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Social Accounting Matrix: A Very Short Introduction for Economic Modeling

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Abstract

The main purpose of this paper is to clarify some important links between the Social Accounting Matrix and Fixed Price Multiplier(FPM) Models. The aim is expository. It is hoped that a brief but historically accurate background and description of SAM and SAM-based fixed price multiplier models will be helpful to the increasing number of researchers who are interested in using SAMs for both FPM and CGE modelling.

1.Introduction

The main purpose of this paper is to clarify some important links between the Social Accounting Matrix and Fixed Price Multiplier(FPM) Models. The aim is expository. I hope that a brief but historically accurate background and description of SAM and SAM-based fixed price multiplier models will be helpful to the increasing number of researchers who are interested in using SAMs for both FPM and CGE modelling.

The roots of SAM go back to the pioneering work in social accounting by Gregory King in 1681. However, modern social accounting is largely inspired by the work of Stone in connection with the Cambridge growth model in the 1950s and 60s. Stone's work with the UN SNA project gave further impetus to developing a disaggregated household sector description. In the 1970s Pyatt, Round and Thorbecke advanced the work to apply the idea of a SAM to developing countries. The work done in the 1980s at Cornell by Thorbecke, Khan and others led to disaggregation of technologies and the inclusion of the informal sector separately within a SAM.

2.Social Accounting Matrices as Consistent Economy wide Data Bases and Fixed Price Multipliers

In this section the Social Accounting Matrix is presented as a data gathering framework as well as an analytical tool for studying the effects of various macroeconomic policies as well as the impact of sectoral growth on poverty alleviation. As mentioned before,the origins of social accounting can be traced as far back as Gregory King's efforts in 1681, but more recent work stems from the attempts by Richard Stone, Graham Pyatt, Erik Thorkbecke and others. [2]

In the methodological framework of application to FPM and CGE models, the SAM can be viewed as a tool for mapping production and distribution at the economy wide level. In this section, first a general SAM is described. Then it is shown how the method for studying the short-run effects of economic growth within this framework follows logically from its structure. The model used is a simple version of a class of SAM-based general equilibrium models.[3] It summarizes succinctly the interdependence between productive activities, factor shares, household income distribution, balance of payments, capital accounts, etc. for the economy as a whole at a point in time. Given the technical conditions of production the value added is distributed to the factors in a determinate fashion. The value added accrued by the factors is further received by households according to their ownership of assets and the prevailing wage structure. In

[2] For a description of SAM as a data gathering device, see G. Pyatt and E. Thorbecke, *Planning Techniques for a Better Future* (Geneva: ILO, 1976).

[3]In Walrasian general equilibrium models the flexible price vector determines the equilibrium. In a Keynesian (dis)equilibrium model in the short-run the quantities vary while the price vector remains fixed.

the matrix form the SAM consists of rows and columns representing receipts and expenditures, respectively. As an accounting constraint receipts must equal expenditures.

As is elaborated further in Khan and Thorbecke (1988), the SAM framework can be used to depict a set of linear relationships in a fixed coefficient model. For deciding the question of determination, the accounts need to be divided into exogenous and endogenous ones. For instance, in the South African SAM used by Khan(1989) to analyze the impact of economic sanctions on the South African economy, there are three endogenous accounts. These are factors, households and production activities, leaving the government, capital and the rest of the world accounts as exogenous.[4]

In examining the poverty profiles in any country, one particular set of accounts assume special importance. These are the household accounts. The proper flow of income and expenditures need to be recorded for these accounts if an accurate picture of poverty as inadequate income/ consumption is to emerge out of a given SAM. For this reason, the classification of households needs special care. There are at least six aspects that need careful attention.

These six aspects are:

(1) to classify households by socio-economic characteristics;
(2) to understand the income generation process by which the households receive their incomes;
(3) to pinpoint the distributional mechanisms;
(4) to understand the household consumption patterns;
(5) to link household income and consumption to social capabilities and functionings; and
(6) to estimate the resource generating capacity and resource absorbing capacity of the households.

