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Philippine Institute for Development Studies

Macroeconomic Models and Stabilization Policy

Josef T. Yap

DISCUSSION PAPER SERIES NO. 94-02

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July 1994

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Macroeconomic Models and Stabilization Policy

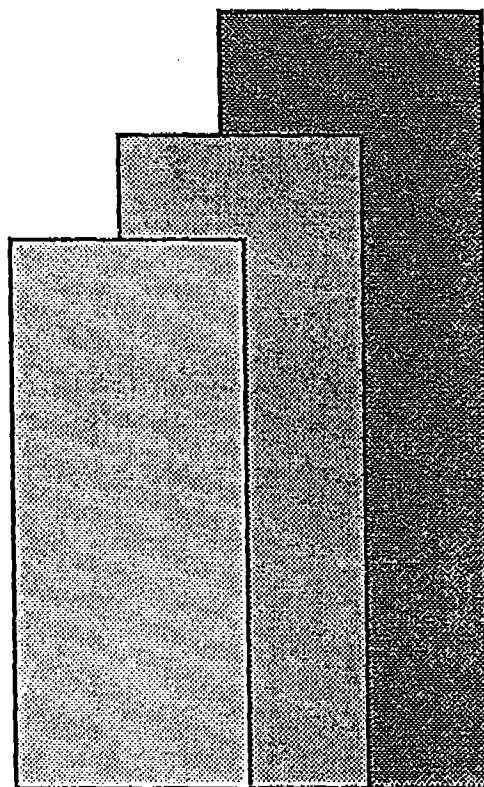
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MACROECONOMETRIC MODELS AND STABILIZATION POLICY*

*Josef T. Yap***

I. INTRODUCTION

Quantitative models of national economies have been increasingly used for policy analysis and projections. Macroeconometric models are part of this genre of economic tools which have developed along the lines of the pioneering work of Jan Tinbergen. While macroeconometric models have lost much of their lustre in the past decade, they nevertheless remain useful in guiding policy decisions and making forecasts.

This paper reviews the basic foundations of macroeconometric models and their use in the analysis of stabilization policy. Section II gives a brief background on the nature of macroeconometric modelling. This is followed by a similar exposition on stabilization policy which includes a segment on the method of modelling the channels of stabilization policy. In Section IV, the latest macroeconometric models of the Philippine economy is reviewed, emphasizing how they incorporate the analysis of stabilization policy. Since the general interest is on the microeconomic impact of macroeconomic adjustment policies, a section on linking an income-distribution bloc to the macroeconomy is included. Areas for future study close the discussion.

II. MACROECONOMETRIC MODELLING¹

This paper is concerned with the estimation and use of structural macroeconometric models. The term "structural" is important as it explicitly excludes the non-theoretical, time-series models of the vector autoregressive (VAR) type. A structural model is a formalization of a theoretical view of how the economy functions. The individual equations can then be given causal interpretation and the model represents a testable version of the underlying theory. By expressing the "structure" quantitatively, two objectives may be accomplished: 1) the testing of

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**Research Fellow, Philippine Institute for Development Studies (PIDS). The author is grateful to Dr. Joseph Y. Lim and the MIMAP staff for helpful comments and to Ms. Merle G. Galvan for help in text processing. The usual disclaimer applies.

1. This section is drawn from Hall and Henry (1988), pp. 131-134.

the theoretical constructs themselves; and 2) the use of the model for prediction and policy analysis.

All structural models may be thought of as representing a set of markets which together describe the macroeconomy. In the very broadest sense we can describe almost all models within the following set of equations:

$$X_i^D = f(P, X^D, X^S, X, Z)$$

$$X_i^S = g(P, X^D, X^S, X, Z)$$

$$X_i = h(P, X^D, X^S, X, Z)$$

$$P_i = j(P, X^D, X^S, X, Z) \quad i=1, \dots, N$$

The economy is made up of N markets with endogenous variables X_i and each market has a demand X^D , and a supply X^S . The actual quantity traded, X , is a function of prices P , the exogenous variables Z , and the demand, supply and quantity traded in all markets. Different classes of models are then produced by imposing broad restrictions on this very general structure. Models are usually classified according to the theory which they represent.

By far the most important, or at least most popular, class of models is the income-expenditure model which implements conventional Keynesian theoretical views. The model generally assumes that the demand side of the model is dominant, so that $X=X^D$. The supply side of many of the markets is then virtually ignored, and prices are set on a fairly "ad hoc" cost mark-up basis. To be more specific, total output is generally determined by total demand which, in turn, is determined by summing the components of aggregate expenditures, consumption, investment, etc. The central part of the model -- expenditure -- then determines the real components of the economy, and it is around this central structure that additional sectors determining prices and monetary aggregates may be added.

Other classes of models include equilibrium models, supply-side models, and disequilibrium models. All of these may be seen as attempts to relax the restrictive assumption of demand-side dominance of the income-expenditure model, and to cope with the question of how prices are actually determined within the system.

An equilibrium model, for instance, makes the general assumption that markets continuously clear so $X=X^D=X^S$, and prices are set so that market clearing occurs. While the assumption of continuous market clearing may be an extreme one, its major advantage is that it does offer a sound theoretical foundation for the determination of prices within the model.

It is worth distinguishing the idea of a "supply side" model from the model just discussed given the increasing attention now paid to supply-side factors. The concept of a supply-side model, however, is not clearly defined; in particular it is not straightforward to use the natural

analogue to a demand-side definition which is that all markets are assumed to be determined on the supply-side. "Supply-side" models do not generally make such an extreme assumption. Instead the term is generally taken to mean that the supply side of the market has some important influence in the determination of the quantities actually traded. In general practice, this means that an unusually large role is played by relative price effects in expenditure equations, without the model being explicitly formed in terms of demand or supply functions with full market clearing.

Disequilibrium models contain both supply and demand equations with a "minimum" condition being applied to determine actual output. A price equation is likewise specified, but it takes on a stock-adjustment form to account for slow movement towards equilibrium.

III. MODELLING STABILIZATION POLICY

A. *Analytical Aspects*

Lamberte *et al.* (1991) note that macroeconomic adjustment policies usually include the following:

- 1) tight monetary policy while savings are encouraged;
- 2) efforts to reduce the budget deficit through, among others,
 - a) a cut in public expenditures and/or
 - b) adoption of new revenue-raising measures;
- 3) exchange-rate reforms usually involving a devaluation;
- 4) reforms in the external sector such as changes in export taxes and import duties; and
- 5) price deregulation while wages are restrained.

The first three policies will be discussed as they directly affect macroeconomic aggregates such as output, employment, and the balance of payments.

The "Dependent Economy" (or Australian) two-sector model will be used to illustrate the stabilization process. Demery and Addison (1987) provide a useful description of the model as follows. The model assumes a small economy, therefore a price-taker, in international trade, with two sectors distinguished as traded (T) and non-traded (NT) sectors. Traded goods are the importables and exportables, while the non-traded goods are produced and consumed domestically. The model emphasizes the role of relative prices in illustrating the process of adjustment.

Figure 1 represents this small-country case with NT as the production frontier for traded and non-traded goods. With expansionary monetary and fiscal stance adopted in the past, the real level of expenditure (OA in terms of the non-traded good) exceeds output, x , with the relative price of traded to non-traded (P_T/P_N) represented as AA'.

