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A REVIEW AND SYNTHESIS OF MACROECONOMIC MODELS
OF THE PHILIPPINES

by

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The views expressed in this study are those of the author and do not necessarily reflect those of the Institute.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Foreign Assistance Models</td>
<td>2</td>
</tr>
<tr>
<td>2.1</td>
<td>Chenery-Strout Model</td>
<td>2</td>
</tr>
<tr>
<td>2.2</td>
<td>Shibuya-Yamashita Model</td>
<td>9</td>
</tr>
<tr>
<td>2.3</td>
<td>Pei-Paauw-Cookson Model</td>
<td>11</td>
</tr>
<tr>
<td>3.</td>
<td>The World Bank Model</td>
<td>13</td>
</tr>
<tr>
<td>4.</td>
<td>Narasimham-Sabater Model</td>
<td>17</td>
</tr>
<tr>
<td>4.1</td>
<td>Output Determination</td>
<td>17</td>
</tr>
<tr>
<td>4.2</td>
<td>Exports</td>
<td>19</td>
</tr>
<tr>
<td>4.3</td>
<td>Imports</td>
<td>20</td>
</tr>
<tr>
<td>4.4</td>
<td>Sectoral Prices</td>
<td>21</td>
</tr>
<tr>
<td>4.5</td>
<td>Projection Results</td>
<td>21</td>
</tr>
<tr>
<td>4.6</td>
<td>Comments on the Narasimham-Sabater Model</td>
<td>22</td>
</tr>
<tr>
<td>5.</td>
<td>The UNCTAD Model</td>
<td>23</td>
</tr>
<tr>
<td>5.1</td>
<td>Model Features</td>
<td>24</td>
</tr>
<tr>
<td>5.2</td>
<td>Comments on the UNCTAD Model</td>
<td>27</td>
</tr>
<tr>
<td>6.</td>
<td>The Encarnacion Macroeconomic Model</td>
<td>28</td>
</tr>
<tr>
<td>7.</td>
<td>The Encarnacion Projection Model</td>
<td>33</td>
</tr>
<tr>
<td>7.1</td>
<td>The Basic Model</td>
<td>36</td>
</tr>
<tr>
<td>7.2</td>
<td>The Monetary Submodel</td>
<td>37</td>
</tr>
<tr>
<td>7.3</td>
<td>The Foreign Trade Submodel</td>
<td>40</td>
</tr>
<tr>
<td>7.4</td>
<td>The Production Submodel</td>
<td>43</td>
</tr>
<tr>
<td>7.5</td>
<td>The Government Submodel</td>
<td>46</td>
</tr>
<tr>
<td>7.6</td>
<td>Projection Results</td>
<td>48</td>
</tr>
<tr>
<td>7.7</td>
<td>Comments on the Encarnacion Model</td>
<td>49</td>
</tr>
<tr>
<td>8.</td>
<td>The Villanueva Model</td>
<td>50</td>
</tr>
<tr>
<td>8.1</td>
<td>The Real Sector</td>
<td>51</td>
</tr>
<tr>
<td>8.2</td>
<td>The Financial Sector</td>
<td>52</td>
</tr>
<tr>
<td>8.3</td>
<td>Comments on the Villanueva Model</td>
<td>55</td>
</tr>
</tbody>
</table>
9. The Zialcita-Alfiler Model----------------- 57
   9.1 Real Sector-------------------------- 58
   9.2 Monetary Sector--------------------- 59
   9.3 Comments on the Zialcita-
       Alfiler Model----------------------- 60
10. The BACHUE Model----------------------- 62
11. Summary Remarks------------------------ 68
    Bibliography-------------------------- 77
A REVIEW AND SYNTHESIS OF MACROECONOMETRIC MODELS
OF THE PHILIPPINES

by

Virgilio T. Velasco*

1. Introduction

This report reviews the various macroeconometric models that had been developed for the Philippines. The review is intended to give insights into econometric model-building and to pave the way for the development of a model that can be used for planning the development of the Philippine economy. The survey is confined to macro models developed for the Philippines after 1965. It does not include industry or sectoral models.

In 1971, Professor J. Encarnación and his associates at the School of Economics of the University of the Philippines developed a macroeconomic model that was used in the preparation of the 1972-76 development plan. The model consisted of eight equations and three identities. It was later expanded to a model consisting of 62 structural equations, 17 identities and 4 assumed relationships. The macroeconomic model has not been used again for development planning. Neither has the expanded model been put to use. This was mainly due to doubts

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cast on the ability of the model to accurately describe relationships in the Philippine economy after 1972. The policies adopted for the New Society may have caused structural shifts in the economy that the models were not able to provide for. In addition, the national income series used in estimating the model equations underwent overall revision, thus making use of the models difficult and impractical.

Realizing the need for a model to test the feasibility and consistency of government plans and policies, the National Economic Development Authority (NEDA), through the Philippine Institute for Development Studies (PIDS), has funded a research project to develop a computer-based econometric model of the Philippines. As a first step in developing such a model, PIDS commissioned the author to review and synthesize macro-econometric models that have been formulated to date.

2. Foreign Assistance Models

2.1 Chenery-Strout Models

Chenery and Strout (2) formulated a theoretical framework designed to analyze the effects of foreign assistance (broadly defined as the net inflow of foreign
capital -- public grants and loans as well as private investment) on the process of development. Among the less developed countries included in their study was the Philippines.

Chenery and Strout single out three factors that constrain the growth process -- skills, savings, and foreign exchange. Limited supplies of skilled labor, entrepreneurs, and other inputs of production as well as limited market potential set limits to levels of investment. A low rate of savings limits the country's capacity to finance investment undertakings. The supply of foreign exchange constrains the importation of machinery and equipment, raw materials, other imported goods and services. To achieve sustained growth, it is necessary to simultaneously increase human and organizational skills, domestic saving and export earnings, as well as to allocate these resources efficiently in meeting the changing demands of economic development. Foreign assistance can relieve the bottlenecks by adding external resources to supplement locally available resources and make their use more efficient.

The Chenery-Strout model postulates that growth proceeds at the highest rate permitted by the most
limiting factor. Two situations are recognized: (1) an investment limited growth with resource limits on skills and savings; and (2) a trade limited growth when the balance of payments constraint is binding. In the investment limited growth situation, foreign assistance is required to close the gap between investment ability and saving ability. In the trade limited growth situation, the capital inflow should be large enough to cover the minimum gap between import requirements and export earnings.

The model assumes that aid is sufficiently limited or expensive that the recipient country will not increase aid merely for consumption (that is, without also obtaining an increase in GNP) and that it seeks to maximize consumption until the target growth rate is achieved.

Output is determined by the amount of investment by way of the incremental capital output ratio, in the tradition of Harrod-Domar. This is plausible in a developing country where the total supply of labor is not a significant limitation. Equation (1) gives the capital-output relationship. Investment is constrained by the supply of skilled inputs. The skill limit parameter $s$
in (2) reflects the skill required to increase productive capacity. The savings limit is based on the marginal savings rate (3). A target rate of growth for GNP is specified (4). Exports are assumed to grow at a constant rate (5). Imports have a minimum level (6) required to sustain a given level of GNP, arising from the relatively inelastic demand for intermediate and investment goods currently imported.

A country goes through several phases of development, depending on which limits prevail. In Phase I, the savings limit is effective and inequality (3) becomes an equality. The increase in GNP is limited by the ability to invest.

CHENERY-STROUT BASIC MODEL

(1) \( Y_t = Y_o + \frac{1}{k} \sum_{T=0}^{t-1} I_T \) where \( k = \frac{I_{t-1}}{Y_t - Y_{t-1}} \)

(2) \( I_t \leq (1 + \beta) I_{t-1} \)

(3) \( S_t \leq \bar{S}_t = S_o + \alpha(Y_t - Y_o) \)

(4) \( Y_t \leq (1 + r) Y_{t-1} \)
(5) \( X_t = X_0 (1 + g)^t \)

(6) \( M_t \geq \bar{M}_t = M_o + m (Y_t - Y_o) \)

Endogeneous Variables:

\( Y_t = \) gross national product
\( I_t = \) gross investment
\( S_t = \) gross domestic savings
\( \bar{S}_t = \) potential gross domestic savings
\( M_t = \) imports of goods and services
\( \bar{M}_t = \) required imports of goods and services
\( X_t = \) exports of goods and services
\( F_t = \) net inflow of foreign capital

Parameters:

\( k = \) incremental gross capital-output ratio
\( \beta = \) maximum rate of growth of investment
\( \alpha = \) marginal savings rate
\( r = \) target rate of growth of GNP
\( g = \) rate of growth of exports
\( m = \) marginal import rate

External assistance fills the gap \((I_t - \bar{S}_t)\) between investment and the potential saving limit. When
investment reaches a level sufficient to sustain the target rate of growth of GNP, Phase I ends and Phase II begins. Inequality (4) becomes effective and replaces (2) as a restriction. (1) and (4) together give the investment required to sustain growth at the target rate:

\[ I_t = k r Y_t \]

The gap between \( I_t \) and \( S_t \) is bridged by external assistance. Phase I and Phase II are investment limited growth situations. It is hoped that government policies will be able to increase savings in due time and eliminate the investment-savings gap. This is achieved by marginal saving rate a sufficiently above the investment rate \( kr \) required by the growth target.

In both Phase I and Phase II, it is assumed that neither the growth path nor the foreign assistance requirements are affected by the continual process of adjustment in imports and exports to make the trade gap equal the desired investment-saving gap. The inequality in (6) means that there is a minimum import level \( M_t \) required to sustain a given level of GNP. The capital inflow \( F_t \) should be able to cover the minimum gap \( (M_t - E_t) \) between import requirements and export earnings.
When the capital inflow determined by the investment-saving gap becomes less than the minimum trade gap, the saving limits of (3) ceases to be binding, and the inflow of capital and growth of GNP becomes controlled by the trade limit. The situation becomes one of trade limited growth and is called Phase III. Limits (2) and (3) become redundant. Inequalities (4) and (6) become equalities, and the external capital inflow is set to equal or exceed the minimum trade gap.

