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TMD DISCUSSION PAPER NO. 69

**A 1998 SOCIAL ACCOUNTING MATRIX FOR
MALAWI**

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February 2001

TMD Discussion Papers contain preliminary material and research results, and are circulated prior to a full peer review in order to stimulate discussion and critical comment. It is expected that most Discussion Papers will eventually be published in some other form, and that their content may also be revised. This paper is available at <http://www.cgiar.org/ifpri/divs/tmd/dp.htm>

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A 1998 Social Accounting Matrix for Malawi

Osten Chulu¹ and Peter Wobst²

1.0 Introduction and Background

The last few years have seen a proliferation of attempts by various institutions to create a framework that would enable analysts to have a broad overview of all transactions in the Malawian economy. A first attempt was made by Lodh and Chulu (1994) to construct a macro accounting framework using data from the National Statistical Office's 1990-1991 Household Expenditure and Small Scale Economic Activities Survey and the National Sample Survey of Agriculture complemented by other data sets such as the Government Budget Estimates, National Accounts and External Trade Statistics. This framework consisted of 9 sectors using 1987 as the base year. However, this framework was lacking in detail such that it was extremely limited in its usefulness as a basis for policy analysis. The main drawback was that it followed the one digit ISIC³ classification: agriculture; mining; manufacturing; construction; utilities; distribution; transport; financial institutions; and community, social and personal services. The exercise created considerable interest by various government agencies such that in 1995, an Input-Output survey was commissioned and subsequently conducted by the National Statistical Office and the Economic Planning Department which lead to the construction of the first comprehensive Input-Output (IO) table for Malawi for the year 1994 (EPD 1996). This formed the groundwork for the construction of a Social Accounting Matrix⁴ (SAM) for Malawi for 1994 (Chulu, Wobst and Brixen 1998). The data from the IO table presented better disaggregation of agriculture and other sectors. Unfortunately, the SAM relied heavily on household data from the 1990-1991 Household Expenditure and Small Scale Economic Activity data which was relatively outdated. In addition, there were numerous inconsistencies in macroeconomic statistics coupled with the fact that 1994 was too distant in the past and that too many structural changes had taken place in the interim, rendering some of the macro-relationships obsolete. Further, the year 1994 was not a "normal" economic year for Malawi. There were several events and changes that took place during that year that included the following:

- # a total liberalization of the exchange rate regime which culminated in a huge depreciation of the domestic currency of over 150%;
- # price deregulation in all commodities except for maize;
- # an unprecedented drought which resulted in huge decreases in agricultural production and hence exports, as well as huge increases in imports of food stuffs;

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²Trade and Macroeconomics Division, IFPRI

³International Standard Industrial Classification

⁴For in depth elaboration of Social Accounting Matrices see Pyatt and Round (1985).

- # the Mozambican refugee crisis;
- # an inflation rate of over 83%;
- # a large government deficit.

These factors, coupled with the fact that the 1994 Social Accounting Matrix stimulated increasing interest by research institutions to further develop it and use it to develop a consistent framework for in depth policy analysis that integrates macro and micro issues led to a rethinking of maintaining 1994 as a base year. It was decided that 1998, the most recent year for which a comprehensive data set is available and a more normal year, would be the base year for the SAM. The National Statistical Office conducted a major household survey⁵ which provided information on budget shares, incomes and many other social-economic characteristics of households. Moreover, 1998 saw marked improvements in External Trade statistics and National Accounts had been rebased to 1994 from 1978. Nonetheless, there are still a lot of inconsistencies between the various official publications referring to the same variables, for instance, there are three different values for government consumption from the Economic Report published by the National Economic Council, the Quarterly Statistical Review published by the Reserve Bank, and the Monthly Bulletin of Statistics published by the National Statistical Office.

Scope and Structure of the Paper

This paper is part of a broader report covering the macroeconomic policy setting and historical background in Malawi (IFPRI 2000), the Malawi Social Accounting Matrix for 1998 (Chulu and Wobst), the documentation of the first Computable General Equilibrium (CGE) model for Malawi (Löfgren 2000a) and simulations with a CGE Model for Malawi on external shocks and domestic poverty alleviation (Löfgren 2000b). It is part of a collaborative effort between the International Food Policy Research Institute (IFPRI) and Bunda College of Agriculture with participation from the Reserve Bank of Malawi and The National Economic Council under the project *Collaborative Research and Capacity Strengthening in Malawi and Southern Africa* funded by the German BMZ. One of the main areas of focus of this project has been to develop a tool that would facilitate the exploration of the effects of external shocks and domestic policy changes aimed at poverty alleviation (Löfgren 2000b) using a SAM based CGE model.

The paper is structured as follows: The first section gives the introduction, including the scope and structure of the paper. The second section of the paper provides a description of the 1998 SAM for Malawi, containing a subsection on the aggregated SAM, herein called the Macro SAM and a subsection on the construction of the disaggregated SAM, herein called the Micro SAM. This subsection presents the datasets used and provides the sectoral breakdown for activities and commodities as well as details on classification of all other accounts. Data transformations and

⁵ The Integrated Household Survey conducted in 1997-98 (NSO 2000).

manipulations is also described in this subsection on the Micro SAM. A third section describes the cross-entropy approach that has been employed to balance the Micro SAM, as well as the assumptions used and constraints imposed. Appendix A2 provides the full balanced Micro SAM of Malawi for 1998 obtained from the construction exercise described in this paper.

