ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC

SOCIAL ACCOUNTING MATRIX BASED MACROMODELS FOR POLICY ANALYSIS IN DEVELOPING COUNTRIES

An Application to the Socialist Republic of Viet Nam

UNITED NATIONS NATIONS UNIES

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List of abbreviations used in the text

BCC	Bank Credit to Commercial sector
BCG	Bank Credit to Government
GDP	Gross Domestic Product
LES	Linear Expenditure System
NFEA	Net Foreign Exchange Assets
NML	Non-Monetary Liabilities of the State Bank of Viet Nam
SAM	Social Accounting Matrix

I. INTRODUCTION

A. Uses and advantages of Social Accounting Matrix based macroeconomic models to policy analysis

A Social Accounting Matrix (SAM) based macroeconomic model for Viet Nam has been developed and its use in the area of policy analysis and short-term forecasting demonstrated, as part of the assistance provided to the Government of Viet Nam. Although the model has been developed for Viet Nam, the methodology could quite easily be replicated for other developing countries of the Asia-Pacific region.

Macroeconomic models are often used to quantitatively simulate the changes in the economic performance in response to proposed changes in policies. Such information is of substantial importance to policy-makers/advisors in evaluating policy alternatives and in making choices. For example, a policy maker needs to select the ways of financing the additional expenditure corresponding to a certain percentage increase in the government wage bill. There are several alternatives available to him. Direct or indirect tax rates can be increased, the additional expenditure can be absorbed by increasing deficit financing or various combination of these options can be activated simultaneously. A policy maker, in advance of implementing a policy, has to decide which alternative to adopt: each alternative has certain costs and benefits in terms of macroeconomic performance as reflected by changes in a set of indicators such as GDP growth, inflation, balance of payments, or the money supply. The

indicators respond differently under each alternative. A macroeconomic model can be used to quantitatively compute: (a) the extent to which the alternative instruments would need to be changed to finance a specified increase in the government wage bill; and (b) the changes in the macroeconomic indicators corresponding to each of these alternatives. The analysis thus helps a policy maker in making informed choice from among the alternatives.

SAM-based macro-models have been successfully used in many developing countries to address a number of situations akin to the one mentioned in the previous paragraph[1]. Policy options evaluated through simulations carried out in these types of models range from monetary or fiscal ones to the management of food buffer stock[2]. Compared to traditional econometric models which require long time series data and involve time-consuming estimation processes, SAM models have distinct advantages as a practical tool for policy analysis.

Firstly, these models essentially require one year of national accounts data from which a SAM can be built. The procedure for estimating most of the parameters of the SAM-based models is straightforward and quick. Also, as will be discussed later, the estimated parameters are fairly robust.

[1] Lance Taylor, *Macro Models for Developing Countries* (McGraw-Hill Book Company, 1979).

[2] A number of policy simulations can be found in Hiren Sarkar and M.K. Panda, "A short-term structural macroeconomic model for India: applications to policy analysis", in *Econometric Modelling and Forecasting in Asia*, Development Papers No. 9, United Nations publication, Sales No. E.91.II.F.7, New York (1991).

Secondly, the results of the policy simulations carried out by these types of model can always be explained in terms of the economic causalities of the model. The specifications of the models, in general, are detailed enough to incorporate most of the important variables of an economy and their causal relationships. For this reason, the simulation helps understand how various forces, often competing, may impact the economy in response to the proposed policy changes. The understanding of the causalities and relative contributions of these economic forces is a precondition for rational policy choices.

Thirdly, these models can be built in phases. The first phase of the exercise where a large number of exogenous variables are often used can be completed fairly quickly. The model can later be extended by endogenizing more variables. However, as will be demonstrated later, even a first-phase model of this type can be used for meaningful policy analysis.

Fourthly, in most of the economies in transition the government's role in many areas of the economy is large and SAM-based models incorporate the government and their transactions in an explicit manner. Also, these models are mostly based on accounting identities (e.g., production-use, income-expenditure) and not on estimated behavioural equations. During the period of transition, frequent changes in economic policy do not allow the reliable estimation of behavioural parameters even when data exist. In such situations, the use of models based on accounting identities saves on time and cost.

These attributes make the SAM-based models extremely suitable for economies such as Viet Nam, which are in

transition to a market economy and where sufficiently long time-series data on variables reflecting a functioning market economy are not available.

B. The modelling procedure

There are four major steps involved in the development and use of a SAM-based macroeconomic model. The first step is to empirically construct a SAM. The second and third steps are to formulate the equations of the model around the SAM and to estimate the parameters of the equations. The fourth step concerns with designing of appropriate simulation runs to evaluate policy options and generate conditional forecasts.

A SAM is a method of organizing the transactions in an economy in a consistent manner. (A detailed discussion on SAMs can be found in Payatt and Thorbeeke (1984) and Taylor (1979)). A SAM is a national balance sheet which shows where, in a particular year, the commodities and services are produced and used, and where the agents of the economy generate income and spend it. The data in the table are organized in such a way so as to bring out the inherent equality between the production and use of commodities and services as well as between the income and expenditure of the economic agents. The economy is characterized by: (a) forms of economic activity (production, consumption and investment); (b) productive sectors and institutional subdivisions; and (c) types of transaction. In the present exercise the SAM is constructed around three broad categories of economic agents whose decisions shape the economy; the private household sector, the government sector and the foreign sector.

Once the elements of the SAM are properly specified, a mathematical model consisting of a system of equations is constructed. Concepts from three well-known economic models viz Leontief's Input-Output Model,[3] Kalecki's price determination model[4] and Stones Linear Expenditure System[5] are used to specify some of the algebraic equations. The parameters of the equation system are either estimated from the SAM in a direct manner or from other subsidiary information and stylized facts; most of the parameters are estimated from the SAM. Once the parameters are estimated, the model can be directly used for policy analysis and short-term forecasting by carrying out appropriate simulations.

C. Organization of the study

The organization of the rest of the study follows the steps described in the previous paragraphs. In section II, a numerical SAM for Viet Nam for 1989 is constructed. The model structure is presented in section III. Section IV deals with estimation of the model parameters. Section V demonstrates the use of the model for estimating investment

[3] W.W. Leontief, *The Structure of American Economy 1919-1939:An Empirical Application of Equilibrium Analysis* (New York, Oxford University Press, 1941).

[4] M. Kalecki, *Selected Essays in the Dynamics of Capitalist Economy 1930-1970* (New York and London, Cambridge University Press, 1971).

[5] Richard Stone, "Linear expenditure system of demand analysis: an application to pattern of British demand", in *Economic Journal* (1964).

multipliers and for generating alternative policy scenarios, corresponding to an increase in the government wage rate. The model with parameters estimated from the 1989 SAM is also used to generate macroeconomic indicators for 1990. This exercise demonstrates the model's usefulness for short-term forecasting and also provides an opportunity to test the reliability of the estimated parameters. Section VI discusses alternative uses and extentions of the model, while section VII contains concluding observations. The equations of the model are shown in appendix I, and symbols are explained in appendix II.

II. A SOCIAL ACCOUNTING MATRIX FOR VIET NAM

A SAM presents the flow of transactions among the various productive sectors and agents of the economy in an organized and consistent manner. Since each transaction can be viewed both as a receipt by one agent or sector and payment by another, the use of a double-entry bookkeeping technique in a matrix form makes the presentation easy and simple. A SAM constructed for Viet Nam for 1989 is shown in table 1. All the relevant data have been taken from the various tables of the National Accounts Statistics.[6] The year 1989 has been chosen due to the fact that it is the only year for which detailed national accounts are available.