Mangahas [13] showed that using the extreme-value parameters of Chenery-Strout for $k$, $\beta$, $\alpha$, $g$, and specifying a 5 percent target growth of GNP, the Philippines would be in Phase III in 1963-64 and would be able to eliminate both trade and savings-investment gaps after 1964, and sustain the target growth rate without relying on external assistance. Mangahas showed that in retrospect, using data for 1962-67, the parameters derived for the Philippines were not realistic. In particular, the marginal propensity to save of 0.3 was high and the minimal marginal propensity to import of 0.01 was unrealistically low.

The significance of the Chenery-Strout model lies in its planning orientation. In fact, the model
has been formulated in linear programming form by Chenery and MacEwan [3] as a tool of analysis for optimal planning of development. The model is also a forerunner of so-called two-gap models that are in use in the World Bank and other international organizations.

2.2 Shibuya-Yamashita Model

Shibuya and Yamashita [19] presented a foreign assistance model for the postwar Philippines, using 1950-1964 data to derive model parameters. The model was used to estimate the contribution of foreign assistance to economic growth. The authors concluded that the Philippine economy was heavily dependent on foreign assistance in the past and will remain so for some time in the future. This is at odds with the conclusions from the Chenery-Strout model.

The Shibuya-Yamashita model defines net inflow of foreign capital as the excess of imports over exports. It is postulated as an explanatory variable of the gross investment and import functions, along with the GNP variable. As Mangahas [13] points out, there seems to be no theoretical basis for inclusion of net inflow of foreign capital in these functions. Thus, no a priori
expectations on the sign and magnitude of its coefficients can be deduced.

GNP is determined by gross capital stock and population. Private consumption is based on its lagged value and on GNP. A similar formulation is given for government consumption expenditures. Exports are assumed to increase linearly in absolute terms. Using the definition of investment as the increment to capital, the national income identity, and the definition of net inflow of foreign capital, the model can be solved.

Using Philippine data, the coefficients of net inflow of foreign capital in the investment and import equations are negative. In addition, the multiplier of capital stock in the reduced-form investment equation is positive, pointing to the indefinite growth of investment induced by current capital stock. Mangahas underscores not only a mis-specification in the model but also a mis-interpretation of analytical results that cast doubt on the conclusion of high dependence on aid in the Philippine case.
2.3 Fei-Paauw-Cookson Model

Fei and Paauw [10] formulated a model to project the gap between investment requirements and domestic savings. GNP is related to capital stock by the capital-output ratio. A per capita marginal savings function is specified such that the average propensity to save is an increasing function through time so long as per capita income increases. A constant population growth rate and a target rate of growth of per capita GNP are assumed. The time paths of investment requirements and of the average savings rate are generated. The savings gap is filled by foreign capital. The conditions for finite termination date for required foreign capital inflows are: (1) the per capita marginal savings ratio must exceed the value of the initial average savings rate; and (2) the long-run limit on domestic savings capacity, represented by the per capita marginal savings ratio, must be high enough so that eventually a rate of growth of income which is financed by domestic savings will exceed the aggregate income target growth rate.

Cookson [4] developed a model to determine the foreign exchange gap arising from trade deficits and debt service requirements. Exports are assumed exogeneous
d increasing at a constant growth rate. Imports are
sumed linked to the level of output by a constant
port-output ratio. Output is specified to grow at a
nstant rate. Debt service is dependent on the interest
te and repayment period of the foreign capital loan
rowed to bridge the foreign exchange gap. The effect
the foreign capital inflow on the economy's stock of
ducive capital and the savings-investment relations
es suppressed. The time paths of the exports, imports,
d debt service are derived. The conditions for the
p to decrease and reach the zero level at some time
are: (1) the export growth rate should be higher than
the output growth rate (or at least greater than the
import growth rate); (2) the rate of interest should be
held "close" to the export growth rate. If the rate of
interest on debt and the output growth rate are both less
than the export growth rate, then a finite termination
date exists. Even if the rate of interest is greater
than the export growth rate, there will still be a
termination date provided the interest rate is sufficiently
close.

Paauw and Cookson [17] applied the Fei-Paauw per
capita marginal savings model and the Cookson debt service
model to data on six Southeast Asian countries, including the Philippines. Using the development plan target growth rates of 2.8 percent for per capita GNP and 3.3 percent for population (or, 6.1% growth rate of aggregate GNP), and a per capita marginal savings rate of 0.36, the savings gap and foreign exchange gaps were projected from 1965 to 1975. The savings gap was projected to fall rapidly from a fairly high level of $118 million to zero within six years. On the other hand, the foreign exchange gap projection was $49 million in 1965 and would increase indefinitely, without a termination date.

3. The World Bank Model

The Economic Analysis and Projections Department of the International Bank for Reconstruction and Development has developed and used a Minimum Standard Model (MSM) for making country projections. Country economists at the Bank used this simple model, with modifications if desired, to project the economic conditions of a country in aggregate terms. The model assumed that gross domestic product (GDP) grew at a specified rate, related total gross investment to the
change in GDP by the use of an incremental capital output ratio, and computed for the trade gap to be filled by external capital.

A revised version of the model, called the Revised Minimum Standard Model (RMSM), disaggregated gross domestic product, imports, and exports, and it specified a maximum savings rate. The revision was done to make the model a more useful analytical device.

The RMSM has three basic sectors: industry, agriculture and others. Each of the sectoral value added is assumed to grow at given rate. The sum of the sectoral value added gives the GDP at factor cost. Indirect taxes are computed as a percentage of GDP at factor cost. Indirect taxes plus GDP at factor prices equals GDP at market prices.

Sectoral incremental capital output ratio coefficients are applied to sectoral value added to derive the sectoral fixed investment. The gross fixed investment is the total of fixed investment in the three sectors plus the "exogenous element of investment which is not related to growth of output, for instance, investment in housing, education and other forms of social and economic
 infrastructure". Alternatively, gross fixed investment is related to both the level of GDP and the increment to GDP. The change in stocks is postulated as proportional to the increment to GDP. Total gross investment equals gross fixed investment plus the change in stocks.

Imports are classified into capital goods, intermediate goods, food, fuels, other consumer goods, and non-factor services. Imports are estimated using import elasticities for each of these categories. Import price indices are then applied to obtain imports by class at current prices. The total of the imports by class gives total imports at current prices.

Exports of goods and non-factor services in constant prices are projected on the level of disaggregation deemed suitable for a country. This may be based on simple growth rates or econometric equations relating exports to national aggregates, sectoral value added, and other socioeconomic variables. The exports figures are expressed in current prices using export price indices and then aggregated. The excess of imports over exports, called the "resource gap" is then determined. This gap is required to be filled by external capital.
Using national income accounting identities, total consumption and savings can be calculated. Government consumption can be projected using a growth rate. Private consumption is computed as a residual. Gross national product is GDP plus net factor income. Gross national income is gross national product adjusted by terms of trade. Similarly, a terms of trade adjustment is added to GDP to obtain gross domestic income, from which consumption is subtracted to yield gross domestic savings. Gross national savings is gross domestic savings plus net factor income plus national taxes.

Potential gross national savings is specified to be the previous year's gross national savings plus maximum marginal savings, which is estimated from the increment to gross national income. The potential gross national savings serves a constraint. If gross national savings exceeds the potential savings, it is set at the maximum potential value and imports of other consumer goods is increased.

Government revenues are projected using an elasticity with respect to GDP at current prices. Government current expenditures are projected to grow at a rate equal to the
growth of government consumption adjusted by the growth rate of the GDP price deflator.

Exhibit I presents the RMSM equations.

4. **Narasimham-Sabater Model**

The model of Narasimham and Sabater [16] consists of 33 behavioral relationships and fourteen identities, with 45 endogenous variables and nine exogenous variables. The variables exogenously specified are: time, quantum index of world exports, index of GNP of Japan, dollar export prices of centrifugal sugar and of copper concentrates, domestic prices of imported raw materials, of imports, and of exports, and imports of consumer durables. The data used for estimating the relationships covers the period 1946 to 1969. Projections are made for 1975 and 1980.

4.1 **Output Determination**

Output is disaggregated into agricultural and non-agricultural. Agricultural output is related to capital stock in agriculture. Non-agricultural output is a function of capital stock in the non-agricultural
sector and of the ratio of non-agricultural to agricultural prices. The mining and manufacturing subsector of the non-agriculture sector is separately treated. The output of this subsector is determined by its capital stock (whose estimate is based on the value of durable equipment that are clearly identified as industrial machinery) and by the price in mining and manufacturing relative to price in agriculture. The output in mining and manufacturing is one of the determinants of imports of raw material and fuel. Sectoral gross fixed investment is determined by lagged value of sectoral output. For the agricultural sector, another determinant of investment is the price ratio of agricultural to non-agricultural commodities. Investment in stocks is related to GNP.

Private and government consumption are considered separately. Private consumption expenditure is determined by disposable income and by its lagged value. Government consumption is related to GNP.

Disposable income (which is a regressor for private consumption expenditures) is defined as GNP less depreciation, taxes, corporate savings, and government revenue from property plus private transfer payments from the
government and from abroad. Functional relationships for each of these adjustment variables are specified. Depreciation is related to total capital stock, taxes and transfer payments from the government are explained by GNP, government revenue from property and transfer payments from abroad are determined by time trend, and corporate saving is a function of non-agricultural income.

4.2 Exports

Exports of five commodity groups (coconut products, centrifugal sugar, logs and lumber, copper concentrates, and all other exports of goods) are explained by demand or supply factors, or both. Exports of coconut products are determined solely by its current and past domestic production levels. Centrifugal sugar exports are explained by current domestic production and its dollar export price. Current production of centrifugal sugar is in turn determined by its lagged production level and its lagged dollar export price. To take into account the fact that Japan is the principal importer of logs and lumber and of copper concentrates, real GNP of Japan is made a determinant of exports of
these two products. Exports of copper concentrates are also explained by its export price. The remaining exports of goods are related to the quantum index of world exports. Exports of services, on the other hand, is simply assumed to increase linearly with time.