2.0 Social Accounting Matrices

A Social Accounting Matrix is a square matrix of monetary flows that reflect all transactions between the various entities in an economy. It maps out all flows of funds emanating from one actor paid to another. The number of transactors, called accounts, constitute the dimension of the square matrix. By convention, all column accounts represent expenditures or outlays, while the row accounts of the SAM represent incomes or receipts. One fundamental characteristic of the SAM is that it provides a comprehensive and consistent record of interrelationships in an economy at the level of individual production sectors and factors, as well as private, public and foreign institutions. SAMs disaggregate the macroeconomic (national) accounts and link these with the economy's input-output accounts.⁶ The SAM is thus an expansion of input-output accounts incorporating more disaggregated details of factors and institutions, such as the various types of labour and households. Thereby, it provides an economywide perspective of all macroeconomic, sectoral and institutional transactions in a fully consistent framework.

A SAM is represented as a square matrix

$$\mathbf{X} = \{x_{ij}\}$$

where x_{ij} is the value of the transaction with income accruing to account i from expenditure by account j . Nominal flows cross the SAM from columns to rows. For transaction involving goods and services, there are corresponding real flows from rows to columns. For financial transaction, there are corresponding flows of assets from rows to columns. For pure transfers, there are only nominal flows from column accounts to row accounts. The corresponding row and column accounts of a SAM must be equal. That is

$$\sum_j x_{kj} = \sum_i x_{ik} \quad \text{for all } k$$

As a consequence of this, SAMs satisfy a variant of Walras's Law. If all accounts but one balance, then the last account must balance as well (Reinert and Roland-Holst 1997).

⁶Input-output accounts capture inter-industry relationships through flows of intermediate inputs between different sectors, *i.e.*, representing the production technology of each economic activity. It also gives a summary of value-added accruing to each activity and finally provides information on the structure of final demand (private consumption, government expenditures, investments, exports and imports).

We distinguish two types of SAMs. The first, the Macro SAM, gives—as the name suggests—an aggregated perspective of the flow-of-funds in an economy. It provides singular aggregates of all accounts without sectoral or institutional detail. Data for the Macro SAM comes from National Accounts statistics, the Balance of Payments statistics, Government Accounts and Foreign Trade statistics. Supplementary data may come from various Reserve Bank sources. The second type of SAM is the disaggregated Micro SAM. It disaggregates most of the Macro SAM accounts with respect to desired sectoral and institutional breakdowns. Sectors are broken down according to what they produce and the technology they employ (input-output relationships), households are broken down according to various predefined characteristics subject to household data availability and factors are disaggregated based on the available data from labour force surveys. The input-output table forms the basis for the activity and commodity accounts in the disaggregated SAM while data on households comes from household surveys. It is indeed worthwhile to note that data from different sources present numerous anomalies and inconsistencies. The SAM constructor has a formidable challenge to bring consistency into the entire framework, especially when dealing with data sets from developing countries.

2.1 The 1998 Macro SAM for Malawi

The 1998 Macro SAM is a square matrix comprising 10 rows and columns forming separate accounts in the economy. Its conceptual scheme is presented in Table 1. The non-zero intersections between rows and columns in the Macro SAM give the specific flows of funds between various accounts. Depending on data availability and the degree of aggregation which the analyst wishes to work with, the Macro SAM can be presented in varying levels of detail. The Macro SAM forms the basis from which a more elaborate and detailed framework, the Micro SAM, is constructed. Most cells in the Macro SAM represents a block or an array of data, disaggregated to the desired detail in the Micro SAM. In essence therefore, the cells in the Macro SAM function as the control totals for the corresponding blocks in the Micro SAM during the disaggregation process. The 1998 Macro SAM (see Appendix A1) for Malawi distinguishes the following accounts:

1. Activities

Activity column entries indicate expenditures incurred during the production process and include purchases of intermediate inputs and payments to the factors of production—including factors used in the production for home consumption (value-added at factor cost). In the absence of production taxes, total factor payments equal total gross output of the economy. In the 1998 Macro SAM for Malawi, intermediate goods are netted out since they are not part of GDP at factor cost (national income). Value-added at factor cost in the 1998 Malawi Macro SAM amounts to MK49,992 million.

2. Commodities

The total supply of commodities, valued at market prices, is given as domestic marketed

production, imports of goods and non-factor services, indirect taxes (sales taxes, domestic and imported goods surtax), as well as export taxes and import duties, as shown in the commodity column in Table 1. The commodity row gives the total demand for marketed commodities and includes intermediate demand of activities (netted out in the Malawi case), household and government consumption, investment demand of both government and private sector, changes in stocks as well as export demand of goods and non-factor services. In the absence of production taxes, total domestic commodity supply (including export supply) in the 1998 Malawi SAM is equal to total value-added at factor cost of MK49,992 million. The intersection between the commodity column and the recurrent government row gives the indirect taxes paid. This is an amalgamation of domestic sales taxes, surtax on imported and domestic goods and import duties, including export taxes paid to government in the first half of 1998. The total Macro SAM value of all indirect taxes on commodities is MK5,089 million. The final non-zero entry in the commodity column is the intersection with the rest of the world. This gives the total value of imports of goods and services at their CIF value of MK23,743 million.

3. Factors

Factors include labour, capital and land. Total factor income (GDP at factor cost or national income) consists of compensation of employees (wages and salaries) as well as operating surplus comprising rents on land and capital, represented by the receipt of the factors row from the activity column. The factor account pays rents on capital and land to enterprises and wages and salaries to households, which is represented by the factor column of Table 1. The factor account may also pay factor taxes to the government and factor payments to the rest of the world account. There is no explicit differentiation between value-added labour and value-added capital at this stage. The GDP at factor cost is a lump sum figure which, after some manipulations can yield value-added paid to labour (households) and value added paid to capital and land (enterprises). In the 1998 Macro SAM, the value added paid to capital and land was computed at MK15,557 million while that paid to labour was MK32,715 million. Factors pay factor taxes to recurrent government amounting to MK489 million. Factors pay to the rest of the world factor payments abroad amounting to MK1,230 million. This value is derived from Balance of Payments statistics. The total for the factor column gives the value added at factor cost of MK49,992 million

4. Enterprises

Enterprises earn profits from capital and land and may receive subsidies from the government in the row account. They pay taxes to the government, distribute profits to households and the rest of the world, and retain some of the profits as savings. The payment by enterprises to households in the 1998 Macro SAM is MK22,313 million and direct enterprise taxes amount to MK1,541 million. Enterprises also pay MK123 million worth of interest and other transfers to the rest of the world. MK142 million was saved by enterprises.