[6] United Nations, *National Accounts Statistics: Main Aggregates and Detailed Tables, 1991* (New York, 1993).

In the table, receipts are shown in rows, and the payments are in columns. The first three rows in the table represent receipts from sale of outputs of the three identified sectors: agriculture, industry including construction and services. The agriculture sector includes crop agriculture and allied activities such as livestock and forestry. Industry covers both manufacturing and construction. The service sector includes all services (trade, transport, banking and all other community and personal services) except public administration and defence, the output of which is treated as the wage bill of the Government. The value of agricultural output was recorded at Dong 14,668 billion in 1989. Of this amount, Dong 1,931 billion was sold to (used by) agriculture itself as inputs in the production process. The industry and service sectors further bought (demanded) agricultural inputs valued at Dong 1,643 billion and Dong 403 billion respectively. The remainder of agricultural production was sold for meeting various categories of final demand: Dong 6,250 billion for private consumption; Dong 308 billion for stock building; and Dong 4,139 billion for net exports (i.e., exports less imports). The second and third rows in table 1, which represent industries and services, can be interpreted in a similar manner.

The fourth row documents the total value added (at market prices) generated from each of the sectors. The different components of value added appear in the next eight rows under the first three columns. Wage and non-wage (profit) incomes are shown in rows 5 and 6, and their total in row 7. Indirect taxes and subsidies paid or received by the sectors are shown in rows 8 and 9. Intermediate imports which have been used for producing outputs are shown in row 11. The government profits of Dong 293 billion from public sector industries are treated as a part of the industrial sector (sector

Table 1. Social accounting matrix for Viet Nam, 1989

	Agricul-ture	Industry and construction	Services	Disposition of private income	Disposition of govt. income
	1	2	3	4	5
1. Agriculture	1 931	1 643	403	6 250	-
2. Industry and const.	1 448	4 768	2 420	5 872	1 683
3. Services	1 448	1 645	1 210	8 022	721
4. Value added (Total)	9 841	5 654	7 002	-	-
5. Wage income	7 097	3 301	2 229	-	4 146
6. Non-wage income	1 913	1 243	3 662	-	-
7. Total priv. income	9 010	4 544	5 891	-	4 146
8. Indirect taxes	831	982	1 111	-	-
9. Subsidies	-	-165	-	-	165
10. Direct taxes	-	-	-	398	-
11. Imports	-	1 173	-	-	-
12. Government income	-	293	-	202	-
13. Gross savings	-	-	-	3 833	-2 089
14. Gross output	14 668	14 883	11 035	24 577	4 626

Note: * Inclusive of 1809 which is government salary payments assumed as GDP from Public Administration and Defence.

(Thousand million Dong)

Fixed investment	Charges on stocks	Disposition of foreign exchange receipts	competitive imports	Indirect taxes	Direct taxes	Value of output income
6	7	8	9	10	11	12
.	308	4 559	-426	-	-	14 668
696	103	1 602	-3 709	-	-	14 883
-	-	539	-2 550	-	-	11 035
-	-	-	-	-	-	24 306
-	-	-	-	-	-	16 773
-	-	986	-	-	-	7 804
-	-	986	-	-	-	24 577
-	-	-	-	-	-	2 924
-	-	-	-	-	-	0
-	-	-	-	-	-	398
1 710	-	-	6 685	-	-	9 568
-	-	809	-	2 924	398	4 626
-	-	1 073	-	-	-	2 817
2 406	411	9 568	0	2 924	398	

2). The first three columns thus show the breakdown of total payments made by the three sectors, whereas the first three rows show the receipts of the same sectors from various sources. It may be seen that total payments made by a sector (column total) equals total receipts of the sector (row total), or the value of output. One may also look at this equality as the income-expenditure balance of each productive sector.

The economic agents considered in the SAM, private households, the Government and the foreign sector, have quite different income/expenditure processes. The households receive wage and non-wage income from the production activities (sectors 1 through 3) in return for their factor services. It is assumed that while the government wage bill and transfers, totalling Dong 4,146 billion accrue as wage income, remittances from abroad, valued at Dong 986 billion, are received as non-wage income. Thus households received a total private income of Dong 24,577 billion in 1989 as indicated by total of row 7. On the expenditure side, column 4 shows how the households used their income. Private income has been used for consumption of various goods and services (first three entries in column 4 totalling Dong 20,144 billion), for paying direct taxes (Dong 398 billion) and making other transfers (Dong 202 billion) to the Government, and for savings (Dong 3,833 billion). The sum of the elements of row 7 equals to that of column 4, signifying the income/expenditure balance of households.

The Government generates income (revenue) from direct taxes, indirect taxes, profit from public enterprises, transfers from households and foreign aid. These appear in row 12 and sum up to Dong 4,626 billion. The government expenditures are accounted for in column 5 as public

consumption, payment of wages and subsidies and miscellaneous (other) transfers. Total current government expenditure exceeds government income (row 12) by Dong 2,089 billion, and is shown as negative government savings.

The sum total of row 11, amounting to Dong 9,568 billion, was the foreign exchange payment of Viet Nam for imports of goods and services. This is equal to the foreign exchange receipt whose disposition is shown in column 8. Foreign exchange was received in the form of exports, remittances, aid to the Government and other foreign savings (Dong 1,073 billion in the form of development assistance and loans for financing the trade deficit).

In order to have overall consistency, the SAM incorporates the savings-investment balance for the economy. Savings are available from three sources; from private households, from the Government and from the foreign sector. The total capital formation of Dong 2,817 billion (comprising Dong 2,406 billion in investment and Dong 411 billion of stock changes) equals the sum of the private savings, government savings and foreign savings. The SAM thus describes the transactions among various sectors and agents in an economy and maintains income (receipt)/expenditure (payment) and savings/investment identities.

III. THE MACRO-MODEL

The macro-model is built around the SAM and accordingly considers three sectors: agriculture, industry and service. The equations of the model are given in appendix I. In this section the model structure and the major relationships among the variables are discussed. The equations are divided into the following nine blocks: (a) price block; (b) output block; (c) income block; (d) investment and savings block; (e) consumption block; (f) Government block; (g) trade block; (h) money supply and mark-up block, and (i) accounting identities.

In the price block, market prices of the three sectors, i.e., agriculture, industry and services are determined. Factors determining the price are: per unit (of output) material and labour cost; per unit profit (mark-up) rate; and the indirect tax rate. Mark-up rates are assumed to be positively related to the overall demand as represented by the money supply. If money supply goes up prices tend to increase. In this way prices respond to both cost push and demand pull factors. In the output block, real sectoral output is computed as the total demand comprising intermediate demand and the final (sum of private consumption, government consumption, capital formation and net exports) demand. Wage and non-wage incomes are calculated in the income block from outputs, labour intensities (employment output coefficients), wage rates and mark-up rates. Prices and incomes are used to determine sectoral private consumption in the consumption block.

Whereas investment is assumed as an exogenous[7] variable in the investment and savings block, savings are determined by applying fixed savings rates on the factor incomes. The government block deals with the formation of government revenue and expenditure. While direct and indirect taxes and other receipts are considered as major components of revenue, government consumption, wage payments, subsidy payments and miscellaneous transfers form the expenditure. In the trade block levels of exports and imports of consumption goods are assumed as exogenous variables external to the model. However, imports of those intermediate products used in the production processes are endogenous or internal to the model, and they are linked with production (output) levels. The differences between expenditure and revenue of the Government or the budget deficit, and that between imports and exports or the trade deficit, are used to estimate the change in money supply in the money block.