4.3 Imports

On the import side, consumer nondurables are exogenously specified. Imports of consumer durables are related to private consumption expenditures, while investment goods imports are linked to total fixed investment (agriculture and non-agriculture). As stated previously, raw material and fuel imports depend on output in the mining and manufacturing subsector. A second determinant of imports of raw materials is its import price relative to the price of goods in mining and manufacturing. The level of international reserves at current prices is hypothesized as a determinant of imports of the four commodities, to reflect the foreign exchange constraint. Imports of services are assured to be a linear function of total merchandise imports.

On the balance of payments, net factor income payments from abroad are determined by cumulative trade
deficits. International reserves are assumed to be a function of gross domestic product.

4.4 **Sectoral Prices**

Sectoral prices are endogenously determined. The price equations are expressed in terms of annual rates of change. Each price change is explained by the growth in sectoral output. Price changes in agriculture are also explained by changes in the prices of exports, most of which are agricultural commodities. In addition to the growth in non-agricultural output, the price change in the non-agriculture sector is affected by the price change in the agriculture sector and by price changes of imported products.

4.5 **Projection Results**

For projection purposes, Narasimham and Sabater set the target growth rate for gross domestic product at 5.5 percent. The sectoral growth rates were derived using income elasticities. Then the national accounts were projected using the model relationships. The savings gap was projected to decrease substantially from 1,273 million pesos in 1969 to 36 million pesos in 1980. On the other
hand, the import gap was projected to increase almost three times, reaching 3,712 million pesos in 1980.

The two-gap projections of Narasimham and Sabater resemble the projections of the Fei-Paauw-Cookson model. The elimination of the savings gap will not be as abrupt as in the Fei-Paauw-Cookson projections. The increasing trade gap is disturbing, but it reflects the country's perennial trade imbalance.

4.6 Comments on the Narasimham-Sabater Model

Two features of the Narasimham-Sabater formulation deserves special mention: (1) the separate treatment of fuel imports; and (2) the dependency of exports of logs and lumber, and copper concentrates on the national output of Japan, the principal importer of these two commodities.

Fuel import requirements can be projected based on estimates of mining and manufacturing output. This in itself will be information and useful. In view of the energy crisis and the increasing price of oil, it will be even more useful if fuel can be explicitly treated as a factor of production and to relate how the cost of fuel imports will affect output, wages and prices. It may be possible to relate the general price level to price of
fuel, or to an import price index with the cost of fuel appropriately weighted. On export dependency, one refinement may be to expand the number of country importers to include the U.S. and some countries in Western Europe and the Asean. National income figures of these countries may be weighted by their share in Philippine exports of specific commodities and the weighted averages may be used as regressors in the export equations. Export prices may be treated as exogenous, as Narasimham and Sabater assumed. In the case of sugar for example, even though the Philippines may be the largest exporter of sugar, it has not been able to significantly influence the world price of sugar. The Philippines may have some influence in the price setting of copra and coconut oil, but this is subject to verification. There is even more justification to assume import prices as exogenous because of the small share of the Philippines in the world market.

The Narasimham-Sabater model does not include wage-employment component. The production and investment functions are rather simplistic. The model does not have a financial block. Thus, monetary policy variables do not appear at all in the model.

5. The UNCTAD Model

UNCTAD has econometric models for some 47 developing countries. These models are used to estimate capital requirements based on varying assumptions regarding the pace of world
growth and pattern of world development.

The individual country models all take as exogenous the volume and value of world trade, commodity prices, and the availability of financial flows. They each have about 20 to 30 stochastic relationships. Differences in model formulation are due to differences in data availability and statistical significance of parameters.

The UNCTAD model of the Philippines, as reported by Ho Dac Tuong [20], consists of 36 equations and identities. Its structure has similarities to the Narasimham-Sabater model. Annual data from 1955 to 1973 were used to estimate the model relationships. For some variables, two or three relationships are estimated and presented in the model description. For the purpose of this survey, whenever several formulations are presented, only one is chosen for discussion.

5.1 Model Features

Gross domestic product is regressed against the total value added in agriculture and non-agriculture sector. The logarithm of agricultural value added is estimated as a linear function of time. Valued added in the non-agriculture sector is related to capital stock lagged by one-half year. Capital stock is proxied by cumulative total investment in fixed assets.
Private consumption is expressed on a per-capita basis as a function of: (1) a per capita income variable which is defined as GNP adjusted for the terms of trade and net of government tax revenues; (2) the ratio of income in agriculture relative to non-agriculture; and (3) lagged per capita private consumption. Government consumption is simply linearly related to tax revenues. Investment in fixed assets is determined by gross domestic product adjusted for terms of trade effect, imports of manufactured goods, and the relative prices of agriculture and non-agriculture products.

Exports of goods are disaggregated into four groups: (1) food, beverage, tobacco; (2) raw materials (excluding fuel); (3) fuel (SITC 3); and (4) manufactured goods. Since the Philippines is not known to be an exporter of fuel, the exports in this category pertain to other export items with code SITC 3. Each export commodity group is expressed as a function of world demand for that commodity as well as the price of exports relative to value index of world exports of the commodity. Total value of exports is estimated as a function (rather than the total) of exports of the commodities. Export of factor services is determined by its lagged value, by world exports and
by a dummy variable. Exports of goods and factor services are regressed against exports of goods, instead of computing it as the sum of exports of goods and exports of factor services. This indicates problems of inconsistency or non-comparability among the data.

Imports are also disaggregated into the same four commodity groups. Food, beverage, tobacco is a proportion of total imports. Imports of raw materials depend on non-agriculture value added and the weighted index of spot prices of raw materials imported relative to the GDP deflator. Imports of fuel and of manufactured goods are each regressed against GDP and the ratio of the weighted spot price to the GDP price deflator. Imports of goods are estimated from the total of imports of the 4 commodity groups. Imports of non-factor services are in turn dependent on imports of goods.

The implicit price deflators for the agricultural and non-agricultural sectors are determined endogenously. Agricultural prices are determined by the price of export goods and by its own lagged value. Prices in the non-agricultural sector are dependent on GDP and value of imports, on agricultural prices, the price of imports, and its own lagged price. The general price level in
turn is a function of the agricultural and non-agricultural prices. The price of exports is determined by the weighted index of spot prices of exports of SITC 0 to 9, and by its lagged value. The price of imports is similarly determined by the weighted index of spot prices of imports and by its lagged value.

Net factor income payment abroad is related to the cumulative trade gaps. Investment in inventories is residually determined from the national income identity.

5.2 Comments on the UNCTAD Model

The UNCTAD model does not have a financial block. This places a limitation on finding determinants of prices. The formulation of the investment function is rather weak. Investment is postulated as a function of GDP adjusted for terms of trade effect, imports of manufactured goods, and the internal terms of trade between agriculture and non-agriculture. The more logical causation is for investment to explain imports, rather than imports being a determinant of investment.

The disaggregation of exports on the basis of SITC grouping is not appropriate because Philippine major
exports falling in the same group are modelled together. It is better to identify the country's leading exports and hypothesize demand/supply relationships for each one of them.

The UNCTAD model is linked directly to variables measuring world growth and trade. The model cannot respond to changing patterns of trade like the ASEAN inter-regional trade that is expected to intensify. Since it is not designed to deal with long-term structural changes and interdependencies, the model is appropriate only for short and medium term projections.

6. The Encarnacion Macroeconomic Model

The macroeconomic model of Encarnacion, Mariano and Bautista consists of eight behavioral equations, three identities, eleven endogenous variables, five exogenous variables, and five notational definitions.

The exogenous variables are money supply, wage rate, import price, exports, and export price. Money supply is considered to be regulated by monetary policy and wage rate by wage legislation. In view of the smallness of the Philippine market relative to the world
market, the price of imports can be considered exogenous. Exports are largely influenced by the prices of the export commodities in the export markets, and by government policies on export promotion and development.

The endogenous variable are GNP, employment, general price level, imports of goods and services, gross domestic investment, capital stock, private consumption, government consumption expenditures, total consumption, capital stock and net factor income from abroad.

The diagram in Figure 1A shows the relationships among real GNP, employment, imports, investment, capital stock and general price level. These endogenous variables are represented by rectangular blocks while the exogenous are shown inside circular nodes. The direction and sign of causality between variables are indicated by the arrows.

Real output, or GNP at constant prices, is determined by capital and labor inputs. It is therefore basically supply-determined. Indirectly however, real output is dependent on money supply, through its effects on employment and price level. Since money supply movements reflect adjustments made by monetary authorities to
conditions in the credit market, balance of payments surplus or deficits, and government deficit spending, it may be said that demand considerations play an indirect, implicit role in the determination of real output.

The employment function expresses demand for labor as dependent on output, money wage rate, and price level. The general price level in turn is formulated in terms of money supply and output. Real output, employment, and general domestic price level can be solved simultaneously but separately from the other endogenous variables. They do influence the other variables in the model according to the postulated relationships.

Imports are determined by real GNP, the price of imports relative to the general domestic price level, and export earnings. Thus the value of exports affects the country's capacity to import.

Investment is undertaken to support real output. Thus a major determinant of investment is real output. Since machinery and equipment are largely imported, imports are hypothesized as a determinant of investment. The profit motive is ever present in investment decisions. To realize profit, the price of the goods to be sold must
ENCARNACION MODEL: Macroeconomic Employment Determination

ENCARNACION MODEL: Macroeconomic Income, Expenditure, Tax Revenue
stay ahead of increase in labor costs and other inputs. Thus the price level and wage rate enter the investment function as explanatory variables.

Capital stock is the cumulative building up of past investments.

Figure 1B shows the relationships by which tax receipts, private consumption, government consumption expenditures, total consumption, and net factor income from abroad are determined. Taxes, comprised of direct and indirect taxes, are based on GNP in current prices and on the value of imports. Customs duties on imported goods represent a substantial percentage of indirect taxes. Private consumption is a function of disposable income, price level and wage rate. Government current expenditures are based on tax revenues. Net factor income from abroad is a residual item set equal to a value that preserves the national income accounting identity and assures that the excess of investment over savings is matched by net inflow of foreign capital.

