

TMD DISCUSSION PAPER NO. 30

**A 1992 SOCIAL ACCOUNTING MATRIX (SAM)
FOR TANZANIA**

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A 1992 Social Accounting Matrix (SAM) for Tanzania

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MACRO
ECONOMIC
REFORMS AND
REGIONAL
INTEGRATION IN
SOUTHERN
AFRICA



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Abstract

This paper documents the construction of a 1992 social accounting matrix (SAM) for Tanzania. On the basis of recently generated national accounts data, a 56-sector SAM is built focusing on the disaggregation of agriculture — which comprises 21 of the 56 sectors. First, a highly aggregated SAM (macrosam) is designed to set the macroeconomic framework that provides the control totals for the disaggregation procedure. Then, the sector disaggregation of the microeconomic SAM (microsam) is done. Data sources and the data adjustments made are presented. The microsam differentiates 4 household types and 5 labor categories. Special features of the microsam include non-monetary, own-household consumption and separate marketing margins on domestic products, exports, and imports — which play a crucial role in the low income economies of sub-Saharan Africa. Since the data base is to be used for economic policy modeling, consideration of these features will have a significant influence on the results of the analysis. Due to data insufficiencies the first microsam obtained from adjusted raw data (protosam) is highly unbalanced. A cross-entropy estimation method is applied to balance the protosam and generate the final estimated 1992 microsam for Tanzania that uses all available information in a consistent framework.

List of abbreviations

BOS	Bureau of Statistics
BOT	Bank of Tanzania
CGE	Computable General Equilibrium
C.I.F.	Cost, Insurance, Freight
GAMS	General Algebraic Modeling System
GDP (f.c.)	Gross Domestic Product at Factor Costs
GFCF	Gross Fixed Capital Formation
GNP (f.c.)	Gross National Product at Factor Costs
F.O.B.	Free on Board
HBS	Household Budget Survey
LFS	Labour Force Survey
macrosam	Macroeconomic Social Accounting Matrix
MERRISA	Macroeconomic Reforms and Regional Integration in Southern Africa
microsam	Microeconomic Social Accounting Matrix
NGO	Non-Government Organization
protosam	Raw (unbalanced) Microeconomic Social Accounting Matrix
ROW	Rest of the World
SAM	Social Accounting Matrix
TShs	Tanzanian Shillings
URT	United Republic of Tanzania

1. Introduction and summary

As part of the Tanzania country study being done under the IFPRI research project on *Macroeconomic Reform and Regional Integration in Southern Africa* (MERRISA), a social accounting matrix (SAM) has been constructed for the base year 1992.¹ A SAM is a square matrix consisting of row and column accounts that represent the different sectors, agents, and institutions of an economy at the desired level of disaggregation. The SAM, a useful framework for consistent multi-sectoral economic data preparation, represents the expenditure-receipt flows among all actors and sectors of the entire economy, capturing both input-output and national income and product data.²

Because the analytical focus of the MERRISA project is agriculture and because agricultural production in Tanzania accounts for about half of GDP, the disaggregated Tanzania SAM contains 21 agricultural sectors out of 56 sectors in total. The Tanzania SAM consists of 56 activity accounts capturing the flows belonging to the domestic production process and 55 commodity accounts capturing the flows belonging to the marketing process of nationally and internationally produced goods.³ The factor disaggregation of productive factors consists of *Capital, Land* and 5 labor categories, while households are divided into *Rural Farmers, Rural Non-Farmers, Urban Farmers, and Urban Non-Farmers*.

The construction of a SAM under poor data conditions is not only an exercise in putting together a complete data set, but also an estimation process on the basis of limited and often inconsistent existing data sources. In the case of Tanzania, data availability and data consistency are very limited and it is extremely difficult to obtain a complete and reliable national data base. To cope with limited data throughout the construction process of the disaggregated microeconomic SAM (microsam), a macroeconomic SAM (macrosam) has to

¹ The MERRISA project consists of five country studies on Malawi, Mozambique, Tanzania, Zambia, and Zimbabwe and a trade focused regional component including South Africa. Social accounting matrices are developed for each of the six countries and a comprehensive data base of regional trade flows is developed. Applying this extensive new data, individual studies of the impact of domestic economic policies are carried out and opportunities and consequences for extended regional integration are analyzed. For a detailed analysis of the Economic Structure, Trade, and Regional Integration in Southern Africa, see Mukherjee and Robinson (1997).

² For a general description of the SAM concept see Pyatt and Round (1985).

³ The difference of one account occurs because the activity account for *Tourism* does not require a respective commodity account since all its domestic production is exported and none of it enters the domestic commodity market. See Table 3 below for a complete list of accounts.

be constructed first. The macrosam provides the main macroeconomic characteristics and magnitudes of the economy and sets the basic data framework for the further development of the microsam. It is highly aggregated and consists of only one activity, commodity, factor and household account, capturing the basic macroeconomic features like total intermediate demand, value-added, factor payments, foreign trade, tax and savings characteristics, domestic supply and demand, and all domestic and international monetary transfers.

The second step to achieve a consistent and balanced microsam is the construction of a preliminary SAM which typically is inconsistent and unbalanced and will be referred to as the protosam. The protosam incorporates all available raw data which are eventually adjusted to match various macroeconomic control totals. For those sub-matrices within the SAM for which an accurate disaggregation of the data is not available, rough estimates are made.

The accounts of the microsam have to be balanced while also achieving the aggregate control totals from the macrosam. The resulting microsam will be used as the data base for computable general equilibrium (CGE) modeling within the MERRISA project. A cross-entropy approach to SAM estimation is used for the balancing process leading from the protosam to the balanced microsam.⁴ The protosam provides a “prior” for the parameter estimation using the cross-entropy method. Although inconsistent, it is a starting point and contains useful “information” which is used along with the various macroeconomic constraints to estimate the new microsam.

Section 2 describes the construction of the Tanzania macrosam for 1992, the data sources used, and the documentation of data entries. Section 3 documents the data sources and disaggregation criteria applied to the microsam, describes the construction of the protosam, presents the cross-entropy technique used for the balancing process, and gives a detailed presentation on figures and indicators of the final microsam.

The construction of a 1992 SAM for Tanzania is quite a challenge considering the above-mentioned data inadequacies. Earlier work on SAMs for Tanzania by Rutayisire and Vos (1991) and Sarris (1994) are based on 1976 national accounts data and the 1976 input-output table for Tanzania — unfortunately the most recent input-output table available.⁵

⁴ The latest discussion on the cross-entropy approach is led by Golan and Judge (1996), but can be best related to the present context in Robinson, Cattaneo, and El-Said (Forthcoming).

⁵ Both versions are financial SAM including domestic financial structure of the economy. Since the CGE approach that is applied within the MERRISA analysis focuses on real variables and aggregates of the economy, the nature of the SAM constructed here is non-financial and allows only limited comparison with the 1976 versions.

However, CGE analysis of structural adjustment, trade liberalization, and elements of the macroeconomic transformation Tanzania experienced in the early and mid-1990s requires a more recent data base. Recently processed national accounts data for 1992 contribute to this requirement. Preparation of an input-output table for 1992 is still in progress, so the 1992 SAM for Tanzania uses the basic structure of the 1976 input-output table with substantial adjustments based on other sources of information. As soon as the 1992 input-output table for Tanzania is published by the Bureau of Statistics in Dar es Salaam — hopefully not later than by the end of 1999 — the current exercise can easily be repeated to obtain a more reliable data base for further analysis. Under the given circumstances, the current 1992 SAM for Tanzania incorporates all data available at this time and applies an extremely powerful method for the final balancing process, the cross-entropy approach. Furthermore, the 1992 Tanzania SAM has to be seen in the context of other SAMs built for African countries, in particular those being developed for comparative study under the MERRISA project, but also for other countries like Madagascar, Botswana, Uganda, and Ghana which are in process or planned to be constructed. Each of these country studies contributes to a broader and deeper knowledge of how to deal with insufficient raw data to construct a comprehensive and consistent data base incorporating African-specific features.

2. A macroeconomic social accounting matrix (macrosam) for 1992

The Tanzania macroeconomic social accounting matrix (macrosam) for the year 1992 contains 31 non-zero entries. The initial macrosam balances the entire economy at a gross output level of TShs 2,759,506 million and a total domestic absorption of TShs 2,940,773 million. The difference results from Tanzania's high trade deficit in 1992 of TShs 387,681 million or 243 percent of total export earnings.

As in many developing countries with insufficient data processing and publishing capacity, data from various sources are often inconsistent. It is necessary to adjust data from these different sources to gain a consistent economywide data base. This adjustment process needs to fulfill certain criteria. Most important is the decision about the core data source, which determines the macrosam's control totals to which all other data will be reconciled and balanced. In the case of the Tanzania macrosam, the *Revised National Accounts of Tanzania 1987-1996*⁶ provides the control totals for the macrosam.

This latest version of the *National Accounts of Tanzania* incorporates a variety of other surveys conducted in recent years⁷ and some new economic features. Besides various household expenditure categories, the most important new feature is the estimate for informal sector activities. Formal GDP (f.c.) is current TShs 935,247 million, informal — or non-monetary — GDP (f.c.) is estimated at current TShs 340,668 million or 36.4 percent of total GDP (f.c.). The informal GDP component considers agriculture, construction, and owner-occupied dwellings and therefore not only provides general information on the informal sector share in total GDP — whose magnitude estimated by different authors ranges from 30 to more than 60 percent — but also allows the explicit specification of own-household consumption.

A second important data source is an unpublished supplementary data set which was used by the Bureau of Statistics for the preparation of the *Revised National Accounts 1987-1996*.⁸ Listing 79 economic sectors, this data set provides sector-specific information on gross output, intermediate demand, imports, tariffs, sales taxes, exports, private consumption,

⁶ Prepared by the Planning Commission at the President's Office, in cooperation with the Bureau of Statistics (BOS) in 1997.

⁷ Among which: The 1991/92 Household Budget Survey, the 1991 Informal Sector Survey, several Agriculture Surveys and the 1994 Survey of Construction, Trade and Transport.

⁸ This data set was made available through staff members of the *National Accounts Section* of the *Bureau of Statistics* in Dar es Salaam.

government consumption, investment, and changes in inventory, which are used as control totals for the Tanzania macrosam and as source of information for the disaggregated microsams.

Table 1 is a schematic diagram which introduces the different features and functionality of the macrosam. The macrosam specifies two government accounts: *Government Recurrent* and *Government Investment*. The former deals with the recurrent budget activities of the government while the latter deals with the development (or investment) budget activities of the government. In the case of the Tanzania SAM, the development budget considers all government expenditures that are related to gross fixed capital formation. Keeping two separate accounts guarantees more flexibility for upcoming modeling purposes where government might boost the national level of infrastructure through increased investment spending. Two additional tax collection accounts are specified which capture the entire national tax scheme at macroeconomic level.⁹ Table 2 presents the Tanzania macrosam for 1992 in million of current TShs, which is used as the macroeconomic point of reference for the construction of the 1992 Tanzania microsams.

⁹ These two tax accounts are pure auxiliary accounts for the collection of different taxes within the economy which then are transferred to government. In the commodity account column they enable the distinction between sales taxes and tariffs which otherwise would have to be combined into one payment from “Commodities” to “Government Recurrent.”

Table 1: Macroeconomic Social Accounting Matrix (MACROSAM)

	Activities	Commodities	Factors	Households	Enterprises	Domestic Taxes	Tariffs	Government Recurrent	Government Investment	Rest of the World	Capital Account	Total
Activities		Domestic Supply		Own HH Consump.						Exports f.o.b.		Total Sales
Commodities	Intermediate Demand			Final HH Consump.				Final Gov. Consump.	Government Investment		Private Investment	Domestic Demand
Factors	Value-Added											Value-Added (f.c.)
Households			VA Labor		Operating Surplus					Remittances from Abroad		Household Income
Enterprises			VA Capital					Government Transfers				Enterprise Income
Domestic Taxes	Indirect Taxes	Sales Tax										Dom. Taxes Subtotal
Tariffs		Import Tariffs										Import Tariffs
Government Recurrent				Income Taxes	Corporate Taxes	Indirect & Sales Taxes	Import Tariffs			Aid-related Grants		Recurrent Gov. Receipts
Government Investment								Gov. Invest. Deficit		Aid-related Loans		Financing Gov. Invest.
ROW		Imports c.i.f.	Factor Paym. abroad					Interest Paym. to ROW				Payments to ROW
Capital Account				HH Savings	Enterprise Savings			Gov. Savings		Net Capital Inflow		Total Savings
Total	Gross Output	Domestic Absorption	Value-Added (f.c.)	HH Expenditure	Enterprise Expenditure	Dom. Tax Subtotal	Import Tariffs	Gov. Recurr. Expenditure	Gov. Invest. Expenditure	ForEx available	Total Private Investment	

Table 2: Tanzania macrosam for 1992 in current million TShs

	Activities	Commo- dities	Factors	Households	Enterprises	Domestic Taxes	Tariffs	Government Recurrent	Government Investment	Rest of the World	Capital Account	Total
Activities		2,320,484		273,340						165,682		2,759,506
Comm.	1,276,427			913,213				279,080	52,521		419,532	2,940,773
Factors	1,456,047											1,456,047
Households			841,879		368,663					96,755		1,307,296
Enterprises			550,669					27,620				578,289
Dom. Taxes	27,032	43,475										70,507
Tariffs		23,451										23,451
Gov. Rec.				16,656	65,054	70,507	23,451			172,671		348,339
Gov. Inv.								34,957		17,564		52,521
ROW		553,363	63,499					24,250				641,112
Capital Acc.				104,087	144,572			-17,568		188,440		419,532
Total	2,759,506	2,940,773	1,456,047	1,307,296	578,289	70,507	23,451	348,339	52,521	641,112	419,532	

2.1. Data sources for the macrosam

The following list of publications provides an overview of the major data sources used in the construction of the macrosam 1992 as presented in Table 2 and documented in the next section:

Bank of Tanzania (1997): *Economic Bulletin for the Quarter Ended 31st March, 1997*, Vol. XXV No.1, Dar es Salaam.

Economic Research Bureau (1996): *Tanzanian Economic Trends - A Bi-annual Review of the Economy*, Vol.8 No.1 and 2, University of Dar es Salaam, Dar es Salaam.

International Monetary Fund. 1996. *Tanzania Statistical Appendix*. IMF Staff Country Report No, 96/2. Washington, D.C.: International Monetary Fund.

The Economist Intelligence Unit (1996): *County Profile: Tanzania / Comoros 1995-96*, London.

The United Republic of Tanzania (1997): *Revised National Accounts of Tanzania 1987-1996*, Dar es Salaam.

The United Republic of Tanzania (1996): *Household Budget Survey 1991/92*, Vol. IV, Dar es Salaam.

The United Republic of Tanzania (1995): *Revised National Accounts of Tanzania 1976-1990*, Dar es Salaam.

The United Republic of Tanzania (1995): *National Accounts of Tanzania 1976-94*, Dar es Salaam.

The United Republic of Tanzania (1993): *Labour Force Survey 1990/91*, Dar es Salaam.