Computations of the real GDP, nominal GDP and the GDP deflator are carried out in the Accounting Identity Block. Real GDP is determined from real sectoral outputs which are computed in the output block. Nominal GDP is calculated as sum of factor incomes computed in the income block. GDP deflator is the ratio of nominal to real GDP.

The blocks describing the relationships between the exogenous and endogenous variables in different segments of

[7] In the context of modelling, exogenous variables are those whose values are pre-set on the basis of external information. On the other hand, endogenous variables are those values of which are determined from the model on the basis of their relationship with exogenous variables. If values of exogenous variables are changed from their pre-set levels, values of endogenous variables will change accordingly.

the economy are linked to one another. It is this interrelationship between the blocks which allows the model to capture some of the realities of a functioning macroeconomic system where various areas viz. price, production, income, consumption etc., are related to each other. In the model, for example, prices which are determined by both demand and cost considerations are related to sectoral private consumption as well as to outputs, incomes, exports, imports, government transactions and money supply. The money supply is, in turn, linked to the prices thereby completing one chain of relationship. As a result of these types of interrelationship within the model when the exogenous (external) variables are changed from their pre-set level, all the model-determined endogenous variables also change. This aspect is demonstrated in chapter V.

A. Description of the blocks

The nine equation blocks for the model are described below.

(a) **Price block**: Price formation equations for the three sectors follow Kalecki's cost plus principle. The price that a producer in a particular sector receives for his product is determined by applying a mark-up rate on the unit 'prime-cost', or the cost of intermediate inputs plus wages per unit of output. Indirect taxes are added to producers' prices to get the market prices that consumers pay. The mark-up rate itself is linked to the supply of money to capture the effects of liquidity (demand) pressure on prices. Thus, both cost-push and demand-pull factors are taken into account in determining prices.

(b) Output block: The Agricultural output level (supply) in the short run is essentially determined by weather conditions and hence is specified exogenously. Agricultural exports are assumed to vary to maintain the demand-supply balance in the sector. Output levels in the industry and services sectors are demand-determined. This character of the model in which supply adjusts to demand in non-agriculture sectors is a reflection of the short-run nature of the model, and this specification allows determination of the Keynesian multiplier effects.

Intermediate demand for goods and services is determined by incorporating inter-industry linkages as in the Leontief's input-output framework; private consumption demand is specified as a function of income in the consumption block described below. The rest of the final demand elements are taken as exogenous; the only exception being agricultural exports which, as mentioned above, balance demand against the fixed supply.

(c) Income block: Two types of income are distinguished in the model: wage income and non-wage income (profits). Wage income depends on wage rates, output levels, and employment output coefficients. The wage bill of the government (public administration and defence), which is treated as exogenous, also accrues as wage income. The major part of the non-wage income depends on the sectoral mark-up rates, prime costs and output levels. Remittance incomes from abroad are treated as the other part of the non-wage income. As non-wage income includes the profits of the public sector undertakings such profits are taken out from non-wage income to compute private income.

(d) Savings-Investment block: Savings from wage and non-wage income are specified as linear functions of incomes with savings rates differing between the two types of income. Total investment is exogenous to the model, with the imported and domestic components of investment being computed on the basis of fixed ratios.

(e) Private consumption block: Total private consumption expenditure in the economy is derived as the sum of wage and non-wage incomes less savings and other payments. The sectoral breakdown of total consumption expenditure is then obtained through the Linear Expenditure System (LES) framework as developed by Stone (1954). The LES envisages certain committed levels of consumption for each sector, with the expenditure level over and above this committed part treated as discretionary and responding inversely to prices. The consumption level for a particular sector is thus influenced by incomes as well as all the sectoral prices.

(f) Government block: Government income, expenditure and current account savings are accounted for in this block. Direct and indirect tax revenues are obtained by applying tax rates to their respective tax bases. Profit from public enterprises is treated as exogenous. Government employment and wage rates are specified exogenously. Government consumption expenditure levels are exogenous in real terms but the corresponding nominal levels vary with changes in prices. The current account savings or deficit of the government sector is the difference between its revenue and expenditure.

(g) Trade block: The model considers two types of imports: that of consumption goods and intermediate goods. While imports of consumption goods augment supplies of products

for consumption, imports of intermediate goods are used as inputs in production. The latter is linked endogenously to industry output through a fixed import output coefficient. Imports of consumption goods are exogenously specified. The current account deficit (surplus) is the difference between total receipts from and payments to the external sector, and it is sensitive to world prices and the nominal exchange rate of the Dong.

(h) Money supply and mark-up block:[8] Money supply equals the sum of bank credit to the Government (BCG), bank credit to the commercial sector (BCC), net foreign exchange assets (NFEA) less non-monetary liabilities of the State Bank of Viet Nam (NML). Of these, BCC and NML are considered as exogenous. The change in BCG during the year equals government current account deficit less other government borrowings (from non-banking sources). The change is added to the previous year's stock to arrive at the current stock of BCG. Similarly, NFEA equals year-end stock of NFEA of the previous year and capital inflows during the year, less the current account deficit on the external account. This block provides the crucial relationship between prices and the overall demand represented by the money supply. This is achieved through a set of assumed positive relationship between sectoral mark-up rates and the money supply.

(i) Accounting Identities: This block contains a number of accounting identities for computing important macroeconomic aggregates and for checking the consistency of the numerical process. Total real GDP is derived by summing up the sectoral

[8] A number of variables of this block do not appear in the SAM. However, their values are documented in the National Account Statistics.

value added figures. These are determined by applying the value-added to output ratios to output of different sectors. Nominal GDP at market prices equals the sum of all the factor incomes and indirect taxes less subsidies. The ratio of nominal GDP to real GDP generates the GDP deflator. Capital formation is derived as the sum of fixed investment and changes in stock. Lastly, the savings/investment balance equation states that the total capital formation in current prices equals total savings in the economy (sum of private savings, government savings and foreign savings). It may be noted that this is not an independent identity and does not form an integral part of the model. When all the sectors are in equilibrium, the savings-investment (income-expenditure) balance must hold. Computing total savings and total capital formation, and comparing them for equality, serves as an overall check on the numerical computations of the model.

B. Major features

The above discussion may be summarized in the following major features of the model:

(1) The model is a short-run income-price determination model.

(2) Industry and service outputs are demand-driven with a Keynesian output determination mechanism in an input-output framework.

(3) Agricultural output is specified exogenously, being mainly influenced in the short-run by weather conditions.

(4) Mark-up pricing in the Kaleckian framework is usual for price determination.

(5) Mark-up rates respond to demand as reflected by the money supply.

(6) The effects of the real side of the economy on money supply take place through current account deficits in the Government budget and in the external sector.

(7) Income-consumption-output interactions take into account effects of price changes.

(8) The model is in the structuralist tradition: prices are not perfectly flexible to clear markets, quantity adjustments also play a major role. This is a common feature of developing country economies with rigidities in different product and factor markets.

(9) Lastly, while the model considers short-run demand creation effects of investment, it does not incorporate the future capacity creation aspects which occur over the medium to long run.

