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# Building Macro SAMs from Cross-Country Databases

## Method and Matrices for 133 Countries

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## Abstract

Social accounting matrices (SAMs) are the key data input for computable general equilibrium (CGE) models. After a brief introduction to SAMs, this paper presents a method and related computer program for constructing macro SAMs from cross-country databases. The method is demonstrated in an appendix where it is used to build such a SAM for Guinea in Excel. With the help of the program, macro SAMs were built for 133 countries, including many low-income and/or fragile countries. The SAMs and the code for the program are available in electronic form. A companion paper presents a CGE model with a user-friendly interface for which such SAMs provide the bulk of the data needed for macro applications.


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# Building Macro SAMs from Cross-Country Databases: Method and Matrices for 133 Countries

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# 1. Introduction

A social accounting matrix (SAM) is an economywide consistent representation of the payments in an economy, linking production, primary factors, and institutions (typically, households, government, and the rest of the world). Economywide databases are indispensable for the analysis of policies and shocks that matter enough to generate repercussions throughout an economy. Consistency has the virtue of assuring that an analysis is not based on contradictory pieces of information. Most of the time, a SAM refers to the economy of a country during one year. SAMs may be used to describe the structure of an economy and as data inputs to economic models, most importantly computable general equilibrium (CGE) models.

However, despite the value of SAMs for description and analysis, the methods for constructing them are not well-known among development practitioners. Via a detailed documentation of a method for constructing macro SAMs (and thus exposing it to criticism and paving the way for improvements), this paper tries to mitigate some of the obstacles that stand in the way of making better and wider use of SAMs in development policy analysis. More specifically, its main purposes are

- to provide a brief introduction to the basic features of SAMs;
- to provide a method and related computer program for constructing macro SAMs from cross-country data sets; and
- to demonstrate the information about a country's economy that may be extracted from a macro SAM.

For illustration, throughout the presentation we use data for a representative (or archetype) low-income country. We also apply the method to cross-country databases available in the summer of 2017, constructing macro SAMs of three types (with different degrees of complexity) for the most recent year possible (for most countries 2015). For the most complex SAM type, we construct SAMs for 133 countries, distributed across all income levels: 17 low-income; 70 middle-income; and 46 high-income; 11 of these countries are currently in a fragile situation according to the World Bank classification in the spring of 2017.

Among the countries covered, low-income countries are well represented despite the general lack of data for this group – 55 percent of the countries in this group are covered compared to an average of 61 percent across all income levels. If we also had turned to country-specific data sources, up-to-date macro SAMs could have been constructed for most countries in this group using the procedure of this paper. This relative data advantage for macro SAMs and the analytical tools that use them is due to the fact that the data required are relatively aggregate, are for a single year, and come with built-in consistency controls, making it easier to dismiss erroneous data. To demonstrate the feasibility of constructing macro SAMs for additional countries, the paper appendix describes the construction of a macro SAM for Guinea using our method; the input data are from a combination of cross-country databases and an IMF Article IV report for Guinea.

A companion paper is designed to pave the way for CGE-based analysis with a model that, apart from the macro SAM, only requires a few elasticities and stock values (Cicowiez and Lofgren 2017). Equipped with country-specific databases and the model, analysts may conduct macro-oriented policy analysis for virtually any country at a low cost in time and other resources.

The current paper is organized as follows. Using data for an archetype low-income country, Section 2 explains the structure of macro SAMs, noting how they differ from alternative SAM types. Section 3 spells out a procedure that may be followed when constructing macro SAMs drawing on freely available cross-country data sets; an automated (and thus low-cost) version of the procedure was used to produce the 133 macro SAMs referred to above. Section 4 summarizes the computer program that was developed to build macro SAMs for a large number of countries. In section 5, we demonstrate how data in a SAM may be presented in a set of tables that describe the economic structure of a country. In Section 6, we conclude with some observations regarding the use of the SAMs. In an appendix, we demonstrate the construction of a macro SAM for Guinea in Excel. A second electronic appendix with the 133 macro SAMs and the computer program for building these is available on request from the authors.

## 2. A Macro SAM for policy analysis

A SAM is a matrix representation of the interrelationships in an economy at the level of individual production sectors, factors, and institutions. As stated in Round (2003), "it is a comprehensive, flexible, and disaggregated framework which elaborates and articulates the generation of income by activities of production and the distribution and redistribution of income between social and institutional groups".[1]

Table 2.1 shows the structure of the key macro SAM of this paper; it is called a "macro" SAM simply because its accounts are highly aggregated. Instead of monetary values, this table describes the content of the different cells that may have values. Its notation is found in Table 2.2. Like any standard SAM, the one in Table 2.1 is a square matrix with identical accounts in rows and columns. The cells show payments from the column account to the row account. The sum of the entries in a column represents the total expenditures of the column account while the sum of the entries in its row shows the total receipts of the row account. Because of consistency (a feature of the real world and, in the absence of errors in data or concepts, also of any SAM), the row and column totals of each account must be equal. This simply means that no account (or no economic entity) can spend more than it receives and that any payment received must be used in some way that is captured in the SAM.

[1] For background on SAMs, see for example Round (2003) and Pyatt and Round (1985).

**Table 2.1. Macro SAM**

| | act-prv | act-gov | com-prv | com-gov | f-lab | f-cap | hhd | gov | row | taxes | cap-hhd | cap-gov | cap-row | inv-prv | inv-gov | dstk | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| act-prv | | | output | | | | | | | | | | | | | | |
| act-gov | interm | interm | | output | | | | | | | | | | | | | |
| com-prv | | | | | | | cons | | exp | | | | | inv | inv | dstk | |
| com-gov | | | | | | | | cons | | | | | | | | | |
| f-lab | va | va | | | | | | | yrow | | | | | | | | |
| f-cap | va | | | | | | | | yrow | | | | | | | | |
| hhd | | | | | va | va | | trnfr | trnfr | | | | | | | | |
| gov | | | | | | | trnfr | | trnfr | taxes | | | | | | | |
| row | | | imp | | yfac | yfac | trnfr | trnfr | | | | | | | | | |
| taxes | taxes | | taxes | | cssoc | | taxes | | | | | | | | | | |
| cap-hhd | | | | | | | sav | | | | | | borr | | | | |
| cap-gov | | | | | | | | sav | | | borr | | borr | | | | |
| cap-row | | | | | | | | | sav | | drf | | | | | | |
| inv-prv | | | | | | | | | | | inv | | inv | | | | |
| inv-gov | | | | | | | | | | | | inv | | | | | |
| dstk | | | | | | | | | | | dstk | | | | | | |
| total | | | | | | | | | | | | | | | | | |

Source: Authors' elaboration.

**Table 2.2. Accounts and cell entries in stylized Macro SAM for GEM-Macro**

| Account | Explanation | Cell entry | Explanation |
|---|---|---|---|
| act-prv | activity - private production | borr | net borrowing |
| act-gov | activity - government production | cons | consumption |
| com-prv | commodity - private production | dstk | stock change |
| com-gov | commodity - government production | exp | exports |
| f-lab | factor - labor | imp | imports |
| f-cap | factor - private capital | interm | intermediate inputs |
| hhd | household | inv | investment (gross fixed capital formation) |
| gov | government | output | production |
| row | rest of world | sav | savings |
| taxes | taxes - domestic and trade | taxes | taxes (direct and indirect) |
| cap-hhd | capital account - household | cssoc | social contributions |
| cap-gov | capital account - government | trnsfr | transfers |
| cap-row | capital account - rest of world | va | value added |
| inv-prv | investment - private capital | yfac | factor income to RoW |
| inv-gov | investment - government capital | yrow | factor income from RoW |
| dstk | stock change | drf | change in foreign reserves |

(*) For the cell sam('cap-hhd','cap-row'), also including non-FDI foreign investment.
Source: Authors' elaboration.

The accounts of the SAM in Table 2.1 may be classified into activities, commodities, factors, institutions, and auxiliary accounts related to institutions, in this case a set of tax and investment accounts. We will here take a tour of the SAM in Table 2.1, pointing out the different roles of these account types.

The activity accounts represent the entities that produce commodities. Here, the SAM has two such accounts, representing private and government production.[2] The sales receipts received in the activity rows are allocated to intermediates, factors (value-added) and (indirect producer) taxes in the activity columns. Subsidies to producers may be represented by negative taxes; negative payments may play a similar role for other taxes.

The two commodity accounts cover the outputs of private and government production. The private output is also imported. The row entries of the commodity accounts represent payments from commodity demanders; the column entries show payments to the suppliers (domestic and foreign, i.e. imports) and for indirect commodity (or product) taxes; the latter

[2] The boundary between private and government may vary across SAMs depending on purpose and data availability. However, often it is preferred that government represents general government while private covers the rest of the economy.

are made up of some combination of taxes on imports, exports, domestic sales, and value-added.

