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SOCIAL ACCOUNTING MATRICES FOR MOZAMBIQUE 1994 AND 1995

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MACRO
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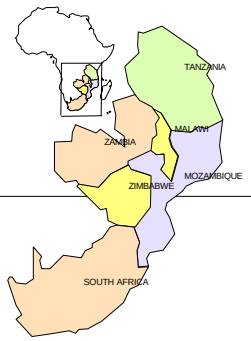

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ABSTRACT

This working paper documents the construction of the 1994 and 1995 Mozambican social accounting matrices (SAMs). The aggregate macro-SAM is called MACSAM, and the disaggregated version is MOZAM. With 13 agricultural and two agricultural processing activities, the primary sectors are particularly well represented in MOZAM. There are also 40 commodities, and the three factors of production: agricultural and non-agricultural labour, and capital. Two household types (urban and rural) are identified, and government expenditure is divided into two separate accounts, recurrent government and government investment. MOZAM includes a number of innovative features, partly reflected in household demand, where a distinction is made between home consumption of own production and private consumption of marketed commodities. Home consumption avoids trade and transport margins. Thus, MOZAM captures prevailing incentives for households to avoid markets and function more as autonomous production/consumption units. The disaggregation of household demand brings marketing margins in focus in relation to decisions regarding production. However, transactions costs are also important for exported and imported commodities. Domestic, export and import marketing margins are therefore explicitly broken out for each activity in MOZAM. Procedures used to balance MACSAM and MOZAM are also documented, including the use of maximum entropy methods to estimate the SAMs, which make efficient use of all available data in a framework that incorporates prior information and constraints.

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Comments are welcome and can be directed to: Finn.Tarp@econ.ku.dk

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LIST OF ABBREVIATIONS

AE	Anuário Estatístico
CGE	Computable General Equilibrium
E	Exports
ERP	Economic Rehabilitation Programme
FOB	Free on Board
GAMS	General Algebraic Modelling System (a software)
GDP	Gross Domestic Product
IO	Input-Output
ISIC	International Standard Industrial Classification
M	Imports
MACSAM	Mozambicam Macroeconomic SAM
MCE	Minimum Cross Entropy
MERISSA	Macroeconomic Reforms and Regional Integration in Southern Africa
MOZAM	Mozambican Microeconomic SAM
MPF	Ministry of Planning and Finance
Mt.	Metical (pl. Meticais)
NA	National Accounts
NDP	National Department of Planning
NDS	National Directorate of Statistics
NGI	Non-Government Investment
NGO	Non-Government Organisation
NIS	National Institute of Statistics
PAU	Poverty Alleviation Unit
RO	Research Office
ROW	Rest of the World
SAM	Social Accounting Matrix
SNA	UN System of National Accounts
UN	United Nations
VA	Value Added

CHAPTER 1

INTRODUCTION

The following document sets forth the procedures employed for developing balanced social accounting matrices (SAMs) for Mozambique for 1994 and 1995. It is intended to serve as a road map for the construction of the SAM. Consequently, it is descriptive in character, and the focus is on data, data related issues, and the structure of the SAM. It is highlighted that while considerable attention has been paid to 1994 in the elaboration of this study, the base year is 1995. In other words, 1994 can be considered an intermediate step in arriving at the goal of producing a useful 1995 SAM with a particular focus on the agricultural sector.

Chapter 2 describes data sources generally including information on the institutions responsible for data collection and dissemination in Mozambique. Chapter 3 carefully details the construction of the 1994 macroeconomic SAM. Chapter 4 explains the disaggregation of the 1994 macroeconomic SAM into a microeconomic SAM containing 40 commodities and 40 activities. Chapter 4 also presents a set of bilateral trade matrices for Mozambique. This information is not currently used in the SAM; but will be used in a planned analysis of trade patterns within the Southern Africa region. Chapter 5 sets out the methods and data employed for updating the SAM from 1994 to 1995. Relevant data and programming files are listed in Annex 1, and they are available from the authors in electronic form upon request, noting that there are minor differences between the 1994 and 1995 files in the treatment of data. They are generally described in what follows. Moreover, the macroeconomic SAMs for 1994 and 1995 are included in respectively Chapter 3 and Chapter 5, and the disaggregated SAM for 1995 is included in Annex 2. The 1994 SAM can of course be provided upon request.

The macro and micro SAMs developed in this study are in many ways standard. Acccordingly, they follow the general structure presented by Pyatt and Round (1985). There are, however, a number of special features, some of them firsts, associated with the macro and micro SAMs developed here. These aspects are therefore in focus in the remainder of this introduction.

1) No up-to-date SAM, macro or micro, has been available for Mozambique. The MERISSA project (Macroeconomic Reforms and Regional Integration in Southern Africa) has consequently tried to fill this gap by developing a picture of the Mozambican economy within the consistency requirements of this kind of accounting framework.

2) The data are new. At the moment, there are two institutions in Mozambique which prepare national accounts information. The macro and micro SAMs developed here rely mainly on the newer, and not yet official, set of national accounts prepared by the National Institute of Statistics (NIS). The NIS national accounts are more detailed and are widely believed to be of higher quality. They also differ substantially from the current official national accounts in both levels

and trends. For example, the NIS national accounts estimate of gross domestic product (GDP) for 1994 is 25 percent higher than the official figure. What is attempted here is to put, for the first time, these new data in a form amenable to in-depth economic analysis.

3) Relative to most SAMs for Africa, the SAM presented in this study contains a large amount of detail on the production side (40 activities). With 12 production agriculture activities and two food processing activities, the agricultural sector is particularly well represented. The population of Mozambique is more than 75 percent rural (Department of Statistics, 1994) with the vast bulk of these dependent upon agriculture for their livelihoods. Consequently, detail in the agricultural sector is highly desirable for analysing poverty alleviation and development strategy.

4) The macro and micro SAMs separate home consumption from consumption of marketed commodities. Home consumption avoids extremely important trade and transport margins, which can easily represent 50 percent or more of the marketed price. The SAM thus captures the prevailing incentives for households, particularly rural households, to avoid markets and function more as autonomous units. While significant domestic trade and transport margins are a feature of many African economies, the authors are unaware of a published SAM which distinguishes clearly between home consumption and consumption of marketed commodities.

5) Trade and transport margins are also important for commodities, which are exported or imported. Due to large distances and high transaction costs, the difference between the free on board (FOB) export price and the farm or factory gate price can be significant. For the same reason, the cost, insurance, and freight (CIF) can be considerably less than the price paid by consumers for imported commodities. Domestic, export, and import marketing margins are explicitly broken out here for each activity in the micro SAM. The authors are not aware of another SAM, which accounts explicitly for these margins.

6) Government expenditure is divided between recurrent government expenditure and government investment in both the macro and micro SAMs. The civil war in Mozambique, which ended in 1992, devastated infrastructure. The division of government expenditure into recurrent and investment categories highlights the role of reconstruction expenditures in the government budget. The division also facilitates the examination of investment expenditures relative to aid receipts and recurrent expenditures relative to tax revenue.

7) For both the micro and macro SAMs, cell entries are estimated subject to row and column sum balance using the minimum cross entropy estimation (MCE) procedure (Golan, Judge and Robinson, 1994). In the micro SAM, magnitudes of cell coefficients vary dramatically by as much as a factor of 10,000. This causes scaling problems in the estimation procedure, so a variable transformation is employed. The variable transformation reduces the computer time required here to solve the MCE problem by about one third.

An additional innovation that is not included in this study would be to regionalise the SAM focussing on the location of agricultural production activities. Due to the enormous distances separating the southern, central, and northern parts of Mozambique and the difficulties inherent in traversing these distances, this would, in fact, be a logical step forward, and would permit a more detailed examination of the critical role of transport margins already referred to above.

Constructing SAMs for use in economic analysis is an ongoing process. Moreover, as is clear in Chapters 2 and 3, data problems are particularly severe in Mozambique, especially with regard to input-output relationships. For the agricultural activities, reliable information on input-output relationships is simply not available. For the non-agricultural activities, an input-output table for 1991 exists. The data are, however, of dubious quality. Consequently, the authors were forced to rely upon scattered data sources and their own judgement. Efforts have been made to corroborate results with experts in Mozambique, and the current SAM reflects comments by experts in particular areas. Nevertheless, there is a definite need for further work in this area in order to improve the SAMs put forward in this document.

The SAM only contains two households: one rural and one urban. More information on households and household characteristics will become available once the 1997 household survey, conducted by NIS becomes available. This information could be used to further divide households into income generating socio-economic categories, which are useful for economic analysis.

CHAPTER 2

DATA AND DATA SOURCES

2.1 Introduction

No up-to-date aggregate SAM or input-output (IO) table has so far been published for Mozambique. There are, however, a number of relevant data sources, including an unpublished 1991 input-output table for non-agricultural activities,[1] which can be relied on in piecing together a consistent set of accounts for the 'real' sector of the economy.[2] This chapter examines the institutions involved in data collection and dissemination particularly for national accounts, briefly compares the two sources for national accounts data, details the information sources employed for construction of the National Institute of Statistics (NIS) national accounts, and presents the advantages of employing 1995 as a base year.

2.2 Data Collection, Analysis and Dissemination

For the years 1994 and 1995, the main central level government agency involved in the collection, analysis and dissemination of such information was the Ministry of Planning and Finance (MPF). The MPF, which is headed by the Minister of Planning and Finance and two Vice-Ministers, consists of a number of national directorates responsible for customs, taxes and auditing, the budget, the treasury, planning, statistics as well as human resources and administration. To this, comes special units dealing with privatisation of state companies, reform of customs and promotion of investment.

Up through 1996, the National Directorate of Planning (NDP) and the National Directorate of Statistics (NDS) were the two key directorates in the MPF which dealt with macroeconomic and other statistical data. The NDS published the Statistical Yearbook (*Anuário Estatístico*), which contains the official national accounts figures elaborated by NDP. The NDP also coordinates the preparation of annual economic and social plans, which are debated in Parliament. Moreover, the NDS and NDP have carried out a number of socio-economic surveys such as the 1991-92 Maputo household survey, the 1991 National Demographic Survey, and the 1992-93 provincial capitals household survey.

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[1] This table was kindly provided to us by the Department of National Accounts of the Ministry of Planning and Finance.

[2] It is highlighted that this study does not address the need for expanding the 'real' SAM to include financial sector transactions.

In 1997, a new National Institute of Statistics (NIS), reporting to the Council of Ministers was established. NIS took over the previous duties of NDS. In addition, it assumed responsibility for publishing all official statistics on the Mozambican economy, including agricultural statistics. The NIS initiated in 1996 a National Household Survey, which is analysed by a special Poverty Alleviation Unit (PAU) in NDP. This survey will be a critical source for future updates and improvements to the SAM. Another institutional development is the creation of a Research Office (RO) in the MPF, which will concentrate its efforts on economic policy studies.

It can, in addition, be mentioned that the Central Bank, *Banco de Moçambique*, regularly publishes data on monetary aggregates. These are not, however, in focus here as the SAM as already noted will be setup to cover 'real' economy transactions only.

The Ministry of Agriculture and Fisheries maintains its own statistical department which conducts regular surveys of production (total production for basic food crops and marketed production for other crops) and prices. Data from these surveys are published and employed in constructing national accounts estimates.

As mentioned in Chapter 1, two institutions, NDP of the Ministry of Planning and Finance and NIS, which has taken over the duties of NDS develop national accounts data. The following section compares the two sets of national accounts.

2.3 Two Sets of National Accounts

So far, the NDP has as already noted above published official national accounts statistics. Hence, international organizations such as the World Bank and International Monetary Fund have relied on this data source. Nevertheless, a new and consolidated set of national accounts covering the period 1991-94 was released by the NDS in June of 1996. The successor of NDS, i.e. NIS, has subsequently produced national accounts for subsequent years, including in particular 1995. These data are not - as already discussed in Chapter 1 - consistent with the official set of national accounts made available by the NDP. In fact, discrepancies between the NIS and NDP national accounts are distinct. The two sets of national accounts portray radically different economic outcomes.

The NIS source of information marks a breakthrough as the data have been compiled in accordance with the UN System of National Accounts (SNA) to as great a degree as possible. Useful information from a variety of different institutions, which will be referred to in more detail in subsequent sections, has also been drawn together. Accordingly, in contrast with the national accounts issued by the NDP in the past, the new NIS accounts provide GDP from the expenditure as well as the production and income side. As a result, value added can be estimated

directly. Moreover, a more detailed institutional setup has also been applied, and commodity balances based on 184 product groups are available.[3]

Another important characteristic of the new NIS accounts is that an attempt has been made to address a number of critical shortcomings in available data. Thus, adjustments have been made to take account of the fact (i) that data on the agricultural sector have so far concentrated on marketed production, not considering home consumption of own production in the subsistence smallholder sector, (ii) that gross fixed capital formation has been overestimated as all aid funded activities have been considered as investments in full even if they are in part of a recurrent nature, and (iii) that many activities in the services sector have not so far been adequately recorded.
A study comparing the two sets of national accounts found the NIS accounts, relative to the NDP accounts, to be more plausible, based on sounder estimation methods, and subject to more rigorous cross checking procedures (Johnson, 1995). The continued heavy reliance of the NDP accounts on official statistics from technical ministries and public enterprises in the context of deregulation and privatization is of particular concern. Reliance on survey data, as in the NIS national accounts, appears more likely to capture emerging sectors in the context of a market oriented economy.

As a result, the main data source used for constructing the 1994 SAMs presented in Chapters 3 and 4 and the 1995 SAM presented in Chapter 5 is the new NIS set of national accounts. Furthermore, the NIS national accounts are set to become the official national accounts as soon as timeliness in production of the figures is satisfactory.

2.4 Sources of Information Employed for the NIS National Accounts

NIS national accounts are based primarily on the following sources:

1. The 1991 demographic survey.
2. Household surveys 1991-93.
3. External trade data.
4. Government accounts.
5. Agricultural production surveys.
6. Industrial data collection.
7. Annual production surveys.
8. Other administrative sources.

These sources will be addressed in turn.

[3] In fact, there were 185 product groups in 1994 as 'special programmes' were included as discussed in Section 2.5. In 1995, these programmes no longer existed.

The demographic survey was conducted in 1991. Due to continued internal strife at the time, the statistical frame covered only about 60 percent of the population. However, during the civil war in the 1980s and early 1990s approximately one million people were estimated killed and millions more displaced. Consequently, inferences from historical data are of dubious value. Nevertheless, the 1991 demographic survey is a first cut at assessing the post-war demographic situation. The survey provides NIS with information regarding total population by region and the distribution of employment between activities. Results from the 1997 census are yet to be published.

Two household surveys provide the primary basis for national accounts estimation. The first was conducted in 1991-92 and concerned the Maputo city area. The second was conducted in 1992-93 and was concerned with the ten provincial capital cities. Due to the internal strife ongoing up to 1992, neither survey ventured deeply into rural areas; and rural households did not comprise a part of the sampling frame. Nevertheless, households with rural characteristics were identified ex post. Information collected from these households serve as the basis for the rural-urban split developed in the national accounts data for the years 1991-1996.

One should note that the present standard of living and consumption patterns of rural households are not adequately represented by the selected 'rural' households found within the sampling frame of the capital cities surveys. The war has come to an end, droughts have not appeared in recent years, and investments have increased considerably. Results from the 1997 national household survey will in due course provide a more satisfactory frame for estimating rural and urban household expenditures. It can also serve as a basis for future national account calculations and as a cross check on the expenditure assumptions underpinning national account calculations for 1991-96.

Only poor quality data exists on external trade. Relative to imports, exports data are considered to be of reasonable quality, due to a more limited number of export articles. Nevertheless, estimates of the value of exports differed by 35 per cent between the NIS and NDP sets of national accounts in 1994. Imports data are believed to be of extremely poor quality, due to widespread smuggling and severe weaknesses in customs administration. NIS estimates trade data based upon customs declarations inflated by estimates of quantities smuggled.

Data on government recurrent expenditures are available. The informational content of these data are limited by the fact that these data only reflect wages and goods consumed. Consumption of fixed capital by government is not considered. As regards government investment, no data are available on disbursement basis, so budgeted figures are relied on in what follows.

As stated above, the Ministry of Agriculture produces estimates of total production of basic food crops and marketed production of other important agricultural commodities. In addition, price information is collected frequently, especially for basic food crops, throughout the year and at various points in Mozambique.

Industrial data are available from a variety of sources including labour force and salary surveys, industrial production surveys, surveys of the construction industry, intermediate consumption and inventory measurements, and a business enterprise survey. These data are collected at regular intervals (some monthly, some by trimester, and some annually). In addition, NIS attempts to obtain a full income statement including a balance sheet from all enterprises with more than 100 employees. From these diverse sources, production information (agricultural production excepted) is pieced together. Quality of the above sources suffer from an incomplete sample frame and low response rates.

Trade margins are calculated as the difference between the price on goods sold and the cost of purchasing the goods (by the wholesaler/retailer). This information consistently indicates a very high trade margin. Formal construction activity is estimated on the basis of production survey data. Informal construction activity is based on employment data, which is used to make benchmark estimates. The value added in the government sector consists of compensation paid to employees.

Estimation of GDP is based on the commodity-flow approach. This relies as already noted on the supply and demand for 184 product groups. The break-down of total demand into intermediate demand, final demand and capital formation, is based on estimated technical coefficients. While potentially inaccurate, the technical coefficient approach is necessary since actual data are not available. The derivation of a consistent input-output (IO) table (as explained in Chapter 4) clearly illustrates the considerable inconsistencies between available technical coefficients and the intermediate consumption row and column sum totals, which can be derived from NIS national accounts.

Administrative sources of information were also relied upon for a variety of other purposes. These include declarations from public enterprises such as electricity, water, and rail.

The above discussion makes it plain that data quality and completeness still leave much to be desired in Mozambique. Data problems are compounded by the substantial transitions in the economy between 1991 (the base year for NIS national accounts elaboration) and 1995 (the benchmark year for the SAM). In that period, the economy shifted from a war to a peace time production mode and from heavy state intervention to a situation where market forces have been unleashed. Under these conditions, the potential for structural shifts is evident. Yet, the national accounts are, to a great degree, structurally dependent upon demographic and household surveys performed in the period 1991-93 when the impact of these changes were either not evident or had just begun to be felt.

Despite these shortcomings, the NIS national accounts are the best set of information available. It is true that much desirable information is either unknown or of uncertain quality. It is also true that much is known about basic production structure (in agriculture as well as industry), consumer habits, government spending and revenue, structure of imports and exports, and

financial flows to Mozambique (especially aid). In addition, the NIS relies on the UN system of national accounts. Consequently, the NIS accounts serve as a reasonable basis for analysis. Efforts are made, in developing the 1994 and 1995 Mozambique SAMs in this document, to maintain as close a correspondence to NIS national accounts as possible.

Finally, in the construction of the macroeconomic SAMs, national accounts information from NIS was supplemented with data from the Statistical Yearbook (Anuário Estatístico) on public finance and balance of payments. In addition, the 1995 IMF Statistical Annex for Mozambique was relied on regarding the breakdown of government interest payments between external and domestic creditors. Substantial supplemental information was required for the construction of the microeconomic SAMs. These additional sources are detailed in Chapters 4 and 5.

2.5 Choice of the Benchmark Year

It is reiterated that the year 1995 was chosen as benchmark in this study, first, because it is the most recent year for which comprehensive and reliable data are available. Secondly, 1995 can certainly be considered a more normal year than any year in the previous decade. In 1995, peace had been attained in Mozambique and no exogenous shocks such as drought hit the economy. The implementation, in 1994, of a number of special programmes (UN peace keeping, elections, de-mining, assistance to the repatriation of refugees etc.) funded by external sources created economic flows and made 1994 somewhat less representative. Special programmes were discontinued completely in 1995. Thirdly, the economic rehabilitation programme (ERP), initiated in 1987, had by 1995 led to the removal of many of the government interventions that were characteristic in the early post-independence period and during the period of damaging internal strife. Finally, by 1995, the process of privatizing state enterprises had begun in earnest.

The tangible differences in the economy between 1994 and 1995 cited above, as well as superior quality of some statistics, provide a rationale for using 1995. Less tangible factors are also very compelling. Conversations with members of government and a variety of other analysts reveal a common view of 1994 as the final year of the 'old' system and 1995 as the first year of the 'new' system. While statistics might not confirm such a clear cut break, the perception is palpable. It is clearly preferable to use the first year of the 'new' system rather than the last year of the 'old' one. Consequently, the effort to update to 1995 appeared worthwhile.

CHAPTER 3

MACSAM: A MACROECONOMIC SOCIAL ACCOUNTING MATRIX

3.1 Introduction

This chapter chronicles the construction of the macroeconomic SAM (MACSAM) for 1994. First, the construction of the unbalanced Macro SAM is detailed. Second, the entropy based procedure used for balancing row and column sums is presented. This entropy procedure is also used for balancing the microeconomic SAMs (MOZAM). Thus, this section applies to Chapters 4 and 5 as well. Finally, the balanced MACSAM for 1994 is presented.

3.2 Building Unbalanced MACSAM for 1994

3.2.1 Definitions and labels

Table 3.1 contains a schematic macroeconomic SAM for Mozambique. It has 12 rows and 12 columns. Corresponding rows and columns share the same label. For example, row five and column five are both labelled 'Households'. In MACSAM, entries are in the form of macroeconomic aggregates, and the row/column labels are defined below. The definitions below the table in Box 3.1 are designed so as to explain how the SAM is structured and give a feeling of how the MACSAM can be disaggregated to illustrate more economic detail.

In a social accounting matrix (SAM), rows track receipts, while columns track expenditures. Hence, row and column sums represent respectively total receipts and total payments by a given account/institution. In the tradition of double entry accounting, row sums must equal column sums.

Consider, for example, the second row/column, labelled commodities. The row sum represents total demand for marketed goods and services in purchaser prices (i.e. producer prices plus marketing margins), comprised of intermediate demand from activities, private and NGO consumption of marketed commodities by households, government consumption, government investment, demand for goods by private investors (including all non-government investment) and exports. Accounting rules dictate that demand for commodities must equal supply, which appears as the commodities column sum. Total supply is composed of market sales of commodities by the activities account, consumption taxes and import tariffs levied by government, as well as imports (CIF) from the rest of the world. Note that marketed production may be either consumed domestically or exported.

Table 3.1. Labels of the Macroeconomic Social Accounting Matrix for Mozambique (MACSAM)

Receipts	Expenditures											
	1. Activities	2. Commodities	3. Factors	4. Enterprises	5. Households	6. Recurrent Government	7. Indirect Taxes	8. Government Investment	9. NGO	10. Capital	11. Rest of World	12. Total
1. Activities		Marketed Production			Home Consumption							Total Sales
2. Commodities	Intermediate Consumption				Private Consumption of Marketed Commodities	Government Consumption	Export Subsidies	Government Investment*	NGO Consumption	Non-Government Investment	Exports (FOB)	Total Marketed Commodities
3. Factors	Value Added at Factor Cost											Value Added at Factor Cost
4. Enterprises			Gross Profits			Subsidies						Enterprise Income
5. Households			Wages incl. Mixed Income	Distributed Profits		Social Security					Net Transfers by Workers	Household Income
6. Recurrent Government		Consumption Taxes	Factor Taxes	Enterprise Taxes	Income Taxes		Indirect Tax Revenue to Government					Government Recurrent Receipts
7. Indirect Taxes	Output Taxes	Import Tariffs										Tariffs plus Output Taxes
8. Government Investment											Aid in Government Budget	Government Aid Receipts
9. NGO											Aid in NGO budget	NGO Aid Receipts
10. Capital				Retained Earnings	Household Savings	Government Savings 1		Government Savings 2			Net Capital Inflow**	Total Savings
11. Rest of World		Imports (CIF)										Imports
12. Total	Total Payments	Total Commodity Supply	Value Added at Factor Cost	Enterprise Expenditure	Household Income Allocated	Tax Financed Government Expenditure	Indirect Tax Receipts less Export Subsidies	Government Investment*	NGO Consumption	Non-Government Investment	Foreign Exchange Available	

*Includes extraordinary items (‘*programas especiais*) sometimes registered as recurrent expenditure.

**Amounting, in principle, to the sum of the balance of payments entries not appearing elsewhere in row or column 9.

Box 3.1	**SAM Definitions**
1. Activities	In the activity row, goods and non-factor services (valued at producer prices) are produced for sale in the commodity market and for home consumption. Thus, the supply of factors to productive activities (in the column) include factors used in the production for home consumption. In addition, more than one activity can in principle produce the same commodity. This is so when different technologies are used. For example, maize might be produced by subsistence farmers, requiring limited inputs, and market oriented farmers, who employ greater quantities of inputs thus obtaining higher yields. Hence, the commodity maize can be produced (in the column) by two activities - one traditional and one modern.
2. Commodities	Commodities are supplied in the column (to the commodity market) by activities in the form of marketed production at producer prices and from the rest of world in the form of imports of goods and non-factor services. Domestic agents demand commodities valued at purchaser prices in the row for intermediate consumption, private and NGO consumption of marketed commodities, government consumption, and investment (both governmental and non-governmental). Exports are demanded by the rest of the world at FOB prices. Note that home consumption does not enter the commodities column/row. Thus, commodities only include goods that are sold in the market. Marketed goods are formed in the commodity column by adding taxes/tariffs and commercial margins to respectively the price of goods supplied at factor cost from domestic production activities and goods imported from the rest of the world at CIF prices.
3. Factors	Factors typically include labour, capital, and land. Total payments to factors from productive activities (in the row) comprise value added at factor cost (including imputed payments to factors producing goods for home consumption), whereas the supply of factor inputs enter in the activity column. Factor income is distributed (in the column) as gross profits, wages and factor taxes.
4. Enterprises	Formal enterprises earn profits and receive subsidies (in the row). This income is distributed (in the column) to households, withheld as retained earnings or paid as taxes. Formal enterprises may be public or private.
5. Households	In more detailed SAMs, households attempt to capture the characteristics of different analytically useful socio-economic groups of the population. Households differ principally in terms of factor endowments owned and consumption patterns. Total income (in the row) consists of wages, including income from informal enterprises, distributed profits from formal enterprises, social security payments, and net transfers by workers from abroad. Income is allocated (in the column) to home consumption, consumption of marketed production, income taxes and household savings.
6. Recurrent Government	An institution which levies a variety of taxes to obtain receipts (in the row) and spends a recurrent budget (in the column). The difference between recurrent spending and total tax revenue represents government savings.

Box 3.1	**SAM Definitions** (cont.)
7. Indirect Taxes	An imaginary institution which collects output taxes and import tariffs (in the row) and pays export subsidies to (collects export taxes from) commodities and total net revenue to recurrent government (in the column).
8. Government Investment	An institution which undertakes investment by government (in the column) and receives assistance from abroad in the form of foreign aid (in the row).
9. NGO	An institution which captures a variety of expenditures undertaken (in the column) by non-governmental organisations (NGOs), and which receive support from abroad (in the row). The expenditures included here cover consumption items such as medical imports, which could not be put elsewhere by NIS. Note that no saving emerges from this institution as what is expended is exactly what is financed from the rest of the world, and that other flows (such as investment) related to the NGO sector are captured by other accounts in the SAM. This account was ignored in the 1994 SAM as the total was very small, but it was of importance in 1995.
10. Capital	The balance between non-government investment (in the column) and total savings (in the row). They include retained earnings by formal enterprises, household savings, government recurrent savings, savings from the government investment account, and net capital inflows defined below.
11. Rest of World	The balance between foreign exchange receipts (in the column) and imports of goods and non-factor services from the rest of the world (in the row). The net capital inflows capture in principle the sum of balance of payments entries not appearing elsewhere in the row or column.
12. Total	Sums of columns and rows. Row sums must by definition equal column sums as explained below.

GDP at market prices can be found as the sum of the following cells:[4]

* (3,1) + (7,1) + (6,2) + (7,2) - (2,7), equivalent to value added at factor prices plus output taxes, import tariffs, and consumption taxes less export subsidies.

or alternatively as:

* (1,5) + (2,5) + (2,6) + (2,8) + (2,9) + (2,10) + (2,11) - (11,2), equivalent to the sum of private and public consumption, investment and exports minus imports.

A complete discussion of the economic relationships embodied in a SAM can be found in Pyatt and Round (1985).

[4] Cell (x, y) refers to row x and column y as numbered in Table 3.1.

The macroeconomic SAM in Table 3.1 treats exports in a manner, which is consistent with the consolidated version of the reduced SNA SAM matrix (UN et al., 1993, p. 462). Exports could alternatively be extracted from marketed production in the commodities column and placed in the activities row and sold to the rest of the world. Consequently, in this formulation marketed production would only refer to commodities produced by domestic firms and consumed on the domestic market. This is sometimes convenient as the column sum of the commodities account would correspond to total absorption. Easy comparison of the magnitude of consumption taxes relative to total absorption would also be possible.

However, in the SNA and in the SAM structure employed for this study, exports are included in the so-called 'goods and services' account as commodities adding to demand alongside other cells in the commodity row. Hence, the SNA 'goods and services' total does not correspond to a concept of absorption in the domestic economy. In addition, since exports are passed to the rest of world through the commodities accounts, the domestic figures in cell (1,2) refer to total marketed sales of activities at producer prices regardless of whether those sales are destined for domestic or international markets.

Moreover, in Table 3.1 home consumption is identified as a cell in the activity row and household column, so as to make it clear that a significant part of economically productive activity is never marketed. Valuation is at producer prices. This is sensible as no marketing is involved. Home consumption is derived directly in the NIS national accounts on the basis of the household surveys and estimated marketed and total production.

Finally, government has in Table 3.1 been divided into two accounts reflecting recurrent government expenditure and government investment, respectively. This breakout permits that recurrent government savings (defined as the difference between recurrent expenditure and total tax revenue) appear explicitly. The breakout also makes it possible to highlight the role of foreign assistance (aid) in the financing of government investment. Since government in 1994 had negative recurrent savings and aid does not finance all government investment (i.e. government savings 2 is negative), household savings, retained earnings and net capital inflows must in sum be positive.

3.2.2 Original 1994 MACSAM

Tables 3.2 and 3.3 list data sources and a brief description of how the value of all the relevant entries (cells) in the macroeconomic SAM were found. With the original values, the macro SAM comes very close to balancing (row sums equal to column sums) exactly. To achieve strict balance, which is required in subsequent stages where MOZAM is built, a minimum cross entropy balancing procedure was applied as set forth in Golan, Judge, and Robinson (1994). The resulting balanced MACSAM is presented in Table 3.4. Notes on assumptions, procedures, and corroborating data are presented in Box 3.2 following Table 3.3.

3.3 Balancing MACSAM

This section presents the method for balancing the 1994 MACSAM so row and column sums are equal. A similar procedure was applied to both to 1994 MOZAM in Chapter 4 and the 1995 SAMs in Chapter 5. The program which balances the MACSAM for 1995 is called 'Macent.gms'. It is included in Annex 1 together with a so-called include file ('imacro.inc'), which reflects the accounts of the MACSAM.

The raw MACSAM has 30 non-zero elements when the NGO sector is suppressed. Since the 1994 MACSAM is a 11x11-matrix, this implies 20 row and column sums (constraints) and thus only 10 degrees of freedom. This does not leave much room for prior restrictions.

The method employed was minimum cross entropy (MCE) as proposed by Golan, Judge, and Robinson (1994). The MCE approach is motivated by Shannon (1948) who derived a function to measure the entropy or randomness of a discrete distribution and Jaynes (1957) who suggested maximizing this function subject to some constraints such as moment conditions.[5] A classic application of Jaynes' maximum entropy principle involves assessing the probability of numerous different outcomes when only limited information, such as averages, are available. In this instance, Jaynes' maximum entropy principle yields the set of probabilities with the maximum entropy while remaining consistent with the information available, such as average of the possible outcomes. In other words, what is known is imposed; everything else is random.