IV. PARAMETER ESTIMATION

The parameters needed for empirical estimation of the model as documented in the previous section may be grouped into two categories: (a) Point Estimates and (b) Econometric Estimates. Point estimates are technical or policy parameters and are estimated from the SAM. The econometric estimates, on the other hand, relate to the behavioural parameters in the model. These are very few in number; e.g., the savings rates and the LES parameters. The behavioural parameters should

ideally be estimated through econometric techniques using cross-section data. Due to the non-availability of appropriate data for Viet Nam, such formal estimations cannot be carried out. The estimates used for the present exercise are, instead, guesstimates derived with the help of known parameters estimates of other countries and some 'stylized facts' on Viet Nam. Estimation details for both types of parameters are given below.

Point Estimates: These include the input-output coefficients, import-output coefficients, labour coefficients, mark-up rates, tax rates, subsidy rates, and the coefficient related to share of imported investment goods. The input-output coefficients and labour coefficients are directly calculated from the SAM by dividing the relevant input flows and wage bill by output. The sum of the input-output coefficients, labour coefficient and the import-output coefficient for a sector generates unit prime cost. Subsequently, the sectoral mark-up rate can be computed by using the following relationship:

Mark-up rate x Unit Prime Cost x Output = Mark-up Income

As the unit prime cost is known and, output and mark-up income levels are given in the SAM, sectoral mark-up rates can be estimated. When unit prime cost and mark-up rates are known, the sectoral indirect tax rates can be estimated from the following type of relations:

Unit Prime Cost x (1+Mark-up Rate) x (1+Indirect tax rate) = Price[9]

[9] Consistent with standard inter-industry linkage models, wage rates and prices for the base year (in this case 1989) are assumed to be normalized to unity.

The above procedure of estimation helps to obtain the estimates in a consistent manner. All other point estimates were computed in similar ways.

Behavioural Parameters: The procedure adopted in this exercise has been to assume values of some key elasticities on the basis of estimates available for other countries, and then to derive the parameters consistent with SAM for 1989.

The marginal propensity to save has been assumed as 0.13 for wage income earners. Since the total household savings for Viet Nam are known from the SAM, the marginal propensity to save of non-wage income earners is derived as a residual (0.22548) from the following type of relation.

> Marginal propensity to save (wage) x Wage income + Marginal propensity to save (non-wage) x Non-wage income = Total savings (SAM)

The values of income elasticity of demand for the agriculture and industry sectors are assumed to be 0.8 and 1.2. The average budget shares are known from the SAM. The elasticities and the average shares can then be utilized together to get the marginal budget shares of the LES as follows:

> Marginal budget share = Income elasticity of demand x Average budget share

While the marginal shares of two sectors are estimated in the above manner, that of the third sector (service) is obtained as a residual so as to satisfy the aggregation criteria that sum of all marginal shares must add up to 1. After

estimating the marginal budget shares, the committed consumption is obtained by calibration so that the relevant LES equation replicates the observed value of sectoral private consumption shown in the SAM, as follows. Discretionary income is taken to be 40 per cent of total income[10]. Assuming all prices to be unity, the following identity holds:

> Sectoral consumption = Committed consumption + (Marginal budget share x Discretionary Income)

When sectoral consumption, marginal budget share and discretionary income are known, the committed consumption levels can be estimated from the above type of relationships.

All the parameters of the model have been estimated in such a way that they are fully consistent with the SAM. This implies that when the equation system is solved with the exogenous variables for 1989, the SAM is reproduced[11]. In econometrically estimated equations, normally the slope parameters are taken as estimates from time series data, and the constant terms are calibrated to reproduce the latest observed data. The calibration procedure followed in this exercise involves the assumption that the observed values in the SAM relate to a benchmark equilibrium for the economy (Shoven and Whalley (1984)). For this reason, care should be taken to avoid using abnormal benchmark years, such as those with natural calamity or war, for the construction of a SAM model.

[10] Lance Taylor, *Macro models for developing countries*, op. cit.

[11] A detailed list of exogenous variables is given at the end of appendix II.

V. APPLICATIONS OF THE MODEL TO POLICY SIMULATIONS AND SHORT-TERM FORECASTING

The model with its full list of parameters can be used for simulating economy-wide effects of a policy change. Policy evaluations are carried out in a comparative static framework involving a reference or base run and a policy run.

Reference/Base Run: The benchmark data set of the SAM normally serve as a base run. The calibration procedure followed in the parameter estimation process ensures that when the model is solved[12] for 1989 the values of the endogenous variables in the reference run are equal to their values in the SAM.

Policy Run: When one or more of the exogenous variables (e.g., investment etc.) or policy instruments (e.g., tax rates) are changed from their values in the reference run and the model is solved, the new solution constitutes a policy run.

Policy Impact: Policy impact is measured by comparing the base run with the policy run.

The following two applications demonstrate the use of the model for the quantification and analysis of the impact of changes in two important variables under alternative assumptions.

[12] Solution of the model involves solving the equation system with a given set of parameter and exogenous variables (1989).

A. Macroeconomic effects of changes in investment and quantification of the GDP and output multipliers

An increase in investment adds to the productive capacity of an economy. Furthermore, additional investment creates additional demand for goods and services. When investment is increased the demand (output) for investment goods (industry) increases directly. Such an increase in output leads to the generation of additional income; consequently, consumption and output of goods and services produced by all sectors[13] of the economy increase in the second round again, but by a smaller amount. This process repeats itself until a stable solution is reached. An initial increase in investment thus multiplies into larger increases in domestic outputs and value added. It is of interest to study this multiplier process for Viet Nam and to quantify the multipliers by using the macro-model developed in the previous section.

One of the characteristics of the Vietnamese economy is that a high portion of fixed investment is imported (up to 70 per cent) and the rest is produced domestically. This reflects a common structural feature of many developing economies where the domestic capital goods sector is not well-developed. In such a situation when investment is increased, the additional demand is met from both domestic and foreign sources. Of the additional demand, 70 per cent is met through increased imports and only 30 per cent adds to the domestic demand to be met from increased domestic output. The former has the

[13] In the model, however, the agricultural output is assumed to be exogenously fixed and any increase in consumption in this sectors leads to a reduction in agricultural exports.

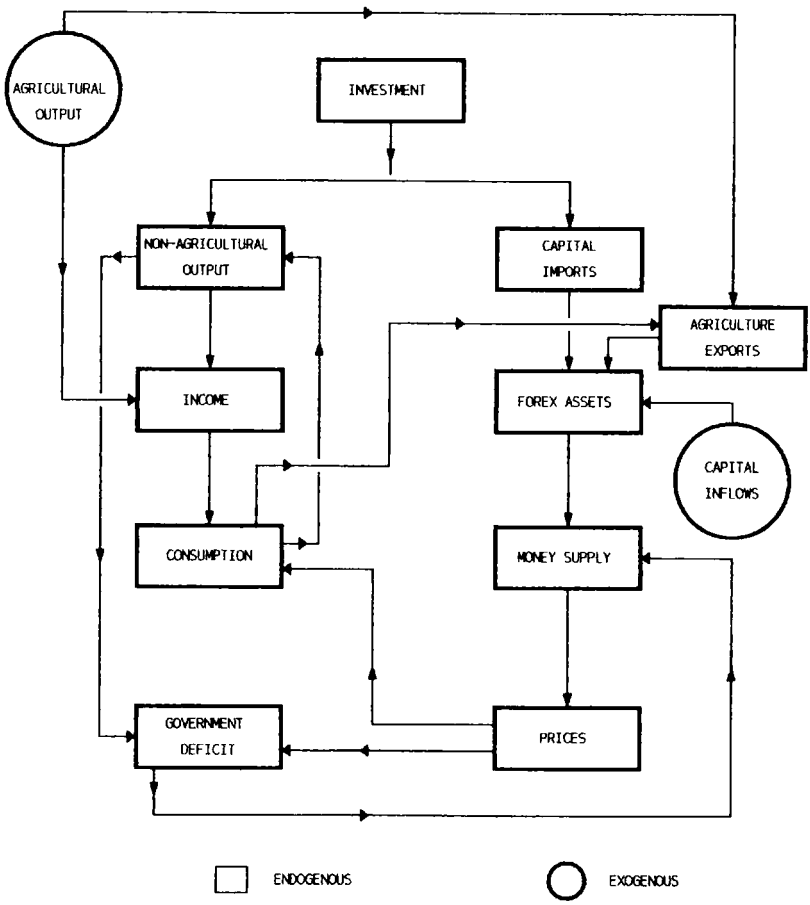
effect of increasing the trade deficit, whereas it is the latter portion which is responsible for activating the domestic output multiplier process. When investment is increased, given the interrelationship between the investment and other macroeconomic variables situation (see figure), the following effects are expected to occur under two possible scenarios.