The factor accounts are also split into two, labor and private capital. Their row entries indicate that they earn value-added from domestic production activities and income from the rest of the world. For labor, income from abroad tends to be less important since it only applies to income from abroad for workers resident in the country of the SAM. [Income from workers resident abroad is part of the payment in the cell sam('hhd','row').] In the columns of the factor accounts, value-added is distributed to the owners of the factors.[3] Also, the cell sam('cssoc','f-lab') singles out social contributions. For capital, the cell sam('row','f-cap') refers to capital rent remittances to the rest of the world. It includes, for example, factor income paid for FDI.

The institutions in the SAM are split into household (an aggregate non-government or "private" institution), government, and the rest of the world (RoW). Each institution has a current account and a capital account. In the rows of their current accounts, these institutions receive value-added, transfers from other institutions, taxes (for the government), and payments for imports (for the rest of the world). As noted above, in an empirical macro SAM, the tax accounts, which pass on their receipts to the government, tend to be disaggregated into direct and multiple indirect taxes. Along their current account columns, the institutions spend on commodity purchases (consumption for the household and the government and exports for the rest of the world), direct taxes (for the household), transfers to other institutions, and savings.[4]

For each institutional capital account, the receipts are savings (from the current account of the same institution) and net borrowing from the capital accounts of other institutions (for the government, from the rest of the world and the household; for the household, from the

[3] In addition to the current entries, it is not uncommon that the government owns part of private capital and earns part of its value-added. Moreover, factors may also pay (direct) taxes, levied on factors as opposed to the household (which tends to be the major direct tax payments).

[4] In GEM-Core, it is also possible to include one or more additional institutions that carry out the functions of an off-budget donor or an NGO – receiving transfers from other institutions (typically the rest of the world and/or the government) and using these resources to purchase services related to health and/or education.

rest of the world). In turn, the payment from the domestic non-government capital account to the foreign capital account records the change in foreign reserves.[5]

In addition to net borrowing to other institutions, the capital accounts spend on private and government investment, a term that in this paper means fixed capital formation, and stock change. The payment from the capital account of the rest of the world to the private investment account is foreign direct investment (FDI). The inclusion of capital accounts and their payments facilitate the calculation of changes in domestic and foreign debts and thus assessing the sustainability of government and private finances. Finally, the financing received by the two investment accounts (private and government) in their rows is, in their columns, passed on to demands for commodities used to construct new capital stocks. For stock (or inventory) change, the financing received in the account row from the household is passed on to a commodity demand. The latter payment may be negative – if so, the stock is reduced.

The SAM presented in this section is a macro SAM with a specific disaggregation and structure. SAMs used in applied analysis may deviate in various ways. A first important deviation is that the factor, activity, commodity and household accounts tend to be more disaggregated – the household (here non-government) may be disaggregated into enterprises and different household types (perhaps split based on income sources). Such more disaggregated SAMs may be referred to as multisector or meso SAMs.[6] Second, the disaggregated capital and investment accounts may be replaced by a single savings-investment account. While reducing data needs, such a more aggregate representation precludes analysis of the specific effects of government investment and how the savings of different institutions are linked to changes in their capital stock endowments and debts.

[5] Note that the financing of the foreign reserves change comes from the household capital account. This reflects the fact that, in the background, the financial sector, which finances the foreign reserve change, is part of the private sector. Algebraically, this treatment of foreign reserves (and the rest of the structure of the capital accounts in the SAM) may be derived from the consistency matrix in Agénor (2004, p. 13) by (1) aggregating the capital accounts for its private and financial sectors; and (2) separating FDI from foreign borrowing to the private sector.

[6] Meso is a word of Greek origin meaning middle, the level between macro and micro at which most SAMs are located, i.e. without data at the level of individual micro units (households or firms) but more disaggregated than what is typical for macro analysis.

Finally, it should be noted that SAMs are part of the system of national accounts and that the information that they contain may be used to define national account indicators such as different measures of national income, product, and expenditures as well as their different components.[7]

## 3. Building a Macro SAM Using Cross-Country Databases

In this section, we describe a straightforward procedure for building macro SAMs. We present three alternative versions with gradually increasing data needs. Macro SAM I has a single sector (one activity and one commodity) and an aggregate treatment of savings and investment. In Macro SAM II, the sectors (activities and commodities) are disaggregated into private and government. Macro SAM III has the same structure as the SAM presented in Section 2; it differs from II in that the treatment of savings and investment is more disaggregated.

### Macro SAM I

Macro SAM I is presented in Table 3.1, using data for an archetype low-income country for illustration.[8] The proposed procedure for building such a SAM for an individual country consists of two main steps. The first step – direct entry of data in raw form and computation of intermediate data -- is covered in Table 3.2. In the first section of the table (1-20; here and in the following discussion of Macro SAMs I-III, the parenthesized numbers refer to rows in relevant tables), data from World Bank and IMF sources are entered into the SAM directly without transformations – this should be done to the maximum extent possible. It is here possible for the indicators that define GDP at market (or purchasers') prices from the expenditure side (domestic final demands, exports, and imports), disaggregated tax payments, and items in the balance of payments related to factor incomes and current transfers. Consistency between receiving and paying accounts is assured thanks to the fact that a single SAM entry applies to both; e.g. government consumption in the national

[7] For example, see European Commission et al. (2009, Chapter 28).

[8] More specifically, the data shown are the weighted average of macro SAMs for the 17 low-income countries for which sufficient information was available in cross-country databases. Each SAM was weighted by its share of GDP at market prices at current US dollars for the countries included.

accounts (part of commodity demands) and in the government budget (part of current government spending) is a single cell entry. Such consistency is not automatic if, let's say, national accounts and government budget data are produced separately. As shown in the second section of Table 3.2 (21-24), additional data needed for calculations are also assembled in this step.

In the second step, shown in Table 3.3, the remaining SAM cells are defined. To make the calculations shorter and more transparent, initially data for a set of intermediate variables are specified (GDP at market prices, net indirect taxes, and total current government revenue) drawing on data covered in Table 3.2 (1-3).[9] After this, the logic behind the different calculations is as follows: Labor and capital (non-labor) value-added is defined as GDP at factor cost (the difference between GDP at market prices and net indirect taxes; computed using data already in the SAM) times the labor and non-labor value-added shares, respectively, using country- or region-specific GTAP data for the latter (4-5).[10] Intermediate consumption is defined as the product of total (labor and capital) value-added times the ratio between intermediate demand and total value-added according to GTAP data (6). Sales of domestic output is simply the sum of the activity column, i.e. its payments for factors of production, intermediates, and activity taxes (7). Household labor incomes are defined as total labor value-added plus net labor incomes from the rest of the world minus social contributions (8). The definition of household capital incomes follows the same logic (9). Household transfers to the government are computed as the difference between total non-tax revenues (in effect different transfers from different sources, foreign and domestic) and transfers to the government from the rest of the world (10). Government savings is computed as the difference between total government current revenue (defined as the sum of tax and non-tax revenue) and total current expenditures (11). Transfers to households from the government are a residual, balancing the government current account (12). It is defined as the difference between the total of the row of the current government account

[9] Reference is made to net indirect taxes to reflect that any activity or commodity subsidies should be deducted. However, in the cross-country databases that are used, such subsidies are not singled out. The interpretation is that they are part of transfers from the government to the household or treated as negative tax payments.

[10] A cell payment is referred to via a bracketed listing of its row and column accounts. For example, [f-lab,act] refers to the payment in the intersection between the row of the account f-lab and the column of the account act, i.e., a payment to the labor account from the activity account.

(total current revenue) and the total of the column, excluding these transfers but including government savings. Rest-of-world savings are viewed from the perspective of the rest of the world; from the perspective of the SAM country, it is the deficit of the current account of the balance of payments. Like government transfers to households, remittances (i.e., transfers from rest of world to households) are also a residual, in this case balancing the current account of the rest of the world. It is defined as the difference between the row (receipt) total and the sum of the other items (expenses) in the column, including rest-of-world savings (13). Household savings, an item for which no exogenous information is available, is similarly a residual. It is the difference between total capital formation and savings from other sources (the government and the rest of the world) (14). The fact that the residual account, in this case the current household account, is in balance when all other accounts are in balance is a manifestation of Walras' law.[11]

The procedure followed generates a balanced SAM with the same structure as the one shown in Table 3.1. It is important to verify that the values for the items that are defined as residuals are reasonable; if they are not, then one or more of the other cells must also be off. For example, the value for remittances should be close to its values according to other sources. Alternative procedures are also possible. For example, instead of defining remittances as a residual, available data for this indicator could have been imposed. If so, some other item would have to be the residual; foreign savings are one option. The choice of procedure may be constrained by data availability – missing data are natural residuals (cf. the residual definition of household savings).