If items 1-6 can be investigated systematically by combining economic and social modes of inquiry in a SAM, proper policy intervention for poverty reduction will become a more tractable exercise than it is at present. In particular, if disaggregated SAMs can be constructed at the local, sub-national levels, then intervention at the local levels may be much more effective than it has been historically in many cases. This is yet to be realized, but clearly is an important goal to pursue. I now turn to a discussion of another particular strength of the SAM framework for data gathering. SAMs have the consistency features that one needs in capturing economic flows for use in a general equilibrium framework.

[4] See Khan and Thorbecke, op.cit., Ch. III. The presentations here follow the cited work closely.

The following tables illustrate in the aggregate the consistency requirements for building a SAM.

TABLE 1. SAM-FORMAT OF SNA-AGGREGATES, KENYA, 1982

(in KE million pounds)

	FACTORS OF PRODUCTION	INSTITUTIONS	PRODUCTION ACTIVITIES	CAPITAL ACCOUNT	INDIRECT TAXES	REST OF THE WORLD (NET)	TOTAL
FACTORS OF PRODCUTION			G.D.P. at factor cost (2931.87)			Net Factor Income from Abroad (-133.80)	Domestic Factor Inocme (2798.07)
INSITUTIONS	G.D.P. at factor cost (2798.07)				Net Indirect Taxes (467.59)	Net Non-Factor Income from Abroad (38.80)	Disposable National Income (3304.46)
PRODUCTION ACTIVITIES		Total Final Consumption (2793.15)		Gross Investments (764.71)		Trade Balance (158.40)	Net Final Demand (3399.46)
CAPTIAL ACCOUNT		Domestic Savings (511.31)				Balance of Payments Deficits (253.40)	Total Savings (764.71)
INDIRECT TAXES			Net Indirect Taxes (467.59)				Net Indirect Taxes (467.59)
TOTAL	Domestic Factor Income (2798.07)	Total Expenditure at Market pr. (3304.46)	G.D.P. at market prices (3399.46)	Total Gross Investments (764.71)	Net Indirect Taxes (467.59)	----------	

TABLE 2. MODULAR COMPOSITION OF THE SAM

	FACTORS OF PRODUCTION	INSTITUTIONS	PRODUCTION ACTIVITIES	CAPITAL ACCOUNT	INDIRECT TAXES	REST OF THE WORLD	TOTAL
FACTORS OF PRODCUTION			Income Generation Module			Factor Income Received from Abroad	Total Factor Income Received
INSITUTIONS	Income Distribution Module	Income Redistribution Module			Total Net Indirect Taxes	Transfers Received from Abroad	Total Disposable National Income
PRODUCTION ACTIVITIES		Domestic Consumption Module	Industrial Transactions Module	Domestic Investment Module		Exports	Total Demand
CAPTIAL ACCOUNT		Domestic Savings Module				Balance of Payments Deficits	Total Savings
INDIRECT TAXES		Indirect Taxes on Final Consumption	Indirect Taxes on Intermediate Consumption	Indirect Taxes on Investment Goods			Total Net Indirect Taxes
REST OF THE WORLD	Factor Income Paid Abroad	Imports of Final Consumer Goods	Imports of Intermediate Consumer Goods	Imports Investment Goods			Total Payments Abroad
TOTAL	Total Factor Income Paid	Total Expenditure of the Institutions	Total Supply	Total Gross Investments	Total Net Indirect Taxes	Total Receipts from Abroad	

In terms of the usefulness of the SAM information base, one can argue that not only is the National SAM a tool for the overall poverty reduction analysis, perhaps even more importantly, the building of local and regional SAMs will help the field-worker to understand the interrelations between households characteristics, the immediate causes of poverty and the best way to help specific types of households out of poverty. I now turn to the discussion of a particular type of modelling exercise that can be carried out with both the national and regional SAMs.

