

## Constructing a 2012 Social Accounting Matrix for Palestine

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### Abstract

The paper presents the construction of a 2012 Social Accounting Matrix (SAM) for Palestine, which is an economy wide data framework for computable general equilibrium (CGE) modeling. The social accounting matrix represents the initial equilibrium and the market clearing conditions in the economy, because in the social accounting matrix framework expenditure has to equal income (row sum equal column sum) for every agent. The social accounting matrix for Palestine differentiates between accounts for activities (production) and commodities. The commodities are activity outputs and imports. The separation of activities from commodities allows the differentiation between home consumption, which is activity

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based, and households marketed consumption, which is commodity based. The government is divided into a core government account and tax account. The taxes paid to tax account, which forwards its revenues to the government account. In order to reconcile the inconsistency in the data which are gathered from various official sources, the study used Cross Entropy balancing technique to balance the prior social accounting matrix for Palestine. This social accounting matrix can be used as the underlying data framework for analysis of the Palestinian economy using Computable General Equilibrium Models.

Keywords: computable general equilibrium, social accounting matrix, input-output matrix.

**JEL Classification:** C68, D58, E52, F31, O21.

### **Introduction:**

The social accounting matrix (SAM) is a system related to national income accounting, gives a conceptual basis to examine growth and distributional issues within an economy. It presents in a single matrix the exchange between production, income, consumption and capital accumulation. It is a comprehensive, flexible, and disaggregated framework which record the generation of income by activities of production and the distribution of income between social and institutional groups (Reinert and Roland-Holst, 1997; Roland-Holst, 2008). A social accounting matrix is presented as a square matrix designed to give a record of the transactions between various economic agents, using a single entry form of booking (Pyatt, 1988). It is a square matrix of monetary flows that specify all transactions between the different entities in an economy with rows equal columns, which brings together data on production and income, and data about consumption of these incomes. The social accounting matrix is used to display socio-economic data from different sources and contains information on the structure of an economy and the pattern of economic transactions settled in a manner better than other methods used for that purpose (Round, 2003).

A Social accounting matrix has the objectives of, organizing information about the economic and social structure of a country over a period of time (income flows in an economy within a year) and providing statistical basis for the creation of models able to present a static image of the economy

along with simulating the effects of policy changes in the economy (King, 1985).

The social accounting matrix is a presentation of the accounting identities double entry, where revenues and expenditures for all sectors of the economy must be equal. Columns correspond to expenditures and rows correspond to revenues. Social accounting matrix was produced to classify all monetary flows from sources to beneficiaries, inside a disaggregated national account. In a social accounting matrix, revenues are intended as receipts for the row accounts and expenditures for the column accounts. Since revenues must be accounted for by expenditures, the total of rows and columns must be equal for a given account. The Social accounting matrix is read from column to row, so each entry comes from its column, going to the row account.

The social accounting matrix is an analytical framework in which social and economic data is integrated. It links within comprehensive integrated framework the macro-statistics of national accounts with the micro-statistics of the labor market and of households. It provides an outline that integrates disaggregated data on production, income and consumption. That allows a systematic listing of different economic transactions for the study of growth and its distribution in the economy. The social accounting matrix lets us identify the relationships between the different economic agents; where the economic agents are classified according to the main institutional sectors, households sector, production sector, government sector and the foreign sector. The performance of these sectors is analyzed in terms of contribution to net value added, net disposable income and net saving (Deb Pal et al., 2012).

The social accounting matrix provides an account of the circular flows in the economy. It is the representation of the flow of money, on one side, and the flow of goods and services on the other side. It shows the distribution of factor incomes of domestic and foreign origin, over institutional sectors. Also, it shows the redistribution of income and the expenditure made by institutional sectors on consumption, investment and savings. A social accounting matrix can be interpreted as an arrangement of the entire market transactions of commodities and factors made in the entire economy. The Walras' law is the principle for organizing the information in the social accounting matrix. It is assumed that agents earn incomes from selling their