The model parameters were estimated using annual data for 1950-1969, and in some functions, data time series of shorter duration. Most of the parameter
estimates are statistically significant, and have signs that conform to ex-ante expectations. Using the model, the time paths of various policy alternatives were studied, and predictions of endogenous variables were made. The short-term predictive accuracy of the 1970 projections was assessed from a comparison between predicted and observed values. Most of the predicted values were reasonably close, and where the difference was large, an explanation was put forward.

7. The Encarnacion Projection Model

The macroeconomic model was expanded to a total of 83 equations, 10 exogenous and more than 80 endogenous variables. The expanded model consists of a basic aggregative model that estimates real output, employment, and price level, and to which are linked submodels for the foreign trade, production, monetary, and fiscal sectors.

Figure 2 depicts the linkages among the basic model and the four submodels.

The direct linkages are primarily one-way, with the endogenous variables of the basic model serving as explanatory variables of the submodels. Variables
Figure 2. ENCARNACION EXPANDED MODEL
generated by the submodels which are exogenous to the basic model are real exports and the export price from the foreign trade sector, and money supply from the monetary sector. Although the endogenous variables of the production submodel do not enter the structural relationships of the basic model, the production sub-model indirectly determines the endogenous variables of the basic model via the foreign trade submodel. More specifically, the price of manufactured output is an explanatory variable for exports of coconut oil; employment in manufacturing determines exports of desiccated coconut; and wage in mining and quarrying affects exports of copper concentrates. Money supply is formulated as an explanatory variable of general price level. In the monetary submodel, money supply is determined given lagged values of government debt, international reserves, and Central Bank loans to banks, and given the exogenous value of the reserve requirement. The determination of money supply does not depend on any of the current values of real income, employment and price level of the basic model. The other monetary variables—domestic credits of the commercial banking system, international reserves and currency ratio—can be determined if GNP, real wages and taxes from the basic model are
known. None of the endogenous variables of the government submodel is a determinant of the behavioral equations of the basic model, or any submodel for that matter.

Consequently, the complete model does not have to be solved simultaneously. The basic model, the foreign trade submodel, and the production submodel will need a simultaneous solution, which in turn will be used to solve the monetary and government submodels.

For projection purposes, it is conveniently assumed that money supply will grow at a certain rate and that there will be no trade gap. With these assumptions, a recursive computational procedure can be used to solve the model. The results are found to be not much different from those of the simultaneous solution approach.

7.1 The Basic Model

This model is very similar to the macroeconomic model initially developed by Encarnacion, Mariano and Bautista. The output, employment, and price level equations are basically the same, except for combining the price and wage variables in a price/wage ratio in the employment equation. The behavioral equation for
imports is removed. In its place, an equation for wages is given, postulating that wage is determined by the money wage and general price level of the previous year. The dependence on the previous year's wages reflects the pressure on wages brought about higher cost of living while the dependence on the prior year's price level (which serves as a proxy to profits) indicates the tendency to pay higher wages if profits increased the year before. The investment equation remains the same. The tax and government consumption relationships are also retained. Net factor income is no longer a residual; it is formulated as a proportion of gross national product. Private consumption is derived as a residual in the national income identity. Imports and exports in current prices are set equal, meaning to say that no trade gap can occur.

7.2 The Monetary Submodel

This submodel consists of seven structural equations, two identities, eight endogenous variables and five exogenous variables. The exogenous variables specific to the submodel are: government debt, reserve requirement ratio, rediscount rate, CB loans to banks, and a variable
that represents all factors, except the trade deficit, which affect the international reserves. The endogenous variables are the currency in circulation, the available reserves of the commercial banking system, the monetary base, the stock of money, the money supply, private domestic bank credits, and international reserves. There are two variables for money supply - the average of end-of-month figures from January to December and the average of end-of-month figures from October of the previous year to September of the current year. The latter definition for money supply is the same one used in the basic model and serves as the link between the monetary submodel and the basic model. The January-December average does not give good statistical results in the equation for price level in the basic model. On the other hand, this average is found to be a statistically significant determinant of money in circulation and of private time and savings deposits.

The monetary base is the sum of bank reserves and currency in circulation. The monetary base is given as a linear function of CB loans to the commercial banking system, government debt and international reserves. Money supply, using both of the definitions above, is a
function of the monetary base and the reserve requirement ratio. Currency in circulation is a linear function of money supply. Demand and supply functions for bank loans to the private sector are specified. The demand for bank loans to the private sector is hypothesized to be related negatively to the rate of interest, positively to current GNP and negatively to real wage (due to the decline in profits expected when real wage increases). The supply of bank credit depends on bank reserves, the reserve requirement ratio and interest rate. The currency ratio, defined as the ratio of currency in circulation to the sum of money supply and private time deposits, is considered a function of real income per capita, the tax ratio and the rate of interest. The currency ratio can be computed separately, after all endogenous variables other than time deposits have been determined. Neither the currency ratio itself nor the time deposits are included in any other relationships in the basic model and submodels.

The submodel's estimates of monetary variables for 1970 are found to be reasonably accurate. However, leads and lags among monetary variables cannot be captured in an annual model. A quarterly semi-annual model is more desirable.
7.3 The Foreign Trade Submodel

The foreign trade submodel consists of three identities and 10 structural equations -- seven supply equations for seven principal export commodities and three demand equations for import of raw materials, capital goods, and services. The seven export commodities are abaca, copper concentrates, coconut oil, copra, dessicated coconut, logs and lumber, plywood. Together, these products and sugar represent about 80-85 percent of total value of merchandise exports.

Supply of copper concentrates for export is theorized to be the output of a production function with capital stock and labor as factors of production. Since data on capital stock is not available, surrogates of it are used. Taking note that the stock of capital is the accumulation of investments made over the years, the bases for making investment decisions are determined and examined in search of surrogates. Since investment decisions are made on the basis of profitability, which is measured roughly by the difference between price and wage rate, it is concluded that the sum of past export prices for copper concentrates and the sum of past wages paid in the mining and quarrying sector and a time
variable are surrogate variables that explain the supply of copper concentrates. Past exports of copper concentrates and employment are not found to be statistically significant determinants of export supply.

By the same logic, the export of abaca is related to historical abaca prices and wages in the agricultural sector while the export of dessicated coconut is determined by past prices of dessicated coconut and of copra, a substitute for dessicated coconut, as well as labor employment in manufacturing.

The supply of copra is hypothesized to be dependent on its price, the price of dessicated coconut, and the domestic output of coconuts (in copra terms). Coconut oil exports are determined by its export price, the domestic output of coconuts, and real wage rate in manufacturing. Exports of logs and lumber are related to their export price, to the export price of their substitute, plywood, and the domestic output of logs. Plywood export is dependent solely on domestic output of plywood. It is found that the only relevant explanatory variable for sugar exports is the U.S. quota on Philippine sugar, inasmuch as most of sugar exports were destined for the US market. Total exports is the sum of the exports
of the eight principal commodities and of non-principal commodities.

Imports of raw materials are determined by production in the manufacturing sector, the domestic general price level and the import price index. The price variables are found to be significant and of opposite signs, as expected, reflecting some price substitution effect between domestic and foreign supplies. Imports of capital goods are related to investment, and are also characterized by price substitution effect. Imports of services, consisting primarily of freight and insurance charges paid to foreign companies, are dependent on the amount of total imports. Imports of consumption goods are derived residually, just as consumption imports are given low priority in the allocation of scarce foreign exchange during the period of controls.

A major feature of the foreign trade submodel is exogeneity of export and import prices. This assumes that the price-setting mechanism for Philippine export products is not influenced by local export supply. This assumption may be subject to question and verification in the case of copra and coconut oil. It is further assumed that the Philippine does not have any influence on import prices.
The relative smallness of Philippine trade makes the above assumptions plausible, by and large.

7.4 The Production Submodel

There are seven sectors in the production submodel: agriculture, fishing and forestry; mining and quarrying; manufacturing; construction; transport, storage, communications and utilities; commerce; and services.

For each of the seven sectors, there are endogenous variables for value added, prices, and employment levels. In the case of mining, transport and commerce sectors, a wage variable is added. The remaining three endogenous variables are price of copper concentrates, and capital stock and investment in the manufacturing sector. The seven exogenous variables are determined in the basic model. These exogenous variables and the fifteen lagged endogenous variables comprise the 22 predetermined variables.

In each sector, there are supply, employment, and demand functions. In the mining, transport, and commerce sectors, wage rate determination is included among the sectoral relationships. In manufacturing, capital stock
formation is also depicted.

In agriculture, value added is dependent on its lagged value and on the agricultural price index. Employment in agriculture is the residual employment obtained by deducting from aggregate employment the sum of employment in the other sectors. This is consistent with the observed migration of laborers from the agricultural lands in search of employment opportunities in other sectors. The price level is included among the explanatory variables in the demand function for agricultural output. The other determinants are disposable income and general money wage rate.

Mining has a supply function similar to that of agriculture. Employment is assumed to grow proportionately to the growth of mining value added. The price of copper concentrates and sectoral wage determine the sectoral price for mining. The price of copper concentrates in turn increases at a specified growth rate. Wage rate in the mining sector is based on lagged sectoral wages and prices. The solution is found recursively.

Production of manufactured goods is dependent on capital stock in manufacturing and the price of the goods.
Employment linearly depends on output. The increase in capital stock is a function of aggregate investment, the general price level and the price level of manufactured goods. Reduced form equations are derived for value added and price.

The value added in construction is determined simultaneously with its price level from the supply and price functions. Employment is determined by wages and output of the sector. Wages and the general price level determine product prices. Prices, output, wages and employment are recursively determined.

In the commerce sector, output and price level are jointly solved from the demand and supply functions. The employment level is then determined from the wage and output values. The wage rate is formulated as function of lagged wage rate and current price level.