The World Bank (1996): *Tanzania - The Challenge of Reforms: Growth, Incomes and Welfare*, Vol. II.

2.2. Documentation of macrosam cell entries

The notation for the cells of the macrosam cells is row, column. For example, “Commodities, Activities” represents an expenditure flow from the column “Activities” to the row “Commodities.” Note that Tanzania’s financial year ends on June 30 and thus all data collected as financial year data have to be estimated for 1992 by computing the averages of 1991/92 and 1992/93 figures.

1. (Commodities, Activities): 1,276,427 — Import-ridden intermediate demand. Total intermediate demand including imports as from unpublished BOS data sources adjusted by other indirect production taxes (Domestic Taxes, Activities).

2. (Factors, Activities): 1,456,047 — Value-added at factor costs. Total value-added at factor costs as in Table 6(a) of *URT (1997): Revised National Accounts of Tanzania 1987-1996* adjusted accordingly to supplementary data to the *Revised National Accounts of Tanzania 1987-96*.

3. (Domestic Taxes, Activities): 27,032 — Other indirect taxes. Other indirect taxes are calculated as a residual of total net taxes on products as in Table 6(a) of *URT (1997): Revised National Accounts of Tanzania 1987-1996* and tariffs and sales taxes as provided by the supplementary data to the *Revised National Accounts of Tanzania 1987-96*.

4. (Activities, Commodities): 2,320,484 — Domestic supply. Domestic supply is computed as the residual of the “Activities” column total (equal to gross output including informal sector activities) minus exports (Activities, ROW) and own-household consumption (Activities, Households).

5. (Domestic Taxes, Commodities): 43,475 — Sales taxes. Total sales tax as provided by the supplementary data to the *Revised National Accounts of Tanzania 1987-96* and double-checked with data from Table 2.1 of *Bank of Tanzania (1997): Economic Bulletin 1st/97*, Dar es Salaam.

6. (Tariffs, Commodities): 23,451 — Import duties. Total import duties as provided by the supplementary data to the *Revised National Accounts of Tanzania 1987-96*.

7. (ROW, Commodities): 553,363 — Imports of goods and services. Total imports of goods and services at f.o.b. prices as in Table 6(b) of *URT (1997): Revised National Accounts of Tanzania 1987-1996*, Dar es Salaam, adjusted by a 75 percent share of the

unrecorded trade and statistical discrepancy (TShs 19.023 million) — the remaining 25 percent are considered within the computation of total exports.

8. (Households, Factors): 841,879 — Labor value-added. Total labor value-added will be generated for the microeconomic SAM¹⁰ using the *URT (1993): Labour Force Survey 1990/91, Dar es Salaam* (LFS 1990/91). For the macrosam it is set at 60 percent of total value-added adjusted for 50 percent of net factor payments abroad (ROW, Factors).¹¹

9. (Enterprises, Factors): 550,699 — Value-added capital. Total value-added capital — including operating surplus and consumption of fixed capital — as a residual of total factor payment (Factors, Activities) minus labor value-added (Households, Factors) and adjusted for 50 percent of net factor payments abroad.

10. (ROW, Factors): 63,499 — Net factor income paid abroad. Total net factor income paid abroad as calculated from Table 1 of the *URT (1995): National Accounts of Tanzania 1976-94, Dar es Salaam*. The difference between GDP (f.c.) and GNP (f.c.) as a ratio to GDP (f.c.) (all 1992) is applied to the new GDP (f.c.) figure as in cell “Factors, Activities.”

11. (Activities, Households): 273,340 — Own-household consumption. Total own-household consumption of agricultural products as the equivalent of total non-monetary agriculture GDP as in Table 1 of *URT (1997): Revised National Accounts of Tanzania 1987-1996, Dar es Salaam*.

12. (Commodities, Households): 913,213 — Final household consumption. Total final household consumption as in Table 6(a) of *URT (1997): Revised National Accounts of Tanzania 1987-1996, Dar es Salaam*, minus *own-household consumption* as in cell “Activities, Households” and adjusted accordingly to the supplementary data to the *Revised National Accounts of Tanzania 1987-96*.

13. (Government Recurrent, Households): 16,656 — Individual income taxes. Total individual income taxes paid by households as in Table 2.1 of *Bank of Tanzania (1997): Economic Bulletin 1st/97, Dar es Salaam*. Income taxes, other taxes, and non-tax revenue are

¹⁰ A detailed description of the computations carried out for the generation of all value-added figures in the microsam is presented in the following section.

¹¹ See the discussion of the value-added split to labor, land, and capital under paragraph 2 (Factors, Activities) of the microsam documentation in section 3.

combined into one figure and shared between households and enterprises according to their relative shares in 1990 as reported in Table 5.2 of *World Bank (1996): The Challenge of Reforms, Vol. II, Washington, D.C.*

14. (Capital Account, Households): 104,087 — Household savings. Total household savings as a residual for balancing purposes.

15. (Households, Enterprises): 368,663 — Operating surplus. Operating surplus distributed to households is calculated as the residual of total receipts of the enterprise account — value-added capital plus government transfers to enterprises — minus enterprise savings (Capital Account, Enterprises) and corporate taxes (Government Recurrent, Enterprises).

16. (Government Recurrent, Enterprises): 65,054 — Corporate taxes. Total corporate taxes paid by enterprises as in Table 2.1 of *Bank of Tanzania (1997): Economic Bulletin 1st/97, Dar es Salaam*. As described under paragraph 13, income taxes, other taxes, and non-tax revenue are combined into one figure and shared between households and enterprises according to their respective shares as from fiscal year 1990 information in Table 5.2 of *World Bank (1996): The Challenge of Reforms, Vol. II, Washington, D.C.*

17. (Capital Account, Enterprises): 144,572 — Enterprise Savings. Total enterprise savings as chosen for balancing purposes. Since the transfer of operating surplus from enterprises to households — paragraph 15 above — is calculated as a residual of total enterprise receipts minus corporate taxes and enterprise savings, enterprise savings can vary. The less enterprises save the more operating surplus is transferred to households. Since household expenditure on own-household consumption, final commodity consumption, and income tax are given, household savings remains the balancing cell of the household account. As a result, the less enterprises save the more households have to save and *vice versa*. This mechanism is used to adjust household and enterprise savings to obtain reasonable economywide rates. However, the sum of enterprise savings and household savings match the reported magnitude of domestic private saving. As a percent of adjusted GDP (m.p.) for the fiscal years 1992 and 1993, these are 10.9 and 14.0 percent, respectively (IMF 1996).

18. (Government Recurrent, Domestic Taxes): 70,507 — Domestic tax collections. Total domestic tax collections of net indirect taxes (Domestic Taxes, Activities) and sales tax (Domestic Taxes, Commodities) paid to the government account.

19. (Government Recurrent, Tariffs): 23,451 — Import duties collections. Total import duties collections (Tariffs, Commodities) paid to the government account.

20. (Commodities, Government Recurrent): 279,080 — Government consumption. Total final government consumption as in the supplementary data to the *Revised National Accounts of Tanzania 1987-96*.

21. (Enterprises, Government Recurrent): 27,620 — Government transfers to enterprises. Domestic government interest payments as reported for the financial years 1992 and 1993 in Table 11 of the *Tanzania Statistical Appendix*, IMF Staff Country Report No. 96/2, adjusted in accordance with the applied final government consumption figure of the macrosam.

22. (Government Investment, Government Recurrent): 34,957 — Government investment account deficit. Non-foreign financed government spending within the development budget to balance the government investment account of the macrosam.

23. (ROW, Government Recurrent): 24,250 — Government transfers to ROW. Foreign interest payments by the government as reported for the financial years 1992 and 1993 in Table 11 of the *Tanzania Statistical Appendix* of the IMF Staff Country Report No. 96/2, adjusted in accordance with the applied final government consumption figure of the macrosam.

24. (Capital Account, Government Recurrent): -17,568 — Government deficit. Total government deficit of recurrent government budget as a residual of total government revenue (Government Recurrent, Total) minus government consumption (Commodities, Government Recurrent), government transfers to enterprises, the balancing position of the government investment account, and government transfers to ROW.

25. (Commodities, Government Investment): 52,521 — Gross fixed capital formation (GFCF) by the government. Total GFCF by the government corresponding to government investment under the developing budget as in Table 5 of the statistical annex of *Economic Research Bureau (1996): Tanzanian Economic Trends - A Bi-annual Review of the Economy, Dar es Salaam*.¹² The figure is adjusted to match the higher total GFCF applied in the macrosam.

26. (Commodities, ROW): 165,682 — Exports of goods and services. Total exports of goods and services at c.i.f. prices as in Table 6(b) of *URT (1997): Revised National*

¹² Since parastatals in this data base are not explicitly distinguished from private sector activities, the GFCF of parastatals as stated in the *Tanzanian Economic Trends* are combined with the private sector GFCF and *not* with the GFCF financed by the government.

Accounts of Tanzania 1987-1996, Dar es Salaam, adjusted by the remaining 25 percent share of the *unrecorded trade and statistical discrepancy* (TShs 19,023 million).

27. (Households, ROW): 96,755 — Remittances. Net direct transfers to households from abroad as computed from Table 4.4 of *Bank of Tanzania (1997): Economic Bulletin 1st/97, Dar es Salaam*, with respect to the relative household share of transfer inflows. This figure probably contains a large share of grants to NGOs which are assumed to be part of households.

28. (Government Recurrent, ROW): 172,671 — Transfers to government from abroad. Net direct transfers to government from abroad as computed from Table 4.4 of *Bank of Tanzania (1997): Economic Bulletin 1st/97, Dar es Salaam*, with respect to the relative government share of transfer inflows. This figure represents primarily foreign aid with a considerable grant component including recurrent government budget support.

29. (Government Investment, ROW): 17,564 — Other transfers to government. Net official sector capital flows in US\$ as in Table 23 of the reference tables in *The Economist Intelligence Unit (1996): County Profile: Tanzania / Comoros 1995-96, London*, applying the exchange rate reported in this publication.

30. (Capital Account, ROW): 188,440 — Net capital inflow. Net capital inflow from *Rest of the World* — not elsewhere specified in the ROW column — as a residual to balance the macroeconomic reference data base and the implicitly generated current account.

31. (Commodities, Capital Account): 419,532 — Net private investment. Total private investment as in the supplementary data to the *Revised National Accounts of Tanzania 1987-96* including *changes in inventory* as in the same data set, adjusted for government investment as described in paragraph 24 (Commodities, Government Investment).

3. Microeconomic social accounting matrix (microsam)

This section describes the disaggregation of the microsam, the choice of data sources, the data manipulation carried out, and the estimation process for balancing the microsam. The documentation follows the section on the macrosam. The same numbering and notation is used for the description of the protosam and microsam entries, although in most cases it is not a single cell entry anymore, but a vector or matrix of entries depending on the disaggregation of the respective macrosam accounts. All crucial calculations, distributions, and data adjustments to estimate the protosam are documented. The cross-entropy approach for estimating the final microsam from the basis of the constructed protosam is discussed, including the implementation in the General Algebraic Modeling System (GAMS) program. In the following section the disaggregation of the microsam is described.

3.1. The disaggregation of the microsam

For the construction of the microsam the activity and commodity accounts of the macrosam are disaggregated into 56 and 55 sectors respectively. Three additional commodity accounts are created to capture different marketing margins for exports, imports, and domestically produced and consumed goods. Since the analytical focus of the underlying study is on agriculture, 21 activities are agricultural. The disaggregation of activities and commodities is based on the 72-sector listing given by the Revised National Accounts of Tanzania 1976-90 which is the same disaggregation that is used for the 1976 I-O Table. In addition, the activity *Tourism* is created to capture this fast growing sector of the Tanzanian economy.¹³ Since the entire gross output of this sector is supposed to be exported, *no* commodity account for *Tourism* had to be created.

The microsam distinguishes six typical export crop activities (*Cotton, Sisal, Tea, Coffee, Tobacco, and Cashew Nuts*), five cereals (*Maize, Wheat, Paddy, Sorghum, and Other Cereals*), *Pulses*, two drought-resistant staple crops (*Cassava and Other Roots*), *Oil Seeds, Sugar, Other Horticulture, Other Crops, Livestock, Fishing*, and finally *Forestry & Hunting*. The non-agricultural sectors are *Mining*, 22 manufacturing sectors, *Electricity, Water, Construction*, and nine service categories including *Commerce, Transport & Communication, and Public Administration*.¹⁴

¹³ Tourism has been the largest foreign currency earning sector since the mid-1990s.

¹⁴ For a detailed listing of the applied sector disaggregation refer to section 3.2. *Accounts of the microsam*.

The factor disaggregation of the microsam follows the breakdown of labor categories in the Labour Force Survey 1990/91. The following five labor categories are chosen — their respective sub-components presented in parentheses: *Professionals* (administrators/managers, professionals, associate professionals), *White Collar* (clerks/cashiers, services/shops), *Blue Collar* (craft workers, machine operators), *Unskilled Labor* and *Agricultural Labor*. Additional factors of production are *Land* and *Capital*.

The disaggregation of households follows the *Household Budget Survey 1991/92 (HBS 91/92)* which provides detailed consumption data for *Urban Farm*, *Urban Non-Farm*, *Rural Farm* and *Rural Non-Farm* households. Since this categorization captures the desired distinction between rural and urban population and has been applied in many other data sources, it appears to be the most appropriate choice. All other institutional accounts of the microsam follow the macrosam.

