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# SESSION 1

## Input output table and SAM

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# A - Input-Output (IO) Tables: Structure and Main Utilization

# Introduction (1)

- Agriculture is a major sector of most developing countries
- Agriculture policies affect all the other sectors through its effects on agricultural output, input demand, employment and income generation.
- Conversely, changes in other sectors may affect production, employment and income distribution in agriculture

The analysis of this type of interaction among sectors and institutions requires economy wide frameworks.

# Introduction (2)

The basis of such analysis must be consistent and complete data set on all transactions among sectors and institutions:

- Consistent: for every income there should be a corresponding outlay or expenditure

- Complete: Both the receiver and the sender of any transaction must be identified

The SAM is an efficient framework to organize economic data in such a way

# Introduction (3)

- Analysis of the interactions among sectors is a key element in the debate over the proper role of agriculture and other sectors in the development process.

- The prevailing view (50's) was that development should be based on industrialization because:

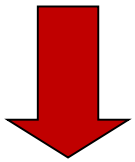
  - Industry is an active sector capable of pulling the whole economy
  - The agricultural sector is passive and unable to lead the economy to the desired development objectives.

- The choice of the strategic sectors in which to invest is based on their capacity to generate forward linkages (encourage sectors requiring their production as input) or backward linkages (encourage sectors supplying inputs to this sector)

# Introduction (4)

- The measure of these linkages is done from the input-output matrix.

- Peasant agriculture is short on linkages effects:
  - As primary production, it has few backward linkages
  - As producer of final commodities, it has low forward linkages



This development strategy based on linkage effects led to the neglect of agriculture.

# Introduction (5)

- Exhaustion of this industrialization strategy led in the 70's and 80's to a complete reversal in the conception of the role of agriculture in development which is due mainly to:

  The extension of the concept of linkage to include income and final consumption linkages. The agricultural sector was recognized as an important source of household incomes, the expenditure of which can induce industrialization under the pull of effective demand.

- Technically, extension of the concept of linkage to include income and final consumption effects was based on extension of the input-output matrix to the SAM.

# The input-output model (1)

- The input-output table presents in a synthetic way the production and exploitation accounts (obtained from national accounting) and realizes the equilibrium between total resources and total demand of goods and services.

- It's reduced to a table with a double entries which can be read in rows or in columns.

- To simplify the exposition of the model, commodities and activities have been aggregated

# The input-output model (2)

| | | | | | | |
|---|---|---|---|---|---|---|
| Sectors (i) | 1 | $P_1X_{11}$ | ……. | $P_1X_{1n}$ | $P_1F_1$ | $P_1X_1$ |
| | ⋮ | ⋮ | | ⋮ | ⋮ | ⋮ |
| | n | $P_nX_{n1}$ | ……. | $P_nX_{nn}$ | $P_nF_n$ | $P_nX_n$ |
| Value added Labor (k) | 1 | $w_1L_{11}$ | | $w_1L_{1n}$ | | |
| | ⋮ | ⋮ | | ⋮ | | |
| | s | $w_sL_{s1}$ | | $w_sL_{sn}$ | | |
| Other | | $\Pi_1$ | | $\Pi_n$ | | |
| Taxes | | T1 | | Tn | | |
| Total supply | | $P_1X_1$ | | $P_nX_n$ | | |

# The input-output model (3)

The input-output tables are often used for assessing the impact of a change in the final demand of a given sector on all sectors of the economy. The technique used is attributed to Vassily Leontief and is known as the Leontief model.

The basic idea of the model is that the amount of sector i's output required for the production of sector j's output $X_{ij}$ is assumed to be proportional to sector j's output $Xj$.

If $a_{ij}$ is such input-output coefficient, then:

(1) $X_{ij} = a_{ij}.Xj, \quad i,j = 1.....,n$

The equilibrium between total supply and total demand for each sector is written:

(2) $$X_i = \sum_{j=1}^{n} X_{ij} + F_i$$

Substituting (1) into equation (2) yields:

(3) $$X_i = \sum_{j=1}^{n} a_{ij}.X_j + F_i, \quad i = 1....., n.$$

# The input-output model (4)

This relationship between final demand and production also holds in changes:

(4) $$\Delta Xi = \sum_{j=1}^{n} aij.\Delta Xj + \Delta Fi$$

If the final demand in a given sector *i* increases by $\Delta F_i$ , initially production increases by the same amount $\Delta X_i^1 = \Delta F_i$.

This increase in production raises the intermediate demand for all sectors, including *i* itself, by $\Delta X_j^2 = \Sigma a_{ji} \Delta X_i^1$.

To produce these intermediate inputs, however, more intermediate inputs are needed and there is a third round of effects $\Delta X_j^3 = \Sigma a_{ji} \Delta X_i^2$

This leads to more and more effects and several rounds occur and the increase of output becomes smaller and smaller such that their total always has a limit. To calculate this limit, we use the matrix form:

# The input-output model (5)

$X = AX + F$ $(I-A)X = F$ $X= (I-A)^{-1}F$ and

$\Delta X = (I - A)^{-1} \Delta F$

- $(I - A)^{-1}$ is a multiplier which can be used to calculate overall changes in sectoral outputs which result from changes in final demand.