The supply of services is projected based on output. Employment in the services sector is linearly dependent on its current output. Price of services depends on current and lagged values of value added: the sector, disposable income, and general price level.
The total of all the sectoral value added is subtracted from GNP which is determined in the basic model. The difference represents depreciation, indirect taxes and net factor income from abroad.

7.5 The Government Submodel

The government submodel has eleven structural equations and two identities. It has thirteen endogenous variables and eleven exogenous variables. Five of the exogenous variables are endogenous variables determined in the basic and monetary submodels.

The submodel disaggregates tax receipts into six tax revenue categories. Direct income tax receipts from business is based on GNP and annual wage rate, serving as surrogate for corporate income. The tax equation also has a dummy variable to reflect the change in tax rates in 1968. Direct income tax receipts from persons are based on personal income, lagged one year. Personal income includes compensation of employees, entrepreneurial income, and property income of persons. Indirect business taxes, such as sales taxes, are projected to depend directly on gross national product.
Import duties are charged against the value of imported goods and services. An adjustment is made to take into account the tariff rate applicable to imports from the U.S. Other indirect taxes consisting of excise taxes, fees and penalties, etc. are explained by current exports and current GNP net of exports. Total tax receipts of the national government are a linear function of total tax receipts which are determined in the basic model. Receipts from all other national taxes are derived residually.

The government submodel also disaggregates government expenditures by functional classification -- economic development, social development, national defense, debt service and general government. Expenditures for economic development are a function of total tax receipts of the national government and the change in total debt outstanding of the government. Social development expenditures are based on tax receipts augmented by borrowing, on population and money wages to be paid to government employees. National defense expenditures are allotted from the defense budget, which is sourced from total tax receipts. A large portion of expenditures for national defense is for wages and salaries of civil and army personnel. Thus national defense expenditures are dependent on total tax receipts
of the national government and on money wage rate. Expenditures for debt service are incurred to repay debt outstanding of the government. Expenditures for general services are spent to pay for salaries and wages and tend to increase with the size of the population that the government serves.

7.6 Projection Results

The expanded Encarnacion model was used to make projections from 1972-1976. The results were generally acceptable, particularly in the earlier years of the projection period. There were however some results that indicated areas for improvement. Specifically, abaca exports and imports of consumer goods became negative in later years, and projected output and employment in the mining sector seemed to be high.

For long-term projection (1977-2001), the performance was not encouraging. Growth rates for aggregate output and capital stock unexpectedly declined after 1976, and savings rate fell from 0.11 to 0.04 over the projection period.
7.7 Comments on the Encarnacion Model

In the basic model of the expanded Encarnacion Model, real income, price level, and employment are completely determined given the money supply and money wage rate. The consumption, investment and import functions determine the composition of real income. The foreign trade, production and government submodels further disaggregate the components of real income. The monetary submodel basically determines the money supply that feeds into the basic model. The price level is determined by real income and money supply. In effect, the demand for money is derived from the real sector variables of the economy, without a role for interest rates in the determination of prices. In the monetary sector, what feeds back into the market for bank loans is GNP in current prices and real wage rate, not equilibrium interest rates in the money market.

Another feature of the expanded Encarnacion model is the absence of financial variables in the investment demand function. The effect of money supply, required reserves, and other financial variables is through the price level, employment, and supply of output.
One area for improvement in the Encarnacion model is a closer linkage between real and financial sectors. Since the movements of interest rates is response to economic forces tend to be more pronounced over a shorter time period, any headway in linking the real and financial sectors will depend on availability of semestral data for the national income accounts. If the leads and lags cannot be captured from semestral data, it will be desirable to use quarterly data (if available).

8. The Villanueva Model

D.P. Villanueva of the International Monetary Fund formulated a 20-equation semi-annual macroeconometric model of the Philippines, based on data from 1967 to 1975. It consisted of five sets of relationships covering income-expenditures, output, monetary, credit and balance of payments. The financial and real sectors are closely linked, with the level of credit and interest rate being major linkage variables. Exhibit II presents the model equations. Whenever applicable, the same symbols used in the Encarnacion model are used in the specification of the Villanueva model in Exhibit II.
8.1 The Real Sector

The real sector of the economy is described by relationships that determine gross domestic demand and supply output -- the income expenditure and output relationships. The income-expenditure set of equations consists of imports (1), private consumption (2), investment (3), and the income-expenditure equilibrium condition (20). The real income, price level, and the loan rate charged by banks together determine imports, private consumption, investment, and aggregate demand for goods and services. Aggregate demand is made consistent with the supply of goods and services, which is determined by the output set of relationships consisting of the production function (4), price-wage-employment relation (5), and the capital stock definition (19).

Demand for real imports is a function of real income and the price of imports relative to the general price level. A dummy variable is included in the specification to reflect shifts in imports resulting from restrictions and liberalization of import policies. Private consumption is a function of disposable income, with taxes treated as exogenous to the model. Investment is determined by real income and the loan rate. The aggregate
production function relates real output to employment and capital stock. The price-wage-employment equation, which depicts the price level as a function of money wage rate and employment level, is the mechanism by which the employment will be set equal to the point of equality between the marginal physical product of labor and the real wage.

8.2 The Financial Sector

The monetary sector is described by the relationships on banks' demand for reserve balances with the Central Bank (6), the banks' holdings of vault cash (7), the demand for currency (10), the demand for deposit substitutes (11), the money supply identity (13), the definition of reserve money (14), and the money market equilibrium condition (12). These relationships determine the values of real income, price level, loan rate, interest rate on deposit substitutes, and net foreign assets of monetary authorities that are consistent with equilibrium in the money market. The equilibrium rate of interest on deposit substitutes equates the demand and supply of money.
The portfolio functions for banks and quasi-banks are described by the demand for reserve balances with CB, the demand for vault cash, and the function setting loan rate. Demand for reserve balances is expected to increase with a decrease in loan rate, an increase in discount rate, and inflows of deposits and deposit substitutes. The demand for vault cash is also expected to positively respond to deposits and deposit substitutes and the CB discount rate. Loan rate is set by demand for domestic credit to private sector and the supply of funds from deposits and issues of deposit substitutes, taking into account the interest cost of deposit substitutes. The equilibrium rate of interest on deposit substitutes is determined in the inverted demand for money equation (12).

The portfolio behavior of the public is described in the demand for currency, the demand for deposit substitutes, and the determination of the equilibrium rate of interest on deposit substitutes. Demand for currency is expected to increase with income and the price level. The demand for deposit substitutes is a function of the rate of interest paid on it, as well as real income. The rate on deposit substitutes is shown
as a function of real income, reflecting demand, and money supply deflated by the general price index.

The money supply is defined in (13). It is shown as equal to the money multiplier times the reserve money. Reserve money is determined from the balance sheet equation setting the assets and liabilities of monetary authorities equal.

The equations for balance of payments consist of the definition of foreign assets of monetary authorities (15) and the import function (1). Balance of payments is an implicit function of net foreign assets of the monetary authorities, real income and price level.

The balance sheet constraint of the banks and non-banks (16) together with the definitions of its component variables comprise the credit sector of the model. The domestic credit to the Government by banks and non-banks is determined by policy-determined variables such as the net foreign asset position of banks, issues of Central Bank bonds to banks and non-banks, credit given by CB and the monetary authorities to banks, and advance deposit requirements on imports.
The net foreign asset position of commercial banks is defined as a policy variable because the monetary authorities can exert influence on the government-owned Philippine National Bank, which is the largest commercial bank in the country. The demand for traditional deposits -- demand, time, and savings deposits -- is determined residually as the difference between money stock and currency held by the non-bank public. The components of total deposits, the definition of capital stock as cumulated investment, and the equilibrium condition for national income are described in the remaining equations.

Figure 3 gives a schematic presentation of the model.

8.3 Comments on the Villanueva Model

In the Villanueva model, the financial and real variables are determined simultaneously by the equilibrium in the real, financial and credit sectors of the economy. It incorporates several monetary policy instruments. Fiscal policy variables are taxes, government consumption expenditures, and credit to the government.

It may be observed that in the Villanueva model, the gross domestic product is determined primarily by
Figure 3. THE VILLANUEVA MODEL
FLOW CHART OF THE MACRO MODEL OF THE PHILIPPINES

* Arrows indicate the direction of main influence
domestic factors. Imports and exports affect the foreign assets of the monetary authorities and, indirectly, the money supply, interest on deposit substitutes, loan rate, investment and aggregate demand. The trade balance also enters into the national income determination identity. It appears that for a country that is so dependent on foreign trade, an attempt should be made to more directly model the impact of imports, exports, and foreign investment.

9. The Zialcita-Alfiler Model

This semestral model is formulated to serve as the underlying framework for monetary policy. Monetary policy is implemented by determining the cost of money (which is proxied by interest rate on savings deposits) and controlling the amount of reserve money whose components are all assumed to be exogeneous. The fixed components of reserve money are programmed by the Monetary Authority while the variable components are controlled through various monetary instruments of the Central Bank -- swap operations, rediscounting, repurchase, reverse repurchase, and purchases and sales of securities. The amount of reserve money determines the level of
domestic credits to the private and government sectors from the commercial banking system. Domestic credits by the commercial banking system serves as the major link between the monetary and real sectors of the economy. Together with the interest rate, domestic credits determine the level of private investment. It also affects the total liquidity (money supply, traditional deposits and deposit substitutes) which in turn affects prices. Subsequently, the gross domestic product is determined.

9.1 Real Sector

The real sector block of the model consists of relationships explaining consumption, investment, government expenditures, imports, prices and gross domestic product.

Private consumption, in logarithmic form, is a function of disposable income and prices. Government consumption expenditures is dependent on tax revenues of the government. Private investment is determined by the availability of credit from the commercial banking
system and the cost of money. Private investment is therefore regressed against domestic credits of the commercial banking system, the rate of interest on savings, and its own lagged value. Public investment of the government is assumed to be an exogenous fiscal variable.

Imports are broken down into: imports of producer goods and imports of consumer goods. Producer good imports are related to total investment, relative price ratio (ratio of general price level to import price index), and a dummy variable reflecting seasonality in import demand. Similarly, imports of consumer goods (in log form) is determined by total consumption (in log form), relative price ratio, and dummy variable for seasonality. Exports are assumed exogenous.