Kullback and Leibler (1951) formulated a cross entropy principle.[6] The Kullback and Leibler minimum cross entropy (MCE) formulation permits imposition of prior information or beliefs on the possible outcomes. Rather than maximize the entropy of the probability distribution subject to what is known, the entropy distance between the prior distribution and a distribution consistent with what is known is minimized. In other words, the distribution which is 'closest', in an entropy sense, to the prior distribution *and* satisfies all constraints is chosen.

In a SAM framework, transformation of SAM entries to SAM coefficients permits application of entropy formulations.[7] In the case of MACSAM, the unbalanced SAM is believed to be close to the true SAM. In addition, row sums must equal column sums. What the MCE formulation

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[5] The function defining entropy is $H(\mathbf{p}) = -\Sigma_i p_i \ln p_i$ where (p_i) is the discrete probability distribution. Thus maximum entropy maximizes S over the probability distribution (p_i).

[6] The function defining cross entropy is $I(\mathbf{p}, \mathbf{q}) = \Sigma_i p_i \ln(p_i/q_i)$ where (q_i) is the prior probability distribution. Thus MCE minimizes S over the probability distribution (p_i). Further details on the cross entropy function is available in Annex 3.

[7] SAM coefficients are analogous to probabilities in that the sum of the coefficients must equal one. In addition, any negative SAM entry in cell (i, j) can be written as a positive entry in cell (j, i). Consequently, SAM coefficients can easily be restricted to being non-negative.

does is to choose SAM coefficients which are as close as possible, in an entropy sense, to the original coefficient values while at the same time ensuring row and column sum balance. Consequently, the MCE formulation chooses the set of values which respects what is known (e.g. row sums must equal column sums) and is closest, in an entropy sense, to the prior information. The MCE formulation also permits fixing of high confidence entries. These properties make the MCE objective attractive.

Table 3.2. Data for MACSAM

Row	*Column*	*Source*[a]	*Description*
Activities	Commodities	NA Tables 2 and 12	Sales of marketed production at producer prices calculated from gross value of production (i.e. total sales) less household home consumption.
Activities	Households	NA Table 16.1	Home consumption.
Commodities	Activities	NA Table 16.1	Intermediate consumption.
Commodities	Households	NA Table 16.1	Marketed consumption by households.
Commodities	Recurrent government	AE page 118	Total government recurrent expenditure including salaries.
Commodities	Indirect taxes	NA Table 12	Export taxes counted as a negative subsidy.
Commodities	Government investment	AE page 118	Government investment expenditures including expenditure on *programas especiais* . This programme included for example UN peace keeping, election monitoring, and mine removal as well as assiatnce to the repatriation of refugees.
Commodities	NGO	NA Table 2	Various NGO consumption items that cannot be placed elsewhere. This account was ignored in 1994 as the total was very small, but the number is of significance in the 1995 SAM.
Commodities	Capital	NA Table 2, AE page 118	Non-government investment (calculated by deducting government investment, exclusive of special programmes, from gross investment, exclusive of special programmes).
Commodities	ROW	NA Table 2	Total export revenue (FOB) (includes export taxes).

Table 3.2. Data for MACSAM

Factors	Activities	NA Tables 16.1 and 17	Value added at factor cost less intermediate consumption of imputed financial services.
Enterprises	Factors	NA Table 2, AE page 117	Gross profits to formal enterprises less factor taxes allocated to capital. This amount equals profits to formal enterprises.
Enterprises	Recurrent government	Zero value	Transfers to formal enterprises.
Households	Factors	NA Tables 2 and 16.1	Private sector wages plus mixed income to informal enterprises less imputed financial services.
Households	Enterprises	Residual	Distributed profits. Equals income of formal enterprises less enterprise taxes (including fishing licenses), retained earnings, and depreciation.
Households	Recurrent government	AE page 118	Government transfers to private households. Social security payments plus interest payments to domestic creditors (IMF, 1996) less fees charged for specific government services (‘*impostos de selo*).
Households	ROW	AE page 105	Foreign remittances to households. Net remittances of workers (1 US$ = 5,918.1 Mt in 1994).
Recurrent government	Commodities	AE pages 117 + 118	Consumption taxes. Comprised of circulation tax plus consumer tax plus petrol tax.
Recurrent government	Factors	AE page 117	Factor taxes. Comprised of property taxes, social security contributions, and other from major heading ‘Other taxes’.
Recurrent government	Enterprises	AE page 117	Enterprise taxes (plus fishing licenses).

Table 3.2. Data for MACSAM

Recurrent government	Households	AE page 117	Income taxes. Composed of *imposto complementar* plus the national reconstruction tax plus commissions and emoluments.
Recurrent government	Indirect taxes	Residual	Transfer of indirect tax revenue, equal to output taxes plus import tariffs less export subsidies, to government recurrent receipts.
Indirect taxes	Activities	AE page 118	Output taxes. Comprised of per unit output price and enterprise subsidies.
Indirect taxes	Commodities	AE page 117	Import tariffs. Comprised of direct import taxes and other.
Government investment	ROW	AE page 119	Foreign aid received by government. Total donations received from abroad less interest payments to external creditors (IMF, 1996) and less foreign aid to NGOs referred to below.
NGO	NGO	Residual	Foreign aid received by NGOs for the consumption items identified in the commodities row.
Capital	Enterprises	Estimated	Retained earnings plus depreciation. Estimated as discussed in note 1 below.
Capital	Households	Estimated	Private savings. Based on a calculation described in note 1 below, which implies a savings rate of 6.7percent of total household income.
Capital	Recurrent government	Implied	Government savings. Government recurrent expenditure less government receipts. The cell adjusts to balance government consumption row and column totals. See note 2.
Capital	Government investment	Implied	Non-aid financed government investment and special programmes. The difference between aid donations received by government and government investment including special programmes.
Capital	ROW	Residual	Net capital inflow. See note 4.
ROW	Commodities	NA Table 2	Imports.

[a] The data sources include Ministry of Planning and Finance (1996 and 1995). Thus, the data can be found in *Sistema de Contas Nacionais 1991-1994* (NA), and *Anuário Estatístico 1994* (AE).

Table 3.3 Original/Unbalanced 1994 Macroeconomic SAM for Mozambique (figures in 100 bio. of 1994 Mt.)*

	ACT	*COM*	*FAC*	*ENT*	*HOU*	*GRE*	*ITX*	*GIN*	*CAP*	*ROW*	*TOT*
ACT		155.78			20.48						176.2
COM	77.58				68.91	17.65	-0.02	21.19	18.94	14.77	219.0
FAC	99.13										99.1
ENT			40.27			0.00					40.2
HOU			58.11	37.12		0.30				2.10	97.6
GRE		7.38	0.74	1.65	1.56		3.05				14.3
ITX	-0.38	3.41									3.0
GIN										17.12	17.1
CAP				1.50	6.54	-3.55		-4.06		18.63	19.0
ROW		52.62									52.6
TOT	176.33	219.19	99.13	40.27	97.49	14.39	3.03	17.12	18.94	52.62	

* This table is based on updated 1994 data, and as such is used in the updating of the 1994 MOZAM.

Box 3.2 **Notes on original (unbalanced) MACSAM.**

1) Private household savings (i.e. capital row-household column) are estimated at 6.7 percent of total household income (i.e. household row total). This estimate was essentially derived from total consumption and total income information available in the national accounts. However, estimated household income exceeds expenditure.[8] In addition, changes in household savings cause imbalance in the capital account. To develop a more satisfactory savings estimate, a procedure where the sum of squared percentage deviations of row and column totals for the household and capital accounts was minimized subject to enterprise retained earnings plus depreciation being greater than or equal to 150×10^9 Mt. This lower bound on retained earnings plus depreciation was included in order to ensure that it was not driven to zero, as the minimizing procedure would otherwise imply. Thus, MACSAM implies a gross private (i.e. households plus enterprises) savings rate of 7.3 percent of GDP. This contrasts with an IMF estimate in IMF (1996) of a private savings rate of 14.2 percent. However, the IMF savings rate is obtained from a different set of national accounts in which GDP estimates are lower. Thus, the two estimates of savings are closer in absolute terms; however, the IMF estimate remains larger in absolute terms.

2) Government revenue and expenditure as presented in MACSAM differ slightly from official totals presented in the

(MPF, 1995 page 118) This difference is due to

counting some revenue items as negative expenditure, placement of interest payments to external sources in the ROW column, ignoring 'diverse' revenue sources, and ignoring small corrections for period adjustments (fiscal versus calendar year). These differences also imply that government savings calculated in MACSAM differ slightly from the official recurrent budget deficit.

3) The sum of the cells government savings 1 and government savings 2 yields the government's total financing requirement. This figure closely matches the official figure for 1994.

4) Net capital inflows in MACSAM are implied by exports and imports of goods and non-factor

(MPF, 1995 page 105), and there are some apparent differences. First, raw

services, net transfers by workers for factor services and aid received by government. In other words, the cell ensures balance between foreign exchange availability and imports of goods and non-factor services.

It is clearly of interest to determine the correspondence between the net capital inflows implied by MACSAM and inflows implied by using the balance of payments information available in the

which relies on the national accounts developed by NDP. As mentioned earlier, NIS and

MACSAM requires a net capital inflow of 1,863 billion Mt. to balance foreign exchange supply with demand. At the official exchange rate of 5,918.1 Mt./US dollar for 1994, this translates into a required capital inflow of $315 million. This is different from the inflow implied by the

NDP national accounts data are not consistent. The balance of trade in goods and services differs between the NDP and NIS sets of the national accounts. Consequently, the net capital inflow requirement must differ.

Accounting in full for this difference is extremely difficult. Data sources differ as discussed in the introduction. Moreover, the interest payments and amortisation figures included in the

[8] Usually, the inverse is true when estimated on the basis of household information. However, in the NIS accounts, the estimate household income is based on household survey information and from value added in production (less retained earnings).

Box 3.2 **Notes on original (unbalanced) MACSAM.** (cont.)

5) It can also be noted that not all aid to government is actually captured in the government investment row. The figure used for 1994 is simply the one reported in the
(page 118). This figure does not include all externally funded projects, as many technical assistance/capacity building activities and non-government organization (NGO) support at the provincial level, is not adequately accounted for. The same applies for direct support to some public enterprises. Yet, if it were decided to increase the aid in government budget figure, the only additional changes this would cause in the SAM framework presented here would be corresponding reductions in the net capital inflow and aid in government budget minus government investment cells. Thus, no adjustments were attempted. Finally, for 1995 some externally funded NGO consumption was separated out as already discussed above.

6) Imputed financial services are treated differently from other product groups in the NIS national accounts and hence can potentially cause confusion. Consumption of imputed financial services as an intermediate good by other sectors is not included in sector by sector value added calculations. Consequently, value added for each sector is overstated by the quantity of imputed financial services consumed as an intermediate good.

This conclusion can be drawn from examination of national accounts tables 12, 16.1 and 2. In NA table 12, value added by sector is calculated. However, total intermediate consumption reported in the NA table 12 is smaller than total intermediate consumption reported in table 16.1 by exactly the value of demand for imputed financial services as an intermediate good. Table 3.2 in the NA signals that the larger intermediate consumption figure reported in table 16.1 is appropriate. In table 2 in the NA, GDP is calculated by summing gross value added (net indirect tax laden) and import tariffs. From this sum, intermediate consumption of imputed financial services is deducted. This indicates that gross value added is overstated by intermediate consumption of imputed financial services.

Consequently in MACSAM, imputed financial services were included in intermediate consumption and deducted from value added at factor cost. It was assumed that imputed financial services represent informal financial services rendered to mixed or informal enterprises. Thus, profits to informal enterprises, which accrue directly to households in MACSAM, were reduced by the value of intermediate consumption of imputed financial services.

The need for consistency in the SAMs has implied that various minor differences, which do, however, in all cases amount to less than one half of one percent, had to be squared out using a balancing procedure. The balancing procedure employed is described in the text.

Nevertheless, the MCE approach also has a potential disadvantage, which is displayed indirectly through the following citation from Golan et. al. (1996, page 12):

The CE [cross entropy] formulation can be viewed as a shrinkage rule where the small frequencies are shrunk more than the large frequencies.[9]

In other words, the MCE-objective puts little weight on the relative differences from the small frequencies, and large weight on the relative differences from the large frequencies. In the context of a SAM, this implies that small SAM-coefficients are likely to change more, in percentage terms, than large coefficients. For some purposes, this feature might be a serious drawback if greater confidence is vested in the magnitudes of the smaller rather than the larger entries.

In raw MACSAM, there are very large differences in the magnitudes of the various entries. For example, the magnitude for marketed production is more than 45 times the magnitude for import tariffs. From the above discussion, it follows that the MCE objective will imply large relative changes in the small entries. In the case of Mozambique, more confidence is in fact vested in the smaller magnitude entries particularly for government revenue and expenses. However, the flexibility of the MCE formulation permitted fixing of government revenues and the government budget deficits.

Even with these restrictions in place, the adjustments required to balance MACSAM were quite small; consequently, no individual element in the SAM suffered undue burden of adjustment. A minimization of squared percentage error objective gave very similar results; however, due to the desirable properties of the MCE objective, results from the MCE objective were retained. These results are presented in the following section.

3.4 Balanced MACSAM

Row and column imbalances in raw MACSAM are minor. The balanced MACSAM values in Table 3.4 are very similar to the original flows in Table 3.3, and a moment restriction ensures that the balanced MACSAM strikes the NIS 1994 GDP figure (10,948.9 billion meticais) exactly. Thus, it is concluded that the balanced MACSAM presented in Table 3.4 can be used as a basis for analysis and further disaggregation.

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[9] This follows from the approximation given in proposition 3.3.1 (Golan et al., 1996 page 31)

$$\Sigma_i\, p_i \ln(p_i / q_i) \approx \Sigma_i\, (1/q_i)(p_i - q_i)^2$$

where p_i is a variable representing an element of the balanced macro SAM and q_i is a prior value for that element of the matrix. From this approximation it follows that the MCE-objective puts more weight on the absolute differences from the smaller frequencies, than on the absolute differences from the larger frequencies. On the other hand, from a simple transformation, it follows that:

$$\Sigma_i\, p_i \ln(p_i / q_i) \approx \Sigma_i\, q_i ((p_i - q_i)/q_i))^2 .$$

From this rewriting of the approximation it follows that the MCE-objective puts little weight on the relative differences from the small frequencies, and large weight on the relative differences from the large frequencies.

Table 3.4. Balanced 1994 Macroeconomic SAM for Mozambique (figures in 100 bio. of 1994 Mt.)

	ACT	*COM*	*FAC*	*ENT*	*HOU*	*GRE*	*ITX*	*GIN*	*CAP*	*ROW*	*TOT*
ACT		155.72			20.48						176.18
COM	77.50				68.98	17.65	-0.02	21.19	18.99	14.76	219.06
FAC	99.05										99.05
ENT			40.24								40.24
HOU			58.07	37.09		0.30				2.09	97.55
GRE		7.38	0.74	1.65	1.56		3.05				14.39
ITX	-0.38	3.41									3.03
GIN										17.12	17.12
CAP				1.50	6.53	-3.55		-4.06		18.58	18.99
ROW		52.55									52.55
TOT	176.18	219.06	99.05	40.24	97.55	14.39	3.03	17.12	18.99	52.55	

CHAPTER 4

MOZAM: A DISAGGREGATED SOCIAL ACCOUNTING MATRIX FOR 1994

4.1 Introduction

To allow for more detailed policy experiments and to establish the basis for a microeconomic computable general equilibrium model (CGE), the MACSAM developed in Chapter 3 must be disaggregated. This chapter documents the procedures employed in producing the very first 1994 disaggregated SAM, which was subsequently updated following the publication of more accurate statistics for 1994. The GAMS files used in this updating are included in Annex 1 under the names 'rasio.gms' and 'rassam.gms'. Also the so-called include files, which document the sectorial disaggregation, form part of Annex 1 as 'imicro.inc' and 'mzsets.inc'.[10]

The final outcome of the above process is a disaggregated social accounting matrix called 1994 MOZAM with 40 production activities, which are not identical to the 40 commodities. This matrix is available upon request, but only the 1995 MOZAM is included in this document as discussed in Chapter 5.

The primary data source for constructing 1994 MOZAM is the NIS national accounts. Using the national accounts information and MACSAM, information exists for many elements of MOZAM. The primary exception is the set of activity columns of MOZAM which contains input-output (IO) relationships (i.e. data on intermediate consumption) as well as information on factor use and output taxes. Here, data problems are severe. This is so in particular for the 12 agricultural sector activities, which are in focus in this study, as well as in the three commerce and two food processing activities identified.

Hence, the necessary detailed information regarding these 17 activities, which make up the agriculture, commerce and food processing sectors, has been derived from a variety of scattered data sources. In contrast, the national accounts and a 1991 IO table provided most of the data relied on for the remaining 23 activities in the Mozambican economy.

More specifically, the national accounts data and the 1991 IO table do not provide all the necessary intermediate consumption column sums for the chosen 12 agriculture, three commerce and two food processing activities. In other words, the disaggregated input structure for these activities cannot be derived from the two data sources mentioned above. As a consequence, in

[10] The GAMS file ('datmanip.inc') in which the very first data manipulations, that are described in detail in this chapter, is available upon request. Moreover, the file which generates Raw MOZAM for updated 1994 and 1995 data is 'rasio.gms'. This is the file which is included in Annex 1.

this chapter, the procedures employed for deriving reasonable IO relationships are emphasized, and due to the lack of data, the authors were in several cases forced to rely upon qualitative judgement in the development of the SAM. The set of judgements included is based, in part, on conversations with numerous experts on Mozambique; but the authors accept full responsibility for all errors and omissions.

In sum, *the primary objective of this chapter is to specify all instances where judgements were made and spell out the exact allocation criteria relied upon in the construction of MOZAM*. In addition, SAM construction for Mozambique is unavoidably an iterative process. Thus, this chapter only marks a first step, which must be further refined in due course. Yet, it can hopefully help in planning future data collection efforts and in the interpretation hereof.

The procedure applied in this chapter strives at developing a balanced micro SAM, MOZAM, while maintaining as close a correspondence as possible with the national accounts data discussed in Chapter 3. To achieve this goal, the procedure was divided into three subsequent steps, involving first the construction of a raw, unbalanced MOZAM, second the balancing of the disaggregated activity columns, leading to a balanced IO MOZAM, and finally the balancing of the complete SAM. These steps are set out in detail in Section 4.2-4.4, in which *descriptions of judgements applied by the authors and other key points for understanding how the final balanced MOZAM was derived are italicized.*

4.2 Building Raw MOZAM

In this first step a raw unbalanced MOZAM, Raw MOZAM, was developed using data from the sources already identified, and there is a one to one correspondence between non-zero cell entries in Raw MOZAM and non-zero cell entries in the final balanced MOZAM in Section 4.4. The cell entries in Raw MOZAM comprise a picture of the economy in 1994, which is taken as prior information in this study. However, due to missing information, data inaccuracies, incompatibilities between micro and aggregate level data, and accounting discrepancies, the row and column sums of Raw MOZAM do not balance even if the macro totals implied by Raw MOZAM are close to the values in MACSAM.

The primary source of discrepancies between row and column sums in the Raw MOZAM developed in this section stem as already noted from the elements in the activity columns, which contain information on input-output relationships, factor use and output taxes.

A general point to be kept in mind throughout this section is that the totals in the 40 activity columns, which are evidently of critical importance since only 25 sectors are identified in the national accounts, were established as follows for Raw MOZAM:

(i) Down the columns, total costs of production (including factor use and output taxes), i.e. total payments, were directly available from the national accounts for all activities except for the 17

agriculture, commerce and food processing activities. Data for the 23 activities, where direct mapping was possible, were therefore included into Raw MOZAM in unchanged form.

(ii) For the 12 agricultural and two food processing activities, total sales figures (i.e. disaggregated totals in the activity rows) were available in the national accounts. They were inserted into Raw MOZAM as column sums as well.

(iii) For commerce, a total payments figure (i.e., column sums) was shared out among the three commerce activities, used here, according to a sharing procedure, which was derived from the distribution of trade margins discussed in Section 4.2.5.

4.2.1 Activities, commodities, factors, and institutions

Disaggregation of MACSAM into MOZAM takes place in the columns and rows for activities, commodities, factors, and households. Activities and commodities were each disaggregated into 40 sub-groups according to Table 4.1, while factors were disaggregated according to Table 4.2. Table 4.1 also shows the SNA four digit code corresponding to each sector. In addition, the largest components, in terms of share of total supply including imports in each aggregate sector appear underneath the sector label. Values in parentheses give magnitudes of total sales for each of these three components.

In Table 4.1, it is noticeable that there are three sectors, which do not have an activities code. This is because there is no domestic production of these commodities. Since there is consumption of imported goods from these sectors, commodities codes have been included. In addition, there are three commerce activities, which represent transport costs and selling margins (retail and wholesale) for exports, imports, and domestically produced and consumed goods. There is, however, no commerce commodity. The net result is that there are exactly as many activities as commodities, 40, but not a one to one relationship between activities and commodities.

Focussing on factors of production, land was not included as a separate factor. As shown by Moll (1996a), aggregate supply of arable land vastly exceeds demand. Despite a surplus of arable land in the aggregate, evidence exists that some farmers, particularly those in favourable agro-climatic zones, confront limits on the quantity of land available to them (MAP/MSU, 1992). Nevertheless, for the purposes of this study, the value (opportunity cost) of agricultural land in most regions is assumed to be small and aggregated with capital, since the assumption of abundant land appears reasonable for 1994 and 1995. Yet, as time progresses, pressure on available land, especially high quality land with good market access, will undoubtedly increase. As Moll points out, one should therefore expect land policy to become an emerging issue, the implication being that land must appear separately in future SAMs.

Households were divided into a rural and an urban household. In future, information from the 1996-97 household survey, conducted by the National Directorate of Statistics, Ministry of

Planning and Finance, could be employed to further divide these households into analytically useful socio-economic categories.

The remaining entries in MOZAM (i.e. enterprises, recurrent government, indirect taxes, government investment, NGO, capital, and rest of the world) correspond exactly to those identified in MACSAM in Chapter 3.

4.2.2 Input-output relationships in general

An intermediate consumption matrix reflecting the input-output relationships of the economy shows activities in the columns, and commodities in the rows. Each activity purchases commodities to operate. Thus, total payments of each activity, for commodity inputs, are represented by column sums. The payments entries for intermediate consumption are measured at market prices. Since there was no available IO table for 1994, which spanned the array of activities of interest in this study, it was necessary to construct a new IO (including the intermediate consumption matrix) on the basis of available information.

Table 4.1: Activity and commodity disaggregation and corresponding ISIC codes.

Sector	Activities code	Commodities code	ISIC code
Maize	AMAIZ	CMAIZ	1110
- maize (635 bio. Mt. - 100 percent)			
Rice	ARICE	CRICE	1110
- rice (88 bio. Mt. - 100 percent)			
Wheat		CWHEA	1110
- wheat (96 bio. Mt. - 100 percent)			
Other Grains	AOGRA	COGRA	1110
- sorghum (51 bio. Mt. - 100 percent)			
Cassava	ACASS	CCASS	1110
- cassava (694 bio. Mt. - 100 percent)			
Beans	ABEAN	CBEAN	1110
- beans (221 bio. Mt. - 100 percent)			
Other Basic Food Crops	AOBFC	COBFC	1110
- other fresh fruit (327 bio. Mt. - 32.3 percent) - vegetables (215 bio. Mt. - 21.2 percent) - tomatoes (155 bio. Mt. - 15.4 percent)			
Raw Cashew	ARCAS	CRCAS	1110
- raw cashew (85 bio. Mt. - 100 percent)			
Raw Cotton	ARCOT	CRCOT	1110
- raw cotton (48 bio. Mt. - 100 percent)			
Other Export Crops	AOEXC	COEXC	1110
- citrus fruits (68 bio. Mt. - 54.1 percent) - copra (39 bio. Mt. - 31.9 percent) - sugar cane (16 bio. Mt. - 13.1 percent)			
Other Crops	AOCRO	COCRO	1110
- other ag. products (58 bio. Mt. - 98.6 percent) - sunflower (0.5 bio. Mt. - 0.9 percent) - mafurra (0.2 bio. Mt. - 0.4 percent)			

Table 4.1: Activity and commodity disaggregation and corresponding ISIC codes (cont.)

Sector	*Activities code*	*Commodities code*	*ISIC code*
Livestock	ALIVE	CLIVE	1110
- sheep & goats (78 bio. Mt. - 27.5 percent) - cattle (69 bio. Mt. - 24.2 percent) - birds (54 bio. Mt. - 19.1 percent)			
Forestry	AFORE	CFORE	1210
- firewood (464 bio. Mt. - 96.1 percent) - logs (18 bio. Mt. - 3.8 percent) - other forestry (0.6 bio. Mt. - 0.1 percent)			
Fishery	AFISH	CFISH	1300
- shrimp (426 bio. Mt. - 69.4 percent) - frozen and fresh fish (158 bio. Mt. - 25.7 percent) - crayfish (23 bio. Mt. - 3.8 percent)			
Mining	AMINE	CMINE	2100-2909
- metallic minerals (31 bio. Mt. - 42.3 percent) - stone, clay and sand (17 bio. Mt. - 23.7 percent) - non-manufactured salt (14 bio. Mt. - 19.3 percent)			
Flour Milling	AGMIL	CGMIL	3116
- maize flour (572 bio. Mt. - 45.1 percent) - processed rice (417 bio. Mt. - 32.9 percent) - wheat flour (131 bio. Mt. - 10.3 percent)			
Other Food Processing	AOFPR	COFPR	3111-3115 3117-3122
- sugar (561 bio. Mt. - 25.7 percent) - bread (268 bio. Mt. - 12.3 percent) - refined oil (193 bio. Mt. - 8.8 percent)			
Beverages and Tobacco	ABEVT	CBEVT	3132-3140
- beer (362 bio. Mt. - 59.1 percent) - non-alcoholic drinks (128 bio. Mt. - 20.9 percent) - cigarettes and tobacco (51 bio. Mt. - 8.4 percent)			

Table 4.1: Activity and commodity disaggregation and corresponding ISIC codes (cont.)

Sector	Activities code	Commodities code	ISIC codes
Textiles	ATEXT	CTEXT	3211-3220
- clothes (175bio. Mt. - 34.4 percent) - cotton fibres (114 bio. Mt. - 22.5 percent) - repairs, excl. clothes (85 bio. Mt. - 16.7 percent)			
Leather	ALEAT	CLEAT	3231-3240
- shoes (21 bio. Mt. - 77.8 percent) - leather (6 bio. Mt. - 22.2 percent)			
Wood Industry	AWOOD	CWOOD	3311-3320
- furniture (92 bio. Mt. - 53.4 percent) - carved wood (54 bio. Mt. - 31.3 percent) - other carpentry (26 bio. Mt. - 15.3 percent)			
Graphic Industry	APACK	CPACK	3412-3420
- paper (352 bio. Mt. - 76.1 percent) - graphic products and publications (110 bio. Mt. - 23.9 percent)			
Fertilizer		CFERT	3512
- fertilizer and pesticides (267 bio. Mt. - 100 percent)			
Fuel		CFUEL	3530
- diesel (402 bio. Mt. - 61.7 percent) - gasoline (210 bio. Mt. - 32.2 percent) - lamp oil (16 bio. Mt. - 2.5 percent)			
Other Chemicals	AOCHE	COCHE	3511 3513-3529 3540-3560
- pharmaceuticals (309 bio. Mt. - 33.8 percent) - soap and hygiene (111 bio. Mt. - 12.1 percent) - tires and tubes (103 bio. Mt. - 11.2 percent)			
Industries excl. Metal	AINXM	CINXM	3610-3699
- cement (159 bio. Mt. - 55.4 percent) - glass (44 bio. Mt. - 15.3 percent) - tiles (22 bio. Mt. - 7.8 percent)			

Table 4.1: Activity and commodity disaggregation and corresponding ISIC codes (cont.)

Sector	*Activities code*	*Commodities code*	*ISIC code*
Metal industries	AMETI	CMETI	3710-3720
- other steel and iron (43 bio. Mt. - 28.5 percent) - laminated iron and steel (28 bio. Mt. - 18.4 percent) - steel and iron tubes (25 bio. Mt. - 16.7 percent)			
Transport and machine equipment	ATMEQ	CTMEQ	3811-3849
- motorised vehicles (587 bio. Mt. - 36.0 percent) - other non-electric machines (156 bio. Mt. - 9.6 percent) - radios (126 bio. Mt. - 7.7 percent)			
Other manufacturing	AOMAN	COMAN	385-39
- other manufacturing (245 bio. Mt. - 100 percent)			
Electricity and water	AELWA	AELWA	4101-4200
- electricity (319 bio. Mt. - 89.1 percent) - water (39 bio. Mt. - 10.9 percent)			
Construction	ACNST	CCNST	5000
- buildings (2,330 bio. Mt - 100 percent)			
Trade (export, import, and domestic)	ACOME ACOMM ACOMD		6200
- commerce (NA)**			
Restaurants and hotels	ARE_H	CRE_H	6300
- restaurants and hotels (310 bio. Mt. - 100 percent)			
Transport and communications	ATR_C	CTR_C	7111-7200
- road transport (958 bio. Mt. - 39.1 percent) - air transport (526 bio. Mt. - 21.4 percent) - communication (447 bio. Mt. - 18.2 percent)			
Financial services and insurance	AFI_I	CFI_I	8100-8200
- banking (690 bio. Mt. - 88.3 percent) - insurance (92 bio. Mt. - 11.7 percent)			
Dwellings	ADWEL	CDWEL	8310
- imputed rents (144 bio. Mt. - 100 percent)			
Public administration and defence	APA_D	CPA_D	9100
- public administration and defence (1,490 bio. Mt. - 100 percent)			

Table 4.1: Activity and commodity disaggregation and corresponding ISIC codes (cont.)

Sector *	Activities code	Commodities code	ISIC code
Education	AEDUC	CEDUC	9310
- public education (190 bio. Mt. - 96.8 percent)			
- private education (6 bio. Mt. - 3.2 percent)			
Health	AHEAL	CHEAL	9330
- public health (95 bio. Mt. - 92.7 percent)			
- private health (7 bio. Mt. - 7.3 percent)			
Other services	AOSER	COSER	9340-9590
- other personal and collective services (1216 bio. Mt. - 92.5 percent)			
- organisational services (46 bio. Mt. - 3.5 percent)			
- home services (21 bio. Mt. - 1.6 percent)			
Special programmes***	ASPEC	CSPEC	NA
- special progammes (528 bio. Mt. - 100 percent)			

* The three largest sub-sectors according to total commodity supply (in parenthesis) are given for each sector. The data are updated 1994 numbers. Note that these numbers are not strictly speaking commodity supplies, since they include home consumption.

** No commodity supply exists for commerce. Commercial margins constitutes part of the commodity supply for other sectors. The total supply of commerce implicit in the total supply of other sectors, amounts to 3,305 bio. Mt. (13.8 percent of total supply incl. home consumption, or 15.1 percent of total supply excl. home consumption).

*** Special programmes is not included in the 1995 MOZAM discussed in Chapter 5.

Table 4.2: Correspondence between factors and codes.

Factor	Factor code
Agricultural Labour	AGLAB
Non-Agricultural Labour	NAGLAB
Capital	CAPITA

The intermediate consumption elements of the IO matrix in Raw MOZAM is primarily based on a working, un-published IO table prepared by NDS for 1991, which covers 26 production activities and 184 commodities. The 25 activities include agriculture, food processing and commerce as three aggregate sectors only. Yet, in MOZAM, agriculture, food processing and commerce are for analytical reasons broken into 12, two and three activities respectively. In addition, MOZAM contains the activity special programmes while the 1991 IO table does not.

