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A SOCIAL ACCOUNTING MATRIX FOR THE TURKISH ECONOMY[1]

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─Abstract ─

The Social Accounting Matrix (SAM) exhibits streams of all economic transactions occur inside an economy. Instead of using T-Accounts, SAM displays national accounts in a matrix format with their structural characteristics by combining "input-output approach" and "income-expenditure equalization".
In this study, built on the aggregated input-output table for the Turkish Economy for the year of 1998, a SAM will be constructed by using public sector general equilibrium, balance of payments and national accounts. The RAS method will be used to balance the SAM.

Key Words: *Computable General Equilibrium Models*, *Social Accounting Matrix, RAS Method.*
JEL Classification: D58, E01

1.INTRODUCTION

Employing general equilibrium analysis to evaluate the effects of alternative government policies requires computable general equilibrium (CGE) models. The advantage of computable general equilibrium models is the possibility they lead to investigate the interactions between the units in the economy and the effect of alternative policy implementations on the endogenous variables like interest rate, capital stock, consumption and saving.

Having it's source in the establishing the numeric results of the general equilibrium models, the constitutive intention to perform CGE models is to ensure quantitative evaluation of policy alternatives. The distinction between theoretical general equilibrium analysis and CGE models come into the open with this object. According to Bandara (1991), the object of general equilibrium theory is to prove the existence of general equilibrium[2] while the CGE Models' is, based on the Walras and Arrow-Debreu Models, to appraise different government policy alternatives in a numerical context.

The socle of the CGE models is based on multi-sector input-output models and linear programming. The multi-sector and convenient structure to analyze inter-sector interactions make these models more advantegous with respect to partial equilibrium models. Bandara (1991) defines CGE models as the natural extension of input-output models and linear programming where the

[1] This paper draws heavily on Ünlükaplan (2006)
[2] See Scarf (1960) and Arrow-Debreu (1954)

output and prices are endogenous, neo-classical substitutability in production and demand is possible, economic agents seek for individual optimization and the economy is regarded as a whole.

The CGE Models operate with data defines the economy as a whole for a base year (benchmark year). The duty of the SAM is to become a database for the benchmark year. The initial solution of the CGE model is the solution of the model that represents observed data for a spesific year. To solve the model and specify the paramater values with the benchmark year data is called "calibration". In practice, with changing one of the exogenous variables in the model and the aim is to compare the "before" and "after" values of the endogenous variables in the model.

The CGE models differantiate from macro-econometric models where they are calibrated so they represent a specific year. While macro-econometric models employ time-series. Moreover, the CGE models are strictly connected to neo-classical microeconomics while the macro-econometric models are not.

The object of this paper is to introduce the mission, the background and the structure of the SAM. First, the theoretical background of the SAM, as a database for the CGE models, will be introduced. Then, the data need and the alternative methods to balance the SAM will be pointed out. Last section of the study consists of two parts. In the first part, the schematic structure of the SAM for the Turkish Economy will be reviewed. The final part comprises the constructed SAM for Turkish Economy for 1998.

2.THE STRUCTURE OF THE SOCIAL ACCOUNTING MATRIX

Constructing and employing CGE models in policy analysis requires a classification of the economic units and goods in the model, collecting and arranging the data, specifying the parameter values in line with this classification and the structure of the model. The database required for a CGE model is called Social Accounting Matrix (SAM). A SAM is a consistent representation of the national account data concerning the different sectors and institutions represented by the parametrised theoretical model. (Munk, 2003:27)

In the late 1940's and early 1950's Richard Stone asseverated that the national accounts can be presented not only in T-accounts used in standart accounting system, but also in a matrix format that explain national accounts with their structural properties and defined this matrix as Social Accounting Matrix. (Stahmer,2002:2)

The CGE models requires data from different resources. The first step in model building is constructing a consistent and detailed database for the benchmark year. The SAM has a deterministic property because it encapsulates every unit in the model and all receipts and outlays and serves the purpose of becoming a database in the operation of CGE models. (Thorbecke, 2002:2). The reasons why the CGE models require this kind of database generate from the specification on parameters in the model and the reaching the initial equilibrium of the model.