The aggregate production function is Cobb-Douglas with employment and capital stock as factors of production. The general price level is a function of aggregate demand, liquidity and a price expectation variable (which is exogenously determined).

9.2 Monetary Sector

The level of domestic credits is dependent on the level of reserve money. Domestic credits from commercial
banks and the Monetary Authority together with net unclassified assets of the monetary system set the level of net domestic assets of the monetary system. The net foreign assets of the monetary system are increased by a balance of payments surplus (deficit). The total liabilities of the monetary system are constrained to equal total domestic and foreign assets. Thus, the total liquidity generated in the system is set against demand for liquidity which is expressed in real terms as a function of real income, domestic prices, and the level of total liquidity in the previous semester. The components of reserve money are defined by the balance sheet constraint of the monetary authority.

Exhibit III presents the model equations. Whenever appropriate, the same symbols as those in the Encarnacion and Villanueva models are used.

9.3 Comments on the Zialcita-Alfiler Model

This model is more aggregative than the Villanueva model. It lumps savings deposits, time deposits, deposit substitutes, and money supply (M₁) into a total liquidity variable. Like the Villanueva model, it includes an interest variable as a determinant in the investment
demand function. Another explanatory variable for private investment is the level of domestic credits by the commercial banking system which is influenced by Central Bank operations through the components of reserve money. In the Villanueva model, domestic credits affect the loan rate which in turn affects total investment. The monetary sector is also linked to the real sector through the influence of total liquidity on prices. The price level appears in the relationships for private consumption and imports of capital and consumer goods. Through indirect linkages, aggregate demand is influenced.

In the Villanueva model, the general price level is set as a result of interactions among the forces that equate the demand and supply for money and deposit substitutes. Price affects imports in the import equation, employment level in the price-wage-employment relationship, and ultimately gross domestic product. Recall that in the Encarnacion model, the primary link between the monetary sub-model and the aggregative model for output-employment-price relationships is money supply as an explanatory variable of price level. There is no monetary variable in the investment demand equation.

The Zialcita-Alfiler model lumps the net foreign assets of commercial banks with the net foreign assets
of the Monetary Authority. In the Villanueva model, the net foreign assets of commercial banks are considered exogenous and subject to influence by monetary policy because the biggest commercial bank, the Philippine National Bank, is government-owned. Villanueva also considered foreign liabilities of the Monetary Authority as exogenous whereas Zialcita and Alfiler net foreign liabilities with foreign assets and considered the net amount endogenous.

The Zialcita-Alfiler model is really more of a monetary model than a macroeconomic model. However, the importance of the linkage between the monetary and real sectors is recognized, and an attempt was made to establish the link.

10. **The BACHUE Model**

The International Labour Organization commissioned the development of an economic-demographic development planning model, called BACHUE-Philippines by Gerry Rodgers et. al. [15]. The model simulated the long-run behavior of economic and demographic aspects of development. It estimated relationships at both macro and micro (household)
levels using time series and cross-sectional data. The model contained three subsystems-economic, labor market and income distribution, and demographic. The disaggregation of the model was extensive, particularly in the demographic subsystem which had some 150 basic demographic categories.

The modelling effort was concentrated on the labor market and income distribution and demographic subsystems, and on the interrelationships between them. The economic subsystem was not as comprehensive, with a number of economic variables omitted or assumed to be exogenous. The economic subsystem was designed primarily to generate market behavior and income distribution. The economic submodel was demand-based, with final demand transformed into outputs of 8 rural and 9 urban producing sectors. The model had over 250 behavioral equations and identities.

Figure 4 is a schematic diagram of the variables and subsystems. The endogenous and exogenous variables are identified. Variables outside the model are also indicated. The main causal relationships between the different model elements are shown in Figure 5.

In the economic subsystem, demand variables constitute the major linkage between population growth
This schematic gives a rough idea of the range of issues treated in BACHUE-Philippines. The categories are: (a) endogenous—all major areas determined by the model; (b) exogenous—major variables affecting endogenous variables, but not affected by them; (c) outside—other areas which may be important for national development planning, but which are not directly represented in BACHUE (some of their effects may however be indirectly represented). Those in the diagram in this category are only a selection of the most important of the areas not treated in the model.
Figure 5. Main relationships in BACHUE-Philippines.

Government interaction is not shown in this diagram because it appears nearly everywhere and would make the diagram overcrowded. Many detailed interactions are omitted for the purposes of this summary diagram, and time is also not explicitly shown.
and employment/labor distribution. Final demand is determined by household consumption, which is dependent on population size, structure and location. Exports, government expenditure, and private investment are also determinants of final demand.

An overall target for total output is set, based on planning targets and estimates of growth rates. This overall target serves as a basis for supply constraints (instead of supply constraints, a balance of payments constraint can be imposed; it is also possible to make the model entirely demand-driven). Using an input-output matrix, output, imports and value added by sector are determined.

The demand for labor, by sector, by location and by educational attainment, is derived. This interacts with labor supply which is determined by age-sex specific labor force participation rates. These rates are based on job classification, education levels, household incomes and occupation of the household head. Among the employed, the self-employed, skilled, unskilled, urban, rural, modern, and traditional labor work forces are distinguished. Unemployment, rural-urban and inter-sectoral migration are modelled. Wages and employment
are solved by the model and are mapped into household incomes. Household incomes are then aggregated into rural and urban income distributions. Household expenditure and savings as well as mortality rate, are determined from the distribution of income.

The demographic subsystem traces the movement of people from birth to death. The system simulates the behavioral factors influencing age at marriage, fertility, mortality, and migration. The behavioral relationships include: (1) marriage rates as a function of education levels and female labor force status; (2) fertility as affected by female labor force participation, mortality, family planning programs, education, proportion of population which is agricultural; (3) rural-urban migration as dependent on education levels, urban-rural wage differentials, differences in rural-urban income distribution, sex, age, and marital status. (4) mortality as a function of level and distribution of income; (5) education levels as determined by school graduation rates and government policy.

In preparing a macroeconometric planning model, the relationships in the Bachue model should be reviewed to see if it is feasible and desirable to adopt any of
its relationships. There will be problems in having a uniform level of disaggregation. An assessment should be made of the extent to which model parameters (i.e. fertility) were estimated from other countries, rather than on Philippine data (obviously because of data problems). The validity of this procedure should be weighed against its pragmatism. In any case, the BACHUE model is a fertile reference in constructing an econometric planning model for the Philippines.

11. Summary Remarks

Having reviewed the various macroeconometric models that have been constructed for or applied to the Philippines, it is but appropriate to reflect on what have been gained from the survey. The comments made on the various models will be summarized and pooled together. Based on the observations made and the insights drawn, some preliminary specifications for a macroeconometric model for development planning and policy analysis will be made. These specifications will tend to be "wants" on the part of the model-builder. They will be constrained by the availability of data.
In the summary, no attempt will be made to reconcile the different parameter values estimated (i.e. marginal propensity to consume) of the various models. Neither will their projection results be compared. The models used different sources of data covering different periods. They were developed for different purposes.

The foreign assistance models and the World Bank RMSM highlight the role of foreign capital inflow to fill either the savings gap or the trade gap. The question raised is: how long will the Philippines be dependent on foreign capital flow to augment its savings for investment purposes or to pay for its imports in excess of exports? This is a very relevant question. The low rate of savings in the Philippines impedes the development of a capital market that will provide the mechanism to finance investment projects. Given the present propensity to save, how large a savings gap would be created by an investment program aimed at achieving a target rate of growth? Will foreign capital be forthcoming to fill the gap? Can the Philippines still service the foreign debt? The low level of international reserves may constrain the investment program of the country. The restraint may be through high cost of capital or increased prices.
It would be interesting if the interplay of market forces can be depicted in a macroeconomic model.

The Philippines has not been successful in eliminating the trade gap. A model that provides for trade gap to exist is certainly more realistic. The Encarnacion projection model assumed that current import will just equal current exports because "the servicing requirements of the large foreign debt would probably constrain the level of imports to the neighborhood of the export level". Narasimham and Sabater use the cumulative trade deficit as a proxy to foreign indebtedness in estimating net factor income payments, and they use the level of international reserves as a regressor in their import functions. This is their attempt to describe the role of foreign exchange constraint. In a projection model, it will be useful if the debt service burden over the projection period can be projected to see if it will reach the IMF limit. It will be ideal (but probably extremely difficult) to model a foreign exchange market that will play a key role in the adjustment towards equilibrium. There may be other adjustment mechanisms, probably centered on the price variable and cost of capital.
The importance of foreign trade in the Philippine setting must be recognized. To capture this dependency, it will be necessary to disaggregate the import and export functions by major commodity groups, as Encarnacion and Narasimham-Sabater have done (and also the UNCTAD model, to some extent, although its use of SITC grouping for exports is not appropriate). The Villanueva model's weakness is the lack of dependence of the economy on imports, exports, foreign investment and foreign capital. However, Villanueva, as well as Zialcita-Alfiler, include the balance of payments deficit (or surplus) in the definition of net foreign assets of the Monetary Authority, which in turn enters the balance sheet constraint of the Monetary Authority and determines reserve money. This, plus the national income identity, provide the interaction between the foreign and domestic factors in the economy. It may be better if imports or exports also appear in the production functions.

With the problems caused by the energy crisis and the rising price of oil, it is only appropriate to relate imports of fuel to sectoral outputs and price of fuel to the general price level. The UNCTAD model has an import function for fuel and fuel imports are aggregated with
other imports to obtain total imports, which in turn enter in the other model equations. Narasimham and Sabater estimate fuel imports from mining and manufacturing income.

To see the impact of fuel on the economy, it will have to be included in the production function of some sectors of the economy. An approach that should be explored is the use of input-output tables, perhaps in the manner of the BACHUE model to obtain sectoral output, imports, and value added. With such a structure, the overall effect of oil price increases can be estimated.