In sum, 22 activities in the 1991 IO table map directly to activities in MOZAM. The agriculture activity in the 1991 IO table maps to the 12 agricultural activities in MOZAM, the food processing activity in the 1991 IO table maps to the two food processing activities in MOZAM, and the commerce activity in the 1991 IO table maps to the three commerce activities. This accounts for 39 of the 40 activities in MOZAM. Special programmes accounts for the remaining activity.

With 184 entries, the commodities data were sufficiently detailed for establishing the 40 commodities in MOZAM. Consequently, from the 1994 national accounts, data on intermediate consumption row totals can be derived for all 40 commodities in MOZAM. However, data on intermediate consumption column totals only exist for the 25 activities represented in the 1991 IO table, three of which are aggregates, plus special programmes. For the 25 activities, referred to here as the NA 25, the 1991 IO table was updated by multiplying 1991 column coefficients by 1994 column totals available in the national accounts.[11]

By using 1991 column coefficients and 1994 column totals, one develops an IO table, which by definition strikes 1994 column totals. However, the implied row totals are likely to differ from the actual 1994 values, for example because the technical coefficients have changed. This is true for every commodity, in principle, and egregiously so in Mozambique for other manufactures and financial services and insurance (COMAN and CFI_I). Total intermediate consumption of these two commodities as derived in the above manner was evidently out of line with reality when compared to 1994 actual row totals.

One option would be to let the minimum cross entropy balancing procedure make the necessary adjustments between column and row totals. Yet, the discrepancies were as noted very large in the case of other manufacturing and financial services and insurance. Thus, intermediate consumption of these two commodities were allocated differently as discussed below to avoid establishing a misconceived prior for the subsequent steps in the construction of MOZAM. Other input-output assumptions made are also highlighted.

Finally, the manipulations to elements of the IO table described in the following sections imply that column sums no longer strike the original targets exactly. *To ensure column balance, each element of the activities column was therefore adjusted proportionately in a final step to*

[11] The relevant NIS source files used internally are TES9194.XLS, CTP94.XLS.

eliminate differences between the actual column sum and the target column sum. For the agricultural sector, *the target column sum was set as the total sales figure for each activity.* Hence, in agriculture, the activities column and row sums are set equal to one another as discussed in Section 4.2. For non-agricultural activities, column sums are derived from cost data from the national accounts. The minimum cross entropy estimation procedure discussed in Section 4.3 was relied upon to strike row total targets.

4.2.3 Input-output relationships outside agriculture, food processing, commerce and special programmes

To minimize the problems related to the distribution of other manufacturing and financial services and insurance just referred to above, *it was assumed that 5 percent of total payments by the 22 activities outside agriculture, food processing, commerce and special programmes are spent on financial services and insurance and that 3 percent of total payments are spent on other manufactures.* Thus, the distributions of the two inputs mentioned across the respective activity rows are similar to the distribution of total payments among the 22 activities at the economy wide level.

MACSAM and thus MOZAM contains divisions between recurrent government and government investment. Yet, the 1991 IO table illustrates government spending only. Thus, investment and recurrent outlays are aggregated. As such using the 1991 input-output coefficient would grossly overestimate government intermediate consumption of the commodity construction (CCNST), which mainly used for investment. This problem was solved by *using a prior value on construction spending in the public administration and defence (APA_D) column equal to 10 percent of the original value*.[12]

4.2.4 Input-output relationships for agriculture, food processing, commerce and special programmes

In the 1991 IO table, agriculture, food processing and commerce appeared as already discussed as three aggregate sectors, and spending by special programmes on commodities did not appear. This section first describes the procedures for breaking agriculture into 12 activities from one, and subsequently discusses the disaggregation of the other sectors.

Subsistence agriculture dominates in Mozambique. Thus, the two main elements of most agricultural activity columns are the intermediate input seed and labour, which creates value added.

[12] The treatment of government consumption and the relationship with specific commodities is discussed further below.

Technical coefficients on seed use for food crops exist from the Early Warning Unit in the Ministry of Agriculture and Fisheries, but also other scattered information of a qualitative nature is available. Consequently, *seed cost shares were derived based upon these technical coefficients and discussions with experts in seed in Mozambique. In this context, a 20 percent premium for seed price over harvest price was assumed*.[13] The activities covered in this way include maize, rice, other grains, beans, other basic food crops, and other crops.

The raw cotton sector purchases seed directly from the textile sector. This, plus extension services provided by the ginneries and use of textiles for bagging, explains the large use of textiles in raw cotton production. Sources for input-output vectors in raw cotton production are Dengo (1995) and Moll (1996b).

For other basic food crops (vegetables and fresh fruit for domestic consumption), cotton, rice, and other crops, fertilizer and pesticide use can be important. A coefficient for fertilizer and pesticide use in cotton was derived from World Bank data (Moll, 1996b; and Dengo, 1995). Fertilizer and pesticide use in cotton illustrates the data problems faced in constructing the SAM. The two World Bank sources cited above are highly contradictory. For the same group of cotton producers, family farms in Montepuez using low input technology, Moll calculates an economic cost share for fertilizer and pesticide of slightly more than 10 percent. Dengo, on the other hand, puts the economic cost share for fertilizer and pesticide at slightly less than 30 percent. Large scale farmers tend to use more pesticide and fertilizer; however, small scale farmers represent more than 70 percent of cotton production. Further, Dengo calculates economic cost shares for 1992-93 when substantial subsidies existed for inputs into cotton. Dengo (page 33) describes financial costs for insecticides (the main purchased input) to smallholders as 'symbolic'. In sum, *the prior for pesticide and fertilizer use in raw cotton employed in Raw MOZAM represents a 20 percent cost share.*

The prior for fertilizer and pesticide use in maize was assumed to be one tenth the use in cotton or a 2 percent cost share. The prior coefficient on fertilizer and pesticide use in other activities was set relative to the maize share in accordance with ratios derived upon judgement of the authors. The ratios are presented in Table 4.3. Zero elements in Table 4.3 indicate zero fertilizer and pesticide use for that activity. *Note that cassava and raw cashew production were assumed to receive no fertilizer.*

[13] The technical coefficients employed refer to non-hybrid seed; consequently, the price premium for seed was assumed to be relatively small.

Table 4.3: Cost shares of fertilizer and pesticide relative to maize across activities

Activity Code	*Cost share ratio*
AMAIZ	1
ARICE	1
AOGRA	0.5
ACASS	0
ABEAN	1
AOBFC	3
ARCAS	0
ARCOT	10
AOEXC	10
AOCRO	5
ALIVE	0
AFORE	0

Priors on IO relationships for the livestock sector were derived based upon judgements of the authors and discussions with individuals with knowledge of the sector.

Agricultural sector activities were also assumed to use positive quantities of textiles, fuel, electricity and water, transport and communication, and financial services and insurance (CTEXT, CFUEL, CELWA, CTR_C, and CFI_I respectively). *Use of these inputs was assumed to be small, and they were generally distributed in such a way that the activity column totals correspond to row totals*. The prior on input use of these commodities by agricultural activities is always less than 1percent of total cost of production.

While the above assessments and data on IO relationships in the agriculture sector could clearly be improved, the Raw MOZAM table does capture the primary essence of Mozambican agriculture. For almost all cropping activities, production costs are dominated by labour as further discussed below and to a lesser extent seed. Significant purchased input use occurs primarily in raw cotton, export crops, and domestically marketed fresh fruit and vegetable production (other basic food crops). Available information, judgement, and balancing conditions allow for a prior allocation of purchased input use across activities. Remaining allocations occur on the basis of the row and column sums and the minimum cross entropy procedure. In sum, the authors

believe the input-output priors supplied to Raw MOZAM capture the stylized facts concerning Mozambican agriculture, and the reader is referred to Section 4.4 for further information on the input-output elements of the balanced MOZAM.

Similar to production agriculture, *intermediate consumption by the two food processing industries was, with a few exceptions, allocated from the single food processing aggregate available according to shares in total sales of food processing (i.e. according to the two row totals available in the national accounts). The exceptions were inputs of grains and cassava into food processing, which were allocated entirely to flour milling (AGMIL), and inputs of other agricultural commodities, which were allocated entirely to other food processing (AOFPR).*

In SAM-context, commerce is as noted in Chapter 3 an activity that provides inputs (in the row) to the commodities column. Thus, goods at farm gate level are transformed into goods that form part of total supply by including a marketing margin together with consumption taxes. In constructing MOZAM, separate margins were allowed for depending on whether goods go for domestic consumption or are exported. Similarly, CIF imports are transformed and enter total supply by adding both an import marketing margin and import tariffs.

Thus, the commerce sector in the activity row and column of MOZAM has three sub-sectors for respectively imports, exports and domestically produced and consumed commodities. Nevertheless, *column coefficients in the three commerce activities mentioned were assumed to be the same, implying that the same commerce technology was relied on.* Moreover, as only one aggregated commerce sector is identified in the original 1991 IO table and the national accounts, this figure had to be disaggregated as discussed in detail in Section 4.2.5 below.

Specific treatment of the special programmes activity was necessary since special programmes did not figure in the basic 1991 IO table. Total payments for intermediate consumption by special programmes in 1994 was available through the national accounts. Consequently, the problem involves allocation of total intermediate consumption to purchases of specific commodities. *The criteria for allocation chosen was a combination of relative weights of public administration (APA_D) and other services (AOSER) from the 1991 IO table. These weights were adjusted based on knowledge of special programmes spending vectors by the authors.*[14]

4.2.5 Other blocks of raw MOZAM

The value added matrix (VA) in the SAM shows labour and capital in the rows, and activities in the columns. Each activity purchases labour and capital to operate alongside intermediate inputs. The value added entries are measured at factor cost. However, in the Mozambican national

[14] Source file: INTCONPE.XLS - hard copy, does not exist electronically.

accounts data on factor income is not available in this format. Instead distinctions are made between wages, family enterprises and formal sector firms. Hence, *the labour share of value added was assumed to contain wages and 95 percent of income from family enterprises, while the capital share of value added was assumed to contain the operating surplus of formal sector firms and the remaining 5 percent of income from family firms*.

The above division of family (or mixed) income into labour and capital components reflects the assumption of heavy reliance on labour in family enterprises already referred to. It can also be noted that labour is broken down into two categories.[15] Agricultural activities employ agricultural labour (AGLAB) while non-agricultural activities, including commerce and food processing, employ non-agricultural labour (NALAB).

The labour and capital use data derived above have to be disaggregated for the agriculture, commerce and food processing sectors along the activity row as was the case for intermediate consumption inputs. For other activities data are immediately available, due to the low level of disaggregation. *Total labour value added was allocated across the 12 agricultural activities based upon shares of each activity in total family sector sales. However, value added by capital was allocated based upon shares of each of the 12 activities in total formal sector sales.*[16] Both family and formal sector sales are available in the national accounts.

As regards, value added by labour and capital in commerce and food processing, the relevant aggregate figures were established on the basis of the above sharing formula. Further *subdivision by the three commerce and the two food processing activities was carried out by using shares derived from total sales in the activity rows*. This is, in other words, the same principle as the one used for sharing out intermediate consumption in the five commerce and food processing activities.

The output taxes vector show output taxes paid by each activity. From the 1994 national accounts, data on output taxes only exist for the 25 activities in the national accounts, and no indirect taxes were levied on special programmes. Further disaggregation of the agricultural, commerce and food processing activities was therefore needed. For the agricultural sector as a whole, output taxes were negative indicating subsidies to the sector. These subsidies are relatively small amounting to about 1 percent of the value of agricultural production, and they can be assumed to reflect payments to state owned farms, which form part of the formal sector. Consequently, *the subsidies were allocated across agricultural activities according to activity*

[15] This was however only done for 1995 only through the use of file 'splthh.gms' in Annex 1. The split is only undertaken after the balacing of the SAM with aggregate labour.

[16] Special treatment was given to tobacco which is a component of the activity other export crops since there was no household sector production of tobacco. Accordingly, the labour and capital value added of the tobacco activity was allocated according to the relative share of tobacco in total agricultural sales.

shares in formal sector sales. Total sales were relied on for disaggregating taxes in the commerce and food processing sub-sectors.

The domestic sales cells are also referred to as the make matrix as it is here that the results of individual activities (in the rows) are combined to form domestic supply of marketed commodities (in the columns). Domestic sales aree calculated by subtracting home consumption from total sales values (i.e. the row totals).[17]

The domestic sales also contain information on marketing margins. These margins are due to transport costs as well as wholesale and retail trade margins. The detailed accounting of margins is as pointed out above a unique feature of MOZAM. For exports, they represent the difference between factory/farm gate and FOB prices, whereas they represent the difference between consumer and CIF prices for imports. For local production destined for the domestic market, they represent the difference between factory/farm gate and consumer prices.

Margins enter each column of the domestic sales matrix along the commerce activities (ACOME, ACOMM, and ACOMD) rows,[18] and since transport and trading costs are high in Mozambique, marketing margins are important. National accounts data provide information on marketing margins, but they do not as alsready referred to discriminate between margins associated with exports, imports, and domestically consumed commodities. *These margins are split between exports (ACOME), imports (ACOMM), and domestics (ACOMD) according to shares in total commodity supply. Export margins for fisheries and other manufactures were set to zero.*

In the MACSAM structure in Chapter 3, consumption taxes appear as an entry along the recurrent government row under the commodities column, and they are defined as the sum of the circulation and consumption taxes from the national accounts. Disaggregated information on these taxes is only available for the 25 activities in the national accounts (NA 25). They can therefore be mapped into commodity columns. However, more than 50.3 percent of the tax receipts in reference are registered as paid to government by the aggregate commerce sector,[19] and there are no commerce commodities in MOZAM. These points create a set of difficulties for the construction of MOZAM as consumption taxes are clearly levied on a commodity basis in Mozambique. This implies in particular that there are consumption taxes on commerce that need to be distributed on a commodity basis.

[17] Source file: EQ18494D.XLS.

[18] The national accounts data set commercial margins to zero for wheat, rice, and raw cotton.

[19] It follows that these taxes are registered in CT95.XLS as payments from the commercial sector to government.

In addition, there is a complex set of problems related to the treatment of consumption taxes on fuel. First, there are three chemical commodities (COCHE, CFERT and CFUEL), which correspond to only one activity (AOCHE). As there is no domestic production of fertilizer and fuel, what this means is that there are zero entries in the AOCHE row in the make matrix for CFERT and CFUEL but a non-zero element for COCHE. Secondly, petroleum taxes are not levied on CFUEL in the national accounts, which would for present purposes seem to be the more satisfactory place. They have been levied on commerce instead, which as noted accounts for more than half of the tax receipts. In other words, consumption taxes on petroleum have been lumped together with other consumption taxes that relate to commerce activities.

Thus, a direct mapping of circulation taxes was used for all those NA activities, which correspond on a one to one basis to a MOZAM commodity. In addition, consumption taxes for agriculture, food processing, and other chemicals were split based upon shares in total commodity supply (i.e. a disaggregation along the lines already discussed above). Finally, in order to reallocate the consumption taxes on commerce an amount assumed to pertain specifically to fuel was first removed from total marketing margins (i.e. commerce). This amount was taken to be equal to total petroleum taxes, which was obtained from the AE. The assumed non-petroleum consumption tax component remaining in marketing margins was secondly distributed across commodities based upon the share of marketing margins associated with each commodity in total marketing margins.

Import tariffs appear in the recurrent government row under the commodities columns, i.e. there are one row and 40 columns with entries pertaining to these tariffs. The national accounts data give sufficient information to establish the import tariffs for all of the commodities of interest.

Imports appear along the rest of world row under the commodities columns. Hence, there are again one row and 40 columns in MOZAM with import data. The national accounts give sufficient information to establish the imports for all of the commodities.

Home consumption is placed in the activities rows as vertical vectors in the two households (rural and urban) columns. Sufficient data exist from the national accounts for all activities and both household types.

The private consumption of marketed commodities matrix shows commodities in rows and consumption values in the rural and urban household columns. Private consumption by each household type is in the national accounts relied on here equal to total household consumption less home consumption.[20]

[20] The source file for import tariffs, imports, home consumption, and private consumption is EQ18494D.XLS.

The export subsidies vector shows commodities in rows in the indirect tax column. From the national accounts, there are two negative entries reflecting export taxes on raw cashew (CRCAS) and other food processing (COFPR).[21]

The government consumption vector shows in the same way commodities in rows down the recurrent government column. Currently, these entries reflect total consumption by government of public administration and defence, education, health, and special programmes. Spending by the corresponding activities on commodities as well as wages is allocated in the four activity columns (APA_D, AEDUC, AHEAL, and ASPEC) pertaining to government.[22]

The government investment vector shows commodities in rows in the government investment column. The main data source is a table provided by National Directorate of Planning (NDP) containing information on planned government investment expenditure. It should be noted that actual expenditure may have differed from planned expenditure.

The NGO consumption vector appears in the commodities rows along the NGO column. Sufficient data are available from national accounts.

The non-government investment vector appears in the commodities rows down the capital column. In the national accounts, non-government investment includes changes in inventories. *Entries in Raw MOZAM reflect total non-government investment less changes in inventories*.

Exports appear in the commodities rows down the rest of world column. Information is available from the national accounts.[23]

The factors column in MACSAM is divided into labour and capital (division into agricultural and non-agricultural labour occurs only for 1995). Entries in the factors column of MACSAM are allocated to the labour and capital columns of Raw MOZAM. *Gross profits are allocated to the capital column and factor taxes are split between non-agricultural labour and capital using shares derived from the Annuario Estatistico 1994.*

Household income and household savings must be split between rural and urban households. Information does not exist concerning the division of savings, wages, distributed profits, social security payments, and net transfers by workers abroad between urban and rural households.

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[21] Source file: CTP94.XLS.

[22] There are in other words use of the relevant government commodities outside the government recurrent account.

[23] The source file EQ18494D.XLS provides information on government consumption, government investment, non-government investment, and exports.

Capital income, social security, income taxes and savings were split between urban and rural households based upon an 80 percent share for urban households. The assumption implies low levels of capital income, savings, and government related transfers with rural households. *Net transfers from abroad were split between rural and urban households based upon the share of urban and rural households in total consumption (the sum of the value of home and marketed consumption)*.

The remaining entries in Raw MOZAM correspond exactly with the entries in MACSAM. These are scalar entries which require no disaggregation.

4.3 Building Balanced IO MOZAM

The estimation procedure for building Balanced IO MOZAM focussed entirely on the activities columns of Raw MOZAM.[24] These columns contain the IO vectors and information on factor usage and output taxes for each activity. This section of the SAM contains the entries with the highest levels of uncertainty as already discussed. By performing a minimum cross entropy estimation on this section of the SAM alone, the entries can be made to conform with already existing information on intermediate consumption row totals, value added at factor cost and output taxes, total sales information (for agriculture) and total payments information (for non-agriculture). Consequently, the implications of high uncertainty in IO relationships is confined to the activities columns of the SAM.

This is important, since if the cell entries in the intermediate consumption section of the activities columns strike the intermediate consumption row totals, divergences in row and column sums across the full SAM are small. This reflects balance in MACSAM and the consistency and breadth of available national accounts information. For most cell entries outside of the activities columns, consistent data exists from either the national accounts or MACSAM. Hence, if the activities row and column sums can be made consistent with national accounts, the entire SAM comes close to balance. The remaining discrepancies in total SAM row and column sums result from minor changes in the macro totals due to the balancing of MACSAM and some differential accounting conventions. For example, the national accounts treats inventory accumulation as investment while the SAM ignores inventory shifts.[25]

Accordingly, cells in the activities columns were estimated subject to the row and column total targets. The resulting SAM is labelled IO Balanced MOZAM. It contains the estimated values for cells in the activities columns. Values for all other cells are equal to the values in Raw MOZAM.

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[24] The relevant file for balancing Raw MOZAM which also produces the balanced IO MOZAM is 'stone.inc', which is called from within the file 'rasio.gms' referred to in Section 4.1 above.

[25] Ignoring inventory shifts is common practice in developing the data which underlie CGE models. See, for example, Hertel (1997).

The procedure employed was a minimum cross entropy estimation as developed in Golan, Just, and Robinson (1994) and described in Chapter 2.

Cell entries in the activities column of Raw MOZAM served as prior information for the estimation procedure. In general, the use of priors influences the outcome of the estimation procedure. Cells with large values as priors tend to have large estimated values. Consequently, the judgement and information reflected in Raw MOZAM strongly influenced estimated cell values. However, as discussed in subsequent sections, the row and column sum targets, which are derived from national accounts data, also strongly influenced the outcome. The cross entropy procedure minimizes the entropy distance between estimated values and priors subject to consistency constraints.

This intermediate estimation procedure on the activities columns of Raw MOZAM prevented as noted errors in the IO table from being spread, via a minimum cross entropy estimation procedure on the entire SAM, to the remaining blocks of the SAM. Consequently, the errors implicit in the scattered statistics and judgement applied to the activities columns are confined to the activities columns and forced to conform to the row and column sum targets supplied by the national accounts data. This approach is consistent with the goal of maintaining as close a correspondence as possible with the national accounts data.

Estimation was performed using the GAMS programming language. GAMS is a general optimization package which includes a number of linear and non-linear solve routines. The estimation problem confronted here is non-trivial. Computer time to reach an optimal solution can be substantial. As is often the case in non-linear estimation problems, scaling of endogenous variables is important. For this problem, magnitudes of endogenous variables can range by a factor of 1,000 or more. The objective function contains terms ln(X) where X is an endogenous variable. The second derivative of ln(X) is $-X^{-2}$. Due to exponentiation, scaling problems become more severe in the Hessian matrix. This hampers performance of the solver.

To alleviate scaling problems in the Hessian, a change of variable was employed from the traditional entropy objective. In the scaled problem, GAMS works on X = Y*SQRT(X0) where X0 is the prior value for the cell coefficient.[26] GAMS solves for Y. This scaling yields second derivatives in terms of Y that are better scaled than the usual entropy objective. As a result of improved scaling, GAMS, using the MINOS5 solver, tends to converge to the optimal solution in about two thirds the time required for the traditional entropy objective. As mentioned in the Chapter 1, copies of all GAMS files and selected data are listed in Annex 1 and they are available upon request.

[26] It can be demonstrated that the solution of the scaled minimum cross entropy problem is equivalent to the solution of the traditional minimum cross entropy problem (see Annex 3).

4.4 Building MOZAM

Balanced IO MOZAM and balanced MACSAM constituted the start-off points for the third step, which involved balancing MOZAM through the use of a file called 'rassam.gms', which is also included in Annex 1. This involved a second minimum cross entropy estimation procedure using the values developed in IO Balanced MOZAM as prior information. Additional constraints were added to assure that MOZAM aggregates to a value no more than 1 percent different from the values in MACSAM. In other words, in the cross entropy estimation procedure, row and columns sums of the SAM were forced to equilibrate, so the final balanced row and columns sums were permitted to fall within the bounds implied by row and column sums in Balanced IO MOZAM.

With the exception of the commodities accounts, differences in row and column sums in Balanced IO MOZAM tended to be small. The major differences, in absolute values, occurred due to differential accounting treatment of inventory accumulation between NA and the micro SAMs developed here. As mentioned earlier, NA treats inventory accumulation as investment. In the SAM approach employed here, inventory accumulation is ignored. This creates imbalances in the commodities accounts. The strongest imbalances were in wheat (13 percent), mining (28 percent), fertilizer (10 percent), and other export crops (7 percent). Other inventory related imbalances were quite small.

Also, due to data inconsistencies with respect to total sales, exports and home consumption, row and column sums differed substantially, in percentage terms, for the commodities other grains and other crops. However, since these are both very small sectors, the absolute value of the differences is small. In all instances of imbalance between row and column sums for the full SAM, the lower value of the row or column sum forms the lower bound for the final SAM while the upper value forms the upper bound. In addition, the elements of MOZAM were as mentioned above constrained to sum to within 1 percent of the corresponding elements of MACSAM.

The change of variable transformation used in the estimation of Balanced IO MOZAM was also used in the estimation procedure for MOZAM.

It is worth mentioning that the process of balancing the SAM for Mozambique highlighted an inconsistency between aggregate data on fertilizer and pesticide use and total levels of fertilizer and pesticide use implied by available information on production practices by crop. In general, very little fertilizer and pesticide is believed to be used in Mozambican agriculture. The exceptions are in cotton and sugar (a sub-item in the aggregate other export crops). However, given a cost share for fertilizer and pesticide in cotton and other export crops of 20 percent, a significant amount of fertilizer remained to be allocated using initial 1994 national accounts data. As indicated earlier, maize, rice, beans, and other grains were assumed to receive small

allocations of fertilizer (about a 2 percent cost share); nevertheless, significant amounts of fertilizer remained to be allocated.

Since cassava production was assumed to receive no fertilizer or pesticide inputs, the only remaining activity which could plausibly consume significant fertilizer is other basic food crops. This sector comprises primarily fresh fruit and vegetable production. While little is known about input use in fresh fruit and vegetables, the aggregate numbers strongly suggest a cost share of about 20 percent for fertilizer and pesticide in this sector which is substantially greater than the prior value of 6 percent. Experimentation with various priors for fertilizer and pesticide use in other basic food crops showed that the final result is rather insensitive to the prior value. Consequently, the row and column sum targets was driving this result.

National accounts personnel in Mozambique were informed of the apparent inconsistency. As a result, fertilizer import figures for 1994 were verified and revised substantially downwards. Other revisions in national accounts figures occurred as well. The revised data have been employed to update 1994 MOZAM. The updating procedure proceeded very similarly to the derivation of the first version of 1994 MOZAM except that input-output coefficients derived in the development of original MOZAM were used as priors in the development of updated MOZAM.

4.5 Foreign Trade Matrices

In addition to the SAM for Mozambique, foreign trade matrices have been developed. These are included for use in a later phase of the project where regional issues for Southern Africa will be analysed. These data are not currently included with the SAMs.

The import and export matrices, for 1994, show 27 sectors in the rows and 10 major trading partners in the columns. Foreign trade is measured in US Dollars. The source of the information is the National Institute of Statistics. The foreign trade statistics published by NIS are based mainly on customs declarations. For 1994, imports and exports are in all likelihood underestimated due to smuggling. National accounts statistics include estimations of smuggling for aggregate trade. The bilateral statistics do not include estimations for smuggling. Consequently, the foreign trade statistics give smaller values for total imports and exports than NA figures.

The row ‘Other’ shows values corresponding to the same item in foreign trade statistics (NIS 1995). The column ‘Other’ countries shows values corresponding both to the same item in foreign trade statistics and to those countries not included in the previous nine columns.

Table 4.4 lists commodities included in the import and export matrices. Table 4.5 lists the trading partners. The commodity disaggregation corresponds to the aggregation decided upon for

analysis of regional issues in Southern Africa. This is less detailed than the commodity aggregation in MOZAM.[27]

[27] An exception is the agricultural processing industry where the trade data contains three agricultural processing sectors and MOZAM contains only two. By aggregating other food processing and other agricultural processing in the trade data, one obtains a one to one correspondence with the agricultural processing sectors in MOZAM.

Table 4.4: Commodity aggregation in trade matrices.

Number	*Commodity*
1	Maize
2	Rice
3	Wheat
4	Other grains
5	Cassava
6	Beans
7	Other basic food crops
8	Raw cashew
9	Raw cotton
10	Other export crops
11	Coffee
12	Tobacco
13	Other crops
14	Livestock
15	Forestry
16	Fishery
17	Minerals
18	Grain milling
19	Other food processing
20	Other agricultural processing
21	Fertilizer
22	Fuel
23	Light manufacturing
24	Other manufacturing
25	Transport and communications
26	Other services
27	Other

Table 4.5: Bilateral partners in trade matrices.

Number	*Partners*
1	Zambia
2	Zimbabwe
3	Tanzania
4	Malawi
5	Republic of South Africa (RSA)
6	Other Southern Africa (SA)
7	United States of America (USA)
8	European Union (EU)
9	Japan
10	Other

CHAPTER 5

UPDATING MACSAM AND MOZAM TO 1995

5.1 Introduction

The development of 1994 MACSAM and 1994 MOZAM was described in Chapter 3 and 4 of this study. The publication of 1995 data and the iterative nature of SAM work bring forward the issue of updating MACSAM and MOZAM to subsequent years. This chapter will describe the steps which were necessary in order to build 1995 MACSAM and 1995 MOZAM on the basis of 1994 MOZAM and new 1995 data. This takes place through the files in Annex 1. With two exceptions, the structure of MACSAM and MOZAM remained exactly the same between 1994 and 1995. The exceptions concern the split of labour into agricultural and non-agricultural types, which was only actually carried out for 1995 MOZAM. A discussion of the procedures for this split is contained in section 5.3. Moreover, the NGO consumption account was not present in the 1994 SAMs. Finally, it is also to be noted that the 'special programmes' activity, which mapped directly into the 'special programmes' commodity in 1994, does not exist in 1995.

5.2 Basic Updating Procedure

The development of 1995 MACSAM was very similar to that of 1994 MACSAM. The same sources of data and the same procedures gave rise to a 1995 Raw MACSAM, which was very close to balancing in all accounts. The 1995 Raw MACSAM entries had - with the exception of the NGO account - a one-to-one mapping with the 1994 MACSAM entries. It is recalled that this account had to be introduced, due to the existence of a variety of expenses that appeared in the national accounts under the commodity 'other services' of recurrent government consumption. These expenses, including medical imports and a variety of other consumption items, were mainly related to the NGO sector, and since they could not be placed sensibly anywhere else they were lumped into one NGO account.

Just as in 1994, 1995 Raw MACSAM was used as a prior in the minimum cross entropy (MCE) procedure, which produced the balanced 1995 MACSAM (file 'macent.gms' refers). It can be noted that the GDP figure implied by 1995 MACSAM equals the NIS 1995 GDP estimate exactly, and that no information from 1994 MACSAM was used in developing 1995 MACSAM. The balanced MACSAM for 1995 is provided in Table 5.1.

The basic steps in the development of 1995 MOZAM were the same as the steps in the development of 1994 MOZAM. Accordingly, data from the NIS national accounts and 1995 MACSAM provided most of the elements, other than the input-output table, of 1995 Raw MOZAM, which is available in Annex 1. As in 1994, NIS data on value added, intermediate consumption and indirect output taxes existed only in aggregate form for agriculture, commerce

and food processing activities. In agriculture, value added by labour was split between activities according to shares in family sector sales, while valued added by capital and indirect taxes were split according to formal sector sales. Total intermediate consumption for each activity was then derived as a residual based on total sales.
Moreover, in food processing, value added, intermediate consumption and indirect taxes were mainly split according to shares in total sales. Technology for the three commerce activities was assumed to be the same, so the disaggregation of the one commerce sector in the national accounts was based entirely on total sales. For further details, including the direct mapping of the activities of other sectors, see Chapter 4, as well as the file 'rasio.gms' in Annex 1.

Unlike the process of developing 1994 MOZAM, an input-output table of the proper structure and aggregation was available, namely the input-output table inherent in 1994 MOZAM. Using 1994 input-output coefficients as priors, a 1995 input-output table was developed which was consistent with 1995 column totals available from NIS national accounts. The process of first balancing the activities columns, where the input-output table resides, prevents errors in the input-output table from being spread to other parts of MOZAM as discussed in Chapter 4. As in 1994, a minimum cross entropy (MCE) balancing procedure was employed for this intermediate step as well as for the purposes of balancing the full SAM.[28] The result of the intermediate step was labelled 1995 Balanced IO MOZAM.

Prior to balancing the entire SAM, households were divided into a rural and an urban household in the same way as in 1994 MOZAM. Thus, allocation of labour and capital income was split in the same manner as in 1994.