3.Fixed Price Multipliers for National and Regional SAMs

In what follows, a national framework with distinct regions where the poor may be located is assumed. Suppose there are n regions indexed by i = 1, 2, ...,n. For each region i, there are intra-regional transactions as well as inter-regional transactions. Then, the national SAM can be disaggregated into 'n' Regional or RSAMs. The typical RSAM for region i can be schematically described as in table 3. Table 4 divides up the regional accounts according to whether these are endogenous or exogenous for the purpose of modelling.

TABLE 3. SIMPLIFIED SCHEMATIC SOCIAL ACCOUNTING MATRIX

				Expenditures				
				Endogenous accounts			Exogenous	
				Factors	Households	Technology production activities	Sum of other accounts	Totals
				1	2	3	4	5
Receipts	Endogenous accounts	Factors	1	0	0	$T_{1.3}$	x_1	y_1
		Households	2	$T_{2.1}$	$T_{2.2}$	0	x_2	y_2
		Production Activities	3	0	$T_{3.2}$	$T_{3.3}$	x_3	y_3
	Exog.	Sum. of other accounts	4	1^1_1	1^1_2	1^1_3	t	y_x
		Totals	5	y^1_1	y^1_2	y^1_3	y^1_x	

The above SAM framework can be used to depict a set of linear relationships in a fixed coefficient model. This is the essential point behind fixed price multiplier modelling approach based on a SAM. For deciding the question of determination of the equilibrium quantities, the accounts need to be divided into exogenous and endogenous ones as in table 4 below.

TABLE 4. SCHEMATIC REPRESENTATION OF ENDOGENOUS AND EXOGENOUS ACCOUNTS IN A SAM

		Expenditures				Totals
		Endogenous	Sum	Exogenous	Sum	
Receipts	Endogenous	T_{nn}	n	Injections T_{nx}	x	y_n
	Exogenous	Leakages T_{xn}	1	Residual Balances T_{xx}	t	y_x
Totals		y_n'		y_x'		

Source: H.A. Khan and E. Thorbecke, *Macroeconomic Effects and Diffusion of Alternative Technologies Within a Social Accounting Matrix* (Aldershott, U.K.,: Gower Publishing Co., 1988).

Essentially the regional income SAM above describes the circular process in which production activities generate household incomes (via the aggregation of factorial income per household category), and household expenditures which generate the demand for output. Other related variables such as government spending, imports and exports, transfers, etc. are linked to this core process where necessary. Transfers to the households from various other institutions including other household are also important for income determination and poverty analysis.

The 1978 income SAM for South Africa which is used by Khan (1999) for poverty analysis, for example, contains 28 separate productive activities. There is clearly enough detail here on the production side. The value added generated in these productive activities is distributed among landowners, capitalists, and forty occupation-by-race groupings. The realism of the classifications captures the nature of the past apartheid regime by indicating the determination of many occupational categories by racial factors. Finally, there are seven groups of households within each of the four racial groups. These are stratified by income. Therefore, both racial and economic stratification are embodied here. For the purpose of studying the relationship between growth and poverty the households are separated into rural and urban types in this paper. Further, within urban and rural areas, households are classified as high, middle and low according to economic status. This six-fold classification is more relevant for exploring questions related to poverty than the aggregated (i.e. urban and rural combined) approach of the original SAM. The justification for reducing the household types to three within the urban or rural categories is that the original household classification was somewhat arbitrary. The top three household categories could be aggregated as high income. The remaining six could be reclassified according to the information provided by the household expenditures survey data into low and middle categories.

The starting point for an analysis based on this SAM is the exogenous nature of the increased demand leading to sectoral output increase. The set of fixed price multipliers can then be used to ascertain the impact of this increase in output on the incomes of specific household groups.