5. Households

The household column indicates the allocation of total household income among the various

uses, namely, combined own account and marketed consumption, income taxes paid to the government and savings, while the row represents total income earned by households and comprises of factor incomes, transfers from the government, as well as net transfers from the rest of the world (*e.g.*, remittances from abroad). The 1998 Macro SAM for Malawi combines own account consumption and the consumption of marketed commodities. Households consumed MK46,314 million worth of commodities, paid MK1,512 million to recurrent government as taxes and saved MK213 million.

6. Recurrent government

The row includes all receipts by government for recurrent uses and includes taxes levied on the various accounts in the economy such as indirect taxes, corporate taxes, income taxes and trade taxes, as well as transfers from the rest of the world in the form of grants. The revenue from these taxes is spent on government expenditures on goods and services, transfers to households and enterprises, as well as government savings represented by the recurrent government column, which shows a total of MK7,199 million as government recurrent expenditure on goods and services, MK1,598 million as direct government transfers to households and MK2,942 representing government saving.

7. Government investment

All outlays paid for investment goods by government funds are located in the intersection between government investment and commodities. The value for this cell in the 1998 Macro SAM for Malawi is MK4,700 million and gives the actual amount of expenditure on the Development Account as reported in the Financial Statement for 2000 (MoF 2000).

8. Savings and investment

The column gives the total investment expenditure in the economy, comprising private sector investment in the intersection with commodities valued at MK1,273 million in 1998, and government investments in the intersection with the government investment row (MK4,700 million). The last non-zero cell in this column is the changes in stocks, amounting to MK1,289 million in 1998. The total of the column represents gross fixed capital formation in the economy.

9. Change in stocks

This account represents changes in inventories in producing sectors which is a component of gross fixed capital formation. The value is taken from national accounts statistics in the Economic Report for 2000 published by National Economic Council (NEC 2000). In 1998, changes in stocks amounted to MK1,289 million.

10. Rest of the world

Exports of goods and services (foreign payments to the commodities account), foreign loans, grants and other transfers are given in the column, while purchases of imports and receipts of factor payments and net interest payments of enterprises by the rest of the world are specified in the row. In 1998, Malawi exported goods and services amounting to MK18,022 million while

grants and transfers from abroad to recurrent government were at MK3,110 million. The loans from the rest of the world on the development account are represented by the intersection between the rest of the world column and the savings-investment row and stood at MK3,964 million.

1998 Macro SAM of Malawi: Data Sources

From these accounts, a general structure of an aggregated SAM is derived, in which each column total equals the respective row totals. Three major sources of data were used to construct the Macro SAM for 1998. The November 1999 issue of the Monthly Bulletin of Statistics published by the National Statistical Office was the primary data source (NSO 1999). This publication contains tables on National Accounts giving details on Gross Domestic Product at factor cost, total Domestic Supply, Gross Fixed Capital Formation, the Balance of Payments, Government Statistics and External Trade Statistics. This was complemented by the Economic Report, 2000 published by the National Economic Council (NEC 2000) and the 1999 Quarterly Statistical Review of the Reserve Bank (RBM 1999). The Financial Statement published by the Ministry of Finance and Economic Planning as part of the Budget Document series provided information on Government operations on both revenues and recurrent expenditures (MoF 2000). Tax data was derived from various reports, but mainly from the Reserve Bank's Quarterly Statistical Review which provides government revenue on a quarterly basis, as opposed to the Ministry of Finance which provides its statistics on a financial year basis (1st July - 30th June). The Quarterly Statistical Review also provides statistics on external loans and grants, capital flows and the external reserve position. The Balance of Payments in both the national accounts chapter of the Economic Report and the Monthly Bulletin of Statistics give both receipts and payments of non-factor incomes and all other transfers including the rest of the world. Inconsistencies still persist in the available data from the different institutions necessitating the employment of some data manipulations to enhance consistency between economic variables.

Table 1: Structure of the 1998 Macro SAM for Malawi

	Activities	Commodities	Factors	Enterprises	Households	Recurrent Governm.	Governm. Investment	Savings / Investment	Changes in Stocks	Rest of the World	Total
Activities		Marketed Production									Total sales
Commodities	Intermediate Consumption				Final Household Consumption	Government Final Recurrent Consumption	Government Expenditure on Investment	Private Investment	Changes in Stocks	Exports (FOB)	Domestic Demand
Factors	Value-Added at Factor Cost										Value-added at Factor Cost
Enterprises			Value-Added Capital								Enterprise Income
Households			Value-Added Labour	Distributed Profits		Subsidies and Social Security					Household Income
Recurrent Governm.		Sale, Surtax, Import duties	Factor Tax	Corporate Tax	Individual Income Tax					Grants and Transfers from ROW	Government Recurrent Receipts
Governm. Investment								Government Investment			Government Investment
Savings / Investment				Enterprise Saving	Household Saving	Government Saving				Loans from ROW on Dev. Account	Savings
Changes in Stocks								Changes in Stocks			Changes in Stocks
Rest of the World		Imports (CIF)	Factor Payments Abroad	Interest Payments etc.							Payments abroad
Total	Gross Output	Total Commodity Supply	Value-added at Factor Cost	Enterprise Expenditure	Household Expenditures	Government Expenditures	Government Investments	Investments	Changes in Stocks	Receipts from abroad	

2.2 The 1998 Micro SAM

After the construction of the 1998 Macro SAM for Malawi, we now have a tool which we can use to control the disaggregation process of the Micro SAM. Constructing a Micro SAM involves a process in which the main account types contained in the Macro SAM and the non-zero data entries are disaggregated to provide a more detailed picture of all flows in the economy. Each of the non-zero cells in the Macro SAM serves as a control total for the associated disaggregated block in the Micro SAM. Each of the different accounts in the Macro SAM are treated separately using data from various sources.