As for 1994 MOZAM, the 1995 Balanced IO MOZAM was used as prior in a second MCE procedure step, which produced the final 1995 MOZAM, which is reproduced in Annex 2. This was done by using the file 'rassam.gms' in Annex 1. The second MCE procedure was subject to two types of specific constraints. First, macroeconomic totals implied by MOZAM totals were allowed to vary by ±1 percent from the actual MACSAM totals. Second, row and column totals of MOZAM were allowed to vary within strict bounds corresponding to the row and column totals of IO Balanced MOZAM. Moreover, it was decided to lock GDP at the NIS estimate.

5.3 Differences and special steps taken for 1995 MOZAM

In 1995, the additional step of splitting labour into agricultural and non-agricultural types was undertaken through file 'splthh.gms' in Annex 1 after the balancing of MOZAM with only one labour category. Allocation of agricultural and non-agricultural wage income across rural and urban households relied upon revenue information from the available household surveys in major cities (National Directorate of Statistics, 1993 and 1994). *The survey indicates that*

[28] The file 'stone.inc', which is called from 'rasio.gms', refers.

approximately 19 percent of labour income for urban households stems from agricultural activities. Once this split of total urban labour income into non-agricultural and agricultural components has been made, the split between agricultural and non-agricultural labour is implied by balance conditions. The conditions imply that about 60 percent of rural labour income stems from agricultural labour with the remainder stemming from non-agricultural labour.

The non-existence of special programmes in 1995 is as noted a particular difference between the Mozambican SAMs for 1994 and 1995 put forward in this study. Spending on special programmes in 1995 was zero. This means that the 1995 MOZAM in this regard provides a cleaner picture of the production activities and income flows in the Mozambican economy.

The 1995 national accounts only contain data on total fixed investment by commodity. NIS does not attempt to divide investment between government and non-government actors. *Informative priors on government and private investment were obtained from the relative shares embodied in 1994 MOZAM.* It is recalled that the split in the 1994 MOZAM was based on planned rather than actual government investment, so this prior is particularly uncertain.

5.4 Looking forward

At this level of aggregation, the process of updating the SAMs from year to year is relatively simple. Provided that the NIS maintains the same format for data exposition, future updates should be even easier since few modification of the programmes in Annex 1 will be necessary.

In future, information from the 1996 household survey, conducted by the National Directorate of Statistics, Ministry of Planning and Finance, can as noted in the introduction be employed to further divide these households either into socio-economic income generating groups of analytical interest or by region. In addition, division of labour into skilled and unskilled categories is also a possibility.

Table 5.1: Balanced 1995 Macroeconomic SAM for Mozambique (figures in 100 bio. of 1995 Mt.)

	ACT	*COM*	*FAC*	*ENT*	*HOU*	*GRE*	*ITX*	*GIN*	*CAP*	*ROW*	*TOT*
ACT		229.53			30.00						259.53
COM	117.30				105.94	17.35		28.63	35.41	23.84	328.48
FAC	142.56										142.56
ENT			62.25								62.25
HOU			79.05	58.37		1.33				3.42	142.16
GRE		10.89	1.26	2.39	2.46		5.50				22.50
ITX	-0.33	5.83									5.50
GIN										17.59	17.59
CAP				1.49	3.76	3.82		-11.04		37.38	35.41
ROW		82.22									82.22
TOT	259.53	328.48	142.56	62.25	142.16	22.50	5.50	17.59	35.41	82.22	

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ANNEX 1: FILES AND DATA USED IN GENERATING MACSAM AND MOZAM

Filename: makefile.
Placement: root directory.
Description: The major part of the makefile is devoted to program statements necessary to develop a balanced disaggregated SAM. Following these, the makefile contains statements necessary to develop a CGE model and to derive accounting and structural path multipliers. In addition the makefile documents the directory structure as well as the placement of all necessary files. The convenience of the makefile is particularly due to the fact that file creation dates is checked for pre-selected files. When output files are not older than the pre-selected files, the program statement considered is skipped. This allows for the skipping of particularly time consuming first steps, like the balancing of the fully disaggregated SAM, while working on later steps, like the development of the CGE model.

```
# Make file for construction of macro and micro SAMS for Mozambique

# Directories

#in      Input data
#new     New source code
#out     Output of final numbers and spreadsheets for analysis
#work    Intermediate files
#rep     Listing files
#docs    Write-up documents

# input files
# GAMS files

# *.gms              Main programmes

# new\macent.gms             Balance macro SAM
# new\rasio.gms              RAS io portion of Micro SAM
# new\rassam.gms             RAS complete SAM after RASing of IO
# new\splthh.gms             Split HH and factors after RAS
# new\endoset.gms            Creates endogenous sets for inversion
# new\micinv.gms             Obtains Leontieff matrix for whole SAM
# new\micinvag.gmsObtains Leontieff matrix for an aggegate of SAM
#                            and produces an aggregate SAM without home consumption
# new\cge\cgehc.gms          Most up to date CGE file with home consumption
# new\cge\cgemc.gms          Most up to date CGE file with only marketed consumption

# *.inc              Code called by programs

# new\mzsets.inc             Sets for aggregation of 184
# new\mapa&c.inc             Set mappings of 184 to activities and commodities
# new\mapac.inc              Map of activities to commodities for imicro
# new\imacro.inc             Macro SAM sets
# new\imicro.inc             Micro SAM sets (all inclusive)
```

```
# new\exog.inc              Exogenous sets for Full micro SAM inverse
# new\micmac.inc            Calculates macro SAM implied by micro SAM
# new\stone.inc             RAS of io portion of Micro SAM
# new\spltset.inc           Selects sets from imicro which are aggregates
#                           and the constituent sets of these aggregates
# new\mapmaca.inc           Maps aggregate SETS to macro SAM
# new\micmacx.inc           Calculates macro SAM for aggregate SAM
# new\agg%\agactiv.inc      Aggregate agricultural activities
# new\agg%\nagactiv.inc     Aggregate non-agricultural activities
# new\agg%\acomme.inc       Commerce activities which are active in the SAM
# new\agg%\acomma.inc       Commerce activities which are active in the CGE
# new\agg%\agcomm.inc       Aggregate agricultural commodties
# new\agg%\nagcomm.inc      Aggregate non-agricultural commodties
# new\agg%\labor.inc        Labor factors
# new\agg%\capital.inc      Capital factors
# new\agg%\enterp.inc       Enterprises
# new\agg%\house.inc        Households
# new\agg%\instg.inc        Government institutions
# new\agg%\kaccrow.inc      Capital account and ROW
# new\agg%\totals.inc       Totals
# new\agg%\mapagg.inc       Map matching Micro SAM sets to aggregate sets
# new\aggsets.inc           File that declares aggregated sets
# new\aggsubs.inc           File that declares subsets of aggregate sets

# *.bat             Batch files which refer to the aggregation number

# new\agg.bat               Refers to the desired aggregation

# *.wk1 and *.dat   Data input into model

#  IN\EQ184.wk1             Raw data from EQ184*.xls
#  IN\CTP.wk1               Raw data from CTP*.XLS
#  in\macsam.wk1            Unbalanced macro SAM
#  in\mzsam.wk1             Prior year SAM for priors on IO table
#  in\gdptarg.dat           GDP target for MACRO SAM
#  in\petro.dat             Value of petroleum taxes

# output files

# out\macsam.wk1            Balanced macro SAM
# out\mzsam.wk1             Final disaggregate SAM
# out\exogcw.wk1            Multiplier matrix full SAM
# out\invagg%.wk1           Multiplier matrix aggregated SAM
# out\mzagg%.wk1            Aggregated SAM number % with home cons.
# out\mcagg%.wk1            Aggregated SAM number % without home cons.
# out\micmac.wk1            Macro SAM implied by micro SAM

# intermediate files

# work\rasio.g0?            Work files for RASIO.GMS, ?=1 to 8
# work\rawsam.wk1           Raw SAM after data manipulations
# work\baliosam.wk1         Raw SAM after first balancing of IO table
```

```
# work\mzsam1.wk1          Balanced RASSAM for 1995
# work\mzagg.wk1           Most recent SAM aggregation with home cons
# work\mcagg.wk1           Most recent SAM aggregation without home cons
# work\cgehc.g0?           Work files for CGE with home cons., ?=1 to 8
# work\cgemc.g0?           Work files for CGE without home cons., ?=1 to 8
# work\mcaggimp.inc        Refer to appropriate aggregation for import
# work\mzaggimp.inc        Refer to appropriate aggregation for import
# work\batagg.inc          Batinclude which sets up aggregation mapping
# work\batsubs.inc         Batinclude file which sets up sub sets
# work\expagg.inc          Export aggregate SAM to out directory
# work\expmcagg.inc        Export og aggregate SAM w/o hc into out

out\agtech.wk1 : work\cgehc.g01 new\cge\agtech.gms new\cge\cgeres.inc
        gams new\cge\agtech r=work\cgehc o=rep\agtech.lst

work\cgehc.g01 : work\mzagg.wk1 work\batagg.inc work\batsubs.inc \
work\mzaggimp.inc  new\aggsets.inc new\cge\cgehc.gms new\aggsubs.inc work\expagg.inc
        gams new\cge\cgehc s=work\cgehc o=rep\cgehc.lst

work\cgemc.g01 : work\mcagg.wk1 work\batagg.inc work\batsubs.inc \
work\mcaggimp.inc  new\aggsets.inc new\cgemc.gms work\expmcagg.inc \
new\aggsubs.inc work\expmcagg.inc
        gams new\cge\cgemc s=work\cgemc o=rep\cgemc.lst

work\mzagg.wk1 work\mcagg.wk1 : work\batmmap.inc \
out\mzsam.wk1 new\micinvag.gms new\aggsets.inc work\batagg.inc \
work\expagg.inc work\expinv.inc new\micmacx.inc new\mapmaca.inc \
new\imacro.inc new\imicro.inc new\mapac.inc
        gams new\micinvag o=rep\micinvag.lst

work\batagg.inc work\expagg.inc work\expinv.inc work\mzaggimp.inc \
work\expmcagg.inc work\mcaggimp.inc work\batmmap.inc : new\agg.bat
        new\agg >rep\agg.lst

out\exogcw.wk1 : out\mzsam.wk1 new\micinv.gms work\endo.inc new\imicro.inc
        gams new\micinv o=rep\micinv.lst

work\endo.inc : out\mzsam.wk1 new\imicro.inc new\exog.inc new\endoset.gms
        gams new\endoset o=rep\endoset.lst

out\mcpath.out : work\mcsam.mat new\mcpath.mat
        mats new\mcpath.mat

out\mzpath.out : work\mzsam.mat new\mzpath.mat
        mats new\mzpath.mat

work\mzsam.mat work\mcsam.mat : \
out\mzsam.wk1 out\mcsam.wk1 new\putmat.gms new\putmat.inc
        gams new\putmat o=rep\putmat.lst

out\mzsam.wk1 : new\splthh.gms work\mzsam1.wk1 new\spltset.inc \
new\micmac.inc out\macsam.wk1 work\mzsam1.wk1 new\mapmac.inc \
```

```
new\imicro.inc new\imacro.inc
        gams new\splthh o=rep\splthh.lst

work\mzsam1.wk1 : work\rasio.g01 new\rassam.gms minos5.opt new\micmac.inc
        gams new\rassam r=work\rasio o=rep\rassam.lst

work\rawsam.wk1 work\baliosam.wk1 work\rasio.g01 : \
new\rasio.gms out\macsam.wk1 in\eq184.wk1 in\ctp.wk1 new\mapac.inc \
new\micmac.inc new\stone.inc new\mzsets.inc new\imacro.inc  \
new\mapa&c.inc in\mzsam.wk1 in\petro.dat  new\imicro.inc
        gams new\rasio s=work\rasio o=rep\rasio.lst

minos5.opt : new\minos5.opt
        copy new\minos5.opt minos5.opt

out\macsam.wk1 : new\macent.gms in\macsam.wk1 in\gdptarg.dat new\imacro.inc
        gams new\macent.gms o=rep\macent.lst
```

Filename: macent.gms
Placement: sub-directory new
Description: The macent.gms file reads in an unbalanced aggregate SAM (in\macsam.wk1), and produces a balanced aggregate SAM (out\macsam.wk1).

```
*File macent.gms

$ontext
Balancing of Macro SAM for Mozambique, 1995 data.
Balancing is necessary due to multiple sources for data on Gov't revenue and a lack
of information on capital inflows, retained earnings, and household savings.

This file uses minimization of maximum entropy to balance the macro sam.

Written by: Channing Arndt, Sherman Robinson, and Henning Tarp Jensen
February 10, 1997
Updated  by Antonio Cruz
May 1, 1997
Updated by Channing Arndt
Nov 7, 1997

INCLUDE FILES

new\imacro.inc      Macro sets
new\putmsam.inc     Puts macro sam in GAMS table form
in\macsam.dat       Raw macro SAM
in\gdptarg.dat      GDP target

$offtext


$OFFSYMLIST OFFSYMXREF OFFUPPER
$INLINECOM { }

option solprint=on, decimals=6;
option limrow=1000;
option limcol=1000;
option nlp=conopt ;


SETS

$include new\imacro.inc

 rvar(imacro)          Non-government row and column headings
          /ACT, COM, FAC, ENT, HOU, NGO, CAP, ROW/
 rpar(imacro)          Government row and column headings
          /GRE, ITX, GIN/
 rwiggle(racc)         Gives a little wiggle room in these sets
          /ACT, COM, FAC, ENT, HOU, CAP, ROW/
 tot(imacro)
          /TOT/
```

```
;


alias(racc,r,c);
alias(imacro,jmacro);
alias(rvar,cvar);
alias(rpar,cpar);

$include in\gdptarg.dat


SCALARS         delta           A small number          /.00000001/
                gamma           Tolerance for entropy   /.0000001 /
                sumtarg0        Sum of targets
                gdp0            Base GDP
                gdp00           GDP from final SAM
                gdpfc0          GDP at factor cost
;

PARAMETERS      target0(imacro)             Targets for macro SAM row totals
                flow0(imacro,jmacro)        Initial flow matrix
                macsam0(imacro,jmacro)      Adjusted coefficients
                flow(imacro,jmacro)         Adjusted flow matrix
                percent1(imacro,jmacro)     Percent change from original flow matrix entropy
                percent2(imacro,jmacro)     Percent change from original flow matrix deviation
                wiggle(rwiggle)             Wiggle room hit GDP target
                ctot(imacro)                Column total
                rtot(imacro)                Row total
;

wiggle(rwiggle)     = 0.004;

$libinclude ssimport flow0 in\macsam.wk1 a1..m13

*Scale SAM
flow0(imacro,jmacro) = flow0(imacro,jmacro)/100000;

*Scale gdptarg
gdptarg             = gdptarg/100000;

flow0("TOT",c)      = SUM(r, flow0(r,c)) ;
flow0(r,"TOT")      = SUM(c, flow0(r,c)) ;

display flow0;

*SR       Flip some negative values in MacSam

SET
 red(imacro,jmacro)             Signals negative flows
;

PARAMETER       redsam(imacro,jmacro)
                redsam1(imacro,jmacro)
;
```

```
red(r,c)$(flow0(r,c) LT 0)      = yes;
redsam(r,c)                     = 0;
redsam(r,c)$red(r,c)            = flow0(r,c);
redsam1(c,r)$red(r,c)           = flow0(r,c);
flow(r,c)           = flow0(r,c) - redsam(r,c) - redsam1(r,c);

flow("TOT",c )      = SUM(r, flow(r,c));
flow(r,"TOT")       = SUM(c, flow(r,c));

redsam("TOT",c)     = SUM(r, redsam(r,c));
redsam(r,"TOT")     = SUM(c, redsam(r,c));

rtot(r)             = SUM(c, flow(r,c));
ctot(c)             = SUM(r, flow(r,c));

macsam0(r,c)        = flow(r,c)/ctot(c);

display redsam, flow;

*SR       Give initial guess at targets
target0(r)          = (ctot(r) + rtot(r))/2;
sumtarg0            = sum(r, rtot(r));

*SR       Compute some macro aggregates from FLOW
gdpfc0              = flow("fac","act");
gdp0                = flow("fac","act") + flow("gre","com")
                    + flow("itx","act") + flow("itx","com")
                    - flow("act","itx") - flow("com","itx");

display gdpfc0, gdp0 ;


VARIABLES

 MACSAM(imacro,jmacro)   Macro sam coefficients for all entries
 FLOWSAM(imacro,jmacro)  Macro sam flows
 TARGET(imacro)          Row targets
 Z                       Objective for entropy
 Z1                      Objective for percentage change
 GDPFC                   GDP at factor cost
 GDP                     GDP at market prices
;

*Set starting values at initial values;
MACSAM.L(r,c)   = macsam0(r,c);
FLOWSAM.L(r,c)  = flow(r,c);
TARGET.L(r)     = target0(r);
Z.L             = 0;
Z1.L            = 0;
GDPFC.L         = gdpfc0;
GDP.FX          = gdptarg;


EQUATIONS
```

```
 ENTROPY                  The cross entropy equation
 ROWSAUM(imacro)          Hit row target
 COLSUM(jmacro)           Hit column target
 SAMMAKE(imacro,jmacro)   Make SAM flows
 PERCHANGE                Percentage change in coefficients
 GDPFCDEF                 Define gdpfc
 GDPDEF                   Define gdp
;

ENTROPY..       Z =E= SUM((r,c)$(macsam0(r,c) gt gamma),
                MACSAM(r,c)*(log(MACSAM(r,c) + delta) - log(macsam0(r,c) + delta)));

PERCHANGE..     Z1 =E= sum((r,c)$(macsam0(r,c) gt gamma),
                sqr((MACSAM(r,c)-macsam0(r,c))/macsam0(r,c)));

ROWSUM(r)..     SUM(c, FLOWSAM(r,c)) =E= TARGET(r);

COLSUM(c)..     SUM(r, FLOWSAM(r,c)) =E= TARGET(c);

SAMMAKE(r,c)..  FLOWSAM(r,c) =E= MACSAM(r,c)*TARGET(c);

GDPFCDEF..      GDPFC =E= FLOWSAM("fac","act");

GDPDEF..        GDP =E= FLOWSAM("fac","act") + FLOWSAM("gre","com")
                + FLOWSAM("itx","act") + FLOWSAM("itx","com")
                - FLOWSAM("act","itx") - FLOWSAM("com","itx");

*SR      End of equations

*SR      Fix unvarying variables
 macsam.lo(r,c)                  = 0;
 macsam.fx(r,c)$(macsam0(r,c) lt gamma) = macsam0(r,c);

*SR      Fix some values

SET
 fixrow1(imacro)     / FAC, ENT, HOU /
 fixrow2(imacro)     / ACT, COM /
;

 FLOWSAM.FX("gre",fixrow1)           = flow("gre",fixrow1);
 FLOWSAM.FX("itx",fixrow2)           = flow("itx",fixrow2);
 FLOWSAM.FX("gre","cap")             = flow("gre","cap");
 FLOWSAM.FX("gin","cap")             = flow("gin","cap");
 FLOWSAM.FX("act","itx")             = flow("act","itx");
 FLOWSAM.FX("ngo","row")             = flow("ngo","row");
 FLOWSAM.FX("com","ngo") = flow("com","ngo");

 TARGET.LO(r)                = min(ctot(r),rtot(r));
 TARGET.UP(r)                = max(ctot(r),rtot(r));
 TARGET.LO(rwiggle)          = (1-wiggle(rwiggle))*min(ctot(rwiggle),rtot(rwiggle));
 TARGET.UP(rwiggle)          = (1+wiggle(rwiggle))*max(ctot(rwiggle),rtot(rwiggle));

 display target.up, target.lo;
```

```
MODEL MACENT          / ENTROPY
                        ROWSUM
                        COLSUM
                        SAMMAKE
                        PERCHANGE
                        GDPFCDEF
                        GDPDEF /
;

macent.holdfixed=1;

SOLVE macent using nlp minimizing z;

abort$(macent.modelstat ne 2) "not optimal";

PARAMETER     macsam1(imacro,jmacro)     SAM flows from entropy diff
              macsam2(imacro,jmacro)     SAM flows from deviation
;

*Move flows to parameter and rescale

macsam1(r,c)        = flowsam.l(r,c);
macsam1("TOT",c)  = SUM(r, macsam1(r,c));
macsam1(r,"TOT")  = SUM(c, macsam1(r,c));

display macsam1;

*SR      Put back negative flows at base values
macsam1(r,c)        = macsam1(r,c) + redsam(r,c) + redsam1(r,c);
macsam1("TOT",c)  = SUM(r, macsam1(r,c));
macsam1(r,"TOT")  = SUM(c, macsam1(r,c));
percent1(imacro,jmacro)$(flow0(imacro,jmacro))
              = 100*(macsam1(imacro,jmacro)
              - flow0(imacro,jmacro))/flow0(imacro,jmacro);

display z.l, z1.l, macsam1, percent1;
display gdp0, gdp.l, gdptarg, gdpfc0, gdpfc.l;

*Note this command puts the entropy derived macsam into spreadsheet
$libinclude ssexport macsam1 out\macsam.wk1 a1..m13

*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#
```