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initial endowments of commodities or primary factors to other agents. The agents spend part of their incomes to buy commodities or primary factors in the markets. All exchanges occur in a way that income formed there must be a corresponding expenditure. The Social accounting matrix is built on walrasian general equilibrium structure and represents the main part of computable general equilibrium model to which it provides data for calibration. The data compiled in a social accounting matrix regarded as a benchmark equilibrium resulting from solving an applied general equilibrium model (Shoven and Whalley, 1992). The main objective of the social accounting matrix is to show various interdependencies in a socioeconomic system as a whole by recording, the actual and imputed transactions and transfers between different agents in the system (Round, 2003). A social accounting matrix links the information available in the Input-output matrix to other economic and social data gathered through the use of surveys on the labor force and on household spending decisions. These data are available from the Sample Survey of the Population, Household Budgetary Surveys and Surveys of Living Standards. The data from these sources are from different time periods, but they still provide a good indication of the structure of the economy and the interactions among social and economic entities (King, 1985).

### **The Mathematical Structure of the Social Accounting Matrix (SAM)**

As I have previously discussed in Eltalla (2010), a social accounting matrix is a single accounting outline which organizes income flows to the institutions and sectors into an equal number of rows and columns. The rows and columns identify different sectors in the economy. The elements of the social accounting matrix refer to the value of transactions between these sectors for a given time. For each row and column, the entries in the row express revenues for that sector where the entries in the corresponding column represent that sector expenditures. The totals for all corresponding row and column must be equal, because all incomes must be matched by corresponding expenditure in the economy (Walras' law). Any element of the social accounting matrix is an income for the sector in the row and it is expenditure for the sector in the column in which the item is located. A social accounting matrix is a square matrix which gives a record of the transactions between different economic agents, using a single entry form of

booking (Pyatt, 1988). Each cell represents a payment from a column account to a row account. If T is the matrix of social accounting matrix transactions, where T is a (g, k) payment from column account k to row account g. From the double entry bookkeeping, the total incomes and expenditures of each sector must balance. That is every row sum must equal the corresponding column sum.

A social accounting matrix is presented as a square matrix:

$$T = [t_{gk}]$$

Where g is the number of the row and k is the number of the column. Incomes are shown in the rows and expenditures are shown in the columns. Thus  $t_{gk}$  is the value of incomes of g from k during the accounting period, and  $t_{kg}$  is the payment to k by g.

A social accounting matrix is a square matrix; each account has its own row and column. The related row and column accounts of a social accounting matrix must be equal. This can be written as:

$$T \cdot g = y = g' \cdot T'$$

$$g' = [1 \dots \dots \dots 1]$$

Where y is the totals of the column vector of row and column of T and T' is the transpose of the matrix T.

The Social accounting matrix should satisfy the condition:

$$y_g = \sum_k T_{gk} = \sum_k T_{kg}$$

Where  $y_g$  are total incomes and expenditures of account g. Thus, social accounting matrixes satisfy Walras's Law.

A Social accounting matrix coefficient matrix,  $A_{gk}$ , is constructed from T by dividing the cells in each column of the Social accounting matrix (T) by the sum of the corresponding columns  $y_k$ :

$$A_{gk} = \frac{T_{gk}}{y_k}$$

All the column sums of A equal one, thus the matrix is singular. Since row sums equal column sums:

$$y = A$$

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Table 1: The Basic SAM structure used in the CGE model

	Activities	Commodities	Factors	Households	Government	Investment	Rest of World	Total
Activities		Marketed outputs		Home consumed outputs				Gross Output
Commodities	Intermediate inputs	Transactions costs		Private consumption	Government consumption	Investment	Exports	Demand
Factors	Value-added					Factor income	Factor income	
Households			Factor income to households		Transfers to households		Transfers to households	Household income
Government	Value-added tax	Sales taxes, Tariffs	Factor taxes	Direct household taxes			Transfers to government	Government income
Saving				Household savings	Government savings		Foreign savings	Savings
Rest of World		Imports	Factor income to RoW		Transfers to RoW			Foreign exchange outflow
Total	Activity expenditures	Supply	Factor expenditures	Household expenditures	Government expenditures	Investment	Foreign Exchange inflow	

Source: Løfgren et al. (2002)