[11] Alternatively, household savings could be defined as the residual of the current account of the household. If so, the savings-investment account would be the residual account, which, by definition, also would be in balance.

**Table 3.1. Macro SAM I for archetype low-income country in 2015 (percent of GDP)**

| | act | com | f-lab | f-cap | hhd | gov | row | tax-act | tax-com | tax-imp | tax-exp | tax-dir | cssoc | sav-inv | dstk | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| act | | 164.8 | | | | | | | | | | | | | | 164.8 |
| com | 72.0 | | | | 80.8 | 11.7 | 19.8 | | | | | | | 19.2 | -6.2 | 197.3 |
| f-lab | 52.5 | | | | | | 0.1 | | | | | | | | | 52.6 |
| f-cap | 40.0 | | | | | | 0.2 | | | | | | | | | 40.2 |
| hhd | | | 52.3 | 37.8 | | 1.6 | 2.8 | | | | | | | | | 94.5 |
| gov | | | | | 1.8 | | 0.9 | 0.3 | 5.7 | 1.4 | 0.0 | 4.0 | 0.0 | | | 14.1 |
| row | | 25.3 | 0.2 | 2.4 | 0.5 | 0.1 | | | | | | | | | | 28.5 |
| tax-act | 0.3 | | | | | | | | | | | | | | | 0.3 |
| tax-com | | 5.7 | | | | | | | | | | | | | | 5.7 |
| tax-imp | | 1.4 | | | | | | | | | | | | | | 1.4 |
| tax-exp | | 0.0 | | | | | | | | | | | | | | 0.0 |
| tax-dir | | | | | 4.0 | | | | | | | | | | | 4.0 |
| cssoc | | | 0.0 | | | | | | | | | | | | | 0.0 |
| sav-inv | | | | | 7.4 | 0.8 | 4.9 | | | | | | | | | 36.4 |
| dstk | | | | | | | | | | | | | | -6.2 | | -6.2 |
| total | 164.8 | 197.3 | 52.6 | 40.2 | 94.5 | 14.1 | 28.5 | 0.3 | 5.7 | 1.4 | 0.0 | 4.0 | 0.0 | 36.4 | -6.2 | |

Note: Grey cells are raw data; data in green cells are from calculations. See Tables 3.2 and 3.3.

Source: Authors' elaboration.

**Table 3.2. Macro SAM I: Data inputs**

| # | SAM cell | Definition | Source | Series Code |
|---|---|---|---|---|
| | *1. Data entered in Macro SAM I without transformation* | | | |
| 1 | [com,hhd] | Household final consumption expenditure, etc. | World Bank WDI (2017) | NE.CON.PETC.CN |
| 2 | [com,gov] | General government final consumption expenditure | World Bank WDI (2017) | NE.CON.GOVT.CN |
| 3 | [com,row] | Exports of goods and services | World Bank WDI (2017) | NE.EXP.GNFS.CN |
| 4 | [com,sav-inv] | Gross fixed capital formation | World Bank WDI (2017) | NE.GDI.FTOT.CN |
| 5 | [com,dstk] | Changes in inventories | World Bank WDI (2017) | NE.GDI.STKB.CN |
| 6 | [row,com] | Imports of goods and services | World Bank WDI (2017) | NE.IMP.GNFS.CN |
| 7 | [cssoc,f-lab], [gov,cssoc] | social contributions | World Bank WDI (2017) | GC.REV.SOCL.CN |
| 8 | [tax-act,act], [gov,tax-act] | Taxes on activities (producer taxes) | World Bank WDI (2017) | GC.TAX.OTHR.CN |
| 9 | [tax-com,com], [gov,tax-com] | Taxes on goods and services | World Bank WDI (2017) | GC.TAX.GSRV.CN |
| 10 | [tax-exp,com], [gov,tax-exp] | Taxes on exports | World Bank WDI (2017) | GC.TAX.EXPT.CN |
| 11 | [tax-imp,com], [gov,tax-imp] | Customs and other import duties | World Bank WDI (2017) | GC.TAX.IMPT.CN |
| 12 | [tax-dir,hhd], [gov,tax-dir] | Taxes on income, profits and capital gains | World Bank WDI (2017) | GC.TAX.YPKG.CN |
| 13 | [row,f-lab] | Labor income transferred to rest of world | IMF BOPS (2017) | BMIPCE_BP6_USD |
| 14 | [row,f-cap] | Capital income transferred to rest of world | IMF BOPS (2017) | BMIPI_BP6_USD |
| 15 | [row,hhd] | Current private transfers to rest of world | IMF BOPS (2017) | BMISO_BP6_USD |
| 16 | [row,gov] | Current government transfers to rest of world | IMF BOPS (2017) | BXISG_BP6_USD |
| 17 | [f-lab,row] | Labor income received from rest of world | IMF BOPS (2017) | BXIPCE_BP6_USD |
| 18 | [f-cap,row] | Capital income received from rest of world | IMF BOPS (2017) | BXIPI_BP6_USD |
| 19 | [gov,row] | Current government transfers received from rest of world | IMF BOPS (2017) | BMISG_BP6_USD |
| 20 | [sav-inv,row] | Foreign savings (current account deficit) | IMF BOPS (2017) | BCA_BP6_USD |
| | *2. Data inputs to calculations for Macro SAM I (intermediate data)* | | | |
| 21 | nontaxrev | Government non-tax revenue ("grants and other revenue") | World Bank WDI (2017) | |
| 22 | shrlabva | Labor share in value-added (or GDP at factor cost) | GTAP (2016) | |
| 23 | intmed/VA | Ratio between intermediate consumption and value-added | GTAP (2016) | |
| 24 | eg | Expense (total government current expenditures) | World Bank WDI (2017) | GC.XPN.TOTL.CN |

Source: Authors' elaboration.

**Table 3.3. Macro SAM I: Calculations**

| # | Item or SAM cell | Definition | Formula |
|---|---|---|---|
| | *Computed intermediate variables* | | |
| 1 | gdpmp | GDP at market prices | = [com,hhd] + [com,gov] + [com,sav-inv] + [com,dstk] + [com,row] - [row,com] |
| 2 | netindtax | Net indirect taxes | = [tax-act,act] + [tax-com,com] + [tax-exp,com] + [tax-imp,com] |
| 3 | yg | Total government current revenue | = netindtax + [tax-dir,hhd] + nontaxrev |
| | *Additional cells in Macro SAM I* | | |
| 4 | [f-lab,act] | Labor value added | = (gdpmp - netindtax)*shrlabva |
| 5 | [f-cap,act] | Capital (non-labor) value added | = (gdpmp - netindtax)*(1 - shrlabva) |
| 6 | [com,act] | Intermediate consumption | = ([f-lab,act] + [f-cap,act])*intermed/VA |
| 7 | [act,com] | Sales of domestic output | = [f-lab-act] + [f-cap-act]+ [com,act] + [tax,act] |
| 8 | [hhd,f-lab] | Household labor income | = [f-lab,act] + {[f-lab,row] – [row,f-lab] – [cssoc,f-lab]} |
| 9 | [hhd,f-cap] | Household capital income | = [f-cap,act] + {[f-cap,row] – [row,f-cap]} |
| 10 | [gov,hhd] | Household transfer to government | = nontaxrev - [gov,row]. |
| 11 | [sav-inv,gov] | Government savings | = yg - eg |
| 12 | [hhd,gov] | Government transfers to household | = yg - ([com,gov] + [row,gov] + [sav-inv,gov]) |
| 13 | [hhd,row] | Foreign savings (current account deficit) | = ([row,com] + [row,f-lab] + [row,f-cap] + [row,hhd] + [row,gov]) - ([com,row] + [f-lab,row] + [f-cap,row] + [gov,row] + [sav-inv,row]) |
| 14 | [sav-inv,hhd] | Household savings | = ([com,sav-inv] + [com,dstk]) - ([sav-inv,gov] + [sav-inv,row]) |

Source: Authors' elaboration.

## Macro SAM II

The distinguishing feature of Macro SAM II compared to I is that the sectors (the activity and commodity accounts) are disaggregated into private and government. A SAM with this structure for an archetype developing country is presented in Table 3.4. The key assumptions that are made in the construction of such a SAM are as follows:

- The household (the private domestic institution) and the government consume only their own commodities, i.e. the private and the government commodity, respectively.[12]
- Only the private commodity is traded internationally (exported and/or imported).
- Intermediate and investment (fixed capital formation) demands are for private commodities.
- Activity and commodity taxes are paid in full by private activities and commodities, respectively.[13]

  Some of these assumptions may not be literally true. For example, some government output may be exported. Data and assumptions should be adjusted whenever they are

[12] This assumption is not as restrictive as it may seem since government demands for private commodities are part of the intermediate consumption of the government activity and thus included in the value of government consumption of the government commodity.