Filename: rasio.gms

Placement: sub-directory new

Description: The rasio.gms file is developing a fully disaggregated, but unbalanced (Raw) SAM. Moreover, the stone.inc file is included for balancing the activities columns of this unbalanced SAM, thus creating a fully disaggregated (IO Balanced) SAM. Note that this SAM is still unbalanced, except for the activity columns. Note also that the gams program statement in the makefile creates work-files which are used subsequently in the development of the fully disaggregated balanced SAM, (see the file rassam.gms).

```
* File rasio.gms

$OFFSYMLIST OFFSYMXREF OFFUPPER
$INLINECOM { }

*  Various Entropy RAS versions programmed by S. Robinson, 1/97
*
*  INCLUDE files used:
*  new\imicro.inc     SAM sets for RASIO
*  out\macsam.wk1  Balanced Macro SAM
*  in\mzsam.wk1       Input SAM to serve as prior for IO
*  new\mzsets.inc     Sets for aggregation of 184
*  new\mapa&c.inc  Set mappings
*  in\eq184.wk1       Raw data from EQ1849?d.xls
*  in\ctp.wk1         Raw data from CTP9?.XLS
*  in\petro.dat       Data on petroleum taxes
*  new\stone.inc      RAS of IO table
*  new\micmac.inc:  Aggregates a MicroSAM into a MacroSAM (useful to compare
*                     data, first attempt at SAM (look for PROTOMAC), and final
*                     SAM (look for NEWMAC))
*  new\putsam.inc:   Program segment for writing a MicroSAM to a file specified
*                     in the include stat, which can be imported into a spreadsheet,
*                     converted in ASCII format and used in the model.
*  new\imacro.inc     Macro sets


 OPTIONS RESLIM=15000,ITERLIM=10000,LIMROW=0,LIMCOL=0,SOLPRINT=Off;
 OPTIONS NLP=MINOS5;

SCALAR              scale       Scale incoming data by this amount        /100000/
;


*################  SETS and SUBSETS of MicroSAM   ########################

SETS
$include new\imacro.inc
$include new\imicro.inc

SET
$include new\mapmac.inc

$ontext
new\imicro.inc introduces subsets of imicro which include
            comm      commodities
            activ     activities
            inst      institutions
            f         factors
            flab      labour factors
            hhld      households
            notacc    totals
            iaga      agricultural activities
            iagc      agricultural commodities
            inaga     non-agricultural activities
```

```
            iacc        dynamic set non-zeros and not totals for SAM accounts
$offtext

  ALIAS (racc,r,c);
  ALIAS (iacc, jacc, iacc1, iacc2);
  ALIAS (iagc,jagc);
  ALIAS (activ,activ2);
  ALIAS (comm,comm1,comm2);
  ALIAS (flab,flab2);
  ALIAS (hhld,hhld1);
  ALIAS (imacro,jmacro,imacro1,imacro2);
  ALIAS (imicro,jmicro,imicro1,imicro2);
  ALIAS (commerce,commerce1);

*Sets for AGGREGATING 184 SECTORS TO THE BASIC SAM AGGREGATION
$include new\mzsets.inc

  ALIAS(all184,all184a);

*Mapping sets
$include new\mapa&c.inc

SET
$include new\mapac.inc


*########### ENTER RAW DATA FROM NATIONAL ACCOUNTS ##############

PARAMETERS      eq184(all184,eqtit)  Product balance from national accounts
                ctp(orig,ctptit)     Value added from national accounts
;

$libinclude ssimport eq184 in\eq184.wk1 a1..y186
$libinclude ssimport ctp in\ctp.wk1 a1..h27

$include in\petro.dat


*############ SCALE NEWLY ENTERED DATA DOWN BY SCALE ############

 eq184(all184,eqtit)  = eq184(all184,eqtit)/scale;
 ctp(orig,ctptit)     = ctp(orig,ctptit)/scale;
 petrotax             = petrotax/scale;

PARAMETER       ngocons              Non government organisation consumption
;

 ngocons              = eq184("183","cogo");
 eq184("183","cogo") = 0;

display scale, EQ184, CTP, petrotax;
```

```
*########################## INPUT PRIOR SAM ############################

*this include file has a balanced microsam for a preceding version or year
PARAMETER       mzsam_1(imicro,imicro1)       Prior micro SAM
;

$libinclude ssimport mzsam_1 in\mzsam.wk1 a1..cp94


*########################## INPUT MACSAM ############################

*this include file has the balanced macrosam from Macent.gms
PARAMETER       macsam(imacro,jmacro)         Macro SAM
;

$libinclude ssimport macsam out\macsam.wk1 a1..m13


*#####################  PUT MACRO SAM IN IFPRI SETS  ##################

SET
 iscal       Non-empty cells in MACROSAM and total marketing margins
           / TOTDOM, HHCONS, EXPOSUB, TOTEXP
             TOTINT, TOTMARG, CP, GPR, GPI, NGOCON, ID
             GPROFIT, YENTGOV
             YHHLAB, YHHENT,YHHGOV, YHHROW
             CTAX, LABTAX, CAPTAX, CORPTAX, HHTAX, INDTAX
             NITAX, TARIFF
             YGOVROW
             YNGOROW
             HHSAV, ENTSAV, GRESAV, GINSAV, FSAV
             TOTIMP /
;

PARAMETER       macro(iscal)                  Flows present in microsam
;


*################## PUT MACROSAM VALUES IN MACRO #################

MACRO("TOTDOM")         = macsam("ACT","COM");
MACRO("HHCONS")         = macsam("ACT","HOU");

MACRO("TOTMARG")        = SUM(all184,eq184(all184,"mg")) - ctp("comm","tc") - petrotax;
MACRO("TOTINT")         = macsam("COM","ACT");
MACRO("CP")             = macsam("COM","HOU");
MACRO("GPR")            = macsam("COM","GRE");
MACRO("EXPOSUB")        = macsam("COM","ITX");
MACRO("GPI")            = macsam("COM","GIN");
MACRO("NGOCON")         = macsam("COM","NGO");
MACRO("ID")             = macsam("COM","CAP");
MACRO("TOTEXP")         = macsam("COM","ROW");

MACRO("GPROFIT")        = macsam("ENT","FAC");
```

```
MACRO("YENTGOV")        = macsam("ENT","GRE");

MACRO("YHHLAB")         = macsam("HOU","FAC");
MACRO("YHHENT")         = macsam("HOU","ENT");
MACRO("YHHGOV")         = macsam("HOU","GRE");
MACRO("YHHROW")         = macsam("HOU","ROW");

MACRO("CTAX")           = macsam("GRE","COM");
MACRO("CORPTAX")        = macsam("GRE","ENT");
MACRO("HHTAX")          = macsam("GRE","HOU");
MACRO("INDTAX")         = macsam("GRE","itx");

MACRO("NITAX")          = macsam("ITX","ACT");
MACRO("TARIFF")         = macsam("ITX","COM");

MACRO("YGOVROW")        = macsam("GIN","ROW");

MACRO("YNGOROW")        = macsam("NGO","ROW");

MACRO("ENTSAV")         = macsam("CAP","ENT");
MACRO("HHSAV")          = macsam("CAP","HOU");
MACRO("GRESAV")         = macsam("CAP","GRE");
MACRO("GINSAV")         = macsam("CAP","GIN");
MACRO("FSAV")           = macsam("CAP","ROW");

MACRO("TOTIMP")         = macsam("ROW","COM");

*Note macro("labtax") and macro("captax") are entered after split below


*###########################################################################
*#### ############## FILL IN VALUES FOR PROTOSAM ####################
*###########################################################################

PARAMETER       protosam(imicro1,imicro2)       Prototype SAM
;

*Initialize protosam
PROTOSAM(imicro1,imicro2) = 0 ;


*#### INPUT-OUTPUT RELATIONS FROM PRECEDING VERSION OR YEAR ####

*Place prior IO coefficients in PROTOSAM
PROTOSAM(comm,activ)$sum(comm2,mzsam_1(comm2,activ)) =
        mzsam_1(comm,activ)/sum(comm2,mzsam_1(comm2,activ));


*################## FILL IN VALUES FROM MACRO SAM  #################

*Gross profits
PROTOSAM("enter","capit")               = macro("gprofit");

*Enterprise subsidies
```

```
PROTOSAM("enter","govre")  = macro("yentgov");

*Corporate taxes
PROTOSAM("govre","enter")  = macro("corptax");

*Aid in government budget
PROTOSAM("govin","world") = macro("ygovrow");

*Aid in non government budget
PROTOSAM("ngovo","world")          = macro("yngorow");

*Retained earning plus depreciation
PROTOSAM("kacct","enter")          = macro("entsav");

*Government recurrent budget deficit
PROTOSAM("kacct","govre") = macro("gresav");

*Government investment less aid
PROTOSAM("kacct","govin") = macro("ginsav");

*Net capital inflow
PROTOSAM("kacct","world") = macro("fsav");

*Intermediate tax revenue
PROTOSAM("govre","intax")  = macro("indtax");


*######### SPLIT FACTOR TAXES BETWEEN CAPITAL AND LABOR #########

SCALAR          lfcttx          Share of factor taxes to labor
;

*From annuario
$include new\lfcttx.inc

*Labor tax is social security contributions
PROTOSAM("govre","labor")  = lfcttx*macsam("gre","fac");
MACRO("labtax")            = lfcttx*macsam("gre","fac");

*Capital taxes are "rendas de casa" and "other"
PROTOSAM("govre","capit")          = (1-lfcttx)*macsam("gre","fac");
MACRO("captax")            = (1-lfcttx)*macsam("gre","fac");

display macro;


*################ PUT IN AND SPLIT VALUES FROM CTP9?.XLS ############

*Enter value added
*Note, put 5% of family return into capital
*Note, put the remaining 95% into labor

SCALAR          tsalefam        Total family sales in agriculture
                tsaleemp        Total formal enterprise sales in agriculture
```

```
;

*Value added for one to one sectors
PROTOSAM("labor",activ)     = SUM(orig$maporiga(orig,activ),
                              ctp(orig,"rem") + 0.95*CTP(orig,"mixed"));

PROTOSAM("capit",activ)     = SUM(orig$maporiga(orig,activ),
                              ctp(orig,"exced")+0.05*CTP(orig,"mixed"));

*Sales taxes for one to one sectors
PROTOSAM("govre",comm)   = SUM(orig$maporigc(orig,comm),
                              ctp(orig,"tc"));

*Export taxes for one to one sectors
PROTOSAM(comm,"intax")   = -SUM(orig$maporigc(orig,comm),
                              ctp(orig,"te"));

*Indirect taxes for one to one sectors
PROTOSAM("intax",activ)     = SUM(orig$maporiga(orig,activ),
                              ctp(orig,"ti"));

*Allocate export taxes to agriculture and food processing
PROTOSAM('crcas','intax')     = -ctp('agri','te');
PROTOSAM('cofpr','intax')     = -ctp('fpro','te');

*Split value added and indirect taxes for agriculture
tsalefam   = SUM(iaga,sum(all184$mapa(all184,iaga),EQ184(all184,"pofa")));
tsaleemp   = SUM(iaga,sum(all184$mapa(all184,iaga),EQ184(all184,"pemp")));

display tsalefam, tsaleemp;

PROTOSAM("labor",iaga)      =
            (ctp("agri","rem")+0.95*ctp("agri","mixed"))*
            SUM(all184$mapa(all184,iaga),EQ184(all184,"pofa"))/tsalefam;

PROTOSAM("capit",iaga)      =
            (ctp("agri","exced")+0.05*ctp("agri","mixed"))*
            SUM(all184$mapa(all184,iaga),EQ184(all184,"pemp"))/tsaleemp;

PROTOSAM("intax",iaga)      =
            ctp('agri','ti')*
            SUM(all184$mapa(all184,iaga),EQ184(all184,"pemp"))/tsaleemp;


*###################PUT IN VALUES FROM EQ1849?D.XLS  ################

*Exports
 PROTOSAM(comm,"world")  = SUM(all184$mapc(all184,comm), eq184(all184,"x"));

*Rural auto-consumption
 PROTOSAM(activ,"rural")     = SUM(all184$mapa(all184,activ), eq184(all184,"auru"));

*Urban auto-consumption
 PROTOSAM(activ,"urban")    = SUM(all184$mapa(all184,activ), eq184(all184,"auci"));
```

```
* Domestic sales in three steps
* Step 1 - total production figure net of export taxes from NIS NA
* Step 2 - remove home consumption
* NOTE: export subsidies do not need to be removed from NIS total
* production figure in calculating domestic sales
* Step 3 - remove consumption taxes. This is performed later after
* consumption taxes have been shared

PROTOSAM(activ,comm)       = SUM(all184$(mapa(all184,activ) and mapac(activ,comm)),
                             eq184(all184,"prod"));

PROTOSAM(activ,comm)$mapac(activ,comm)
                           = protosam(activ,comm) - SUM(hhld,protosam(activ,hhld));

*Park total margins in domestic margins slot temporarily
PROTOSAM("acomd",comm) = SUM(all184$mapc(all184,comm), eq184(all184,"mg"));

*Imports
PROTOSAM("world",comm)   = SUM(all184$mapc(all184,comm), eq184(all184,"m"));

*Import tariffs
PROTOSAM("intax",comm)   = SUM(all184$mapc(all184,comm), eq184(all184,"dm"));

*Rural Private consumption of marketed commodities
PROTOSAM(comm,"rural")   = SUM(all184$mapc(all184,comm), eq184(all184,"coru"));

*Urban Private consumption of marketed commodities
PROTOSAM(comm,"urban")   = SUM(all184$mapc(all184,comm), eq184(all184,"coci"));

*Government consumption
PROTOSAM(comm,"govre")   = SUM(all184$mapc(all184,comm), eq184(all184,"cogo"));

*Non government consumption
PROTOSAM("coser","ngovo")= ngocons;

*Note that special programs are treated as recurrent expenditure
*in the national accounts. They thus fall into the ‘govre’ column through
*the above manipulation. Later, this quantity is moved to investment.


*############### SPLIT VALUE ADDED FOR FOR PROCESSING ###############

*It is useful to calculate some preliminary totals
PROTOSAM(activ,"total")      = SUM(iacc, PROTOSAM(activ,iacc));

PROTOSAM("labor","agmil") = (ctp("fpro","rem")+0.95*ctp("fpro","mixed"))*protosam("agmil","total")/
                            (protosam("agmil","total")+protosam("aofpr","total"));

PROTOSAM("capit","agmil") = (ctp("fpro","exced")+0.05*ctp("fpro","mixed"))*protosam("agmil","total")/
                            (protosam("agmil","total")+protosam("aofpr","total"));

PROTOSAM("labor","aofpr") = (ctp("fpro","rem")+0.95*Ctp("fpro","mixed"))*protosam("aofpr","total")/
                            (protosam("agmil","total")+protosam("aofpr","total"));
```

```
PROTOSAM("capit","aofpr")  = (ctp("fpro","exced")+0.05*Ctp("fpro","mixed"))*protosam("aofpr","total")/
                             (protosam("agmil","total")+protosam("aofpr","total"));

*Put indirect taxes in food processing to other food processing
PROTOSAM("intax",'aofpr')   = ctp('fpro','ti');

*############ SPLIT CONSUMPTION TAXES FOR AGRICULTURE, ###########
*################## FOOD PROCESSING, AND CHEMICALS ################

*Split on the basis of total sales for domestic consumption
SCALAR          totagds             Total agricultural domestic sales for domestic cons.
;

PARAMETER       domsales(comm)      Domestic sales for domestic consumption
;

domsales(comm)              = protosam('total',comm) - protosam(comm,"world")
                              - protosam("world",comm) - protosam("intax",comm)
                              - protosam("govre",comm) - SUM(commerce,protosam(commerce,comm));

totagds                     = SUM(iagc,domsales(iagc));

*Do in two steps
PROTOSAM("govre",iagc)      = domsales(iagc)/totagds;
PROTOSAM("govre",iagc)      = ctp("agri","tc")*protosam("govre",iagc);

*Split sales taxes for food processing
*Again in two steps
PROTOSAM("govre","cgmil") = domsales("cgmil")/(domsales("cofpr")+domsales("cgmil"));

PROTOSAM("govre","cofpr")  = domsales("cofpr")/(domsales("cofpr")+domsales("cgmil"));


PROTOSAM("govre","cgmil") = ctp("fpro","tc")*PROTOSAM("govre","cgmil");

PROTOSAM("govre","cofpr")  = ctp("fpro","tc")*PROTOSAM("govre","cofpr") ;

*Split sales taxes for chemicals
*In multiple steps

PROTOSAM("govre","coche") =
        domsales("coche")/(domsales("coche")+domsales("cfert")+domsales("cfuel"));

PROTOSAM("govre","cfert")  =
        domsales("cfert")/(domsales("coche")+domsales("cfert")+domsales("cfuel"));

PROTOSAM("govre","cfuel")  =
        domsales("cfuel")/(domsales("coche")+domsales("cfert")+domsales("cfuel"));

PROTOSAM("govre","coche") = ctp("chem","tc")*protosam("govre","coche");

PROTOSAM("govre","cfert")  = ctp("chem","tc")*protosam("govre","cfert");

PROTOSAM("govre","cfuel")  = ctp("chem","tc")*protosam("govre","cfuel");
```

```
*######## REMOVE SALES TAXES FROM DOMESTIC SALES (STEP 3) ########

PROTOSAM(activ,comm)$mapac(activ,comm)
                                = protosam(activ,comm) - protosam('govre',comm);

*It is useful to recalculate some totals
PROTOSAM(activ,"total")      = SUM(iacc, protosam(activ,iacc));

*### PULL COMMERCIAL SALES TAXES OUT OF COMMERCIAL MARGINS ###
*################## AND PUT THEM INTO SALES TAXES ###################

SCALAR          sum1            Sum of commercial margins less petroleum taxes
;

PARAMETER       shrcomtx(comm)  Share commercial taxes across commodities
;

sum1                            = SUM(comm, protosam("acomd",comm)) - petrotax;

shrcomtx(comm)                  = protosam("acomd",comm)/sum1;
shrcomtx('cfuel')               = (protosam('acomd','cfuel') - petrotax)/sum1;

PROTOSAM("acomd",comm) = protosam("acomd",comm) - shrcomtx(comm)*(ctp("comm","tc") - petrotax);

PROTOSAM("govre",comm)  = protosam("govre",comm) + shrcomtx(comm)*(ctp("comm","tc") - petrotax);

*take petroleum taxes out of marketing margin and put into consumption tax
PROTOSAM("acomd",'cfuel')  = protosam("acomd",'cfuel') - petrotax;

PROTOSAM("govre",'cfuel')   = protosam("govre","cfuel") + petrotax;

*############## DOMESTIC, EXPORT, AND IMPORT MARGINS ###############

PARAMETERS      xmargshr(comm)  Export margin share
                mmargshr(comm)  Import margin share
                chkmarg(comm)   Check to insure margins
;

xmargshr(comm)$(  SUM(activ$mapac(activ,comm),
                  protosam(activ,comm))+protosam("world",comm)+protosam("intax",comm)) =
                  protosam(comm,"world")/
                   (SUM(activ$mapac(activ,comm),protosam(activ,comm))
                  + protosam("world",comm) + protosam("intax",comm));

mmargshr(comm)$( SUM(activ$mapac(activ,comm),
                  protosam(activ,comm))+protosam("world",comm)+protosam("intax",comm)) =
                  (protosam("world",comm)+protosam("intax",comm))/
                  (SUM(activ$mapac(activ,comm),protosam(activ,comm))
                  + protosam("world",comm)+protosam("intax",comm));

*Set export margin for CFISH to zero
xmargshr("cfish")    = 0;
```

```
*Set export margin for COMAN to zero
xmargshr("coman") = 0;

*Set export margin share for non-exported commodities to zero
*and reduce export margins for COCRO
xmargshr("cfert")    = 0;
xmargshr("cfuel")    = 0;
xmargshr("cwhea")  = 0;
xmargshr("cocro")   = xmargshr("cocro")/5;

*Set import margin share for non-produced commodities to one
*and reduce import margins for COCRO
mmargshr("cfert")   = 1;
mmargshr("cfuel")   = 1;
mmargshr("cwhea") = 1;
mmargshr("cocro")  = mmargshr("cocro")/5;

chkmarg(comm)      = xmargshr(comm)+mmargshr(comm);

display chkmarg;

loop( comm,
        if( chkmarg(comm) gt 1,
                abort 'negative domestic sales';
        );
);

display xmargshr, mmargshr ;

*Export margins
PROTOSAM("acome",comm)  = protosam("acomd",comm)*xmargshr(comm);

*Import margins
PROTOSAM("acomm",comm) = protosam("acomd",comm)*mmargshr(comm);

*Domestic commercial margins
PROTOSAM("acomd",comm)  = protosam("acomd",comm)*(1 - xmargshr(comm) - mmargshr(comm));

*Control for small values
PROTOSAM(commerce,comm)$(abs(protosam(commerce,comm)) lt .00001) = 0;

PARAMETER       chkmargins(commerce,comm)  Check to see if margins are positive
                 shrmargins(commerce)          Calculate the share of each type in total margins
;


chkmargins(commerce,comm) = protosam(commerce,comm);

display chkmargins;

loop( (commerce,comm),
        if( chkmargins(commerce,comm) lt 0,
                abort "negative marketing margins";
        );
```

```
);

shrmargins(commerce)        = SUM(comm, protosam(commerce,comm))/
                              SUM((commerce1,comm1), protosam(commerce1,comm1));

*######## SPLIT FOR INCOME OF RURAL AND URBAN HOUSEHOLDS ########

*Use shares in total consumption for remittances

PARAMETER     hhsplit(hhld)     Split factor for wages and taxes between rurals and urbans
              chkcoef(activ)    Check coefficients in IO matrix sum to 1
;

chkcoef(activ)              = SUM(comm,protosam(comm,activ));

display chkcoef;

hhsplit("urban")            = SUM(all184,EQ184(all184,"toci"))/SUM(all184a,EQ184(all184a,"toco"));
hhsplit("rural")            = 1 - hhsplit("urban");

*Net transfers by workers
PROTOSAM(hhld,"world")      = hhsplit(hhld)*macsam("hou","row");

*SPLIT CAPITAL INCOME, SOCIAL SECURITY, INCOME TAXES, AND SAVINGS
*############ GIVING 80% TO URBANS AND 20% TO RURALS ###############

hhsplit("urban")            = .8;
hhsplit("rural")            = 1 - hhsplit("urban");

*Income taxes
PROTOSAM("govre",hhld)      = hhsplit(hhld)*macsam("gre","hou");

*Distributed profits
PROTOSAM(hhld,"enter")      = hhsplit(hhld)*macsam("hou","ent");

*Social security and other transfers to households
PROTOSAM(hhld,"govre")      = hhsplit(hhld)*macsam("hou","gre");

*Household saving
PROTOSAM("kacct",hhld)      = hhsplit(hhld)*macsam("cap","hou");

*################### WAGES ARE SPLIT RESIDUALLY ####################

*Calculate total household spending
PROTOSAM("total",hhld)      = SUM(iacc, protosam(iacc,hhld));

*Calculate total household income other than labor
*Note wages are currently zero in protosam
PROTOSAM(hhld,"total")      = SUM(iacc, protosam(hhld,iacc));

*Total wages including mixed income
PROTOSAM(hhld,"labor")      = protosam("total",hhld) - protosam(hhld,"total");

*Calculate total household income
```

```
PROTOSAM(hhld,"total")      = SUM(iacc, protosam(hhld,iacc));

SCALAR          diffwage            Difference between MACSAM and implied wages
;

diffwage        = SUM(hhld, protosam(hhld,'labor')) - macsam("hou","fac");

display diffwage;

*############ SPLIT GOVERNMENT AND PRIVATE INVESTMENT ############

PARAMETER       govicoef(comm)      Government investment coefficients from prior
                kacccoef(comm)      Capital account coefficients from prior
;

 SCALAR         govisum             Sum of government investment coefficients
;

 govicoef(comm)     = mzsam_1(comm,"govin")/
                      (SUM(comm2, mzsam_1(comm2,"govin")) - mzsam_1("cspec","govin"));

 govicoef('cspec')  = 0;

 govisum            = SUM(comm, govicoef(comm));

 display govisum, govicoef;

*Government investment
PROTOSAM(comm,"govin")  = govicoef(comm)*(macsam("com","gin") - protosam("cspec","govre"));

*Non-government investment
PROTOSAM(comm,"kacct")  = SUM(all184$mapc(all184,comm), eq184(all184,"fbkf"))
                          - protosam(comm,"govin");

*Move special programmes from ‘govre’ into ‘govin’ column
PROTOSAM("cspec","govin") = protosam("cspec","govre");
PROTOSAM("cspec","govre") = 0;

*Put special programmes in kacct equal to zero
PROTOSAM("cspec","kacct")  = 0;

*Move negative kacct column entries into govin column
PROTOSAM(comm,"govin")$(protosam(comm,"kacct") lt 0) =
                          protosam(comm,"govin") + protosam(comm,"kacct");
PROTOSAM(comm,"kacct")$(PROTOSAM(comm,"kacct") lt 0) = 0;


*Intermediate consumption column totals

PARAMETER       intconctot(activ)   Intermediate consumption column totals
;

*Map one to one sectors
intconctot(activ)   = SUM(orig$maporiga(orig,activ) ,ctp(orig,"intcon"));
```

```
*Derive ag intermediate consumption from total sales
intconctot(iaga)       = protosam(iaga,"total") - protosam("intax",iaga) - SUM(f, protosam(f,iaga));

*derive ag processing intermediate consumption by shares
intconctot("agmil")  = ctp("fpro","intcon")*protosam("agmil","total")/
                       (protosam("agmil","total")+protosam("aofpr","total"));

intconctot("aofpr")  = ctp("fpro","intcon")*protosam("aofpr","total")/
                       (protosam("agmil","total")+protosam("aofpr","total"));

display intconctot;

SCALAR mincoef   Minimum % of sales for intermediate consumption and capital          /.01/
;

*Fix negatives in intconctot;
*Remove value from labor and set intconctot to 1% of total sales
PROTOSAM("labor",activ)$(intconctot(activ) lt 0) =
                       protosam("labor",activ) + intconctot(activ) - mincoef*protosam(activ,"total");

intconctot(activ)$(intconctot(activ) lt 0) = mincoef*protosam(activ,"total");

*Fix negatives in capital
*Remove value from labor and set intconctot to 1% of total sales
PROTOSAM("labor",activ)$(protosam("capit",activ) lt 0) =
                       protosam("labor",activ) + protosam("capit",activ) - mincoef*protosam(activ,"total");

PROTOSAM("capit",activ)$(protosam("capit",activ) lt 0) = mincoef*protosam(activ,"total");

*Remove negatives in labor
PROTOSAM("labor",activ)$(protosam("labor",activ) lt 0) = mincoef*protosam(activ,"total");

*Expand coefficients by intermediate consumption column totals
PROTOSAM(comm,activ)      = protosam(comm,activ)*intconctot(activ) ;

*Search and fix remaining illegal negatives
PROTOSAM(activ,comm)$(protosam(activ,comm) lt 0)        = 1;
PROTOSAM(comm,activ)$(protosam(comm,activ) lt 0)        = 1;
PROTOSAM("world",comm)$(protosam("world",comm) lt 0)  = 1;

*Share commerce activity columns by type of commerce
PROTOSAM(imicro,commerce) = shrmargins(commerce)*SUM(commerce1, protosam(imicro,commerce1));

*Share intermediate consumption between commerce sectors
intconctot(commerce)           = shrmargins(commerce)*intconctot('acomm');

*Totals
PROTOSAM(imicro1,"total")  = 0;
PROTOSAM("total",imicro2)  = 0;

PROTOSAM(imicro1,"total")  = SUM(iacc, protosam(imicro1,iacc));
PROTOSAM("total",imicro2)  = SUM(iacc, protosam(iacc,imicro2));

PARAMETER       TMR(comm)          Tariff rate
```

```
;

TMR(comm)$protosam("world",comm) = protosam("intax",comm)/protosam("world",comm) ;

display tmr;

$batinclude new\micmac.inc "PROTOMAC" "PROTOSAM"

display macsam, protomac, protosam;

PARAMETER        samcheck(imicro1)
;

SAMCHECK(imicro1) = protosam(imicro1,"total") - protosam("total",imicro1);

display 'this is with implied intermediate consumption row totals';
display samcheck;


*######################### PUT RAW PROTO SAM ##########################

$libinclude ssdump protosam work\rawsam.wk1 a1..a1

*########################### RED ALERT!!! ###############################

*THE ENTROPY RAS USES LOGARITHMS: negative flows in the SAM are NOT GOOD!!!

*The option I will use here is to detect any negative flows and net them out
*of their respective symmetric cells, eg. negative flow GOV → ENT is set
*to zero and ADDED to ENT → GOV as a positive number.
*The entropy RAS can then be carried out.
*After the RAS, if the symmetric cell was previously zero (ENT → GOV) it
*is set to zero and its value is placed with a negative sign in the original cell.

SETS
 red(imicro,jmicro)              Signals negative flows
;

PARAMETER        redsam(imicro,jmicro)          Negative adjustment matrix
                 redsam1(imicro,jmicro)         Second negative adjustment matrix
                 oldproto(imicro,jmicro)        Save old protosam
;

red(iacc,jacc)$(protosam(iacc,jacc) lt 0)   = yes;
redsam(iacc,jacc)                           = 0;
redsam1(iacc,jacc)                          = 0;
redsam(iacc,jacc)$red(iacc,jacc)            = protosam(iacc,jacc);
redsam1(jacc,iacc)$red(iacc,jacc)           = protosam(iacc,jacc);

display red;

oldproto(imicro,jmicro)                     = protosam(imicro,jmicro);

PROTOSAM(iacc,jacc)                         = protosam(iacc,jacc) - redsam(iacc,jacc) - redsam1(iacc,jacc);
```

```
PROTOSAM(iacc,"total")                  = SUM(jacc, protosam(iacc,jacc));
PROTOSAM("total",jacc)                  = SUM(iacc, protosam(iacc,jacc));
PROTOSAM("total","total")               = SUM(iacc, protosam(iacc,"total"));


*################### RAS IO PORTION OF THE SAM ######################

*IO PORTION HAS THE LARGEST PROBLEMS

*CA Ras ag io part of PROTOSAM using subset indices;
*make a vector of targets

PARAMETERS      colsumio(imicro)     Column sums of the io table
                iomat(imicro,activ)  The io matrix
                intrtot(imicro1)     Intermediate row totals
;

*Initialize parameter values
iomat(imicro,activ)  = protosam(imicro,activ);
colsumio(activ)      = SUM(iacc, iomat(iacc,activ));
intrtot(comm)        = SUM(all184$(mapc(all184,comm)), eq184(all184,"di"));

*Imputed financial services already added to intrtot("cfi_i") row total

display intrtot ;

*If intermediate row consumption equals zero,
*set it at level implied by current io
intrtot(comm)$(intrtot(comm) eq 0) = SUM(activ, protosam(comm,activ));

display intrtot;

*Check for negatives
loop( comm,
        if( intrtot(comm) lt 0,
                display intrtot;
                abort 'intermediate consumption row total lt zero';
        );
);

PROTOSAM(comm,"total")    = protosam(comm,"total") - SUM(activ, protosam(comm,activ)) + intrtot(comm);

SAMCHECK(imicro1) = protosam(imicro1,"total") - protosam("total",imicro1);

display 'this is with NIS intermediate consumption row totals';
display samcheck;

*Redo total row sums
PROTOSAM(imicro1,"total")  = SUM(iacc, protosam(imicro1,iacc));

*Cmplete vector of row totals
intrtot("labor")      = macro("yhhlab") + macro("labtax");
intrtot("capit")      = macro("gprofit") + macro("captax");
```

```
display iomat,colsumio,intrtot ;

SCALAR          rowscale
                colscale
;

rowscale        = SUM(imicro, intrtot(imicro));
colscale        = SUM(activ, colsumio(activ));

display rowscale, colscale;

intrtot(imicro)     = intrtot(imicro)*colscale/rowscale;

rowscale        = SUM(imicro, intrtot(imicro));
colscale        = SUM(activ, colsumio(activ));

display rowscale, colscale;

*SR     Balance PROTOSAM using Stone RAS procedure, using average of
*       row and column totals as control row and column.

$include new\stone.inc

PROTOSAM(iacc,"total")      = SUM(jacc, protosam(iacc,jacc));
PROTOSAM("total",jacc)      = SUM(iacc, protosam(iacc,jacc));
PROTOSAM("total","total")   = SUM(iacc, protosam(iacc,"total"));

PARAMETER       samcheck2(imicro1) Percentage error in row and column sums
;

SAMCHECK2(imicro1)$(protosam("total",imicro1) gt 0) =
                100*(protosam(imicro1,"total") - protosam("total",imicro1))/protosam("total",imicro1);

display samcheck2;

$libinclude ssdump protosam work\baliosam.wk1 a1..a1

*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#
```

Filename: stone.inc
Placement: sub-directory new
Description: The stone.inc file is an include file which performs the balancing of the activity columns of the fully disaggregated unbalanced SAM. This file is included when running the rasio.gms file.

```
*File stone.inc

*RAS IO table first and separately

*SR 1/97  Subroutine to do entropy diff on a rectangular matrix
*         Note new automatic scaling

 SET
 csumchk(*)          Rowcheck for data consistency
 rsumchk(*)          Colcheck for data consistency
;

*SR Do not domain check if sets are variable in calling program

PARAMETERS      colsm2(activ)          Column sums of input flows matrix
                rowsm2(imicro)         Row sums of input flows matrix
                stonec0(*,*)           Initial coefficients matrix
                scalec0(imicro,activ) Scale matrix
                checkcol(*)            Check initial columns sums against
;

SCALAR          matsum1                Check sum
                matsum2                Check sum and scaling factor
;

*SR       Check that sum of rowsm2 equals sum of colsm2.
*         Rescale row sums to match sum of column sums, but print input.
*         Note that control column sums (colsum) are assumed correct and
*         input matrix columns are normalized to match column totals.

colsm2(activ)                          = SUM(iacc, iomat(iacc,activ));
checkcol(activ)                        = colsumio(activ) - colsm2(activ);
iomat(iacc,activ)$colsm2(activ)        = iomat(iacc,activ)*colsumio(activ)/colsm2(activ);
rowsm2(iacc)                           = SUM(activ, iomat(iacc,activ));
matsum1                                = SUM(iacc, rowsm2(iacc));
matsum2                                = SUM(activ, colsm2(activ));
rowsm2(iacc)                           = rowsm2(iacc)*matsum2/matsum1;

rsumchk(activ)$((colsm2(activ) eq 0)$colsumio(activ))       = yes;
rsumchk(activ)$((colsm2(activ))$(colsumio(activ) eq 0))     = yes;
csumchk(iacc)$((rowsm2(iacc) eq 0)$intrtot(iacc))           = yes;
csumchk(iacc)$((rowsm2(iacc))$(intrtot(iacc) eq 0))                 = yes;

display rsumchk, csumchk, matsum1, matsum2, checkcol;
csumchk('intax')      = no;
```

```
SCALAR              chktst                  Number of data inconsistencies
;

chktst = 0 ;

loop( activ,
        if( rsumchk(activ),
                display "Data error in column";
                chktst = chktst + 1;
        );
);

loop( iacc,
        if( csumchk(iacc),
                display "Data error in row";
                chktst = chktst + 1;
        );
);

display chktst;

if( chktst, abort "Data errors --check rsumchk csumchk and chktst"; );

*SR     Define initial coefficients matrix
stonec0(iacc,activ)$colsm2(activ)                       = iomat(iacc,activ)/colsm2(activ);
scalec0(iacc,activ)$(stonec0(iacc,activ) gt 0)          = sqrt(stonec0(iacc,activ));


VARIABLES

  ZENTIO            Entropy objective
*  STONEC(imicro,activ)     Coefficients
  SCALEC(imicro,activ)      Scaled coefficiencts
;

*STONEC.L(iacc,activ)       = stonec0(iacc,activ);
*STONEC.LO(iacc,activ)      = 0;

SCALEC.L(iacc,activ)        = scalec0(iacc,activ);
SCALEC.LO(iacc,activ)       = 0;


EQUATIONS

  ENTSUBIO                  Entropy difference
  RCONST(imicro)            Row constraint
  CCONST(activ)             Column constraint
*  AGCOEFu(ccoef,iag)       Coefficients for uninformed rows in ag io the same
*  AGCOEFl(ccoef,iag)       Coefficients for uninformed rows in ag io the same
*  FERTCOEFU(iagf)          Coefficients for fertilizer row in ag io
*  FERTCOEFL(iagf)          Coefficients for fertilizer row in ag io
*  ENTSUBIO1                Entropy difference unscaled
*  RCONST1(imicro)          Row constraint unscaled
*  CCONST1(activ)           Column constraint unscaled
```

```
;

*ENTSUBIO1..      ZENTIO =E= SUM((iacc,activ)$(stonec0(iacc,activ) gt 0),
*                 STONEC(iacc,activ)*(log(STONEC(iacc,activ) + .000001)
*                 - log(stonec0(iacc,activ) + .000001) ));

ENTSUBIO..        ZENTIO =E= SUM((iacc,activ)$(stonec0(iacc,activ) gt 0),
                  SCALEC(iacc,activ)*scalec0(iacc,activ)*
                  (log(SCALEC(iacc,activ)*scalec0(iacc,activ) + .000001)
                  - log(stonec0(iacc,activ) + .000001) ));

*CCONST1(activ)$colsumio(activ)..
*                 SUM(iacc, STONEC(iacc,activ)) =E= 1;

CCONST(activ)$colsumio(activ)..
                  SUM(iacc, SCALEC(iacc,activ)*scalec0(iacc,activ)) =E= 1;

*RCONST1(iacc)$intrtot(iacc)..
*                 SUM(activ, STONEC(iacc,activ)*colsm2(activ))/matsum2 =E= intrtot(iacc)/matsum2;

RCONST(iacc)$intrtot(iacc)..
                  SUM(activ, scalec(iacc,activ)*scalec0(iacc,activ)*colsm2(activ))/matsum2 =E=
                  intrtot(iacc)/matsum2;


*SR       Fix zero cells and ignore zero columns and rows
*SR       Also fix any negative cells to initial values and exclude from adjustment

*STONEC.FX(iacc,activ)$(iomat(iacc,activ) lt 0)    = stonec0(iacc,activ);
*STONEC.FX(iacc,activ)$(iomat(iacc,activ) eq 0)    = 0;

*SCALEC.FX(iacc,activ)$(iomat(iacc,activ) lt 0)    = 1;
SCALEC.FX(iacc,activ)$(iomat(iacc,activ) eq 0)     = 0;

$ontext
*Keep changes in factor returns and government revenue within 20% of prior
SCALEC.LO(f,activ)          = 0.8*scalec0(f,activ);
scalec.lo('govr',activ)     = 0.8*scalec0('govr',activ);
scalec.up(f,activ)          = 1.2*scalec0(f,activ);
scalec.up('govr',activ)     = 1.2*scalec0('govr',activ);
$offtext

*Keep changes in input use for cassava to a reasonable amount
SCALEC.UP('cfuel','acass')     = 0.1*scalec0('cfuel','acass');
SCALEC.UP('ctr_c','acass')     = 0.1*scalec0('ctr_c','acass');


*###########################################################################
*###################### MODEL FORMULATION ##################################
*###########################################################################


 MODEL STONE  / ENTSUBIO
                CCONST
```

```
                    RCONST /
;

STONE.holdfixed = 1;
OPTION NLP = MINOS5;
*OPTION NLP = CONOPT;

SOLVE stone minimizing zentio using nlp;

abort$(stone.modelstat ne 2) "not optimal";

*Replace coefficients with flows

display scalec.l, scalec0;

PROTOSAM(iacc,activ)        = scalec.l(iacc,activ)*scalec0(iacc,activ)*colsm2(activ);

*Check unscaled solution
*STONEC.L(iacc,activ)       = scalec.l(iacc,activ)*scalec0(iacc,activ);

*MODEL STONE1            / ENTSUBIO1
*                          CCONST1
*                          RCONST1 /
*;

*SOLVE stone1 minimizing zentio using nlp;

*stonec0(iacc,activ)  = stonec.l(iacc,activ) - scalec.l(iacc,activ)*scalec0(iacc,activ);

*display stonec0;

*Measure cross entropy
SCALAR          sce         Cross entropy measure
;

sce         = SUM((iacc,activ)$(stonec0(iacc,activ) gt 0),
            scalec.l(iacc,activ)*scalec0(iacc,activ)*log(scalec.l(iacc,activ)*scalec0(iacc,activ) + .000001))/
            SUM((iacc,activ)$(stonec0(iacc,activ) gt 0), stonec0(iacc,activ)*log(stonec0(iacc,activ) + .000001));

display sce;


$ontext
AGCOEFU(ccoef,iag)$(scalec0(ccoef,iag) and scalec0(ccoef,iag++1))..
                    SCALEC(ccoef,iag)*scalec0(ccoef,iag) =L=
                    1.1*coefrat(iag++1)*SCALEC(ccoef,iag++1)*scalec0(ccoef,iag++1);

AGCOEFl(ccoef,iag)$(scalec0(ccoef,iag) and scalec0(ccoef,iag++1))..
                    SCALEC(ccoef,iag)*scalec0(ccoef,iag) =G=
                    0.9*coefrat(iag++1)*SCALEC(ccoef,iag++1)*scalec0(ccoef,iag++1);

FERTCOEFU(iagf)..
                    SCALEC('cfert',iagf)*scalec0('cfert',iagf) =L=
                    10*coefrat(iagf++1)*SCALEC('cfert',iagf++1)*scalec0('cfert',iagf++1);
```

```
FERTCOEFL(iagf)..
                        SCALEC('cfert',iagf)*scalec0('cfert',iagf) =G=
                        0.1*coefrat(iagf++1)*scalec('cfert',iagf++1)*scalec0('cfert',iagf++1);
$offtext

*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#*
```

