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## **UPDATING AN INPUT-OUTPUT TABLE FOR USE IN POLICY ANALYSIS\***

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## UPDATING AN INPUT-OUTPUT TABLE FOR USE IN POLICY ANALYSIS

### *Abstract*

*One of the constraints impinging on applied general equilibrium analysis is the long lag in the publication of input-output tables. Model builders often use out-dated databases leading to their models being inappropriate for the policy questions being addressed. This occurs particularly when there exists a significant structural change in the economy. In this paper, we discuss the updating of an input-output table of the Philippines from 1985 to 1992 by simulation technique. A detailed computable general equilibrium (CGE) model of the Philippine economy with comparative static and forecasting capabilities is utilised. The data emanate from known percentage changes of macroeconomic variables such as those in the national accounts and structural variables such as employment and output by industry. Detailed descriptions of the techniques are discussed.*

**Keywords:** input-output tables, computable general equilibrium, Philippines

### *Introduction*

One of the constraints in applied general equilibrium analysis is the use of out-dated input-output (IO) tables. Published IO tables usually lag years behind known economic data making them unsuitable for policy analysis especially when there is a significant structural change in the economy.

In this paper, we discuss the updating of an IO table of the Philippines from 1985 to 1992 by simulation technique. A detailed computable general equilibrium (CGE) model of the Philippine economy with comparative static and forecasting capabilities is utilised. The data used are known percentage changes of macroeconomic variables such as those in the national accounts and structural variables such as employment and output by industry during the period 1985-1992. The updated IO table reflects the economy's structure for the year 1992. It can readily be used for agricultural policy analysis as well as for the analysis of other sectors of the economy.

The next section of this paper describes the CGE model used in simulations. The third section discusses the base 1985 IO table, the transformed 1985 IO table suited to the model, and the historical data. The subsequent section discusses in detail the historical simulations that allow the updating of the IO table from 1985 to 1992. The techniques, particularly the model closure, are also presented. The updated table is presented prior to concluding comments.

### *An Overview of the Model*

The CGE model employed in this study was constructed by Buetre (1996)<sup>1</sup>. It is more disaggregated and more flexible or user friendly than its counterparts. Philippine CGE models such as Habito (1984), Clarete (1984) and, more recently, the APEX model developed by Clarete and Warr (1992) are designed for comparative static analysis. As such, they do not have update capabilities and other features that will allow data updating by simulation. This section outlines the key behavioural assumptions in the model.

There are 59 industries in the model, eight of which are agricultural. They produce 59 commodities. The formulation in the production side of the model allows the industries to produce more than one commodity. This feature reflects the production structure of most of the Philippine industries which are usually integrated. The composition of industry output is reflected in the make matrix. Producers are assumed to be price takers both for their outputs and inputs. They choose their output mixes to maximise revenue subject to a CET transformation function. They also minimise costs subject to a constant-returns-to-scale production function with a series of Leontief/CES nests. The nesting specification allows no substitution between inputs of different commodity categories or between produced inputs, primary factors and "other costs". Substitution takes place between alternative sources (that is, domestically produced goods and imports) of produced inputs of a given commodity category, and between aggregate labour (a CES combination of labour of two types), capital and agricultural land. Hence, input demands are functions of activity variables and of the relative prices of substitutable inputs. For example, the demand for land in an agricultural industry is a function of the industry's activity level and of the prices of aggregate labour, capital and land.

There are also 59 investors which are themselves the industries. Each investor minimises the cost of imported or domestic investment good subject to the CES production function. An equation links industry investment to capital stock accumulation allowing for the dynamics of capital stock accumulation. The dynamic accumulation equations are used to give relationships between the growth rates of sector-specific capital and sector-specific investment.

Investors are assumed to be price takers. They choose inputs of produced investment goods to minimise costs subject to the capital creation production function. Substitution is allowed between alternative sources of each investment good but not between commodity categories. Thus, demands for inputs into capital creation are functions of the industries' investment levels and of

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<sup>1</sup> The model was based on the ORANIF model of the Australian economy (Horridge et al., 1993). Modifications were made to allow measurement of technological, taste and labour productivity changes, quantification of shifts in export demand, measurement of shifts in preferences between domestic and imported goods, updating of the database for the CGE model, and identification and quantification of sources of growth or structural change.

the prices of source specific investment commodities. Investments by industries are determined via a capital accumulation equation.

Households are assumed to choose the consumption of composites of domestically produced and imported commodities to maximise a Stone-Geary utility function subject to the aggregate-spending constraint. To maximise utility subject to the expenditure constraint, households minimise the cost of obtaining any given quantity of a composite commodity, subject to the CES functions which define the composites. Thus, household demands for source-specific commodities are functions of the demands for the relevant composites and of source-specific commodity prices. The composite commodities are CES combinations of source-specific commodities with the same way of aggregation as in intermediate input and investment demands. Hence, household demands for composite commodities are functions of the aggregate expenditure level and of the relative prices of the commodities.

The foreign sector is modeled in a way similar to the small country assumption. For exports, some flexibility on export prices is given allowing downward sloping export demand curves for some commodities. This is done via the assignment of export elasticities of demand. For instance, for some commodities, the export elasticities are relatively smaller while for most of the export commodities, the export elasticities are large making export demand curve virtually flat. This implies that for most commodities, the quantities of Philippine exports have a very small effect on export price. The supply of imports is assumed to be perfectly elastic. Hence import prices are exogenous (that is, import requirements of the Philippines can be purchased at an unlimited quantity without any impact on import prices). Government is represented in the model, but its consumption level is essentially exogenous. The default assumption for government consumption is that it moves at the same rate as aggregate household consumption.

The model includes market-clearing constraints for domestically produced commodities. This means that the output of domestically produced commodities is equal to the purchases of the five users, namely, producers, consumers, investors, exporters and government. Through the simple dynamics incorporated into the model via the capital accumulation equations, the model can be used for forecasting. Forecasting needs some values of unobservable variables whose effects on output cannot be ignored. These are productivity, taste and technological change which can be estimated given the known variables. One of the important attributes of the model is its flexibility. It can be used for the analysis of policy issues requiring comparative static simulation by turning the capital accumulation equations off. Conversely, when these accumulation equations are in use, the model is turned into a forecasting tool.

### *Data*

The data comprise the base IO table which is for 1985, and the historical data which are percentage changes of the known variables during the period 1985 to 1992.

#### *The Transformed 1985 IO Table*

The 1985 IO table of the Philippines (see Figure 1) does not directly suit the specified model. For example, there is only one investor in the 1985 table, primary factors are not disaggregated to our specification (for example, capital, skilled/unskilled labour, and land) and taxes are not separated from the purchases of users. A long process was undertaken to transform the IO table according to the specification of the model<sup>2</sup>. The resulting IO table is shown diagrammatically in Figure 2.