3.2. Accounts of the microsam

Table 3: Accounts of the microsam

	Acc. Code	Description	Acc. Code	Description
AG-Sectors (Activities)	1 ACOTT	Cotton	2 ASISA	Sisal
	3 ATEA	Tea	4 ACOFF	Coffee
	5 ATOBA	Tobacco	6 ACASH	Cashew Nuts
	7 AMAIZ	Maize	8 AWHEA	Wheat
	9 APADD	Paddy	10 ASORG	Sorghum
	11 AOCER	Other Cereals	12 ABEAN	Beans
	13 ACASS	Cassava	14 AROOT	Other Roots & Tubers
	15 AOILS	Oil Seeds	16 ASUGA	Sugar
	17 AOHOR	Other Horticulture	18 AOCRO	Other Crops
	19 ALIVE	Livestock	20 AFISH	Fishery
	21 AFOHU	Forestry & Hunting		
NON-AG Sectors (Activities)	22 AMINE	Mining	23 AMEAT	Meat & Dairy Prod.
	24 AFOOD	Processed Food	25 AGRAI	Grain Mill Products

	Acc. Code	Description	Acc. Code	Description
	26 ABEVT	Beverages	27 ATEXT	Textiles nes.
	28 AWEAR	Wearing Apparel	29 ALEAT	Leather Products
	30 AWOOD	Wood & Wood Prod.	31 APAPE	Paper & Printing
	32 ACHEM	Other Chemicals nes	33 AFERT	Fertilizer & Pesticides
	34 AFUEL	Petroleum Refineries	35 ARUBB	Rubber Products
	36 APLAS	Plastic Products	37 AGLAS	Glass Products
	38 ACEME	Cement, Clay, etc.	39 AIRON	Iron & Steel
	40 AFMPR	Manu. of Metal prod.	41 AMAEQ	Machinery Equipment
	42 AELEQ	Electrical Equipment	43 ATREQ	Transport Equipment
	44 AOMAN	Other Manufactures	45 AELEC	Electricity
NON-AG (cont.)	46 AWATE	Water	47 ACNST	Construction
	48 ATRAD	Wholesale & Retail	49 AHORE	Hotels & Restaurants
	50 ATR_C	Transport & Comm.	51 AFL_I	Financial Institutions
	52 AREAL	Real Estate	53 ABUSI	Business Services
	54 APUBA	Public Administration	55 AOSER	Other Services
	56 ATOUR	Tourism		
<p>The same sector disaggregation as for activities applies to the respective commodity accounts — except for Tourism (ATOUR). In addition, three marketing margin accounts are specified under commodities.</p>				
Marketing Margin (MM) Acc. (Commodities)	112 CCOME	Export MM	113 CCOMD	Domestic MM
	114 CCOMI	Import MM		
Factors of Production	115 UPRO	Professional labor	116 UWCO	White collar labor
	117 UBCO	Blue collar labor	118 UNSK	Unskilled labor
	119 RURA	Agricultural labor	120 LAND	Land
	121 CAPITAL	Capital		
Households	122 HHUFA	Urban Farmers	123 HHUNF	Urban Non-Farmers

	Acc. Code	Description	Acc. Code	Description
	124 HHRFA	Rural Farmers	125 HHRNF	Rural Non-Farmers
Other Institutional Accounts	126 ENTR	Enterprises	127 ITAX	Domestic Indirect Taxes
	128 TTAX	Tariffs	129 GOVR	Government Recurrent
	130 GOVI	Government Investment	131 WORLD	Rest of the World
	132 KACCOU	Capital Account	133 DST	Change in Inventory

Note that: AG = Agriculture, NON-AG = Non-Agriculture, nes. = not elsewhere specified

3.3. Documentation of data entries in the microsam

Following the documentation in the macrosam chapter, each corresponding cell entry, vector or sub-matrix of the microsam is discussed. Data sources are presented which provide clean data, raw data or structural information for data adjustments. Decisions for data manipulations are justified in this section as well.

1. (Commodities, Activities): To derive the intermediate demand matrix of the microsam, normalized input-output coefficients — coefficients of the intermediate demand sub-columns add up to one — are applied to sectoral intermediate demand figures, given by the supplementary data to the *Revised National Accounts for Tanzania 1987-96*. The applied coefficients are adjusted values of the 1976 input-output table of Tanzania, the most recent available source of information. Consequently, the general production technology and economic structure which is assumed to characterize the Tanzanian economy is that of 1976. It provides a starting point (“prior”) for the protosam and determines the estimation of the final technology of the microsam.

Because the 1976 input-output table covers domestically produced intermediates only and contains tax and subsidy information that does not match with the economic characteristics of the early 1990s, the coefficients have to be adjusted. Since the structure of subsidies changed completely between the mid 1970s to the early 1990s¹⁵ the respective coefficients are netted out and thus subsidies are removed from the system.

To adjust the (domestic) intermediate demand coefficients for imported intermediate demands, an import matrix is developed. Control totals for total imports per commodity are provided in the *Revised National Accounts* — see also paragraph 7 (ROW, Commodities).

¹⁵ In 1976 the share of subsidies in “Taxes on Production and Imports” was 5.6 percent and in 1990 only 1.4 percent (URT 1990b).

Shares of investment demand (capital goods), household and government demand (consumer goods), and intermediate demand for imports are derived from Table 3.5 of the most recent World Bank (1996) Country Report on Tanzania.¹⁶ On the basis of the domestically produced intermediate demand for each commodity with (strictly positive) imported intermediate demand, row coefficients are calculated and applied to imported intermediate demand totals. Imported intermediate demand is further adjusted using information from Balsvik and Brandemoen (1994), who compile intermediate demand use of imports for some crops on the basis of the annual crop reviews by the Marketing Development Bureau. The derived imported intermediate demand matrix is eventually combined with the matrix of domestically produced intermediate demands to obtain the “total” coefficients.

Since the Revised National Accounts provides information on total intermediate demand of sector products¹⁷ row coefficients are calculated from the intermediate demands and applied to these control row totals. This technique ensures the consistency of sectoral production and absorption data, and also guarantees the correct magnitude of the total intermediate demand matrix.

The derived structure of the intermediate input matrix is translated into final (sub-) column coefficients which can be applied to sectoral figures for total intermediate demand by sector. Since the supplemental information on the latest national accounts publication distinguishes total expenditure on inputs and value-added, the two sub-technologies — intermediate use and generation of value-added — can be applied separately instead of applying the entire sector technology to the respective gross output.

For sectors with indirect taxes (Domestic Taxes, Activities), the intermediate demand entries of the respective column entries are reduced relatively, so that the sum of intermediate demand and indirect taxes meet the *Revised National Accounts of Tanzania 1987-96* information.

2. (Factors, Activities): Information on GDP (f.c.) per sector is provided by supplementary data to the *Revised National Accounts of Tanzania 1987-96*. Data from the *Labour Force Survey 1990/91* is used to calculate the value-added paid to the different labor factors. First, the survey provides detailed information on sectoral employment for 9 different labor categories — for urban and rural areas respectively — which have been aggregated to the 5 categories used in the microsam. Second, the survey differentiates primary and secondary occupations, including their respective average weekly working time in hours.

¹⁶ *The Challenge of Reforms: Growth, Incomes and Welfare*, Vol. II, p. 21.

¹⁷ This is the intermediate use of a sectoral output by all sectors of the economy — e.g. total intermediate use of cotton by all productive activities including cotton itself — and it is *not* the total intermediate use of inputs by the cotton sector.

Third, average monthly wages for the different labor categories for rural and urban areas are derived from the survey.¹⁸ This employment and wage information is used to compute a sector-specific spread of total labor value-added among the different labor categories. Subsequently, the sum of value-added to land and capital for each sector is calculated as the residual of sectoral GDP (f.c.) and total labor value-added. Since information on the spread between land and capital value-added is not available, 40 percent is arbitrarily allocated to land and 60 percent to capital, following general practice in the literature.¹⁹

3. (Domestic Taxes, Activities): Indirect taxes related to the production process are calculated through their respective input-output coefficients.²⁰ The coefficients are applied to the sectoral gross output figures given by supplementary data to the *Revised National Accounts of Tanzania 1987-96* and subsequently adjusted to match total *other indirect taxes* as specified in the macrosam.

4. (Activities, Commodities): The entries of the main diagonal of this matrix represent the domestic supply of domestically produced goods. The off-diagonal entries are zero for all commodity accounts, because the present SAM does not include multi-commodity producing activities nor multiple activities producing the same commodity. In other words, each activity produces exactly one good, which is exclusively supplied to its commodity market.²¹ However, three marketing margin accounts are introduced to capture the transportation and marketing costs related to each commodity. Since the national accounts statistics of Tanzania categorize transportation and marketing costs for all commodities with the retail sector, the share of final demand for the retail sector is about 14 percent of total

¹⁸ Many economic activities in low income countries like Tanzania are carried out as secondary occupations by employees who either have a primary paid job or carry out an unpaid (mostly self-employed) main activity (e.g. farming).

¹⁹ Information on the primary factor splits for agriculture derived by the Global Trade Analysis Project (GTAP) of the Center for Global Trade Analysis, Purdue University, indicates a 15:60:25 split of agricultural value-added between land, labor, and capital for Sub-Saharan African countries (Republic of South Africa and Republic of Zimbabwe). Consequently, a 40:60 split of non-labor value-added between land and capital appears reasonably close to the reported 15:25 — this is 37.5:62.5 — split of the GTAP data.

²⁰ As mentioned earlier, the applied coefficients are adjusted for their respective subsidy coefficients — these used to be substantial shares of gross output in 1976 but accounts for only one percent of GDP (f.c.) in 1990.

²¹ The only exception is the activity account for *Tourism* which does not have a commodity account since all of its produce is exported and none enters the domestic market.

final demand. Consequently, each commodity is associated with a certain amount of transportation and marketing costs of the retail sector for its “delivery” to the destination of its final demand. Therefore, each commodity account buys its relevant transport and marketing costs out of the three marketing margin accounts, depending on its shares of domestic, imported or exported production. Simultaneously, all final consumption and investment demands are adjusted for these additional costs and in turn, the final demand for retail (the commodity CTRAD) is eliminated. To balance the three marketing margin accounts their totals are bought out of the activity account *Trade* (ATRAD). The remaining flow from the commodity trade to the activity trade account (ATRAD, CTRAD) represents the part of gross output in trade that enters the domestic market for intermediate demand. The supply of domestic produce entries are obtained by subtracting own-household consumption and exports — as described in the paragraphs 10 and 26 below — from total sectoral gross output (obtained from previous calculations).

4.a. (Commodities, Commodities): All commodity accounts showing marketing margins for domestic produce and/or imports buy their marketing margin values out of the respective marketing margin commodity accounts (CCOMD and CCOMI).²² That way final household and investment demand for trade is eliminated and each commodity is associated with its own marketing margin.

5. (Domestic Taxes, Commodities): Sales taxes are directly adopted from supplementary data to the *Revised National Accounts of Tanzania 1987-96*.

6. (Tariffs, Commodities): Tariffs are directly adopted from supplementary data to the *Revised National Accounts of Tanzania 1987-96*.

7. (ROW, Commodities): Import values for all 55 commodities are obtained from sectoral information in the supplementary data to the *Revised National Accounts of Tanzania*

²² The marketing margin flow for exports is considered under paragraph 1 (Commodities, Activities) since activities buy the marketing margin flow associated with their export component out of the marketing margin account “CCOME.” This practice follows the assumption that exports are reported in F.O.B. prices including their respective marketing margin. Since exports (at F.O.B. prices, including marketing margins) are bought out of activities (Activities, ROW), but the activity columns usually report on gross output at farm/factory gate prices (excluding marketing margins), the marketing margins for exports have to be incorporated somewhere in the production process (the column technology). However, this practice violates the clean definition of the column sum being sectoral gross output since the net gross output figure of each column is adjusted by its respective export marketing margin flow. Consequently, gross output for Trade (ATRAD) is adjusted for the sum of all export marketing margin flows and the ATRAD column entries are recalculated.

1987-96 and adjusted for the import control total given by Table 6 (a) of the *Revised National Accounts of Tanzania 1987-96*. The import control total is increased by 75 percent of the *Unrecorded Trade and Statistical Discrepancy* figure reported in this table.²³ Further adjustments are made for the sectors *Machinery Equipment* and *Other Manufacturing*. The two sectors show higher exports than gross output figures, which implies negative domestic supply of domestic produce. This phenomenon indicates re-exports of imported goods because the economy exports more than its produced gross output. The two export figures are netted out and their respective import figures are lowered by the equivalent values.

8. (Households, Factors): Labor Value-added is distributed to households according to the calculations described in paragraph 2 (Factors, Activities). The information on rural and urban employment allows the distribution of labor value-added to rural and urban households. Farm households (*HHRFA* and *HHUFA*) are assumed to be endowed with the factor *Farming Labor (RURA)* and non-farm households (*HHRNF* and *HHUNF*) are endowed with the remaining four labor factors. Consequently, household shares for each labor factor are calculated and applied to the respective total value-added by factor. The obtained distribution of labor value-added among household groups for the microsam — after applying the cross-entropy balancing approach — is reported in Table 3. Note that *Professional Labor (UPRO)* value-added is decreased by 50 percent of *Net Factor Income Paid Abroad* as specified in paragraph 10 (ROW, Factors).²⁴ Furthermore, distribution of *Agricultural Labor (RURA)* value-added to non-farm households (*HHUNF* and *HHRNF*) results from *Total Agricultural Own-Household Consumption* of the respective household.²⁵ Total land value-added is distributed to rural and urban farm households according to their relative labor income.

²³ The remaining 25 percent is deducted from total exports.

²⁴ The remaining 50 percent of *Net Factor Income Paid Abroad* is deducted from the operating surplus paid from enterprises to households.

²⁵ The non-farm households are assumed to have no *Agricultural Labor* endowment and should therefore not be considered in its value-added distribution. Nevertheless, most of the non-farm households — although not commercially involved in agriculture — carry out some non-commercial farming for own-household consumption which is reported by the *HBS 91/92*. This production volume is assumed to be also considered in the informal sector GDP reported by the *Revised National Accounts of Tanzania 1987-96* and as such being part of value-added to *Agricultural Labor*.

**Table 4: Distribution of Labor Value-Added
Values and Shares per HH Group in Million TShs & Percent**

	UPRO	UWCO	UBCO	UNSK	RURA	Total	in %
HHUFA	0	0	0	0	102,,358	102,358	12.1
HHUNF	62,914	58,158	111,930	52,966	5,721	291,689	34.6
HHRFA	0	0	0	0	402,218	402,218	47.7
HHRNF	20,809	4,595	10,255	4,254	7,519	47,432	5.6

9. (Enterprises, Factors): Total capital value-added — net of 50 percent of *Net Factor Income Paid Abroad* — is transferred to enterprises for further distribution. The enterprise account represents all productive enterprises in the economy and acts as a collecting point for total capital value-added. Besides value-added capital, the enterprise account receives transfers from the government. On the expenditure side, the enterprise account pays corporate taxes to the government, enterprise savings to the capital account, and distributes the remaining “operating surplus” to households (as described in paragraphs 14 to 16).

10. (ROW, Factors): Total net factor income is paid abroad as described in paragraph 10 of the macrosam documentation. Since there is no information on which part of this factor payment is related to labor or capital, half of it is netted out from factor payments *Professional Labor* — considering the relative shares of different households — and half of it is netted out from factor payments *Capital*.

11. (Activities, Households): The disaggregation of *Own-Household Consumption* is calculated according to the respective household shares in *Own Produced Food* as provided by the *HBS 91/92*. The survey not only reports on total household shares of non-monetary food expenditures, but also reports on the commodity distribution of these expenditures for each household. The sum of own-household consumption and final household consumption has to match the sector control total for total consumption for each household given by the supplementary National Accounts data. Consequently, sector-specific coefficients are applied to these control totals, which are calculated on the basis of first estimates for the distribution of own and final household consumption.

Own-household consumption is a direct demand by private households for output of activities. The goods are produced by activities, but not fed through the commodity accounts to enter the domestic markets for intermediate or final consumption. The reason is that own consumption is assumed to be valued at producer prices, with no trade margins. In other

words, own-household consumption reduces sectoral gross output supplied to the domestic commodity market (as described under paragraph 4 (Activities, Commodities)).

The consideration of own-household consumption within the SAM framework captures agricultural subsistence demand, an extremely important feature of the Tanzanian economy. The incorporation of own-household consumption into the SAM is important for policy analysis of its effects on household income, effective consumption, and welfare. Usually, this kind of transaction is netted out within the *Production Consumption Process of a Household Production Unit* and appears neither on the income nor on the expenditure side. Consequently, reported income of small-scale farmers often is underestimated.

