Philippine Review of Economics and Business
Volume XXX, No. 2, December 1993

"GETTING PRICES RIGHT", HOW IMPORTANT IS IT?: A CGE MODELING APPROACH

By Manuel S. Gaspay*

A dynamic computable general equilibrium (CGE) model of the Philippines, with alternative versions of fiscal policy behavior, is constructed to examine the neo-classical claim about the relationship between trade restrictions and economic performance. The results indicate that the economic output and income distribution influences of price distortion from tariffs are indeed modest. In the growth process, it is the government revenue role of tariffs that matters rather than the impact of tariffs on factor allocation efficiency. There must be consistency, therefore, between the government's fiscal policy and its trade liberalization program for the latter to be successfully implemented.

1. Introduction

This paper explores whether "getting prices right" can have a major impact on Philippine economic performance. Output growth and equity in income distribution are the two main gauges of economic performance examined.

"Getting prices right" refers to the call for the elimination of all trade restrictions so that domestic prices mirror international prices. This policy approach, driven by insights from the neo-classical model, believes that higher output growth and more equitable income distribution would occur if only trade restrictions were eliminated (e.g., R. Bautista, 1987). The Philippines, since 1981, has been liberalizing its trade policies. But despite major headways in reducing trade restrictions, especially in the last six years, there is no clear indication that the anticipated improvement in growth and income distribution has occurred. Real GDP has grown at an annual average of 4.8 percent from 1986 to 1991, lower even than the 5.9 percent average annual growth rate from 1950 to 1980.[1] The

---

*This paper is based on the author's doctoral dissertation and was submitted while he was still with the Food Research Institute, Stanford University. He is now an Associate Professor at the Asian Institute of Management.

[1]Figures were computed from the World Bank's *World Development Report* (1982 and 1991).

Gini coefficient of inequality, while indeed lower in 1988 (0.45) than in 1961 (0.48) and in 1971 (0.51), is practically unchanged from its value in 1985.[2]

The argument to "get prices right", therefore, needs to be reexamined because it fails to consider 1) the modest gains in static efficiency from trade liberalization which have been consistently measured since Harberger (1959), and 2) the work of the structuralists (e.g., Lysy and Taylor, 1980) suggesting that the equity in income distribution is barely affected by these policies. Moreover, for developing countries, trade liberalization entails an important complication often assumed away in the neo-classical analysis — tariffs affect fiscal policy objectives.

The paper analyzes the empirical dimensions of the neo-classical argument using a dynamic computable general equilibrium (CGE) model of the Philippines. The model is constructed with two versions of government fiscal behavior to bring out the complications between fiscal policy and trade policy. To capture the essence of the neo-classical argument, the model is formulated with Walrasian aggregate closure mechanisms, e.g., factors are always fully employed. The two versions of the model are subjected to trade policy simulations aimed at quantifying the immediate and long-run effects of tariff restrictions on aggregate output and income distribution.

2. The "Getting Prices Right" Argument: A Background

2.1. Economic Efficiency

The push for trade liberalization is based on the theory that liberal trade policies improve economic performance. The most persuasive pieces of evidence in support of this theory come from a

[2]The Gini values for 1971, 1985, and 1988 were computed from the *1990 Philippine Statistical Yearbook* published by the National Statistical Coordination Board of NEDA. The value for 1961 was taken from Paukert (1973).

well-known body of empirical work establishing a correlation between trade policy orientation and economic growth.[3]

Despite this overwhelming empirical evidence indicating a link between liberal trade policy and economic growth, there is no agreement about the reasons that satisfactorily explain this link. As Krueger (1980) observed, there are a number of hypotheses competing to explain the statistical relationship, each of which has different implications for policy implementation. One hypothesis is that phenomena such as increasing returns to scale, indivisibilities in the production process, and lumpiness in efficient plant sizes provide overwhelming superiority for economic growth through export-oriented policies that imply less reliance on trade protection. A second hypothesis is that differences in growth rates have resulted, not from trade strategy per se, but rather from excesses in the administration of the import substitution policies. The third hypothesis is that export promotion generally requires less distortion in the allocation of domestic resources (i.e., domestic marginal rate of transformation = international marginal rate of transformation). It should, therefore, lead to higher growth rates. The first and second hypotheses invoke the notion of an "infant industry" protection policy that requires some initial and exogenous push for growth. The third, by contrast, takes the view that higher growth would occur only if the prices were right.