[13] Indirectly, the government pays indirect taxes as part of its intermediate demands for the private commodity, for which it pays the market (purchaser) price.

critical to analytical findings. However, if an assumption is not critical (and a small value of government exports is unlikely to make any qualitative difference to any analysis based on a macro SAM), it may be better to retain the erroneous assumption and save time for other tasks.[14]

Apart from the assumptions, we also note that, according to the national accounts, government value added is a payment to labor, i.e. the capital share is zero. Furthermore, since services cannot be stored, the demand for stock change must be for the private commodity since, as opposed to the government commodity, it includes goods (which are storable).

Mathematically, the split of the balanced accounts act and com of Macro SAM I into private and government accounts (act-gov, act-prv, com-gov, com-prv) is a balanced extraction to the government activity and commodity accounts (act-gov, com-gov) of selected payments from the aggregate activity and commodity accounts (act and com), drawing on the above-mentioned data and assumptions. After this, the accounts act and com, which remain balanced, are renamed to act-prv and com-prv.

As stated in Table 3.5, the only new information that is needed (beyond what is found in Macro SAM I) is the ratio between intermediate inputs and (labor) value added for the government, a piece of information that we extracted from the GTAP database (1). The rest of Table 3.5 shows the details of how the accounts act and com are split. Cells not involved in payments to or from act or com are unchanged compared to Macro SAM I. Government consumption is moved to a new cell (2) and, given the values for government consumption and the ratio between government intermediates and value added, the government payment to labor is defined using a formula that is derived in the table note (3). The government payment to intermediates is what remains of the government consumption value (4). Government output sales may be defined as government consumption or the production cost of the government activity (5). The private activity payments to labor and for intermediates are the differences between total activity cells in Macro SAM I and what the government pays (6-7). Only the private

[14] Cf. Rodrik (2016, p. 94-98) on assumptions in economics, including the observation that is echoed here: there is no need for assumptions to be true if they make no critical difference to findings.

activity pays capital rent and activity taxes (8-9). Private activity output sales are total activity output sales in Macro SAM I less government sales (10); it could also have been defined as the total production cost (column total) of the private activity. The remaining entries, all to or from the private commodity, are identical to the payments to or from the aggregate commodity in Macro SAM I (11-18).

**Table 3.4. Macro SAM II for archetype low-income country in 2015 (percent of GDP)**

| | act-prv | act-gov | com-prv | com-gov | f-lab | f-cap | hhd | gov | row | tax-act | tax-com | tax-imp | tax-exp | tax-dir | cssoc | sav-inv | dstk | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| act-prv | | | 153.1 | | | | | | | | | | | | | | | 153.1 |
| act-gov | | | | 11.7 | | | | | | | | | | | | | | 11.7 |
| com-prv | 63.6 | 8.4 | | | | | 80.8 | | 19.8 | | | | | | | 19.2 | -6.2 | 185.6 |
| com-gov | | | | | | | | 11.7 | | | | | | | | | | 11.7 |
| f-lab | 49.1 | 3.3 | | | | | | | 0.1 | | | | | | | | | 52.6 |
| f-cap | 40.0 | | | | | | | | 0.2 | | | | | | | | | 40.2 |
| hhd | | | | | 52.3 | 37.8 | | 1.6 | 2.8 | | | | | | | | | 94.5 |
| gov | | | | | | | 1.8 | | 0.9 | 0.3 | 5.7 | 1.4 | 0.0 | 4.0 | 0.0 | | | 14.1 |
| row | | | 25.3 | | 0.2 | 2.4 | 0.5 | 0.1 | | | | | | | | | | 28.5 |
| tax-act | 0.3 | | | | | | | | | | | | | | | | | 0.3 |
| tax-com | | | 5.7 | | | | | | | | | | | | | | | 5.7 |
| tax-imp | | | 1.4 | | | | | | | | | | | | | | | 1.4 |
| tax-exp | | | 0.0 | | | | | | | | | | | | | | | 0.0 |
| tax-dir | | | | | | | 4.0 | | | | | | | | | | | 4.0 |
| cssoc | | | | | 0.0 | | | | | | | | | | | | | 0.0 |
| sav-inv | | | | | | | 7.4 | 0.8 | 4.9 | | | | | | | | | 36.4 |
| dstk | | | | | | | | | | | | | | | | -6.2 | | -6.2 |
| total | 153.1 | 11.7 | 185.6 | 11.7 | 52.6 | 40.2 | 94.5 | 14.1 | 28.5 | 0.3 | 5.7 | 1.4 | 0.0 | 4.0 | 0.0 | 36.4 | -6.2 | |

Source: Authors' elaboration.

**Table 3.5. Macro SAM II: Additional calculations**

| # | Item or SAM cell | Definition | Formula/Source |
|---|---|---|---|
| | *New data inputs to calculations for Macro SAM II (intermediate data)* | | |
| 1 | gintmed/VA | Ratio bt. government intermediate demand and value-added | GTAP (2016) |
| | *New cells in Macro SAM II compared to Macro SAM I* | | |
| | Government activity and commodity | | |
| 2 | [com-gov,gov] | Government consumption | = [com,gov] |
| 3 | [f-lab,act-gov] | Government payment to labor* | = [com-gov,gov]/ (1 + gintmed/va) |
| 4 | [com-prv,act-gov] | Government payment for intermediates | = [com-gov,gov] - [f-lab,act-gov] |
| 5 | [act-gov,com-gov] | Sales of government output | = [com-gov,gov] (=[f-lab,act-gov] + [com-prv,act-gov]) |
| | Private activity and commodity | | |
| 6 | [f-lab,act-prv] | Private payment to labor | = [f-lab,act] - [f-lab,act-gov] |
| 7 | [com-prv,act-prv] | Private payment for intermediates | = [com,act] - [com-prv,act-gov] |
| 8 | [f-cap,act-prv] | Private payment to capital | = [f-cap,act] |
| 9 | [tax-act,act-prv] | Private payment to activity taxes | = [tax,act] |
| 10 | [act-prv,com-prv] | Sales of private output | = [act,com] - [act-gov,com-gov] |
| 11 | [row,com-prv] | Imports | = [row,com] |
| 12 | [tax-com,com-prv] | Sales taxes | = [tax-com,com] |
| 13 | [tax-imp,com-prv] | Import tariffs | = [tax-imp,com] |
| 14 | [tax-exp,com-prv] | Export taxes | = [tax-exp,com] |
| 15 | [com-prv,hhd] | Household consumption | = [com,hhd] |
| 16 | [com-prv,row] | Exports | = [com,row] |
| 17 | [com-prv,sav-inv] | Investment | = [com,sav-inv] |
| 18 | [com-prv,dstk] | Stock change | = [com,dstk] |
| *Derivation of the formula for government payment to labor: | | | |
| Known relationships: | | | |
| (1) [com-prv,act-gov] = gintmed/va*[f-lab,act-gov] | | | |
| (2) [com-gov,gov] = [f-lab,act-gov] + [com-prv,act-gov] | | | |
| Substituting for intermediate demand in 2 using 1: | | | |
| [com-gov,gov] = [f-lab,act-gov] + gintmed/va*[f-lab,act-gov] = [f-lab,act-gov]*(1 + gintmed/va) | | | |
| Solving for government payment to labor: | | | |
| [f-lab,act-gov] = [com-gov,gov]/ (1 + gintmed/va) | | | |

Source: Authors' elaboration.

## Macro SAM III

Compared to Macro SAM II, Macro SAM III replaces the aggregate savings-investment account by multiple capital and investment accounts. Such a SAM for an archetype country is shown in Table 3.6. Except for its disaggregation of the "taxes" account, its structure is identical to that of the SAM in Section 2.

New data and computations are shown in Table 3.7. With reference to the row numbers in this table, the only new data that are used (i.e., data other than the information in Macro SAM II) is information on government and foreign direct investment (1-2), government foreign borrowing (3), and change in foreign reserves (4). Government and private investment are defined using new investment data and the adding-up constraints for total

investment (5-6). The savings payments of the different institutions enter new cells (7-9). Given data on FDI (10), household investment financing is the residual (10-11). By assumption, the household (as opposed to the government) pays for stock change (12). As it is part of its budget, the government finances its own investment (13). Government foreign borrowing is defined as the product of (i) total foreign borrowing (the difference between foreign savings and FDI); and (ii) the share of government foreign borrowing in total foreign borrowing (14). Remaining borrowing by the government must come from the household (15) while remaining borrowing of the household (the difference between total spending on its capital, i.e. the sum of its payments for private investment, stock change and to finance the government, and its savings) must come from abroad (16).