The linkages between the financial and real sectors are strong in the Villanueva model. There is virtually no linkage in the foreign assistance model, the World Bank RMSM, and the Narasimham-Sabater model. The Encarnacion projection model has a monetary submodel, but its linkage with the real sector is primarily through money supply, which is a determinant of price level. The basic model has a feedback to the monetary submodel through the effect of trade deficit (surplus) on the level of international reserves. The linkage in the Encarnacion model is weak. It is difficult to capture the interactions among monetary and real variables with
annual data. Villanueva and Zialcita-Alfiler use semi-
annual data. Villanueva uses an interest rate variable
in the investment demand function. This interest rate
is determined in the demand and supply equations for
credit; the supply of credit on the other hand is
interlinked with the demand and supply for deposit
substitutes and the money supply equation. In the
Zialcita-Alfiler model, the major link is provided by
the domestic credits of the commercial banking system.
This together with the interest rate variable determine
the level of investment, and subsequently prices and
income. Being primarily a monetary policy model, the
Zialcita-Alfiler model does not have an extensive
description of the real sector. In a macroeconometric
model for the Philippines, the linkages between the real
and monetary sectors must be established. The monetary
authorities have a strong influence on the development
of the economy through various monetary instruments of
policy. In fact, foreign exchange transactions are
under the purview of the Central Bank. There is an
effort to synchronize monetary policies with the fiscal
program of the country. So, the financial system should
be a major component of the economic system to be modelled.
The Encarnacion model describes the government sector in some detail, by disaggregating expenditures by functional classification and receipts by source. Most of the other models simply have one government consumption function and a government investment function. There is presently interest in the Budget Commission to have a fiscal planning model that will go down to the program level in projecting expenditures, and one that will serve as guide in budget allocation. There is also the need for a model to assist in managing the national debt, both internal and external. Servicing of foreign debt can be related to the balance of payments and money supply. It is probably too ambitious to incorporate all of these requirements in one macroeconometric model. Perhaps, after a macro model has been developed, tested and used, serious thought should be given to extending it along the dimensions mentioned.

Before ending these summary remarks, the problem of data inavailability and inconsistency needs to be addressed. The modelling effort exerted so far has suffered from lack of data. For instance, the data on capital formation is sorely lacking. There is no disaggregation of private consumption by commodity group.
If data are taken from different sources, they are found to be inconsistent. The timing of the data (fiscal year versus calendar year) poses a problem. Government data obtained from the national income accounts are on obligation basis. Data on cash basis may be obtained from the Budget Commission. There is also the problem caused by frequent revisions to the national income accounts. The CY 1971-75 national income accounts which were revised as of September 1976 cover only 5 years. Using semi-annual data, the number of observations will double. But even 12-16 observations for an econometric model limit the number of degrees of freedom for statistical hypothesis testing (not to mention the reduction in degrees of freedom if first differences or rates of change are used). Monetary time series are available even on a monthly basis. However, the other national accounts are available only on a semestral and annual basis. Developing a macro-econometric model for development planning with sectoral components will inevitably entail constructing time series from unofficial or unpublished sources. This makes the modelling work much more difficult. But it also poses a challenge.
Econometric model-building in the Philippines is still a new science (and art). It is hoped that this review and synthesis of macroeconometric models will contribute to its development.
BIBLIOGRAPHY


EXHIBIT I

REVISED MINIMUM STANDARD MODEL
OF THE
INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT

Notation

\( a_i \) = exogenous coefficient
\( g_i \) = exogenous growth rate
\( * \) = current prices
\( ' \) = growth rate
\( \Delta \) = increment

Model Equations

\[
\begin{align*}
YAG &= YAG_{t-1}(1 + g_1) \\
YIND &= YIND_{t-1}(1 + g_2) \\
YSER &= YSER_{t-1}(1 + g_3) \\
GDPFC &= YAG + YIND + YOTH \\
INDTX &= a_5 GDPFC \\
Y &= GDPFC + INDTX \\
\Delta Y &= Y_t - Y_{t-1} \\
\Delta STK &= a_4 \Delta Y \\
IF &= a_1 Y_t + a_2 \Delta Y_{t-1} + K \\
OR: IF &= a_2 \Delta YAG + a_1 \Delta YIND \\
&\quad + a_3 YOTH + k \\
I &= IF + \Delta STK \\
MCAP &= (1 + a_6 IF') \cdot MCAP_{t-1}
\end{align*}
\]

Definition of Left-Hand-Side Variable

Value added, agriculture
Value added, industry
Value added, other
GDP at factor cost
Indirect taxes
GDP at market prices
Increment to GDP
Change in stocks
Fixed investment
Fixed investment
Total investment
Imports, capital goods
Model Equations

\[ M_{\text{INT}} = (1 + a_7 Y'\text{IND}) \cdot M_{\text{INT}}_{t-1} \]
\[ M_{\text{FUEL}} = (1 + a_8 Y') \cdot M_{\text{FUEL}}_{t-1} \]
\[ M_{\text{FOOD}} = (1 + a_9 PC') \cdot M_{\text{FOOD}}_{t-1} \]
\[ M_{\text{OCG}} = (1 + a_{10} PC') \cdot M_{\text{OCG}}_{t-1} \]
\[ M_{G} = M_{\text{INT}} + M_{\text{FUEL}} + M_{\text{FOOD}} + M_{\text{OCG}} \]
\[ M_{\text{NFS}} = (1 + a_{11} Y') \cdot M_{\text{NFS}}_{t-1} \]
\[ M = M_{G} + M_{\text{NFS}} \]
\[ X = X_1 + X_2 + X_3 \ldots + X_n \]
\[ X_1^* = X_1 \cdot X_{PI1} \]
\[ X_{PI1} = \text{given} \]
\[ X^* = X_1^* + X_2^* + X_3^* \ldots + X_n^* \]
\[ M_{PI1} = \text{given} \]
\[ M_{PI}^* = M_{PI} \cdot M_i \]
\[ M^* = M_{\text{CAP}}^* + M_{\text{INT}}^* + M_{\text{FUEL}}^* \]
\[ + M_{\text{FOOD}}^* + M_{\text{OCG}}^* + M_{\text{NFS}}^* \]
\[ R_{G^*} = M^* - X^* \]
\[ T_{\text{TADJ}} = \frac{X^*}{M_{\text{FT}}} - \frac{X^*}{X_{PI}} \]
\[ X_{\text{ADJ}} = X + T_{\text{TADJ}} \]
\[ G_{\text{DY}} = \text{GDP} + T_{\text{TADJ}} \]
\[ C = G_{\text{DY}} - I + M - X_{\text{ADJ}} \]
\[ G_{\text{C}} = G_{\text{C}}_{t-1} (1 + g_4) \]
\[ P_{\text{C}} = C - G_{\text{C}} \]

Definition of Left-Hand-Side Variable

Imports, intermediate goods
Imports, fuel
Imports, food
Imports, other consumer goods, potential
Imports, total goods
Imports, services
Imports, goods + non-factor services
Exports, goods + non-factor services
Exports, i\textsuperscript{th} commodity
Export price index, i\textsuperscript{th} commodity
Exports current prices
Import price index, i\textsuperscript{th} end use class
Imports current prices, i\textsuperscript{th} end use class
Imports, current prices
Resource Gap, current prices
Terms of trade adjustment
Exports, adjusted
Gross domestic income
Consumption
Government consumption
Private consumption
### Model Equations

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPY</td>
<td>given (from balance of payments)</td>
</tr>
<tr>
<td>GNP</td>
<td>GDP + NPY</td>
</tr>
<tr>
<td>GNY</td>
<td>GNP + TTADJ</td>
</tr>
<tr>
<td>GDS</td>
<td>GDY - C</td>
</tr>
<tr>
<td>NT</td>
<td>given</td>
</tr>
<tr>
<td>GNS</td>
<td>GDS + NPY + NT</td>
</tr>
<tr>
<td>MAXMSR</td>
<td>given</td>
</tr>
<tr>
<td>GNSP</td>
<td>( \text{MAXMSR} \cdot (\text{GNY}<em>t - \text{GNY}</em>{t-1}) ) + GNS(_{t-1})</td>
</tr>
</tbody>
</table>

**IF GNS > GNSP then:**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GNS</td>
<td>GNSP</td>
</tr>
<tr>
<td>PC</td>
<td>GNY - GC - GNS</td>
</tr>
<tr>
<td>M</td>
<td>( I - (\text{EDP} - \text{PC} - GC) + X )</td>
</tr>
<tr>
<td>MOCG</td>
<td>( M - \text{MCAP} - \text{MINT} - \text{MFOOD} - \text{MNFS} )</td>
</tr>
</tbody>
</table>

**IF GNS < GNSP then:**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOCG</td>
<td>MOCGP</td>
</tr>
<tr>
<td>IPD</td>
<td>( \text{IPD} \cdot (1 + g_6) )</td>
</tr>
<tr>
<td>GDP*</td>
<td>( \text{GDP} \cdot \text{IPD} )</td>
</tr>
<tr>
<td>GR</td>
<td>( 1 + (\text{all} \cdot \text{GDP}^*) \cdot \text{GR}_{t-1} )</td>
</tr>
<tr>
<td>GE</td>
<td>( \text{GE}_{t-1} \cdot (1 + g_6) \cdot \left( \frac{\text{GC}<em>t}{\text{GC}</em>{t-1}} \right) )</td>
</tr>
</tbody>
</table>

