EXAMINING ECONOMIC LINKAGES IN ETHIOPIA: A SOCIAL ACCOUNTING MATRIX (SAM)–BASED MULTIPLIER ANALYSIS

Tadele Ferede* and Solomon Fikru**

INTRODUCTION

The effects of macroeconomic adjustment and subsequent policy design have traditionally been measured in terms of the behaviour of key macroeconomic variables such as current account deficit, inflation, GDP, employment etc. These variables, however, hide a multitude of changes since the various sectors of the economy react in quite different ways to policy-induced or any exogenous changes so that the macroeconomic average can hide large shifts. In order to improve the living standard of the population and attain development through well designed strategies; the inclusion of distributional variables during the process of policy design together with other macroeconomic variables is crucial. Thus, an in-depth treatment of the real interaction among production activities, factors of production and decision-making units is of paramount importance for the short-term analysis of demand management and policy design. This is so because it is only through the understanding of the microeconomic behaviours of the different social institutions that a proper picture of the functioning of the economy as a whole is obtained. As such, the analysis of these types of interconnections among sectors and institutions, such as the effects of exogenous changes on the economy, requires the specification of an economic model. Such type of economy-wide interactions can be captured by Social Accounting Matrix (SAM)-based economic model. However, the country has no such comprehensive analytical model, which takes into account the interdependence of the various sectors of the economy. In other words, the interactions of the different sectors of the economy have not been measured in the country to date. This study is designed to bridge this gap. The objective of this paper is, therefore, to measure the size and magnitude of inter-sectoral linkages in

* Department of Economics, Addis Ababa University.
** Ministry of Economic Development and Co-operation (MEDaC)

the Ethiopian economy. This is obviously essential for more insightful macroeconomic as well as sectoral policy design for Ethiopia.

In order to accomplish the stated mission, this study is structured in the following way. The second section deals with method of analysis; the third section discusses linkages and the final section offers conclusions.

METHOD

In order to use SAM for analytical framework, it is necessary to partition the SAM into endogenous and exogenous accounts. This will enable us to identify the impact of a change in the latter on the former. The basic assumptions of the linear equilibrium model include that constant relative prices, average and marginal propensities are equal and they are linear and fixed, expenditure and income elasticities are equal to unity for the accounting model. Furthermore, this model assumes that the economy is typified by under capacity utilisation of resources.

Endogenous accounts consist of production factors, institutions (households), and production activities for they form part of the stated objectives. In other words, the objective(s) of any economic policy is to bring growth, alleviate poverty, and the like. Hence, it is necessary to endogenize households, factors of production, and production activities to see how they respond to policy measures. On the other hand, exogenous accounts include government, combined capital account, and the rest of the world. Government is viewed as an interventionist institution that formulates policies and uses instruments such as taxes, subsidies, and the like to achieve its objectives. Capital account is also assumed to be exogenous because it does not have effects over other accounts in the short-run. This model assumes that there is under capacity utilisation of resources in the Ethiopian economy implying any increase in exogenous demand is met by output increase. Due to the existence of idle capacity in the economy, in the short-term, no additional investment is required to bring output-income increase in the economy resulting from an exogenous demand increase. Finally, the rest of the world account is set exogenous since Ethiopia is considered to be a small open economy and hence its macroeconomic policies cannot influence world aggregates. In other words, Ethiopia is too small to influence world aggregates. It takes, for instance, export price of coffee as given.

The separation of SAM into endogenous and exogenous accounts is presented in a schematic form as follows.

Table 2.1: Partitioning of SAM

Payments Receipts	Endogenous Accounts			Exogenous Accounts		
	Production Factors 1	Institutions 2	Activities 3	Government 4	Capital Acc 5.	ROW 6
Production Factors Institutions Activities	Endogenous Transactions			Injections		
Government Capital Account Rest of the World	Leakages			Exogenous Transactions		

Source: Vandemoortele, 1987

As depicted in the above table, the intersection of the third row and the second column represents the transaction matrix of the endogenous accounts. The intersection of the third row and third column represents the matrix of an injection, a transaction from exogenous accounts into endogenous accounts and may take the form of current transfers from the government or from abroad to households. By the same analogy, government final consumption, gross fixed capital formation and exports represent injections for they raise the demand for the output of production activities.