Several factors are taken into account when deciding on the level of disaggregation. First, a decision has to be made about how we want to disaggregate the cells in the Macro SAM. This decision is based on what we want to analyze and how we want to achieve this. Sometimes we wish to analyze the impact of specific policies on the welfare of different types of households, or impact of policies on production. In each case, the disaggregation adopted will have to suit the purpose of the analysis. Second, we have to determine how we can disaggregate the cells from the Macro SAM. This depends, to a large extent, on the availability of data and the way in which data is presented by the relevant authorities. In many instances, data comes in formats that are difficult for analysts to manipulate without making some very critical assumptions. Government expenditure figures are, for instance, given on the basis of a financial year while most other information is on calendar year basis. In the absence of government calendar year values, assumptions have to be made about average monthly expenditures of the government which then have to be calendarized⁷.

Household disaggregation also requires the availability of a household budget survey to be reliably accurate. The level of disaggregation of households is dependent on the way the data was collected and the way the data is presented. The household characteristics that are sought when undertaking a household survey dictate the detail at which households can be classified. Linked to household disaggregation is the disaggregation of factors. Factors, in a SAM framework earn incomes that are then channeled into households and other institution. One has to be careful to have particular factors mapped to particular households.

Malawi, like many developing countries, presents its statistics in various official publications, notably the Economic Report, the annual Financial Statement, the Government Budget Estimates, Agricultural Statistical Bulletins, the External Trade Statistics Reports and the Household Surveys. Unfortunately, there are many differences and inconsistencies in these publications. The National Accounts aggregates in the Economic Report from the National Economic Council differ from those presented in the Annual Statistical Review published by the Reserve Bank. The same is true for exports and imports. The Balance of Payments give one version of imports and exports and their corresponding tariffs while the External Trade Statistics gives another. In some instances, different publications from the same institution give different values for the same variable. In these situations, informed judgements have to be made taking

⁷Transforming fiscal year data from two subsequent years into data for one calendar year.

into account the views of the concerned institutions, including judgements based on the most consistent macro-flows as given by the Macro SAM.

2.2.1 The Disaggregation of the Accounts in the 1998 Micro SAM

The main data source that forms the basis of the 1998 Micro SAM is the 1994 IO matrix. In the absence of an input-output table for 1998, we have assumed that technical coefficients⁸ have not changed much since 1994, *i.e.*, the technology employed in producing commodities in 1994 is basically the same for 1998. Accounting for the production of goods and the supply of commodities to domestic and export markets makes up the largest part of the Micro SAM. The 1998 Micro SAM distinguishes 38 productive activities, which is an aggregation of the 45 activities in the 1994 IO matrix. The 1994 IO matrix contained one commodity representing complementary imports for which no Malawian substitutes exist. The complementary import commodity row of the 1994 IO table was broken down according to the commodity weights in the import value of the complementary import and spread to the various activities. Thus the 1998 Micro SAM's intermediate input block contains both domestically produced intermediate inputs and imported intermediate goods.

The 1998 Micro SAM also distinguishes between small-scale and large-scale activities in three of the agricultural sectors where the production technologies employed differ significantly, namely tea, tobacco and other crops. Small-scale activities refer to those activities that are classified as "smallholders" by the Ministry of Agriculture and the National Statistical Office (less than 10 ha). In the case of agriculture, large-scale activities are mainly estates or farms of more than 10 ha or sectors with more than 100 employees and/or a turn-over of over MK1,000,000. Owing to the commodity's strategic importance, petroleum products are separated from the chemicals commodity and treated separately for simulation purposes.⁹

Of the 38 productive activities defined in the Micro SAM, 11 are agricultural activities, 18 are manufacturing activities, and 9 are service activities out of which 3 are distribution activities. However, the Micro SAM only distinguishes between 36 commodities, each corresponding to a unique activity with the following exceptions:

- There are three agricultural activities that are disaggregated into large-scale and small-scale, but produce the same commodity. Large-scale and small-scale Tea will produce one commodity, Tea; large-scale and small-scale Tobacco produce one commodity, Tobacco; and similarly, large-scale and small-scale Other crops produce one commodity, Other crops.
- There is one commodity for which does no corresponding activity exists, which is petroleum products. Malawi does not produce any petroleum, but it appears as a separate commodity because of its strategic importance.

⁸ Technical coefficients refer to the share of each intermediate input element in total sectoral gross output.

⁹All petroleum products are imported as a finished product and there is no domestic production. However, due to the petroleum sector's importance and strong linkages with a vast majority of the other sectors in the economy, we separate it out of the chemicals sector to facilitate focused simulations at the CGE modeling stage.

The complete sectoral disaggregation of the Micro SAM is presented in Table 2.

The Micro SAM contains one account for each activity and one for each commodity, although each commodity account can be perceived as consolidating four accounts, one for import, one for export supply, one for domestic supplies to domestic markets and one for composite supply to domestic markets.