### **The 2012 Palestinian Social Accounting Matrix:**

One way of portraying the economy is the circular flow diagram, which represents all transfers and real transactions between institutions and sectors. Manufacture activities, capital and labor inputs from the factor markets, and intermediate inputs from product markets, which utilize these to manufacture goods and services. Imports are added to these goods and services and then sold through product markets to households, the government, investors and foreigners, where each institution's expenditure becomes another institution's income. The Palestinian social accounting matrix is an economy-wide data framework describing the Palestinian economy. The social accounting matrix for Palestine is a square matrix, its rows and columns present separate accounts in the economy. The non-zero interchanges between rows and columns give the flows of funds between sectors. Production is divided into two types, activities and commodities. The activity account refers to the domestic producers account. The column consists of intermediate consumptions, value added and producer taxes. The row accounts are for domestic production. The sum of the activity purchases is gross domestic output (production at factor costs). The commodity account represents the market for goods, the column shows from where domestic sectors buy the goods. The column shows domestic production, imports, import tariffs and commodity taxes. The column total is total absorption. The domestic absorption is total absorption less exports. The row shows the domestic sectors, the activities buying goods in the form of intermediate goods (the supply and use matrix) and households, government, capital and the rest of the world buying final goods. The Social Accounting Matrix for Palestine has the following accounts:

#### **Commodities (COM):**

The entire supply of commodities valued at market prices, is domestic marketed production, imports of goods and services, indirect taxes (sales taxes, surtax on domestic and imported goods), and import tax. The commodity row presents the total demand for marketed goods and services. It includes intermediate demand of activities, household consumption, government consumption, investment demand of both private sector and government, changes in stocks and export demand of goods. The intersection among the commodity column and the taxes row gives the taxes paid. This is a compound of surtax on imported and domestic goods,

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domestic sales taxes and import duties. The values in the commodity column with the rest of the world give the whole value of imports of goods and services.

(Commodities, Activities)

The demand for intermediate goods by sectors is determined by the information in the supply and use matrix (SUT). The row shows the purchases by the activities of goods in the form of intermediate goods. Thus, the supply and use coefficient matrix represents the intermediate consumptions by the activities (The interactions between commodities and activities).

- (COM, HHD): 6436.8 million USD. Private Consumptions (PMA, 2013a).
- (COM, GOV): 2027.1 million USD. Government Consumptions (PMA, 2013a).
- (COM, S-I): 1353.0 million USD. Gross Fixed Capital Formation (PCBS, 2013a).

### **Activities (ACT):**

The activity column indicates expenditures happened during the production and include intermediate inputs purchases and compensations to the factors of production (value-added at factor cost).

(Activities, Commodities)

Total marketed output is the gross output. Which is the sum of intermediate consumptions, GDP at factor cost (FAC, ACT), and activity taxes. The social accounting matrix for Palestine, distinguishes between activities and commodities. The interactions between activities and commodities are in a one to one mapping between activities and commodities.

### **Factors:**

The factors entry in the social accounting matrix for Palestine has two columns and two rows, for aggregated labor and capital. The factors obtain factor income from abroad and value added payments from the activities account along the row. Down the column, factors make payments to the institutions (household and tax accounts). Total factor income is GDP at factor cost, which consists of compensation of employees (wages and salaries) and operating surplus comprising interest on capital. The GDP at factor cost is the value-added paid to labor and the value added paid to capital, which represented by the income of the factors row from the activity column. The factor account pays returns on capital, wages and salaries to households, which is represented by the factor column. The factor account also pay factor taxes to tax accounts, which transfer to the government and factor payments to the rest of the world.

(Factors, Activities)

Total factor income is the gross domestic product (GDP) at factor cost and is taken from national accounts. In constructing the social accounting matrix for Palestine this single value is disaggregated across two factors of production labor and capital. The value-added is 5737.3 million USD was disaggregated across factors of production using information from both national accounts and the 1998 input-output (I-O) matrix (PCBS, 2013a).

- (Labor, Activities): 3155.5 million USD.
- (Capital, Activities): 2581.8 million USD.