- Once the change in $X$ is known, changes in primary-input requirements can be similarly calculated:

Assuming that the amount of labor category $k$ needed for the production of one unit of product $j$, $b_{kj}$, is constant, the total amount of labor $k$ required is $L = BX$

$L$ is the vector of labor requirements, $L_k$, $k = 1,\ldots s$ and $B$ is the matrix of $b_{kj}$'s

# The input-output model (6)

**Interpretation of the Leontief model**

- The crucial assumption is that sectoral production is completely demand driven which means:

  - The production capacity is not fully used and that it can meet any increase in the demand

  - The increase in the demand will not increase the output price

- Because of these strong assumptions, input-output models are more useful as guidelines to potential induced linkage effects in a growing economy, than as predictive models.

- The underlying production function assumes constant returns to scale and no substitution among the different inputs.

Intermediate inputs can be disaggregated into domestic and imported goods. The multipliers can thus represent more closely the multiplier effect on the domestic economy

# B - SAM: Structure and Main Utilization

# The social accounting matrix

- A SAM is a square matrix in which each transactor or account has its own row and column. The payments (expenditures) are listed in columns and the receipts in rows.

- As the input-output table represents only the transactions between the activities accounts, it gives only a partial representation of the whole economic circuit and don't take into account the transfers which occur between all the economic agents.

- A SAM overcomes this problem by the representation of all the monetary transactions in an economy during one year.

- A SAM contains six accounts: the activities, commodities, and factors (labor and capital) accounts, institutions accounts which are generally divided into households, firms and government, the capital account and the rest of the world account.

# Structure of a SAM

| | Activities | Commod | Factors | Institutions | Capital account | Rest of World | Total |
|---|---|---|---|---|---|---|---|
| Activities | | Domestic sales | | Export subsidies | | Exports | Prod |
| Commod | Intermediate demand | | | Hh and gov cons | Investment | | Dom demand |
| Factors | Wages and rents | | | | | Factor incomes from abroad | GNP at factor cost |
| Institution | Indirect taxes | Tariff and indirect taxes | Lab income, Dist profit and undist profit | Transfers | | Transfers | Instituti income |
| Capital Account | | | | Hh, firm and gov savings | | Capital transfers | Total savings |
| Rest of world | | Imports | Factor payments | Current transfers abroad | | | Imports |
| Total | Production | Domestic supply | Factor outlay | Institution expenditure | Tot investment | Foreign exchange earnings | |

# The social accounting matrix

- There is not a unique way of disaggregating and organizing data in a SAM. The number of accounts in each category depends on the objective of the study:

  - We can disaggregate the household accounts into different socioeconomic classes if the study is focused on distribution effects.
  - If agriculture is of interest, it has to be broken down into several activities

- SAMs also vary in the way transactions are recorded:

  Remittances can be introduced as receipts for the labor factor account or as transfer for households from the rest of the world.

- The most common use of SAMs is at the national level. However, they have also been built for regional economies and for villages.

- Finally all SAMs must respect the same logic of complete and consistent accounting.

# The SAM Multipliers (1)

- The equilibrium between the total receipts and total expenditures for each account allows the representation of the whole economy in a linear form similar to what has been presented in the case of the input-output model.

- Extension of the input output model to a SAM framework is performed by partitioning the accounts into endogenous and exogenous accounts and assuming that the column coefficients of the endogenous accounts are all constant.

- Endogenous accounts are those for which changes in the level of expenditure directly follow any change in income.

- Exogenous accounts are those for which we assume that the expenditures are set independently of income.

- The standard practice is to choose for the exogenous accounts one or more among: the government, capital and rest of the world account according to the objectives of the study

# The SAM Multipliers (2)

| | Endogenous accounts (n) | Sum of exogenous accounts (1) | Total |
|---|---|---|---|
| Endogenous accounts (n) | $M.X$ | $F$ | $X$ |
| Exogenous accounts (m) | $B.X$ | $L$ | |
| Total | $X$ | | |

# The SAM Multipliers (3)

- The SAM multipliers can be derived in a similar way as before:

$M X + F = X$ $\quad F = X - M X$ $\quad \Delta X = (I - M)^{-1} \Delta F$

$\Delta L = B \Delta X$

With

$M$: the square matrix ($n \times n$) of the endogenous accounts

$X$: the vector of total income or expenditure of the endogenous accounts

$F$: the vector sum of the expenditures of the exogenous accounts

$L$: the column vector of the income of the exogenous accounts

$B$: the rectangular matrix ($m \times n$) of the coefficients with exogenous accounts as rows and endogenous accounts as columns

*$\Delta F$ the vector of shocks*

*$\Delta X$ the vector of impacts*

*$\Delta L$ the leakages*

# The SAM Multipliers (4)

- A shock or injection is given by a change in elements of the exogenous accounts and multipliers like their input output analogues, are completely demand driven.
- The coefficients in the rows of the exogenous accounts provide the "leakages": the induced demand for imports, the induced government revenues, and the induced savings.
- The obtained results are not independent of the choice of the exogenous accounts.
- The range of shocks that can be studied with a SAM model is directly derived from the choice of the exogenous accounts. For example, if the capital account is chosen to be exogenous, then shocks are mainly changes in the investment.
- In all cases, the multiplier model gives the impact on the structure of production, labor income, income of households, government revenues, savings and imports.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