12. (Commodities, Households): Total private household consumption reported in the *Revised National Accounts of Tanzania 1987-1996* and adjusted for own-household consumption, is distributed among the four household groups according to (a) the sectoral distribution of total household consumption in 1992 given by the supplementary National Accounts data and (b) the relative commodity distribution among households given by the *HBS 91/92*. As described in the previous paragraph, the distribution of final household consumption is calculated in connection with household spending on own-household consumption. The coefficients which are derived from the first estimates of own and final household consumption are applied to the respective sector control totals. Since the relative sector spread of total household consumption gets distorted by this procedure, the relative shares of total consumption expenditure among households in the *microsam* differ from their shares in the *HSB 91/92* as is shown in Table 4.

Table 5: Final Household Consumption
Values and Shares per HH Group in Million TShs & Percent

	HHUFA	HHUNF	HHRFA	HHRNF	Total
HBS 91/92	136,563	197,244	348,782	27,527	710,116
in %	19.23	27.78	49.12	3.88	100.00
microsam	155,260	254,857	455,108	47,989	913,213
in %	17.0	27.9	49.8	5.3	100.00

13. (Government Recurrent, Households): Total individual income taxes, as computed in paragraph 13 of the *macrosam* documentation, are distributed among the four household groups according to their relative labor income. Each labor type is taxed with a specific rate. In 1992, the Tanzanian income tax scheme ranged from 0 to 30 percent of monthly taxable income, and permitted several deductions. The ratio of total individual income taxes over total labor value-added shows an average income tax rate of only 2.1

percent for the economy as a whole. The enormous difference between this *de facto* average income tax rate and the nominal income tax rates is partly due to the high share of small-scale agriculture and informal sector activities in the Tanzanian economy, which are not taxed at all. Furthermore, the efficiency in tax collection is affected by extremely low administrative and technical standards. As a result, it appears quite reasonable that *de facto* and nominal income tax rates show substantial differences.

A tax rate scheme is developed on the basis of a *Monthly Income Distribution of Government Employees According to the Individual Tax Rate Brackets* provided by the Tanzanian Income Tax Department. Although the sample contains government employees only (and thus does not represent the entire formal labor force of the economy) and the data reports on 1996 incomes, it delivers persuasive evidence for an extremely narrow range of effective income tax rates over all income brackets. For an aggregation of all nine income brackets to three brackets which represent the SAM labor categories (a) Professionals, (b) White and Blue Collar and (c) Unskilled and Rural Labor, the effective average income tax rates are 3.7, 3.4 and 1.1 percent, respectively. To guarantee a gradual progression across the three income groups in the microsam, tax rates of 5.0, 3.0 and 1.0 percent are applied to the respective income flows in the microsam. Finally, these rates are adjusted to match total individual income tax revenue of TShs 16,656 million for the fiscal year 1992. After the adjustment of the applied tax rates and the balancing procedure, the final income tax rates for the four household groups are 0.6, 1.0, 1.5, and 2.5 percent, respectively. Individual household rates, values, and shares of total income taxes are shown in Table 5.

Table 6: Individual Income Tax
Rates, Values and Shares per HH Group in Million TShs & Percent

	HHUFA	HHUNF	HHRFA	HHRNF	Total / Average
Rate in %	0.7	1.0	2.3	2.9	1.6
Value in TShs	1,258	2,845	11,011	1,542	16,656
Share in %	7.6	17.1	66.1	9.3	100.0

14. (Capital Account, Households): Saving shares for different household groups are derived from non-consumption expenditure information of Appendix 6 of the *HBS 91/92*. The saving shares and respective values for the four household groups after the balancing procedure are presented in Table 6.

Table 7: Household Savings
Rates, Values and Shares per HH Group in Million TShs & Percent

	HHUFA	HHUNF	HRFA	HHRNF	Total / Average
Rate in %	19.0	11.7	2.0	7.0	8.4
Value in TShs	36,476	33,923	9,443	3,603	83,446
Share in %	43.7	40.7	11.3	4.3	100.0

15. (Households, Enterprises): The distribution of operating surplus to households is calculated according to group-specific income-expenditure deficits that result after all household expenditures and all household incomes except capital income and remittances are taken into account. The operating surplus distributed to households is calculated as a residual of total enterprise receipts net of enterprise savings and corporate taxes.

16. (Government Recurrent, Enterprises): Since the microsam contains only one representative enterprise — as in the macrosam — no changes occur in total corporate taxes being paid by enterprises to recurrent government in the order of TShs 65,054 million as described earlier.

17. (Capital Account, Enterprises): Again, since the microsam contains only one enterprise account, no distribution of the macrosam figure for enterprise savings is necessary. However, after the balancing procedure total enterprise savings equals TShs 195,335 million.

18. (Government Recurrent, Domestic Taxes): Since there is no difference in the function of the intermediate tax collection accounts in the macrosam and the microsam, the flow from the intermediate tax account *Domestic Taxes* to the government account (representing the sum of all domestically collected taxes as described under paragraphs 3 and 5) is the same as described in the macrosam section.

19. (Government Recurrent, Tariffs): The same argument holds for the *Tariffs* account. The flow of total collected tariffs — as described in paragraph 6 — from the intermediate tax account *Tariffs* to the government account works the same way as described in the macrosam section.

20. (Commodities, Government Recurrent): Final government consumption follows the supplementary National Accounts information and consists of government demand for

Public Administration only. This specification assumes none or very little private demand for *Public Administration*²⁶ and that government consumes the major share and provides it to the public.²⁷

21. (Enterprises, Government Recurrent): Government transfers to enterprises as specified in the macrosam section remain a single cell entry and are fixed at their initial value of TShs 27,620 million after the balancing procedure.

22. (Government Investment, Government Recurrent): Government spending on the development budget remains one entry as specified in the macrosam counting for TShs 34,957 million after the cross-entropy.

23. (ROW, Government Recurrent): Government spending on foreign interest payments remains a single entry in the microsam as well and remains at TShs 24,250 million after the balancing procedure.

24. (Capital Account, Government Recurrent): Government saving in the microsam is calculated as the residual between total government revenue (that is the row total of the government account) and final government consumption, government transfers to enterprises, and the payments to the government investment account as described in paragraphs 20 to 22. Since the macro control totals of all government revenue categories and the macro control totals for all other government expenditure categories are constrained during the balancing procedure, the government deficit remains at its initial value of TShs -17,586 million. However, if the government recurrent account payment to the government investment account were eliminated, the government recurrent account would show a surplus of TShs 17,389 million and the government investment account a deficit of TShs -34,957 million.

25. (Commodities, Government Investment): Gross fixed capital formation by government as specified in the macrosam, and remains a single entry in the microsam, representing demand of construction at the same level as initialized.

²⁶ The SAM for Tanzania incorporates education and health services in *Public Administration*. The related private demand equals 2.5 percent of total government demand for *Public Administration*.

²⁷ There are two general practices to deal with public administration and government services. Either the government demand a bundle of commodities and provides these items to the public or the public administration activity does contain this consumption bundle as part of its intermediate demand. In latter case, the government has no final demand for any other item than public services produced under the public administration activity.

26. (Commodities, ROW): Export values for all 56 activities are obtained from sectoral information of the supplementary data to the *Revised National Accounts of Tanzania 1987-96* and adjusted for the export control total given by Table 6 (a) of the *Revised National Accounts of Tanzania 1987-96*. The export control total is reduced by 25 percent of the *Unrecorded Trade and Statistical Discrepancy* figure reported in Table 6 (a) as mentioned in paragraph 7. Furthermore, the sectoral adjustments for *Machinery Equipment* and *Other Manufacturing* as described in paragraph 7 are taken into account.

27. (Households, ROW): Remittances from abroad to the four household groups are distributed according to group-specific income-expenditure deficits as described for the distribution of operating surplus in paragraph 15 and remain at their initial level.

28. (Government Recurrent, ROW): Net direct transfers to government from abroad as described in the macrosam section remain at their initial level.

29. (Government Investment, ROW): Capital inflows from abroad supporting the government development budget as described in the macrosam section remain at their initial level.

30. (Capital Account, ROW): Net capital inflows from *Rest of the World* as described in the macrosam section changes to TShs 158,320 million after the balancing procedure.

31. (Commodities, Capital Account): Final private investment demand per sector as reported in the supplementary data to the *Revised National Accounts of Tanzania 1987-96* net of government investment in *Construction* (considered under the government investment account). As opposed to the procedure in the macrosam section, the values represent GFCF *only* and are net of changes in inventories, which are considered under a separate account as specified in paragraph 33 (Commodities, Change in Inventory).

32. (Change in Inventory, Capital Account): The flow represents the balancing of the *Change in Inventory* account through the *Capital Account*. The *Change in Inventory* account is not an explicit feature of the macrosam where GFCF and changes in inventory are combined. However, for later modeling purposes, these two flows are separated in the microsam.

33. (Commodities, Change in Inventory): Change in inventory demand per sector is as reported in the supplementary data to the *Revised National Accounts of Tanzania 1987-96* adding up to TShs 4,146 million.

Due to the above mentioned limitations and inconsistencies of the available data for the “SAM-making” process, the commodity columns and rows of the generated protosam are showing high deviations which make it difficult for the solver of the balancing program to find an optimal solution. To cope with this problem and to provide the solver with a better starting point, several adjustment are made. The input-output matrix is cleared of unreasonable entries, some negligible exports and imports are netted out from their respective counter flows, and activity columns or commodity rows are scaled up or down according to their sectoral excess demand or excess supply values. After this adjustment sub-routine the obtained protosam is balanced through the cross-entropy balancing procedure as described in section 3.4.

For detailed information on the microsam entries refer to Table A1 of the Annex. The new macrosam, which is recalculated after the balancing of the microsam using the cross-entropy estimation method, is presented in section 3.5, after the description of the cross-entropy approach.

3.4 Balancing the SAM using a cross-entropy approach²⁸

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

The SAM used so far is defined as a matrix T of monetary flows $T_{i,j}$ (a payment from account j to account i), representing receipts and expenditures of all economic agents. Following the convention of double-entry bookkeeping, total receipts and total expenditures of a particular agent i have to be equal, *i.e.* respective row and column sums are balanced:

²⁸ For a more detailed discussion of the cross-entropy approach to SAM estimation see Robinson, Cattaneo, and El-Said (Forthcoming).

$$y_i = \sum_j T_{i,j} = \sum_j T_{j,i} \quad (1)$$

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

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

In matrix notation it follows that:

$$y = Ay \quad (3)$$

Balancing a SAM is an underdetermined estimation problem using information from many sources and various years. The cross-entropy approach²⁹ allows the incorporation of errors in variables, inequality constraints, and prior knowledge about any part of the SAM — not just row and column sums. These features of the cross-entropy estimation technique allow great flexibility in incorporating specific information and implementing certain limits to which the estimation results are restricted. The general cross-entropy approach³⁰ is described by the following optimization problem

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

where \bar{A} is a coefficient matrix representing any (perhaps inconsistent and unbalanced) prior that was chosen as a starting point of the cross-entropy balancing process to achieve the

²⁹ Following information theory developed by Shannon (1948) and further developed by Theil (1967) the expectation of separate information values can be described as the expected information of data points: $-I(p:q) = -\sum_{i=1}^n \frac{p_i \ln p_i}{q_i}$, where q and p are prior and posterior probabilities regarding a set of

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

³⁰ As formulated by Golan, Judge, and Robinson (1994) to update an input-output table by solving for a new coefficient matrix A which minimizes the entropy difference between the underlying prior \bar{A} and the new matrix A .

desired new coefficient matrix A^* .³¹ The described problem is set up to minimize the entropy difference between the two coefficient matrices which becomes more obvious by rearranging it to

$$\min \sum_{i,j} A_{i,j}^* \cdot (\ln A_{i,j}^* - \ln \bar{A}_{i,j}) \quad (5)$$

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

$$\sum_{i,j} G_{i,j}^{(k)} \cdot T_{i,j} = \gamma^{(k)} \quad (6)$$

where $\gamma^{(k)}$ is the value of the aggregate and the T_{ij} 's are the microsam flows.

Measurement errors in variables can be incorporated into the system through

$$y = \bar{x} + e \quad (7)$$

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

$$e_i = \sum_w W_{i,w} \cdot \bar{v}_{i,w} \quad (8)$$

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

$$\sum_w W_{i,w} = 1 \quad \text{with} \quad 0 \leq W_{i,w} \leq 1 \quad (9)$$

For the purposes of the Tanzania microsam, a symmetric distribution around zero given lower and upper bounds is chosen, using three weights.³² Consequently, the optimization problem of minimizing the entropy difference now contains a term for the weights W

³¹ This means that the prior \bar{A} does *not* need to satisfy the model $y = \bar{A}y$, but the sum of its column coefficients adds up to one, *i.e.* $\sum_i \bar{A}_{i,j} = 1 \quad \forall j$.

³² Note that if the error distribution is symmetrically centered around zero and all weights are equal — as their initial prior values — the respective error equals zero.

$$\min \left(\sum_i \sum_j A_{i,j}^* \cdot (\ln A_{i,j}^* - \ln \bar{A}_{i,j}) + \sum_i \sum_w W_{i,w} \cdot \ln W_{i,w} \right) . \quad (10)$$

The explicit application of the cross-entropy estimation procedure on the Tanzania microsam contains a set of additional constraints that constrain various sums over sub-matrices of the SAM to their respective macro control totals. First, within activities, the sum over all factor payments is fixed to their aggregate value as specified in the macrosam. As a result, total GDP (f.c.) is constrained to its original value. Sectoral production may change within specified lower and upper limits which are imposed through the error specification, allowing shifts in relative sector shares of production in the economy.

Second, the foreign trade entries are constrained to their macro totals, although the relative commodity composition of imports and exports may change. Third, total final household, government, and investment demands are bound to their macro totals as reported in the *Revised National Accounts of Tanzania 1987-96* as well as total own-household consumption. Finally, total income taxes, sales taxes, other indirect taxes, tariffs, and total remittances to households from abroad are fixed at their macro totals. Some single-cell entries are locked to their initial values if the data source applied is reliable, such as government investment demand and factor payments abroad. For a detailed description of the imposed constraints, refer to the GAMS program presented in the Annex.

3.5. The new macrosam after the balancing procedure

The distribution of macroeconomic data according to the sector disaggregation of the microsam as described in section 3.3 and the cross-entropy estimation procedure to balance the protosam, as described in the previous section, leads to the final Tanzania microsam for 1992. The Tanzania microsam 1992 is presented in Table A1 of the annex. The sector-specific structure of the economy can be seen from Table A2 of the annex. After obtaining the final microsam the final macrosam is aggregated. This allows the comparison between initial and final macroeconomic structure and points out the changes that took place during the balancing procedure. The obtained values of the new macrosam are presented in Table 7 including their respective changes from the initial macrosam.