1. Pure investment increase

(a) Imports will increase leading to an expansion of the trade deficit resulting in reduction (depletion) of foreign exchange assets with a consequent negative effect on the money supply. The reduction in money supply, through the direct money supply - mark-up rate relationship, will lead to a fall in the overall price level.

(b) Overall GDP and non-agricultural outputs will increase due to the multiplier effect explained before.

The above scenario is feasible when the country possesses sufficient foreign exchange assets that they can be depleted to finance the additional imports. In the absence of such adequate foreign exchange reserves, an investment increase should be accompanied by additional capital inflows. In this latter situation, given the structure of the model the following macroeconomic effects are expected to take place when investment is increased.



Flow diagram showing interaction of investment and other major variables

2. Investment increase accompanied by increase in net capital inflows

(a) Imports will increase leading to an expansion of trade deficit. However, increase in trade deficit will be met from additional capital inflows and there will be no effect on changes in foreign exchange assets. Consequently, there will be no change in the money supply and in the overall price level.

(b) Overall GDP and non-agricultural outputs will increase due to the multiplier effect but the magnitude of the multipliers are expected to differ from the previous case 1, because of the difference in the price response.

The macroeconomic model is used to simulate situations 1 and 2. For this purpose, the following simulation runs have been designed.

(a) Simulation 1: Pure investment increase

Total fixed investment (which is exogenous) is increased by 10 per cent from the base value of Dong 2,406 billion to Dong 2,646 billion.

(b) Simulation 2: Investment increase accompanied by increase in net capital inflow

Total fixed investment is increased by 10 per cent accompanied by additional capital inflow, so that the money supply remains same as in the base run.

The model is solved for both situations. The resulting solutions together with base solution (SAM 1989) are documented in table 2.

In the case of simulation 1 in table 2, as mentioned above, the trade deficit expands leading to an equivalent reduction in net foreign exchange assets. As a result, the money supply declines by Dong 241 billion, representing a change of 3.5 per cent. This, in turn, leads to a fall in the overall price level by 0.6 per cent due to reduction of the sectoral mark-up rates. On the output side, the 30 per cent of the additional investment (amounting to Dong 70 billion) which is met from domestic sources sets the multiplier process in motion. As a result, GDP increases by Dong 115 billion, representing a growth of 0.5 per cent, the output of industry increases by 1.2 per cent (Dong 175 billion) and that of services by 0.7 per cent (Dong 75 billion). The implicit GDP multiplier with respect to the domestic component of investment turns out to be 1.7 and the multiplier for non-agricultural output is computed at 3.6.

In simulation 2 of table 2 where the investment increase is accompanied by increased capital inflow, in contrast to the earlier situation, money supply remains at the same level as in the base situation and so does the overall price. The overall price in this scenario thus, is higher than that in scenario 1. As a result, the multiplier effects of investment are somewhat reduced. In response to the Dong 70 billion of additional investment demand which is met from the domestic supply of investment goods, GDP expands by Dong 83 billion and output of non-agricultural sectors goes up by Dong 189 billion. The implicit GDP multiplier and that of non-agricultural output are 1.2 and 2.7 respectively.

Table 2. Macroeconomic effects of a 10 per cent increase in fixed investment

(Billion Dong)

Variable	Base level	*Simulation 1* Investment increased by 10 per cent		*Simulation 2* Investment increased by 10 per cent with additional capital inflows	
		Absolute change from base	Percentage change over base	Absolute change from base	Percentage change over base
Overall price [a]	1.00	-0.0055	-0.55	0.0	0.0
Real GDP	24 306	115	0.47	83	0.34
Industrial output	14 883	175	1.18	145	0.97
Service output	11 035	75	0.68	44	0.40
Private consumption	20 143	107	0.53	57	0.28
Imports	9 568	185	1.93	183	1.91
Exports	6 700	-46	-0.69	-31	-0.46
Trade deficit	2 868	233	8.13	215	7.50
Money supply	6 935	-241	-3.48	0.0	0.00
Capital formation	2 817	234	8.30	240	8.50

[a] Index with base = 1.00

The simulations described in this section demonstrate the use of the model for quantitatively evaluating the macroeconomic effects of an investment increase under alternative assumptions. An investment increase has major short-term effects on a number of economic indicators viz. growth, price, output, money supply, balance of payments etc. Without the help of a model such as the present one it would be impossible for a policy maker to comprehend the magnitude of the changes in all these indicators, and to trace through the various economic forces which act on these indicators. Quantification of various indices, such as the multipliers computed in the present exercise, can serve as important input into policy making and is a major use of the model. A clear understanding of the economic causalities underlying such computations is equally important to a policy maker for correctly interpreting the results. The present model can serve both these objectives. This aspect is further elaborated in the following simulation.

B. Simulation on a government wage increase

Often, transitional economies have to cope with high rates of inflation during the transition phase. High inflation, in turn, generates pressure to increase wage rates including those of the government sector. When government wage rates are increased, current expenditure of the Government in the form of the government wage bill go up. On the other hand, an increase in government wage rate leads to increased private income and results in the expansion of private consumption expenditures. In response to increased private consumption

demand, outputs of the non-agricultural sectors[14] go up, which lead to further increases[15] in sectoral incomes and so on. Due to the economic expansion, the tax bases improve. However, the additional revenue generated due to this multiplier process is inadequate to offset the increase in government current expenditure incurred in accommodating the wage increase. This leaves an additional[16] gap in the government current account to be financed by increasing the government deficit financing, by generating additional revenue or by a bit of both.

In order to trace the impact of this process on macroeconomic, three scenarios have been simulated. It is assumed that there is 20 per cent increase in the government wage rate. The scenarios are as follows:

Scenario simulation 1: The increased government wage bill is absorbed by incurring an additional fiscal deficit.

Scenario simulation 2: Direct tax rates are increased to finance the increased government wage bill, the fiscal deficit remaining unaltered at the base level.

Scenario simulation 3: Indirect tax rates are increased to finance the increased government wage bill, the fiscal deficit remaining unaltered at the base level.

[14] Output of agriculture is assumed to be exogenous. Increase in private consumption in agriculture leads to a reduction in agricultural exports.

[15] Of smaller magnitude compared to the initial increases.

[16] Over and above the gap which might exist in normal circumstances.

The results are presented in table 3. The first column in the table shows the values of the key variables for the base or reference run. The three other columns refer to the three scenarios in the order mentioned above. While the absolute values of the variables are reported for the reference run, for the three scenarios, the results are documented in the form of percentage change over the base run. The results corresponding to the three scenarios are analyzed in the following paragraphs.