Filename: rassam.gms
Placement: sub-directory new
Description: The file rassam.gms is developing a fully disaggregated balanced SAM (MOZAM). Note that the gams program statement in the makefile is running the rassam.gms file, based on work-files created by rasio.gms. This explains why there is no apparent reading in of sets or data in this file.

```
*File rassam.gms

*########################## ENTROPY RAS ##############################

*THIS FILE USES BALANCED IO MOZAM AS A PRIOR TO CREATE MOZAM

*Updated by Channing Arndt 7 November 1997 to account for sales taxes
*Note negative values for indirect taxes and export subsidies

 OPTION DECIMALS=6 ;

*Priors for various cross entropy methods

PARAMETERS      a0(imicro,jmicro)           Base flows matrix
                rasmat0(imicro,jmicro)      Base column coefficient matrix
                rootmat0(imicro,jmicro)     Root of base columne coefficient matrix
                entmat0(imicro,jmicro)      Base total coefficient matrix
                ddelta(comm)                Domestic sales lower limit for exportables
                edelta(comm)                Exports lower limit
;

SCALARS         delta           Zero check for logs in objective        / .000001 /
                gamma           Coefficient size lower limit for evaluation     / .00001 /
                sumsam0         Total of all initial SAM flows
;

SETS
 igamma(imicro,jmicro)      Find very small values in micro sam
 jgamma(imicro,jmicro)      Check for negative values in flipped micro sam
;

*Initialize matrices and new row and column control totals

macro(iscal)        = macro(iscal);
redsam(iacc,jacc)   = redsam(iacc,jacc);
redsam1(iacc,jacc)  = redsam1(iacc,jacc);
a0(imicro,jmicro)   = protosam(imicro,jmicro);
rasmat0(iacc,jacc)$a0(iacc,jacc)        = a0(iacc,jacc)/a0("total",jacc);
rootmat0(iacc,jacc)$A0(iacc,jacc)       = sqrt(rasmat0(iacc,jacc));
sumsam0             = SUM((iacc,jacc), a0(iacc,jacc));
entmat0(iacc,jacc)  = a0(iacc,jacc)/sumsam0;

ddelta(comm)        = .001;
edelta(comm)        = .25;
```

```
 jgamma(iacc,jacc)$(rasmat0(iacc,jacc) lt 0) = yes ;

 display jgamma ;

 display a0, rasmat0, rootmat0, sumsam0;

VARIABLES

  NEWSAM(imicro,jmicro)     New flows
  RASMAT(imicro,jmicro)     Column coefficients
  ROOTMAT(imicro,jmicro)    Root of column coefficients
  ENTMAT(imicro,jmicro)     Total coefficients
  ROWTOT(imicro)            Row total
  COLTOT(jmicro)            Column total
  SUMSAM                    Total of all SAM flows
  DENTROPY1                 Entropy difference
  DENTROPY2                 Entropy difference via root scaling
  DENTROPY3                 Matrix entropy difference
*
  TM(comm)                  Tariff rates
  MARGTOT                   Total margins
  INTTOT            Total intermediates
  DOMTOT                    Total Domestic sales
  EXPTOT                    Total exports
  IMPTOT                    Total imports
  HHTOT                     Total home consumption of non-marketed activities
  CPTOT                     Total household consumption of marketed commodities
  GPRTOT                    Total government recurrent consumption of commodities
  CTAXTOT                   Total consumption taxes
  GPITOT            Total government investment spending on commodities
  IDTOT                     Total private investment
  TARTOT                    Total tariff revenue
  NITAXTOT                  Total net indirect taxes including export subsidies

*############################## HOUSEHOLD ##############################
*############################## ADDITIONS ##############################

  WAGTOT                    Total wages incl. mixed income
  PROTOT                    Total distributed profits
  SOCTOT                    Total social security
  TRANSTOT                  Total transfers from workers
  HHTAXTOT                  Total income tax revenue
  HHSAVTOT                  Total household savings
;


*Set lower bounds for variables

 rasmat.lo(iacc,jacc)       = 0;
 rootmat.lo(iacc,jacc)      = 0;
 entmat.lo(iacc,jacc)       = 0;

*Variable initialization
```

```
 DENTROPY1.L                 = 0;
 DENTROPY2.L                 = 0;
 DENTROPY3.L                 = 0;
 RASMAT.L(iacc,jacc)         = rasmat0(iacc,jacc);
 ROOTMAT.L(iacc,jacc)        = rootmat0(iacc,jacc);
 ENTMAT.L(iacc,jacc)         = entmat0(iacc,jacc);
 NEWSAM.L(imicro,jmicro)     = a0(imicro,jmicro);
 ROWTOT.L(iacc)              = SUM(jacc, a0(iacc,jacc));
 COLTOT.L(jacc)              = SUM(iacc, a0(iacc,jacc));
 SUMSAM.L                    = sumsam0;
 TM.L(comm)                  = tmr(comm);
 MARGTOT.L                   = macro("totmarg");
 INTTOT.L                    = macro("totint");
 DOMTOT.L                    = macro("totdom");
 EXPTOT.L                    = macro("totexp");
 IMPTOT.L                    = macro("totimp ");
 HHTOT.L                     = macro("hhcons");
 CPTOT.L                     = macro("cp");
 GPRTOT.L                    = macro("gpr");
 CTAXTOT.L                   = macro("ctax");
 GPITOT.L                    = macro("gpi");
 IDTOT.L           = macro("id");
 TARTOT.L                    = macro("tariff");
 NITAXTOT.L                  = macro("nitax");

*############################## HOUSEHOLD ##############################
*############################## ADDITIONS ##############################

 WAGTOT.L                    = macro("yhhlab");
 PROTOT.L                    = macro("yhhent");
 SOCTOT.L                    = macro("yhhgov");
 TRANSTOT.L                  = macro("yhhrow");
 HHTAXTOT.L                  = macro("hhtax");
 HHSAVTOT.L                  = macro("hhsav");

*SAM cells that are zero must remain zero
 rasmat.fx(iacc,jacc)$(rasmat0(iacc,jacc) eq 0)      = 0;
 rootmat.fx(iacc,jacc)$(rootmat0(iacc,jacc) eq 0)    = 0;
 entmat.fx(iacc,jacc)$(entmat0(iacc,jacc) eq 0)      = 0;
 newsam.fx(iacc,jacc)$(rasmat0(iacc,jacc) eq 0)      = 0;


EQUATIONS

  ENTROPY1                   Entropy difference measure
  ENTROPY2                   Entropy difference with root scaling
  ENTROPY3                   Matrix entropy difference
  SAMDEF1(imicro,jmicro)     Define NEWSAM from coefficients in RASMAT
  SAMDEF2(imicro,jmicro)     Define NEWSAM from coefficients in ROOTMAT
  SAMDEF3(imicro,jmicro)     Define NEWSAM from coefficients in ENTMAT
  SUMCOEF(jmicro)            SAM Coefficients for columns add up to 1
  ROWSUM(imicro) Defines row total
  COLSUM(jmicro)             Defines column total
  SAMSUM                     Defines SAM total
```

```
 BALANCE(imicro)          SAM balancing constraint
 EDOMSALE(comm)           Ensure positive domestic sales for exportables
 EMARGINS(comm)           Ensure margin-latent exports greater than margins
 TARRT(comm)              Tariff rates
 TOTMARG                  Total marketing margins constraint
 TOTINT          Total intermediates constraint
 TOTDOM                   Total domestic constraint
 TOTEXP                   Total exports
 TOTIMP                   Total imports
 TOTHH                    Total household autoconsumtion
 TOTCP                    Total consumption
 TOTGPR                   Total government recurrent consumption
 TOTGPI          Total government investment
 TOTID                    Total private investment investment
 TOTCTAX                  Total consumption taxes
 TOTTAR                   Total tariff revenue
 TOTITAX                  Total indirect tax revenue

*############################## HOUSEHOLD ##############################
*############################## ADDITIONS ##############################

 TOTWAG                   Total wages incl. mixed income
 TOTPRO                   Total distributed profits
 TOTSOC                   Total social security
 TOTTRANS                 Total transfers from workers
 TOTHHTAX                 Total income tax revenue
 TOTHHSAV                 Total household savings
;


ENTROPY1..       DENTROPY1 =E= SUM((iacc,jacc)$rasmat0(iacc,jacc),
                 RASMAT(iacc,jacc)*
                 (log(RASMAT(iacc,jacc) + delta) - log(rasmat0(iacc,jacc) + delta)));

ENTROPY2..       DENTROPY2 =E= SUM((iacc,jacc)$rootmat0(iacc,jacc),
                 ROOTMAT(iacc,jacc)*rootmat0(iacc,jacc)*
                 (log(ROOTMAT(iacc,jacc)*rootmat0(iacc,jacc) + delta) - log(rasmat0(iacc,jacc) + delta)));

ENTROPY3..       DENTROPY3 =E= SUM((iacc,jacc)$entmat0(iacc,jacc),
                 ENTMAT(iacc,jacc)*
                 (log(ENTMAT(iacc,jacc) + delta) - log(ENTMAT0(iacc,jacc) + delta)));

SUMCOEF(jacc)..  SUM(iacc, RASMAT(iacc,jacc)) =E= 1;

SAMDEF1(iacc,jacc)$(RASMAT0(iacc,jacc) gt 0)..
                 NEWSAM(iacc,jacc) =E= RASMAT(iacc,jacc)*COLTOT(jacc);

SAMDEF2(iacc,jacc)$(ROOTMAT0(iacc,jacc) gt 0)..
                 NEWSAM(iacc,jacc) =E= ROOTMAT(iacc,jacc)*rootmat0(iacc,jacc)*COLTOT(jacc);

SAMDEF3(iacc,jacc)$(ENTMAT0(iacc,jacc) gt 0)..
                 NEWSAM(iacc,jacc) =E= ENTMAT(iacc,jacc)*SUMSAM;

ROWSUM(iacc)..   ROWTOT(iacc) =E= SUM(jacc, NEWSAM(iacc,jacc));
```

```
COLSUM(jacc)..   COLTOT(jacc) =E= SUM(iacc, NEWSAM(iacc,jacc));

SAMSUM..         SUMSAM =E= SUM(iacc, COLTOT(iacc));

BALANCE(iacc)..  ROWTOT(iacc) =E= COLTOT(iacc);

EMARGINS(comm)..
                 NEWSAM(comm,"world") =G= (1 + edelta(comm))*NEWSAM("acome",comm);

EDOMSALE(comm)..
                 SUM(activ$mapac(activ,comm), NEWSAM(activ,comm)) =G= (1 + ddelta(comm))*
                 (NEWSAM(comm,"world") + redsam(comm,"intax") - NEWSAM("acome",comm));

TARRT(comm)$A0("world",comm)..
                 TM(comm)*NEWSAM("world",comm) =E= NEWSAM("intax",comm);

TOTMARG..        MARGTOT =E= SUM((commerce,comm), NEWSAM(commerce,comm));

TOTINT..INTTOT =E= SUM((comm,activ), NEWSAM(comm,activ));

TOTDOM..         DOMTOT =E= SUM((comm,activ), NEWSAM(activ,comm));

TOTEXP..         EXPTOT =E= SUM(comm, NEWSAM(comm,"world"));

TOTIMP..         IMPTOT =E= SUM(comm, NEWSAM("world",comm));

TOTHH..          HHTOT =E= SUM((activ,hhld), NEWSAM(activ,hhld));

TOTCP..          CPTOT =E= SUM((comm,hhld), NEWSAM(comm,hhld));

TOTGPR..         GPRTOT =E= SUM(comm, NEWSAM(comm, "govre"))
                 + SUM(comm, redsam(comm,"govre"));

TOTGPI.. GPITOT =E= SUM(comm, NEWSAM(comm, "govin"));

TOTID..          IDTOT =E= SUM(comm, NEWSAM(comm, "kacct"));

TOTCTAX..        CTAXTOT =E= SUM(comm, NEWSAM("govre",comm))
                 + SUM(comm, redsam("govre",comm));

TOTTAR..         TARTOT =E= SUM(comm, NEWSAM("intax",comm))
                 + SUM(comm, redsam(comm,"intax")) + SUM(comm, redsam("intax",comm));

TOTITAX..        NITAXTOT =E=
                 SUM(activ, NEWSAM("intax",activ)) - SUM(activ, NEWSAM(activ,"intax"));


*############################## HOUSEHOLD ##############################
*############################## ADDITIONS ##############################

TOTWAG..         WAGTOT =E= SUM(hhld, NEWSAM(hhld,'labor'));

TOTPRO..         PROTOT =E= SUM(hhld, NEWSAM(hhld,'enter'));
```

```
TOTSOC..        SOCTOT =E= SUM(hhld, NEWSAM(hhld,'govre'));

TOTTRANS..      TRANSTOT =E= SUM(hhld, NEWSAM(hhld,'world'));

TOTHHTAX..      HHTAXTOT =E= SUM(hhld, NEWSAM('govre',hhld));

TOTHHSAV..      HHSAVTOT =E= SUM(hhld, NEWSAM('kacct',hhld));


*#########################################################################
*######## LIMIT CHANGE IN CELLS IN SAM YOU BELIEVE ARE VALID #######
*#########################################################################


*SET tolerances for macro constraints
SCALAR          beta    Tolerance for macro constraints         / .01 /
;

 TM.LO(comm)            = 0.75*TMR(comm);
 TM.UP(comm)            = 1.25*TMR(comm);


*############################ LOWER BOUNDS ############################

 NEWSAM.LO(trans,trans1)  = (1-beta)*a0(trans,trans1);
 NEWSAM.LO(trans,'labor') = (1-beta)*a0(trans,'labor');
 NEWSAM.LO(trans,'capit') = (1-beta)*a0(trans,'capit');
 MARGTOT.LO               = (1-beta)*macro("totmarg");
 INTTOT.LO                = (1-beta)*macro("totint");
 DOMTOT.LO                = (1-beta)*macro("totdom");
 EXPTOT.LO                = (1-beta)*macro("totexp");
 IMPTOT.LO                = (1-beta)*macro("totimp");
 HHTOT.LO                 = (1-beta)*macro("hhcons");
 CPTOT.LO                 = (1-beta)*macro("cp");
 GPRTOT.LO                = (1-beta)*macro("gpr");
 GPITOT.LO                = (1-beta)*macro("gpi");
 IDTOT.LO                 = (1-beta)*macro("id");
 CTAXTOT.LO               = (1-beta)*macro("ctax");
 TARTOT.LO                = (1-beta)*macro("tariff");
 NITAXTOT.LO              = (1-beta)*(macro("nitax"));

*############################ HOUSEHOLD ############################
*############################ ADDITIONS ############################

 WAGTOT.LO                = (1-beta)*macro("yhhlab");
 PROTOT.LO                = (1-beta)*macro("yhhent");
 SOCTOT.LO                = (1-beta)*macro("yhhgov");
 TRANSTOT.LO              = (1-beta)*macro("yhhrow");
 HHTAXTOT.LO              = (1-beta)*macro("hhtax");
 HHSAVTOT.LO              = (1-beta)*macro("hhsav");


*############################ UPPER BOUNDS ############################
```

```
NEWSAM.up(trans,trans1)    = (1+beta)*a0(trans,trans1);
NEWSAM.up(trans,'labor')   = (1+beta)*a0(trans,'labor');
NEWSAM.up(trans,'capit')   = (1+beta)*a0(trans,'capit');
MARGTOT.UP                 = (1+beta)*macro("TOTMARG");
INTTOT.UP                  = (1+beta)*macro("TOTINT");
DOMTOT.UP                  = (1+beta)*macro("TOTDOM");
EXPTOT.UP                  = (1+beta)*macro("TOTEXP");
IMPTOT.UP                  = (1+beta)*macro("TOTIMP");
HHTOT.UP                   = (1+beta)*macro("HHCONS");
CPTOT.UP                   = (1+beta)*macro("CP");
GPRTOT.UP                  = (1+beta)*macro("GPR");
GPITOT.UP                  = (1+beta)*macro('GPI');
IDTOT.UP                   = (1+beta)*macro("ID");
ctaxTOT.UP                 = (1+beta)*macro("ctax");
TARTOT.UP                  = (1+beta)*macro('TARIFF');
NITAXTOT.UP                = (1+beta)*(macro('NITAX'));

*############################## HOUSEHOLD ##############################
*############################## ADDITIONS ##############################

WAGTOT.UP                  = (1+beta)*macro("yhhlab");
PROTOT.UP                  = (1+beta)*macro("yhhent");
SOCTOT.UP                  = (1+beta)*macro("yhhgov");
TRANSTOT.UP                = (1+beta)*macro("yhhrow");
HHTAXTOT.UP                = (1+beta)*macro("hhtax");
HHSAVTOT.UP                = (1+beta)*macro("hhsav");

COLTOT.LO(jacc)            = min(a0(jacc,"total"),a0("total",jacc));
COLTOT.UP(jacc)            = max(a0(jacc,"total"),a0("total",jacc));


*#########################################################################
*###################### MODEL FORMULATION ########################
*#########################################################################


MODEL ENTROPY12        /ENTROPY2
                        SAMDEF2
                        ROWSUM
                        COLSUM
                        SAMSUM
                        BALANCE
                        EDOMSALE
                        EMARGINS
                        TARRT
                        TOTINT
                        TOTDOM
                        TOTEXP
                        TOTIMP
                        TOTHH
                        TOTCP
                        TOTGPR
                        TOTGPI
```

```
                        TOTID
                        TOTCTAX
                        TOTTAR
*                       TOTITAX
                        TOTWAG
                        TOTPRO
                        TOTSOC
                        TOTTRANS
                        TOTHHTAX
                        TOTHHSAV /
;


ENTROPY12.holdfixed     = 1;

ENTROPY12.optfile       = 1;

OPTION NLP = MINOS5;
OPTIONS RESLIM=15000, ITERLIM=70000, LIMROW=0, LIMCOL=0, SOLPRINT=on;

SOLVE entropy12 minimizing dentropy2 using nlp ;

abort$(entropy12.modelstat ne 2) "not optimal";

display beta;

display TOTINT.M
        TOTDOM.M
        TOTEXP.M
        TOTIMP.M
        TOTHH.M
        TOTCP.M
        TOTGPR.M
        TOTGPI.M
        TOTID.M
        TOTCTAX.M
        TOTTAR.M
*       TOTITAX.M
        TOTWAG.M
        TOTPRO.M
        TOTSOC.M
        TOTTRANS.M
        TOTHHTAX.M
        TOTHHSAV.M
        ROWSUM.M
        COLSUM.M
        BALANCE.M
;

*Check cross entropy measure

sce     =  SUM((iacc,jacc)$rootmat0(iacc,jacc), ROOTMAT.L(iacc,jacc)*rootmat0(iacc,jacc)*
        log(ROOTMAT.L(iacc,jacc)*rootmat0(iacc,jacc) + delta))/
        SUM((iacc,jacc)$rootmat0(iacc,jacc), rasmat0(iacc,jacc)*LOG(rasmat0(iacc,jacc) + delta));
```

```
display sce;


PARAMETER       newsam1(imicro,jmicro)      SAM obtained with entropy RAS
                checknew(imicro)
                compar(imicro,jmicro)       Compares NEWSAM1 and PROTOSAM
                compar_p(imicro,jmicro)     Percent change from PROTOSAM to NEWSAM1
;

*Re flip negative values in protosam
PROTOSAM(iacc,jacc)         = protosam(iacc,jacc) + redsam(iacc,jacc) + redsam1(iacc,jacc);

redsam(iacc,jacc)$(redsam(iacc,jacc) lt 0 and oldproto(jacc,iacc) eq 0) = -newsam.l(jacc,iacc);
redsam1(iacc,jacc)          = redsam(jacc,iacc);

NEWSAM1(iacc,jacc)          = newsam.l(iacc,jacc) + redsam(iacc,jacc) + redsam1(iacc,jacc);
NEWSAM1("total",jacc)       = SUM(iacc, newsam1(iacc,jacc));
NEWSAM1(iacc,"total")       = SUM(jacc, newsam1(iacc,jacc));

CHECKNEW(iacc)              = newsam1(iacc,"total") - newsam1("total",iacc);
COMPAR(imicro,jmicro)       = newsam1(imicro,jmicro) - protosam(imicro,jmicro);
COMPAR_P(imicro,jmicro)$PROTOSAM(imicro,jmicro)
                            = 100*(compar(imicro,jmicro)/protosam(imicro,jmicro));

TMR(comm)$PROTOSAM("world",comm)
                            = newsam1("govre",comm)/newsam1("world",comm);

display tmr, tm.l;

display newsam1, compar, compar_p, checknew;

newsam1(imicro,jmicro)$(not newsam1(imicro,jmicro)) = eps;

$libinclude ssdump newsam1 work\mzsam1.wk1 a1..a1

*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#*
```

Filename: splthh.gms
Placement: sub-directory new
Description: The splthh.gms file splits labour into aglab and nalab, within the fully disaggregated balanced SAM, while keeping it balanced.

```
*File splthh.gms

$OFFSYMLIST OFFSYMXREF OFFUPPER
$INLINECOM { }

*This file uses the balanced Micro SAM with aggregate values for labor
*and rural and urban households to strictly split labor and households
*As of 1/7/97 only labor has been split into ag and non-ag components

*  INCLUDE files used:
*  work\mzsam1.wk1          Input the 1995 SAM from RASSAM
*  new\micmac.inc:          Aggregates a MicroSAM into a macrosam (useful to compare
*                           data, first attempt at SAM (look for PROTOMAC), and final
*                           SAM (look for NEWMAC))
*  new\imacro.inc           Macro SAM sets
*  new\imicro.inc           Micro sets including subsets
*  new\mapmac.inc           Mapping between macro and micro sets

 OPTIONS RESLIM=15000, ITERLIM=10000, LIMROW=0, LIMCOL=0, SOLPRINT=OFF;
 OPTIONS NLP=MINOS5, DECIMALS=6;


*################  SETS and SUBSETS of MicroSAM   ########################

SETS
$include new\imacro.inc
$include new\imicro.inc
$include new\spltset.inc

SET
$include new\mapmac.inc

  ALIAS (racc,r,col);
  ALIAS (iacc, jacc, iacc1, iacc2);
  ALIAS (activ,activ2);
  ALIAS (comm,comm2);
  ALIAS (flab,flab2);
  ALIAS (hhld,hhld1);
  ALIAS (imacro,jmacro,imacro1,imacro2);
  ALIAS (imicro,jmicro,imicro1,imicro2);

PARAMETERS      mzsam(imicro,imicro1)          Final disaggregated SAM
;

$libinclude ssimport mzsam work\mzsam1.wk1 a1..cq95

SCALAR              labagurb              Share of ag labor in labor for urban households       /.19/
```

```
;

*The value for ‘labagurb’ is derived from the capital cities survey
*p. 121 receipts as share of ag income in total earned income
*ag income includes autocons, ag sales,+ receitas eem especie

*NOTE mzsam has values in aggregate instead of split sets

*Disaggregate labor
mzsam('aglab',iaga)             = mzsam('labor',iaga);
mzsam('nalab',inaga)            = mzsam('labor',inaga);

*Charge factor taxes to nalab
mzsam('govre','nalab')          = mzsam('govre','labor');
mzsam('urban','aglab')          = labagurb*mzsam('urban','labor');
mzsam('urban','nalab')          = (1 - labagurb)*mzsam('urban','labor');
mzsam('rural','nalab')          = SUM(activ, mzsam('nalab',activ))
                                - mzsam('urban','nalab') - mzsam('govre','nalab');
mzsam('rural','aglab')          = SUM(activ, mzsam('aglab',activ)) - mzsam('urban','aglab');

*Zero aggregated sets
mzsam(aggreg,imicro)            = 0;
mzsam(imicro,aggreg)            = 0;

*Recalculate totals
mzsam(imicro1,"TOTAL")          = SUM(iacc, mzsam(imicro1,iacc));
mzsam("TOTAL",imicro2)          = SUM(iacc, mzsam(iacc,imicro2));

PARAMETER       samcheck(imicro1)
;

samcheck(imicro1)               = mzsam(imicro1,"TOTAL") - mzsam("TOTAL",imicro1);

display samcheck;

*Put final SAM into spreadsheet
$libinclude ssexport mzsam out\mzsam.wk1 a1..cq95

*Calculate implied macsam and put into spreadsheet
$batinclude new\micmac.inc "newmac" "mzsam"

$libinclude ssexport newmac out\micmac.wk1 a1..m13

PARAMETERS      macsam(imacro,jmacro)       Macro SAM from macent.gms
                chkmac(imacro,jmacro)       Macro check in percent deviations
;

*Check micmac versus macsam

$libinclude ssimport macsam out\macsam.wk1 a1..m13

chkmac(imacro,jmacro)$macsam(imacro,jmacro)
                = 100*(macsam(imacro,jmacro) - newmac(imacro,jmacro))/macsam(imacro,jmacro);

display chkmac;

*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#
```

Filename: imacro.inc
Placement: sub.directory new
Description: The file imacro.inc is an include file which defines the set of accounts for the aggregated SAM

```
*File imacro.inc

IMACRO          MACROSAM accounts

        / ACT   Activities
          COM   Commodities
          FAC   Factors
          ENT   Enterprises
          HOU   Households
          GRE   Recurrent Government
          ITX   Indirect Taxes
          GIN   Government Investment
          NGO   Non Government Organisations
          CAP   Capital
          ROW   Rest of World
          TOT /


RACC(imacro)    MACROSAM accounts omitting totals

        / ACT   Activities
          COM   Commodities
          FAC   Factors
          ENT   Enterprises
          HOU   Households
          GRE   Recurrent Government
          ITX   Indirect Taxes
          GIN   Government Investment
          NGO   Non Government Organisations
          CAP   Capital
          ROW   Rest of World /

*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#
```

Filename: imicro.inc
Placement: sub-directory new
Description: The file imicro.inc is an include file which defines the full set of accounts for the disaggregated SAM, as well as most of the necessary subsets.

```
*File imicro.inc

*these are SAM sets for RASSAM


IMICRO          All sets used in the SAM including later disaggregations
/
*Activities
 AMAIZ
 ARICE
 AOGRA
 ACASS
 ABEAN
 AOBFC
 ARCAS
 ARCOT
 AOEXC
 AOCRO
 ALIVE
 AFORE
 AFISH
 AMINE
 AGMIL
 AOFPR
 ABEVT
 ATEXT
 ALEAT
 AWOOD
 APACK
 AOCHE
 AINXM
 AMETI
 ATMEQ
 AOMAN
 AELWA
 ACNST
 ARE_H
 ATR_C
 AFI_I
 ADWEL
 APA_D
 AEDUC
 AHEAL
 AOSER
 ASPEC
 ACOMM
 ACOMD
 ACOME

*Commodities
```

CMAIZ
CRICE
CWHEA
COGRA
CCASS
CBEAN
COBFC
CRCAS
CRCOT
COEXC
COCRO
CLIVE
CFORE
CFISH
CMINE
CGMIL
COFPR
CBEVT
CTEXT
CLEAT
CWOOD
CPACK
CFERT
CFUEL
COCHE
CINXM
CMETI
CTMEQ
COMAN
CELWA
CCNST
CRE_H
CTR_C
CFI_I
CDWEL
CPA_D
CEDUC
CHEAL
COSER
CSPEC

*Factors

AGLAB	Agricultural labor
NALAB	Non-agricultural labor
LABOR	Total labor
CAPIT	Capital

*Institutions

ENTER	Enterprises
URBAN	Urban households
RURAL	Rural households
GOVRE	Government recurrent
INTAX	Indirect taxes
GOVIN	Government investment
NGOVO	Non-government organisations

*Row and totals

KACCT Capital account
WORLD Rest of world
TOTAL Sum over all accounts
/

COMM(imicro) Commodities
/
CMAIZ
CRICE
CWHEA
COGRA
CCASS
CBEAN
COBFC
CRCAS
CRCOT
COEXC
COCRO
CLIVE
CFORE
CFISH
CMINE
CGMIL
COFPR
CBEVT
CTEXT
CLEAT
CWOOD
CPACK
CFERT
CFUEL
COCHE
CINXM
CMETI
CTMEQ
COMAN
CELWA
CCNST
CRE_H
CTR_C
CFI_I
CDWEL
CPA_D
CEDUC
CHEAL
COSER
CSPEC
/

ACTIV(imicro) Activities
/
AMAIZ
ARICE
AOGRA
ACASS

ABEAN
AOBFC
ARCAS
ARCOT
AOEXC
AOCRO
ALIVE
AFORE
AFISH
AMINE
AGMIL
AOFPR
ABEVT
ATEXT
ALEAT
AWOOD
APACK
AOCHE
AINXM
AMETI
ATMEQ
AOMAN
AELWA
ACNST
ACOMM
ACOMD
ACOME
ARE_H
ATR_C
AFI_I
ADWEL
APA_D
AEDUC
AHEAL
AOSER
ASPEC
/

F(imicro) Factors
/
AGLAB Agricultural labor
NALAB Non-agricultural labor
LABOR Total labor
CAPIT Capital
/

FLAB(f) Labor factors
/
AGLAB Agricultural labor
NALAB Non-agricultural labor
LABOR Total labor
/

INST(imicro)

```
/
 ENTER          Enterprises
 URBAN          Urban households
 RURAL          Rural households
 GOVRE          Government recurrent
 INTAX          Indirect taxes
 GOVIN          Government investment
 NGOVO          Non-government organisations
/

HHLD(inst)
/
 URBAN          Urban households
 RURAL          Rural households
/


NOTACC(imicro)
/
 TOTAL
/


IAGA(activ)        Agricultural activities
/
 AMAIZ
 ARICE
 AOGRA
 ACASS
 ABEAN
 AOBFC
 ARCAS
 ARCOT
 AOEXC
 AOCRO
 ALIVE
 AFORE
/


 COMMERCE(activ)          Commerce activities
/
 ACOMM
 ACOMD
 ACOME
/


IAGC(comm)         Agricultural commodities
/
 CMAIZ
 CRICE
 CWHEA
 COGRA
 CCASS
 CBEAN
 COBFC
```

```
 CRCAS
 CRCOT
 COEXC
 COCRO
 CLIVE
 CFORE
 CFISH
/



TRANS(imicro)      Headings which transfer directly from macrosam
/
 ENTER             Enterprises
 GOVRE             Government recurrent
 INTAX             Indirect taxes
 GOVIN             Government investment
 NGOVO             Non-government organisations
 KACCT             Capital account
 WORLD             Rest of world
/


INAGA(activ)       Non ag activities
IACC(imicro)       SAM accounts
;


IACC(imicro)       = not notacc(imicro);
INAGA(activ)       = not iaga(activ);


ALIAS(trans,trans1);

*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#
```

Filename: mzsets.inc
Placement: sub-directory new
Description: This file is an include file which defines all the necessary sets for reading in data from the national accounts files ctp.wk1 and eq184.wk1.

```
*File mzsets.inc

SETS

all184
/
 1        TRIGO
 2        ARROZ COM CASCA
 3        MILHO
 4        MAPIRA
 5        FEIJAO
 6        OUTRAS LEGUMINOSAS
 7        CEBOLA
 8        TOMATE
 9        MANDIOCA FRESCA
 10       HORTICOLAS
 11       OUT.TUBERCULOS E RAIZES
 12       CITRINOS
 13       OUTRAS FRUTAS FRESCAS
 14       CASTANHA DE CAJU
 15       CHA FOLHA
 16       CANA DE ACUCAR
 17       TABACO
 18       GIRASSOL
 19       COPRA
 20       AMENDOIM
 21       MAFURRA
 22       ALGODAO CAROCO
 23       SISAL FOLHA
 24       OUTROS PRODUTOS DE USO INDUSTRIAL
 25       OUTROS PROD. AGRICOLAS
 26       GADO BOVINO
 27       GADO SUINO
 28       AVES VIVAS
 29       GADO OVINO E CAPRINO
 30       LEITE SEM PROCESSAMENTO
 31       OVOS FRESCOS
 32       OUTROS PROD.DE ORIGEM ANIMALSERV.AGRIC.E CACA
 33       LENHA E CARVAO VEGETAL
 34       MADEIRA EM TOROS
 35       OUTROS PRODUTOS DA SILVICULTURA E EXPLORACAO FLORESTAL
 36       PEIXES FRESCOS OU REFRIGERADOS
 37       CAMARAO + GAMBA
 38       GAMBA
 39       LAGOSTA
 40       OUTR.PROD.DA PESCA
 41       CARVAO MINERAL
 42       MINERAIS METALICOS
 43       PEDRA ARGILA E AREIA
 44       SAL NAO REFINADO
```