According to Robinson *et al* (1999), the SAM integrates two different sentiments in the economic science. The first is the input-output table, reverberating the involvements between the industries. With reference to input-output table, if the sector purchases an internadiate good from the other sector this dealing is an "input" for the buyer sector and the "output" for the seller sector. Although, in the input-output table this interaction is shown with a single cell, the operation above has "input" and "output" properties. The SAM generalizes the principle of the input-output table for the whole economy. The interdependency principle between the sectors in the input-otput table is expanded in the SAM by comprising all units in the economy. Every cell in the SAM is a receipt for the row of the account that the cell belongs to and an outlay for the column. The second sentiment is national income accounting where the income must be equal to expenditures. The SAM requires income-expenditure equality for every factor. As a squared matrix, in the SAM, income is shown on the rows, while the expenditure is on the columns and row sum must be equal to column sum.

The basic element that determines the size of the SAM (the accounts in the SAM) is the scope of the model. The SAM which will be constructed in this study consists of ten accounts hereby ten rows and ten columns.

3.METHODS TO BALANCE THE SOCIAL ACCOUNTING MATRIX

The construction of the SAM requires data from different resources. These data resources are input-output tables, national income statistics, balance of payment statistics and public sector revenue/expenditure statistics. Combining the data acquired from different resources to construct the SAM sets forth the possibility of the inequalization of the row and column sums because of the discordance of the data. To correct this inequalization and get the equalization of row and column sums, three methods in the CGE literature have been introduced:

In this method, all cells in the SAM are adjusted so as to minimize the changes in the initial values' weighted sums with respect to row and column sums consistency constraint. This constrained matrix problem is shown below

i. Matrix Adjustment Method: In this method, all cells in the SAM are adjusted so as to minimize the changes in the initial values' weighted sums with respect to row and column sums consistency constraint. (Hosoe,2001,55). This constrained matrix problem is shown below:

$$\min_{x_{ij},yi} \quad \omega = \sum_{i,j} \left(\frac{v_{ij} - v_{ij}^0}{v_{ij}^0} \right)^2$$

s.t.

$$\sum_j v_{ij} = ss_{i,} \quad \forall i$$

$$\sum_j v_{ji} = ss_i, \quad \forall i$$

ω : Objective Function

v_{ij} : Cells in the SAM

v_{ij}^0 : Cells in the SAM Before the Adjustment

ss_i : Row and Column Sum in SAM

ii. Cross Entropy Method: To balance a SAM, the cross entropy approach was first used by Robinson *et al* (2001). The method finds its roots by the information theory by Shannon (1948). Then, Jaynes (1957) used this method for statistical inference and estimation and Theil (1967) introduced this method for economical aprroach. The procedure is based on minimizing cross-entropy measure[3] of the distance between the new and the prior estimated probabilities.

iii. RAS Method: A classic method of matrix adjustment suggested in the input-output literature is to generate a new matrix X^* from an existing matrix X (to satisfy new known row and column totals) by applying row and column multipliers, r and s respectively

$$X^* = \hat{r} X \hat{s}$$

The *(2n-1)* unknown multipliers are determined by the *(2n-1)* independent row and column restrictions using an iterative adjustment procedure. (Round, 2003:176)

4. THE SOCIAL ACCOUNTING MATRIX FOR THE TURKISH ECONOMY

The SAM in this study was built on the 1998 aggragated input-output table (SIS, 2004) by using public sector general equilibrium, balance of payments, national income accounts[4] [5]. Table 1 presents the schematic structure of the SAM.

The SAM built for this study with the 1998 data consists of ten accounts, therefore ten rows and ten columns. The column sum of an account exhibits the expenditure of that account while the row sum exhibits the revenue.