Table 2: Activities and Commodities in the Micro SAM

	Activities	Description	Commodities
1	AMAIZE	Maize	CMAIZE
2	ATEAS	Tea and coffee small-scale	CTEA
3	ATEAL	Tea and coffee large-scale	
4	ASUGA	Sugar growing	CSUGA
5	ATOBAS	Tobacco growing small-scale	CTOBA
6	ATOBAL	Tobacco growing large-scale	
7	AOCRPS	Other crops small-scale	COCRP
8	AOCRPL	Other crops large-scale	
9	AFISH	Fisheries	CFISH
10	ALIVE	Livestock and poultry	CLIVE
11	AFORE	Forestry	CFORE
12	AMINE	Mining	CMINE
13	AMEAT	Meat products	CMEAT
14	ADAIR	Dairy products	CDAIR
15	AGRAI	Grain milling	CGRAI
16	ABAKE	Bakeries and confectioneries	CBAKE
17	ASUGP	Sugar production	CSUGP
18	ABEVE	Beverages and tobacco manufacturing	CBEVE
19	ATEXT	Textiles and wearing apparel	CTEXT
20	AWOOD	Wood products, furniture and fittings	CWOOD
21	APAPE	Paper and printing	CPAPE
22	ACHEM	Chemicals	CCEM
23		Petroleum products	CPETR
24	ASOAP	Soaps, detergents and toiletries	CSOAP
25	ARUBB	Rubber products	CRUBB
26	ACEME	Non-metallic mineral products	CCEME
27	AMETA	Fabricated metal products	CMETA
28	AMACH	Plant and machinery	CMACH
29	AELEC	Electricity and water	CELEC
30	ACNST	Construction	CCNST
31	AOILD	Oil distribution	COILD
32	AAGR	Agricultural distribution	CAGR
33	AOTHD	Other distribution	COTHD
34	AHOTE	Hotels, bars, restaurants and rooming houses	CHOTE
35	ATELE	Telecommunications, transport, clearing and forwarding	CTELE
36	ABANK	Banking and insurance	CBANK
37	ABUSI	Business services	CBUSI
38	APUBS	Public services	CPUBS
39	APERS	Personal, social and community services	CPERS

The intersection between the activity columns and the commodity rows gives the Input-Output

relationships mentioned before. 1998 value-added figures derived from the National Accounts statistics are superimposed on the 1994 technical coefficients to yield the new 1998 technical relationships.

2.2.2 Disaggregation of the Main Accounts

Factors

The 1997-98 Integrated Household Survey provides a rich source of information for classifying the various factors of production. The 1998 Micro SAM distinguishes between three basic factors of production: Labour, Land and Capital.

Labour

Labour is disaggregated into eight categories distinguished by type of occupation and level of education. First, we classify labour according to main occupation, namely agricultural labour and non-agricultural labour. Second, we further distinguish these by the level of education of the head of household in the following manner:

- No education agricultural labour;
- No education non-agricultural labour;
- Low education agricultural labour;
- Low education non-agricultural labour;
- Medium education agricultural labour;
- Medium education non-agricultural labour;
- High education agricultural labour;
- High education non-agricultural labour.

No Education implies that the head of household never had any formal schooling; Low education means that the head of household had between one to four years formal schooling; Medium education is for those with education between five years to ten years and, High education households are those with the head having more than ten years of education.

The IHS is the main source for disaggregating labour into these categories. The first step is to split the value-added by sector derived from the 1994 IO matrix adjusted to 1998 into value-added labour and value-added capital. Once this split is done, we take the value-added labour and superimpose ratios derived from the IHS specifying the various shares of the labour types to total labour income in each sector to obtain value added labour paid to each of the eight labour categories.

Land

Land is only allocated to agriculture and is demarcated according to the type of activities. Sectors which are predominantly large-scale were allocated "Large-scale land" and those that are small-scale in nature are allocated "Small-scale land".

Land value added is extracted from value added capital and accrues only to agricultural activities producing crops. We use hecterage and crop data contained in the Smallholder Crop Estimates published by the Ministry of Agriculture and calculate the hecterage-output ratios for small-scale agriculture and superimpose these on the gross output of the respective crops given in the IO matrix. Large-scale hecterage is derived from the Annual Agricultural Statistical Bulletin published by the Ministry of Agriculture. This gives hecterage of all large-scale crops which we use to calculate the hecterage-gross output ratio. Again we superimpose these ratios on the gross output to derive value-added land for large-scale agricultural sectors.

Capital

Capital is sub-divided into Capital agriculture small-scale; Capital agriculture large-scale and Capital non-agriculture in accordance with the three types of enterprises which in turn have been chosen in accordance with different activity types.

Value-added capital is what remains once value-added land has been extracted from the initial value-added capital obtained from the IO matrix. The distinction between agriculture small-scale and agriculture large-scale is straight forward. All agricultural activities classified as large-scale receive large-scale capital, with the inclusion of sugar growing and forestry. Agriculture small-scale capital goes to maize, fisheries, and livestock and the sectors that are explicitly specified as small-scale. The rest is non-agriculture capital without the distinction between large and small-scale.

Institutions

Enterprises

Enterprises are classified in accordance with activities as follows:

- Enterprises agricultural small-scale;
- Enterprises agriculture large-scale;
- Enterprises non-agriculture.

Enterprises receive profits (operating surplus or value added capital) which they distribute to households, pay to recurrent government, save and also pay off interest payments and other enterprise transfers to the rest of the world. All agricultural large-scale capital goes to enterprises agriculture large-scale while agriculture small-scale capital goes into enterprises agriculture small-scale. Non-agriculture capital naturally goes to enterprises non-agriculture. The information required for these allocations is imputed within the Micro SAM construction process. The data is not exogenously found.

Households

The Integrated Household Survey 1997-98 provides the basis for classifying households in the household accounts. The 1998 Micro SAM distinguishes fourteen household types, classified according to main occupation, land holding sizes, level of education and household location.