---

[3]This body of empirical work starts with Emery (1967) and Maizels (1968). Michalopoulos and Jay (1975), and Michaely (1977) made additional contributions. But, it was Balassa (1978) who explicitly suggested that since differences in export performance were a function of differences in trade policy orientation (e.g., levels of trade restrictiveness), then the observed differences in economic growth can be ascribed to differences in trade policy, i.e., more liberal trade policies lead to better economic performance. Alam (1991), using the World Bank's taxonomy of trade orientation among 41 developing countries, gave more specific proof that "outward oriented" countries achieved higher output growth. Feder (1983), however, had earlier argued that the empirically observed association of export performance with economic performance can be due to the externality effect of exports on domestic productivity (e.g., the spread of superior imported technology to domestic activities) rather than merely due to fewer price distortions.

The World Bank's perspective, which influences much of the Philippine push for trade liberalization, leans more towards the third hypothesis.[4] It emphasizes the allocation efficiency costs of trade protection and the need for government to withdraw from actively intervening in the economic development process. The danger in this argument is that emphasizing the correction of price distortions intimidates the government from pursuing other economic development interventions that are important for growth under a more liberal trade regime.

Protection imposes a static burden on the economy due to a sub-optimal production and consumption schedule.[5] But the historical evidence for this type of economic loss suggests that it is modest at most.[6] Furthermore, though Corden (1971) and Johnson (1971) have shown that this static efficiency argument can be extended to the economic growth process, the results of their analyses are clouded with ambiguities. While the static inefficiency from the misallocation of resources tends to lower the capital formation capacity and, consequently, the growth output, there are other influences that may offset this effect depending on assumptions about import-intensiveness of the investment good, factor-intensiveness of exports, and savings rate differences among factor owners.[7]

---

[4]This is evident in the 1990 World Bank country report for the Philippines which emphasizes the importance of trade reforms in improving economic efficiency (World Bank, 1990, pp. 49-57).

[5]Ricardo (1817) and the neo-classicalists (Hecksher, 1919; Ohlin, 1933; Samuelson, 1938) have argued this well.

[6]Harberger (1959) reported that a 50% tariff protection in Chile contributed to a 2.5% loss in that country's national income. Johnson (1965b) reported a 5.4% difference in the cost of maintaining the social utility level at free trade compared to a 60% tariff. Afzal and Guisinger (1974) using the case of Pakistan in the 1960s found only a half-percent of GNP loss. For the Philippines, Clarete (1989) estimated a 5% GNP loss due to the tariff structure in 1979.

[7]For example, if the investment good is import-intensive relative to the consumption good, then liberalizing imports will lower the relative cost of the investment good, leading to a higher rate of capital formation and higher growth of output. However, if the consumption good is the import-intensive good, then the investment good becomes more expensive and a lower rate of capital formation ensues. The growth rate can also decrease if the export-good is labor-intensive because more income is shifted to the wage-earners who are assumed to have lower savings rates. See Corden (1971).

2.2. Income Distribution

Proponents of liberal trade policies also argue that free trade is not only economically efficient, but that it promotes a more equitable distribution of income as well (R. Bautista, 1987). The basis for this argument mostly rests on the reasoning that, since most of the country's poor households are in the rural areas, a liberal trade policy that corrects the anti-agriculture price bias of Philippine trade policy will improve the relative income of these poor rural households.

Further basis for the income distribution claim comes from the Stolper-Samuelson (1941) theorem that says the income of the mobile factor intensively used in the production of the competitive good will increase proportionately more than the income of the other mobile factors. Since the Philippine's comparative advantage is in the more labor-intensive goods (e.g., agricultural crop production, food processing), then trade liberalization should improve the income share of wage-earners, who typically are the poorer households.

There is not much empirical evidence, however, that trade policy leads to significant changes in the equity of income distribution. In fact, what Adelman and Robinson (1978), Ahluwalia and Lysy (1979), and Lysy and Taylor (1980) have found out is that the overall size distribution of income is difficult to change through price policy interventions.[8] Hence, equity in the overall income distribution can only be altered substantially by major shocks (e.g., reallocation of factor endowments), even if price policies can significantly affect the income distribution between different socioeconomic groups (e.g., urban poor versus rural poor). Trade policies, therefore, may have little impact on overall poverty even if they can dramatically alter the composition of the poor.