Simulation (a): The increase in the government wage bill leads to growth and inflation. An increase in the government wage rate by 20 per cent results in an expansion of real GDP by 1.1 per cent and a price rise of 0.8 per cent. The GDP growth is due to the multiplier effect: output of both the industry and service sectors increase by more than 2 per cent.

Total government expenditure increases by 5.7 per cent. Both direct and indirect tax revenues increase due to an expansion in the tax bases, even though the tax rates remain unaltered. The net effect of changes in expenditure and revenue is an increase in current account budget deficit by 14.5 per cent. Accordingly, bank credit to the Government also increases.

The expansion in economic activities leads to increased imports of intermediate raw materials, while exports fall as a greater portion of the fixed agricultural output gets diverted to meet the increased domestic demand. Due to both these effects, the trade deficit increases by 6.6 per cent, leading to a fall in foreign exchange reserves by 22 per cent.

Table 3. Macroeconomic effects of a 20 per cent increase in the government wage rate

(Percentage change over base)

Variable	Base level (Billion Dong)	Government wage rate increased by 20 per cent with:		
		Deficit financing	Direct tax rate increased by 75 per cent	Indirect tax rate increased by 22 per cent
		(a)	(b)	(c)
Overall price [a]	1.00	0.76	0.00	3.90
Real GDP	24 306	1.10	0.25	-1.46
Industrial output	14 883	2.12	0.46	-0.26
Service output	11 035	2.10	0.48	-2.95
Private consumption	20 143	2.26	0.51	-1.25
Direct tax revenue	398	3.27	77.40	1.30
Indirect tax revenue	2 924	2.36	0.40	22.40
Government total revenue	4 626	1.77	6.90	14.30
Government expenditure	6 715	5.75	5.40	7.00
Government deficit	2 089	14.55	2.10	-9.20
Imports	9 568	0.27	0.06	-0.30
Exports	6 700	-2.41	-0.52	2.51
Trade deficit	2 868	6.56	1.43	-6.80
Bank credit to government	2 600	11.69	1.70	-7.35
Foreign assets	834	-22.30	-4.70	23.70
Money supply	6 935	1.73	0.00	0.00

[a] Index with base = 1.00

There are two factors which affect the money supply in opposing directions. On one hand, increased bank borrowing of the Government causes the money supply to expand, while the decline in foreign exchange assets leads to its contraction. The first factor, however, dominates and the combined effect is an increase in the money supply by 1.7 per cent. This increase translates into an increase in the price level through the mark-up rate responses.

Simulation (b): In this scenario, along with the increased wage rate as above, direct tax rates on both the income categories (wage and non-wage) are increased on a *pro-rata* basis so that the money supply remain at the same level as in the reference run. The objective in this simulation has been to neutralize the money supply increase generated in simulation (a). The direct tax rate increase needed to achieve this objective is of a high order (viz. 75 per cent) as the direct tax base in Viet Nam is narrow. The increase in direct tax rate reduces disposable incomes and consequently GDP growth declines as compared with Simulation (a): real GDP grows by only 0.25 per cent in Simulation (b) as against 1.1 per cent in Simulation (a).

Simulation (c): In this scenario, the direct tax rate is kept at the same level as in the base run and the indirect tax rates of all the three productive sectors are increased on a *pro rata* basis to generate enough additional government revenue to neutralize the money supply increase obtained in Simulation (a). The required increase in indirect tax rates for achieving this is of the order of 22 per cent. It is interesting to note that, unlike in Simulation (b), neutralization of money supply does not help to control inflationary pressures. While the money supply effect on mark-up rates is controlled, increased indirect taxes exert upward pressure on sectoral prices leading to

increase in the overall price level. In fact, the price increase in the scenario is estimated at 3.9 per cent over the base, higher than that Simulation (a). A price increase of this magnitude affects demand adversely and reduces growth by as much as 1.5 per cent.

The above simulation results may be summarized as follows:

(1) A government wage increase without additional resource mobilization leads to both growth and inflation.

(2) When the additional expenditure due to the government wage increase is financed by increasing direct tax rates, compared to the previous scenario, GDP growth is less but there is no increase in overall prices.

(3) When increase in government expenditure due to the increase in wage rate is financed by increasing indirect tax rates, the price level increases substantially and real GDP contracts. This mode of alternative financing helps neither growth nor control of inflation.

The results of this exercise help the policy makers to understand and quantify the various economic outcomes associated with alternate modes of financing a proposed increase in the government wage bill. A policy maker can use these results as important inputs in his decision-making process.

As indicated earlier, without a model it is not possible to comprehend the complex interretionships between the various segments of an economy and how they influence the outcomes of a proposed policy change. In this regard even the present "first phase" model has been found to be quite useful for tracing the causalities behind the various economic effects which come into play when policy instruments are changed.

C. Short-term forecasting

While mainly designed for policy simulations, the model can also serve as a useful tool for short-term forecasting. Given the values of all the exogenous variables for a particular year, the model can be used to compute the levels of the endogenous variables. The set of endogenous variables constitutes a conditional "forecast" for that year, with the forecast numbers satisfying all the accounting identities and equations of the model. The main advantage of such a forecast is that all the variables are internally consistent. This is a major advantage over similar forecasts generated by time-series forecasting models. However, the present model, which is short term in nature and incorporates a number of point estimates, should only be used to forecast for periods close to the base period (1 to 3 years) for which the SAM has been constructed.

To demonstrate the capacity of the present model to generate conditional "forecasts", the key macroeconomic indicators for 1990 have been computed using the model estimated for 1989 and values of the major exogenous variables compiled for 1990. However, the real (constant price) values of most of the exogenous variables cannot be

ascertained directly for 1990 as detailed National Accounts Statistics are not available for that year. Price deflators (GDP deflators, consumer price index etc.) have been used in preparing the set of exogenous variables. Table 4 shows a selected number of macroeconomic indicators computed for 1990 using the model. The observed values of those indicators are also shown for comparison.

The computed values of the indicators are reasonably close to their observed levels. Despite the fact that a large number of parameters are estimated from data of one period and are thus liable to be associated with large errors, such performance can be taken as satisfactory. This performance indicates the model's reliability and the reasonableness of its parameters.

Table 4. Simulated macroeconomic indicators for 1990

(Billion Dong)

	Computed	Observed	Deviation[a]	Percentage[b] deviation
Growth rate of real GDP (percentage)	5.6	5.1	-0.5	-0.9
Consumer price index (1989 = 1)	1.63	1.67	0.4	2.3
Real private consumption (at 1989 price)	19 249	18 947	-302	-1.5
Trade deficit	1 866	2 108	242	11.4
Government revenue	6 788	8 109	1 321	15.0
Government expenditure	8 102	9 186	1 084	11.0
Government deficit	-1 314	-1077	237	21.0

Notes: [a] Derived as Observed minus Computed.
[b] With respect to Observed.

VI. SOME ALTERNATIVE USES AND EXTENSIONS OF THE MODEL

The model as described in Section III permits simulation of a wide range of policy variables. The fiscal policy simulations carried out in the previous section to evaluate the efficiency of direct and indirect tax rates as instruments of resource mobilization is one such example. The model in its present form, or with appropriate extensions, can be used in many other areas for evaluating policy alternatives. A brief discussion on such possible uses of the model is given below.

