apparent complexity lies in the pattern of the transactions whereby the government receives royalties in respect of mineral – primarily diamond – extraction, but this is only part of the reason. The rest is to be found in a combination of detailed accounting for inter institutional transactions, which capture the pathways by which incomes are received and limits on the amount of detail available in the underlying data that necessitate the use transfer accounts where details about both payees and recipient are not complete.

The importance of incomes as a source of government incomes is shown by the fact that transfers account for 46% of government income, which is slightly more than the 44% that comes from tax revenues. The government is also a major source of investment funds providing 65% of all investment funds with a further 43% coming from other institutions and only 4% from households. However, as part of government policy, the running of a trade surplus means that the balance on the capital account is negative, i.e., there is an outflow of investment funds.

Overall even the macro SAM for Botswana is illustrative of the potential information content of a SAM while demonstrating the importance of at the least some knowledge of an economy to assist in interpreting the information. A full version of the SAM for Botswana is included in the accompanying Excel workbook.

6.2 Suggested Methods for Aiding the Interpretation of SAM

The best suggestion that can be made is to get copies of different SAMs and spend time analysing their information content. With practice users will find some things become second

nature when confronted by a new SAM. The following are a series of steps that can save time; some of them, especially the first few, might appear so trivial that you can ignore them but you do so at your peril. These steps can all be done in Excel; the computations take a matter of minutes once you have developed them once (certainly less time than would be required to organise the data so that they can be calculated in GAMS).

1. Before looking at the SAM learn about the economy.
    - Are there any structural features about the economy that should be reflected in the SAM, e.g., natural resource exports, income distribution, role of government, etc?
    - Are there accounts that should appear in the SAM, given the structural features of the economy?
    - What are the values of the macroeconomic indicators for the year of the SAM? (Look these up at the economy's statistical agency or the World Bank database.)
    - Was the year for the SAM a typical year, e.g., was there a drought, was there an oil price spike?
2. Check that the SAM has an appropriate set of accounts.
    - Does the account structure (commodities, activities, factor, households) reflect the structure of the economy?
    - Is there sufficient detail in the factor accounts to provide sufficient detail about sources of household incomes, and vis-a-versa?
3. Check that there are the same number of rows and columns.
    - Some practitioners have claimed that a SAM can be non-square; they are **wrong**.
    - Check the row and column labels are matched in terms of both the text and order; both inconsistencies are a nuisance and will cause problems later. This can be done using a simple IF statement where the value is zero if they match and 1 if they do not match.

- Some programmes, e.g., GAMS, do not report zero values, which means that a column/row can sum to zero if the respective row/column contains a specific mix of positive and negative values. If this is the case it may be helpful to reorganise the SAM by transposing the negative values and changing the sign.

4. Check that the row totals and the column totals are identical.

    - If the row and column total are not identical then there is a problem with the SAM.

        - GAMS works to double precision so identical means the same to abouy 14 decimal places. Some programmes work to single precision, e.g., GEMPACK, so identical would be about 7 decimal places.

    - If the row and column total are not identical, use the computed totals and differences to determine which transaction or transactions are apparently wrong. It may be a simple typing error!!!

    - If the errors are widespread in the SAM, and/or there is no obvious explanation, it is not worth analysing the information content before resolving the errors.

5. Compute the column coefficients.

    - The column coefficients are cost shares and are the **most important determinants** of the results from CGE models.

        - Column coefficients for some sub matrices may be needed to 'unmask' odd entries.

    - If the column coefficients are the same for two, or more, accounts within the same group then, unless there is a known good reason the accounts should be aggregated. The interpretation of common column coefficients, assuming they are based on data, would be

        - Activities: two, or more, activities are producing an identical output;

        - Factors (expenditures): two, or more, institutions have identical patterns of factor ownership;

        - Households: two, or more, households have identical preferences.

- Intermediate Input Use (additional column coefficient matrices)
    - it is not uncommon for data compilers to have very little information on the breakdown of intermediate input costs. Check for logically inconsistent entries, e.g., energy producing activities that use small amounts of fossil fuels, etc.
- Factor Use by activity (additional column coefficient matrix)
    - are the factor costs logically consistent? Are the cost shares for capital logical, i.e., higher for capital intensive industries; are the cost shares for skilled labour consistent with the nature of the activity, etc.
- Households
    - Are savings and direct tax rates logical, e.g., are the tax and savings rates greater for richer households? Are the direct tax rates consistent with expectations, e.g., are poorer households paying high direct rates? Are the consumption patterns consistent, e.g., is the share of expenditure on food higher or lower for poorer households?
- Exports
    - Are the patterns of exports consistent with expectations, e.g., diamonds from Botswana, oil from Saudi Arabia, car from Germany?

6. Compute the row coefficients

- Are the patterns of tax revenue to the government consistent with expectations, e.g., is the share of direct tax high for a developing economy?
- Are the patterns of household incomes consistent with expectations, e.g., do richer households get more of their incomes from capital and skilled labour?
- Imports
    - Are the patterns of imports consistent with expectations?

References

CSO (1990). *Social Accounting Matrix 1985/86*. Gaborone: CSO.

CSO (1996). *Social Accounting Matrix 1992/93*. Gaborone: CSO.

Defourny, J. and Thorbecke, E., (1984). 'Structural Path Analysis and Multiplier Decomposition Within a Social Accounting Matrix Framework', Economic Journal, Vol 94, pp 111-136.

Keuning, S.J., (1994). 'The SAM and Beyond: Open, SESAME!', *Economic Systems Research*, Vol 6, pp 21-50.

Miller, R.E. and Blair, P.D., (1985). *Input-Output Analysis: Foundations and Extensions*. Englewood Cliffs: Prentice-Hall.

Pyatt, G., (1987). 'A SAM Approach to Modelling', *Journal of Policy Modeling*, Vol. 10:327-352.

Pyatt, G. and Round, J.I., (1979). 'Accounting and Fixed Price Multipliers in a Social Accounting Matrix Framework', Economic Journal, 89, 850-873.

King, B.B., (1985). 'What is a SAM?', in Pyatt, G. and Round, J.I. (ed), Social Accounting Matrices: A Basis for Planning. Washington: World Bank.

Pyatt, G. and Round, J.I., (1977). 'Social Accounting Matrices for Development Planning', Review of Income and Wealth, Vol 23, pp 339-364.

Pyatt, G., (1991). 'Fundamentals of Social Accounting', *Economic Systems Research*, Vol 3, pp 315-341.

Pyatt, G., (2005). Sir Richard Stone: an appreciation

Reinert, K.A. and Roland-Holst, D.W., (1997). 'Social Accounting Matrices' in Francois, J.F. and Reinert, K.A., (eds) (1997). Applied Methods for Trade Policy Analysis. Cambridge University Press: Cambridge.

Stone, R., (1962). *A Social Accounting Matrix for 1960*. Volume 2 in A Programme for Growth. London: Chapman and Hall.

Stone, R., (1974). 'Forward' in Pyatt, G., Roe, A.R. and Associates, Social Accounting Matrices for Development Planning with Special Reference to Sri Lanka. Cambridge: Cambridge University Press.

UN, (1993). *System of National Accounts*. New York: UN.

UN, (2009). *System of National Accounts 2008*. New York: UN.

UN, (1999). *Handbook of Input-Output Table Compilation and Analysis*. Studies in Methods Series F, No. 74, Handbook of National Accounting. New York: United Nations.