---

[8]The size distribution of income is a neo-classical concept defined as the distribution of income to atomistic individuals or households, as contrasted to the classical concept of functional income distribution which is the distribution among groups in the economy defined by their ownership of a type of factor (see Dervis, de Melo, and Robinson 1985, p. 398). The Lorenz curve is a method of characterizing the size distribution (e.g., "size" of income of each individual) so that a normative value judgment (e.g., distance from egalitarianism) can be made on particular income distributions.

2.3. *The Influence of Government Fiscal Policy*

The standard literature on trade policy and economic growth does not do justice to the importance of the government's budget constraint on trade policy performance. Corden (1974) did recognize that the difference in the propensity to save between governments and households may influence the impact of trade policy on economic growth, but no quantitative indications of its significance were provided. Studies on trade reforms often include some afterthought on the need for maintaining some positive but low rate of tariffs to support a reasonable level of government activity. There is, however, no careful analysis of how government fiscal constraints can affect the optimality of a proposed trade policy.[9]

Trade taxes are an important component of government revenues in developing countries (Greenway and Milner, 1991). The Philippine government relies on trade taxes for about a quarter of its revenues (24.6 % of revenues from 1976-1982).[10] A commonly accepted reason for this dependence on trade taxes in developing countries is that when per-capita incomes are low, other forms of taxation cost more to collect than trade taxes.[11] Changes in the tariff rates, therefore, can have a considerable fiscal impact as well.

The government is also the biggest employer in developing countries, and its budget is spent mostly on salaries and wages. In 1983, the government accounted for 11.5 percent of all wages in the

---

[9]Corden (1974, p. 287) recognized that the benefits from a tariff that raises government revenues, e.g., increased public services and public investments, may outweigh the efficiency costs of the price distortions created by the tariff. However, the trade policy literature (including Corden himself) has consistently treated this tension in the role of tariffs as having limited importance. There is, generally, no attempt in the analysis of tariffs to measure this trade-off. One reason for this is the unjustified assumption of the ability of a more efficient means of taxation to replace the revenues lost from tariffs. Another possible reason is the previous difficulty of empirically isolating these separate influences using only the tools of qualitative analysis.

[10]Revenues from taxing foreign trade have always formed a significant portion of the total Philippine government income. Sherwood (1956) notes that from 1951-1955, when foreign trade taxation was applied through foreign exchange taxes, it contributed 19% to 24% of government revenues. In 1990 this contribution was at 26% based on NEDA's report of government accounts (*1990 Philippine Statistical Yearbook*)

[11]The 1988 *World Development Report* provides evidence that the administrative cost of collecting trade taxes in developing countries is 1%-3% while it is 5% for value-added taxes (VAT), and 10% for income taxes.

Philippines (16% on non-agriculture wages) and wages accounted for 48.4 percent of its operating expenditures.[12] A reduction in the government expenditures because of reductions in its tariff collections can significantly affect the demand for labor, hence, decrease wages and the purchasing power of wage-dependent households. These influences can significantly modify the predicted performance of trade policy.

An emerging body of literature on public finance is beginning to recognize the complications between trade policy and fiscal policy (e.g., Dahl, Devarajan, and Winbergen, 1986). The question of optimal tariff policy, in the presence of government revenue constraints, is receiving careful scrutiny. Using mathematical programming techniques, these studies search for the combinations of tax instruments that yield market equilibrium with maximum social welfare.[13] This body of work relies on a methodology similar to that applied in this paper.

3. Testing the Empirical Validity of the Neo-Classical Argument

This paper applies computable general equilibrium (CGE) modeling techniques in establishing the quantitative significance of the neo-classical argument (e.g., getting the domestic marginal rate of transformation to approach the international marginal rate of transformation) on trade liberalization in the Philippines.

Harberger (1959) began the tradition of empirically measuring the neo-classical argument about the economic efficiency of free trade. He used the Marshallian method of welfare triangles to measure the aggregate income gain from eliminating an equivalent 50 percent import tariff for the Chilean economy, and concluded that this static aggregate income gain can be no more than 2.5 percent of that country's ex-ante national income. This method is simple to apply and is a good first approximation of the static income gain from free trade policy (Rodrik, 1992). However, it is indirect, highly aggregative, and is also conceptually difficult to extend into a dynamic framework.