The transformed IO table in this figure appears similar to the original 1985 IO table. It represents flows of commodities to various users, domestic taxes paid by users, payments to primary factors, commodity composition of industry outputs and tariffs on imported commodities. The basic flows from two sources (imported and domestic) represent the basic value of commodities used as intermediate inputs by industries, as inputs for capital creation by investors, as consumption goods, as exports, and for other demand. The basic value of a commodity is the price received by the producers. It excludes sales taxes. For imports, the basic values are inclusive of import taxes.

Summing over the basic flows of domestically produced commodities across the users gives the commodity supply. This is analogous to the commodity flows in the original IO accounts. The main difference is that the commodity valuation in the IO accounts includes taxes. The tax revenues summed over the users give the domestic tax revenues from all commodities from two sources.

The columns of the table show the purchases made by the five users. For industries, it shows payments for intermediate inputs both for domestically produced and imported commodities, indirect taxes, primary factors composed of land, labour and capital, and other cost tickets. The purchases of investors, households, export and "other" are composed of basic values of domestic and imported commodities and domestic taxes including tariffs on imports. Only the production sector requires primary factors.

The Make matrix represents the commodity composition of output of the industries net of indirect taxes. Summing it across industries yields the commodity output regardless of which industry

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<sup>2</sup> The transformation process is discussed in detail in Chapter IV of Buettre (1996).

produced it. This is equal to the domestic supply computed from the basic flows. The cost to each industry  $i$  in the absorption matrix is equal to the make matrix summed over commodities. The industry costs are payments on inputs and taxes regardless of what commodity it is producing. For industries producing a single product, there is a one-to-one correspondence between industries and commodities. In this case, the cost to the industry equals the output of its principal commodity. In multi-product industries, commodity output  $c$  is not equal to industry output  $q$ .

In sum, the transformed IO table which now suits the model specification, is a snapshot of the economy in 1985. This is what we attempt to update to 1992 by simulation using the CGE model described previously. We will need historical data to achieve this end.

#### *Data for Historical Simulations*

The IO table presented above reflects the structure of the economy in 1985. We will update it using the latest economic statistics which are for 1992<sup>3</sup>. The 1992 data are historical in the sense that their levels are already known but have not been incorporated into the CGE database. These data inputs could be macroeconomic or sectoral data. Macroeconomic data include expenditures in the national accounts such as aggregate consumption, aggregate investment, aggregate exports and imports, and government consumption, and data on their respective price indices. Data on national income such as aggregate capital stock, compensation of labour and aggregate taxes are also among the macroeconomic variables which are usually published by statistical agencies. Sectoral data include industry and commodity outputs, commodity prices, imports and exports and government and private consumption of goods and services, including tariffs. Most of these variables are usually endogenous or model-determined in simulations. That is, their changes are normally predicted.

It is desirable to gather as much information as possible but the availability of official statistics and the inconsistencies in statistical reports have impaired our ability to collect all of the changes in observable variables. Nevertheless, we presume that the data we were able to collect are sufficient to reflect the changes in the structure of the economy. Most of these data were not readily useable and have to be processed<sup>4</sup>.

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<sup>3</sup> When the research project was conducted, the latest economic statistic available were for 1992. Given the economic statistics for 1985 and 1992, percentage changes of the variables were computed.

<sup>4</sup> For further details of historical data construction, see Chapter V of Buetre (1996).

### *Macroeconomic Data*

The macroeconomic data used are aggregates from the demand and supply sides of the economy. These are private and government consumption, capital formation, exports and imports from the expenditure side, and employment and population from the supply side. We also have some data on consumer price index. These data are presented in Table 1.

### *Sectoral Data*

The available sectoral data are commodity imports and exports, industry output and employment. The information on quantity and value of imports and exports for 1985 to 1992 is available from the International Trade Statistics Yearbook of the United Nations. This is supplemented by data from the 1993 Philippine Statistical Yearbook and 1993 Philippine Yearbook. The data on imports and exports from these sources were supplemented and processed according to model specifications<sup>5</sup>. There is no information on exports of services. We assumed that they moved along with the aggregate exports. For export prices of services, we used the aggregate export price index in the absence of service-specific prices. The estimates of commodity imports and exports (that is, percentage changes from 1985 to 1992) are found in Table 2.

For industry output, we used the gross value added of each industry in constant prices. These data were taken from the 1993 Philippine Statistical Yearbook and shown in Table 2. The industry classification in the Yearbook is the same as in the model. Our procedure in putting information on output into the model is based on commodities. For this reason we transformed the observed percentage changes in industry output into output by commodity. We do this by using the structure of production in each industry which is available from the Make matrix.

Employment for industries is also available from the Statistical Yearbook. This is, however, on nine aggregate industries (displayed in Table 3). We used a mapping between the nine aggregate industries and the 59 industries of the model. Then we assumed that the changes in productivity for sectors within each of the 9 aggregate industries are the same. This enabled us to estimate the change in employment in each of the 59 industries in the model. This assumption was made due to the lack of industry-specific employment data. The estimates of employment by industry are presented in Table 2.

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<sup>5</sup> The procedures are found in Buetre (1996).

### Updating the IO Table<sup>6</sup>

To illustrate the updating process, it is convenient to present the model in a compact form:

$$A(Z^B)z = 0 \quad (1)$$

where  $A$  is an  $m \times n$  matrix of coefficients whose components are functions of base period values ( $Z^B$ ) of variables, and  $z$  is an  $n \times 1$  vector of percentage changes in variables. The number of variables,  $n$ , is greater than  $m$ , the number of equations. The base period values ( $Z^B$ ) are normally read from the model's IO database. It is an initial solution to Equation (1).

The  $A$  matrix contains costs and sales shares computed from the entries in the IO database. The vector  $z$  contains percentage changes in prices and quantities and other variables. An example of a component equation in (1) is:

$$x_c \cdot S_i B_{ci} x_{ci} = 0 \quad (2)$$

where  $x_c$  is the percentage change in the demand for commodity  $c$ ,

$x_{ci}$  is the percentage change in the demand for commodity  $c$  by user  $i$ , and

$B_{ci}$  is the share of the sale of commodity  $c$  to user  $i$ .

By specifying values for percentage changes in  $n-m$  exogenous variables, the system can be solved for percentage changes in the remaining  $m$  endogenous variables according to:

$$A_1(Z^B)z_1 + A_2(Z^B)z_2 = 0 \quad \text{or} \quad (3a)$$

$$z_1 = -A_1^{-1}(Z^B)A_2(Z^B)z_2 \quad (3b)$$

where  $z_1$  is the column vector of endogenous variables

$z_2$  is the column vector of exogenous variables, and

$A_1$  and  $A_2$  are submatrices of  $A$  formed from the  $m$  and  $(n-m)$  columns corresponding to the endogenous and exogenous variables.

The shocks are the values to be used for  $z_2$ , the vector of exogenous variables. Solutions to (3a) above are approximations to the solutions of the non-linear system of equations implied in the theory of the model. The solutions are valid when the shocks are small; otherwise linearisation errors occur. These errors are minimised by applying a multi-step simulation in which the exogenous shocks (the values assigned to  $z_2$ ) are applied in a number of steps. The multi-step

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<sup>6</sup> Database and IO table are used interchangeably in this paper.

simulation can only be done by updating the values of ( $Z^B$ ). When this is updated the  $A$  matrix also changes since it is a function of the former.