First, the households are classified by location, *i.e.*, whether they are located in rural areas (all areas in Malawi except for the four urban centres), or in urban areas (Lilongwe, Blantyre, Mzuzu and Zomba). Then the households are classified according to the predominant activity – agriculture or non-agriculture. For agricultural households in the rural areas, a further breakdown is employed with land holding size as the basis. Non-agricultural households in rural and urban areas are classified according to the level of education of the head of household. In urban areas, there is only one agricultural household type. The final household accounts represent the following types of households:

- Rural agriculture less than 0.5 ha land holding;
- Rural agriculture between 0.5 ha and 1.0 ha land holding;
- Rural agriculture between 1.0 ha and 2.0 ha land holding;
- Rural agriculture between 2.0 ha and 5.0 ha land holding;
- Rural agriculture more than 5.0 ha land holding;
- Rural non-agriculture no education;
- Rural non-agriculture low education;
- Rural non-agriculture medium education;
- Rural non-agriculture high education;
- Urban agriculture;
- Urban non-agriculture no education;
- Urban non-agriculture low education;
- Urban non-agriculture medium education;
- Urban non-agriculture high education.

The households consume some of their produce as “own-account” consumption, purchase commodities in the market¹⁰ (final consumption which here is combined with own-account consumption), pay taxes to government and save. On the other hand, they receive incomes from the sale of their labour, incomes from enterprises and also transfers from government and from the rest of the world.

The data for the household account is drawn mainly from the IHS. Households are grouped according to the criteria laid out above, then budget shares from marketed and own account consumption are calculated from the household expenditure module of the IHS. Own account consumption is derived by multiplying the quantities consumed by respective prices taken from marketed consumption to yield own account consumption values. We then superimpose the total final consumption expenditure value from national accounts on these budget shares to obtain household consumption by commodity. Inter-household distribution of the control total is the weighted share of each household types total consumption to total household consumption for all household types.

¹⁰The commodities purchased and their respective values are derived from the Integrated Household Survey 1997-98 with a few adjustments to account for differences with published national accounts household consumption data.

Trade and Transport Margins

There are three distribution activities that are explicit in the Micro SAM, Agricultural Distribution, Oil Distribution and Other Distribution. These three sectors contain the trade and transport margins accruing to all commodities in the Micro SAM. The sectors are explicitly distinguished in the IO matrix and carried over in the Micro SAM¹¹.

Other Accounts

These accounts are those that are not broken down into sub-components in the 1998 Micro SAM for Malawi.

Government Recurrent

The Micro SAM contains a government recurrent expenditure account whose data is derived from the actual estimates of expenditure as published in the government budget reports, one government investment account with data from the same source as government recurrent expenditures and separate tax accounts which are used as conduits to shift funds from tax paying institutions and activities to government:

- Consumption taxes (sales taxes and surtaxes);
- Export taxes;
- Import tariffs;
- Factor taxes; and
- Direct taxes (individual income taxes and corporate taxes).

This account is not disaggregated into sub-groups but directly derived from the government budget reports. Particular commodities are reclassified to suit the Micro SAM specifications. However, most of the data here are presented in financial year basis and hence the main task was to transform all values into their calendar year equivalents. The supplementary data sources were the Economic Report (NEC); the Quarterly Statistical Review (RBM) and the Financial Statement (MoF). The Monthly Bulletin of Statistics (NSO) also gives a considerable amount of information on government operations.

Government Investment

The government investment account gives a commodity breakdown of all expenditures by government on investment goods. Investment goods for government are those goods that form part of gross fixed capital formation and constitute expenses of government on the development account. The Financial Statement (MoF 2000) gives a commodity breakdown of all investment outlays. These are reclassified in the Micro SAM, and then calendarized.

¹¹See Chulu, Wobst and Brixen (1998).

Savings and Investment (Private Investments)

The SAM also features a Savings-Investment account, representing private investments, savings and their sources of funds. The Macro SAM gives a control total for private investment which is then broken down by type of investment commodity. The IO matrix gives a commodity breakdown of investment outlays by the private sector which forms the basis for calculating commodity shares which are then used in tandem with the control total to yield the new investment values. Related to this is the change in stocks which is derived directly from National Accounts, recording the difference between stocks at the beginning of an accounting period and stocks at the end of the accounting period.

Rest of the World

This account records all transactions with the rest of the world. The main data sources for this account are the External Trade Statistics and the Monthly Bulletin of Statistics supplemented by the Balance of Payments statistics. The External Trade Statistics also gives information on import duties and surtaxes by commodity which are fed into the government recurrent account. Exports are valued at FOB while imports are valued at CIF. Figures for loans, grants and other factor and non-factor payments (net) to the rest of the world can be found in the Balance of Payments and the Quarterly Review of Statistics.

For good measure, row and column totals are also represented in the Micro SAM and these should ideally balance. In reality however, a data framework of this magnitude, derived from different and sometimes contradictory sources is difficult to balance. To balance the Micro SAM, a procedure, known as the cross-entropy method, is employed and described in the next section.

2.3 Balancing the SAM using a cross-entropy approach¹²

The Micro SAM entries presented in Appendix A2 are not only the result of sectoral data information and relative spreads within the various sub-groups of accounts, but also the result of the final balancing procedure of the SAM. A cross-entropy approach to SAM estimation is used for the balancing process leading from the unbalanced to the balanced Micro SAM. Since data availability and data consistency are limited, the cross-entropy approach is an appropriate tool for estimating a balanced and consistent data base starting from an unbalanced data base that contains all available information.