Table 8: New macrosam for 1992 in current million TShs

	Activities	Commo- dities	Factors	Households	Enterprises	Domestic Taxes	Tariffs	Government Recurrent	Government Investment	Rest of the World	Capital Account	Total
Activities		2,440,513 +120,029		273,340						165,682		2,879,535
Comm.	1,396,456 +120,029	211,682 new		913,213				279,080	52,521		419,532	3,272,484
Factors	1,456,047											1,456,047
Households			884,150 +42,272		275,629 -93,033					126,875 +30,120		1,286,655
Enterprises			508,398 -42,272					27,620				536,018
Dom. Taxes	27,032	43,475										70,507
Tariffs		23,451										23,451
Gov. Rec.				16,656	65,054	70,507	23,451			172,671		348,339
Gov. Inv.								34,957		17,564		52,521
ROW		553,363	63,499					24,250				641,112
Capital Acc.				83,446 -20,642	195,335 +50762			(17,568)		158,320 -30,120		419,532
Total	2,879,535	3,272,484	1,456,047	1,286,655	536,018	70,507	23,451	348,339	52,521	641,112	419,532	

For the cross-entropy balancing procedure certain macroeconomic control totals are imposed as constraints. In other words, some cell entries and some sub-matrix totals of the proposed macrosam are fixed at their initial levels. In particular, this is true for:

- total value-added
- the three tax aggregates (other indirect taxes, sales taxes, and tariffs)
- the trade flows (total exports and imports)
- all aggregate final demand categories (household, government, government investment, and private investment demands as well as own-household consumption)
- total factor payments abroad
- corporate and total individual income taxes
- government transfers to enterprises and abroad
- transfers from abroad to the government (recurrent and investment accounts).

Consequently, the respective cells of the new macrosam do not show any changes compared to the initial macrosam. Other cells are not explicitly, but implicitly fixed. Since the government investment demand and the related inflow from abroad are fixed the balancing flow from government recurrent to government investment cannot change either. Consequently the government deficit is the last unconstrained cell of the government expenditure column, but since the totals of all government revenue sources are fixed, the government deficit is implicitly constrained.

Total intermediate demand (Commodities, Activities) remains unrestricted for the balancing process since it has to adjust to total value-added, which is increased to match total final consumption of the national accounts data. The macro total for intermediate demand increases by TShs 120,029 million including TShs 18,213 million for total marketing margins for exports. The net change accounts for 8.0 percent of the original value and the resulting change in total gross output accounts for 4.3 percent. According to the mechanism of the macrosam where domestic supply equals gross output minus exports and own-household consumption (which are both fixed), the change in the total domestic supply value is the same as the reported increase of total intermediate demand.

The new entry in the new macrosam (Commodities, Commodities) represents total import and domestic marketing margin values. In the protosam TShs 226,911 million are distributed from final demand for retail and wholesale trade (CTRAD) to the two marketing margin accounts for domestic products and imports. The final figure of TShs 211,682 million corresponds to a decrease of 6.7 percent.

The initially chosen distribution of total value-added into capital value-added paid to enterprises and non-capital value added paid directly to households changed by TShs 42,272

million, a 5.0 percent change from the initial factor payments to households. Total household savings are adjusted from TShs 104,087 million to TShs 83,446 million whereas enterprise savings increase from TShs 144,572 million to TShs 195,335 million. Households receive TShs 93,033 million less value-added capital distributed through enterprises and TShs 30,120 million more remittances from abroad. Consequently, the payments to the capital account from abroad decrease by latter amount.

References

- Bacharach, M. 1970. *Biproportional matrices and input-output change*. University of Cambridge, Department of Applied Economics. Cambridge: Cambridge University Press.
- Balsvik, R. and A. Brendemoen. 1994. *A computable general equilibrium model for Tanzania: Documentation of the model, the 1990 Social Accounting Matrix and Calibration*. Oslo-Kongsvinger: Statistics Norway.
- Bank of Tanzania. 1997. *Economic bulletin for the quarter ended 31st March, 1997*. Vol. XXV, No. 1. Dar es Salaam: BOT.
- Economic Research Bureau. 1996. *Tanzanian economic trends - A bi-annual review of the economy*, Vol.8, No.1 and 2. Dar es Salaam: University of Dar es Salaam.
- Golan, A. 1998. Entropy, Likelihood and Uncertainty: A Comparison. In Erickson, G. *Maximum entropy and Bayesian methods*, ed. G. Erikson. Kluwer Academic Publishers, forthcoming.
- Golan, A. and G. G. Judge. 1996. *A maximum entropy approach to empirical likelihood estimation and inference*. Working Paper Berkeley: University of California.
- Golan, A., G. G. Judge, and D. Miller. 1996. *Maximum entropy econometrics: Robust estimation with limited data*. New York: John Wiley & Sons.
- Golan, A., G. G. Judge, and S. Robinson. 1994. Recovering information from incomplete or partial multisectoral economic data. *Review of Economics and Statistics* 76:541-549.
- International Monetary Fund. 1996. *Tanzania statistical appendix*. IMF Staff Country Report No. 96/2. Washington, D.C.: International Monetary Fund.
- Mukherjee, N. and S. Robinson. 1997. Economic structure, trade, and regional integration in Southern Africa. In *Achieving food security in Southern Africa*, ed. L. Haddad. Washington, D.C.: International Food Policy Research Institute.
- Pyatt, G. and J. I. Round. 1985. *Social accounting matrices: A basis for planning*. Washington, D.C.: The World Bank.

- Robinson, S., A. Cattaneo, and M. El-Said. Estimating a Social Accounting Matrix Using Entropy Difference Methods. TMD Discussion Paper Series. Washington, D.C.: International Food Policy Research Institute, forthcoming.
- Rutayisire, L and R. Vos. 1991. *A SAM for Tanzania*. Working Paper Sub-Series on Money, Finance and Development No. 39. The Hague: Institute of Social Studies.
- Sarris, A. 1994. *A social accounting matrix for Tanzania*. Washington, D.C.: Cornell University Food and Nutrition Policy Program.
- Schneider, M. H. and S. A. Zenios. 1990. A comparative study of algorithms for matrix balancing. *Operations Research*, Vol. 38, pp. 439-55.
- The Economist Intelligence Unit. 1996. *County profile: Tanzania / Comoros 1995-96*. London: The Economist Intelligence Unit.
- The United Republic of Tanzania. 1997. *Revised national accounts of Tanzania 1987-1996*. Dar es Salaam: Bureau of Statistics.
- _____. 1996. *Household budget survey 1991/92*, Vol. IV. Dar es Salaam: Bureau of Statistics.
- _____. 1995a. *Revised national accounts of Tanzania 1976-1990*. Dar es Salaam: Bureau of Statistics.
- _____. 1995b. *National accounts of Tanzania 1976-94*. Dar es Salaam: Bureau of Statistics.
- _____. 1993. *Labour force survey 1990/91*. Dar es Salaam: Bureau of Statistics and Labour Department.
- The World Bank. 1996. *Tanzania - The challenge of reforms: Growth, incomes and Welfare*, Vol. II. Washington, D.C.: The World Bank.

Annex

TABLE A1: TANZANIA MICROSAM 1992 IN CURRENT TSHS MILLION

	ACOTT	ASISA	ATEA	ACOFF	ATOBA	ACASH	AMAZ	AWHEA	APADD	ASORG	AOCER	ABEAN	ACASS	AROOT	AOILS	ASUGA	AOHOR	AOCRO	ALIVE	AFISH	
ACOTT																					
ASISA																					
ATEA																					
ACOFF																					
ATOBA																					
ACASH																					
AMAZ																					
AWHEA																					
APADD																					
ASORG																					
AOCER																					
ABEAN																					
ACASS																					
AROOT																					
AOILS																					
ASUGA																					
AOHOR																					
AOCRO																					
ALIVE																					
AFISH																					
AFOHU																					
AMINE																					
AMEAT																					
AFOOD																					
AGRAI																					
ABEVT																					
ATEXT																					
AWEAR																					
ALEAT																					
AWOOD																					
APAPE																					
ACHEM																					
AFERT																					
AFUEL																					
ARUBB																					
APLAS																					
AGLAS																					
ACEME																					
AIRON																					
AFMPR																					
AMAEQ																					
AELFQ																					
ATREQ																					
AOMAN																					
AELFC																					
AWATE																					
ACNST																					
ATRAD																					
ATOUR																					
AHORE																					
ATR_C																					
AFL_I																					
AREAL																					
ABUSI																					
APUBA																					
AOSER																					
CCOTT																					
CSISA		0.080																			
CTEA																					
CCOFF				0.711																	
CTOBA					0.112																
CCASH							17.832														
CMAIZ								2.016													
CWHEA									10.726												
CPADD																					
CSORG																					
COCER										3.120											
CBEAN											1.030										
CCASS												6.975									
CROOT													0.801								
COILS														0.961							
CSUGA															2.923						
COHOR																9.449					
COCRO																	7.413				
CLIVE																		2.130			
CFISH					0.731											1.040			6.715		
CFOHU					0.813											1.186				5.448	
CMINE					0.590											0.902					
CMEAT																			0.042	0.034	
CFOOD																			0.813	0.636	
CGRAI																			0.440	0.351	
CBEVT																			1.892	1.476	
CTEXT																			0.880	0.682	
CWEAR	1.287			0.058	0.394	0.672	6.440	0.299	0.136	0.042	0.014	0.091	0.011	0.013	0.035		0.094	0.027	0.369	0.286	
CLEAT																					
CWOOD																					
CPAPE					0.218																
CCHEM	6.315		1.945	1.090	0.696	0.603	6.341	0.906	0.050	0.017	0.110	0.013	0.015	0.042	24.516		0.113	0.033			
CFERT	1.360		0.418	0.235	0.151	0.131	1.383	0.198	0.010	0.003	0.023	0.003	0.003	0.009	1.764		0.023	0.007			
CFUEL		0.114	0.008					0.811	0.105						1.253				0.006	0.005	
CRUBB																					
CPLAS																					
CGLAS																					
CCEME																					
CIRON																					
CFMMPR		0.307							0.065							2.345			0.102	0.081	
CMAEQ		0.046							0.011							0.312			0.015	0.012	
CELEQ																					
CTREQ		0.228	0.022	0.002																	
COMAN																0.037			0.052	0.042	
CELEC		1.635																			
CWATE		0.498																			
CCNST																					
CCOME			1.703	1.262	0.342	1.129	0.031					0.187			0.665		0.527	0.371	0.066		
CCOMD																					
CCOMI																					
CTRAD	0.162	0.303	0.338	0.047	0.069	0.004	0.568	3.380	0.396	0.004	0.001	0.010	0.001	0.001	0.004	3.790	0.010	0.003	0.505	0.404	
CHORE																					
CTR_C	0.644		0.074	0.108	0.217	0.047	3.879		3.782	0.031	0.010	0.068	0.008	0.010	0.026	14.982	0.070	0.020	0.150	0.120	
CFL_I	0.863	1.232	1.289	0.207	0.120	0.001	0.083		0.085	0.002	0.001	0.005	0.001	0.001	0.002	2.432	0.005	0.002	0.466	0.372	
CREAL																					
CBUSI																					
CPUBA																					
COSER																					
UPRO																					
UWCO																					
UBCO																					
UNSK																					
RURA	8.406	0.656	2.270	5.159	5.582	6.071	101.377	2.581	22.863	8.160	1.895	34.243	18.296	21.793	19.178	16.977					

TABLE A1: TANZANIA MICROSAM 1992 IN CURRENT TSHS MILLION (CONT.)

	AFOHU	AMINE	AMEAT	AFOOD	AGRAI	ABEVT	ATEXT	AWEAR	ALEAT	AWOOD	APAPE	ACHEM	AFERT	AFUEL	ARUBB	APLAS	AGLAS	ACEME	AIRON	AFMPR
ACOTT																				
ASISA																				
ATEA																				
ACOFF																				
ATOBA																				
ACASH																				
AMAZ																				
AWHEA																				
APADD																				
ASORG																				
ACOCER																				
ABEAN																				
ACASS																				
AROOT																				
AOILS																				
ASUGA																				
AOHOR																				
AOCRO																				
ALIVE																				
AFISH																				
AFOHU																				
AMINE																				
AMEAT																				
AFOOD																				
AGRAI																				
ABEVT																				
ATEXT																				
AWEAR																				
ALEAT																				
AWOOD																				
APAPE																				
ACHEM																				
AFERT																				
AFUEL																				
ARUBB																				
APLAS																				
AGLAS																				
ACEME																				
AIRON																				
AFMPR																				
AMAEQ																				
AELFQ																				
ATREQ																				
AMAN																				
AELC																				
AWATE																				
ACNST																				
ATRAD																				
ATOUR																				
AHORE																				
ATR_C																				
AFL_I																				
AREAL																				
ABUSI																				
APUBA																				
AOSER																				
CCOTT																				
CSISA																				
CTEA				0.743			3.538													
CCOFF				1.516			2.344													
CTOBA						11.243														
CCASH				1.238																
CMAIZ					34.508	9.184														
CWHEA				0.935	7.109															
CPADD					23.036															
CSORG																				
COCER						1.260														
CBEAN																				
CCASS																				
CROOT																				
COILS				1.140								0.133								
CSUGA				24.315																
COHOR				5.768																
COCRO				0.811	6.366															
CLIVE				1.358																
CFISH			1.943						1.917											
CFOHU	2.289	0.098	2.193																	
CMINE	0.014			1.169		2.408				4.723	0.788	0.118								0.015
CMEAT	0.261											0.326	0.011					1.165	8.057	
CFOOD	0.148							0.429												
CGRAI	0.605																			
CBEVT	0.273																			
CTEXT	0.120	0.414		1.147			0.736				0.018				0.004			0.001		
CWEAR																				0.661
CLEAT								3.285												0.252
CWOOD				0.994		2.003				1.256		0.781	0.028							
CPAPE		0.230	0.891	0.633	4.955	1.281				1.266	1.266	0.490	0.017	0.004	0.588	0.123	0.121	0.075	0.505	0.798
CCHEM		0.188		0.048		0.095		4.353	0.184	1.752	1.049	3.197		0.006						0.500
CFERT																				0.175
CFUEL	0.002	0.291	0.196	0.150	1.306	0.285	0.030	0.119	0.005	0.050	0.030	0.047	0.002	0.108	0.235	0.049	0.030	0.201	0.035	0.025
CRUBB										0.061					3.178					
CPLAS				0.709	1.454	0.061	0.253	0.011	0.098	0.062	0.856	0.030				2.170			0.054	0.036
CGLAS				0.248	0.516				0.032		0.288	0.010					0.412			
CCEME																		2.836		
CIRON																			20.631	10.638
CFMPR	0.034		1.595	1.136		2.322	0.521	0.101	1.005		0.745	0.026					0.126			0.223
CMAEQ	0.005		0.211	0.159	1.323	0.306	0.089	0.348	0.015	0.143	0.086	0.110	0.004	0.005	0.144	0.031	0.019	0.128		0.758
CELEQ			0.582	0.391	3.171	0.828	0.192	0.921	0.037	0.345	0.216	0.274	0.010	0.012	0.362	0.076	0.047	0.308		
CTREQ	0.018	0.150	0.101	0.076		0.148	0.046	0.180	0.008	0.073	0.045	0.060		0.043	0.211	0.027	0.182	0.107		
COMAN			0.041	0.346	0.079	0.023	0.090	0.004	0.037	0.021	0.028	0.001	0.001	0.036	0.008	0.005	0.033		0.759	
CELEC		0.975	1.556	1.068	7.550	2.059	0.479	2.206	0.095	0.895	0.541	0.659	0.024	0.024	0.666	0.142	0.087	0.563	0.536	0.396
CWATE		0.281	0.450	0.303		0.561	0.172	0.636	0.030	0.263	0.164	0.203	0.007	0.201	0.007	0.201	0.027	0.180	0.184	0.132
CCNST		0.099								0.052		0.387	0.014				0.011	0.073	0.008	0.008
CCOME	0.181		0.090	0.303		0.091	1.542	6.790	0.457	1.181	0.250				0.039	0.020	0.054	0.411		0.521
CCOMD																				
CCOMI																				
CTRAD	0.170	0.605	2.968	1.987	13.005	3.693	0.838	3.719	0.170	1.531	0.953	1.740	0.065	0.017	1.313	0.282	0.174	1.101	1.167	0.868
CHORE			1.344	0.957		1.951					0.391	0.726					0.069		0.502	0.365
CTR_C	0.050	0.970	2.336	1.572	10.444	2.944	0.240	1.071	0.049	0.442	0.272	0.804	0.030	0.015	1.042	0.224	0.138	0.877	0.402	0.298
CFL_I	0.156		5.367	3.399	18.409	5.768	2.163	8.799	0.456	3.754	2.495	2.305	0.091	1.304	2.619	0.577	0.357	2.150	1.266	0.960

TABLE A1: TANZANIA MICROSAM 1992 IN CURRENT TSHS MILLION (CONT.)