---

[12]Computed from 1983 Philippine I-O Table (NCSO, 1983) and national income accounts (NEDA's *Philippine Statistical Yearbook*, various years).

[13]Among their more controversial findings is that, contrary to the World Bank paradigm, tariff equalization can not be justified on the basis of static efficiency gains alone. See Robinson (1990, pp. 8-9).

The development of computable general equilibrium modeling (CGE) techniques renewed interest in more directly measuring the income gain from trade policy using a more disaggregated description of the economy (e.g., Clarete and Whalley, 1988). In this method, the simultaneous clearing of all markets in the economy subject to the income consistency condition is explicitly modeled. The economy is also provided a more realistic structure by disaggregating production and consumption into several sectors, households, and the government. The neo-classical argument about the allocative efficiency superiority of free trade is captured by specifying a Walrasian closure (e.g., the fixed supply of factors is always fully employed). The model is empirically calibrated by making the model fit a benchmark equilibrium point.[14] Then, trade policy parameters (e.g., tariff rates) are changed and a new equilibrium point solved. The national incomes associated with each equilibrium point are then compared.

This paper extends this approach into a dynamic framework. A Walrasian static CGE is constructed and made to generate a dynamic sequence of equilibria for each set of simulated trade policies. The level and growth of aggregate income (GDP) associated with each policy are then compared. The changes in the equity of income distribution associated with each policy are also compared using the Gini coefficient measure.

3.1. Constructing a Dynamic CGE Model

The diversity of CGE modeling formulations found in the general economic modeling literature is also reflected in the Philippine literature. There are several published CGE models for the Philippines some of which had been extended for additional applications.[15] None of these models, however, are dynamic, and only C. Bautista (1987) pays attention to the interaction between trade policy and fiscal policy. This interaction, however, was modeled within a non-Walrasian framework (i.e., more macro-oriented), and consequently failed to address the factor allocation efficiency issue argued by the neo-classicalists.

---

[14]Operationally, this means deriving the scale and share parameters of the model equations from the national income accounts of a particular year when the economy being modeled was thought to be in equilibrium.

[15]See Ahammed and Herdt (1981), Habito (1984, 1986), Clarete (1984, 1989), Clarete and Whalley (1988), R. Bautista (1986), C. Bautista (1987), and Coxhead and Warr (1991).

The model used in this paper can be described as a dynamic sequence of static equilibria similar to the formulation in Ballard *et al.* (1984). At each period, the model generates a static general equilibrium solution that includes the level of capital formation for that period. This new capital adds to the capital endowment for the next period. The equilibria in any sequence are dynamically connected to each other through this endogenous process of capital formation. In this type of dynamic model, no optimization across periods is being performed by the economic agents. Households and producers optimize based only on information for the past and current periods. They are not forming forward-looking expectations. In this sense, the model, though dynamic, is myopic. It is simply a dynamic progression generated by a static CGE model.

There are two versions of the model, differentiated only in their depiction of fiscal policy behavior, that are applied in this paper. Version A assumes that fiscal policy is fully responsive to changes in government revenue — the real level of government expenditure adjusts to satisfy the government revenue constraint. Version B, on the other hand, assumes that fiscal policy is such that it acts independently of the revenue constraint. Hence, a real level of government expenditure is defended by adjusting the government deficit in this model version. Clearly, actual Philippine fiscal behavior lies somewhere between these two extremes. But, these two extremes circumscribe the range of possibilities and are sufficient to dramatize the point about fiscal behavior and trade policy complications that this paper is concerned about.

3.2. Solving for the Static Equilibria

The general equilibrium solution for each period is generated by a static model belonging to the class of Walrasian CGE models associated with the World Bank modeling tradition (e.g. Adelman and Robinson, 1978; Dervis, de Melo, and Robinson, 1985; Habito, 1984). Although basically neo-classical in character, these models incorporate a number of structuralist features such as an input-output production structure, a Keynesian savings allocation behavior, differences in household endowments and consumption preferences, and distortions from government behavior.

The model in this paper is built around the behavior of 28 economic agents: 17 production sectors, 9 stylized households, the government, and a foreign agent. The model is real (i.e., no monetary component), Walrasian, savings-led, and is a small open economy.