Looking at tables 3 and 4, which represent a SAM, we can see immediately that

$$y = n + x \quad (1)$$
$$y = 1 + t \quad (2)$$

Now if we divide the entries in the matrix Tnn by the corresponding total income (i.e. Yn), we can define a corresponding matrix of average expenditure propensities. Let us call this matrix A. We now have:

$$y = n + x = Ay + x \quad (2.1)$$
$$y = (1 - A)^{-1}x = Mx \quad (2.2)$$

M can be called the matrix of *accounting* multipliers. for these multipliers, when computed, can account for the results (e.g. income, consumption, etc.) obtained in the SAM without explaining the process that led to them. Let us now partition the matrix A in the following way.

$$A = \begin{pmatrix} 0 & 0 & A_{1.3} \\ A_{2.1} & A_{2.2} & 0 \\ 0 & A_{3.2} & A_{3.3} \end{pmatrix}$$

Given the accounts factors, household and the production activities, now we see that the income levels of these accounts (call them y_1, y_2, and y_3 respectively) are determined as functions of the exogenous demand of all other accounts. In this respect, what we have is a reduced-form model which can be consistent with a number of structural forms. This is quite satisfactory as far as tracing the effects of a certain injection in the economy is concerned or for prediction purposes when the structural coefficients are more or less unchanged.

One limitation of the accounting multiplier matrix M as derived in equation (2.2) is that it implies unitary expenditure elasticities (the prevailing average expenditure propensities in A are assumed to apply to any incremental injection). A more realistic alternative is to specify a matrix of marginal expenditure propensities (C_n below) corresponding to the observed income and expenditure that prices remain fixed. Expressing the changes in income (dy) resulting from changes in injections (dx), one obtains,

$$\begin{aligned} dy_n &= C_n dy_n + dx \\ &= (I - C_n)^{-1} dx = M_c dx \end{aligned}$$

M_c can be termed a fixed price multiplier matrix and its advantage is that it allows any nonnegative income and expenditure elasticities to be reflected in M_c. In particular, in exploring the macroeconomic effects of exogenous changes in the output of different product-cum-technologies on other macroeconomic variables, it would be very unrealistic to assume that consumers react to any given proportional change in their incomes by increasing expenditures on the different commodities by exactly that same proportion (i.e. assuming that the income elasticities of demand of the various socioeconomic household groups for the various commodities were all unitary). Since the expenditure (income) elasticity is equal to the ratio of the marginal expenditure propensity (MEP_i) to the average expenditure propensity (APE_i) for any given good i, it follows that the marginal expenditure propensity can be readily obtained once the expenditure elasticity and the average expenditure propensities are known, i.e.,

$$Ey_i = \frac{MEP_i}{AEP_i}$$, *where Eyi is the income elasticity for*

$$MEP_i = E\,y_i . AEP_i$$

Thus, given the matrix A_{32} of average expenditure propensities, and the corresponding expenditure elasticities of demand, y_i the corresponding marginal expenditure propensities matrix C_{32} could easily be derived.

As a further example, one can mention the use of SAMs for poverty analysis.For analyzing poverty both at the national and the subnational levels these multipliers can be further decomposed in terms of their effects on poor households incomes Tracing out these effects can be computationally demanding, but under assumptions of distributional neutrality of growth, the pure effects of growth on poverty have been estimated by Thorbecke and Jung(1996) for Indonesia and by Khan(1999) for South Africa. The latter used the South African SAM described above and found that the lack of human capital and more generally, basic capabilities in Sen's framework, was the main reason why growth left out the rural Black poor in particular.

4. Conclusions:

I have tried to clarify very briefly some important links between the Social Accounting Matrix and Fixed Price Multiplier(FPM) Models. The aim has been expository. I hope that this brief but historically accurate background and description of SAM and SAM-based fixed price multiplier models will be helpful to the increasing number of researchers who are interested in using SAMs for both FPM and CGE modelling. The examples given here could be multiplied easily since the already large literature is growing apace. Instead of surveying all the applications, the focus here has been on the exposition of a few significant aspects of SAMs for modelling purposes.

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