A. Agricultural issues

A straightforward use of the model will be to analyze policy options for minimizing the economic impact of weather-induced agricultural shock. Such exogenous shocks will have very strong repercussion for the economy of Viet Nam, which has a large weather-dependent rice sector. If production in rice is expected to fall (due to drought or any other reason) the model can be used to evaluate alternative options available for coping with the situation. For example, the fall in agricultural output is expected to affect the agricultural price, agricultural value added, domestic consumption and exports. The model can be simulated to analyse the interrelationships between these variables. Such information can be used as inputs into policy-making. When simulations on agricultural price and output are carried out, the corresponding exports which are determined endogenously can be used for setting export quotas, in order to keep the domestic prices at an acceptable level in drought year. Alternatively, if stock change in agriculture (food) is assumed to balance supplies with demand in the sector (instead of exports in the current version), the relationship between the depletion of government food buffer stocks and the agriculture price (which assume great importance in drought years), can be studied.

B. Wage policy

In the present structure of the model, sectoral wage rates have been kept exogenous. But it would be fairly easy to introduce a wage indexation mechanism through additional equations by linking wages to overall price or to the consumer price index. This extension would permit the model to be used for examining the effects of introducing partial (or full) wage indexation for different sectors and to simulate on the degree of indexation.

C. Trade policy

The model could be extended for studying impacts of changes in the nominal exchange rate. For this purpose, import and export functions with appropriate price elasticities would have to be introduced. The real effects of measures like devaluation can be very different depending upon the import and export elasticities used (Sarkar and Panda, 1991).

D. Poverty measures

In order to examine the effects of macroeconomic policies on the incidence of poverty, the model structure can be extended to incorporate certain measures of absolute poverty. This would require appropriate mapping of factor income distribution to size distribution of income. One standard method to achieve this objective is to use an income distribution coefficient matrix, the elements of which indicate the proportions of sectoral factor income accruing to different income groups. Such distribution can be used to compute the Gini coefficient which, along with the mean income level of each group, can generate estimates of the proportion of population whose income fall below an absolute poverty line.

E. Environmental issues

These issues have assumed a great deal of importance in recent years. Macroeconomic policies can be extremely relevant in the context of reducing pollutants like carbon dioxide. The model structure can be extended to analyse this aspect by linking sectoral outputs to levels of carbon dioxide, which is mostly emitted by fossil fuel used during production of commodities and services. The sectoral fuel coefficients can be translated into carbon emission coefficients which can be incorporated in the model (Parikh and others, 1994). For carrying out meaningful simulations on environmental variables a different sectoral classification scheme would be required, incorporating the major emitting sectors. Evaluation of policies for reducing pollution through carbon tax or appropriate fuel pricing can then be performed through the model.

VII. CONCLUSION

The major purpose of this publication has been to document the development of a Social Accounting Matrix based macroeconomic model for Viet Nam and its use for policy simulations and short-term forecasting. Some of the factors which led to the choice of the present Social Accounting Matrix based model are: non-availability of consistent and reliable time series data in Viet Nam; direct applicability of the model for analyzing a relatively wide range of policy issues; its economy-wide coverage; and the fact that the model structure permits the simulation results to be explained in terms of clear economic causalities.

The model developed for Viet Nam utilizes data from the National Accounts Statistics for one year. Such data are available in practically all countries. For this reason, similar models can easily be replicated for other countries of the region, including the economies in transition and least

developed countries which suffer from paucity of reliable time-series statistics. The model directly incorporates a large number of variables (e.g., direct and indirect tax rates, government expenditures, money supply, bank credit to commercial sector, exchange rate etc.),[17] which are often used by Governments as policy instruments. Consequently, the model can be used to simulate changes in the macroeconomic indicators corresponding to a large number of policy scenarios where one or more policy instruments are changed.

As a demonstration, the model has been applied to evaluate the impact of alternative modes of financing possible increase in the government wage bill. The other use of the model is in the area of short-term forecasting. To test the reliability of its forecasting ability, the model estimated for 1989 has been used to estimate the endogenous macroeconomic indicators for 1990. The closeness of the estimated and observed indicators establishes the reasonableness of the model as an instrument for forecasting and broadly validates the model structure, assumptions and the parameter estimates.

Even with all the positive aspects of the present model described above it is still in its early stage of development. Before the model can be used as a full-blown comprehensive tool for policy analysis, more effort is needed for extending the model structure to suit the practical needs of the policy makers of Viet Nam and for generating better estimates of the parameters. From this point of view the present model is a starting point.

The model, in its present form, has a number of limitations. It is a static model and, hence, capable of generating only short-run effects of policy changes. Supply side considerations are not explicitly incorporated in the model. Producers respond to demand in non-agricultural sectors and it is implicitly assumed that the corresponding primary inputs and raw materials would be supplied. In case

[17] A detailed list is given in appendix II.

any supply bottleneck becomes binding the model results will not be reliable.

The above limitations should be kept in mind while interpreting the scenarios derived from the model. Despite these limitations, however, the model serves as a practical tool for analyzing a wide range of policies and for short-term forecasting.

Appendix I

Model Equations

I. Price Block

1. $B_1 = a_{11} P_1 + a_{21} P_2 + a_{31} P_3 + a_{01} e P_1^* + b_1 W_1$
2. $P_1 = B_1 (1+\tau_1) (1+t_1)$
3. $B_2 = a_{12} P_1 + a_{22} P^s + a_{32} P_3 + a_{02} e P_2^* + b_2 W_2$
4. $P_2 = B_2 (1+\tau_2) (1+t_2)$
5. $B_3 = a_{13} P_1 + a_{23} P_2 + a_{33} P_3 + a_{03} e P_3^* + b_3 W_3$
6. $P_3 = B_3 (1+\tau_3) (1+t_3)$
7. $P^s = K_2 P_2$

II. Output Block

8. $X_1 = a_{11} X_1 + a_{12} X_2 + a_{13} X_3 + C_1 + G_1 + ST_1 + E_1 - M_1$
9. $X_2 = a_{21} X_1 + a_{22} X_2 + a_{23} X_3 + C_2 + G_2 + I_2 + ST_2 + E_2 - M_2$
10. $X_3 = a_{31} X_1 + a_{32} X_2 + a_{33} X_3 + C_3 + G_3 + ST_3 + E_3 - M_3$

III. Income Block

11. $Y_w = b_1 W_1 X_1 + b_2 W_2 X_2 + b_3 W_3 X_3 + W_g L_g + T_{gw}$
12. $Y_{nw} = \tau_1 B_1 X_1 + \tau_2 B_2 X_2 + \tau_3 B_3 X_3 - GP_2 + e.REM + Y_m + Y_e$
13. $Y_m = (P_1 - e.P_1^*) M_1 + (P_2 - e.P_2^*) M_2 + (P_3 - e.P_3^*) M_3$
14. $Y_e = (e.P_1^* - P_1) E_1 + (e.P_2^* - P_2) E_2 + (e.P_3^* - P_3) E_3$
15. $Y_{dw} = (1 - t_{dw}) Y_w - T_{wg}$
16. $Y_{dnw} = (1 - t_{dnw}) Y_{nw} - T_{nwg}$

IV. Savings-Investment Block

17. $S_p = s_w Y_{dw} + s_{nw} Y_{dnw}$
18. $I_0 = K_I . I$
19. $I_2 = (1 - K_I) . I$

V. Private Consumption Block

20. $Y_c = Y_{dw}+Y_{dnw}-S_p$
21. $Y_c^* = \theta_1 P_1+\theta_2 P_2+\theta_3 P_3$
22. $C_1 = \theta_1+(m_1/P_1).(Y_c-Y_c^*)$
23. $C_2 = \theta_2+(m_2/P_2).(Y_c-Y_c^*)$
24. $C_3 = \theta_3+(m_3/P_3).(Y_c-Y_c^*)$
25. $C = C_1+C_2+C_3$