For example, suppose that we knew that the change in exports during the period 1985 to 1992 was 50 percent and decided to apply a two-step simulation. The flows data that will be directly affected is  $V4BAS_c$  in the TABLO notation of the model in Appendix 1. The components of  $V4BAS$  are flows in Peso values of commodity  $c$  to the export market. As such, they are products of prices and quantities. The updating formula is:<sup>7</sup>

$$V4BAS_c^{1992} = V4BAS_c^{1985} \times [1 + [p4_c + x4_c]/100] \quad (4)$$

where  $V4BAS_c^{1992}$  and  $V4BAS_c^{1985}$  are the updated and the original values of exports of commodity  $c$ , and  $p4_c$  and  $x4_c$  are the percentage changes in price and quantity of exports of commodity  $c$ . Prices and quantities are usually endogenous in simulations. In this case, we already know the value of  $x4_c$  so that, instead of allowing the model to estimate its values, we feed into it the actual or historical change, that is 50 percent. This is done by adopting a closure in which  $x4_c$  is made exogenous and the actual change in its exports is introduced as a "shock". With a two-step simulation, the shocks are broken into two pieces and on the first step, the original values of the database are the values before the first step and the updated values are the ones written on the database after the step. The updated data are used for the second step and other updated data are written at the end of the second step. In other words, for every step in a multi-step simulation, an updated database is written. In the two-step simulation where we put the known increase in export of commodity  $c$ , we start by using Equation (3b) to calculate the effects of a uniform 25 percent increase in exports of commodity  $c$ . The solution would include the effect of this shock on other endogenous variables particularly prices and quantities. The flows data  $V4BAS_c$ , and other components of  $Z^B$  would be updated according to the price changes resulting from the shock and the 50 percent actual increase in the quantity of exports according to updating equations like Equation (4) above. In other words, the whole flows database is updated in accordance with the movements in the endogenous variables by moving the entries in the IO table to reflect the situation after the 25 percent increase in exports of commodity  $c$ . This updated IO table allows the evaluation of the  $A$  matrix (that is, the cost and sales shares as in Equation (3)). These new costs and sales shares are then used in the computation of the remaining increase in exports that is sufficient to make the total increase in exports to 50 percent. Improved accuracy of solution could be attained by increasing the number of steps in the simulation. That is, we may

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<sup>7</sup>With GEMPACK's TABLO program, there is no need to write this explicit update of V4BAS. TABLO uses some rules in updating database flows such that this update statement is interpreted by TABLO as Equation 5 (See GPD-1 for details). By TABLO language, the above updating procedure is conveniently written as: Update (All,c,COM) V4BAS(c) = p4(c) \* x4(c).

break the 50 percent shock in much smaller pieces by augmenting the number of steps in the simulations.

In the actual updating, we solved (simulated) Equation (1) in which the exogenous shocks consisted of known changes in variables between the period 1985 to 1992. In the process, we moved the database from 1985 to 1992. The database written at the end of the final step of a multi-step simulation was the estimated 1992 IO table. Two types of simulations were employed, one being macroeconomic historical simulation and the other sectoral historical simulation<sup>8</sup>.

### *Macroeconomic Historical Simulations*

In the macroeconomic historical simulation, we put into the model the actual changes in aggregate consumption ( $x3tot = 34.62$ ), investment ( $x2tot_i = 71.43$ ), exports ( $x4tot = 74.41$ ), imports ( $x0cif_c = 140.31$ ) and government consumption ( $x5tot = 35.76$ ) from 1985 to 1992 as in Table 1<sup>9</sup>. These aggregate variables are usually endogenous in the model. That is, they are usually estimated from the respective changes in the expenditures on commodities in each of the five categories of final demand. To put this information into the model rather than estimate it, requires the adoption of a new closure or endogenous-exogenous split of the model. It also requires a similar number of variables to be endogenised for the model to have a solution. The following variables were endogenised:

*a1prin gen* - is a general technological change variable. This was endogenised in place of the aggregate consumption ( $x3tot$ ).

*ff\_accum* - a general shifter for aggregate investment. This facilitated the exogenisation of aggregate investment ( $x2tot_i$ ).

*twist\_src\_bar* - a general twister for imports. This is endogenised in place of aggregate imports ( $x0cif_c$ ).

*f4q\_general* - a general shifter for exports. Facilitates the exogenisation of aggregate exports.

*f5tot2* - a shifter for aggregate "other" demand. We endogenised this for the government consumption to be exogenised.

<sup>8</sup> These are historical in the sense that the values of variables are already known.

<sup>9</sup> That is, we exogenized and shocked them at their observed levels.

The closure in this simulation is exhibited in Figure 2. It worked as follows<sup>10</sup>:

- On the expenditure side, the aggregate consumption, investment, government, exports and imports were fixed to their actual changes from 1985 to 1992. The gross domestic product should therefore be endogenous as it is implied by its components. Although we also know the gross domestic product, exogenising it will make the model over-determined and will not work. Fixing the aggregate final demands to the known changes does not mean that their commodity components will move in the same magnitude. The commodity components vary subject to the exogenous aggregate demand.
- With fixed exports and imports, the balance of trade must be endogenous.
- On the income side, fixing the economy-wide rate of return ( $r/cap_i$ ) allowed the aggregate capital stock ( $x/cap_i$ ) to be endogenously determined. This determines the real wage rate via the factor price frontier. Aggregate employment, fixed at observed level, also helps to determine the capital stock via the production function. The industry changes in capital stocks were allowed to vary in accordance with the changes in their respective rates of return which are endogenous.
- These known aggregate variables from the income side were sufficient to set the value of the gross domestic product (GDP). However, GDP is also implied in the expenditure side. It is an accounting requirement that the GDP estimates from income and expenditure sides are equal. To reconcile the GDP from income and expenditure sides, a technical change variable ( $a/primgen$ ) was endogenised.

In addition to having a valid closure and the shocks to the above macroeconomic variables, we also introduced the following shocks:

- $defFudge, defUnity = 1$ . These two variables were shocked for the dynamic equations to work.
- Employment ( $employ_i$ ) = 20.79. This is the percentage change in aggregate employment in the Philippines during the period. Not taking this into consideration, would indicate scarcity of labour thus making wages higher than the actual changes. It will also allow for the over-substitution of capital for labour.
- Number of households ( $q$ ) = 17.54. This allowed for the changes in consumption to be measured in terms of per household basis.
- Consumer price index = 81.40. This allowed the actual change in aggregate consumer price to be imposed exogenously. Commodity price variations still work subject to this aggregate percentage change. This shock made the updated database expressed in 1992 values.

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<sup>10</sup> A closure is important in running models as it influences results and determines whether the equation system can be solved or not.