	AMAEQ	AELEQ	ATREQ	AOMAN	AELEC	AWATE	ACNST	ATRAD	ATOUR	AHORE	ATR_C	AFL_I	AREAL	ABUSI	APUBA	AOSER	CCOTT 3.538	CSISA 2.428	CTEA 4.702	CCOFF 4.047
ACOTT																				
ASISA																				
ATEA																				
ACOFF																				
ATOBA																				
ACASH																				
AMAZ																				
AWHEA																				
APADD																				
ASORG																				
ACER																				
ABEAN																				
ACASS																				
AROOT																				
AOILS																				
ASUGA																				
AHOR																				
AOCRO																				
ALIVE																				
AFISH																				
AFOHU																				
AMINE																				
AMEAT																				
AFOOD																				
AGRAI																				
ABEVT																				
ATEXT																				
AWEAR																				
ALEAT																				
AWOOD																				
APAPE																				
ACHEM																				
AFERT																				
AFUEL																				
ARUBB																				
APLAS																				
AGLAS																				
ACEME																				
AIRON																				
AFMPR																				
AMAEQ																				
AELEQ																				
ATREQ																				
AOMAN																				
AELEC																				
AWATE																				
ACNST																				
ATRAD																				
ATOUR																				
AHORE																				
ATR_C																				
AFL_I																				
AREAL																				
ABUSI																				
APUBA																				
AOSER																				
CCOTT																				
CSISA																				
CTEA																				
CCOFF																				
CTOBA																				
CCASH																				
CMAIZ															2.557					
CWHEA																				
CPADD																				
CSORG																				
COCER									0.184											
CBEAN																				
CCASS																10.672				
CROOT																6.464				
COILS																6.040				
CSUGA																4.594				
COHOR									1.742											
COCRO				0.004					0.247											
CLIVE									2.373											
CFISH									2.690											
CFOHU							5.634													
CMINE				0.001			61.934													
CMEAT																				
CFOOD										0.285										0.451
CGRAI										0.161										0.255
CBEVT										0.787										
CTEXT			1.444		0.015			1.880		0.297		0.034	0.010	0.002						0.036
CWEAR			0.547							0.416			0.388							0.833
CLEAT										0.134			0.134							0.369
CWOOD	0.133	0.264	1.275	0.032			0.444	3.453	0.148	0.315			0.337	0.071		7.483			0.727	
CPAPE	0.083	0.165	0.798	0.020	0.109	0.119	0.296			0.194	2.663	0.841	0.196	0.044		5.026			0.459	
CCHEM			0.255		0.138	0.148	0.691	2.292	0.123	0.262	0.286		0.019			11.871			2.793	
CFERT																				
CFUEL	0.005	0.010	0.005	0.001	0.559	0.446	0.682	0.725	0.025	0.055	8.618	0.098	0.029	0.006		1.591			0.153	
CRUBB			0.006					0.300	0.023		23.842									
CPLAS																				2.524
CGLAS	0.003	0.005					1.299													0.965
CCEME							22.141													
CIRON	0.113	0.228	1.304	0.242			13.860													
CFMPR	0.096	0.191	0.724				4.169			0.133						1.373				
CMAEQ	0.692		0.108	0.150			0.603	0.123	0.010	0.020	0.025	0.039	0.012	0.002		0.157			0.033	
CELEQ		1.738	0.268	0.095			1.424	0.299	0.023	0.048	0.079	0.096	0.028	0.006		0.398			0.085	
CTREQ	0.069	0.138	0.004	0.004		0.057	0.957	0.544	0.042	0.088	2.941	0.156	0.046	0.010		1.743			0.200	
COMAN	0.692	1.372	0.027	0.075			0.166	0.031	0.002	0.005	0.012			0.001		0.039			0.008	
CELEC	0.093	0.183	0.302	0.022	1.268		0.445	4.857	0.298	0.677	5.738	1.538	0.403	0.090		7.476			2.889	
CWATE	0.028	0.056	0.093			7.799	0.117	1.060	0.092	0.197	1.381	0.436	0.123	0.028		1.611			0.834	
CCNST			0.027		1.571	1.297	1.440	1.221	0.095	0.202	15.727	6.981	1.755	0.389		5.221			1.973	
CCOME																				
CCOMD																				
CCOMI																				
CTRAD	0.208	0.408	1.633	0.050	1.261	1.106	2.334	4.940	0.407			0.768	0.217	0.049		7.054			0.654	
CHORE	0.083	0.165				0.458			6.742		1.392	12.084	0.290	0.085		6.201			0.348	
CTR_C	0.071	0.140	0.275	0.017	1.562	1.362	1.820	59.530	4.634	10.179	20.132	3.929	0.985	0.244		10.627			1.023	
CFL_I	0.242	0.471	1.906	0.059	0.366		0.718	4.874	0.677	1.350	2.907	12.391	0.449						2.283	
CREAL	0.288	0.569	2.377	0.070	0.430		0.997	15.425	0.880	2.013	6.635					2.393			3.268	
CBUSI	0.015	0.029	0.124	0.004	0.022		0.082	0.972	0.045	0.096	0.400					0.162			0.175	
CPUBA							10.879													
COSER	0.053	0.115	0.308</																	

TABLE A1: TANZANIA MICROSAM 1992 IN CURRENT TSHS MILLION (CONT.)

	CTOBA	CCASH	CMAIZ	CWHEA	CPADD	CSORG	COCER	CBEAN	CCASS	CROOT	COILS	CSUGA	COHOR	COCRO	CLIVE	CFISH	CFOHU	CMINE	CMEAT	CFOOD
ACOTT																				
ASISA																				
ATEA																				
ACOFF																				
ATOBA	11.715																			
ACASH		6.075																		
AMAZ			78.280																	
AWHEA				9.471																
APADD					37.287															
ASORG						6.011														
AOCER							2.078													
ABEAN								25.173												
ACASS									6.575											
AROOT										9.634										
AOILS											24.025									
ASUGA												58.754								
AOHOR													69.271							
AOCRO														16.864						
ALIVE															36.809					
AFISH																43.745				
AFOHU																	46.886			
AMINE																		58.316		
AMEAT																			50.091	
AFOOD																				29.499
AGRAI																				
ABEVT																				
ATEXT																				
AWEAR																				
ALEAT																				
AWOOD																				
APAPE																				
ACHEM																				
AFERT																				
AFUEL																				
ARUBB																				
APLAS																				
AGLAS																				
ACEME																				
AIRON																				
AFMPR																				
AMAEQ																				
AELFQ																				
ATREQ																				
AOMAN																				
AELFC																				
AWATE																				
ACNST																				
ATRAD																				
ATOUR																				
AHORE																				
ATR_C																				
AFI_I																				
AREAL																				
ABUSI																				
APUBA																				
AOSER																				
CCOTT																				
CSISA																				
CTEA																				
CCOFF																				
CTOBA																				
CCASH																				
CMAIZ																				
CWHEA																				
CPADD																				
CSORG																				
COCER																				
CBEAN																				
CCASS																				
CROOT																				
COILS																				
CSUGA																				
COHOR																				
COCRO																				
CLIVE																				
CFISH																				
CFOHU																				
CMINE																				
CMEAT																				
CFOOD																				
CGRAI																				
CBEVT																				
CTEXT																				
CWEAR																				
CLEAT																				
CWOOD																				
CPAPE																				
CHEM																				
CFERT																				
CFUEL																				
CRUBB																				
CPLAS																				
CGLAS																				
CCEME																				
CIRON																				
CFMPR																				
CMAEQ																				
CELEQ																				
CTREQ																				
COMAN																				
CELEC																				
CWATE																				
CCNST																				
CCOME																				
CCOMD	3.351	1.858	17.269			4.809	1.011	3.388	2.732	1.616	3.693	17.102	14.610	1.466	9.539	15.478	6.946		9.829	2.132
CCOMI											0.058		0.055		0.272		0.117		0.219	5.526
CTRAD																				
CHORE																				
CTR_C																				
CFI_I																				
CREAL																				
CBUSI																				
CPUBA																				
COSER																				
UPRO																				
UWCO																				
UBCO																				
UNSK																				
RURA																				
LAND																				
CAPITAL																				
ENTR																				
HHUFA																				
HHUNF																				
HHRFA																				
HHRNF																				
GOVR																				
GOVI																				
ITAX				0.107																

Table A2: Structure of the economy¹

	Composition (%)				Ratios (%)		Elasticities	
	X share ²	VA share	E share	M share	E / X	M / Q	SIGT	SIGC
ACOTT	0.7	0.7	11.8		83.1		5.0	3.0
ASISA	0.2	0.1	1.9		53.7		5.0	3.0
ATEA	0.2	0.2	1.4		31.2		5.0	3.0
ACOFF	0.3	0.4	3.1		53.4		5.0	3.0
ATOBA	0.4	0.6	0.6		6.8		5.0	3.0
ACASH	0.3	0.5	1.9		31.4		5.0	3.0
AMAIZ	5.1	7.2	0.0		0.0		1.2	3.0
AWHEA	0.3	0.2	0.1	0.1	0.8	6.2	1.2	2.0
APADD	1.4	1.6						3.0
ASORG	0.4	0.6	0.0		0.1		1.2	3.0
AOCER	0.1	0.2	0.0	0.7	0.6	58.3	1.2	3.0
ABEAN	1.6	2.6	0.2		0.6		1.2	3.0
ACASS	0.8	1.4	0.4		2.5		1.2	3.0
AROOT	0.9	1.6	0.0	0.2	0.2	11.0	1.2	3.0
AOILS	0.9	1.4	0.6	0.0	3.3	0.8	1.2	3.0
ASUGA	2.9	1.3						3.0
AOHOR	3.0	5.1	0.7	0.0	1.3	0.3	1.2	3.0
AOCRO	0.8	1.3	0.3		2.1		1.2	3.0
ALIVE	2.3	3.4	0.1	0.2	0.3	2.2	1.2	3.0
AFISH	1.7	2.5	1.0		3.0		1.2	3.0
AFOHU	2.5	4.4	0.2	0.1	0.4	0.8	1.2	3.0
AMINE	2.1	3.5	1.1	2.3	2.8	18.4	1.2	1.5
AMEAT	1.8	2.0	0.5	0.3	1.5	2.7	1.2	1.5
AFOOD	2.5	1.4	1.0	7.5	2.1	53.7	1.2	1.5
AGRAI	5.1	1.0	0.0	2.5	0.0	8.8	1.2	1.5
ABEVT	3.8	3.0	0.3	0.6	0.4	2.8	1.2	1.5
ATEXT	2.5	1.2	14.2	4.2	28.7	29.7	1.2	1.5
AWOOD	1.9	1.4	4.9	1.8	13.1	15.9	1.2	1.5
ACHEM	0.9	0.4		12.5		68.1		1.5
ARUBB	1.7	1.0	1.7	8.0	5.2	45.4	1.2	1.5
AIRON	1.9	0.7	2.6	8.7	6.9	47.2	1.2	1.5
AMAEQ	1.0	0.9		35.7		75.7		1.5
AELEC	2.4	2.5						1.5
ACNST	7.0	5.2						1.5
ATRAD	10.4	12.8						1.5
ATOUR	0.9	0.7	17.9		100.0		0.5	
AHORE	2.1	2.3	7.5	1.3	17.9	12.8	0.5	1.5
ATR_C	7.2	6.6	6.2	0.9	4.4	2.5	0.5	1.5
AFL_I	2.9	3.5	0.0	4.4	0.1	23.1	0.5	1.5
AREAL	2.6	4.4		7.9		37.7		1.5
APUBA	10.3	6.8	0.1		0.1		0.5	1.5
AOSER	1.8	1.5	17.6		50.7		0.5	1.5
Total Ag	27.0	37.3	24.3	1.4	4.7	1.3		
Total NAg	73.0	62.7	75.7	98.6	5.3	21.8		

¹ The 42 sector structure of this table is more aggregated in the non-agriculture sector than the micosam.

² Note that: **X** = Output, **VA** = Value-Added, **E** = Exports, **M** = Imports, **Q** = Absorption, **SIGT** = Elasticity of Transformation, and **SIGC** = Elasticity of Substitution, **Ag** = Agriculture, **NAg** = Non-Ag.