VI. Government Block

26. $T_d = t_{dw}Y_w+t_{dnw}Y_{nw}$
27. $T_{id} = t_1(1+\tau_1)B_1X_1+t_2(1+\tau_2)B_2X_2+t_3(1+\tau_3)B_3X_3$
28. $G_r = T_d+T_{id}+GP_2+T_{wg}+T_{nwg}$
29. $G_w = L_g.W_g$
30. $G_s = (P_2-P^s)a_{22}X_2$
31. $G_e = P_1G_1+P_2G_2+P_3G_3+T_{gw}+G_w+G_s$
32. $S_g = G_r-G_e$

VII. Balance of Payments Block

33. $M_{nc} = a_{01}.e.P_1^*.X_1+a_{02}.e.P_2^*.X_2+a_{03}.e.P_3^*.X_3+I_0.e.P_2^*$
34. $M_c = e.P_1^*.M_1+e.P_2^*.M_2+e.P_3^*.M_3$
35. $E = e.P_1^*.E_1+e.P_2^*.E_2+e.P_3^*.E_3$
36. $TRD = M_c+M_{nc}-E$
37. $CAD = TRD-e.FAID-e.REM$

VIII. Money Supply and Mark-up Block

38. $M_2 = BCG+BCC+NFEA-NML$
39. $BCG = BCG_0-GSAVE-OBORG$
40. $NFEA = NFEA_0-CAD+OCI$
41. $\tau_1 = \tau_1^0 (M_2/M_2^*)^{\epsilon_1}$
42. $\tau_2 = \tau_2^0 (M_2/M_2^*)^{\epsilon_2}$
43. $\tau_3 = \tau_3^0 (M_2/M_2^*)^{\epsilon_3}$

IX. Accounting Identities

44. $GDPR = v_1X_1+v_2X_2+v_3X_3$
45. $GDP = Y_w-T_{gw}+Y_{nw}-e.REM+GP_2+T_{id} - G_s$
46. $GDPDEF = GDP/GDPR$
47. $P = \alpha_1P_1 + \alpha_2P_2 +\alpha_3P_3$
48. $TCAP = I_2.P_2+I_0.e.P_2^*+P_1ST_1+P_2ST_2+P_3ST_3$
49. $S_p+S_g+CAD = TCAP$

The last equation is not an independent equation. The endogenous variables are those in the left-hand side of equations 1 through 48. One exception is X_1 which is exogenous and E_1 is the corresponding endogenous variable.

Appendix II

Notations for Model Equations[a/]

I. Price Block

a_{0i}: Imported input output coefficient

a_{ij}: Input output coefficient (amount of sector i's output required as intermediate input for producing sector j's output at unit level).

b_i: Labour output coefficient

B_i: Prime cost of sector i

τ_i: Mark-up rate of sector i

e: Exchange rate

P_i: Price of sector i

P_i^*: World price of sector i

P^s: Subsidized input price for sector 2

t_i: Indirect tax rate for sector i

W_i: Wage rate in sector i

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a/ (1) In current prices unless stated specifically.
(2) Separate lists of exogenous variables and parameters with their values/estimates consistent with the SAM is given at the end.
(3) Notations are given by blocks as they appear in appendix I. Within a particular block notations follow alphabetical order as far as possible.

II. Output Block

E_i: Real exports in sector i

G_i: Real government consumption of sector i

I_2: Real investment of domestic origin (produced by sector 2)

M_i: Real competitive imports in sector i

ST_i: Changes in stocks in sector i

X_i: Output of sector i

III. Income Block

GP_2: Government profit from public sector

REM: Remittances from abroad

Y_e: Gains by exporters due to price differences between domestic and international prices

T_{gw}: Current transfers from government to households with wage income

Y_m: Gains by importers due to price differences between domestic and international prices

Y_{nw}: Income of non-wage income earners

T_{nwg}: Current transfers from households with non-wage income to government

T_{wg}: Current transfers from households with wage income to government

IV. Savings-Investment Block

I: Real total fixed investment

I_0: Real imported investment

K_i: Proportion of imported investment in total fixed investment

S_p: Private savings

V. Private Consumption Block

C_i: Real consumption of sector i

m_i: Marginal budget share of sector i

Y_c : Income available for private consumption (Total expenditure at current prices)

Y_c^*: Income spent for committed consumption

Y_{dnw}: Disposable income from non-wage component

Y_{dw}: Disposable income from wage component

Y^e: Total "committed" consumption expenditure

θ_i: Committed consumption of sector i

VI. Government Block

E_g: Government employment

G_e: Total government expenditure

G_r: Government revenue

G_s: Subsidy expenditure of the government

G_w: Government wage and salary bill

S_g: Government savings (deficit, if negative); current account

t_d: Direct tax rate

T_d: Tax revenue (direct)

T_{id}: Tax revenue (indirect)

Y_w: Income of wage earners

W_g: Government wage rate

VII. Trade Block

CAD: Current account deficit (external)

E: Total exports

FAID: Foreign aid

M_c: Total competitive imports

M_{nc}: Total non-competitive imports

TRD: Trade deficit

VIII. Money Supply and Mark-up Block

BCC: Bank credit to commercial sector

BCG: Bank credit to government

BCG_0: Bank credit to government at the end of previous year

M_2: Money supply (Broad money)

M_2^*: Money supply in reference run

NFEA: Net foreign exchange assets

$NFEA_0$: Net foreign exchange assets at the end of previous year

NML: Non-monetary liabilities of banking sector

OBORG: Other borrowings of government (from non-banking sector)

OCI: Other capital inflows (through capital account)

IX. Accounting Identities

α_i: Weight of sector i in overall price index

GDPDEF: GDP deflator

GDPR: Real gross domestic product

P: Overall price index for the economy (average of sectoral prices)

TCAP: Total capital formation

v_i: Valued added to output ratio for sector i

Values of Exogenous Variables

P^*	:	0.96539	a_{11}	:	0.13165	b_1	:	046394
W_1	:	1.0	a_{21}	:	0.09872	b_2	:	022160
W_2	:	1.0	a_{31}	:	0.09872	b_3	:	020199
W_3	:	1.0	a_{12}	:	0.11039			
W_g	:	1.0	a_{22}	:	0.32037			
t_1	:	0.06005	a_{32}	:	0.11053			
t_2	:	0.07065	a_{13}	:	0.03652			
t_3	:	0.11196	a_{23}	:	0.21930			
G_1	:	0.0	a_{33}	:	0.10965			
G_2	:	1683	a_{02}	:	0.07881			
G_3	:	721	r_1	:	0.16043			
ST_1	:	308	r_2	:	0.12422			
ST_2	:	103	r_3	:	0.58480			
ST_3	:	0.0	m_1	:	0.24822			
E_1	:	4559	m_2	:	0.34980			
E_2	:	1602	m_3	:	0.40198			
E_3	:	539	θ_1	:	4250			
M_1	:	426	θ_2	:	3053			
M_2	:	3709	θ_3	:	4763			
M_3	:	2550	t_{dw}	:	0.01186			
L_g	:	1809	t_{dnw}	:	0.02550			
T_{gw}	:	2337	s_w	:	0.13			
T_{wg}	:	101	s_{nw}	:	0.22548			
T_{nwg}	:	101						
GP_2	:	293						
I	:	2406						
K_1	:	0.7015						

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