**Table 3.6. Macro SAM III for archetype low-income country in 2015 (percent of GDP)**

| | act-prv | act-gov | com-prv | com-gov | f-lab | f-cap | hhd | gov | row | tax-act | tax-com | tax-imp | tax-exp | tax-dir | cssoc | cap-hhd | cap-gov | cap-row | inv-prv | v-gov | dstk | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| act-prv | | | 153.1 | | | | | | | | | | | | | | | | | | | 153.1 |
| act-gov | | | | 11.7 | | | | | | | | | | | | | | | | | | 11.7 |
| com-prv | 63.6 | 8.4 | | | | | 80.8 | | 19.8 | | | | | | | | | | 14.4 | 4.8 | -6.2 | 185.6 |
| com-gov | | | | | | | | 11.7 | | | | | | | | | | | | | | 11.7 |
| f-lab | 49.1 | 3.3 | | | | | | | 0.1 | | | | | | | | | | | | | 52.6 |
| f-cap | 40.0 | | | | | | | | 0.2 | | | | | | | | | | | | | 40.2 |
| hhd | | | | | 52.3 | 37.8 | | 1.6 | 2.8 | | | | | | | | | | | | | 94.5 |
| gov | | | | | | | 1.8 | | 0.9 | 0.3 | 5.7 | 1.4 | 0.0 | 4.0 | 0.0 | | | | | | | 14.1 |
| row | | | 25.3 | | 0.2 | 2.4 | 0.5 | 0.1 | | | | | | | | | | | | | | 28.5 |
| tax-act | 0.3 | | | | | | | | | | | | | | | | | | | | | 0.3 |
| tax-com | | | 5.7 | | | | | | | | | | | | | | | | | | | 5.7 |
| tax-imp | | | 1.4 | | | | | | | | | | | | | | | | | | | 1.4 |
| tax-exp | | | 0.0 | | | | | | | | | | | | | | | | | | | 0.0 |
| tax-dir | | | | | | | 4.0 | | | | | | | | | | | | | | | 4.0 |
| cssoc | | | | | 0.0 | | | | | | | | | | | | | | | | | 0.0 |
| cap-hhd | | | | | | | 7.4 | | | | | | | | | | | 0.4 | | | | 7.7 |
| cap-gov | | | | | | | | 0.8 | | | | | | | | 2.5 | | 1.5 | | | | 4.8 |
| cap-row | | | | | | | | | 4.9 | | | | | | | -0.1 | | | | | | 4.7 |
| inv-prv | | | | | | | | | | | | | | | | 11.6 | | 2.9 | | | | 14.4 |
| inv-gov | | | | | | | | | | | | | | | | | 4.8 | | | | | 4.8 |
| dstk | | | | | | | | | | | | | | | | -6.2 | | | | | | -6.2 |
| total | 153.1 | 11.7 | 185.6 | 11.7 | 52.6 | 40.2 | 94.5 | 14.1 | 28.5 | 0.3 | 5.7 | 1.4 | 0.0 | 4.0 | 0.0 | 7.7 | 4.8 | 4.7 | 14.4 | 4.8 | -6.2 | |

Source: Authors' elaboration.

**Table 3.7. Macro SAM III: Additional calculations**

| # | Item or SAM cell | Definition | Formula/Source |
|---|---|---|---|
| | *New data inputs to calculations for Macro SAM III (intermediate data)* | | |
| 1 | shrginv | Government share in total investment | IMF Investment and Capital Stock Dataset* |
| 2 | fdi | Foreign direct investment | WB International Debt Statistics Database |
| 3 | shrgfbor | Government share in total foreign borrowing | WB International Debt Statistics Database |
| 4 | drf | Change in foreign reserves | IMF BOPS (2017) |
| 5 | fbor | Total foreign borrowing | = [sav-inv,row] + drf - fdi** |
| | *New cells in Macro SAM III compared to Macro SAM II* | | |
| 5 | [com-prv,inv-gov] | Government investment | = [com,sav-inv] * shrginv |
| 6 | [com-prv,inv-prv] | Private investment | = [com,sav-inv] - [c-prv,inv-gov] |
| 7 | [cap-hhd,hhd] | Household savings | = [sav-inv,hhd] |
| 8 | [cap-gov,gov] | Government savings | = [sav-inv,gov] |
| 9 | [cap-row,row] | Foreign savings | = [sav-inv,row] |
| 10 | [inv-prv,cap-row] | FDI | = fdi |
| 11 | [inv-prv,cap-hhd] | Household financing of private investment | = [com-prv,sav-inv] - [invng,cap-row] |
| 12 | [dstk,cap-hhd] | Household financing of stock change | = [com-prv,dstk] |
| 13 | [inv-gov,cap-gov] | Government investment financing | = [com-prv,inv-gov] |
| 14 | [cap-gov,cap-row] | Foreign financing of the government | = min{([cap-gov,gov] - [invg,cap-gov]), fbor*shrgfbor} |
| 15 | [cap-gov,cap-hhd] | Household financing of the government | = [invg,cap-gov] - ([cap-gov,gov] + [cap-gov,cap-row]) |
| 16 | [cap-hhd,cap-row] | Foreign financing of household | = ([cap-gov,cap-hhd] + [invng,cap-hhd] + [dstk,cap-hhd]) - [cap-hhd,hhd] |
| 17 | [cap-row,cap-row] | Change in foreign reserves | = drf |

*If no data is available, the average for countries in same income group was used.

**If no data is avaiable in World Bank (2017), IMF (2017) is used.

Source: Authors' elaboration.

## 4. A computer program for building macro SAMs from cross-country data

Using the procedure described in Section 3, macro SAMs were put together for 133 countries drawing on data extracted from cross-country databases. The SAMs and a computer program that applies the procedure are available on request from the authors as an electronic appendix to this paper.

In outline, the program does the following: First, it assembles relevant data from the World Bank, IMF, and GTAP in a computer-readable format.[15] [16] On the basis of a check on country-level data availability, it then identifies the most recent year (2010 or later) with sufficient information to construct each of the three macro SAMs for each country. After this, it defines the three macro SAMs using the procedure presented in Section 3,

[15] The process was programmed in the GAMS (the General Algebraic Modeling System) software, drawing on raw data entered in a GAMS-readable format in Excel.

[16] GTAP is a database with full global coverage, in the version used (version 9) splitting the world economy into 140 regions, most of which are individual countries.

complemented by checks designed to catch errors and signal outliers. Among other things, the checks verify that the resulting SAMs are balanced, have values in all obligatory cells, and only have negative values when this is legitimate.

Depending on data availability, the program may deviate from the procedure of Section 3. This may be due to that exogenous data are available for values that are residual under the above procedure and at the same time missing (or deemed to be of relatively low quality) for some information that currently is imposed. For example, if data for government savings are available (which is commonly the case), then this information could be imposed instead of being residual. If so, some other item would typically have to be residual, for example transfers to the household from the government.

Table 4.1 summarizes the country coverage in the database by type of SAM and country income group; data were insufficient for excluded countries. Of a total of 218 countries (across all income groups), sufficient information was available to produce Macro SAMs of all three types for 133 countries. Not surprisingly, the higher the income group, the higher the coverage rate. However, also among low-income countries coverage seems good (considering general data paucity).

**Table 4.1. Country coverage of macro SAM database**

| Item | Low income | Lower middle income | Upper middle income | High income | Total |
|---|---|---|---|---|---|
| # of countries covered | 17 | 36 | 34 | 46 | 133 |
| # of countries in group | 31 | 53 | 56 | 78 | 218 |
| Share of countries covered (%) | 54.8 | 67.9 | 60.7 | 59.0 | 61.0 |

Source: Authors' elaboration.

## 5. SAM description: An example

This section demonstrates how selected pieces of information contained in a SAM may be extracted and presented in a set of tables that is in line with how data more often are presented, albeit with the disadvantage of not making links between accounts explicit (which is done within the SAM format). The information, presented in Tables 5.1-5.5, covers GDP structure (from the spending side), the current and capital accounts of the balance of

payments, the government budget, sector structure, and structure of sector factor use, respectively. The data are all from Macro SAM III for the archetype low-income economy (Table 3.6), i.e. a GDP-weighted average of the low-income countries for which sufficient data were available. Given this, they may be taken to show the situation for an average low-income country in 2015 (brushing aside the issue of whether the data for low-income countries with sufficient data deviate systematically from those without data). Like Table 3.6, the unit in these tables is percent of GDP, a choice that makes the numbers more meaningful and easier to interpret.

In terms of GDP spending structure (Table 5.1), absorption (domestic final demands) exceeds total GDP by 5.6 percent thanks to a trade deficit of the same magnitude. Among domestic final demands, the private sector and the government account for 89.0 and 16.5 percent, respectively. Government final demands are relatively focused on fixed investment: its ratio between fixed investment and consumption ratio is 0.41 as opposed to 0.18 for the private sector.

The current account of the balance of payments (Table 5.2) shows that the trade deficit and absorption in excess of GDP were made possible by foreign savings (a current account deficit) at 4.9 percent and a surplus for non-trade items in the current account at 0.7 percent (with non-government transfers or “worker remittances” as the main inflow). In the capital account of the balance of payments, the current deficit is mainly covered by FDI (2.9 percent) and government financing (mainly borrowing; 1.5 percent).