45 OUTR. MINERAIS NAO METALICOS
46 CARNE DE BOVINO
47 CARNE DE SUINO
48 CARNE DE AVES
49 CARNE GADO ABATIDO DE OUTRAS
50 CONSERVAS DE CARNE
51 OUTR. PRODUTOS COMEST. RESULT. DE ABATE DE GADO
52 LEITE PROCESSADO E DERIVADOS
53 FRUTOS E PRODUTOS HORTICOLAS CONSERVADOS
54 FARINHA DE PEIXE
55 CONSERVAS DE PEIXE
56 OLEO DE VEGETAIS CRU
57 OLEO REFINADO
58 OUTROS OLEOS E GORDURAS ANIMAIS
59 BAGACO DE SEMENTES OLEAGINOSAS
60 FARINHA DE MILHO
61 FARINHA DE TRIGO
62 ARROZ DESCASCADO
63 FARINHAS DE MANDIOCA
64 FARELOS E SEMEAS
65 OUTR. PROD. MOAGEM DESC.E TRITURACAO
66 PAO
67 PRODUTOS DE PASTELARIA E DOCARIA
68 BOLACHAS E BISCOITOS
69 MASSAS ALIMENTICIAS
70 ACUCAR
71 MELACO DE ACUCAR
72 CACAU CHOCOLATE E PRODUTOS DE CONFEITARIA
73 CHA EM FOLHA TRANSFORMADO
74 AMENDOA DE CAJU INTEIRA E PARTIDA
75 OUTR. PRODUTOS DAS IND.ALIM.
76 RACOES
77 VINHO
78 MALTE
79 CERVEJA
80 OUTR. BEBIDAS ESPIRITUOSAS
81 BEBIDAS NAO ALCOOLICAS
82 CIGARROS E TABACO
83 FIBRA DE ALGODAO
84 CAPULANA
85 OUTR. PRODUTOS DA FIACAO TECELAGEM
86 PRODUTOS TEXTEIS EM OBRA EXCEPTO VESTUARIO
87 OUTR. PRODUTOS DE MALHAS TAPECARIAS E CORDOARIA
88 VESTUARIO DE MALHA E TEXTEIS
89 CURTUMES E ARTIGOS DE COURO
90 CALCADO DE COURO
91 PRODUTOS DA SERRACAO DE MADEIRA
92 OUTR. PRODUTOS DE CARPINTARIA FOLHEADOS E CONTRAPLACADOS
93 MOBILIARIO DE MADEIRA
94 PAPEL E ARTIGOS DE PAPEL E CARTAO
95 PRODUTOS DAS ARTES GRAFICAS E EDICAO DE PUBLICACOES
96 OUTR. PRODUTOS QUIMICOS INDUSTRIAIS
97 ADUBOS E PESTICIDAS
98 RESINAS SINTECT. MATER.PLAST.
99 TINTAS ESMALTES LACAS VERNIZES DILUENTES E SOLVENTES
100 PRODUTOS FARMACEUTICOS
101 SABOES E SABONETES DETERGENTES PRODUTOS DE TOCADOR E HIGIENE

102 PRODUTOS QUIMICOS DIVERSOS
103 PETROLEO DE ILUMINACAO
104 GASOLINA
105 GASOLEO
106 FUEL-OLEO
107 LPG
108 OLEOS MASSAS LUBRIFICANTES E OUTROS PRODUTOS RESULTANTES DA RE.
109 OUTR. PRODUTOS DERIVADOS DO PETROLEO
110 PNEUS E CAMARAS DE AR
111 ARTIGOS DIVERSOS DE BORRACHA
112 ARTIGOS DE PLASTICO PARA USO DOMESTICO
113 COBERTURAS OU EMBALAGENS DE MATERIAS PLASTICAS
114 CALCADO DE PLASTICOS
115 OUTR. PRODUTOS DE PLASTICO
116 ARTIG. DE PORCELANA FAIANCA GRES FINO
117 VIDRO E ARTIGOS DE VIDRO
118 MATERIAIS DE BARRO PARA A CONSTRUCAO E PROD. REFRACTARIOS
119 CIMENTO
120 CLINQUER
121 CAL GESSO E ABRASIVOS
122 CHAPA DE FIBROCIMENTO
123 PEDRA PARA CONSTRUCAO E OUTROS PRODUTOS NAO METALICOS
124 PRODUTOS LAMINADOS DE FERRO E ACO E FOLHAS DE FLANDRES
125 VARAO DE FERRO OU ACO
126 ARAME
127 TUBOS DE FERRO OU ACO
128 OUTR. PRODUTOS BASICOS DE FERRO OU ACO
129 ALUMINIO E SUAS LIGAS
130 COBRE E SUAS LIGAS
131 PRODUTOS DA INDUSTRIA BASICA DE METAIS NAO FERROSOS
132 CUTELARIAS FERRAMENTAS MANUAIS
133 MOBILIARIO METALICO E SEUS ACESSORIOS
134 ELEMENTOS DE CONSTRUCAO EM METAL
135 UTENSILIOS DOMESTICOS METALICOS
136 PREGOS PARAFUSOS E ARTIGOS DE ARAME
137 LATOARIA E EMBALAGENS METALICAS
138 OUTR. PRODUTOS METALICOS
139 TRACTORES E SEUS ACESSORIOS MAQUINAS E EQUIPAMENTOS AGRICOLAS
140 MAQUINAS E EQUIPAMENTOS PARA A INDUSTRIA
141 OUTR. MAQUINAS NAO ELECTRICAS
142 MAQUINAS E APARELHOS INDUSTRIAIS
143 EQUIPAMENTO E APARELHOS DE RADIO
144 APARELHOS DE AR CONDICIONADO DOMESTICOS
145 OUTR. APARELHOS ELECTRODOMESTICOS
146 PILHAS E ACUMULADORES
147 OUTR. MATERIAIS ELECTRICOS
148 EMBARCACOES E REPARCOES NAVAIS
149 MATERIAL DE CAMINHOS DE FERRO
150 VEICULOS A MOTOR
151 BICICLETAS
152 MOTOCICLOS
153 MATERIAL DE TRANSPORTE N.E.
154 OUTR. PRODUTOS DAS INDUSTRIAS TRANSFORMADORAS
155 ENERGIA ELECTRICA
156 AGUA
157 CONSTRUCAO E REPARACAO DE EDIFICIOS
158 CONSTRUCAO E MONTAGEM DE ENGENHARIA

159 COMERCIO
160 RESTAURANRES E HOTEIS
161 TRANSPORTES FERROVIARIO
162 TRANSPORTES RODOVIARIO
163 TRANSPORTE POR OLEODUTOS
164 TRANSPORTES MARITMO E CABOTAGEM
165 TRANSPORTES AEREOS
166 SERVICOS RELACIONADOS COM TRANSPORTES
167 COMUNICACOES
168 SERVICOS BANCARIOS E FINANCEIROS
169 SERVICOS DE SEGUROS
170 SERVICOS COM IMOVEIS E SERVICOS PRESTADOS AS EMPRESAS
171 ADMINISTRACAO PUBLICA E DEFESA
172 EDUCACAO PUBLICA
173 EDUCACAO PRIVADA
174 SAUDE PUBLICA
175 SAUDE PRIVADA
176 SERVICOS RECREATIVOS E CULTURAIS
177 SERVICOS DE REPARACAO DE AUTOMOVEIS
178 SERVICOS DE REPARACAO DE ARTIGOS DE MOBILIARIO
179 SERVICOS DE REPARACAO DE APARELHOS DOMESTICOS
180 SERVICOS DE REPARACAO DE DIVERSOS
181 SERVICOS DOMESTICOS
182 SERVICOS PESSOAIS DIVERSOS E OUTROS SERVICOS DE COLECTIVIDADES
183 SERVICOS de ORGANIZACOES
184 SERVICOS BANCARIOS IMPUTADOS
185 SPECIAL PROGRAMS
/

EQTIT Headings for the eq184 table
/
OGLO OFERTA GLOBAL
PROD TOTAL
PEMP EMPRES.
POFA TOTAL
FC FAMILIAR COMER.
FNC N.COM.
M IMPOR TACOES CIF
DM DIREIT IMPOR
MG DE COMER.
PGLO PROCUR GLOBAL
DI PROCUR INTERMED
COGO CONS. GOBERNO
TOCO TOTAL CONSUMO AGREGADOS FAMILIARES TOTAL
TOCI CIDADES
TORU RURAL
AUCO AUTOCONSUMO TOTAL
AUCI CIDADE
AURU RURAL
COMP TOTAL
COCI COMPRAS CIDADE
CORU RURAL
FBKF F.B.CAP. FIXO
VE VAR. EXIST.
X EXPORTACOES
/

```
ORIG                Original 26 commodities from the NA plus special programmes
/
AGRI
FISH
MINE
FPRO
BEVT
TEXT
LEAT
WOOD
PACK
CHEM
INXM
METI
TMEQ
OMAN
ELWA
CNST
COMM
RE_H
TR_C
FI_I
DWEL
PA_D
EDUC
HEAL
OSER
SPEC
/

CTPTIT              Headings for the ctp table
/
TC        Indirect taxes
REM       Wages
EXCED     Formal business profits
MIXED     Profits to family enterprises
INTCON    Intermediate consumption column totals
TE        Export taxes
TI        Indirect taxes
/
;

*#*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#*#
```

Filename: mapa&c.inc
Placement: sub-directory new
Description: This file is an include file which contains all the necessary mappings between sets defined in imicro.inc and mzsets.inc.

```
*File mapa&c.inc

SETS

MAPA(all184,activ)
/
 3          .          AMAIZ
 2          .          ARICE
(1
 4)         .          AOGRA
 9          .          ACASS
 5          .          ABEAN
(6
 7
 8
 10
 11
 13
 20)        .          AOBFC
 14         .          ARCAS
 22         .          ARCOT
(12
 15
 16
 17
 19
 23)        .          AOEXC
(18
 21
 24
 25)        .          AOCRO
(26
 27
 28
 29
 30
 31
 32)        .          ALIVE
(33
 34
 35)        .          AFORE
(36
 37
 38
 39
 40)        .          AFISH
(41
 42
 43
 44
```

45) . AMINE
(60
61
62
63
64
65) . AGMIL
(46
47
48
49
50
51
52
53
54
55
56
57
58
59
66
67
68
69
70
71
72
73
74
75
76) . AOFPR
(77
78
79
80
81
82) . ABEVT
(83
84
85
86
87
88) . ATEXT
(89
90) . ALEAT
(91
92
93) . AWOOD
(94
95) . APACK
(96
97
98
99
100
101

102
103
104
105
106
107
108
109
110
111
112
113
114
115) . AOCHE
(116
117
118
119
120
121
122
123) . AINXM
(124
125
126
127
128
129
130
131) . AMETI
(132
133
134
135
136
137
138
139
140
141
142
143
144
145
146
147
148
149
150
151
152
153) . ATMEQ
154 . AOMAN
(155
156) . AELWA
(157
158) . ACNST

159 . ACOMM
160 . ARE_H
(161
162
163
164
165
166
167) . ATR_C
(168
169
184) . AFI_I
170 . ADWEL
171 . APA_D
(172
173) . AEDUC
(174
175) . AHEAL
(176
177
178
179
180
181
182
183) . AOSER
185 . ASPEC
/

MAPC(all184,comm)
/
3 . CMAIZ
2 . CRICE
1 . CWHEA
4 . COGRA
9 . CCASS
5 . CBEAN
(6
7
8
10
11
13
20) . COBFC
14 . CRCAS
22 . CRCOT
(12
15
16
17
19
23) . COEXC
(18
21
24
25) . COCRO
(26

27
28
29
30
31
32) . CLIVE
(33
34
35) . CFORE
(36
37
38
39
40) . CFISH
(41
42
43
44
45) . CMINE
(60
61
62
63
64
65) . CGMIL
(46
47
48
49
50
51
52
53
54
55
56
57
58
59
66
67
68
69
70
71
72
73
74
75
76) . COFPR
(77
78
79
80
81
82) . CBEVT
(83

84
85
86
87
88) . CTEXT
(89
90) . CLEAT
(91
92
93) . CWOOD
(94
95) . CPACK
97 . CFERT
(103
104
105
106
107) . CFUEL
(96
98
99
100
101
102
108
109
110
111
112
113
114
115) . COCHE
(116
117
118
119
120
121
122
123) . CINXM
(124
125
126
127
128
129
130
131) . CMETI
(132
133
134
135
136
137
138
139
140

```
 141
 142
 143
 144
 145
 146
 147
 148
 149
 150
 151
 152
 153)     .       CTMEQ
 154      .       COMAN
(155
 156)     .       CELWA
(157
 158)     .       CCNST
 160      .       CRE_H
(161
 162
 163
 164
 165
 166
 167)     .       CTR_C
(168
 169
 184)     .       CFI_I
 170      .       CDWEL
 171      .       CPA_D
(172
 173)     .       CEDUC
(174
 175)     .       CHEAL
(176
 177
 178
 179
 180
 181
 182
 183)     .       COSER
 185      .       CSPEC
/

MAPORIGA(orig,activ)        Original 27 sectors mapped to activities one to one
/
* AGRI  does not map one to one
 FISH     .       AFISH
 MINE     .       AMINE
* FPRO does not map one to one
 BEVT     .       ABEVT
 TEXT     .       ATEXT
 LEAT     .       ALEAT
 WOOD     .       AWOOD
 PACK     .       APACK
```

```
 CHEM    .           AOCHE
 INXM    .           AINXM
 METI    .           AMETI
 TMEQ    .           ATMEQ
 OMAN    .           AOMAN
 ELWA    .           AELWA
 CNST    .           ACNST
 COMM    .           ACOMM
 RE_H    .           ARE_H
 TR_C    .           ATR_C
 FI_I    .           AFI_I
 DWEL    .           ADWEL
 PA_D    .           APA_D
 EDUC    .           AEDUC
 HEAL    .           AHEAL
 OSER    .           AOSER
 SPEC    .           ASPEC
/

MAPORIGC(orig,comm)        Original 27 sectors mapped to commodities one to one
/
* AGRI  does not map one to one
 FISH    .           CFISH
 MINE    .           CMINE
* FPRO does not map one to one
 BEVT    .           CBEVT
 TEXT    .           CTEXT
 LEAT    .           CLEAT
 WOOD    .           CWOOD
 PACK    .           CPACK
* CHEM does not map one to one
 INXM    .           CINXM
 METI    .           CMETI
 TMEQ    .           CTMEQ
 OMAN    .           COMAN
 ELWA    .           CELWA
 CNST    .           CCNST
 COMM    .           CCOMM
 RE_H    .           CRE_H
 TR_C    .           CTR_C
 FI_I    .           CFI_I
 DWEL    .           CDWEL
 PA_D    .           CPA_D
 EDUC    .           CEDUC
 HEAL    .           CHEAL
 OSER    .           COSER
 SPEC    .           CSPEC
/
;

*#*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#*#
```

Filename: mapmac.inc
Placement: sub-directory new
Description: This file is an include file which contains the necessary mapping between sets defined in imicro.inc and imacro.inc.

```
*File mapmac.inc

MAPMACRO(imacro,imicro)              SAM mapping
/
*Activities
act         .          ( AMAIZ
                         ARICE
                         AOGRA
                         ACASS
                         ABEAN
                         AOBFC
                         ARCAS
                         ARCOT
                         AOEXC
                         AOCRO
                         ALIVE
                         AFORE
                         AFISH
                         AMINE
                         AGMIL
                         AOFPR
                         ABEVT
                         ATEXT
                         ALEAT
                         AWOOD
                         APACK
                         AOCHE
                         AINXM
                         AMETI
                         ATMEQ
                         AOMAN
                         AELWA
                         ACNST
                         ACOMM
                         ACOME
                         ACOMD
                         ARE_H
                         ATR_C
                         AFI_I
                         ADWEL
                         APA_D
                         AEDUC
                         AHEAL
                         AOSER
                         ASPEC )
*Commodities
com         .          ( CMAIZ
                         CRICE
                         CWHEA
                         COGRA
```

```
                    CCASS
                    CBEAN
                    COBFC
                    CRCAS
                    CRCOT
                    COEXC
                    COCRO
                    CLIVE
                    CFORE
                    CFISH
                    CMINE
                    CGMIL
                    COFPR
                    CBEVT
                    CTEXT
                    CLEAT
                    CWOOD
                    CPACK
                    CFERT
                    CFUEL
                    COCHE
                    CINXM
                    CMETI
                    CTMEQ
                    COMAN
                    CELWA
                    CCNST
                    CRE_H
                    CTR_C
                    CFI_I
                    CDWEL
                    CPA_D
                    CEDUC
                    CHEAL
                    COSER
                    CSPEC )
*Factors
fac         .       ( AGLAB
                    NALAB
                    LABOR
                    CAPIT )
*Institutions
hou         .       ( URBAN
                    RURAL )
ent         .       ENTER
gre         .       GOVRE
itx         .       INTAX
gin         .       GOVIN
ngo         .       NGOVO

*Row and totals
cap         .       KACCT
row         .       WORLD
tot         .       TOTAL
/
;

*#*#*#*#*#*#*#*#*#* THE END *#*#*#*#*#*#*#*#*#
```

Input-output table (1995 Raw MOZAM)

	AMAIZ	ARICE	AOGRA	ACASS	ABEAN	AOBFC	ARCAS	ARCOT	AOEXC	AOCRO	ALIVE	AFORE	AFISH	AMINE	AGMIL	AOFPR	ABEVT	ATEXT	ALEAT	AWOOD	APACK	AOCHE	AINXM	AMETI	ATMEQ	AOMAN	AELWA	ACNST	ARE_H	ATR_C	AFI_I	ADWEL	APA_D	AEDUC	AHEAL	AOSER	ACOMD	ACOME	ACOMM
CMAIZ	0.38615														3.34715		0.14670												0.02881				0.19497		0.00070	0.00165			
CRICE		0.10867													0.10754																		0.00038		0.00010	0.00010			
CWHEA															1.34385																				0.00023	0.00426			
COGRA			0.07195														0.02465																							
CCASS											0.37268				0.26063														0.02721		0.00036		0.40979		0.03698	0.00644			
CBEAN					0.18695						0.05157		0.00337		0.00708														0.02484				0.06859						
COBFC						0.09239							0.01420			0.25987	0.00288					0.00295					0.00023		0.12299		0.00010		0.08549		0.01727	0.00352	0.00016	0.00002	0.00016
CRCAS																0.91954																							
CRCOT																		0.54296																					
COEXC									0.00078							0.55346	0.02641	0.01095				0.00396							0.00216				0.02287		0.00110	0.00073	0.00023	0.00003	0.00024
COCRO										0.01299								0.00043				0.00008							0.00842						0.00045				
CLIVE													0.00411			1.71938		0.00142											0.00545				0.00009						
CFORE														0.00281		0.01917	0.00055	0.00019	0.00033	0.18348	0.00100	0.00255	0.00073	0.00029			0.19263	0.34486										
CFISH													0.01411	0.00133		0.84182													0.01594				0.15311		0.01398	0.00557			
CMINE											0.00168		0.00405	0.00012		0.00011					0.00003	0.00063	0.02764	0.00277	0.00003		0.20190	0.00118	0.00019				0.00007						
CGMIL											0.05580		0.02068	0.00041		1.36997	0.00088	0.00157		0.00149		0.00024	0.00008		0.00016				0.07922		0.00412		0.16979		0.01424	0.00206			
COFPR											0.18709		0.04905	0.00045		0.97840	0.03740	0.00098	0.00191	0.00088	0.00228	0.00257	0.00008	0.00008	0.00003	0.00005			0.15815						0.00821				
CBEVT													0.14993	0.00005		0.01241	0.21572					0.00130							0.60570		0.01608		0.07061			0.00494			
CTEXT	0.00368	0.00136	0.00075	0.13279	0.00103	0.00111	0.02202	0.07735	0.01052	0.00050	0.00358	0.09022	0.03395	0.00448	0.00100	0.00268		0.41883	0.00060	0.01655	0.00123	0.00436	0.00159	0.00092	0.00453	0.00099	0.04342		0.06813	0.00436	0.01049		0.08834		0.03706	0.00211			
CLEAT													0.02581					0.01494	0.04528	0.00475		0.00004			0.00023					0.01200									
CWOOD													0.00634	0.00066		0.00610	0.00020	0.00006	0.00007	0.09635	0.00024	0.00064	0.00019	0.00008				0.67621											
CPACK													0.13965	0.00071	0.02777	0.25101	0.05789	0.01562	0.00040	0.00366	0.21106	0.01177	0.05168	0.00121	0.00832	0.00449	0.01186	0.57062	0.00743	0.94527	0.20607		0.91139	0.08941	0.01494	1.21047	0.22741	0.02634	0.22888
CFERT	0.33476	0.04389	0.01984		0.03951	1.20591		0.12031	0.40675	0.01160												0.00304																	
CFUEL	0.00548	0.00154	0.00083	0.03357	0.00122	0.00313	0.02372	0.00494	0.01289	0.00052	0.00545	0.18822	0.83264	0.03666	0.02975	0.15853	0.05687	0.05605	0.00040	0.04204	0.02980	0.52578	0.26987	0.05408	0.01351	0.00040	0.18867	0.54288	0.01643	3.84670	0.01063		0.39054	0.01464	0.02502	0.26282	0.02051	0.00238	0.02065
COCHE													0.48348	0.03455	0.01297	0.45184	0.06038	0.09809	0.02282	0.20997	0.04768	0.19128	0.12263	0.01482	0.09217	0.00459	0.05440	2.17946	0.05087	4.03258	0.00991		0.40154	0.08502	0.42252	1.47385	0.12826	0.01485	0.12909
CINXM														0.00771		0.03529	0.04636	0.00271		0.03658	0.00135	0.01574	0.26239	0.00696	0.02169	0.00032	0.00278	4.54475	0.05928	0.01021	0.00012		0.02642	0.06334	0.01158	0.08711	0.00986	0.00114	0.00993
CMETI													0.04946	0.01289		0.01688	0.00128	0.01099		0.02694	0.00228	0.00501	0.00207	0.05999	0.07748	0.00141	0.00094	1.08927		1.03216			0.00307		0.00037	0.08560			
CTMEQ													0.01843	0.01773	0.02319	0.31889	0.10266	0.01660	0.00053	0.06226	0.01247	0.01566	0.07249	0.01254	0.30300	0.00258	0.78337	1.84515	0.01003	0.59003	0.02386		0.33657	0.07268	0.01763	1.05173	0.00690	0.00080	0.00695
COMAN													0.04874	0.02978	0.03285	0.05557	0.07349	0.03760	0.00510	0.05403	0.01866	0.05271	0.07482	0.01466	0.03139	0.00143	0.07425	0.00192	0.06233	0.00199	0.06850	0.04433	0.00498	0.04927	0.03713	0.10142	0.00702	0.00081	0.00706
CELWA	0.00561	0.00156	0.00082	0.36369	0.00123	0.00334	0.02355	0.00496	0.01306	0.00052	0.00560	0.19746	0.00278	0.04264	0.02647	0.14719	0.10981	0.06101	0.00092	0.02155	0.04396	0.04293	0.14280	0.03658	0.02063	0.00077	1.28603	0.30023	0.06741	0.49059	0.03832		0.08728	0.04958	0.02635	0.39150	0.02613	0.00303	0.02630
CCNST														0.00027	0.00232	0.04799	0.06313	0.04041	0.00066	0.01158	0.01243	0.01187	0.01697	0.00192	0.02578	0.00082	0.28583			1.89452	0.05221	0.31845	0.32325		0.03223	0.50770			
CRE_H													0.05935	0.00082			0.01638	0.00583	0.00033	0.01288	0.00104	0.00686	0.00093	0.00119	0.00567	0.00009	0.00958	0.21098		1.22623	0.04094		0.23985	0.02220	0.00615	0.32271	0.28926	0.03350	0.29112
CTR_C	0.00638	0.00163	0.00086	0.04720	0.00131	0.00468	0.02458	0.00507	0.01377	0.00053	0.00632	0.24430	0.25241	0.02943	0.03118	0.57912	0.15961	0.09745	0.00119	0.06289	0.04207	0.06997	0.24466	0.01803	0.08909	0.00164	0.08443	2.42774	0.00825	3.54319	0.59969		1.14960	0.26617	0.09869	1.35950	4.60757	0.53361	4.63733
CFI_I	0.00579	0.00158	0.00081	0.39278	0.00126	0.00363	0.02382	0.00499	0.01327	0.00053	0.00580	0.20930	0.34108	0.05169	0.15029	0.88267	0.16486	0.12269	0.00817	0.10681	0.03407	0.12485	0.14158	0.02495	0.05987	0.00263	0.23956	1.74691	0.21077	1.57928	0.72996	0.09442	0.47434	0.13532	0.08511	1.59522	0.95330	0.11040	0.95946
CDWEL													0.00082	0.00111	0.00047	0.00529	0.00227	0.00115		0.00063	0.00055	0.00093	0.00104	0.00059	0.00130	0.00005	0.00184	0.01561	0.00552	0.03427	0.00890	0.00078	0.00202	0.00675	0.00236	0.02295	0.00071	0.00008	0.00072
CPA_D														0.00044			0.00845	0.00275	0.00020	0.00695	0.00060	0.00336	0.00048	0.00067	0.00305	0.00005	0.00456	0.02612		0.11980	0.00614					0.09346	0.02538	0.00294	0.02554
CEDUC																																							
CHEAL																																							
COSER													0.51408	0.02730	0.00741	0.12918	0.05872	0.03295	0.00092	0.01464	0.01364	0.02601	0.02419	0.01360	0.03314	0.00104	0.05230	4.03725	0.08334	5.20852	0.45399	0.02026	0.14991	0.20188	0.06081		0.23893	0.02767	0.24047

Make matrix (1995 Raw MOZAM)

	CMAIZ	CRICE	CWHEA	COGRA	CCASS	CBEAN	COBFC	CRCAS	CRCOT	COEXC	COCRO	CLIVE	CFORE	CFISH	CMINE	CGMIL	COFPR	CBEVT	CTEXT	CLEAT	CWOOD	CPACK	CFERT	CFUEL	COCHE	CINXM	CMETI	CTMEQ	COMAN	CELWA	CCNST	CRE_H	CTR_C	CFI_I	CDWEL	CPA_D	CEDUC	CHEAL	COSER
AMAIZ	2.65751																																					
ARICE		0.28489																																				
AOGRA				0.02359																																		
ACASS					0.82498																																		
ABEAN						0.91347																																	
AOBFC							3.57179																																
ARCAS								0.81135																															
ARCOT									0.61160																														
AOEXC										1.02809																													
AOCRO											0.13413																												
ALIVE												2.33922																											
AFORE													3.06730																										
AFISH														9.05952																									
AMINE															1.10391																								
AGMIL																6.78664																							
AOFPR																	12.02653																						
ABEVT																		1.53349																					
ATEXT																			3.30608																				
ALEAT																				0.03521																			
AWOOD																					1.74892																		
APACK																						0.67323																	
AOCHE																									2.44434														
AINXM																										1.98107													
AMETI																											0.55733												
ATMEQ																												1.14418											
AOMAN																													0.02212										
AELWA																														4.31010									
ACNST																															41.78003								
ARE_H																																3.84668							
ATR_C																																	35.93605						
AFI_I																																		13.56002					
ADWEL																																			0.63327				
APA_D																																				12.13456			
AEDUC																																					3.69455		
AHEAL																																						1.86233	
AOSER																																							18.48742
ACOMD	0.73715			0.01950	2.47542	0.50184	4.19947	0.32539	0.00002	0.13313	0.22343	0.31462	0.37062	0.91173	0.02210	5.08309	4.34934	0.88117	0.37369	0.00586	0.35633	0.24706			0.93905	0.61304	0.07602	0.12849	0.00353										
ACOME	0.01946				0.00012	0.00232	0.05766	0.02593		0.34758	0.00335	0.00195	0.07271		0.05062	0.08053	1.12053	0.00987	0.57205	0.00696	0.09141	0.00291			0.13313	0.00395	0.05572	0.03863											
ACOMM	0.65310					0.40026	0.53998	0.00004		0.03642	0.03794	0.03043	0.00086		0.01883	4.12751	4.08286	1.26728	0.66264	0.12076	0.15497	0.51122	0.70870	1.14562	3.63853	0.87026	0.30971	3.83596	0.28762										

The institutional part of the activity and commodity columns (1995 Raw MOZAM)

	AMAIZ	ARICE	AOGRA	ACASS	ABEAN	AOBFC	ARCAS	ARCOT	AOEXC	AOCRO	ALIVE	AFORE	AFISH	AMINE	AGMIL	AOFPR	ABEVT	ATEXT	ALEAT	AWOOD	APACK	AOCHE	AINXM	AMETI	ATMEQ	AOMAN	AELWA	ACNST	ARE_H	ATR_C	AFI_I	ADWEL	APA_D	AEDUC	AHEAL	AOSER	ACOMD	ACOME	ACOMM
labor	6.47252	1.27991	0.88590	9.34158	2.12809	7.61956	1.15312	0.25919	0.65168	0.27090	3.62120	4.76349	3.13999	0.26420	1.11157	1.98852	0.27862	0.64096	0.02381	0.36466	0.08689	0.26867	0.24820	0.05842	0.29991	0.00022	0.72547	7.07431	0.39694	5.26429	2.11976	1.25581	6.36969	2.62510	0.79896	7.30866	5.00218	0.57931	5.03448
capit	0.07218	0.02291	0.00383	0.01185	0.01373	0.43396		0.15285	0.32562	0.00054	0.25967	0.35349	3.55568	0.55366	0.49653	0.88824	0.12607	0.96282	0.00035	0.43760	0.00673	0.27176	0.25811	0.18260	0.01144	0.00022	0.25869	14.33710	1.37600	6.13056	9.15987	0.40871		0.01318	0.09214	2.89584	11.76430	1.36245	11.84027
enter																																							
URBAN																																							
RURAL																																							
govre																																							
intax	-0.00853	-0.00271	-0.00045	-0.00140	-0.00162	-0.05130		-0.01807	-0.03849	-0.00006	-0.03070	-0.04179		-0.01799									-0.00993					-0.04029		-0.03050							-0.01704	-0.00197	-0.01715
govin																																							
ngovo																																							
kacct																																							
WORLD																																							
total	7.28402	1.46036	0.98514	10.32206	2.37271	9.31643	1.27080	0.61160	1.40984	0.29858	4.54576	6.00470	9.76420	1.10389	7.02000	12.63911	1.84224	3.19800	0.11399	1.77914	0.57005	1.66751	1.95529	0.50695	1.10244	0.02378	4.31010	41.78003	3.84668	35.93605	13.56002	2.14275	12.13456	3.69455	1.86233	18.80191	23.29107	2.69739	23.44148