GAMS model specification:

```
$offsymlist offsymxref offupper
$inlinecom { }
```

```
*tanzania sammaker
*peter wobst 07/98
```

```
Scalar
delta  small number / .0001 /
scale  scaling factor / 1000 /;
```

```
*include sets and data
$include setmap59.inc
$include input.dat
$include macsam.dat
$include iocoeff.dat
$include na55b.dat
```

Parameter `microsam0(insam2,insam3)` protosam to be constructed ;

```
microsam0(insam2,insam3) = 0 ;
```

```
*read in and scale relevant data from oldmicro (input.dat) and macrosam
*(from million to billion tshs.)
```

```
oldmicro(insam2,insam3) = oldmicro(insam2,insam3) / scale ;
macrosam0(imacro,jmacro) = macrosam0(imacro,jmacro) / scale ;
```

```
*no ohc for "acnst" and "areal"
```

```
oldmicro("ccnst",hh) = oldmicro("ccnst",hh) + oldmicro("acnst",hh) ;
oldmicro("acnst",hh) = 0 ;
oldmicro("creal",hh) = oldmicro("creal",hh) + oldmicro("areal",hh) ;
oldmicro("areal",hh) = 0 ;
```

```
*and none for "afood" and "awhea" either
```

```
oldmicro("cwhea",hh) = oldmicro("cwhea",hh) + oldmicro("awhea",hh) ;
oldmicro("awhea",hh) = 0 ;
oldmicro("cfood",hh) = oldmicro("cfood",hh) + oldmicro("afood",hh) ;
oldmicro("afood",hh) = 0 ;
```

```
*new macro knowledge and respective adjustments of microsam
```

```
*=====
```

```
*suck government investment out of private investment demand for construction
```

```
Microsam0("ccnst","govt") = macrosam0("com","gin") ;
```

```
*government deficits
```

```
Microsam0("kaccoun","govr") = macrosam0("cap","gre") ;
Microsam0("govi","govr") = macrosam0("gin","gre") ;
Microsam0("world","govr") = macrosam0("row","gre") ;
```

```
*loans, grants and transfers from abroad
```

```
Microsam0("govr","world") = macrosam0("gre","row") ;
Microsam0("govi","world") = macrosam0("gin","row") ;
Microsam0("kaccoun","world") = macrosam0("cap","row") ;
```

```
*introduce factor payment abroad
```

```
Microsam0("world","upro") = macrosam0("row","fac")/2 ;
Microsam0("world","capital") = macrosam0("row","fac")/2 ;
```

```
*production tax tx
```

```
microsam0("itax",activ) = na55bac(activ,"rawtx") ;
```

```
*new sales taxes
```

```
microsam0("itax",comm) = na55bco(comm,"rawtc") ;
```

```
*new import tariffs
```

```
microsam0("ttax",comm) = na55bco(comm,"rawtm") ;
```

```
*new dst
```

```
microsam0(comm,"dst") = na55bco(comm,"newdst") ;
```

```
*indirect tax collection account to government
```

```
microsam0("govr","itax") = sum(activ, microsam0("itax", activ))
+ sum(comm, microsam0("itax",comm)) ;
```

```
*new imports
```

```
microsam0("world",comm) = na55bco(comm,"newimp") ;
```

```
*tariff collection account to government
```

```
microsam0("govr","ttax") = sum(comm, microsam0("ttax",comm)) ;
```

```
*exports
```

```
microsam0(activ,"world") = na55bac(activ,"newexp") ;
```

```
*new cg
```

```
microsam0(comm,"govr") = na55bco(comm,"newcg") ;
```

```
*new ci (adjust for government investment)
```

```
microsam0(comm,"kaccoun") = na55bco(comm,"newci") ;
microsam0("ccnst","kaccoun") = microsam0("ccnst","kaccoun") -
microsam0("ccnst","govt") ;
```

```
*### new na55b.xls adjustments ###*
```

```
* ===== *
```

```
*create new intermediate demand matrix
```

```
microsam0(comm,activ) = na55bac(activ,"newint") * iocoeff(comm,activ) ;
```

```
*shift some va labor to va capital to gain an appropriate va distribution to households!!!
```

```

Set ctp(insam2) / acnst, atrad, apuba / ;
scalar adj / .6 / ;
oldmicro(lab,ctp) = adj*oldmicro(lab,ctp) ;
oldmicro("capital",ctp) = oldmicro("capital",ctp) + sum (lab, (1-adj)*oldmicro(lab,ctp)) ;

```

```

*apply old va distribution to new sectoral va totals
microsam0(f,activ)$sum(fct, oldmicro(fct,activ))
= na55bac(activ,"newva") * Oldmicro(f,activ) / sum(fct, oldmicro(fct,activ)) ;

```

```

Parameter vatot1st, vatot2nd ;
vatot1st = sum((f,activ), microsam0(f,activ)) ;

```

```

*and blow up to macro control total
microsam0(f,activ) = microsam0(f,activ)/vatot1st*macrosam0("fac","act") ;

```

```

vatot2nd = sum((f,activ), microsam0(f,activ)) ;

```

```

Display vatot1st, vatot2nd ;

```

```

*and blow up intdem matrix accordingly
microsam0(comm,activ) = microsam0(comm,activ)/vatot1st*macrosam0("fac","act") ;

```

```

$include tourism.inc

```

```

*avoid negativ domestic supply by cutting ohc
oldmicro("aroot",hh) = 0.05 * oldmicro("aroot",hh) ;
oldmicro("afood",hh) = 0.5 * oldmicro("acass",hh) ;
*adopt consumption pattern for sectors with final hh consumption which had no before
oldmicro("ctea",hh) = oldmicro("ctoba",hh) ;
oldmicro("ccoff",hh) = oldmicro("ctoba",hh) ;
oldmicro("cceme",hh) = oldmicro("cfuel",hh) ;

```

```

*ohc and final hh consumption according to their old spread applied to new cp totals
microsam0(activ,hh)$sum((comm,hhld)$map(activ,comm), oldmicro(activ,hhld)
+ oldmicro(comm,hhld))
= oldmicro(activ,hh) / sum((comm,hhld)$map(activ,comm),
Oldmicro(activ,hhld) + oldmicro(comm,hhld)) *
sum(comm$map(activ,comm), na55bco(comm,"newcp")) ;

```

```

microsam0(comm,hh)$sum((activ,hhld)$map(activ,comm), oldmicro(activ,hhld)
+ oldmicro(comm,hhld))
= oldmicro(comm,hh) / sum((activ,hhld)$map(activ,comm), Oldmicro(activ,hhld) +
oldmicro(comm,hhld)) * Na55bco(comm,"newcp") ;

```

```

*### marketing margins ###*
*=====

```

```

Parameter
erate(activ) export marketing margin rate
drate(comm) domestic marketing margin rate
mrater(comm) import marketing margin rate
totccome total export marketing margins
totfirst total of all first cut marketing margins

```

```

;

```

```

*read in rates from data file input.dat
erate(activ) = sum(comm$map(activ,comm), mmrate0(comm,"erat")) ;
drate(comm) = mmrate0(comm,"drat") ;
mrater(comm) = mmrate0(comm,"mrater") ;

```

```

*compute export mm before calculating domestic supply -- exports in f.o.b. prices
microsam0("ccome",activ) = microsam0(activ,"world")*erate(activ)/(1+erate(activ)) ;
totccome = sum(activ, microsam0("ccome",activ)) ;

```

```

*increase gross output of "atrad" by sum over export mm
*=====
Parameter techtrad(insam2) technology of the trade sector ;

```

```

microsam0("total","atrad") = sum(iacc, microsam0(iacc, "atrad")) ;
techtrad(iacc) = microsam0(iacc,"atrad") / microsam0("total","atrad") ;
microsam0("total","atrad") = microsam0("total","atrad") + totccome ;
microsam0(iacc,"atrad") = techtrad(iacc)*microsam0("total","atrad") ;
techtrad("total") = sum(iacc, techtrad(iacc)) ;

```

```

Display techtrad ;

```

```

*domestic supply
microsam0(activ,comm)$map(activ,comm) = sum(iacc, microsam0(iacc,activ)) -
microsam0(activ,"world") - sum(hh, microsam0(activ,hh)) ;

```

```

*distribute labor factor payments to households
microsam0(hh,lab)$sum(hhld, oldmicro(hhld,lab))
= sum(activ, microsam0(lab,activ)) * oldmicro(hh,lab) / sum(hhld, oldmicro(hhld,lab));

```

```

*and land factor payments to households
microsam0("hhufa","land") = sum(activ, microsam0("land",activ)) *
microsam0("hhufa","rura") / (microsam0("hhufa","rura") + microsam0("hhrfa","rura"));
microsam0("hhrfa","land") = sum(activ, microsam0("land",activ)) * microsam0("hhrfa","rura") /
(microsam0("hhufa","rura") + microsam0("hhrfa","rura"));

```

```

*adjust domestic factor payments according to factor payments abroad
microsam0(hh,"upro")$microsam0(hh,"upro") = microsam0(hh,"upro") -
Macrosam0("row","fac") / 2 * (microsam0(hh,"upro") /
sum(hhld,microsam0(hhld,"upro")));

```

```

microsam0("entr","capital") = sum(activ, microsam0("capital",activ)) - macrosam0("row","fac")/2
;

```

```

*income taxes households according to existing shares
microsam0("govr",hh)$sum(hhld, oldmicro("govr",hhld))
= macrosam0("gre","hou")*(oldmicro("govr",hh)/sum(hhld, oldmicro("govr",hhld))); ;

```

```

*household savings according to existing shares
Microsam0("kaccoun",hh)$sum(hhld, oldmicro("kaccoun",hhld))

```

```

= macrosam0("cap","hou")*(oldmicro("kaccoun",hh)/sum(hhld,
oldmicro("kaccoun",hhld)));

*corporate tax and savings
microsam0("govr","entr") = macrosam0("gre","ent");
microsam0("kaccoun","entr") = macrosam0("cap","ent");

*government transfers to enterprises
microsam0("entr","govr") = macrosam0("ent","gre");

*apply mozambique marketing margins

microsam0("ccomd",comm) = sum(activ, macrosam0(activ,comm))*drate(comm);

microsam0("ccomi",comm) = (microsam0("world",comm) +
microsam0("ttax",comm))*mrate(comm);

Parameter totfirst, totfirstc, totagri, totmanu, totdai(comm), mmfinal(comm,inst)
Mmfintot, cp_ci_cd(comm), instcons(inst), instmm(inst);

Totfirst = sum(comm, macrosam0("ccomd",comm) + macrosam0("ccomi",comm));

*scale mrdfs and mrmfs
microsam0("ccomd",comm) = macrosam0("ccomd",comm)/totfirst*(226911/scale);
microsam0("ccomi",comm) = macrosam0("ccomi",comm)/totfirst*(226911/scale);

totfirstc = sum(comm, macrosam0("ccomd",comm) + macrosam0("ccomi",comm));

Display totfirst, totfirstc;

Totagri = sum(agrise, macrosam0("ccomd",agrise) + macrosam0("ccomi",agrise));
totmanu = sum(manusec, macrosam0("ccomd",manusec)
+ macrosam0("ccomi",manusec));

Totdai(comm) = macrosam0("ccomd",comm) + macrosam0("ccomi",comm);

Alias(instwdst,instwdst2);

Mmfinal(comm,instwdst)$sum(instwdst2, macrosam0(comm,instwdst2))
= totdai(comm) * macrosam0(comm,instwdst) / sum(instwdst2,
microsam0(comm,instwdst2));

Mmfintot = sum((comm,instwdst), mmfinal(comm,instwdst));

Instcons(inst) = macrosam0("ctrad",inst);
instmm(inst) = sum(comm, mmfinal(comm,inst));

Microsam0("ctrad",inst) = 0;
microsam0(comm,instwdst) = macrosam0(comm,instwdst) + mmfinal(comm,instwdst);

*balance the margin accounts through the "atrad" account
microsam0("atrad","ccome") = sum(activ, macrosam0("ccome",activ));

```

```

microsam0("atrad","ccomd") = sum(comm, macrosam0("ccomd",comm));
microsam0("atrad","ccomi") = sum(comm, macrosam0("ccomi",comm));
microsam0("atrad","ctrad") = macrosam0("total","atrad") - macrosam0("atrad","ccome") -
Microsam0("atrad","ccomd") - macrosam0("atrad","ccomi");

*pay dst through kaccoun
microsam0("dst","kaccoun") = sum(comm, macrosam0(comm,"dst"))
- sum(comm, macrosam0("dst",comm));

*and of course compute new microsam0 totals.
Microsam0(iacc,"total") = sum(jacc, macrosam0(iacc,jacc));
microsam0("total",jacc) = sum(iacc, macrosam0(iacc,jacc));

*calculate total household income gaps
Parameter incgap(hh);
microsam0(hh,"govr") = 0;
microsam0(hh,"world") = 0;
microsam0(hh,"entr") = 0;

incgap(hh) = sum(jacc, macrosam0(hh,jacc)) - sum(iacc, macrosam0(iacc,hh));

*distribute remittances accordingly to income gaps
Microsam0(hh,"world") = macrosam0("hou","row")
*(incgap(hh)/sum(hhld, incgap(hhld)));

*and so do with factor payments from enterprises to households
Microsam0(hh,"entr") = (sum(iacc, macrosam0("entr",iacc)) - sum(iacc, macrosam0(iacc,"entr")))
*(incgap(hh)/sum(hhld, incgap(hhld)));

##### 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(insam2,insam3) signals negative flows
;
Parameter
redsam(insam2,insam3) negative adjustment matrix
oldproto(insam2,insam3) save old microsam0
;

red(iacc,jacc)$ (microsam0(iacc,jacc) lt 0) = yes;
redsam(iacc,jacc) = 0;
redsam(iacc,jacc)$red(iacc,jacc) = macrosam0(iacc,jacc);

```

redsam(jacc,iacc)\$red(iacc,jacc) = microsam0(iacc,jacc) ;

oldproto(insam2,insam3) = microsam0(insam2,insam3) ;

microsam0(iacc,jacc) = microsam0(iacc,jacc) - redsam(iacc,jacc) ;
microsam0(iacc,"total") = sum(jacc, microsam0(iacc,jacc)) ;
microsam0("total",jacc) = sum(iacc, microsam0(iacc,jacc)) ;
microsam0("total","total") = sum(iacc, microsam0(iacc,"total")) ;

red alert - the end !!!

\$include adjust.inc

*and compute new sam totals

microsam0(iacc,"total") = sum(iacc2, microsam0(iacc,iacc2)) ;
microsam0("total",iacc2) = sum(iacc, microsam0(iacc,iacc2)) ;
microsam0(iacc,"diffval") = microsam0(iacc,"total") - microsam0("total",iacc) ;
microsam0(iacc,"diffper")\$microsam0("total",iacc)
= 100*microsam0(iacc,"diffval")/microsam0("total",iacc) ;

*print protosam to spreadsheet

\$libinclude ssexport microsam0 proto59.wk1 klaus

\$batinclude micmac.inc "firstmac" "microsam0"

Parameter

coeff0(insam2,insam3) column coefficients for intermediate demand matrix
coltot0(insam3) column totals as read in
rowtot0(insam2) row totals as read in
ratioiv0(insam3) ratio between total intdem and total va per activity
conshatot0(hhld) households' shares of total household expenditure
share of marketing
tm(comm) tariff rate
tx(activ) other indirect tax rate
;

coltot0(jacc) = sum(iacc, microsam0(iacc,jacc)) ;

rowtot0(iacc) = sum(jacc, microsam0(iacc,jacc)) ;

coeff0(iacc,jacc)\$coltot0(jacc) = microsam0(iacc,jacc)/coltot0(jacc) ;

*\$batinclude micmac.inc "einsraus" "microsam0"

ratioiv0(activ)\$sum(fct, microsam0(fct,activ))
= sum(comm,microsam0(comm,activ))/sum(fct, microsam0(fct,activ)) ;

conshatot0(hhld)\$sum(hh, microsam0("total",hh)) = microsam0("total",hhld)
/sum(hh,microsam0("total",hh)) ;

Tm(comm)\$microsam0("world",comm) = microsam0("ttax",comm) / microsam0("world",comm)
;

tx(activ)\$microsam0("total",activ) = microsam0("itax",activ) / microsam0("total",activ) ;

#####*

* add code to use errors in variables on column sums.
* for a uniform distribution, set jwt to only two entries.
* error range set below with the vbar parameter.

Set

jwt weights on errors in variables / 1*3 / ;

* add parameter on error bounds on errors in variables.