Having incorporated these changes into the database, we were left with the question of whether the sectoral estimates generated by the model during macroeconomic historical simulations were consistent with the observed or known sectoral changes. The only way to tell was to compare simulated values with the observed sectoral changes. Unfortunately, our findings showed that for some variables, there were wide differences among the model results and the observed sectoral changes. The main reason is that taste changes, technology changes and import twists were not uniform across commodities and industries. This compelled us to do the task of putting the known changes in the sectoral variables into the model. These sectoral variables must add up to the known macroeconomic variables (for example, the aggregate of the known changes in commodity imports must equal to the known aggregate imports). This questioned the purpose of doing the macroeconomic historical simulations. We did it for the following reasons:

- To test the ability of the model to reproduce the known macroeconomic variables, and
- To allow us to test the model before going into more detailed historical simulations.

Experience indicated that it was easier to detect problems when we were dealing with few changes in the model. By this, we mean that identifying the problems would be extremely difficult once we put too many historical data all at once. In sectoral historical simulation therefore, we put the historical data one by one. This was a long and tedious process but better than being troubled with tracking the problem when all the data were simulated simultaneously.

### *Sectoral Historical Simulations*

After detecting differences between predicted and actual changes in sectoral variables, we put into the model the changes in the components of final demand. We did this only on imports, exports and government consumption, since it is on these that we had data. We did this step by step. Firstly, we worked on export volumes followed by import volumes. Then we worked on industry output. Finally, we included employment changes in the database.

For imports, two variables were introduced into the data, import volumes and import prices. Import prices are usually exogenous so their changes can be easily introduced into the model by shocking their respective components with the observed changes. Import volumes are, however, usually endogenous. To exogenise them requires a similar number of components to be endogenised in order to solve the model. This is accomplished by endogenising the components of twist variables ( $twist\_src(c)$ )<sup>11</sup>. We adopted a step-by-step introduction of observed data for reasons outlined previously. Since aggregate import ( $x0cif_c$ ) was now implied from the import components, it was endogenised. This was accomplished by swapping it with the aggregate twist

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<sup>11</sup> The role and interpretation of twist variables are presented in Buetre (1996).

variable. The respective changes in import volumes must add up to the known aggregate import volume. If the computed and known changes in aggregate import volume are not identical, we change the closure and activate the import volume adjusting equation (Equation E\_x0impObs in Appendix 1). In this adjustment equation, the aggregate import volume becomes exogenous and shocked with its observed value. A scalar variable adjusted the values of observed components of imports to hit the known aggregate. The percentage changes in commodity outputs were included in the data as shocks to  $x0don(c)$  variable which were exogenised by endogenising the uniform taste/input-saving technological change  $uc(c)$ .

The observed changes in export volume by commodity were incorporated into the model as shocks to the respective components of the export volume vector ( $x4Obs(c)$ ). Since the aggregate export volume is implied from those exogenous changes, the shifters must be made endogenous. In cases where the implied aggregate change in export volume did not add up to the observed change, we activated the export  $\alpha$  equation (E\_x4Obs) to hit the historical value of export. This is made possible by making the aggregate export volume as exogenous and endogenising a scalar variable. This scalar variable scales the observed exports by commodity up or down such that its weighted sum is equal to the exogenous aggregate export volume. Known export prices were introduced as shocks to the respective components of export price vector variable. This was made possible by endogenising the usual exogenous export tax variable instead of the normally endogenous export prices.

Finally, the changes in employment in the nine major industry groups were introduced as shocks to the nine industry-wide employment variables. Labour productivity was allowed to vary in this nine industry grouping by endogenising the labour productivity variable. Through a mapping incorporated into the TABLO file of the model and in the database, the shocks were distributed among the 59 industries in the model according to the map. This enabled the model to provide estimates for the labour productivity in each of the 59 industries. However, the productivity estimates were the same for each of the industries that belong to a particular major industry.

With all the known sectoral variables exogenised and shocked at their 1985 to 1992 changes, a database for 1992 was created post-simulation by the GEMPACK program.

#### *New Database for the Philippines*

A by-product of historical simulations is a new database suitable for the model presented earlier. This new database reflects the structure of the economy in 1992 rather than the base year since the observed variables imposed on the model are changes during the period 1985 to 1992. The creation of this new database was made possible by the incorporation of update statements in the TABLO file of the model allowing the database illustrated in Figure 1 to change in accordance

with the changes in the variables. The structure of the database is the same as the old IO table. Their properties (that is, equality between sales and costs, output composition, etc.) are preserved. Only the levels changed. A summary of the updated data is reported in Table 4. The original data are displayed in Table 5 to facilitate comparison.

### *A Balanced Database*

One of the important questions that may be asked is whether the database remained balanced after updating. The answer is definitely yes, provided that the updating is made correctly. To illustrate this, let us consider the example below:

Suppose that  $Z$  refers to a variable in levels,  $z$  to percentage change in  $Z$ ,  $z^*$  to the fractional change, and  $Z^*$  to the updated value of  $Z$ . From this we can infer that:

$$z^* = z/100, \text{ and} \quad (5)$$

$$Z^* = Z(1 + z/100) = Z(1 + z^*) \quad (6)$$

We apply these definitions to a case where the quantity demanded is equal to the quantity supplied, that is:

$$\sum_j Q_j = \sum_t Y_t \quad (7)$$

where  $Q_j = P_j \times X_j$  and  $Y_t = W_t \times N_t$  are flows in dollar values which usually constitute the database. The percentage and fractional changes in  $Q_j$  and  $Y_t$  are:

$$q_j = p_j + x_j \text{ and so } q_j^* = p_j^* + x_j^*, \quad (8)$$

Similarly

$$y_t^* = w_t^* + n_t^* \quad (9)$$

The updated values are:

$$Q_j^* = Q_j(1 + p_j^* + x_j^*), \text{ and} \quad (10)$$

$$Y_t^* = Y_t(1 + w_t^* + n_t^*). \quad (11)$$

Because Equation (10) holds, the linearised form of it must be a consequence of one or more of the linearised equations of the model. Thus the simulation results have the property that:

$$\sum_j (P_j \times X_j / C)(p_j + x_j) = \sum_t (W_t \times N_t / C)(w_t + n_t) \quad (12)$$

where  $C$  is the total of either side of (11) above. It follows that:

$$\begin{aligned}
 \sum_j Q_j^* &= \sum_j Q_j(1 + p_j^* + x_j^*) \\
 &= \sum_j Q_j + \sum_j Q_j(p_j^* + x_j^*) \\
 &= \sum_t Y_t + \sum_t Y_t(w_t^* + n_t^*) \\
 &= \sum_t Y_t^*
 \end{aligned} \tag{13}$$

Hence, the updated data are balanced and they will remain so in the  $n$ -step simulations. This balance is seen in the updated data shown in Table 4 where for all commodities, domestic sales are equal to domestic output, GDP from income is equal to the GDP from expenditure side, and industry output is equal to the industry costs.

#### *Concluding Comments*

In this paper, we demonstrated that an IO table can be updated by simulations. One of the advantages of using the CGE model in the updating process is that it allowed us to estimate the unobservable variables such as technological change, taste change, and shifts in exports and import twists. The values of these variables are usually assumed in simulations or taken from other sources. The estimates of these unobservable variables are consistent with the observed changes in the economy. The technique also preserved the properties of the IO table.