**Table 5.1. GDP Structure, low-income archetype country in 2015 (percent of GDP)**

| Item | Value |
|---|---|
| Absorption | 105.6 |
| Private consumption | 80.8 |
| Government consumption | 11.7 |
| Fixed investment | 19.2 |
| Private fixed investment | 14.4 |
| Government fixed investment | 4.8 |
| Change in inventories | -6.2 |
| Exports | 19.8 |
| Imports | 25.3 |
| GDP at market prices | 100.0 |
| Net indirect taxes | 7.5 |
| GDP at factor cost | 92.5 |

Source: Authors' calculations based on Table 3.6.

**Table 5.2. Balance of Payments, low-income archetype country in 2015 (percent of GDP)**

| Item | Value |
|---|---|
| Current account, inflows of foreign exchange | |
| Exports | 19.8 |
| Transfers to non-government | 2.8 |
| Transfers to government | 0.9 |
| Factor income | 0.3 |
| Foreign savings | 4.9 |
| Total | 28.5 |
| Current account, outflows of foreign exchange | |
| Imports | 25.3 |
| Transfers from non-government | 0.5 |
| Transfers from government | 0.1 |
| Factor income | 2.6 |
| Total | 28.5 |
| Capital account | |
| Net foreign financing to non-government | 0.4 |
| Net foreign financing to government | 1.5 |
| Foreign direct investment | 2.9 |
| Change in foreign reserves | 0.1 |
| Total | 4.9 |

Source: Authors' calculations based on Table 3.6.

In the government budget (Table 5.3), taxes, at 11.5 percent of GDP, are the main receipt while foreign transfers only amount to 0.9 percent. Government savings (0.8 percent) fall

well short of government investment (4.8 percent), a shortfall that is covered by domestic and foreign financing.

**Table 5.3. Government budget, low-income archetype country in 2015 (percent of GDP)**

| Item | Value |
|---|---|
| Recurrent receipts | |
| Direct taxes | 4.0 |
| Social contributions | 0.0 |
| Activity taxes | 0.3 |
| Commodity taxes | 5.7 |
| Tariffs | 1.4 |
| Export taxes | 0.0 |
| Domestic transfers | 1.8 |
| Foreign transfers | 0.9 |
| Total | 14.1 |
| Recurrent spending | |
| Consumption | 11.7 |
| Domestic transfers | 1.6 |
| Foreign transfers | 0.1 |
| Total | 13.4 |
| Savings* | 0.8 |
| Investment | 4.8 |
| Surplus** | -4.0 |
| Financing | |
| Net domestic financing | 2.5 |
| Net foreign financing | 1.5 |
| Total | 4.0 |

*Savings is the difference between the totals for recurrent receipts and recurrent spending.
**Surplus is the difference between savings and investment.
Source: Authors' calculations based on Table 3.6.

The production and trade structure of the country is summarized in in Table 5.4. The columns "Exports" and "Imports" show the share of each sector in total exports and imports, respectively while the columns "Export-Output ratio" and "Import-Demand ratio" present, for each sector, the share of exports in output and the share of imports in domestic demands, respectively. In sum, the private sector accounts for more than 96 percent of value added and all of exports while all imports are categorized as private. Within the

private sphere, most production is nevertheless for the domestic market (only 12.9 percent is exported) while most domestic demands are satisfied with domestic output (imports only amount to 16.7 percent).

**Table 5.4. Sectoral structure, low-income archetype country in 2015 (percent)**

| | Value added | Production | Exports | Export-Output ratio | Imports | Import-Demand ratio |
|---|---|---|---|---|---|---|
| Private sector | 96.4 | 92.9 | 100.0 | 12.9 | 100.0 | 16.7 |
| Government sector | 3.6 | 7.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total | 100.0 | 100.0 | 100.0 | 12.0 | 100.0 | 15.6 |

Source: Authors' calculations based on Table 3.6.

Table 5.5 shows the factor shares in total sectoral value added. As indicated, the government is only recorded as paying for labor; it does not pay any rent for its use of government capital (created from government investment) The overall labor share in value added (56.7 percent) is within the expected range (Gollin, 2002).

The information found in Tables 5.1-5.5 could be presented in a more disaggregated manner if it were based on a more disaggregated SAM. This would be important for many analytical purposes. For example, analyses of issues related to structural transformation and income distribution could benefit from more disaggregated sector information in Tables 5.4 and 5.5. When a SAM serves as data input to a CGE model, the model would explain the evolution of the payments in the different SAM cells, including that they often depend on changes in prices, quantities, and tax rates.

**Table 5.5. Sectoral factor intensity, low-income archetype country in 2015 (percent)**

| | Labor | Capital | Total |
|---|---|---|---|
| Private sector | 55.1 | 44.9 | 100.0 |
| Government sector | 100.0 | 0.0 | 100.0 |
| Total | 56.7 | 43.3 | 100.0 |

Source: Authors' calculations based on Table 3.6.

## 6. Concluding observations

Country-level macro SAMs are useful for description and policy analysis and as inputs to the building or updating of more disaggregated SAMs. This paper presents a simple procedure for constructing macro SAMs of three types, accompanied by an electronic appendix with a program that, drawing on cross-country databases, uses the procedure to build such matrices for 133 countries. If the procedure is implemented manually in a spreadsheet, it is straightforward to draw on additional country-specific sources, making it possible to construct a SAM for virtually any country; this is demonstrated in the paper appendix in an application to Guinea. A companion paper – Cicowiez and Lofgren (2017) -- presents and applies a policy-oriented CGE model that only requires a macro SAM and a handful of elasticities and stock parameters.

We hope that by making the procedure and its data sources transparent, it can be applied by others and improved. The paper suggests that, in order to better facilitate SAM construction and economywide analysis, cross-country databases need to provide more complete and detailed data for the government budget and the balance of payments, subjecting the information generated to consistency checks.

Before being used in analysis, the SAMs in the electronic appendix should be scrutinized by country experts who can compare the data to what is available in additional country-specific sources and adjust when needed; given the high level of aggregation, it is straightforward for anyone familiar with the procedure to adjust selected cells while maintaining a balanced SAM.

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## Appendix. Building Macro SAMs for Guinea

This appendix demonstrates the construction of macro SAMs in Excel, applied to Guinea, a low-income country for which it was not possible to construct the three macro SAMs using cross-country data; most of the data for the SAMs are from a country-specific source, an IMF report (IMF 2016). The appendix is made up of a set of tables that show (a) 2016 Macro SAMs for Guinea of the three types described in the main text; and (b) the input data and computations that underlie the construction of these SAMs.

More specifically, Table A.1 shows a macro SAM of type I, i.e. with a single sector (one activity and one commodity) and an aggregate treatment of savings and investment. The notation is the same as used in the main text. The data used to build Table A.1 are shown in Table A.2, also indicating the sources used. It is split into two sections. The first covers the data that were entered directly into SAM cells while the second lists the data that were inputs to calculations that produced values for other cells. Table A.3 shows the calculations used for each SAM cell, drawing on the data in Table A.2.

**Table A.1. Macro SAM I for Guinea in 2016 (billions of current Guinean francs)**

| | act | com | f-lab | f-cap | hhd | gov | row | tax-act | tax-com | tax-imp | tax-exp | tax-dir | sav-inv | dstk | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| act | | 93,654 | | | | | | | | | | | | | 93,654 |
| com | 42,789 | | | | 49,974 | 6,061 | 16,357 | | | | | | 9,842 | 0 | 125,023 |
| f-lab | 17,043 | | | | | | 0 | | | | | | | | 17,043 |
| f-cap | 32,008 | | | | | | 0 | | | | | | | | 32,008 |
| hhd | | | 17,043 | 29,583 | | 2,977 | 716 | | | | | | | | 50,318 |
| gov | | | | | 2,065 | | 811 | 1,814 | 5,132 | 2,241 | 0 | 1,650 | | | 13,713 |
| row | | 23,996 | 0 | 2,426 | 0 | 0 | | | | | | | | | 26,422 |
| tax-act | 1,814 | | | | | | | | | | | | | | 1,814 |
| tax-com | | 5,132 | | | | | | | | | | | | | 5,132 |
| tax-imp | | 2,241 | | | | | | | | | | | | | 2,241 |
| tax-exp | | 0 | | | | | | | | | | | | | 0 |
| tax-dir | | | | | 1,650 | | | | | | | | | | 1,650 |
| sav-inv | | | | | -3,370 | 4,675 | 8,537 | | | | | | | | 9,842 |
| dstk | | | | | | | | | | | | | 0 | | 0 |
| total | 93,654 | 125,023 | 17,043 | 32,008 | 50,318 | 13,713 | 26,422 | 1,814 | 5,132 | 2,241 | 0 | 1,650 | 9,842 | 0 | |

Note: Grey cells are raw data; data in green cells are from calculations in Tables A.2 and A.3.
Source: Authors' elaboration.