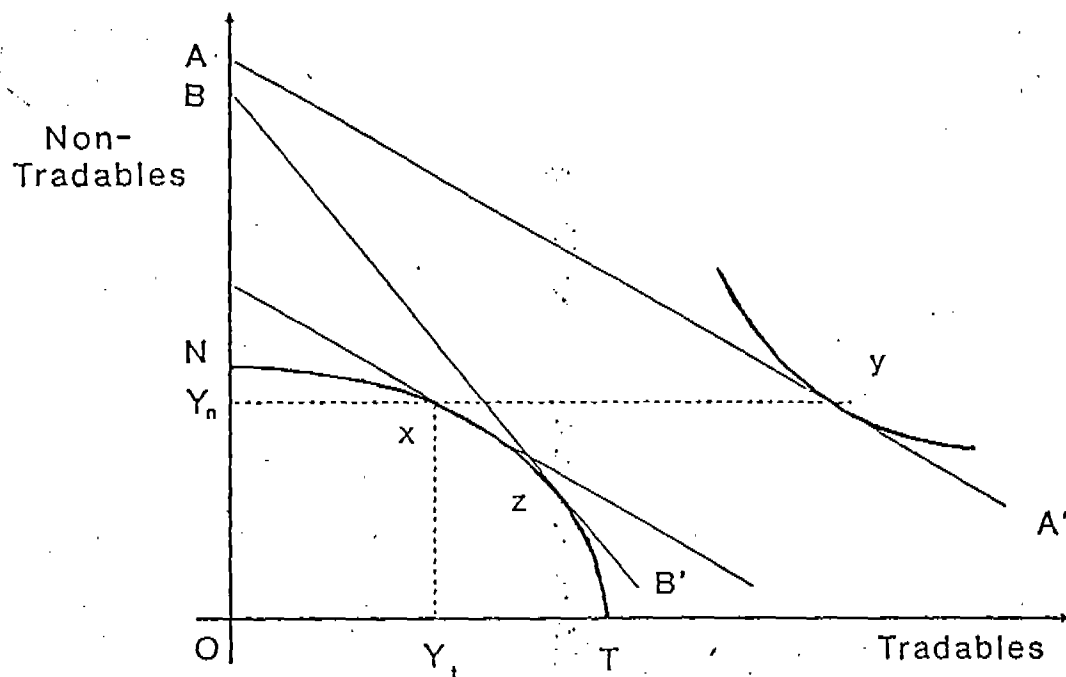


Figure 1
Macroeconomic Impact of Adjustment
Policies with Flexible NT Price

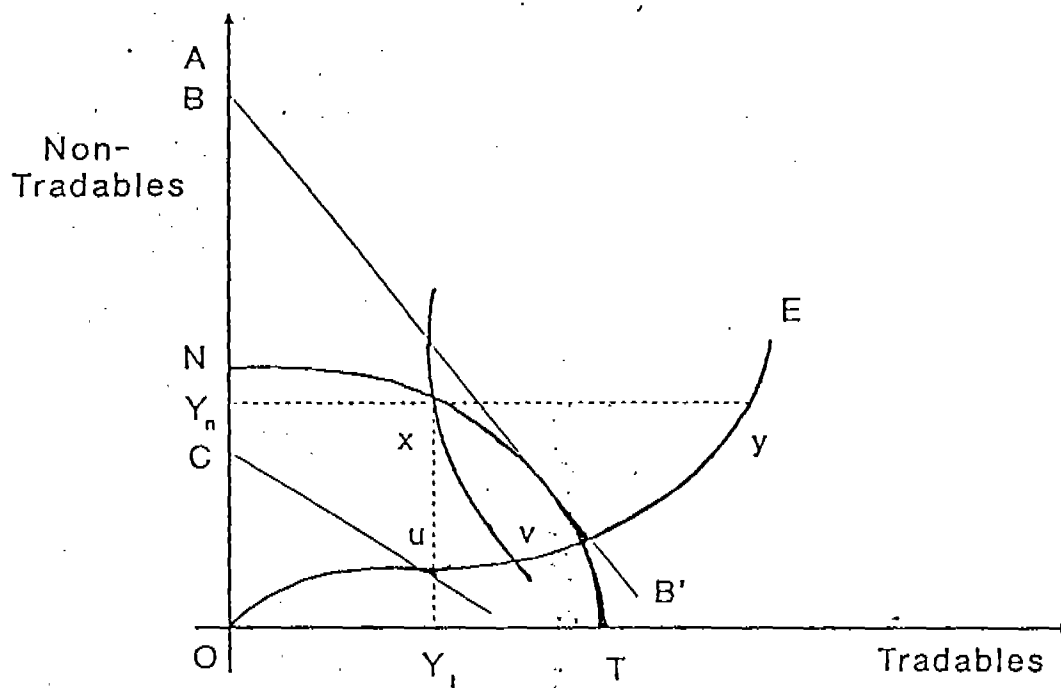


Figure 2
Macroeconomic Impact of Adjustment
Policies with Fixed NT Price

Source: Addison and Demery, 1985.

Given expenditure at y , the monetary and fiscal expansion leads to an internal balance (since NT demand is equal to supply), but at a trade deficit equal to xy . This trade deficit can be eliminated by reducing the level of aggregate expenditure or absorption if the price of NT is fully flexible and a combination of disabsorption and devaluation, if the price of NT is inflexible downward.

1. Adjustment with a flexible NT price

Reducing the level of aggregate expenditure or absorption creates an excess supply of non-traded goods, resulting in a fall in their prices and a devaluation of the real exchange rate or an increase in P_T/P_N . This then leads to switching of production from non-traded goods into traded goods. As shown in Figure 1, real absorption is cut back to OB and the real exchange rate to BB', with internal and external balances restored at z . The general price level falls since the price of traded goods is unchanged while the price of non-traded goods has fallen.

The stabilization process can be either due to an "automatic" response mechanism or to discretionary policy intervention. With the automatic response, the loss of foreign exchange caused by the trade deficit will lead to a decline in the domestic money supply, assuming that authorities do not "sterilize" this effect. This leads to a reduction in expenditures and a decline in P_N . With the policy intervention, the decline in absorption may not only involve a decline in money supply to limit private-sector expenditure but also fiscal contraction which may include either an increase in taxes or reductions in government spending.

2. Adjustment with a non-flexible NT price

In this situation, the change in the real exchange rate is effected through an increase in the price of T rather than a fall in the price of NT. With the devaluation, the general price level increases since the price of T goods rises in domestic currency and NT prices remain fixed. If there is no devaluation and P_N remains fixed, the absorption must be reduced to OC to have external balance (Figure 2). At point u , external balance is achieved at the cost of the internal balance, with the excess supply of NT equal to ux . It therefore requires a greater reduction in expenditures to achieve external balance when there is excess supply of NT goods than the reduction needed when accompanied by a devaluation. With inflexible NT prices, stabilization requires a combination of absorption and exchange-rate changes.

3. Monetary and fiscal restraint

A tight monetary program is adopted by the government to ease inflationary pressures. For any given BOP deficit, a sufficient contraction of the money stock will restore external balance. The underlying reason for this is that since monetary contraction raises interest rates and reduces spending, a contraction in economic activities ensues, thereby resulting in a decline in income and therefore a decline in imports. As shown by the Dependent Economy model, monetary and fiscal restraint can achieve internal and external equilibrium at z if prices are flexible (Figure 1).