	CMAIZ	CRICE	CWHEA	COGRA	CCASS	CBEAN	COBFC	CRCAS	CRCOT	COEXC	COCRO	CLIVE	CFORE	CFISH	CMINE	CGMIL	COFPR	CBEVT	CTEXT	CLEAT	CWOOD	CPACK	CFERT	CFUEL	COCHE	CINXM	CMETI	CTMEQ	COMAN	CELWA	CCNST	CRE_H	CTR_C	CFI_I	CDWEL	CPA_D	CEDUC	CHEAL	COSER
labor																																							
capit																																							
enter																																							
URBAN																																							
RURAL																																							
govre	0.10825		0.00300	0.00143	0.18159	0.06784	0.35291	0.02590	0.00000	0.03962	0.02018	0.02594	0.03363	0.08097	0.04491	0.92173	1.04454	1.60057	0.34489	0.01853	0.11978	0.11323	0.06274	2.09962	0.42751	0.26913	0.08394	0.39169	0.02234	0.05593	0.05593	0.62202	0.47918						1.15926
intax	0.02715		0.06905			0.09634	0.03475	0.00001		0.00528	0.01511	0.01093	0.00041		0.01071	0.27652	0.49987	0.09288	0.33500	0.02108	0.06811	0.19244	0.14195	0.71912	0.52329	0.20810	0.09694	2.23581	0.19432										
govin																																							
ngovo																																							
kacct																																							
WORLD	2.26679		1.39275			0.62887	0.41830	0.00008		0.07261	0.32412	0.21393	0.00552		0.27520	5.14835	8.47705	2.08813	1.98143	0.31044	0.53722	1.18437	0.89936	5.14168	7.77178	2.58618	1.21338	24.02691	1.61054	1.16363		2.65091	3.99757	0.16542					7.34649
total	6.46941	0.28489	1.46480	0.04452	3.48210	2.61094	9.17487	1.18870	0.61162	1.66272	0.75826	2.93702	3.55104	10.05222	1.52628	22.42437	31.60073	7.47339	7.57578	0.51884	3.07674	2.92447	1.81275	9.10603	15.87762	6.53173	2.39303	31.80167	2.14046	5.52966	41.83596	7.11961	40.41280	13.72544	0.63327	12.13456	3.69455	1.86233	26.99317

The institutional diagonal matrix (1995 Raw MOZAM)

	labor	capit	enter	URBAN	RURAL	govre	intax	govin	ngovo	kacct	WORLD	total
labor												91.777
capit												69.042
enter		62.860										62.860
URBAN	36.548		47.176			1.062					1.812	86.598
RURAL	55.110		11.794			0.265					1.610	68.779
govre	0.330	0.930	2.390	1.968	0.492		5.546					22.534
intax												5.545
govin											17.587	17.587
ngovo											5.531	5.531
kacct			1.500	10.846	2.711	4.471		-11.043			24.971	33.456
WORLD												83.899
total	91.988	63.790	62.860	86.598	68.779	22.534	5.545	15.424	5.531	30.877	83.899	1159.510

The institutional part of the activity and commodity rows (1995 Raw MOZAM)

	labor	capit	enter	URBAN	RURAL	govre	intax	govin	ngovo	kacct	WORLD	total
AMAIZ				0.41891	4.20760							7.28402
ARICE				0.28049	0.89498							1.46036
AOGRA					0.96155							0.98514
ACASS				0.40009	9.09699							10.32206
ABEAN				0.10503	1.35421							2.37271
AOBFC				0.66143	5.08321							9.31643
ARCAS				0.05946	0.39999							1.27080
ARCOT												0.61160
AOEXC				0.05857	0.32318							1.40984
AOCRO				0.01232	0.15213							0.29858
ALIVE				0.46903	1.73751							4.54576
AFORE				0.32344	2.61396							6.00470
AFISH				0.13545	0.55331							9.74828
AMINE												1.10391
AGMIL												6.78664
AOFPR				0.03502	0.18064							12.24219
ABEVT				0.00249	0.01627							1.55225
ATEXT												3.30608
ALEAT												0.03521
AWOOD												1.74892
APACK												0.67323
AOCHE												2.44434
AINXM												1.98107
AMETI												0.55733
ATMEQ												1.14418
AOMAN												0.02212
AELWA												4.31010
ACNST												41.78003
ARE_H												3.84668
ATR_C												35.93605
AFI_I												13.56002
ADWEL				0.19737	1.31211							2.14275
APA_D												12.13456
AEDUC												3.69455
AHEAL												1.86233
AOSER				0.31449								18.80191
ACOMD												23.29108
ACOME												2.69739
ACOMM												23.44148

	labor	capit	enter	URBAN	RURAL	govre	intax	govin	ngovo	kacct	WORLD	total
CMAIZ				2.24560	0.99222						0.06835	7.41231
CRICE												0.21680
CWHEA												1.34834
COGRA				0.02259	0.02193							0.14112
CCASS				0.31837	0.82788						0.00004	2.26039
CBEAN				1.05031	0.52530						0.00421	1.92222
COBFC				5.28691	2.70302						0.04838	8.64055
CRCAS							-0.00004				0.05988	0.97938
CRCOT												0.54296
COEXC				0.14163	0.08496						0.74337	1.59288
COCRO				0.30452	0.39386						0.02999	0.75074
CLIVE				0.70048	0.10109					0.06578	0.01439	2.61218
CFORE				1.06800	1.22168						0.50308	3.54136
CFISH				1.19386	0.53190		-0.00018				6.86663	9.63806
CMINE				0.05375	0.15414		-0.00002				0.76842	1.21669
CGMIL				8.29157	11.41538						0.10584	21.53350
COFPR				16.67534	10.32972		-0.00003				2.46370	30.89633
CBEVT				5.45668	0.85287		-0.00008				0.01699	7.40319
CTEXT				1.87131	2.28124		-0.00007				1.99974	7.24275
CLEAT				0.34435	0.11114						0.01911	0.57765
CWOOD				1.04259	0.02009					0.67539	0.35705	2.88225
CPACK				0.21091	0.14596						0.00785	5.60002
CFERT											0.01865	2.20428
CFUEL				0.51352	0.60388						0.28306	9.13021
COCHE				2.55399	1.42487						0.30350	15.11195
CINXM				0.17191	0.08313						0.01268	5.53136
CMETI							-0.00001				0.23572	2.71379
CTMEQ				2.81898	0.80138		-0.00001	10.00704		7.86871	0.26447	27.48531
COMAN				0.19741	0.22582			0.91933			0.00955	2.34393
CELWA				1.87180								5.98600
CCNST								14.91218		20.55307		39.11557
CRE_H				1.38697	0.23036						1.58202	6.00325
CTR_C				7.47730				0.62846			7.77805	37.23498
CFI_I				1.68559							0.29490	13.77430
CDWEL				0.51617								0.63489
CPA_D				0.13580	0.11697	11.62903						12.21272
CEDUC				0.16802	0.02107	3.50546						3.69455
CHEAL				0.22835	0.03190	1.60208						1.86233
COSER				4.30595	0.43460				5.53067	1.71379	7.52813	31.18530

ANNEX 2: THE BALANCED 1995 MOZAM

Input-output table (1995 MOZAM)

	AMAIZ	ARICE	AOGRA	ACASS	ABEAN	AOBFC	ARCAS	ARCOT	AOEXC	AOCRO	ALIVE	AFORE	AFISH	AMINE	AGMIL	AOFPR	ABEVT	ATEXT	ALEAT	AWOOD	APACK	AOCHE	AINXM	AMETI	ATMEQ	AOMAN	AELWA	ACNST	ARE_H	ATR_C	AFI_I	ADWEL	APA_D	AEDUC	AHEAL	AOSER	ACOMD	ACOME	ACOMM
CMAIZ	0.25341														2.57420		0.11137												0.02256				0.08375		0.00063	0.00054			
CRICE		0.11489													0.16893																		0.00060		0.00011	0.00028			
CWHEA															1.15704																				0.00021	0.00184			
COGRA			0.07189														0.02092																						
CCASS											0.53218				0.57880														0.03810		0.00134		1.10025		0.04347	0.03469			
CBEAN					0.24453						0.08626		0.01155		0.02004														0.03973				0.28000						
COBFC						0.19097							0.03011			0.50373	0.00282					0.00476					0.00032		0.16285		0.00034		0.19257		0.01976	0.01448	0.00112	0.00003	0.00114
CRCAS																1.11558																							
CRCOT																		0.61162																					
COEXC									0.00082							0.59223	0.02365	0.01200				0.00590							0.00240				0.02914		0.00116	0.00128	0.00053	0.00003	0.00053
COCRO										0.01356								0.00071				0.00015							0.01495						0.00060				
CLIVE													0.00553			1.84100		0.00156											0.00603				0.00014						
CFORE														0.00275		0.01064	0.00045	0.00018	0.00011	0.17439	0.00117	0.00349	0.00070	0.00031			0.07203	0.31194										
CFISH													0.02222	0.00140		1.10962													0.01878				0.23811		0.01511	0.01287			
CMINE											0.00258		0.01140	0.00013		0.00034					0.00004	0.00107	0.03393	0.00320	0.00004		0.30556	0.09528	0.00029				0.00028						
CGMIL											0.06418		0.03182	0.00043		1.75382	0.00082	0.00180		0.00159		0.00037	0.00009		0.00017				0.09246		0.00767		0.25684		0.01533	0.00460			
COFPR											0.18702		0.05593	0.00046		0.85029	0.03249	0.00103	0.00062	0.00089	0.00271	0.00373	0.00008	0.00009	0.00003	0.00005			0.16404						0.00835				
CBEVT													0.15519	0.00005		0.00954	0.18400					0.00185							0.60481		0.01724		0.06533			0.00512			
CTEXT	0.00373	0.00136	0.00075	0.13050	0.00101	0.00113	0.02195	0.07759	0.01063	0.00050	0.00336	0.08893	0.03379	0.00449	0.00118	0.00198		0.41629	0.00019	0.01635	0.00146	0.00619	0.00158	0.00101	0.00451	0.00092	0.04160		0.06698	0.00406	0.01065		0.07778		0.03671	0.00205			
CLEAT																		0.00078	0.01311	0.00091		0.00001			0.00009														
CWOOD													0.00624	0.00066		0.00438	0.00017	0.00006	0.00002	0.09493	0.00029	0.00092	0.00019	0.00009				0.58797											
CPACK													0.09903	0.00068	0.02538	0.11805	0.04599	0.01390	0.00013	0.00340	0.24448	0.01573	0.04810	0.00130	0.00796	0.00417	0.00980	0.12362	0.00640	0.24882	0.13045		0.52677	0.07827	0.01387	0.60111	0.09778	0.02391	0.09787
CFERT	0.27273	0.04175	0.01924		0.03570	0.91544		0.11846	0.39384	0.01147												0.00411																	
CFUEL	0.00567	0.00154	0.00083	0.00340	0.00120	0.00324	0.02373	0.00497	0.01308	0.00052	0.00519	0.18895	0.85295	0.03681	0.03541	0.12000	0.04842	0.05626	0.00013	0.04175	0.03527	0.74880	0.27046	0.05924	0.01346	0.00037	0.18311	0.56864	0.01635	3.92667	0.01124		0.35662	0.01473	0.02493	0.26512	0.02127	0.00239	0.02141
COCHE													0.49744	0.03471	0.01549	0.34377	0.05143	0.09859	0.00734	0.20867	0.05645	0.27285	0.12300	0.01624	0.09189	0.00427	0.05290	2.32578	0.05069	4.18337	0.01054		0.36866	0.08569	0.42117	1.49914	0.13414	0.01495	0.13504
CINXM														0.00778		0.02794	0.03972	0.00276		0.03656	0.00161	0.02257	0.26478	0.00764	0.02170	0.00030	0.00275	5.51625	0.05976	0.01192	0.00016		0.02520	0.06457	0.01161	0.09392	0.01113	0.00116	0.01121
CMETI													0.04833	0.01288		0.01204	0.00108	0.01087		0.02653	0.00269	0.00707	0.00206	0.06555	0.07680	0.00131	0.00090	0.93021		0.88403			0.00266		0.00036	0.07880			
CTMEQ													0.02251	0.01817	0.03134	0.30315	0.09045	0.01764	0.00017	0.06384	0.01491	0.02291	0.07525	0.01385	0.30794	0.00240	0.82120	4.08304	0.01069	1.14617	0.03211		0.38184	0.07813	0.01816	1.48490	0.01089	0.00085	0.01099
COMAN													0.03248	0.02847	0.02872	0.02414	0.05776	0.03277	0.00163	0.04961	0.02153	0.06955	0.06876	0.01571	0.02979	0.00133	0.05959	0.00036	0.05232	0.00045	0.03977	0.04031	0.00268	0.04213	0.03407	0.04468	0.00263	0.00073	0.00263
CELWA	0.00549	0.00154	0.00082	0.33990	0.00119	0.00322	0.02333	0.00496	0.01311	0.00052	0.00515	0.18900	0.00265	0.04245	0.02982	0.10088	0.09215	0.05971	0.00030	0.02111	0.05180	0.06033	0.14091	0.03991	0.02038	0.00072	1.20643	0.22626	0.06505	0.37731	0.03636		0.07245	0.04846	0.02587	0.34055	0.02254	0.00298	0.02266
CCNST														0.00028	0.00311	0.04462	0.05547	0.04268	0.00021	0.01184	0.01484	0.01728	0.01755	0.00212	0.02615	0.00076	0.29723			3.44049	0.06849	0.32935	0.35849		0.03307	0.69204			
CRE_H													0.06828	0.00083			0.01426	0.00608	0.00011	0.01307	0.00124	0.00996	0.00096	0.00131	0.00572	0.00009	0.00980	0.36284		1.91724	0.05076		0.25291	0.02335	0.00627	0.40679	0.39456	0.03476	0.39789
CTR_C	0.00687	0.00164	0.00087	0.00474	0.00130	0.00508	0.02477	0.00512	0.01409	0.00053	0.00617	0.25339	0.27260	0.02974	0.03856	0.46945	0.13728	0.09950	0.00038	0.06306	0.04994	0.10050	0.24781	0.01980	0.08930	0.00152	0.08388	3.18745	0.00839	4.39302	0.68091		1.12086	0.27320	0.09929	1.51790	5.40724	0.54404	5.44752
CFI_I	0.00599	0.00158	0.00082	0.39788	0.00123	0.00376	0.02383	0.00501	0.01347	0.00053	0.00552	0.21001	0.34916	0.05190	0.17878	0.66761	0.14037	0.12310	0.00263	0.10606	0.04032	0.17770	0.14186	0.02733	0.05965	0.00245	0.23242	1.82382	0.20956	1.60780	0.76946	0.09435	0.43274	0.13611	0.08475	1.60669	0.98463	0.11091	0.99115
CDWEL													0.00086	0.00111	0.00058	0.00402	0.00194	0.00116		0.00063	0.00065	0.00133	0.00105	0.00064	0.00130	0.00004	0.00179	0.01635	0.00549	0.03491	0.00941	0.00079	0.00187	0.00680	0.00235	0.02313	0.00078	0.00009	0.00079
CPA_D														0.00044			0.00705	0.00266	0.00006	0.00676	0.00071	0.00470	0.00048	0.00073	0.00300	0.00004	0.00422	0.01706		0.08124	0.00558					0.07612	0.02017	0.00287	0.02027
CEDUC																																							
CHEAL																																							
COSER													0.45616	0.02697	0.00797	0.08123	0.04867	0.03155	0.00030	0.01416	0.01601	0.03612	0.02356	0.01479	0.03250	0.00097	0.04765	2.28509	0.07833	3.13191	0.39240	0.01962	0.11452	0.19237	0.05894		0.17547	0.02672	0.17624

Make matrix (1995 MOZAM)

	CMAIZ	CRICE	CWHEA	COGRA	CCASS	CBEAN	COBFC	CRCAS	CRCOT	COEXC	COCRO	CLIVE	CFORE	CFISH	CMINE	CGMIL	COFPR	CBEVT	CTEXT	CLEAT	CWOOD	CPACK	CFERT	CFUEL	COCHE	CINXM	CMETI	CTMEQ	COMAN	CELWA	CCNST	CRE_H	CTR_C	CFI_I	CDWEL	CPA_D	CEDUC	CHEAL	COSER
AMAIZ	2.63984																																					
ARICE		0.28481																																				
AOGRA				0.07368																																		
ACASS					0.82168																																	
ABEAN						0.86039																																
AOBFC							3.54240																															
ARCAS								0.81065																														
ARCOT									0.61160																													
AOEXC										1.02702																												
AOCRO											0.13398																											
ALIVE												2.25532																										
AFORE													3.03128																									
AFISH														9.04750																								
AMINE															1.10385																							
AGMIL																6.78664																						
AOFPR																	11.9990 4																					
ABEVT																		1.53128																				
ATEXT																			3.23933																			
ALEAT																				0.03521																		
AWOOD																					1.74892																	
APACK																						0.66887																
AOCHE																									2.36579													
AINXM																										1.95816												
AMETI																											0.55439											
ATMEQ																												1.10244										
AOMAN																													0.02212									
AELWA																														4.31010								
ACNST																															41.7800 1							
ARE_H																																3.84668						
ATR_C																																	35.9359 5						
AFI_I																																		13.5600 2					
ADWEL																																			0.63327				
APA_D																																				12.1345 6			
AEDUC																																					3.69455		
AHEAL																																						1.86233	
AOSER																																							18.4352 2
ACOMD	0.73933			0.06094	2.47858	0.47387	4.22168	0.32571	0.00002	0.13332	0.22344	0.30426	0.36804	0.92287	0.02209	5.06320	4.32605	0.88058	0.37550	0.00586	0.35612	0.24735			0.94029	0.61507	0.07608	0.12728	0.00352									
ACOME	0.01954				0.00012	0.00220	0.05569	0.02596		0.34817	0.00336	0.00189	0.07224		0.05061	0.08046	1.11889	0.00988	0.57534	0.00696	0.09139	0.00292			0.13358	0.00397	0.05578	0.03844										
ACOMM	0.65584					0.37813	0.54380	0.00004		0.03649	0.03795	0.02945	0.00086		0.01883	4.12911	4.08572	1.26828	0.66680	0.12075	0.15497	0.51210	0.70858	1.14520	3.65442	0.87424	0.31013	3.82224	0.28752									

The institutional part of the activity and commodity columns (1995 MOZAM)

	AMAIZ	ARICE	AOGRA	ACASS	ABEAN	AOBFC	ARCAS	ARCOT	AOEXC	AOCRO	ALIVE	AFORE	AFISH	AMINE	AGMIL	AOFPR	ABEVT	ATEXT	ALEAT	AWOOD	APACK	AOCHE	AINXM	AMETI	ATMEQ	AOMAN	AELWA	ACNST	ARE_H	ATR_C	AFI_I	ADWEL	APA_D	AEDUC	AHEAL	AOSER	ACOMD	ACOME	ACOMM
aglab	6.66666	1.27606	0.88656	9.43559	2.07493	7.81772	1.15319	0.26042	0.66108	0.27046	3.43730	4.77146																											
nalab													3.20562	0.26523	1.31978	1.49896	0.23712	0.64250	0.00766	0.36192	0.10281	0.38215	0.24857	0.06398	0.29872	0.00021	0.70301	7.30147	0.39423	5.30672	2.22613	1.25405	5.79150	2.63771	0.79522	7.32331	5.13356	0.58153	5.16729
capit	0.07200	0.02270	0.00382	0.01145	0.01325	0.42718		0.15314	0.32821	0.00054	0.24155	0.34474	3.47646	0.55305	0.57151	0.63317	0.10642	0.95156	0.00011	0.43089	0.00795	0.38368	0.25625	0.19953	0.01134	0.00021	0.24595	12.2968 1	1.34351	5.27043	9.05901	0.40429		0.01304	0.09096	2.66996	10.8896 7	1.35141	10.9539 9
enter																																						
URBAN																																						
RURAL																																						
govre																																						
intax	-0.00847	-0.00269	-0.00045	-0.00140	-0.00162	-0.05092		-0.01807	-0.03820	-0.00007	-0.03055	-0.04150		-0.01803									-0.00981					-0.04031		-0.03060							-0.01707	-0.00198	-0.01720
govin																																						
ngovo																																						
kacct																																						
WORLD																																						
total	7.28408	1.46038	0.98514	10.3220 6	2.37272	9.31681	1.27080	0.61160	1.41013	0.29857	4.54591	6.00498	9.74828	1.10385	6.78664	12.2421 9	1.55225	3.23933	0.03521	1.74892	0.66887	2.36579	1.95816	0.55439	1.10244	0.02212	4.31010	41.7800 1	3.84668	35.9359 5	13.5600 2	2.14275	12.1345 6	3.69455	1.86233	18.8019 1	23.2910 5	2.69738	23.4414 3

	CMAIZ	CRICE	CWHEA	COGRA	CCASS	CBEAN	COBFC	CRCAS	CRCOT	COEXC	COCRO	CLIVE	CFORE	CFISH	CMINE	CGMIL	COFPR	CBEVT	CTEXT	CLEAT	CWOOD	CPACK	CFERT	CFUEL	COCHE	CINXM	CMETI	CTMEQ	COMAN	CELWA	CCNST	CRE_H	CTR_C	CFI_I	CDWEL	CPA_D	CEDUC	CHEAL	COSER
aglab																																							
nalab																																							
capit																																							
enter																																							
URBAN																																							
RURAL																																							
govre	0.10846		0.00237	0.00447	0.18171	0.06403	0.35424	0.02592	0.00000	0.03967	0.02018	0.02508	0.03338	0.08183	0.04489	0.91467	1.03343	1.59752	0.34612	0.01852	0.11965	0.11331	0.06268	2.09197	0.42693	0.26973	0.08398	0.38585	0.02231	0.05577	0.05595	0.62006	0.46975						1.15145
intax	0.02730		0.05464			0.09106	0.03506	-0.00002		0.00529	0.01512	0.01058	0.00041		0.01071	0.27782	0.50323	0.09309	0.33759	0.02108	0.06815	0.19288	0.14197	0.72010	0.52716	0.20931	0.09711	2.24118	0.19433									
govin																																							
ngovo																																							
kacct																																							
WORLD	2.27911		1.10207			0.59438	0.42201	0.00010		0.07277	0.32424	0.20711	0.00550		0.27528	5.17247	8.53437	2.09276	1.99671	0.31045	0.53753	1.18705	0.89951	5.14876	7.82945	2.60124	1.21555	24.0842 5	1.61065	1.16379		2.65287	4.00710	0.16542					7.40649
total	6.46941	0.28481	1.15909	0.13909	3.48210	2.46405	9.17487	1.18835	0.61162	1.66272	0.75826	2.83368	3.51169	10.0522 1	1.52628	22.4243 7	31.6007 3	7.47339	7.53738	0.51884	3.07674	2.92447	1.81275	9.10603	15.8776 2	6.53173	2.39303	31.8016 7	2.14046	5.52966	41.8359 6	7.11961	40.4128 0	13.7254 4	0.63327	12.1345 6	3.69455	1.86233	26.9931 7

The institutional diagonal matrix (1995 MOZAM)

	aglab	nalab	capit	enter	URBAN	RURAL	govre	intax	govin	ngovo	kacct	WORLD	total
aglab													38.711
nalab													53.251
capit													63.790
enter			62.860										62.860
URBAN	6.942	29.593		47.168			1.064					1.830	86.598
RURAL	31.770	23.324		11.793			0.266					1.627	68.779
govre		0.333	0.930	2.414	1.997	0.488		5.547					22.534
intax													5.546
govin												17.411	17.411
ngovo												5.531	5.531
kacct				1.485	10.776	2.645	4.426		-11.000			24.789	33.121
WORLD													83.899
total	38.711	53.251	63.790	62.860	86.598	68.779	22.534	5.546	17.411	5.531	33.121	83.899	

The institutional part of the activity and commodity rows (1995 MOZAM)

	aglab	nalab	capit	enter	URBAN	RURAL	govre	intax	govin	ngovo	kacct	WORLD	total
AMAIZ					0.43028	4.21397							7.28408
ARICE					0.28555	0.89002							1.46038
AOGRA						0.91146							0.98514
ACASS					0.40980	9.09058							10.32206
ABEAN					0.11234	1.39999							2.37272
AOBFC					0.67992	5.09449							9.31681
ARCAS					0.06088	0.39927							1.27080
ARCOT													0.61160
AOEXC					0.06007	0.32304							1.41013
AOCRO					0.01269	0.15191							0.29857
ALIVE					0.49954	1.79105							4.54591
AFORE					0.33548	2.63822							6.00498
AFISH					0.14096	0.55982							9.74828
AMINE													1.10385
AGMIL													6.78664
AOFPR					0.04135	0.20181							12.24219
ABEVT					0.00298	0.01799							1.55225
ATEXT													3.23933
ALEAT													0.03521
AWOOD													1.74892
APACK													0.66887
AOCHE													2.36579
AINXM													1.95816
AMETI													0.55439
ATMEQ													1.10244
AOMAN													0.02212
AELWA													4.31010
ACNST													41.78001
ARE_H													3.84668
ATR_C													35.93595
AFI_I													13.56002
ADWEL					0.20156	1.30792							2.14275
APA_D													12.13456
AEDUC													3.69455
AHEAL													1.86233
AOSER					0.36669								18.80191
ACOMD													23.29105
ACOME													2.69738
ACOMM													23.44143

	aglab	nalab	capit	enter	URBAN	RURAL	govre	intax	govin	ngovo	kacct	WORLD	total
CMAIZ					2.34177	1.00595						0.07523	6.46941
CRICE													0.28481
CWHEA													1.15909
COGRA					0.02384	0.02244							0.13909
CCASS					0.32600	0.82712						0.00015	3.48210
CBEAN					1.20301	0.57378						0.00517	2.46405
COBFC					5.31750	2.66278						0.06961	9.17487
CRCAS								-0.00004				0.07281	1.18835
CRCOT													0.61162
COEXC					0.13932	0.08226						0.77146	1.66272
COCRO					0.30730	0.38899						0.03200	0.75826
CLIVE					0.76216	0.10606					0.09463	0.01657	2.83368
CFORE					1.12578	1.24915						0.55858	3.51169
CFISH					1.14893	0.50598		-0.00019				6.97938	10.05221
CMINE					0.05705	0.15835		-0.00002				0.85678	1.52628
CGMIL					8.57755	11.49933						0.11548	22.42437
COFPR					17.22025	10.39124		-0.00003				2.68145	31.60073
CBEVT					5.56272	0.84926		-0.00008				0.01835	7.47339
CTEXT					1.95309	2.31425		-0.00007				2.19892	7.53738
CLEAT					0.36755	0.11482						0.02156	0.51884
CWOOD					1.04892	0.01986					0.93310	0.37895	3.07674
CPACK					0.19515	0.13459						0.00776	2.92447
CFERT													1.81275
CFUEL					0.52199	0.59989							9.10603
COCHE					2.87774	1.53617						0.35949	15.87762
CINXM					0.18695	0.08717						0.01460	6.53173
CMETI								-0.00001				0.22887	2.39303
CTMEQ					1.92247	0.57986		-0.00001	11.12603		8.91723	0.19258	31.80167
COMAN					0.14109	0.16958			1.03786			0.00734	2.14046
CELWA					1.83142								5.52966
CCNST									15.46799		20.91191		41.83596
CRE_H					1.32543	0.21794						1.59717	7.11961
CTR_C					7.11049				0.77929			7.81530	40.41280
CFI_I					1.60564							0.29687	13.72544
CDWEL					0.51341								0.63327
CPA_D					0.12632	0.10830	11.64576						12.13456
CEDUC					0.15745	0.01968	3.51742						3.69455
CHEAL					0.21758	0.03016	1.61459						1.86233
COSER					3.96912	0.39952				5.53067	2.26444	7.33921	26.99317

ANNEX 3: THE SCALED MINIMUM CROSS ENTROPY PROBLEM

The traditional cross entropy objective function can be represented as follows:

$$I(p,q) = \sum_{k=1}^{K} p_k \ln(p_k/q_k)$$

The general minimum cross entropy problem with moment-restrictions is given by:

$$\begin{aligned} &Min \quad I(p,q) \\ &s.t. \quad \sum_{k=1}^{K} p_k f_t(x_k) = y_t \quad , \quad t = 1,...,T \\ &\qquad \sum_{k=1}^{K} p_k = 1 \end{aligned}$$

The Lagrangean is

$$L = \sum_{k=1}^{K} p_k \ln(p_k/q_k) + \sum_{t=1}^{T} \lambda_t (y_t - \sum_{k=1}^{K} p_k f_t(x_k)) + \mu(1 - \sum_{k=1}^{K} p_k)$$

The derivatives of the Lagrangean are:

$$\begin{aligned} \frac{\delta L}{\delta p_k} &= \ln(p_k) + 1 - \ln(q_k) - \sum_{t=1}^{T} \lambda_t f_t(x_k) - \mu \\ \frac{\delta L}{\delta \lambda_t} &= y_t - \sum_{k=1}^{K} p_k f_t(x_k) \\ \frac{\delta L}{\delta \mu} &= 1 - \sum_{k=1}^{K} p_k \end{aligned}$$

The first order conditions associated with the above derivatives give the following solution to the traditional problem:

$$p_k(\lambda_1,...,\lambda_T) = \frac{q_k}{\Omega(\lambda_1,...,\lambda_T)}\exp(\sum_{t=1}^{T}\lambda_t f_t(x_k))$$
$$\Omega(\lambda_1,...,\lambda_T) = \sum_{k=1}^{K} q_k \exp(\sum_{t=1}^{T}\lambda_t f_t(x_k))$$

The scaled cross entropy objective function is

$$I^*(p,q) = \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2} \ln((p_k^{1/2} q_k^{1/2})/q_k)$$
$$= \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2} \ln(p_k^{1/2}/q_k^{1/2})$$

The general scaled minimum cross entropy problem with moment-restrictions is

$$\begin{aligned} &Min \quad I^*(p,q) \\ &s.t. \quad \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2} f_t(x_k) = y_t \quad , \quad t = 1,...,T \\ &\qquad \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2} = 1 \end{aligned}$$

The Lagreangean is

$$L = \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2} \ln(p_k^{1/2}/q_k^{1/2}) + \sum_{t=1}^{T}\lambda_t(y_t - \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2} f_t(x_k)) + \mu(1 - \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2})$$

The derivatives of the Lagrangean are

$$\frac{\delta L}{\delta p_k} = q_k^{1/2}\ln(p_k^{1/2}) + q_k^{1/2} - q_k^{1/2}\ln(q_k^{1/2}) - q_k^{1/2}\sum_{t=1}^{T}\lambda_t f_t(x_k)) - q_k^{1/2}\mu$$

$$\frac{\delta L}{\delta \lambda_t} = y_t - \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2} f_t(x_k)$$

$$\frac{\delta L}{\delta \mu} = 1 - \sum_{k=1}^{K} p_k^{1/2} q_k^{1/2}$$

The first order conditions associated with the above derivatives provide following solution to the scaled problem

$$q_k^{1/2} p_k^{1/2}(\lambda_1,...,\lambda_T) = \frac{q_k}{\Omega(\lambda_1,...,\lambda_T)}\exp(\sum_{t=1}^{T}\lambda_t f_t(x_k))$$

$$\Omega(\lambda_1,...,\lambda_T) = \sum_{k=1}^{K} q_k \exp(\sum_{t=1}^{T}\lambda_t f_t(x_k))$$

On the basis of the above calculations, it can be concluded that the solution of the scaled minimum cross entropy problem is equivalent to the solution of the traditional minimum cross entropy problem.

The purpose of introducing the scaled cross entropy function, is that the Hessian associated with this problem allows for more efficient use of numerical optimization tools. The improvement can be judged from the second derivatives of the respective objective functions. The second derivatives of the *traditional* cross entropy objective function are

$$\frac{\partial I(p,q)}{\partial p_k} = \ln(p_k/q_k) + 1$$

$$\frac{\partial^2 I(p,q)}{\partial p_k^2} = p_k^{-1}$$

The second derivatives of the *scaled* cross entropy objective function are

$$\frac{\partial I^{*}(p,q)}{\partial p_k} = \frac{1}{2} p_k^{-1} (q_k^{1/2} p_k^{1/2} \ln(p_k^{1/2}/q_k^{1/2}) + q_k^{1/2})$$

$$\frac{\partial I^{*2}(p,q)}{\partial p_k^2} = \frac{1}{4} p_k^{-2} (q_k^{1/2} p_k^{1/2} \ln(p_k^{1/2}/q_k^{1/2}))$$

From these formulas it follows that the scaled cross entropy problem will have a better performance in connection with numerical optimization procedures. This is so since the non-zero diagonal elements of the inverse Hessian will be proportional to $p_k^{3/2}/\ln(p_k^{1/2})$ in the case of the scaled problem and proportional to p_k in the case of the traditional problem.