Parameter

vbar(insam2,jwt) Error bounds on columns
;

#####

variables

coeff(insam2,insam3) Scaled sam coefficients
coltot(insam3) Column totals
rowtot(insam2) Row totals
Err(insam3) Error on column totals
w(insam3,jwt) Error weights
microsam(insam2,insam3) Sam entries
klaus Total entropy minimand

*variables for additional constraints

Totinttot Total intermediates
oittot Total other indirect taxes
sttot Total sales taxes
domtot Total domestic
exptot Total exports
imptot Total imports
ittot Total import tariffs
xtot Total production
labtot(lab) Va per labor category
captot Va capital
landtot Va land
vatot Total value-added
ohctot Total own household consumption
cptot Total hh consumption
gptot Total government consumption
idtot Total investment
dsttot Total change in inventory

*wob variables to constrain certain sam entries

*=====

ownlivtot Own livestock consumption
ownfortot Own forestry and hunting consumption
ownfistot Own fishing consumption
owndwetot Owner occupied dwellings
owncontot Own construction
shhhtax Household share of direct taxes
shenttax Enterprise share of direct taxes
shhhsav Household share of total savings

shentsav Enterprise share of total savings
savhhtot Total household savings
taxhhtot Total household taxes
rowhhtot Total household receipts from abroad
govhhtot Total government transfers to households
sammre(activ) Sam marketing margin ratio export
sammrd(comm) Sam marketing margin ratio domestic
sammrm(comm) Sam marketing margin ratio import
facpaya Total factor payments abroad
;

* initialize variables and fix small coefficients

coeff.l(iacc,jacc) = coeff0(iacc,jacc) ;
coltot.l(jacc) = coltot0(jacc) ;
rowtot.l(iacc) = rowtot0(iacc) ;
err.l(jacc) = 0.0 ;
w.l(jacc,jwt) = 1/card(jwt) ;
microsam.l(iacc,jacc) = microsam0(iacc,jacc) ;
totinttot.l = sum((comm,activ), microsam0(comm,activ)) ;
oitot.l = sum(activ, microsam0("itax",activ)) ;
sttot.l = sum(comm, microsam0("itax",comm)) ;
domtot.l = sum((comm,activ), microsam0(activ,comm)) ;
exptot.l = sum(activ, microsam0(activ,"world")) ;
imptot.l = sum(comm, microsam0("world",comm)) ;
ittot.l = sum(comm, microsam0("ttax",comm)) ;
xtot.l = domtot.l + exptot.l ;
labtot.l(lab) = sum(activ, microsam0(lab,activ)) ;
captot.l = sum(activ, microsam0("capital",activ)) ;
landtot.l = sum(activ, microsam0("land",activ)) ;
vatot.l = sum((fct,activ), microsam0(fct,activ)) ;
ohctot.l = sum((activ,hhld), microsam0(activ, hhld)) ;
cptot.l = sum((comm,hhld), microsam0(comm, hhld)) ;
gptot.l = sum(comm, microsam0(comm,"govr")) ;
idtot.l = sum(comm, microsam0(comm, "kaccoun")) ;
dsttot.l = sum(comm, microsam0(comm,"dst")) ;
- sum(comm, microsam0("dst",comm)) ;

Sammre.l(activ)\$microsam0(activ,"world") - microsam0("ccome",activ))
= microsam0("ccome",activ) / (microsam0(activ,"world") - microsam0("ccome",activ)) ;

Sammrd.l(comm)\$sum(activ, microsam0(activ,comm)) = microsam0("comd",comm)
/ sum(activ, microsam0(activ,comm)) ;

Sammrm.l(comm)\$microsam0("world",comm) = microsam0("ccomi",comm) /
(microsam0("world",comm) + microsam0("ttax",comm));

Equations

scalef(insam2,insam3) Scaled coefficients for minimand
sumcoef(insam3) Sam coefficients for columns add up to 1
rowtotal(insam2) Row totals
coltotal(insam3) Column totals
errreq(insam3) Errors in variable

sumw(insam3) Sum of error weights
balance(insam2) Sam balancing constraint
entropy Total entropy minimand
*additional constraints
totoit Total other indirect taxes
totst Total sales taxes
totexp Total exports
Totimp Total imports
totit Total import tariffs
totva Total payments to all factors
totohc Total own household consumption
totcp Total consumption
totgp Total gov. consumption
totid Total investment
totdst Total change in inventory

*wob equations to constrain certain sam entries

* =====
totownliv Own livestock consumption
totownfor Own forestry and hunting consumption
totownfis Own fishing consumption
hhunfrura Factor payment rura to hhunf
hhrnfrura Factor payment rura to hhrnf
ivratio(activ) Intermediate-value-added ratio per sector
totconsha1(hhld) Shares of total HH expenditure for lower bound
totconsha2(hhld) Shares of total HH expenditure for upper bound
totlhsav Total household savings
eqsammre(activ) Sam marketing margin ratio export
eqsammrd(comm) Sam marketing margin ratio domestic
eqsammrm(comm) Sam marketing margin ratio import
eqfacpaya Total factor payments abroad
;

Scalef(iacc,jacc)\$microsam0(iacc,jacc)..

Coeff(iacc,jacc)*(coltot(jacc) + err(jacc)) =e= microsam(iacc,jacc) ;

Sumcoef(jacc)\$sum(iacc, microsam0(iacc,jacc))..

Sum(iacc, coeff(iacc,jacc)) =e= 1 ;

Rowtotal(iacc)..

Sum(jacc\$microsam0(iacc,jacc), microsam(iacc,jacc)) =e= rowtot(iacc) ;

Coltotal(jacc).. Sum(iacc\$microsam0(iacc,jacc), microsam(iacc,jacc))
=e= (coltot(jacc) + err(jacc)) ;

Errreq(jacc).. Err(jacc) =e= sum(jwt, w(jacc,jwt)*vbar(jacc,jwt)) ;

Sumw(jacc).. Sum(jwt, w(jacc,jwt)) =e= 1 ;

Balance(iacc).. Rowtot(iacc) =e= coltot(iacc) + err(iacc) ;

Entropy.. Klaus =e= sum((iacc,jacc)\$microsam0(iacc,jacc),
Coeff(iacc,jacc) * (log(coeff(iacc,jacc) + delta)

```

- log(coeff0(iacc,jacc) + delta))
+ sum((jacc,jwt),w(jacc,jwt)*log(w(jacc,jwt) + delta));

Totoit.. Oittot           =e= sum(activ, microsam("itax",activ));
Totst..  Sttot           =e= sum(comm, microsam("itax",comm));
Totexp.. Exptot          =e= sum(activ, microsam(activ,"world"));
Totimp.. Imptot          =e= sum(comm, microsam("world",comm));
Totit..  Ittot           =e= sum(comm, microsam("ttax",comm));
Totva..  Vatot           =e= sum((fct,activ), microsam(fct,activ));
totohc.. Ohctot         =e= sum((activ,hhld), microsam(activ,hhld));
Totcp..  Cptot           =e= sum((comm,hhld), microsam(comm,hhld));
Totgp..  Gptot           =e= sum(comm, microsam(comm,"govr"));
Totid..  Idtot           =e= sum(comm, microsam(comm,"kaccoun"));
Totdst.. Dsttot         =e= sum(comm, microsam(comm,"dst"))
- sum(comm, microsam("dst",comm));

Totownliv.. Ownlivot     =e= sum(hhld, microsam("alive",hhld));
Totownfor.. Ownfortot    =e= sum(hhld, microsam("afohu",hhld));
Totownfis.. Ownfistot    =e= sum(hhld, microsam("afish",hhld));
Hhunfrura.. Microsam("hhunf","rura") =e= sum(activ, microsam(activ,"hhunf"));
Hhrnfrura.. Microsam("hhrnf","rura") =e= sum(activ, microsam(activ,"hhrnf"));

Ivratio(activ)..          ratioiv0(activ) * sum(fct, microsam(fct,activ))
=e= sum(comm,microsam(comm,activ));

Totconsha1(hhld).. conshatot0(hhld) * sum((iacc,hh), microsam(iacc,hh))
=l= 1.05 * sum(iacc, microsam(iacc,hhld));

Totconsha2(hhld).. conshatot0(hhld) * sum((iacc,hh), microsam(iacc,hh))
=g= 0.95 * sum(iacc, microsam(iacc,hhld));

Tothtax.. Taxhhtot =e= sum(hh, microsam("govr",hh));

Eqsammre(activ)$microsam0(activ,"world"..
Sammre(activ) * (microsam(activ,"world") - microsam("ccome",activ))
=e= microsam("ccome",activ);

Eqsammrd(comm)$sum(activ, microsam0(activ,comm)).

```

```

Sammrd(comm) * sum(activ, microsam(activ,comm))
=e= microsam("ccomd",comm);

Eqsammrm(comm)$microsam0("world",comm)..
Sammrm(comm) * (microsam("world",comm) + microsam0("ttax",comm))
=e= microsam("ccomi",comm);

Eqfacpaya.. Facpaya =e= microsam("world","upro") + microsam("world","capital");

*fix variables at zero that should be zero
microsam.fx(iacc,jacc)$microsam0(iacc,jacc) eq 0) = 0;
coeff.fx(iacc,jacc)$microsam0(iacc,jacc) eq 0) = 0;

*avoid negativ sam flows and coefficients and negative row or column sums
Scalar lor lower limit / 0 / ;
coeff.lo(iacc,jacc)$coeff0(iacc,jacc) = lor;
coeff.up(iacc,jacc)$coeff0(iacc,jacc) = 1.0;
coltot.lo(jacc) = lor;
rowtot.lo(iacc) = lor;
microsam.lo(iacc,jacc) = lor;

ownlivot.fx = 27815/scale;
ownfortot.fx = 24699/scale;
ownfistot.fx = 3653/scale;

*fix income taxes acording to marco data
microsam.fx("govr","entr") = macrosam0("gre","ent");
taxhhtot.fx = macrosam0("gre","hou");

*macroconstraints
oittot.fx = macrosam0("ita","act");
sttot.fx = sum(comm, microsam0("itax",comm));
exptot.fx = macrosam0("act","row");
imptot.fx = macrosam0("row","com");
ittot.fx = macrosam0("tta","com");
vatot.fx = macrosam0("fac","act");
ohctot.fx = macrosam0("act","hou");
cptot.fx = macrosam0("com","hou");
Gptot.fx = macrosam0("com","gre");
Microsam.fx("ccnst","govi") = macrosam0("com","gin");
idotot.fx = macrosam0("com","cap");
dsttot.fx = macrosam0("com","change");

*fix factor payment abroad
facpaya.fx = macrosam0("row","fac");

*fix government transfers to enterprises and to row
microsam.fx("entr","govr") = macrosam0("ent","gre");
microsam.fx("world","govr") = macrosam0("row","gre");
microsam.fx("govr","world") = macrosam0("gre","row");
microsam.fx("govi","world") = macrosam0("gin","row");

```

```

*fix the marketing margins
sammre.fx(activ)$ (sammre.l(activ) lt .8) = sammre.l(activ) ;
sammre.fx(activ)$ (sammre.l(activ) gt .8) = .8 ;
sammrd.fx(comm)$ (sammrd.l(comm) lt .8) = sammrd.l(comm) ;
sammrd.fx(comm)$ (sammrd.l(comm) gt .8) = .8 ;
sammmr.fx(comm)$ (sammmr.l(comm) lt .8) = sammmr.l(comm) ;
sammmr.fx(comm)$ (sammmr.l(comm) gt .8) = .8 ;

*set bounds around all coefficients
coeff.lo(iacc,jacc)$ (coeff0(iacc,jacc) and (coeff0(iacc,jacc) lt 0.5))
= 0.5 * coeff0(iacc,jacc) ;
coeff.up(iacc,jacc)$ (coeff0(iacc,jacc) and (coeff0(iacc,jacc) lt 0.5))
= 2.5 * coeff0(iacc,jacc) ;

*introduce row coefficients and fix cells where column and
*row coefficients are smaller than a certain value.

Parameter rowcoeff(insam2,insam3) row coefficeint matrix ;

Rowcoeff(iacc,jacc) = microsam0(iacc,jacc) / sum(iacc2, microsam0(iacc,iacc2)) ;

Coeff.fx(iacc,jacc)$ ((coeff.l(iacc,jacc) lt .01) and (rowcoeff(iacc,jacc) lt .01))
= coeff.l(iacc,jacc) ;

*avoid infeasibilities:
coeff.lo(iacc,"cfohu")$coeff.l(iacc,"cfohu") = 0 ;
coeff.up(iacc,"cfohu")$coeff.l(iacc,"cfohu") = 1 ;

*sr 9/97 add error bounds and fix column totals

coltot.fx(jacc) = coltot.l(jacc) ;

vbar(jacc,"1") = 0.5*coltot.l(jacc) ;
vbar(jacc,"3") = -0.5*coltot.l(jacc) ;
vbar(jacc,"2") = 0.0 ;

w.l(jacc,jwt) = 1/card(jwt) ;
w.lo(jacc,jwt) = 0.0 ;
w.up(jacc,jwt) = 1.0 ;

#####

model samras /
scalef
sumcoef
rowtotal
coltotal
erroreq
sumw
balance
entropy
*additional constraints

```

```

totoit
totst
totexp
totimp
totit
totva
totohc
totcp
totgp
totid
totdst
totownliv
totownfor
totownfis
hhunfrura
hhrnfrura
ivratio
totconsha1
totconsha2
tothtax
eqsammre
eqsammr
eqsammmr
eqfacpaya
/;

Samras.holdfixed = 1 ;

Options reslim=1000000, limrow=3, limcol=3, iterlim=1000000 ;
option nlp=conopt2 ;
*option nlp=conopt ;
*option nlp=minos5 ;

samras.optfile = 1 ;

solve samras minimizing klaus using nlp ;

##### red alert - part two #####

Parameter newsam1(insam2,insam3) sam obtained with entropy ras (adjusted)
Checknew(insam2)
Compar(insam2,insam3) compares newsam1 and microsam0
Compar_p(insam2,insam3) percent change from microsam0 to newsam1 ;

Newsam1(iacc,jacc) = microsam.l(iacc,jacc) ;
*wob now reflipp negative (ras-changed) numbers!
Newsam1(iacc,jacc)$red(iacc,jacc) = microsam.l(iacc,jacc) - microsam.l(jacc,iacc) ;
Newsam1(iacc,jacc)$red(jacc,iacc) = 0 ;
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(insam2,insam3) = newsam1(insam2,insam3) - microsam0(insam2,insam3);
Compar_p(insam2,insam3)$microsam0(insam2,insam3) = 100*(compar(insam2,insam3)
/microsam0(insam2,insam3));
```

```
$batinclude micmac.inc "newmac" "newsam1"
```

```
$include macexp.inc
```

```
*##### red alert - part two - the end #####
```

```
*and compute new sam totals
```

```
newsam1(iacc,"total") = sum(iacc2, newsam1(iacc,iacc2));
newsam1("total",iacc2) = sum(iacc, newsam1(iacc,iacc2));
newsam1(iacc,"diffval") = newsam1(iacc,"total") - newsam1("total",iacc);
newsam1(iacc,"diffper")$newsam1("total",iacc)
= 100*newsam1(iacc,"diffval")/newsam1("total",iacc);
```

```
*export balanced sam to spreadsheet
```

```
$libinclude ssexport newsam1 newsam1.wk1 klaus
```