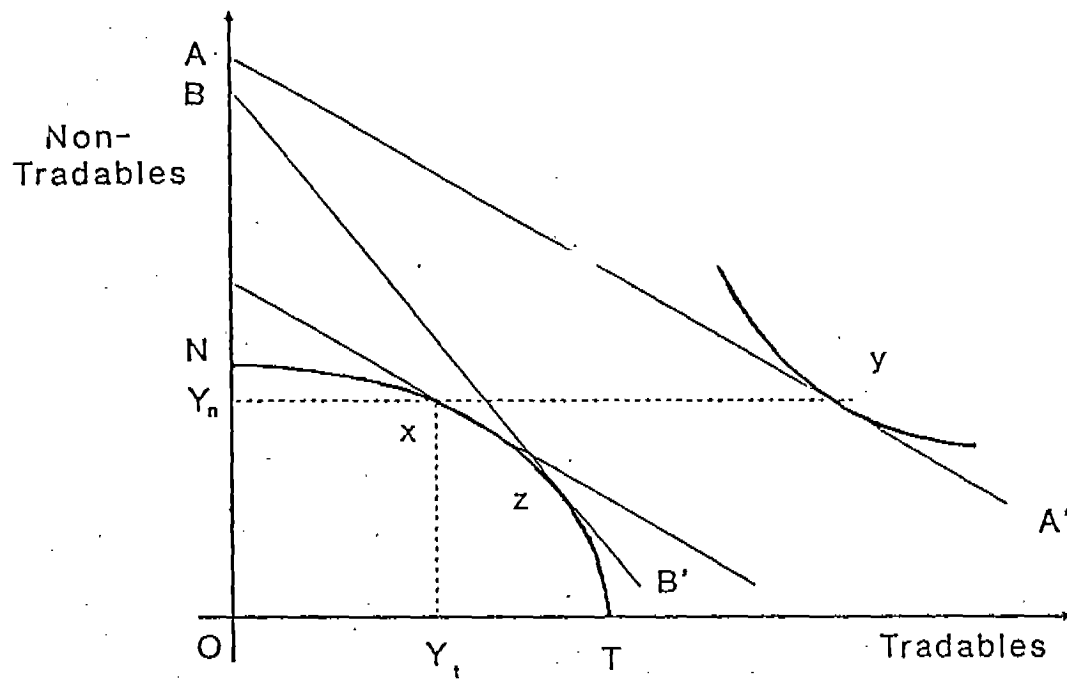


Figure 1
Macroeconomic Impact of Adjustment
Policies with Flexible NT Price

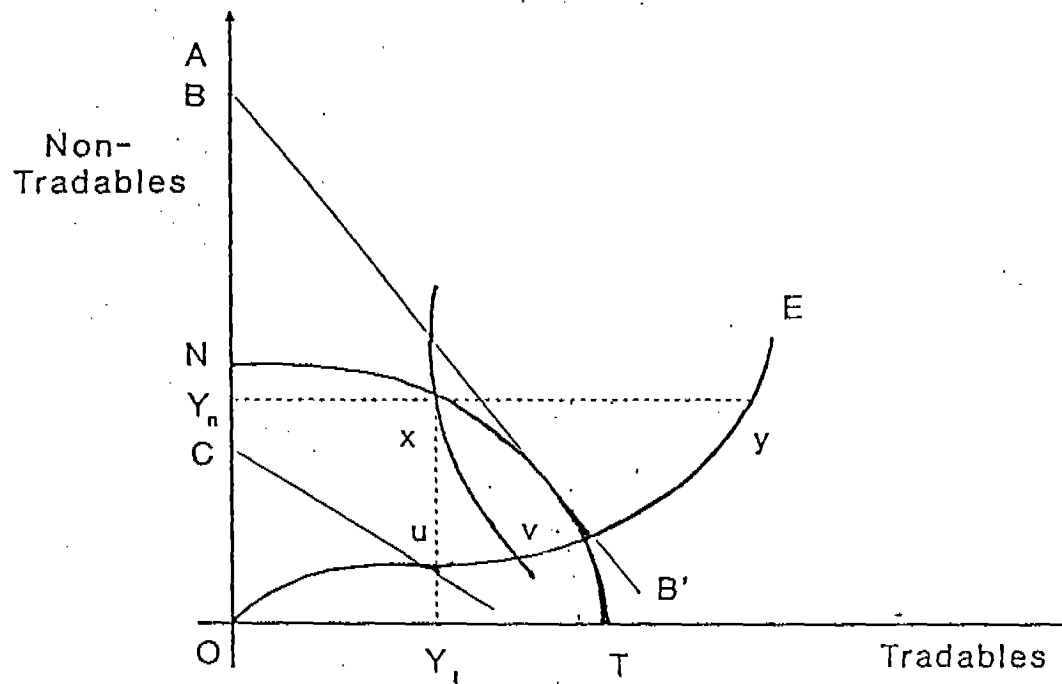


Figure 2
Macroeconomic Impact of Adjustment
Policies with Fixed NT Price

Source: Addison and Demery, 1985.

Financial reforms are likewise implemented to increase savings and to ensure their efficient use. Interest-rate ceilings are usually removed to achieve positive interest rates and regulations are usually abolished.

Studies which correlate monetary restraint with output contraction show mixed results. These cases are, however, limited by the highly aggregative nature of the studies. It was observed that it is only through the specification and estimation of the mechanisms and the intermediate variables (mainly through investment) that monetary restraint affects output. Khan and Knight (1985) examined cases on the relationship between monetary policy and investment and noted that there is a significant effect on the private capital formation.

A model was likewise developed by Taylor (1983) in which monetary restraint, associated with increased interest rates drives up the cost of loans on working capital and investment. Firms then tend to raise prices and reduce activity. The contraction in aggregate supply can exceed the reduction in aggregate demand (generated by monetary contraction), resulting in an increase in the level of excess demand in the product market.

4. Devaluation

Devaluation has generated such controversy owing to two broad areas of concern:

- 1) the effectiveness and appropriateness of devaluation; and
- 2) the politically destabilizing effects of devaluation which are closely related to income-distribution changes.

Demery and Addison (1987) contend that the presence of two effects may determine whether or not devaluation will improve the current account. These two effects are:

- 1) expenditure-switching brought about by the change in the relative price of traded to non-traded goods; and
- 2) expenditure reduction which has been shown to be a direct result of devaluation.

Foxley (1983) notes that conventional theory predicts that devaluation will help reduce the BOP deficit since it improves the relative price of traded *vis-à-vis* non-traded goods, thereby shifting services toward exports or import-substituting activities. At the same time, there will be an excess demand for the relatively cheaper non-traded goods which will result in an increase in the price of domestic goods. With such inflationary effects, real wages may fall constraining consumption and reducing aggregate demand (absorption). Such a reduction in aggregate demand may dominate any improvement that might have been achieved in the trade balance. The net effect in the economy therefore, will be recessionary.

Ahluwalia and Lysy (1981) support this view with the contention that exports may not sufficiently respond to devaluation. They note that in many developing economies, exports are primary commodities whose supply is rigidly limited in the short-run by sector-specific capital,

such as the number of rubber trees, or are otherwise characterized by low income and price elasticities of demand. Moreover, imports in these countries are the minimal necessary raw materials or capital goods with which no domestic industry can hope to compete. Production may then be depressed as a result of higher import costs for industries.

B. *Model Specification*

To capture the effects of stabilization policies using a macroeconometric model, the following broad principles must be considered:

- 1) the specification of the economic sector (e.g., financial sector) such that the appropriate policy variables are present;
- 2) the specification of proper linkages among the various sectors that allows the effects of policy to be transmitted in a reasonable manner; and
- 3) adherence to a consistent theoretical framework in order that results of policy simulations may be interpreted accurately.

The discussion in the previous section on the adjustment process involved in stabilization policies readily gives rise to the appropriate policy variables that must be made explicit in each sector of the economy.

In the case of the financial sector, policy tools must be present that allow the monetary authorities to influence the level of money supply and the interest rate. A useful framework is the reserve-multiplier approach to determine money supply. If TL is total domestic liquidity, defined as the sum of currency, total deposits and deposit substitutes, m is the money multiplier and MB is the monetary base, then

$$TL = m \cdot MB$$

The money multiplier can be expressed as a function of the currency deposit ratio (CU/TD) and the ratio of total reserves to total deposits (RES/TD)

$$m = (1 + CU/TD)/(CU/TD + RES/TD)$$

while the monetary base defined from the sources side is the sum of net foreign assets and net domestic assets

$$MB = NFA + NDA.$$

The reserves-deposit ratio is determined by the reserve-requirement ratio which is a policy instrument of the Bangko Sentral. The level of net domestic assets likewise depends on the policy stance of the BSP. For example, in order to tighten money supply, the BSP can reduce credit to deposit money banks, which is a component of NDA.

The fiscal sector generally centers on the determination of the national government's budget deficit and the identification of the different ways by which the deficit can be financed. Government expenditures and the tax rate are considered to be the major policy tools. A useful concept to deal with is the financeable deficit (Anand and Van Wijnbergen 1989) which is defined as the deficit that does not require more financing that is compatible with sustainable external and internal borrowing and with existing targets for inflation and output growth. This will ensure consistency between macroeconomic targets and stabilization policy.