### Definition of Left-Hand-Side Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPY</td>
<td>Net Factor Income</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Product</td>
</tr>
<tr>
<td>GNY</td>
<td>Gross National Income</td>
</tr>
<tr>
<td>GDS</td>
<td>Gross Domestic Savings</td>
</tr>
<tr>
<td>NT</td>
<td>Net Transfers abroad</td>
</tr>
<tr>
<td>GNS</td>
<td>Gross National Savings</td>
</tr>
<tr>
<td>MAXMSR</td>
<td>Maximum Marginal Savings Rate</td>
</tr>
<tr>
<td>GNSP</td>
<td>Potential Gross National Savings</td>
</tr>
<tr>
<td>GNS</td>
<td>Gross National Savings</td>
</tr>
<tr>
<td>PC</td>
<td>Private Consumption</td>
</tr>
<tr>
<td>M</td>
<td>Imports</td>
</tr>
<tr>
<td>MOCG</td>
<td>Imports, Other Consumer Goods</td>
</tr>
<tr>
<td>IPD</td>
<td>Implicit Price Deflator of GDP</td>
</tr>
<tr>
<td>GDP*</td>
<td>GDP, current prices</td>
</tr>
<tr>
<td>GR</td>
<td>Government revenue</td>
</tr>
<tr>
<td>GE</td>
<td>Government current expenditures</td>
</tr>
</tbody>
</table>
EXHIBIT II
THE VILLANUEVA MODEL

BEHAVIORAL EQUATIONS

Imports at constant prices

(1) \( M = -2659.2 + 0.219Y + 2084.049 \frac{P}{P_m} \)

Private Consumption at constant prices

(2) \( C_p = -76.57 + 0.821 (Y - T) \)

Gross investment at constant prices

(3) \( I = 812.1 + 0.397Y - 367.51 R_b \)

Production Function

(4) \( Y = 7814.7 + 0.565 N + 0.111 K \)

Price-wage-employment

(5) \( P_p = -3.985 + 0.0006 N + 0.0014 W + 0.2606 \frac{U}{P} \)

Commercial banks' reserve balances with CB

(6) \( Z_a = 1399.6 - 188.152 R_b + 0.057 D + 73.129 R_d + 170.135 U_r \)

Commercial banks' holding of vault cash

(7) \( Z_v = -9.918 + 0.0230 D + 8.489 R_d \)
Loan rate -- supply of credit from banks and non-banks

(8) \( R_b = 1.309 = 6.636 \frac{Lbp}{D} + 0.256 R_{ds} \)

Demand for credit by private sector

(9) \( \frac{Lbp}{P} = 349.5 + 0.542 Y - 224.76 R_b \)

Demand for currency

(10) \( Z_c = -3545.9 + 0.308 Y + 447.456 P \)

Demand for total deposit substitutes

(11) \( \frac{D_s}{P} = -8958.2 + 0.486 Y + 173.743 R_{ds} \)
\( + 450.361 U_{ds} \)

Interest rate on deposit substitute

(12) \( R_{ds} = 13.202 + 0.0007 Y - 0.0019 \frac{Z}{P} \)

DEFINITIONS AND IDENTITIES

Money

(13) \( Z = \frac{Z_c + D_{dp} + D_{tp}}{Z_c + Z_v + Z_a} \cdot Z_r \)

 Reserve money (balance sheet constraint of monetary authorities)

(14) \( Z_r = FA_m^m + L_{mg} + L_{mb} - B_m + OA_m \)

Foreign Assets of the monetary authorities

(15) \( FA_m^m = FA_{-1}^{m} + FA_{-1}^{b} - FA_{-1}^{a} + P \cdot X - P_m \cdot M + OA_f \)
Balance sheet constraint on banks and quasi-banks

\[ (16) \quad FA^b + L_{bg} + L_{bp} + Z_v + Z_a + B_m = D_{dp} + D_{tp} + D_s + D_{mr} + L_{mb} + OL_b \]

Demand for traditional deposits

\[ (17) \quad D_{dp} + D_{tp} = Z - Z_c \]

Total deposit and quasi-deposit liabilities

\[ (18) \quad D = D_{dp} + D_{tp} + D_s \]

Capital stock

\[ (19) \quad K = K_{-1} + I_{-1} \]

Equilibrium Condition

\[ (20) \quad Y = C_p + C_g + I + X - M \]

DEFINITION OF VARIABLES

Endogenous Variables

- \( Y \) = real gross domestic product
- \( M \) = real imports
- \( C_p \) = real private consumption
- \( I \) = real gross investment
- \( K \) = capital stock
- \( P \) = price deflator for gross domestic product
- \( N \) = employment in thousand persons
\[ Z = \text{money supply (currency plus demand, savings, and time deposits)} \]

\[ Z_a = \text{commercial banks' reserve balances with Central Bank} \]

\[ Z_v = \text{commercial banks' vault cash} \]

\[ Z_c = \text{currency held by non-bank public} \]

\[ Z_r = \text{reserve money} \]

\[ D_{dp} = \text{demand deposits} \]

\[ D_{tp} = \text{time and savings deposits} \]

\[ D_s = \text{deposit substitutes} \]

\[ D = \text{deposit substitutes, demand deposits, time and savings deposits} \]

\[ R_b = \text{rate of interest on domestic credit charged by banks} \]

\[ R_{ds} = \text{rate of interest on deposit substitutes} \]

\[ L_{bp} = \text{domestic credit to private sector from banks and non-banks} \]

\[ L_{bg} = \text{domestic credit to Government from banks and non-banks} \]

\[ FA^m = \text{net foreign assets of Monetary Authorities} \]

(Note: Villanueva considered gross foreign assets of Monetary Authorities as endogenous and foreign liabilities of Monetary Authorities as exogenous).
**Exogenous Variables**

\[ P_m = \text{price deflator for imports} \]
\[ P_x = \text{price deflator for exports} \]
\[ X = \text{real exports} \]
\[ T = \text{taxes} \]
\[ C_g = \text{Government consumption expenditures} \]
\[ W = \text{money wage rate} \]
\[ R_d = \text{Central Bank discount rate} \]
\[ D_{mr} = \text{import deposit requirements} \]
\[ F_{Ab} = \text{net foreign assets of commercial banks} \]
\[ O_{Af} = \text{net other items in the balance of payments including errors and omissions} \]
\[ L_{mg} = \text{net credit of the Monetary Authorities to Government} \]
\[ L_{mb} = \text{net credit of the Monetary Authorities to commercial banks} \]
\[ B_m = \text{issue of central bank bonds by Monetary Authorities} \]
\[ O_{Am} = \text{net other assets of Monetary Authorities} \]
\[ O_{Lb} = \text{net other liabilities of banks and non-banks} \]
\[ U_m = \text{dummy variable for imports:} \]
\[ -1 \text{ in 1969:II, 1971:I to 1973:I; } \]
\[ 1 \text{ in 1974:I to 1976:I; zero otherwise} \]
\[ u_p = \text{dummy variable in price level equation:} \]
\[-1 \text{ in } 1968:\text{II and } 1972:1 \text{ to } 1973:1; \]
\[1 \text{ in } 1969:\text{II; zero otherwise} \]

\[ u_r = \text{dummy variable for changes in reserve requirement:} \]
\[-1 \text{ in } 1973:1; 1 \text{ in } 1968:\text{II, 1969:1,} \]
\[1975:\text{II, and 1976:1; zero otherwise} \]

\[ u_{ds} = \text{dummy variable in deposit substitutes:} \]
\[-1 \text{ in } 1970:\text{II and } 1971:\text{II to 1973:1} \]
\[1 \text{ in } 1969:1, 1974:1, \text{ and } 1975:1 \& \text{II,} \]
\[\text{zero otherwise} \]
EXHIBIT III
THE ZIALCITA-ALFILER MODEL

MODEL EQUATIONS

1. \( \log C = 2.9482 + 0.3064 \log (Y-T) + 0.1881 \log P \)
2. \( I_p = 8829.1 + 0.1550 L_b - 1083.5 R_{sd} + 0.0269 I_p - 1 \)
3. \( C_g = 658.16 + 0.0811 T \)
4. \( M_k = 5773.2 + 0.2655 I - 2994.8 P/P_m + 356.64 U_1 \)
5. \( \log M_c = -10.132 + 1.5312 \log C + 1.1538 P/P_m + 0.0449 U_1 \)
6. \( L_b = -9711.1 + 5.77 Z_r \)
7. \( P = 0.6503 - 0.0002 Y + 0.00002 TL + 0.6804 P_e \)
8. \( \log TL/P = -4.4618 + 1.2951 \log Y - 0.2588 \log P + 0.6837 \log (TL/P) - 1 \)
9. \( \log Y = 0.8285 + 0.2195 \log N + 0.5362 \log K \)
10. \( I = I_p + I_g \)
11. \( K = K_1 + I \)
12. \( M = M_c + M_k \)
13. \( FA = F A_1 + P_x \cdot X - P_m \cdot M + O A_f \)
14. \( Z_r = F A_m + L_m - B_m + O A_m \)
15. \( K A + L_m + L_b = TL + O L \)
DEFINITIONS

Endogeneous Variables

\[ Y = \text{real gross domestic product} \]
\[ M = \text{real imports} \]
\[ M_k = \text{real imports of producer goods} \]
\[ M_C = \text{real imports of consumer goods} \]
\[ C_p = \text{real private consumption} \]
\[ C_g = \text{real government consumption expenditures} \]
\[ I_p = \text{real private investment} \]
\[ I = \text{real gross domestic capital formation} \]
\[ K = \text{capital stock} \]
\[ P = \text{consumer price index} \]
\[ Z_r = \text{reserve money} \]
\[ TL = \text{total liquidity} \]
\[ L_b = \text{domestic credits of the commercial banking system} \]
\[ FA = \text{net foreign assets of the monetary system} \]

Exogeneous Variables

\[ P_m = \text{import price index} \]
\[ P_x = \text{export price index} \]
\[ X = \text{real exports} \]
\[ T = \text{taxes} \]
\[ R_{sd} = \text{interest rate on savings deposits} \]
N = employment index
P_e = price expectation variable
X = real exports
I_g = real public investment
O_A_f = net other assets in the balance of payments, including errors and omissions
L_m = domestic credits of the Monetary Authority
B_m = issue of Central Bank Certificate of Indebtedness held outside the monetary system
F_A_m = net foreign assets of the Monetary Authority
O_A_m = net other assets of the Monetary Authority, including net unclassified assets, claims on deposit money banks, and capital accounts of the Monetary Authority
O_L = other liabilities of the monetary system net of unclassified assets of the monetary authority and commercial banks
U_1 = dummy variable representing seasonal influences on import demand