The SAM is defined as a matrix $T_{i,j}$ (a payment from account j to account i) of monetary flows, representing receipts and expenditures of all economic agents. Following the convention of double-entry bookkeeping, total receipts and total expenditures of a particular agent i have to be

¹²For a more detailed discussion of the cross-entropy approach to SAM estimation see Robinson, Cattaneo, and El-Said (2000).

equal, *i.e.*, respective row and column sums are balanced:

$$y_i = \sum_j T_{i,j} = \sum_j T_{j,i} \tag{1}$$

Dividing every cell entry of the flow matrix T by its respective column total generates a matrix A of column coefficients:

$$A_{i,j} = \frac{T_{i,j}}{y_j} \quad \text{with} \quad \sum_i A_{i,j} = 1 \quad \forall j \tag{2}$$

In matrix notation it follows that:

$$y = Ay \tag{3}$$

Balancing a SAM is an underdetermined estimation problem using information from many sources and various years. The cross-entropy approach¹³ allows the incorporation of errors in variables, inequality constraints, and prior knowledge about any part of the SAM—not just row and column sums. These features of the cross-entropy estimation technique allow great flexibility in incorporating specific information and implementing certain limits to which the estimation results are restricted. The general cross-entropy approach¹⁴ is described by the following optimization problem

$$\begin{aligned} \min & \sum_i \sum_j A_{i,j} \ln \left(\frac{A_{i,j}}{\bar{A}_{i,j}} \right) \\ \text{s.t.:} & \sum_j A_{i,j} y_j = y_i \quad \text{and} \quad \sum_j A_{i,j} = 1 \quad \forall i \end{aligned} \tag{4}$$

where \bar{A} is a coefficient matrix representing the (perhaps inconsistent and unbalanced) initial data (prior) that was chosen as a starting point of the cross-entropy balancing process to achieve the desired new coefficient matrix A .¹⁵ The described problem is set up to minimize the entropy difference between the two coefficient matrices which becomes more obvious by

¹³Following information theory developed by Shannon (1948) and further developed by Theil (1967) the expectation of separate information values can be described as the expected information of data points:

$$I(p:q) = \sum_{i=1}^n \frac{p_i \ln p_i}{q_i}, \text{ where } q \text{ and } p \text{ are prior and posterior probabilities regarding a set of events } E_i \text{ and}$$

$I(p:q)$ is the Kullback-Leiber (1951) measure of the “cross-entropy” distance between the two probability distributions. The cross-entropy approach minimizes the cross-entropy distance between the probability distributions that are consistent with the information in the data and the prior.

¹⁴As formulated by Golan, Judge, and Robinson (1994) to update an input-output table by solving for a new coefficient matrix A which minimizes the entropy difference between the underlying prior \bar{A} and the new matrix A.

¹⁵This means that the prior \bar{A} does *not* need to satisfy the model $y = \bar{A}y$, but the sum of its column coefficients adds up to one, *i.e.*, $\sum_i \bar{A}_{i,j} = 1 \quad \forall j$.

rearranging it to

$$\min \sum_i \sum_j A_{i,j} \left(\ln A_{i,j} \& \ln \bar{A}_{i,j} \right) \tag{5}$$

Additional equality and inequality constraints can be formulated as linear “adding-up” constraints on various elements of the SAM. For an aggregator matrix G , which has ones for those Micro SAM entries that correspond to a certain Macro SAM aggregate and zeros otherwise, the formulation for k such aggregation constraints is given by

$$\sum_i \sum_j G_{i,j}^{(k)} T_{i,j} = \tilde{a}^{(k)} \tag{6}$$

where $\tilde{a}^{(k)}$ is the value of the aggregate and the T_{ij} 's are the Micro SAM flows.

Measurement errors in variables can be incorporated into the system through

$$y = \bar{x} + e \tag{7}$$

where y is a vector of row sums and \bar{x} the initially known vector of column sums measured with error. The error e is defined as a weighted average of known constants

$$e_i = \sum_w W_{i,w} v_{i,w} \tag{8}$$

where w is a set of weights W , v are constants, and weights are subject to

$$\sum_w W_{i,w} = 1 \quad \text{with} \quad 0 \neq W_{i,w} \neq 1 \tag{9}$$

For the purposes of the Malawi Micro SAM, a symmetric distribution around zero given lower and upper bounds is chosen, using three weights.¹⁶ Consequently, the optimization problem of minimizing the entropy difference now contains a term for the weights W

$$\min \left(\sum_i \sum_j A_{i,j} \left(\ln A_{i,j} \& \ln \bar{A}_{i,j} \right) + \sum_i \sum_w W_{i,w} \ln W_{i,w} \right) \tag{10}$$

The explicit application of the cross-entropy estimation procedure on the Malawi Micro SAM contains a set of additional constraints that constrain various sums over sub-matrices of the SAM to their respective macro control totals that were presented in the Macro SAM.

First, within activities, the sum over all factor payments is fixed to their aggregate value as specified in the Macro SAM. As a result, total GDP at factor costs is constrained to its original value. Sectoral production may change within specified lower and upper limits which are imposed through the error specification, allowing shifts in relative sector shares of production in the economy. Second, the foreign trade entries are constrained to their macro totals, although the relative commodity composition of imports and exports may change. Third, total final household, government, and investment demands are bound to their macro totals as reported in

¹⁶Note that if the error distribution is symmetrically centered around zero and all weights are equal—as their initial prior values—the respective error equals zero.

the Macro SAM, as well as total own-household consumption. Finally, total income taxes, sales taxes, other indirect taxes, tariffs, and total remittances to households from abroad are fixed at their macro totals. Some single-cell entries are locked to their initial values if the data source applied is reliable, such as government investment demand and factor payments abroad.

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Appendix A1: Malawi Macro SAM 1998

	Activities	Commodities	Factors	Enterprises	Households	Recurrent Government	Government Investment	Savings / Investment	Changes in Stocks	Rest of the World	Total
Activities		49,992									49,992
Commodities					46,341	7,199	4,700	1,273	1,289	18,022	78,823
Factors	49,992										49,992
Enterprises			15,557								15,557
Households			32,715	13,771		1,585					48,072
Recurrent Government		5,088	489	1,527	1,522					3,110	11,736
Government Investment								4,700			4,700
Savings / Investment				136	209	2,952				3,964	7,262
Changes in Stocks								1,289			1,289
Rest of the World		23,743	1,230	122							25,096
Total	49,992	78,823	49,992	15,557	48,072	11,736	4,700	7,262	1,289	25,096	