In order to understand the relationship between fiscal deficits and other key macroeconomic variables, and to assess whether a deficit is financeable, we can use the following relation:

$$D + iB + i^*B^*E = \dot{B} + \dot{B}^*E + \dot{DC}_g$$

The left-hand side of the equation lists the expenses of the public sector (net of taxes): its noninterest deficit, D , plus nominal interest payments on domestic and foreign debt. The variable i (i^*) is the nominal domestic (foreign) interest rate on domestic (foreign) debt B (B^*). E is the nominal exchange rate. These expenses are covered (on the right-hand side) by the issue of domestic or foreign debt, plus central-bank advances to the public sector, the stock of which equals DC_g (with "." indicating change in the value of the variable). The non-interest deficit, D , and the interest payments should include the obligations of all government entities: national government, LGUs, and public corporations.

To incorporate the Bangko Sentral into the accounting identity above, central-bank profits need to be subtracted from the deficit and its increase in net worth (NW) from the public sector's increase in liabilities (sources of financing). This would yield the following modification:

$$D + iB + i^*(B^* - NFA^*)E = \dot{B} + \dot{B}^*E + \dot{DC}_g - \dot{NW}$$

By further manipulation which entails consolidation of all balance sheets the following equation is derived:

$$D + iB + i^*(B^* - NFA^*)E = \dot{B} + (\dot{B}^* - \dot{NFA}^*)E + \dot{M}$$

where M is base money (equivalent to MB above)

The analysis can be further extended, in particular by expressing the public-sector deficit identity in real terms; but for our purposes the last equation is adequate. The government budget constraint, which links deficits to sources of financing, can be used to evaluate the consistency between fiscal deficits and other macroeconomic targets. Fiscal deficits can be financed in three

ways: through the issue of external or internal interest-bearing debt, or through monetary financing. Macroeconomic targets, such as the inflation rate, external debt, and GNP growth, however, imply restrictions on each of these financing methods. These restrictions add up to a total financeable deficit; if the actual deficit exceeds that financeable deficit, one of the nonfiscal targets will have to be abandoned or fiscal policy will need to be adjusted.

If the effects of a currency devaluation are to be determined, the exchange rate is specified to be exogenous in the macroeconomic model. Endogenizing the exchange rate is an alternative that can be adopted if the effects of monetary policy and fiscal policy on the exchange rate are to be evaluated. The majority of exchange-rate models are based on the open-arbitrage condition which simply postulates that assets will move to maximize the expected value of the stock of assets. This formulation, however, implies that funds will continue to flow across exchange markets until the interest-rate differential is eliminated. A slightly more general approach is to model the determination of equilibrium asset stock associated with a given interest-rate differential. This is derived by introducing the effect of risk in the maximization of expected returns on the asset and is justified since uncertainty drives a wedge into the open-arbitrage condition.

Hall (1987) specifies such a model for the exchange rate and makes adjustments to overcome certain limitations. First, he includes a lagged exchange-rate variable based on the government's objective of guarding against abrupt fluctuations in the exchange rate. Second, he adds the current-account balance as a determinant of the exchange rate. The inclusion of this variable accounts for the smooth historical trend of exchange-rate data which is not consistent with the possibility of large jumps due to expectations about future interest rates.

A real depreciation will, *ceteris paribus*, increase the ratio of foreign debt to GNP and restrict external financing if the debt-output level is to be maintained at a particular level. This link, which can be gleaned from the fiscal-deficit identity above, points to a potential conflict between fiscal retrenchment and increasing external competitiveness through exchange-rate depreciation in the presence of a substantial foreign debt. This relationship must be considered when incorporating exchange-rate adjustment in stabilization policy.

The standard procedure is to model the effects of the exchange rate on the trade balance. Import demand is usually specified as a function of import prices, which is the dollar import price converted to its equivalent peso level using the exchange rate, relative to domestic prices. A similar procedure is followed for exports although the relative price variable is interpreted as a supply incentive.

The various transmission mechanisms are integrated in the real sector of the economy. Credit variables which reflect the degree of tightness of monetary policy should be specified as determinants of supply variables. If credit rationing is not the prevailing condition, the interest rate should appear instead. The import price level is also an important determinant of the level of supply since the Philippines is highly dependent on imported inputs. Other standard explanatory variables are own-price, tax rates, and the wage rate.

The expenditure sector is generally divided into consumption and investment. The public-sector component of consumption, which is the transmission mechanism from the fiscal sector, is usually taken to be a policy variable and, hence, exogenous to the model. Another linkage from the fiscal sector to the real sector is the amount of tax revenues which enters into the consumption function via the level of disposable income.

Perhaps investment spending is the most crucial variable to model since it is the key to future economic growth and stabilization policy is largely aimed at improving the investment climate. For developing countries, the usual method followed in specifying the investment function is to modify standard approaches established for industrialized countries which usually include the following: accelerator elements based on aggregate demand changes; the existing capital stock (usually captured by lagged private investment); user cost of capital or interest rate; financing variables such as cash flow or credit levels; and variables reflecting business conditions such as capacity utilization or inflation.

The special conditions of developing countries are then captured by adding variables to a standard private investment equation in an ad hoc manner. Three aspects have received particular attention:

- 1) the interaction between public and private investment;
- 2) the foreign exchange constraint;
- 3) the role of international variables in modelling private investment risks.

It may be hypothesized that crowding out is occurring because of the following:

- 1) public investment displaces private investors from profitable project opportunities;
- 2) domestic funding of public investment by bond issues reduces credit supply to the private sector;
- 3) funding by monetary expansion causes inflation and business uncertainty; and
- 4) funding by external debt increases the perceived risk by foreign and domestic investors.

It is hypothesized that crowding-in is a longer-term effect and that infrastructure provision accomplishes the following:

- 1) increases the profitability of those private sector activities directly affected;
- 2) leads to faster aggregate output growth;
- 3) increases exports, providing foreign exchange for capital goods imports;
- 4) increases exports, providing foreign exchange for capital goods imports; and
- 5) generates increased private savings rates as real incomes rise.

Stabilization policy has mixed effects on investment depending on which variables appear as determinants and the actual values of the coefficients.

The idea behind the foreign-exchange constraint is that investment is affected by an economy's import capacity since capital goods are generally source from abroad. Fitzgerald, *et al.* (1993) provide a theoretical framework based on the standard accelerator model that can incorporate an import constraint. Their framework was prompted by the relatively poor recovery

of private investment in developing countries undergoing structural adjustment programs. They argue that the misplaced optimism of policymakers may be based on an underestimation of the influence of external-sector imbalances on domestic private investment..

IV. MACROECONOMETRIC MODELS IN THE PHILIPPINES

A. *A Brief Review*

Three articles provide an adequate review of the structure and application of macroeconomic models in the Philippines up to 1988: Velasco (1980), Montes (1986) and Bautista (1988). This review focuses on macroeconomic modelling efforts from 1989 and deals only with those which have been circulated to the public.

The center of modelling efforts shifted in the mid-1980s to the Philippine Institute for Development Studies with the development of the *PIDS-NEDA Annual Macroeconomic Model*. Begun in 1985 as a joint effort by PIDS and the National Economic Development Authority, the model aimed to aid government economic planners in arriving at annual and medium-term economic forecasts and targets and in assessing the implications of various policy options.

Of those options, the impact of the country's economic adjustment program, which is usually formulated in connection with the country's use of a funding facility from the International Monetary Fund (IMF), necessitated a model which could accommodate the analysis of stabilization policy. The first version of the model arose in 1985, consisted of 73 equations and accommodated all those options (Constantino and Mariano 1987). Since then there were two major revisions, one in 1989 and one beginning in 1992 and continuing today (Reyes and Yap 1993). The latest effort stems mainly from the change in the base year of the National Income Accounts from 1972 to 1985.

In previous versions of the PIDS-NEDA model, the level of total liquidity was determined based on the reserve-multiplier concept of money supply, readily capturing the effect of monetary policy. With recent financial-sector data, however, it has become increasingly difficult to arrive at reasonable equations for the components of monetary base; moreover, the forecasting ability of the model suffers greatly when using this approach to determine money supply. The reserve-multiplier concept was, therefore, dropped in favor of a more straightforward money-demand function. It has been proposed that two models be maintained, one for forecasting purposes which contains the latter specification, and one for policy analysis which has explicit monetary-policy tools.