3.2.1. Production

Production takes place in 17 sectors: eight agricultural, one resource extractive, four manufacturing, one construction, and three service sectors (see Table 1). In sixteen sectors, the services of domestic factors (labor, mobile capital, and fixed capital) are combined to form value-added. Labor and mobile capital are both assumed to be freely movable between sectors. Fixed capital, however, is assumed to be serviceable only in specific sectors. Thus, there is no reallocation of fixed capital between sectors and it earns a unique return in each sector.

Value-added is combined with commodity inputs to form a product that is marketed both for export and the domestic market. In the domestic market, this product is combined with imports in order to satisfy local demand. Production, in general, is a two-step process of four levels of activities depicted in Figure 1. For the government services sector, only one level of activity is specified: the application of one factor (labor) in the production of government services.

The first step in the four-level production process is the production of the domestic product. There are two activity levels in this step: the formation of value-added from the combination of factors of production in a CES (constant elasticity of substitution) function and the combination of commodity inputs into an aggregate input through a Leontief function at the first level, and then the combination of value-added with the aggregate input through another CES function at the next level.[16]

---

[16]The CES function is a general function of the form:

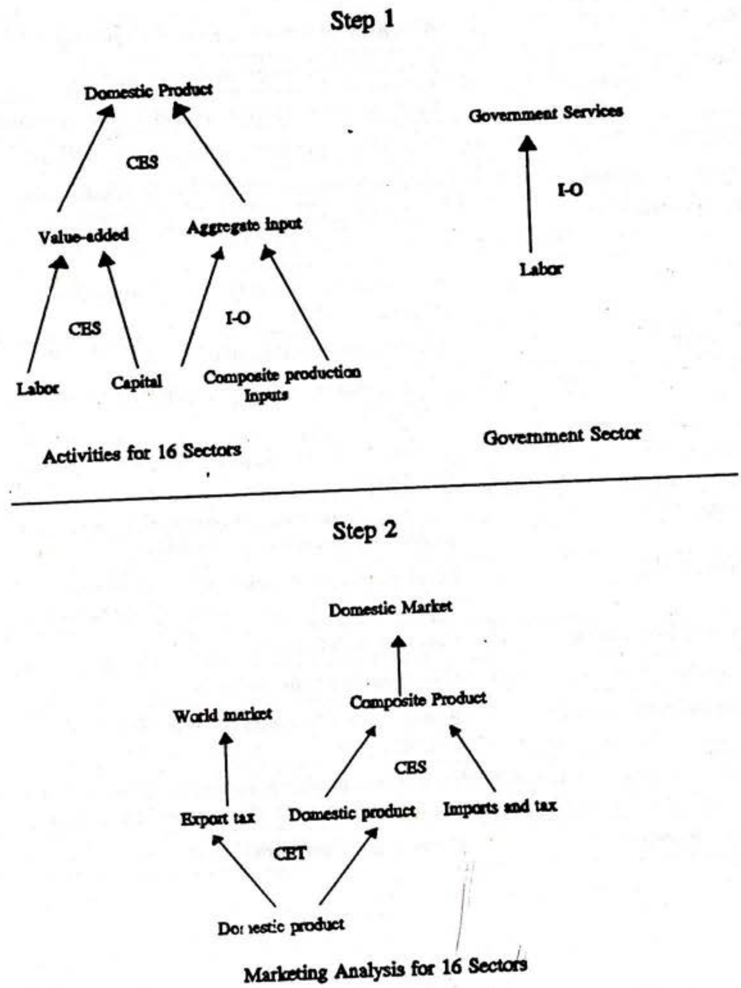
$$Q = A\, L^{((\sigma-1)/\sigma)} + \beta KM^{((\sigma-1)/c)} + (1-\alpha-\beta)\, KF^{((\sigma-1)/\sigma)\,\sigma/(\sigma-1)}$$

where Q is the unit of output (e.g., value-added); I is the quantity of labor; KM the mobile capital; KF the fixed capital; A, α, and β are share parameters; and σ the elasticity of substitution. Nested within the more general CES functional form are other more familiar functions. A CES elasticity value of one corresponds to the Cobb-Douglas, while a value of zero collapses the CES to a Leontief specification. An infinite value of elasticity, on the other hand, collapses it to a linear *combination so that one factor can be perfectly substituted for another* without diminishing returns.