## Table A.2. Macro SAM I: Data inputs (billions of current Guinean francs)

| # | SAM cell / item name | Definition | Source/Comment | Value |
|---|---|---|---|---|
| | *Data entered in cells in Macro SAM I without adjustment** | | | |
| 1 | [com,gov] | General government final consumption expenditure | IMF (2016, p. 34); sum of spending on "wages" and "goods and services" | 6,061 |
| 2 | [com,row] | Exports of goods and services | IMF (2016, p. 38); | 16,357 |
| 3 | [com,sav-inv] | Gross fixed capital formation | IMF (2016, p. 33) | 9,842 |
| 4 | [com,dstk] | Changes in inventories | No data | 0 |
| 5 | [row,com] | Imports of goods and services | IMF (2016, p. 38) | 23,996 |
| 6 | [tax-act,act], [gov,tax-act] | Taxes on activities (producer taxes) | IMF (2016, p. 34) | 1,814 |
| 7 | [tax-com,com], [gov,tax-com] | Taxes on goods and services | IMF (2016, p. 34) | 5,132 |
| 8 | [tax-exp,com], [gov,tax-exp] | Taxes on exports | No data | 0 |
| 9 | [tax-imp,com], [gov,tax-imp] | Customs and other import duties | IMF (2016, p. 34) | 2,241 |
| 10 | [tax-dir,hhd], [gov,tax-dir] | Taxes on income, profits and capital gains | IMF (2016, p. 34) | 1,650 |
| 11 | [row,f-lab] | Labor income transferred to rest of world | No data | 0 |
| 12 | [row,f-cap] | Capital income transferred to rest of world | IMF (2016, p. 38) | 2,426 |
| 13 | [row,hhd] | Current private transfers to rest of world | Not applicable since netted | 0 |
| 14 | [row,gov] | Current government transfers to rest of world | Not applicable since netted | 0 |
| 15 | [f-lab,row] | Labor income received from rest of world | Implicitly part of net current private transfers | 0 |
| 16 | [f-cap,row] | Capital income received from rest of world | Not applicable since netted | 0 |
| 17 | [gov,row] | Current government transfers received from rest of world | IMF (2016, p. 38); official transfers | 811 |
| | *Data inputs to calculations for Macro SAM I (Table A.3)* | | | |
| 18 | nontaxrev | Government non-tax revenue ("grants and other revenue") | IMF (2016, p. 34); sum of "non-tax revenue" and "grants" | 2,876 |
| 19 | shrlabva | Labor share in value-added (or GDP at factor cost) | Aguiar et al. (2016) -- the GTAP 9 database | 0.347 |
| 20 | intmed/VA | Ratio between intermediate consumption and value-added | Aguiar et al. (2016) -- the GTAP 9 database | 0.872 |
| 21 | eg | Total government current expenditures | IMF (2016, p. 34) | 9,038 |

*Compared to the original source, data may have been summed and/or transformed from US dollars or GDP shares to Guinean francs using 2016 data for exchange rate or GDP.

Source: Authors' elaboration.

## Table A.3. Macro SAM I: Calculations (billions of current Guinean francs)

| # | SAM cell / item | Definition | Formula | Value |
|---|---|---|---|---|
| | *Computed intermediate variables* | | | |
| 1 | gdpmp | GDP at market prices | = [com,hhd] + [com,gov] + [com,sav-inv] + [com,dstk] + [com,row] - [row,com] | 58,238 |
| 2 | netindtax | Net indirect taxes | = [tax-act,act] + [tax-com,com] + [tax-exp,com] + [tax-imp,com] | 9,187 |
| 3 | yg | Total government current revenue | = netindtax + [tax-dir,hhd] + nontaxrev | 13,713 |
| | *Calculations defining remaining cells in Macro SAM I* | | | |
| 4 | [hhd,row] | Current private transfers received from rest of world | Residual (defined to replicate current account balance) | 716 |
| 5 | [com,hhd] | Household final consumption expenditure, etc. | Residual (defined to replicate GDP at market prices) | 49,974 |
| 6 | [f-lab,act] | Labor value added | = (gdpmp - netindtax)*shrlabva | 17,043 |
| 7 | [f-cap,act] | Capital (non-labor) value added | = (gdpmp - netindtax)*(1 - shrlabva) | 32,008 |
| 8 | [com,act] | Intermediate consumption | = ([f-lab,act] + [f-cap,act])*intermed/VA | 42,789 |
| 9 | [act,com] | Sales of domestic output | = [f-lab-act] + [f-cap-act]+ [com,act] + [tax,act] | 93,654 |
| 10 | [hhd,f-lab] | Household labor income | = [f-lab,act] + {[f-lab,row] – [row,f-lab]} | 17,043 |
| 11 | [hhd,f-cap] | Household capital income | = [f-cap,act] + {[f-cap,row] – [row,f-cap]} | 29,583 |
| 12 | [gov,hhd] | Household transfer to government | = nontaxrev - [gov,row]. | 2,065 |
| 13 | [sav-inv,gov] | Government savings | = yg - eg | 4,675 |
| 14 | [hhd,gov] | Government transfers to household | = yg - ([com,gov] + [row,gov] + [sav-inv,gov]) | 2,977 |
| 15 | [sav-inv,row] | Foreign savings (current account deficit) | = ([row,com] + [row,f-lab] + [row,f-cap] + [row,hhd] + [row,gov]) - ([com,row] + [f-lab,row] + [f-cap,row] + [hhd,row] + [gov,row]) | 8,537 |
| 16 | [sav-inv,hhd] | Household savings | = ([com,sav-inv] + [com,dstk]) - ([sav-inv,gov] + [sav-inv,row]) | -3,370 |

Source: Table A.2.

The presentation is similar for the SAMs of type II (which is identical to I except for disaggregation of activities and commodities into private and government) and III (which is identical to II except for disaggregation of accounts related to savings and investment). SAMs II and III are displayed as Tables A.4 and A.6, and related data inputs and calculations are found in Tables A.5 and A.7, respectively.

## Table A.4. Macro SAM II for Guinea in 2016 (billions of current Guinean francs)

| | act-prv | act-gov | com-prv | com-gov | f-lab | f-cap | hhd | gov | row | tax-act | tax-com | tax-imp | tax-exp | tax-dir | sav-inv | dstk | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| act-prv | | | 87,593 | | | | | | | | | | | | | | 87,593 |
| act-gov | | | | 6,061 | | | | | | | | | | | | | 6,061 |
| com-prv | 39,163 | 3,625 | | | | | 49,974 | | 16,357 | | | | | | 9,842 | 0 | 118,962 |
| com-gov | | | | | | | | 6,061 | | | | | | | | | 6,061 |
| f-lab | 14,607 | 2,436 | | | | | | | 0 | | | | | | | | 17,043 |
| f-cap | 32,008 | | | | | | | | 0 | | | | | | | | 32,008 |
| hhd | | | | | 17,043 | 29,583 | | 2,977 | 716 | | | | | | | | 50,318 |
| gov | | | | | | | 2,065 | | 811 | 1,814 | 5,132 | 2,241 | 0 | 1,650 | | | 13,713 |
| row | | | 23,996 | | 0 | 2,426 | 0 | 0 | | | | | | | | | 26,422 |
| tax-act | 1,814 | | | | | | | | | | | | | | | | 1,814 |
| tax-com | | | 5,132 | | | | | | | | | | | | | | 5,132 |
| tax-imp | | | 2,241 | | | | | | | | | | | | | | 2,241 |
| tax-exp | | | 0 | | | | | | | | | | | | | | 0 |
| tax-dir | | | | | | | 1,650 | | | | | | | | | | 1,650 |
| sav-inv | | | | | | | -3,370 | 4,675 | 8,537 | | | | | | | | 9,842 |
| dstk | | | | | | | | | | | | | | | 0 | | 0 |
| total | 87,593 | 6,061 | 118,962 | 6,061 | 17,043 | 32,008 | 50,318 | 13,713 | 26,422 | 1,814 | 5,132 | 2,241 | 0 | 1,650 | 9,842 | 0 | |

Note: Data in green cells are from calculations in Table A.5.

Source: Tables A.1-A.3 and A.5.