The fiscal sector is specified along standard lines with expenditure components exogenous to the model. In the government budget constraint, commercial-bank financing of the deficit is taken as the residual component, which in turn feeds into the interest-rate equation. This accounts for potential crowding-out effects of deficit spending. Interest payments on both

domestic and foreign debt, however, are also specified as exogenous and hence the link between a currency devaluation and the fiscal deficit is lacking.

The exchange rate was exogenous in past versions of the model. With the liberalization of regulations governing transactions in foreign exchange, it has become imperative to attempt to model exchange-rate behavior. An equation along the lines of the Hall model was estimated with mild success. The exchange rate then feeds into a general price equation, export equations as a supply incentive variable, and also import-demand equations through the import-price index.

Output in the PIDS-NEDA model is determined from the production side but is reconciled with the expenditure sector via adjustments in the statistical discrepancy, a procedure that follows the practice in the National Income Accounts. Credit constraints and government capital outlays appear as determinants in the various supply functions, but it is the price variable that dominates the production sector. The general price variable (the wholesale price index), which is an explanatory variable in the majority of sectoral price equations, is specified in mark-up over cost fashion and has the wage rate, import price, growth in capital stock and an excess liquidity variable as determinants. Stabilization policy affects the production sector primarily through these variables.

The expenditure sector is likewise specified along standard lines. The investment equations include the following explanatory variables:

- 1) the level of imports which captures the foreign exchange constraint;
- 2) the real interest rate which confirms the crowding-out phenomenon;
- 3) the inflation rate reflecting the effect on business uncertainty; and
- 4) government investment, in order to account for possible crowding-in effects.

A model where output is completely determined from the supply side is that of Lim (1992). The monetary and fiscal sectors of his model are highly simplified, consisting mainly of bridge equations, since the main objective of the study is to assess the impact of changes in the exchange rate.

Among the components of the consolidated public sector deficit (CPSD) only the national government deficit is endogenous, being equal to the product of a predetermined deficit-to-GDP ratio and nominal GDP. The past value of CPSD then determines the amount of domestic debt service which, together with government payments for foreign debt, appears in the government budget constraint. The latter is used to determine "fiscal savings" which then feeds into the government investment equation. Lim's model has the added advantage of being able to capture the effect of a devaluation on debt service payments.

CPSD is also a determinant of monetary base which in turn is related to total liquidity via a behavioral equation. Monetary policy instruments are notably lacking in this model. Total liquidity functions as a credit constraint in the equation for private investment. Following the supply-side structure of the model, capital formation does not affect the level of current output but its future time path through the build-up of capital stock.

A novel feature of the Lim model is the use of gross international reserves instead of the exchange rate in the supply function. He argues that inasmuch as the exchange rate is restricted due to Central Bank interventions, the actual exchange rate does not capture the shadow price of foreign exchange and fails to measure the scarcity of foreign exchange. It captures only the relative cost of imports for privileged agents with access to rationed foreign exchange traded at the lower exchange rate. A drawback of this specification is that a simulation of a stabilization policy that aims to curtail imports to shore up foreign-exchange reserves may result in a positive impact on output. This, of course, is a perverse outcome since the import elasticity of supply in the Philippines is quite high and a reduction in our import capacity is generally contractionary.

A rather compact macroeconometric model is that of Bautista (1993). The equations of his model are directly derived from a standard IS-LM model, determine the model demand and providing it with a firm theoretical basis. The price equation appears as an inverted supply function. As in the case of the Lim model, the choices of policy instruments are limited, there being only the level of government spending, the exchange rate and money supply (which has to be exogenized in policy simulation). The model assumes only monetization of the fiscal deficit and hence the alternative methods of deficit financing cannot be evaluated in the model.

A disequilibrium model was attempted recently by Reyes (1993) using the PIDS-NEDA model as a basis. This generalizes the production sector since, in the standard version, specific sectors were identified as either being market clearing, where demand is equated to supply in order to determine value added, or fixprice, where value added is equal to demand. Sectoral demand and supply functions were estimated using the method of Fair and Jaffee which is a two-stage least-squares procedure. Alternative estimates using maximum likelihood with sample separation were also obtained. However, this model is theoretically unsound in that it does not take into account spillover effects across markets. However, it would be almost impossible to estimate the disequilibrium model without this simplifying assumption.

B. *Some Simulation Results*

Validation procedures require that the models be used for multiplier analysis in order to test whether the effects of changes in exogenous variables are reasonable in terms of magnitude and direction. This section will also give a flavor of potential effects of stabilization policy.

A devaluation of the peso is contractionary in the PIDS-NEDA model even if the anticipated improvement in the trade balance materializes. This result stems from the strong exchange-rate pass through that is present in the model. Among the explanatory variables in the general price equation, the import-price index has the highest estimated elasticity, suggesting that in order for a devaluation to have beneficial effects, the following reforms should be implemented:

- 1) reduction of the import elasticity of production especially in the export sector; and
- 2) elimination or reduction of the oligopolistic structure of the industry sector in order to mitigate the exchange-rate pass through.

The model of Lim yields a completely different result because a devaluation increases the level of gross international reserves via an improvement in the trade balance. In this exercise, the exchange rate is equated to the Devarajan measure of the desired level. The equation for this measure shows that the growth rate of the exchange rate should exceed the growth rate for the price for domestic goods in order to correct for the world price changes, for changes in the terms of trade, and for changes in the trade balance.

Bautista only presents the simulation results of a relaxation of the fiscal constraint. Since an increase in the budget deficit is automatically financed by money creation, output expansion is accompanied by an increase in the inflation rate and a decline in the interest rate. The latter result shows that the liquidity effect dominates the potential Fisher effect.

The PIDS-NEDA model was applied to analyze alternatives to overcome the fiscal bind of the economy (Yap and Reyes 1993). The results show that an increase in capital outlays accompanied by an increase in revenues has the largest impact in increasing output. Deficit financing via an increase in government domestic borrowing, while having a positive impact in the short-run, has long-term adverse effects. Another potential source of financing for investment spending is the reallocation of resources away from government consumption spending towards infrastructure. Of course, the political consequences of such a move are not captured in the model.

V. STABILIZATION POLICY AND INCOME DISTRIBUTION²

A. *Microeconomic Effects of Stabilization Policy*

Broadly, structural adjustment policies affect household welfare by changing income levels, employment status, returns to production factors owned by households, relative prices of goods and services and, particularly relevant to low-income groups, transfers and government expenditures on social services. The magnitude and direction of impact depend largely on the nature and composition of household income and assets (e.g., land/rent or wages/salaries), the breakdown of government expenditures and revenues (among and within the social sectors), the intra-household distribution of production/income-generation and consumption (husband-wife employment, male-female food consumption, etc.), and the ability of the household to substitute items and activities in response to income and price changes.

Figure 3 depicts a general framework for analyzing the impact of economic adjustment policies on income distribution. The macroeconomy determines the aggregate supply and demand of goods and services, the overall price and employment levels, and the aggregate balance of trade in goods and services and international financial flows with the rest of the world. The interface between the macroeconomy and household level can be described as a Stolper-