(Factors, Rest of World)

The factors receive factor income from abroad (PCBS, 2013b).

- (LAB, ROW): 1250.9 million USD.
- (CAP, ROW): 240.1 million USD.

### **Household (HHD):**

Institutions are consisting of the household, the government, and the rest of the world. The labor account pays wages to the household and taxes to the government through tax account. The household column displays the distribution of household income between the different uses, consumption, income taxes and savings, and the row represents total income received by households and includes factor incomes, transfers from the government, and net transfers from the rest of the world. The gross income of the households consists of the payments of the factors of production (Labor and Capital) and the received transfers of the government, and the rest of the world.

(Households, labor)

Households' income from labor domestic and remittance from abroad was 4406.4 million USD (PCBS, 2013a, 2013b).

- (HHD, LAB): 4406.4 million USD.

(Households, Capital)

Households' income from Capital domestic and from abroad was 2821.9 million USD (PCBS, 2013a, 2013b).

- (HHD, CAP): 2821.9 million USD.

### **Rest of the world (ROW):**

The rest of world row account obtains payments for imports from the commodities account, and obtains capital outgoings and foreign payments from the government. Exports of goods and services are the rest of world payments to the commodities account, foreign aids and other transfers are

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given in the column. Imports and factor payments and net interest payments by the rest of the world are in the row. The foreign savings is the balance of the current account expressed by the intersection among the rest of the world column (ROW) and the savings-investment row (S-I).

(Government, Rest of World)

- (GOV, ROW): 931.6 million USD. Foreign aid to the Palestinian Authority (PMA, 2013b).

(Households, Rest of World)

- (HHD, ROW): 189.4 million USD. Transfer income to the household from the rest of the world (PCBS, 2013b).

(Savings, Rest of World)

- (S-I, ROW): 2192.6 million USD. Foreign savings is the balance of the current account in the Palestinian balance of payments (PCBS, 2013b).

(Commodities, Rest of World)

The aggregate value of exports to the rest of the world is taken from national accounts (foreign trade and Palestinian balance of payments). The Palestinian exported 1090.3 million USD of goods and services in 2012 (PMA, 2013a; PCBS, 2013b).

- (COM, ROW): 1090.3 million USD. The aggregate value of exports to the rest of the world

(Rest of World, Commodities)

The aggregate value of imports from the rest of the world is taken from national accounts (foreign trade and Palestinian balance of payments). The Palestinian imported 4091.1 million USD of goods and services in 2012 (PMA, 2013a; PCBS, 2013b).

- (ROW, COM): 4091.1 million USD. The aggregate value of imports from the rest of the world.

### **Taxes:**

The tax accounts consist of a number of different tax accounts. These include accounts for activity tax represents payments by activities to the government for such items as business licenses, motor vehicle taxes and stamp duty, income tax, sales tax, factor tax and import tax (PMA, 2013b).

Tax Revenues: 479.0 million USD.

Nontax Revenues: 226.3 million USD.

Clearance Revenues: 1583.4 million USD.

### **Government (GOV):**

The government receives the activities taxes, the commodities taxes which include import tariffs, and sales taxes, social security taxes from the labor account, and income taxes from households. Foreign aids are recorded in the row as a payment from the rest of the world. The government buys commodities, gives transfers to households, and makes interest payments to the rest of the world. The row includes all incomes by government includes all taxes imposed on the different accounts in the economy and transfers from the rest of the world in the form of foreign aids. The government revenue is spent on spending on goods and services, transfers to households and government savings.

(Government, Taxes)

All tax accounts pay their tax revenue to the government (PMA, 2013b).

- (GOV, TAX): 2288.7 million USD.

### **Savings and investment (S-I)**

The savings-investment account receives private household savings, government savings, and foreign savings (the balance of current account) in the row and invests in the commodities account in the column.

- (S-I, ROW): 2192.6 million USD. Foreign savings (PCBS, 2013b).
- (S-I, HHD): -775.9 million USD. Household savings (PMA, 2013c).
- (S-I, GOV): -55.2 million USD. Government savings (PMA, 2013b).