	BZ	CA	CB	CC	CD	CE	CF	CG	CH	CI	CJ	CK	CL	CM	CN	CO			
1	cont. Appendix A2: 1998 Micro SAM for Malawi (in million KW)																		
2																			
3	L	A			B			O			R	L A N D		C A P I T A L			E N T E R P R I S E S		
4	NEALAB	NENLAB	LEALAB	LENLAB	MEALAB	MENLAB	HEALAB	HENLAB	LANDS	LANDL	CAPAGS	CAPAGL	CAPNAG	ENTERAS	ENTERAL	ENTER			
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91																			
92											1,350.6								
93												1,594.6							
94													12,612.0						
95	568.5	285.5	367.2	319.6	520.7	755.9	36.4	226.1	76.9						27.2				
96	709.9	287.1	656.8	309.6	692.2	504.1	42.2	132.0	191.0						67.7				
97	680.9	169.1	771.4	362.2	1,230.9	621.7	38.7	94.7	305.1						108.3				
98	184.7	64.8	203.0	57.8	473.6	228.7	38.0	18.8	1,324.8						472.1				
99	1.4		6.8	17.2	46.7	8.6			943.5	240.5					336.9	226.4			
100	461.8	849.5																	
101			550.7	1,068.6															
102					1,002.6	3,039.8													
103							101.2	890.3											
104	5.0	57.2	9.8	39.8	56.9	533.6	20.5	210.5	956.4	322.5				338.5	303.6				
105	6.4	454.8																	
106			6.9	283.0												2,700.9			
107					45.6	2,709.4					406.0				382.1	3,219.1			
108							57.1	3,102.2			652.0				613.6	4,974.8			
109																			
110																			
111																			
112						319.1		169.9											
113															62.6	1,464.6			
114															6.2	130.1			
115																			
116													1,230.4			122.5			
117																			
118	2,618.4	2,168.0	2,572.5	2,457.8	4,069.2	8,720.9	334.0	4,844.4	3,797.7	1,621.1	1,350.6	1,594.6	13,842.4	1,350.6	1,594.6	12,612.0			

	DD	DE	DF	DG	DH	DI	DJ	DK	DL	DM	DN				
1	cont. Appendix A2: 1998 Micro SAM for Malawi (in million KW)														
2															
3	T	H	E	R	I	N	S	T	I	T	U	T	I	O	N
4	GOVRE	GOVIN	IMTAX	COTAX	FATAX	EXTAX	DITAX	S-I	CHANGE	WORLD	TOTAL				
5											5,102.3				
6											413.9				
7											1,897.8				
8											260.8				
9											2,687.0				
10											6,016.5				
11											6,115.4				
12											2,984.6				
13											335.8				
14											1,532.2				
15											659.9				
16											707.3				
17											1,652.7				
18											528.2				
19											7,784.7				
20											424.0				
21											1,604.9				
22											3,078.5				
23											2,300.5				
24											1,878.6				
25											1,858.4				
26											2,159.6				
27											1,743.0				
28											448.8				
29											504.2				
30											1,989.4				
31											1,173.7				
32											2,864.4				
33											3,220.3				
34											583.9				
35											3,338.4				
36											8,378.5				
37											2,774.1				
38											3,421.1				
39											2,462.5				
40											1,396.3				
41											6,201.2				
42											2,166.1				
43	225.1									120.2	6,940.0				
44									28.5	1,639.5	2,342.5				
45									189.1		265.8				
46									1.1	8,605.5	8,759.9				
47									4.8	1,915.6	9,279.6				
48										19.7	352.9				
49			2.4					117.0	32.2	0.4	1,582.8				
50	6.8										679.8				
51											727.6				
52											2,473.3				
53											730.4				
54	104.9								111.7	18.1	8,850.6				
55											672.5				
56									21.6	529.0	1,807.3				
57									116.9	82.5	3,320.3				
58	76.4	7.1							37.1	586.2	4,334.6				
59		185.9							5.2	69.2	2,254.2				
60	826.5	4.1							10.7	138.6	2,765.6				
61	956.3								612.2	40.4	6,175.5				
62									59.8	67.5	2,106.0				
63									28.1	353.3	1,471.3				
64	4.9								5.4	9.5	1,059.2				
65	41.5	1,245.9						505.6		14.8	3,622.3				
66		542.3						101.0	19.4	486.0	6,830.3				
67	664.2									4.8	2,916.1				
68		2,712.4						549.6			3,308.7				
69											600.7				
70											3,407.5				
71											8,460.6				
72	519.8									768.4	4,610.7				
73	978.0									924.5	5,589.6				
74	169.1									1,292.1	4,266.0				
75	1,633.6									341.0	2,315.3				
76	554.1										6,374.1				
77	437.4										2,227.3				
78											2,618.4				
79											2,168.0				
80											2,572.5				
81											2,457.8				
82											4,089.2				
83											8,720.9				
84											334.0				
85											4,844.4				
86											3,797.7				
87											1,621.1				
88											1,350.6				
89											1,594.6				
90											13,842.4				
91											1,350.6				
92											1,594.6				
93											12,612.0				
94	237.9										3,421.7				
95	313.6										3,906.2				
96	234.9										4,617.9				
97	92.8										3,159.0				
98											1,828.1				
99	47.7										1,359.0				
100	79.3										1,698.5				
101	65.7										4,108.2				
102											991.5				
103	190.6										3,044.9				
104	239.3										700.5				
105	51.4										3,042.3				
106	32.0										6,794.2				
107											9,399.7				
108			1,403.9	3,627.9	489.0	56.5	3,049.1			3,110.0	11,736.3				
109								4,700.1			4,700.1				
110											1,403.9				
111											3,627.9				
112											489.0				
113											56.5				
114											3,049.1				
115	2,952.5									3,964.0	7,261.9				
116								1,288.6			1,288.6				
117											25,095.9				
118	11,736.3	4,700.1	1,403.9	3,627.9	489.0	56.5	3,049.1	7,261.9	1,288.6	25,095.9					

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