2. This section is drawn from Yap, *et al.* (1993).

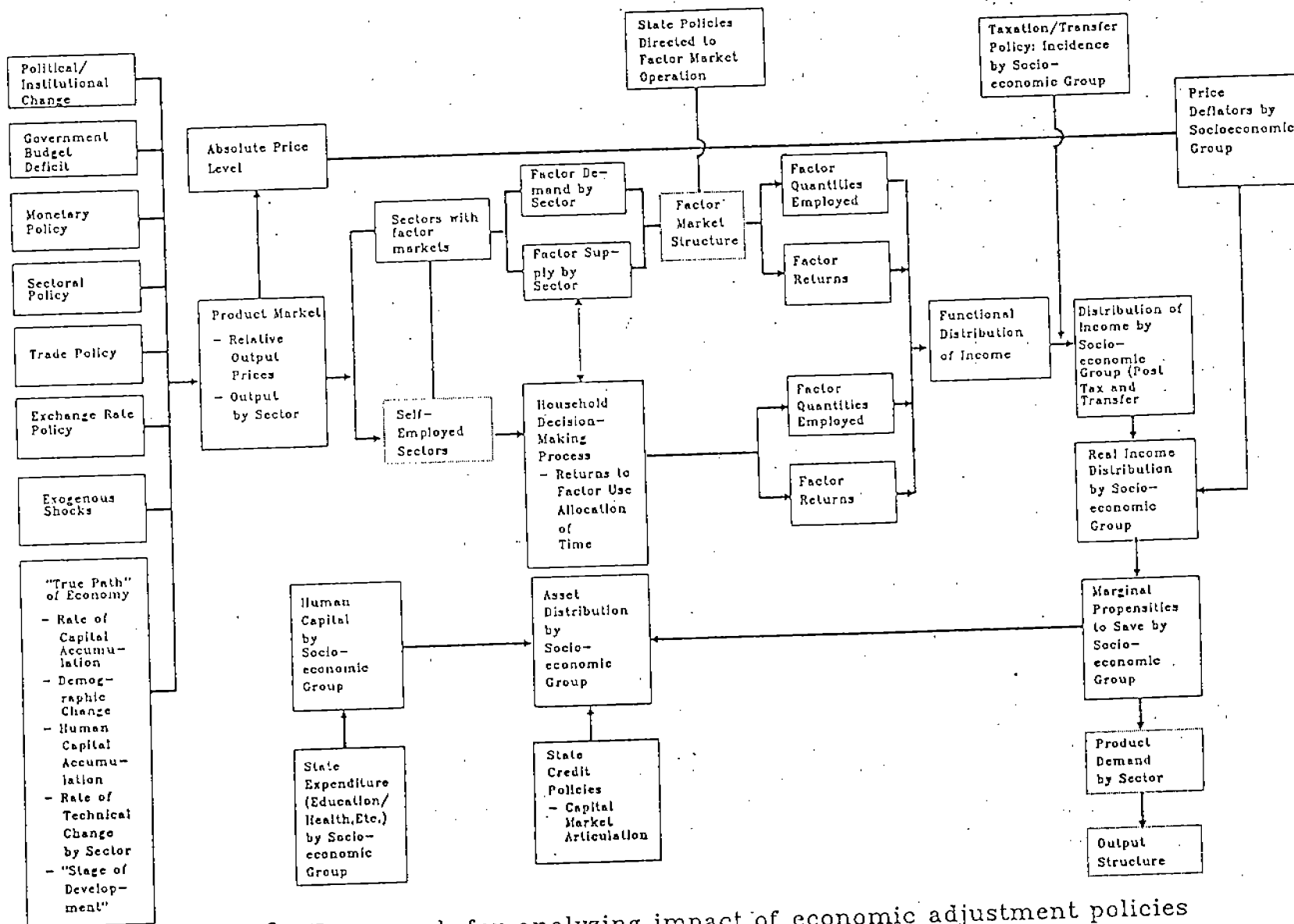


Figure 3. Framework for analyzing impact of economic adjustment policies on income distribution.

Source: Behrman (1988). Reprinted from Addison and Demery, "Macroeconomic Stabilization, Income Distribution and Poverty: a Preliminary Survey" London: Overseas Development Institute, 1985, p.35.

Samuelson setting where output, relative and general price levels affect sectoral factor demand and supply, factor quantities employed, factor returns and the functional distribution of income. The stipulated ownership and access to the various productive factors then determine the size distribution of income.

A similar framework was presented by Dagum (1978) wherein the process of production and distribution is modelled as a sequential game. In this structure, the human and physical capital variables are the most relevant among the variables that contribute to the explanation and determination of the level of income of each economic agent. What is relevant for our analysis are the macroeconomic variables or forces accounting for the levels, composition, and distribution of human and physical capital. The list should include the rate of economic growth, per capita income of the population, the educational system, economic institutions (e.g., financial system and tax structure), social institutions (e.g., health care system and social security system), investment in research and development, investment in social infrastructure, and natural resource endowment. Most of these variables are represented in Figure 3.

B. *The Time Series Approach*

The studies presented in this section examine actual changes in the size distribution of income and attempt to relate these changes to those in macroeconomic conditions. I focus on the time-series approach because of the nature of the data that is used to estimate the econometric models. Nolan (1988) argues that the time-series approach presents the difficulty that the observed changes in the size distribution are the net result of many different factors, structural as well as macroeconomic, probably working in different directions. Data problems are also serious: the time-series data on the size distribution may not be consistent over time or sufficiently reliable for changes from one year to the next to bear the weight of analysis. In the case of the Philippines, it is the availability or, more accurately, the non-availability, of an extended time series on income distribution that constrains the methods that can be used in the study.

Schultz (1969) began the econometric analysis of the interaction between the macroeconomy and income distribution, estimating an equation relating the inequality in the distribution as measured by the Gini coefficient to variables such as inflation, unemployment, the growth rate, and time trend. Because of the aggregate nature and relative stability of this inequality measure, some authors questioned the use of this type of specification. In subsequent work a particular functional form was fitted to the distribution and changes over time in the parameters of this form were related to macroeconomic variables.

1. Metcalf's study

Metcalf's study (1972), for example, fits a displaced lognormal distribution using US income data. This probability distribution has at least two favorable properties. First, a transformation of the normal distribution which possesses the desired degree of skewness may be fit to the data, unlike the two-parameter lognormal distribution. Second, the degree of

skewness in the distribution may vary over time, independently of changes in the variance of the distribution. Three dimensions are available not only to describe the distribution at a point in time, but also to register its movements over time.

Thus, if y is income and exhibits a certain degree of skewness, $\log(y + c)$ is assumed to follow a lognormal distribution, where c is the constant of displacement, and $c > 0$. The lognormal distribution would thus be characterized by three parameters: its mean, μ , its standard deviation, σ , and the displacement parameter c .

Suppose the median is observed at d and the cutoffs of the lower and upper deciles are at $h \cdot d$ and $j \cdot d$ respectively. From the assumption of normality of the transformed distribution, we have:

$$\frac{\log[(d+c)/(hd+c)]}{\sigma} = \frac{\log[(jd+c)/(d+c)]}{\sigma} = g.$$

Then $c/d = (hj-1)/(2-h-j)$. The constant of displacement as a proportion of the median is a simple observable function of the two quantile cutoffs, expressed as proportions of the median. Given c , μ and σ can be solved for by substitution, where g is observable from the standard normal table:

$$\mu = \log(d+c)$$

$$\sigma = \frac{\log[(d+c)/(hd+c)]}{g} = \frac{\log[(jd+c)/(d+c)]}{g}$$

A displaced lognormal distribution with parameters estimated in the above manner will be consistent with the observed data, in the sense that the estimated cumulative distribution will have zero error at the three chosen quantiles. Any three quantiles may be chosen as the points at which the estimated distribution has zero cumulative error; the median need not be one of them. A simple solution exists as long as the second of the three points is midway between the other two measured in standard deviation units (under the hypothesis of normality).

To summarize, the major point of this exposition is that given the parameters c , d , h , j , μ , σ , one has to determine just three of them in order to specify the actual distribution.

Metcalf examines different subgroups of the population rather than the aggregate population. He then specifies econometric equations for the mean, the lower decile and the upper decile of each distribution. He is quite fortunate to have annual data for each distribution.