### **The Prior Social Accounting Matrix**

The prior social accounting matrix is built by using the most recent information accessible. The preliminary job in building a social accounting matrix involves assembling data from various sources into the social accounting matrix structure. For Palestine, the information was drawn from national accounts, national supply-use tables, government budgets and balance of payments. The process of compiling the database and constructing the prior social accounting matrix is done in Excel file. We started with the new supply and use table, the new data which are collected for the relevant years organized in the Excel file around the supply and use table in a social accounting matrix structure. The prior social accounting matrix checked for differences between demand and supply in the commodity accounts, and between income and expenditure in the household and government accounts. The information often uses different years.

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Therefore, the prior social accounting matrix has imbalances between row and column account totals. The balancing procedure will adjust the differences between the totals of rows and columns (Arndt, 2010).

### Cross Entropy Method Estimation for Social Accounting Matrix

When building the social accounting matrix the preliminary one will not be consistent, there will be measurement errors, and some data are more reliable than others. The cross-entropy method contemplates these factors when balancing the social accounting matrix (Robinson et al., 1998). The cross-entropy method minimizes the cross-entropy gap between the probability distributions that are consistent with the new data and the previous data. It utilizes all available information, including prior parameter estimation. The cross-entropy method involves smaller number of assumptions (Robillard and Robinson, 2001). It is a method started from the information theory. Robinson et al. (1998) apply the cross entropy method to balance the social accounting matrix. The final phase of building the social accounting matrix for Palestine requires balancing the prior social accounting matrix using cross-entropy method, which capture advantage of the particular flows within the social accounting matrix while accounting for lack of data, and other inconsistencies. The social accounting matrix of Palestine is balanced by running the Cross-Entropy code in GAMS (Table 2).

**Table 2: The macro 2012 social accounting matrix of Palestine**

	1	2	3	4	5	6	7	8	Total
<b>Activities</b>		10456.04							10456.04
<b>Commodities</b>	4886.99	1033.29		6394.38	2302.57	1097.75		1091.46	16806.44
<b>Factors</b>	5386.21								5386.21
<b>Households</b>			5671.96		371.43				6043.39
<b>Government</b>							1801.95	818.65	2626.60
<b>Saving-Invest.</b>				-750.92	-47.40			1896.07	1097.75
<b>Taxes</b>	182.84	1225.18		399.93					1801.95
<b>Rest of the world</b>		4091.93	-285.75						3806.18
<b>Total</b>	<b>10456.04</b>	<b>16806.44</b>	<b>5386.21</b>	<b>6043.39</b>	<b>2626.60</b>	<b>1097.75</b>	<b>1801.95</b>	<b>3806.18</b>	

Source: Authors' calculations.

**Table 3: The base-year (benchmark) values correspond to the values found in the Palestinian social accounting matrix.**

National Accounts	Base line (millions USD)	Base line (As % of GDP)
Absorption	9794.700	144.162
Private consumption	6394.380	94.115
Gov. consumption	2302.570	33.890
Investment	1097.750	16.157
Exports	1091.460	16.065
Imports	4091.930	60.227
Net Taxes	1408.024	17.291
GDP	6794.230	100.000
GDP at factors cost	5386.206	79.276
Trade Deficit	3000.470	44.157

Source: Authors' calculations.

### **Conclusions:**

The social accounting matrix is a database for computable general equilibrium (CGE) modeling. It represents the initial equilibrium and the market clearing conditions in the economy, because in the social accounting matrix framework expenditure has to equal income (row sum equal column sum) for every agent. This paper has presented the construction of a 2012 social accounting matrix for Palestine. The social accounting matrix for Palestine differentiates between accounts for activities (production) and commodities. The commodities are activity outputs and imports. The separation of activities from commodities allow activities to produce multiple commodities and a commodity may be produced by many activities. The separation of activities from commodities allows the differentiation between home consumption, which is activity based, and households marketed consumption, which is commodity based. The government is divided into a core government account and tax accounts. The taxes paid to tax account, which forwards its revenues to the government account. The cross entropy method is used to provide a consistent and balanced social accounting matrix which can supply the underlying data for analysis of the Palestinian economy using a Computable General Equilibrium Models.

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