The methodology employed will enable the model user to continuously update the IO tables whenever latest economic statistics are made available. However, due to the rarely complete economic statistics, the methodology offers only a substitute to the real IO tables. In our case we only managed to collect variables on changes in output, imports, exports, and some prices. Most of these variables are concerned with the demand side of the economy. We were unable to obtain detailed information on the supply side such as employment, capital stock, and land utilization.

The updated table which now reflects the latest structure of the economy is suited for sectoral policy analysis particularly for the agricultural sector which is vulnerable to numerous factors such as weather conditions, pests and diseases and the globalization of trade. The updated database is additionally a good base for forecasting purposes using a CGE model.

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**FIGURE 1**  
*1985 Input-Output Table of the Philippines*

**ABSORPTION MATRIX**

Intermediate Demand	Private Consumption	Capital Formation	Exports	Change in Inventories	Government
D o m  I m p	(C x I)	(C x I)	(C x I)	(C x I)	(C x I)
	(I x I)	(I x I)	(I x I)	0	(I x I)
Primary Factors (3 x I)					
Indirect Taxes (I x I)					

**MAKE MATRIX**

(C x I)

C = 59 commodities  
 I = 59 industries

**FIGURE 2**  
*The Database*

		Absorption Matrix				
		1	2	3	4	5
		Producers	Investors	Household	Export	Other
Size		← 1 →	← 1 →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ CxS ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS
Taxes	↑ CxS ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX
Labour	↑ O ↓	VILAB				
Capital	↑ I ↓	VICAP				
Land	↑ J ↓	VILND				
Other Costs	↑ I ↓	VIOCT				

C = Number of Commodities  
 I = Number of Industries  
 S = 2; Domestic, Imported  
 O = Number of Occupation Types

Size	← 1 →
↑ C ↓	MAKE

Size	← 1 →
↑ C ↓	VOTAR

where:

$V1BAS(c,s,i)$  - flow of commodity c in basic value from source s to industry i for intermediate use.

$V2BAS(c,s,i)$  - flow of commodity c in basic value from source s to industry i for investment.

$V3BAS(c,s)$  - flow of commodity c in basic value from source s for household consumption.

$V4BAS(c,s)$  - flow of commodity c in basic value from source s for export.

$V5BAS(c,s)$  - flow of commodity c in basic value from source s for government consumption.

V1TAX(c,s,i) - sales tax imposed on commodity c from source s for intermediate use by industry i.

V2TAX(c,s) - sales tax imposed on commodity c from source s for investment use by industry I.

V3TAX(c,s) - sales tax imposed on commodity c from source s consumed by households.

V4TAX(c,s) - sales tax imposed on export commodity c from source s

V5TAX(c,s) - sales tax imposed on commodity c from source s for government consumption.

V1LAB(i,o) - Wage bill by industry i by occupation.

V1CAP(i) - Capital rentals by industry I.

V1LND(i) - Land rentals by industry I.

V1OCT(i) - Other cost tickets by industry I.

MAKE(c,i) - Make matrix by commodity c, by industry I.

V0TAR(c) - Tariff revenue by commodity c.

**FIGURE 3**  
*Diagrammatic Representation of Macroeconomic Closure*

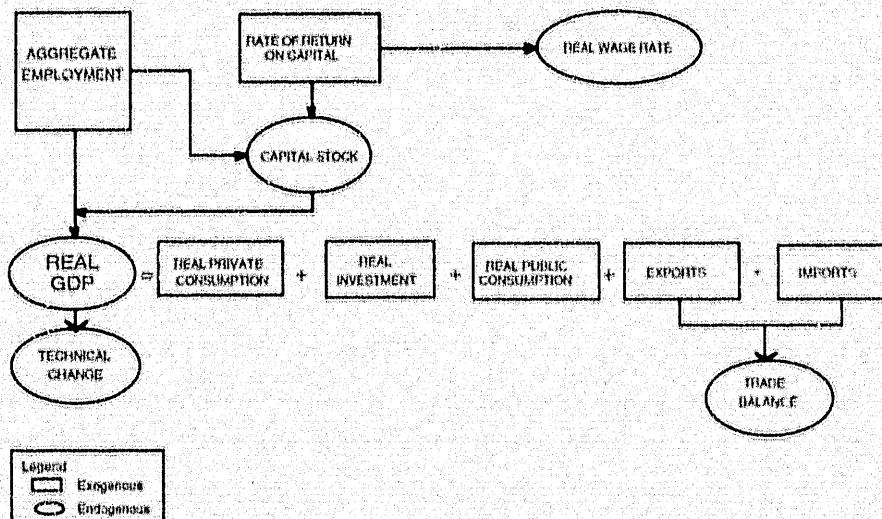


TABLE I  
*Macroeconomic Data for Historical Simulations\**

Variable	1985	1992	Change %
Personal Consumption Expenditure	416,961	561,319	34.62
Government Consumption	40,490	54,968	35.76
Capital Formation	93,290	159,930	71.43
Exports	136,010	237,218	74.41
Imports	124,206	298,485	140.31
Gross National Product	562,545	714,950	27.09
Gross National Expenditure	550,741	776,217	40.94
Employment(1000 persons)	19,801	23,917	20.79
Population(1000 persons)	54,668	64,258	17.54
CPI			81.40