The intersection of the fourth row and second column of the same table shows the matrix of leakages, transactions from endogenous accounts into exogenous accounts and can take the form of taxes, international transfers, savings, and imports. Finally, the fourth row and third column shows the transaction matrix of exogenous accounts.

Thus by partitioning the SAM, the effects of changes in the exogenous accounts on the endogenous accounts of the economy can be captured. Multiplier analysis corresponding to the SAM-based linear fixed coefficient model can do this.

Following Pyatt and Round's (1979) formulation and denoting Y as the column vector whose elements are the row sums of the endogenous accounts (y_1, y_2, y_3), we have

$$Y = T + X \qquad (1)$$

Where:

T refers to the matrix of transactions between endogenous accounts and

X refers to the matrix of injections into endogenous accounts. Here an injection is a transaction from exogenous accounts into endogenous accounts and can take the form of current transfers from the government or from the rest of the world to households.

Further, defining the matrix of average endogenous transaction propensities as A_n, then we have

$$A_n = T/Y \Leftrightarrow T = A_n Y \qquad (2)$$

Alternatively, equation (2) can be expressed as

$$An = \begin{bmatrix} 0 & 0 & T_{13}y_3^{-1} \\ T_{21}y_1^{-1} & T_{22}y_2^{-1} & 0 \\ 0 & T_{32}y_2^{-1} & T_{33}y_3^{-1} \end{bmatrix} = \begin{bmatrix} 0 & 0 & A_{13} \\ A_{21} & A_{22} & 0 \\ 0 & A_{32} & A_{33} \end{bmatrix} \quad (3)$$

The subscripts 1, 2, and 3 refer, respectively, to factors of production, endogenous institutions, and production activities. As indicated in equation (3), the matrix of average endogenous transaction propensities A*n* is composed of five sub matrices:

(a) Payment matrix of factors of production by production activities A_{13}

(b) transaction matrix of factor incomes into institutional incomes A21

(c) transaction matrix between endogenous institutions A22

(d) consumption matrix A32, and

(e) industrial transaction matrix A33

From equation (1) and (2) we get

$$Y = A_n Y + X \qquad (4)$$

Equation (4) shows that total endogenous income is the sum of the value of endogenous transactions and the value of exogenous injections.

Rearranging Equation (4) yields

$$Y = (I - A_n)^{-1} X \qquad (5)$$

Letting $M = (I - A_n)^{-1}$, We have

$$Y = MX \qquad (6)$$

Matrix M has been termed as the accounting multiplier matrix since it explains the endogenous variables such as factors of production, production activities, and endogenous institutions in terms of the exogenous variables as government, capital account and rest of the world. The basic departure of equation (6) from the conventional input-output model is that the former concerns the simultaneous determination of the levels of output, incomes of the factors of production and household consumption. By contrast, the input-output model concerns the determination of output levels only.

The multiplier matrix shows how a change in any element of the exogenous accounts will affect the endogenous accounts. in other words, it measures the aggregate effect of injections into the economy on the interwoven parts of the endogenous system such as structure of output, factor demand, income distribution and consumption patterns.

This method will be used to explore the main characteristics of the Ethiopian economy. The discussion of the results is presented below.

ANALYSIS OF LINKAGES

It is known that the various sectors of the economy are interdependent as users of inputs from other sectors and as suppliers of inputs to other sectors. According to Herischman's terminology, the former is termed as backward linkage and the latter is called forward linkage (Sadoulet and Javry 1995). Backward linkage measures the proportion of an activity's output that represent purchases from other activities, while forward linkage measures the proportion of an activity's output that is used as inputs by other sectors. Before the 1970s, linkages had been measured based on input-output matrix. Linkages based on only inter-activity flows have been the main reason for ignoring agriculture while giving due emphasis to industrialisation. Since peasant agriculture, the dominant activity in most developing economies, is the producer of primary commodities, it has weak backward linkages. And since it is the producer of final commodities, it has low forward linkages. However, the inclusion of income and final consumption linkages into input-output matrix brought the key role of agriculture in development from the 1970s onwards (ibid.: 273). In developing economies like Ethiopia, the largest segment of the population is dependent on agriculture. As such, agriculture is considered to be the main source of household income and expenditure. Expenditures of agricultural households can induce industrialisation under the force of effective demand. Thus, when we consider the linkage effects brought by agricultural incomes, then agriculture will be as strong as industrial sector and induce a relatively more equitable distribution of growth (Ibid.: 291).