The column sum of the production activities account gives production cost and row sum gives aggregate supply. Total production cost consists of payments for intermediate inputs, factor payments and production taxes. When the constant returns to scale is assumed, total production

[3] For more information about "Cross Entropy" see Kullback-Leibler (1951)

[4] Other data sources in this study were the web sites of Turkish Republic Central Bank, State Planning Organization and Ministry of Finance.

[5] 1998 input-output table was obtained by adding domestic production matrix at basic prices based on the assumption of industry technology and import matrix and was aggregated to five main sectors.

cost equals the value of the production, or so called "aggregate supply". In the SAM, aggregate supply consists of domestic sales and exports.

The column sum of the goods account which gives information about goods and services supply is aggregate demand, row sum gives total domestic demand. Aggregate demand is the sum of domestic sales, consumption taxes and the import.Total domestic demand consists of intermadiate inputs, private consumption, government consumption expenditures, investment expenditures of firms and changes in stocks.

The column sum of the labour account shows payments to the labour as a factor (wages, total premium payments). Also named "labour cost". The row sum of the labour account is the labour income. Similiarly, the column sum of the capital account is capital cost while the row sum is the capital income.

In the household account, the column sum corresponds to household expenditures, the row sum is private income. Household expenditures consist of private consumption, income tax and private savings. Household income is the sum of wages, distributed profits and transfer payments received from the government.

The column sum of the government account gives government expenditures, the row sum is government revenues. The government expenditures are the sum of government consumption expenditures and transfer payments. The government revenues are the sum of production taxes, consumption taxes, income taxes and corporation income tax revenues. The positive difference between government revenues and the government expenditures is the "public saving- investment surplus".

The column sum of the firm account is firm expenditures, row sum is the firm revenues. Firm expenditures are the sum of distributed profits and corporation income taxes. Firm revenues are the capital income, interest on public debt and subsidies.

The column sum of the social security institutions account gives the expenditures of social security institutions, the row sum is the revenue of social security institutions. The expenditures of social security institutions are the payment to households while their revenues are the total premium payments and government transfer to social security institutions in order to finance their deficit.

The column sum of the saving account is the aggregate investments, the row sum is the aggregate savings. Aggregate investments correspond to the sum of investment expenditures and changes in stocks. Aggregate savings are the sum private savings, external resources and public saving-investment surplus[6].

[6] In the case of an inequalization between investment and saving, external resource inflow/outflow maintains the Walrasian equilibrium in the SAM.

Considering international trade account, the column sum is the foreign currency revenues while the row sum is the foreign currency expenditures. The currency revenues are the exports and foreign resources, the currency expenditures are the imports.

Table 2 represents the SAM compiled for the Turkish Economy for 1998. In table 2, domestic sales in the production activities account was calculated as residual corresponds to the difference between production cost and the export. Public saving- investment surplus in the saving account was calculated a residual too and has a negative value since government expenditures exceed government revenues. Similarly, distributed profits in the firms account and foreign resources in the international trade account were calculated as a residual.

To form production activities account, input-output table, to form goods account, national income accounts were used. Public consumption, on the row of goods account and at the columns of government account, was taken from consolidated budget statistics as "current expenditures". The taxes on consumption, on the column of the goods account and on the row of the government account, was taken from the consolidated budget revenue realizations as " indoor VAT". Transfer payments to households, on the row of household account and on the column of the government account, were taken as the sum of tax restitution, social transfers to scholars and transfers to official credit and scholarship institution. Transfers to firms are the sum of interest on domestic public debt, agricultural price supports and tax restitution for export. The positive difference between the expenditures and revenues of the social security institutions are "transfers to social security institutions" in the government account. To eliminate the row and column inequalization generated by data acquired by different official resources, the RAS method was employed to maintain row/column equalization.

5. CONCLUSION

The CGE models are based on Walrasian general equilirium theory. Considering the last two decades, there are some reasons why the use of the CGE models has been increased. The first one is about the computational technology. The progress in computational analysis has enabled academicians to assess the general principles and mechanism of the economic system also as a second reason the effect of alternative scenarios on the particular endogenous variables can be predicted within a numerical CGE model. The range of issues on which CGE models have an influence include public finance, agriculture, international trade, structural adjustment policies, poverty and income distribution.