For example, one group consists of households classified as either MWL (male head, wife in labor force) or MWN (male head, wife not in labor force). Thus a total of six equations will have to be specified for both these groups. We list the equations for the MWL group.

$$BMWL = (a_1 + a_2T + a_3PAR1) \cdot W \cdot E + a_4UBR \cdot U + a_5Y_{TR} + a_6(Y_{ID} + Y_0) + u.$$

$$HML = [(b_1 + b_2U) \cdot UBR + (b_3 + b_4T + b_5PAR1) \cdot W \cdot (b_6 + b_7E) + b_8Y_{TR} + b_9(Y_{ID} + Y_0)] / BMWL + u.$$

$$JMWL = c_1PROF + [(c_2 + c_3T + c_4 \cdot CWEN + c_5PAR1) \cdot W \cdot E + c_6Y_{TR} + c_7Y_{ID}] / BMWL + u.$$

The definition of variables is as follows:

BMWL - mean income;

HML - income below which 10 percent of families lie, divided by the group median;

JMWL - income above which 10 percent of families lie, divided by the group median;

PAR1 - number of families in MWL group as proportion of number of families in MWL and MWN groups combined;

W - private wage and salary disbursements per private wage and salary employee (constant prices);

E - employment rate;

UBR - unemployed benefits per unemployed person;

U - unemployment rate;

Y_{TR} - government transfer payments per capita, excluding unemployment benefits;

Y_0 - other income per capita;

PROF - corporate profits and capital consumption allowance as a share of gross private product;

CWEN - rate of change of nominal wage;

T - time trend.

Given estimates of these three variables, appropriate identities are then specified for the other parameters of the lognormal distribution. We can write, for example:

$$GPV_i = \left[\log \left[\frac{YPV_i + C_i}{N_i + C_i} \right] \right] / \sigma_i$$

where C_i is the constant of displacement (derived from an identity), N_i is the median (also derived from an identity related to the estimated mean), YPV_i is the income level and GPV_i is a point on the cumulative distribution measured in deviation units. If YPV_i is a poverty threshold for the group, the above equation will provide a standard deviation measure which defines an estimate of the incidence of poverty in the group.

Another advantage of the specification adopted by Metcalf is the ready economic interpretation of the distribution parameters which appear as dependent variables, facilitating the choice of right hand side variables. Metcalf deals solely with income variables. The specification of explanatory variables that follows is quite straightforward.

2. Beach: the indirect quantile approach

Beach (1976, 1977) and Blinder and Esaki (1978) avoid the imposition of a particular functional form on the distribution. Beach employs an "indirect quantile approach" wherein a distribution is characterized by a set of quantile income levels which are then related to corresponding fluctuations in macroeconomic activity via a set of specified reduced-form equations. Changes in economic aggregates affect inequality only indirectly (as contrasted to the methodology of Schultz) via their impacts on a set of income quantiles.

In his specification of the model, Beach assumes the individual rather than the family to be the basic income-receiving unit in order to avoid complications associated with changing compositions and cyclical fluctuations in the number of family units. For empirical convenience, the quantiles analyzed are nine deciles. Thus $y(i)$ represents the gross money income of individuals at the i^{th} decile position in the income distribution, and can be decomposed into several components according to the income source:

$$y(i) = YE(i) + YU(i) + YPF(i) + YTR(i) + YTP(i) + v(i) \quad (1a)$$

where $YE(i)$ is income received from employment, $YU(i)$ average unemployment benefits received, $YPF(i)$ farm proprietary income, $YTR(i)$ and $YTP(i)$ relief transfers and pension transfers, and $v(i)$ a random term assumed to represent remaining minor sources of income. The first two labor income components can be further factored as

$$YE(i) = PR(i) \cdot ER(i) \cdot W(i)$$

and

$$YU(i) = PR(i) \cdot UR(i) \cdot UB(i) \quad (2a)$$

where $PR(i)$ is the decile's labor force participation rate; $ER(i) = 1 - UR(i)$ is its employment rate; $W(i)$, its wage and salary income per employed person at that decile point; and $UB(i)$, the decile's average unemployment benefits per unemployed person.

Upon adding an equation for the mean, μ , of the income distribution, one ends up with a set of ten income equations written in matrix form as

$$y(i) = x(i)\beta(i) + v(i) \quad i = 1, \dots, 9$$

$$\mu = x_\mu \beta_\mu + v_\mu \quad (3a)$$

where $y(i)$ and μ are column vectors of T observations each, $x(i)$ and x_μ matrices of observations on terms involving the independent variables PR , ER , W , YPF , YTR , etc., and $\beta(i)$ and β_μ conformable column vectors of coefficients derived from the linear substitutions made into (1a) and (2a).

Since the right-hand variables in (1a) and (2a) are generally unobserved, these are assumed to be nondecreasing linear functions of corresponding observed economic aggregates. Thus the x vector would contain twelve elements: ER , PR , $PR \cdot ER$, $ER \cdot W$, $PR \cdot W$, W , $PR \cdot ER \cdot W$, YPF , YTR , YTP , YK , and the constant term. In order to simplify and render feasible the estimation, *a priori* constraints specifying the beta coefficients on some of the labor income terms to be zero were imposed. The model thus consists of a set of 10 seemingly unrelated equations subject to a set of adding-up constraints, and was estimated for the income distribution of individual males from annual data over the period 1947-1973. Since autocorrelation and multicollinearity appeared significant in several of the equations, a constrained version of Parks's estimation procedure with multicollinearity adjustments was developed and used on the full set of equations so as to yield consistent and asymptotically efficient estimates.

3. Blinder and Esaki

Blinder and Esaki use a simpler framework, with the basic statistical model being

$$S_i(t) = \alpha_i + \beta_i U(t) + \tau_i \pi(t) + \delta_i T(t) + \epsilon_i(t)$$

where $S_i(t)$ is the share of the i^{th} quintile ($i = 1, \dots, 5$) in the distribution of income among US families in the t^{th} year ($t = 1947, \dots, 1974$), U the overall unemployment rate, π the rate of inflation as measured by the GNP deflator, and T a linear time trend beginning with 1 in 1947.

The time trend is included in the estimating equation in order to separate secular trends in the distribution data from cyclical influences although one must exercise caution in using a trend variable when the dependent variable is bounded either from below or above. Estimation of the equations was by ordinary least squares (OLS), which automatically imposes the cross-equation constraints

$$\sum \alpha_i = 1$$

$$\sum \beta_i = \sum \tau_i = \sum \delta_i = 0$$

$$\sum \epsilon_{it} = 0 \text{ for all } t.$$

The set of five equations for the quintile shares are in fact a set of "seemingly unrelated regressions" but the SURE estimation reduces to OLS when the right-hand side variables are the same in each equation. In addition to the quintile shares, Blinder and Esaki estimated an equation of the same form for the share of the top 5 percent of the families.

Although Beach and Blinder and Esaki do not situate their models in an economy-wide framework, it would be quite straightforward to do so. The latter model has the advantage of relating explicitly both inflation and unemployment to income-distribution variables while the former is specified in a manner similar to Metcalf where only unemployment is explicit. The aggregate income variables, however, could form the link between distribution of income and the macroeconomy as is the case with the Metcalf model.

In summarizing the results of the above-mentioned studies, Nolan notes that while Schultz failed to identify any significant influence of macroeconomic variables on the Gini coefficient for the US distribution, the more disaggregated studies did find such effects on the distribution time series. The most consistent result across these was the significant disequalizing effect of increases in unemployment, reducing the shares of lower groups. Results on the effect of inflation were much more limited and variable; Blinder and Esaki suggested that increases in the inflation rate might have an equalizing effect whereas Metcalf found an adverse effect on some lower groups.³

4. Blejer and Guerrero: An application to the Philippines

Application of these empirical methods to developing countries has been quite limited, most likely due to the paucity of relevant data. Blejer and Guerrero (1990) acknowledge this to be a "rather under-researched area" which is a cause for concern considering the severity of the macroeconomic stabilization programs that have been imposed on these countries. In their study of the Philippines they estimated an equation of the following form:

$$\begin{aligned} \log(S_L/S_H) = & C + \beta_1 \log p + \beta_2 U + \beta_3 \log E + \beta_4 \log g \\ & + \beta_5 r + \beta_6 \pi + \beta_7 t \end{aligned}$$

where S_L/S_H is the ratio between the family income pertaining to the lower deciles and the income of the higher deciles, expressed as a function of productivity (p), underemployment (U),

3. Nolan (1988), p. 6.

real government spending (g), the real exchange rate (E), the real rate of interest (r), and the rate of inflation (π), with a constant time trend.

In the actual estimation, S_L/S_H is calculated as the ratio of the share of income of the lowest three deciles of families to the share of income of the highest decile. The data for estimation covers the period 1980-1986 with quarterly data primarily obtained from the National Income Accounts and the Integrated Survey of Households (ISH). The results were used mainly to shed some light on the Philippine experience with the draconian stabilization program implemented in the latter part of 1983 lasting up to the early part of 1986.