Source: 1993 Philippine Statistical Yearbook for 1992

\*Expenditures are in Million Pesos, Constant 1985  
prices

Formula for % change:  $(C-B) \times 100/B$

TABLE 2  
*Sectoral Data (%), 1985-1992*

Sector	Domestic Output	Exports (Volume)	Imports (Volume)	Employ-ment	Price of Exports
1 Palay	8.26		-98.78	4.69	
2 Corn	8.11		-90.68	6.29	
3 Coconut/copra in farms	-29.33	31.60	0.00	-53.95	
4 Sugarcane	13.56		0.00	11.72	
5 Banana	-21.21	8.05	0.00	-34.33	
6 Other crops incl. agric. services	23.44	34.44	170.07	22.14	
7 Livestock	61.73	-100.00	429.08	83.33	
8 Poultry	80.16	0.00	669.15	138.08	
9 Fish & fishery products	19.51	123.06	610.76	12.84	
10 Logs & other forest products	-38.53	-38.21	47.98	-66.06	
11 Copper	-28.77	12.39		-27.29	
12 Gold & other precious metals	-16.53	63.32		-3.73	
13 Chromium ores	-59.71	34.28	17.08	-56.18	
14 Nickel	-43.06	16.00		-61.11	
15 Other metallics	-47.04	30.04	230.83	-57.22	
16 Sand, stone & gravel	57.66	0.00	106.69	144.32	
17 Other non-metallic minerals	34.93	104.77	0.00	82.71	
18 Food manufactures	4.10	35.57	131.40	-22.87	47.23
19 Beverage products	13.78	35.57	139.85	-15.37	
20 Tobacco manufactures	-3.58	11.67	79.77	-29.54	
21 Textiles & textile goods	3.08	210.26	250.02	-20.10	42.77
22 Wearing apparel & footwear	99.09	152.38	179.46	105.16	57.12
23 Wood, cork & cane products	27.10	-19.19	106.98	8.87	
24 Furntrrs & fxtrs, primarily of wood	28.51	86.41	106.98	12.14	
25 Paper & paper products	60.17	100.00	144.08	62.28	
26 Publishing & printing services	76.73	128.00	348.27	80.95	
27 Leather & leather products	6.14	58.38	56.60	-15.51	
28 Rubber products	35.88	0.00	68.96	21.36	
29 Chem. & chem. prod. except petrol. & coal	15.32	88.05	109.38	-8.36	
30 Products of petroleum & coal	78.38		275.65	141.01	
31 Non-metallic mineral products	70.04	40.50	106.98	86.33	
32 Basic metal products	-1.85	-46.27	208.43	-37.97	
33 Fabricated metal products	34.04	39.47	313.04	18.84	
34 Machinery except electrical	59.40	185.82	116.27	55.03	
35 Electrical machinery	89.89	125.79	285.49	103.15	
36 Transport equipment	109.53	115.82	134.89	137.65	
37 Miscellaneous manufactures	56.80	146.31	127.72	53.44	
38	19.90	74.41	106.98	40.32	
39 Electricity & gas	28.65			27.23	
40 Water services	20.80			18.66	
41 Land transport	23.86	74.41	468.31	29.15	47.70
42 Water transport services	20.31	74.41		20.67	47.70
43 Air transport services	26.07	74.41	278.23	27.23	47.70
44 Storage & services incidental to transport	10.85	74.41	279.70	9.83	47.70
45 Communication	43.31	74.41	290.76	57.56	47.70
46 Trade	47.59	74.41		25.74	47.70

47 Banking services	84.03	74.41	126.50	55.30	47.70
48 Non-banks services	55.21	74.41		33.07	47.70
49 Insurance services	36.26	74.41	312.20	4.37	47.70
50 Real estate services	63.08	74.41	565.04	45.93	47.70
51 Ownership of dwelling	22.68			0.00	
52 Government services	34.05			27.82	
53 Private education services	21.16	74.41	474.33	11.32	
54 Private health services	38.72	74.41	452.09	31.66	
55 Private business services	27.24	74.41	298.21	-7.06	
56 Recreational services	44.13	74.41	157.45	40.59	
57 Private personal services	26.07	74.41	522.31	14.09	47.70
58 Restaurants & hotels	26.40	74.41	67.10	15.07	47.70
59 Other private services	14.41	74.41	490.94	1.99	

Sources: Computed from Philippine Statistical Yearbook, UN International Trade Statistics and FAO Trade Yearbook

TABLE 3

*Employment by Major Industry Groups, 1985 to 1992 (1000 persons)*

Major Industry Group	Third Quarter 1985	Oct-92	% Change
Total	19,801	23,917	20.79
Agriculture, fishery & forestry	9,699	10,879	12.07
Mining and quarrying	128	143	11.72
Manufacturing	1,923	2,549	32.47
Electricity, gas and water	73	92	26.03
Construction	684	1,036	51.32
Wholesale and retail trade	2,612	3,286	25.74
Transp., storage & communication	931	1,222	31.15
Financing, insurance, real estate and bus. services	342	452	32.16
Community, social & personal services	3,409	4,258	24.82

Source: 1993 Philippine Statistical Yearbook

TABLE 4  
*Summary of Updated Data (Million Pesos)*

	Labour	Capital	Land	Indirect Tax	Investment	Consumption	Govt Invent	Export	Import	Sales	Output
1	19,851	12,549	7,664	1,098	-	153	(342)	1	0	51,203	51,
2	8,800	4,435	3,126	(785)	-	2,177	-	13	205	19,788	19,
3	3,423	1,994	693	160	-	113	(59)	645	-	6,778	6,
4	3,722	2,327	580	330	-	179	-	-	-	9,103	9,
5	2,095	1,086	94	360	-	1,574	-	2,483	-	4,783	4,
6	29,560	28,951	1,984	3,301	15,010	39,843	(63)	4,179	14,369	78,895	78,
7	10,914	12,744	-	905	3,699	5,628	118	1	193	45,915	45,
8	6,927	17,413	-	856	6,485	12,761	24	4	425	38,137	38,
9	20,610	26,139	-	2,420	-	54,535	-	5,192	68	68,838	68,
10	1,947	1,294	-	685	1,218	247	1,046	418	266	7,777	7,
11	1,231	989	-	748	-	-	89	2,364	-	5,858	5,
12	3,371	2,811	-	663	-	57	1,644	5,102	-	9,908	9,
13	108	25	-	45	-	-	(157)	406	87	262	-
14	91	64	-	9	-	-	243	796	-	1,515	1,
15	45	25	-	41	-	-	70	9	142	275	-
16	954	1,430	-	84	-	50	(359)	157	121	4,190	4,
17	1,272	3,120	-	1	-	639	223	8	40,010	6,521	6,
18	26,625	35,771	-	8,973	-	170,711	570	27,289	18,272	237,384	237,
19	1,544	4,120	-	3,046	-	21,693	(38)	208	652	21,532	21,
20	1,566	1,517	-	3,111	-	15,832	116	84	393	16,312	16,
21	3,139	2,718	-	1,273	991	6,042	(598)	7,950	25,226	18,825	18,
22	9,693	7,146	-	903	-	19,906	(143)	30,016	11,019	38,534	38,
23	2,053	2,197	-	172	-	89	(391)	780	107	5,306	5,
24	1,513	1,206	-	68	4,191	1,782	10	3,091	21	9,125	9,
25	1,528	3,150	-	496	-	1,209	(853)	1,551	6,059	15,346	15,
26	2,204	2,342	-	289	358	2,593	(91)	140	1,238	10,840	10,
27	122	130	-	16	-	-	(16)	72	2,216	538	-
28	1,511	1,670	-	607	-	5,877	(203)	298	3,733	9,457	9,
29	6,007	8,699	-	4,099	-	23,637	(278)	5,498	34,373	48,744	48,
30	1,869	23,650	-	30,983	-	21,863	(1,305)	3,551	13,913	84,745	84,
31	2,342	6,065	-	342	842	1,273	(2,507)	1,088	1,112	20,374	20,
32	1,505	3,896	-	1,007	-	302	(369)	7,314	14,540	29,888	29,
33	2,074	2,483	-	525	4,073	1,900	(290)	206	7,476	13,608	13,
34	1,449	1,614	-	248	20,065	200	(287)	1,350	16,916	6,946	6,
35	9,016	10,915	-	4,455	27,660	15,657	1,157	72,755	86,691	82,601	82,
36	1,949	2,469	-	312	8,604	3,009	(320)	1,301	8,053	12,083	12,
37	2,276	2,399	-	560	2,978	1,925	(34)	8,469	5,968	8,920	8,
38	36,055	21,049	-	4,424	114,867	507	-	6,214	859	122,760	122,
39	5,163	19,351	-	(496)	-	13,919	-	-	-	52,592	52,
40	782	1,249	-	13	-	1,374	-	-	-	2,920	2,
41	19,618	17,531	-	3,082	2,987	68,683	-	12,200	11,527	82,425	82,
42	3,278	4,031	-	572	731	4,522	-	8,759	322	14,902	14,
43	772	1,925	-	188	-	7,123	-	12,026	3,506	16,888	16,
44	4,288	3,411	-	586	702	2,617	-	8,175	2,917	10,937	10,
45	2,671	12,136	-	558	-	6,031	-	4,499	1,907	17,382	17,
46	64,541	147,624	-	12,773	17,012	145,196	-	34,867	(0)	299,108	299,
47	13,209	7,663	-	5,501	-	8,997	-	16,105	12,960	36,947	36,
48	2,277	4,486	-	680	-	2,698	-	9,570	-	11,602	11,
49	3,846	4,065	-	652	-	6,588	-	735	2,000	13,504	13,
50	4,697	9,092	-	2,329	-	16,144	-	5,631	1,307	41,098	41,
51	-	38,842	-	-	-	44,134	-	-	-	44,134	44,
52	57,729	1,051	-	6	-	80	91,468	-	-	92,330	92,
53	5,478	2,231	-	241	-	13,517	-	166	119	14,082	14,
54	4,585	5,405	-	245	-	16,450	-	454	380	17,549	17,