Traditional national accounts are presesented in *T*-tables where every transaction is recorded twice, once as a payment on the left side of the account and once as a receipt on the right side. In contrast, in the SAM each transaction is recorded once, into the cell of the matrix.

A SAM is a square matrix in which each account has its row and column. The columns represent the expenditures and the rows represent the receipts. For a given account, the expenditures must be equal to the receipts. This means, considering a particular account row sums must be equal to the column sums. That is why the SAM is called a "square matrix". In the SAM, every flow must go

from some unit to other unit where there will be no leakage or injection into the system. The SAM is broadly used to assess the interrelationships of income and transfer flows between the economic accounts.

The usage of the SAMs have been popular to provide databases for constructing the CGE models. In order to build the SAM, data from different resources must be collected. National accounts, household budget and labor force surveys, foreign trade statistics, government budgets, balance of payments, and various other government publications are the examples of these data sources. Compounding the data collected from these different resources to construct the SAM exposes the possibility of the inequalization of the row and column sums because of the discordance of the data.

The object of this study was to point out the background and the structure of the SAM. First, the theoretical background of the SAM, as a database for the CGE models was introduced. Then, the data need and the alternative methods to balance the SAM were pointed out. Last section of the study consists of the schematic structure of the SAM for the Turkish Economy and the constructed SAM for Turkish Economy for 1998 by employing the RAS method to correct the data(1998 aggragated input-output table, public sector general equilibrium, balance of payments, national income accounts) conflict that resulted in the unbalanced SAM.

The Schematic Structure of the Turkish SAM

	Production Activities	Goods	Labour	Capital	Households	Government	Firms	Social Security Institutions	Saving	International Trade	
Production Activities		Domestic Sales								Export	Aggregate Supply
Goods	Intermediate Inputs				Private Consumption	Government Consumption Expenditures			Investment Expenditures and Change in Stocks		Aggregate Domestic Demand
Labour	Wages										Labour Income
Capital	Capital Income										Capital Income
Households			Wages			Transfer Expenditures to Household	Distributed Profits	Expenditure of Social Security Institutions			Household Income
Government	Production Taxes	Consumption Taxes			Income Taxes		Corporation Income Tax				Government Revenues
Firms				Capital Income		Interest on Domestic Public Debt and Firm Subsidies					Firm Revenues
Social Security Institutions			Total Premium Payments			Transfers on the Deficits of the Social Security Institutions					Revenue of Social Security Institutions
Saving					Private Savings	Public Saving-Investment Surplus				Foreign Resources	Aggregate Savings
International Trade		Import									Foreign Currency Expenditures
	Cost of Production	Aggregate Demand	Cost of Labour	Cost of Capital	Household Expenditures	Government Expenditures	Firm Expenditures	Expenditure of Social Security Institutions	Aggregate Investments	Foreign Currency Revenues	

Table 2: The Turkish SAM for 1998(Billions, TL)

	Production Activities	Goods	Labour	Capital	Households	Government	Firms	Social Security Institutions	Saving	International Trade	
Production Activities		75.495.182								12.713.300	88.208.482
Goods	39.431.668				37.348.460	1.316.835			13.560.503		91.657.466
Labour	12.878.068										12.878.068
Capital	35.280.133										35.280.133
Households			10.511.092			388.135	40.282.374	3.620.648			54.802.249
Government	618.613	1.589.060			3.481.752		748.383				6.437.808
Firms				35.280.133		5.750.624					41.030.757
Social Security Institutions			2.366.976			1.253.672					3.620.648
Saving					13.972.037	-2.271.458				1.859.924	13.560.503
International Trade		14.573.224									14.573.224
	88.208.482	91.657.466	12.878.068	35.280.133	54.802.249	6.437.808	41.030.757	3.620.648	13.560.503	14.573.224	

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