Accordingly, the ith column sum of the aggregate multiplier matrix gives the total input requirement from all sectors and this is the economy-wide backward linkage of this sector. The ith row sum of the aggregate multiplier matrix indicates the total forward linkage of the ith sector. These linkage types can be used for assessing the degree of interdependence of a given sector. Looking at the aggregate multiplier matrix, *teff* has got the highest backward linkage (10.764), followed by wheat (10.671). Food processing and textiles have also strong backward linkages indicating their high dependence on domestic sources and less dependence on imported materials.
Surprisingly, backward linkages with the magnitude of less than 5 occur in beverage (4.148), non-metals (4.471) and metals (2.352). This is clearly a sign of their high import dependence. As indicated earlier, non-metals and metals have high import-intensity with magnitudes of 0.70 and 0.90, respectively. These sub-sectors have weak integration with the rest of the domestic economy (For details see Tadele 2000).

Concerning forward linkages, it can be gleaned from the same table that teff has got the highest forward linkage (4.305) followed by metals (3.620), beverages (3.382), and textiles (3.157). Among the industrial sub-sectors, metals have got the highest forward linkages followed by beverages.

Relating these linkages for individual sectors to the overall linkage effect, the sectoral degree of interdependence can be examined. Taking the column elements of the aggregate multiplier matrix, a sector's backward linkage can be expressed as:

Backward Linkage = $n\Sigma i\ rij / \Sigma i \Sigma j\ rij$

Where n= number of sectors

rij = elements of the aggregate multiplier matrix

Forward linkage = $n\Sigma j\ rij / \Sigma i \Sigma j\ rij$

According to this method, a sector has high forward or backward linkage when it has a linkage greater than unity. As indicated, all agricultural sub-sectors have backward linkages higher than unity implying that they have greater integration with the rest of the economy. Surprisingly, all industrial sub-sectors have backward linkages below unity showing their high import dependence. With regard to forward linkages, all agricultural and industrial activities have forward linkages less than unity indicating weak integration with the rest of the economy.

The total linkage, which is the composite of the multipliers of different accounts, is useful in assessing the aggregate effect expected at the national level. The individual effects can be calculated and they are called partial forward or backward linkages. Looking at the accounts of production activities, wheat has the largest partial backward linkage (4.364) followed by teff (4.319). Among the industrial sub-sectors, food processing has the largest partial backward linkage (3.727) followed by textile (3.610). Between households, rural households have the largest partial backward linkage effects of (3.483). In addition, between factors of production, labour has higher partial backward linkage (3.286) as compared to capital.

It is also important to consider the degree of per account partial forward linkages. In this respect, the partial forward linkages of factors of production are 45.152 while that of households and production activities are 48.363 and 67.626, respectively. The production activities have the largest partial forward linkages, followed by households. The sum of these linkages gives us the economy-wide linkage.

CONCLUSIONS

In this paper, an attempt has been made to provide empirical evidence regarding the size and magnitude of economic linkages in Ethiopia. The analysis has been based on the Social Accounting Matrix (SAM) -based multiplier. The advantage of this method is that it captures both the direct and indirect effects of any exogenous changes. Based on the SAM-multiplier analysis, the following are the main conclusions and policy implications. This paper indicated that the indirect effects enhance the interdependence of the Ethiopian economy. In other words, when general equilibrium effects are taken into consideration, agriculture is found to be superior, through income and consumption linkages, in terms of stimulating economic growth in the country. More specifically, teff, wheat, maize, and coffee have higher backward linkages with the rest of the economy. Of the industrial sub-sectors, food processing, metals, beverages, and textiles have strong linkages with the rest of the economy.

With regard to the per account partial linkages, wheat has the largest backward linkage, followed by teff. Among the industrial sub-sectors, food processing has the largest partial backward linkage, followed by textile. Between households, rural households have the largest partial backward linkage effects. And between factors of production, labour has higher partial backward linkage as compared to capital.

The above linkage effects are very important for the choice of development strategy. Based on the aggregate linkage effects, the implication is that policies directed towards the expansion of the rural sector in general and the agricultural sector in particular and on selected manufacturing activities (food processing, textiles, and metals) would generate substantial stimulus for the economy. It is important to note that in addition to the linkage size, the choice of development strategy is based, among other things, on the availability of technology and its suitability to specific conditions.

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