55	3,721	3,993	-	784	-	2,992	-	3,265	5,132	17,480	17,4
56	5,641	9,031	-	1,942	-	10,009	-	11,893	5,753	18,916	18,9
57	8,304	8,137	-	874	-	18,922	-	2,383	3,708	29,591	29,5
58	5,770	4,749	-	1,229	-	21,453	-	29,384	24,118	32,667	32,6
59	1,610	854	-	52	-	3,007	-	592	117	4,408	4,4
Totals	448,940	569,462	14,141	108,638	232,473	849,324	88,074	361,707	390,396	2,045,076	2,045

Note: Sector equivalents are in Table 2.

TABLE 5  
*Summary of Original Data (Million Pesos)*

	Labour	Capital	Land	Indirect Tax	Investment	Consumption	Govt Invent	Export	Import	Sales	Output
1	10,731	8,118	4,335	627	2,596	76	(208)	0	0	51,203	51,203
2	4,706	2,814	1,730	241	900	1,299	0	8	700	19,788	19,788
3	3,586	5,169	2,189	275	1,653	201	(70)	565	0	6,778	6,778
4		1,371	295	176	439	83	0	0	0	9,103	9,103
5	1,625	1,413	122	335	452	1,702	0	1,756	0	4,783	4,783
6	14,098	15,030	876	681	4,806		(30)	1,904	4,134	78,895	78,895
7	3,819	3,943	0	313	1,261	1,839	64	4	36	45,915	45,915
8	1,989	3,936	0	217	1,258	3,555	11	2	47	38,137	38,137
9	10,409	15,017	(0)	1,261	4,802	28,832	0	1,647	8	68,838	68,838
10	2,604	7,356	0	1,021	2,352	914	1,180	787	128	7,777	7,777
11	876	1,658	0	638	530	0	58	1,411	0	5,858	5,858
12	1,923	2,826	0	496	904	45	1,058	2,196	0	9,908	9,908
13	107	110	0	31	35	0	(101)		51	262	262
14	101	496	0	10	159	0	173	498	0	1,515	1,515
15	47	132	0	10	42	0	51	5	34	275	275
16	272	390	0	28	125	12	(146)	65	44	4,190	4,190
17	448	1,230	0	29	393	280	107	2	26,809	6,521	6,521
18	18,199	31,276	0	2,805	10,001	104,736	379	14,117	6,021	237,384	237,384
19	973	3,111	0	1,751	995	12,913	(26)	110	208	21,532	21,532
20	1,158	1,539	0	2,118	492	10,316	79	52	120	16,312	16,312
21	2,098	2,278	0	259	728	2,722	(380)	1,965	5,761	18,825	18,825
22	3,095	1,790	0	187	572	8,014	(79)	8,017	3,076	38,534	38,534
23	1,091	1,240		194	397	366	(727)	1,939	39	5,306	5,306
24	770	630	0	37	202	1,422	7	1,309	7	9,125	9,125
25	582	1,032	0	137	330	456	(521)	541	1,905	15,346	15,346
26	771	670	0	50	214	726	(44)	37	226	10,840	10,840
27	78	96	0	7	31	555	(12)	37	1,022	538	538
28	724	788	0	213	252	2,416	(119)	174	1,614	9,457	9,457
29	3,574	5,931	0	1,204	1,896	10,844	(187)	2,171	12,356	48,744	48,744
30	516	4,780	0	10,877	1,528	8,679	(965)	1,010	2,981	84,745	84,745
31	800	1,673	0	125	535	341	(1,174)	401	404	20,374	20,374
32	1,228	4,788	0	260	1,531	164	(322)	10,754	3,719	29,888	29,888
33	1,013	1,208	0	96	386	574	(161)	89	1,470	13,608	13,608
34	571	556	0	78	178	77	(160)	329	5,912	6,946	6,946
35	2,896	2,753	0	581	880	3,158	1,148	16,869	18,147	82,601	82,601
36	555	517	0	98	165	868	(152)	354	2,619	12,083	12,083
37	905	822	0	110	263	994	(21)	2,448	1,994	8,920	8,920
38	15,609	10,353	0	2,092	3,310	233	0	2,212	312	122,760	122,760
39	2,406	9,804	0	(224)	3,135	5,936	0	0	0	52,592	52,592
40	391	721	0	7	231	695	0	0	0	2,920	2,920
41	9,070	8,766	0	1,277	2,803	28,977	0	4,273	1,691	82,425	82,424
42	1,590	2,197	0	280	702	2,848	0	3,248	60	14,902	14,902
43	354	939	0	76	300	3,602	0	4,363	747	16,888	16,888
44	2,246	2,145	0	262	686	1,544	0	3,112	619	10,937	10,937
45	1,046	4,624	0	186	1,478	2,056	0	1,400	394	17,382	17,382
46	30,409	60,459	0	5,423	19,332	58,459	0	12,890	(0)	299,108	299,108