The empirical results of Blejer and Guerrero show that underemployment and inflation are strongly regressive. The same is true for the level of government expenditure, reflecting the specific composition of public spending during the period. Productivity levels, the real interest rate, and the real exchange rate were found to be progressive instruments, since gains in these variables improved the relative income shares of the poor. However, these results should be interpreted with caution since there are trade-offs in targeting the explanatory variables. Policy trade-offs could be captured to a reasonable degree if the above equation could be situated in an economy-wide model.

There are also problems associated with ISH data specifically with regard to the extent of coverage and timing of income sources. Thus the dependent variable used by Blejer and Guerrero may be subject to gross measurement errors.

C. *The Simulation Type Approach*

This method was developed in order to overcome a major difficulty associated with time-series approaches -- distinguishing the effects of different macroeconomic factors, and separating the different macroeconomic influences (e.g., inflation and unemployment) from each other. The general procedure in the simulation approach is to take cross-section data on incomes of individuals/families for a particular year, usually from sample surveys, and examine the impact on the size distribution of macroeconomic policies which have specific effects on factor incomes. These effects are normally derived from time-series evidence on the behavior of macroeconomic aggregates, such as the behavior of aggregate income from particular sources as unemployment or inflation increase.

A particular application is with regard to the effect of the level of economic activity on factor and personal-income shares and ultimately income distribution. Nolan summarizes the process as: level of economic activity--> shares of factor incomes--> shares of income types in personal income--> shares of income types in household income--> distribution of household income among households.

The flow from the level of economic activity to shares of income types in household income is developed using a macroeconometric model based on National Income Accounts data. Following Nolan's methodology, the first step is to regress components of factor incomes on a

capacity-utilization index and a time trend. In his study, Nolan decomposes factor income into employment income, self-employment income, gross trading profits, and rents. These changes in factor income shares then lead to changes in the shares in total personal income made up of the different types of income from work and property going to persons, such as employment income, self-employment income, rent, interest and dividends. In addition, fluctuations in economic activity affect the various forms of transfer going to persons. Given the different categories of income, it is evident that in looking at the link between changes in factor income type shares and those in personal sector incomes, focus must be on the relationship between the factor incomes "profits" and "rent," and the personal component "rent, dividends, and interest."

A similar process is pursued in relating the personal-income sector to household income. The latter is composed of employment income (excluding employers' contributions), self-employment income, rent, gross interest and dividends (excluding imputed rent), pensions, and other current grants. The next step is to examine the effect of changes in income-type shares on the size distribution of personal income. This is done by simulating the impact of changes in the shares of income from different sources on the observed size distribution for a particular year, based on cross-section data on the income from different sources of individuals/families/households. Nolan uses the Family Expenditure Survey (FES) data for 1977 in his study of income distribution in England.

The effects of short-term shifts in the shares of income from different sources are then quantified using two different approaches. The first involves the use of the disaggregation of inequality measures by income source. This type of analysis has been applied by Fei, Ranis and Kuo (1978) and has been generalized by Kanbur (1987). The second involves simulating the effects of such shifts on the income of each recipient in the FES sample. Since we are assuming no changes in shares in the various sources of income due to structural changes in the economy, the analysis must be confined to the effects of short-term shifts in factor income. This is likewise a shortcoming, albeit an implicit one, of the time-series approach.

D. The Bourguignon, Branson, and de Melo Micro-Macro Model

Given the data constraints, the use of CGE models is a more practical approach. Analysis of income distribution in CGE models is considered an extension of the simulation type approach whereby econometric models are absent and the parameters of the model are largely derived from data obtained from a baseline period. The use of a pure CGE model would overcome the primary weakness of the time-series approach in the absence of any firm foundation in economic theory. At best the equations estimated by Metcalf, Beach, Blinder and Esaki, and Blejer and Guerrero can be viewed as reduced forms of an unspecified structural model.

The Bourguignon, Branson, and de Melo (1992) model provides a suitable framework to assess the microeconomic impact of structural adjustment policies. The model combines the explicit microeconomic optimizing behavior characteristic of computable general equilibrium models with asset portfolio behavior of macroeconomic models in Tobin's tradition.

The structure of the macroeconomic sector is similar to a standard IS-LM framework for an open economy. The microeconomic sector is then developed by disaggregating product and factor markets across socioeconomic (or household) groups. The link between the macroeconomy and microeconomy is established by mapping physical and human wealth (originating from factor incomes) across socioeconomic groups, showing that households receive incomes from several sources. In this model there are four main mechanisms by which policy changes affect the distribution of income and wealth. First, changes in factor rewards directly affect household income distribution. Second, household real incomes are affected by changes in their respective cost-of-living indexes. Third, household real incomes are affected by changes in real returns on financial assets since household incomes include income from financial holdings. Fourth, household wealth distribution is affected by capital gains and losses.

The authors claim that the distinctive characteristic of their simulation model is that it links the short-run impact of macroeconomic policies that affect the distribution of income through inflation, the interest rate and other price changes, with the more-often emphasized medium-run impacts of adjustment policies (i.e., incentive reforms) that affect the distribution of income through relative commodity and factor price changes. In the paper, though, the manner in which they account for medium- to long-run adjustment is by changing the values of certain exogenous variables and obtaining a "period equilibrium" by simulating the model. There are no shifts in the sense of a changing economic structure, which can be simulated by varying the parameters of the model.

An added advantage of the Bourguignon *et al.* model is its ability to handle a large number of different parametrizations and closures, among them the Walrasian regime. It is not clear in the discussion, however, how a market-clearing process in the microeconomic sector is consistent with disequilibrium in the macroeconomic sector. The ability to incorporate a Keynesian closure via mark-up pricing in a way solves this dilemma. As a matter of fact, the authors note that typically a mixture of the two closures is adopted with a Walrasian closure for agriculture and a Keynesian closure for manufacturing. In other words, the end result is still a pseudo-CGE model.

VI. KEY ISSUES AND FUTURE DIRECTIONS

Obviously there is no dearth of macroeconometric models for use in the analysis of stabilization policy. Improvement in the present crop of macroeconometric models lies in three general areas:

- 1) use of a more flexible approach in model specification that allows for less theoretical rigor as in the LSE approach;
- 2) experimentation with alternative estimation procedures, e.g., the Error Correction Model; and
- 3) a more explicit approach in modelling and estimating expectations variables.

For the MIMAP project the major limitation of macroeconomic models is the difficulty of incorporating an income-distribution bloc which will become the basis for the quantitative analysis of microeconomic issues. The solution is the availability of more time-series data on income distribution to ensure more rigorous estimation results. Since the solution lies in the future, the alternative is to rely on CGE models for this purpose. Of course, it is possible to combine the use of macroeconomic and CGE models with the former identifying the time path of key macroeconomic variables which will then be fed into the CGE model.

Perhaps the most practical approach given the current constraints is a modified version of the Bourguignon *et al.* model. This would entail the following process.

- 1) The macroeconomic component will be derived from any of the macroeconomic models reviewed in Section IV. One advantage of this approach over the straightforward CGE framework adopted by Bourguignon *et al.* is the ability to incorporate dynamics in the model. A more realistic adjustment process can then be traced.

- 2) A mapping procedure should be designed to relate output in various sectors to factor incomes. Ideally factor incomes should also be endogenous variables in the macroeconomic model but data limitations prevent the estimation of the relevant equations.

- 3) There should be a subsequent mapping from factor incomes to incomes of the identified households. A parallel mapping should be designed to relate macroeconomic outcomes to wealth distribution. Steps (2) and (3) are expected to be the most difficult and time consuming stages in the process.

Of course an inventory of the data requirements and available data should be undertaken before embarking on this effort. A rather conspicuous drawback of the procedure outlined above is the absence of a feedback mechanism from household income distribution to macroeconomic outcomes. Given the data constraints, however, and the ambitious goals of the project, this is a shortcoming that can be tolerated.

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