## Table A.5. Macro SAM II: Additional calculations (billions of current Guinean francs)

| # | Item or SAM cell | Definition | Source or Formula | 2016 |
|---|---|---|---|---|
| | *New data inputs to calculations for Macro SAM II (intermediate data)* | | | |
| 1 | gintmed/VA | Ratio bt. government intermediate demand and value-added | Aguiar et al. (2016) -- the GTAP 9 database | 1.489 |
| | *New cells in Macro SAM II compared to Macro SAM I* | | | |
| | Government activity and commodity | | | |
| 2 | [com-gov,gov] | Government consumption | = [com,gov] | 6,061 |
| 3 | [f-lab,act-gov] | Government payment to labor* | = [com-gov,gov]/ (1 + gintmed/va) | 2,436 |
| 4 | [com-prv,act-gov] | Government payment for intermediates | = [com-gov,gov] - [f-lab,act-gov] | 3,625 |
| 5 | [act-gov,com-gov] | Sales of government output | = [com-gov,gov] (=[f-lab,act-gov] + [com-prv,act-gov]) | 6,061 |
| | Private activity and commodity | | | |
| 6 | [f-lab,act-prv] | Private payment to labor | = [f-lab,act] - [f-lab,act-gov] | 14,607 |
| 7 | [com-prv,act-prv] | Private payment for intermediates | = [com,act] - [com-prv,act-gov] | 39,163 |
| 8 | [f-cap,act-prv] | Private payment to capital | = [f-cap,act] | 32,008 |
| 9 | [tax-act,act-prv] | Private payment to activity taxes | = [tax-act,act] | 1,814 |
| 10 | [act-prv,com-prv] | Sales of private output | = [act,com] - [act-gov,com-gov] | 87,593 |
| 11 | [row,com-prv] | Imports | = [row,com] | 23,996 |
| 12 | [tax-com,com-prv] | Sales taxes | = [tax-com,com] | 5,132 |
| 13 | [tax-imp,com-prv] | Import tariffs | = [tax-imp,com] | 2,241 |
| 14 | [tax-exp,com-prv] | Export taxes | = [tax-exp,com] | 0 |
| 15 | [com-prv,hhd] | Household consumption | = [com,hhd] | 49,974 |
| 16 | [com-prv,row] | Exports | = [com,row] | 16,357 |
| 17 | [com-prv,sav-inv] | Investment | = [com,sav-inv] | 9,842 |
| 18 | [com-prv,dstk] | Stock change | = [com,dstk] | 0 |
| *Derivation of the formula for government payment to labor: | | | | |
| Known relationships: | | | | |
| (1) [com-prv,act-gov] = gintmed/va*[f-lab,act-gov]; and (2) [com-gov,gov] = [f-lab,act-gov] + [com-prv,act-gov] | | | | |
| Substituting for intermediate demand in 2 using 1: | | | | |
| [com-gov,gov] = [f-lab,act-gov] + gintmed/va*[f-lab,act-gov] = [f-lab,act-gov]*(1 + gintmed/va) | | | | |
| Solving for government payment to labor: | | | | |
| [f-lab,act-gov] = [com-gov,gov]/ (1 + gintmed/va) | | | | |

Source: Authors' elaboration.

**Table A.6. Macro SAM III for Guinea in 2016 (billions of current Guinean francs)**

| | act-prv | act-gov | com-prv | com-gov | f-lab | f-cap | hhd | gov | row | tax-act | tax-com | tax-imp | tax-exp | tax-dir | cap-hhd | cap-gov | cap-row | inv-prv | inv-gov | dstk | total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| act-prv | | | 87,593 | | | | | | | | | | | | | | | | | | 87,593 |
| act-gov | | | | 6,061 | | | | | | | | | | | | | | | | | 6,061 |
| com-prv | 39,163 | 3,625 | | | | | 49,974 | | 16,357 | | | | | | | | | 4,535 | 5,307 | 0 | 118,962 |
| com-gov | | | | | | | | 6,061 | | | | | | | | | | | | | 6,061 |
| f-lab | 14,607 | 2,436 | | | | | | | 0 | | | | | | | | | | | | 17,043 |
| f-cap | 32,008 | | | | | | | | 0 | | | | | | | | | | | | 32,008 |
| hhd | | | | | 17,043 | 29,583 | | 2,977 | 0 | | | | | | | | | | | | 49,602 |
| gov | | | | | | | 2,065 | | 811 | 1,814 | 5,132 | 2,241 | 0 | 1,650 | | | | | | | 13,713 |
| row | | | 23,996 | | 0 | 2,426 | 0 | 0 | | | | | | | | | | | | | 26,422 |
| tax-act | 1,814 | | | | | | | | | | | | | | | | | | | | 1,814 |
| tax-com | | | 5,132 | | | | | | | | | | | | | | | | | | 5,132 |
| tax-imp | | | 2,241 | | | | | | | | | | | | | | | | | | 2,241 |
| tax-exp | | | 0 | | | | | | | | | | | | | | | | | | 0 |
| tax-dir | | | | | | | 1,650 | | | | | | | | | | | | | | 1,650 |
| cap-hhd | | | | | | | -4,086 | | | | | | | | | | 6,688 | | | | 2,602 |
| cap-gov | | | | | | | | 4,675 | | | | | | | 0 | | 632 | | | | 5,307 |
| cap-row | | | | | | | | | 9,253 | | | | | | | | | | | | 9,253 |
| inv-prv | | | | | | | | | | | | | | | 2,602 | | 1,933 | | | | 4,535 |
| inv-gov | | | | | | | | | | | | | | | | 5,307 | | | | | 5,307 |
| dstk | | | | | | | | | | | | | | | 0 | | | | | | 0 |
| total | 87,593 | 6,061 | 118,962 | 6,061 | 17,043 | 32,008 | 49,602 | 13,713 | 26,422 | 1,814 | 5,132 | 2,241 | 0 | 1,650 | 2,602 | 5,307 | 9,253 | 4,535 | 5,307 | 0 | |

Note: Data in green cells are from calculations in Table A.5.

Source: Tables A.1-A.5 and A.7.

## Table A.7. Macro SAM III: Additional calculations (billions of current Guinean francs)

| # | Item or SAM cell | Definition | Source/Comment or Formula | 2016 |
|---|---|---|---|---|
| | *Data inputs to calculations for new cells in Macro SAM III (intermediate data)* | | | |
| 1 | ginvgdp | Government investment as share of GDP | IMF (2016, p. 34) | 0.091 |
| 2 | fdi | Foreign direct investment | IMF (2016, p. 38) | 1,933 |
| 3 | fbor | Total foreign borrowing | IMF (2016, p. 38); defined as [sav-inv,row] minus fdi | 7,320 |
| 4 | shrgfbor | Government share in total foreign borrowing | IMF (2016, p. 38); government is all except private short-term | 0.337 |
| | *New cells in Macro SAM III (not in Macro SAM II)* | | | |
| 5 | [com-prv,inv-gov] | Government investment | = gdpmp * ginvgdp | 5,307 |
| 6 | [com-prv,inv-prv] | Private investment | = [com,sav-inv] - [c-prv,inv-gov] | 4,535 |
| 7 | [cap-hhd,hhd] | Household savings | = [sav-inv,hhd] | -4,086 |
| 8 | [cap-gov,gov] | Government savings | = [sav-inv,gov] | 4,675 |
| 9 | [cap-row,row] | Foreign savings | = [sav-inv,row] | 9,253 |
| 10 | [inv-prv,cap-row] | FDI | = fdi | 1,933 |
| 11 | [inv-prv,cap-hhd] | Household financing of private investment | = [com-prv,inv-prv] - [inv-prv,cap-row] | 2,602 |
| 12 | [dstk,cap-hhd] | Household financing of stock change | = [com-prv,dstk] | 0 |
| 13 | [inv-gov,cap-gov] | Government investment financing | = [com-prv,inv-gov] | 5,307 |
| 14 | [cap-gov,cap-row] | Foreign financing of the government | = min{([inv-gov,cap-gov]-[cap-gov,gov]), fbor*shrgfbor} | 632 |
| 15 | [cap-gov,cap-hhd] | Household financing of the government | = [inv-gov,cap-gov] - ([cap-gov,gov] + [cap-gov,cap-row]) | 0 |
| 16 | [cap-hhd,cap-row] | Foreign financing of household | = ([cap-gov,cap-hhd] + [inv-prv,cap-hhd] + [dstk,cap-hhd]) - [cap-hhd,hhd] | 6,688 |
| | *Derivation of the formula for government payment to labor: | | | |
| | Known relationships: | | | |
| | (1) [com-prv,act-gov] = gintmed/va*[f-lab,act-gov] | | | |
| | (2) [com-gov,gov] = [f-lab,act-gov] + [com-prv,act-gov] | | | |
| | Substituting for intermediate demand in 2 using 1: | | | |
| | [com-gov,gov] = [f-lab,act-gov] + gintmed/va*[f-lab,act-gov] = [f-lab,act-gov]*(1 + gintmed/va) | | | |
| | Solving for government payment to labor: | | | |
| | [f-lab,act-gov] = [com-gov,gov]/ (1 + gintmed/va) | | | |

Source: Authors' elaboration.