47	5,282	2,428	0	1,975	776	3,236	0	5,980	4,351	36,947	36,947
48	1,021	1,687	0	280	539	1,545	0	3,502	0	11,602	11,602
49	2,107	2,089	0	295	668	3,043	0	301	394	13,504	13,504
50	1,945	3,018	0	768	965	5,020	0	1,828	166	41,098	41,098
51	0	26,530	0	0	8,483	29,882	0	0	0	44,134	44,134
52	26,961	491	0	3	157	42	41,778	0	0	92,330	92,330
53	2,830	1,241	0	128	397	7,129	0	65	17	14,082	14,082
54	2,063	2,384	0	118	762	7,942	0	182	57	17,549	17,549
55	2,229	2,388	0	372	764	1,477	0	1,377	1,043	17,480	17,480
56	2,403	3,634	0	714	1,162	4,179	0	4,274	1,726	18,916	18,916
57	4,182	4,326	0	400	1,383	8,612	0	931	500	29,591	29,591
58	2,895	2,513	0	426	804	12,468	0	11,968	10,524	32,667	32,667
59	891	536	0	27	171	1,565	0	321	17	4,408	4,408
Totals	218,779	291,760	9,546	42,461	93,290	416,961	40,498	136,010	124,206	2,045,076	2,045,076

Note: Sector equivalents are in Table 2

## APPENDIX 1

### *Relevant Equations and Variables in Historical Simulations*

#### A. Equations

Equation E\_ac\_c

$\text{Sum}(i, \text{IND}, \text{Sum}(c, \text{COM}, (\text{V1PUR}_S(c,i) + \text{V2PUR}_S(c,i)) * \{\text{ac}(c) - \text{ac\_c}\})) = 0;$

Equation E1\_ac # Uniform Input using Tech Changes #

$(\text{All}, c, \text{COM})(\text{All}, s, \text{SRC})(\text{All}, i, \text{IND})$

$a1(c,s,i) = ac(c) + fa1(c,s,i);$

Equation E2\_ac # Uniform Input using Tech Changes #

$(\text{All}, c, \text{COM})(\text{All}, s, \text{SRC})(\text{All}, i, \text{IND})$

$a2(c,s,i) = ac(c) + fa2(c,s,i);$

Equation E3\_ac # Uniform Taste Changes #

$(\text{All}, c, \text{COM})$

$ffx3_s(c) = ac(c) + fa3(c);$

Equation E\_x0impObs # Exogenous imports#

$(\text{All}, c, \text{COM}) x0imp(c) = x0impObst(c) + fx0imp;$

Equation E\_x4Obs # Exogenous imports#

$(\text{All}, c, \text{TRADEXP}) x4(c) = x4Obst(c) + ff4q;$

Equation E\_employ9 # Employment in 9 wide groups #

$(\text{All}, i, \text{LAB9})$

$\text{Sum}(i, \text{IND}; \text{IND\_TO\_LAB9}(i) \text{ EQ } \text{ORD9}(i), \{\text{TINY} + \text{VILAB}_O(i)\} * \{\text{employ9}(i) - x1lab_o(i)\}) = 0;$

Equation E1\_cneutral # Allows Cost Neutral ac Shift #

$(\text{All}, i, \text{IND})$

$\text{Sum}(c, \text{COM}, (\text{V1PUR}_S(c,i) / \text{V1TOT}(i)) * \text{ac}(c)) = -a1tot(i) + fac1(i);$

Equation E\_x0dom # Total output of domestic commodities #

$(\text{all}, c, \text{COM}) \text{MAKE}_I(c) * x0dom(c) = \text{Sum}(i, \text{IND}, \text{MAKE}(c,i) * q1(c,i));$

Equation E\_p0\_B # Demand equals supply for non margin commodities #

$(\text{All}, c, \text{COM})$

$\text{SALES}(c) * x0dom(c) =$

$\text{Sum}(i, \text{IND}, \text{V1BAS}(c, "dom", i) * x1(c, "dom", i))$

$+ \text{V2BAS}(c, "dom", i) * x2(c, "dom", i))$

$+ \text{V3BAS}(c, "dom") * x3(c, "dom")$

$+ [\text{V4BAS}(c) + \text{TINY}] * x4(c)$

$+ \text{V5BAS}(c, "dom") * x5(c, "dom");$

Where:

$(\text{All}, c, \text{COM})(\text{All}, s, \text{SRC})(\text{All}, i, \text{IND}) a1(c,s,i) \# \text{Intermediate } #;$

$(\text{All}, c, \text{COM}) ac(c) \# \text{Uniform Taste/Tech Shifter } #;$

$(\text{All}, i, \text{IND}) a1tot(i) \# \text{All Input Augmenting Technical Change } #;$

$(\text{All}, i, \text{LAB9}) \text{employ9}(i) \# \text{Employment in 9 wide groups } #;$

$(\text{All}, c, \text{COM})(\text{All}, s, \text{SRC})(\text{All}, i, \text{IND}) a2(c,s,i) \# \text{Investment } #;$

```

(All,i,LAB9) employ9(i) # Employment in 9 wide groups #;
(All,c,COM)(All,s,SRC)(All,i,IND) fa1(c,s,i) # Intermediate Shift#;
(All,c,COM)(All,s,SRC)(All,i,IND) fa2(c,s,i) # Investment Shift#;
(All,c,COM) fa3(c) # Household Shift#;
(All,i,IND) fae1(i) # Cost-Neutral "ac" Shifter Intermediate #;
                           fx0imp #Scaling variable for Imports#;
(All,c,COM) ffx3_s(c) # Taste Shift Variables #;
ff4q #Scaling variable for Exports, traditional#;
(All,c,COM)(All,i,IND) q1(c,i) # Output of commodity c by industry i #;
(All,c,COM) x0dom(c) # Total Supplies of Domestic Goods #;
(All,c,COM) x0imp(c) # Total Supplies of Imported Goods #;
(All,c,COM) x0impObs(c) #Observed imports#;
(All,i,IND) x1lab_o(i) # Effective Labour Input #;
(All,c,COM) x4(c) # Export #;
(All,c,TRADEXP) x4Obs(c) #Observed exports, traditional #;

```

## Coefficient

```

Coefficient ! Flows at Purchasers prices !
Coefficient (All,c,COM)(All,i,IND) MAKE(c,i)
# production of commodity c by industry i #;
(All,c,COM) SALES(c) # Total sales of domestic commodity c #;
Basic Flows of Commodities
(All,c,COM)(All,s,SRC)(All,i,IND) V1BAS(c,s,i) # Intermediate #;
(All,c,COM)(All,s,SRC)(All,i,IND) V2BAS(c,s,i) # Investment #;
(All,c,COM)(All,s,SRC) V3BAS(c,s) # Households #;
(All,c,COM) V4BAS(c) # Export #;
(All,c,COM)(All,s,SRC) V5BAS(c,s) # Other Demand #;
(All,c,COM)(All,s,SRC)(All,i,IND) V1PUR(c,s,i) # Intermediate #;
(All,c,COM)(All,s,SRC)(All,i,IND) V2PUR(c,s,i) # Investment #;
(All,c,COM)(All,s,SRC) V3PUR(c,s) # Households #;
(All,c,COM) V4PUR(c) # Export #;
(All,i,IND) V1TOT(i) # total cost in each industry #;

(Integer)(All,i,IND)
IND_TO_LAB9(i) # the element of LAB9 containing industry i #;
(Integer)(All,i,LAB9)
ORD9(i) # natural numbers 1 to 9 #;
(All,i,IND) VILAB_O(i) # total labour bill in industry i #;

```