Table 1 - Production Sectors

Sectors	Description
1. Rice	All palay production and rice milling.
2. Corn	All corn production and corn milling.
3. Coconut	Coconut production including copra drying.
4. Sugar	Sugarcane production and sugar milling.
5. Fruits/Vegetables	All fruits and vegetables crop production.
6. Other Crops	All other crop production, i.e. beans and root crops.
7. Livestock	All livestock production, i.e. cattle farm, piggery, poultry.
8. Fishery	All fish production, marine and inland.
9. Mining & Forestry	All natural resource extraction, i.e. mining, timbering.
10. Food Mfg.	All food processing, including tobacco and beverages
11. Light Mfg.	Textile, garments, leather and shoes, wood, paper and chemical processing.
12. Heavy Mfg.	Steel production, cement, machineries including electrical, transport equipment.
13. Petrol Processing	Petroleum refining.
14. Construction	Construction industries.
15. Commercial Services	Banking and finance, wholesaling, and retailing.
16. Other Private Services	Transport, utilities, entertainment, tourist industries, and all other private services.
17. Gov. Services	Government services.

Figure 1. - Flow of Production



The second step is the marketing flow of the domestic product. First, the domestic product is allocated between the export market and the domestic market through the CET (constant elasticity of transformation) function.[17] Then, the domestically marketed product is aggregated with its competing import through a CES function to form that sector's composite product.[18] The composite product is used to satisfy all forms of domestic demand like consumption, investments, and production input demands. These production characterizations lead to equations (1) to (15) — basically the first-order conditions for profit maximizing firms faced with competitive output and input prices.

Clearly, the value of the elasticities of the CES and the CET functions is crucial in determining the production flexibility of a sector. The values used in the model are shown in Table 2.[19] At the value-added formation level, Mansur and Whalley's (1984) survey of production elasticity estimates suggests that elasticity is generally lower than one at this level, and that it tends to get lower the more primary the activity. Agricultural activities in this model, therefore, are assumed to have less flexibility in substituting between labor and both forms of capital than manufacturing activities. On the other hand, there is evidence that inputs like fertilizer and pesticides can augment scarce factors like land in the production of agricultural output. This is true in the Philippines especially for the case of rice, and to a more limited extent also for corn and sugar. Therefore, the model has specified non-zero CES elasticities in combining value-added and inputs to acknowledge the possibility of fertilizer substitution for factors in these three sectors.

---

[17]The CET specification indicates that the gross output produced by the activity is transformed into different output commodities according to this function (see Powell and Gruen, 1968). It assumes that the sector maximizes the total value of output given the function and the current export and domestic prices. A CET elasticity value of negative infinity indicates that there are no costs involved in transforming the product from one market to the other (i.e., markets are perfectly substitutable) so that an infinitesimal difference in market prices will cause the product to be all allocated to the market with the lower price. This would force domestic and export prices to equal. This also means that one market acts as a residual for absorbing excess production.

[18]This is the familiar Armington assumption (see Armington, 1969).

[19]The CES elasticities for the formation of value-added were adapted from Mansur and Whalley's (1984) survey of econometrically estimated production elasticities. The bounded CET elasticities adapted some values from Powell and Gruen's (1968) estimates, but are generally higher. The domestic-import composite CES elasticities were adapted from Habito (1984), which in turn were lifted from what CGE modelers have conjectured as reasonable values of trade elasticities.

Table 2 - Production Elasticities

Sector	Value-Added Formation (CES)	Activity Output Formation (CES)	Market Allocation (CET)	Composite Product Formation (CES)
1. Rice	0.4	0.4	-inf	0.0
2. Corn	0.4	0.4	-inf	inf
3. Coconut	0.4	0.0	-inf	0.0
4. Sugar	0.4	0.4	-inf	0.0
5. Fruits/Vegetables	0.4	0.0	-1.5	2.0
6. Other Crops	0.4	0.0	-1.5	1.0
7. Livestock	0.4	0.0	-1.5	2.0
8. Fishery	0.4	0.0	-1.5	2.0
9. Mining/Forestry	0.4	0.0	-1.5	0.0
10. Food Mfg	0.5	0.0	-1.5	1.5
11. Light Mfg	0.6	0.0	-0.5	1.5
12. Heavy Mfg	0.5	0.0	-0.5	0.5
13. Petrol	0.5	0.0	-inf	0.0
14. Construction	0.6	0.0	-0.5	0.3
15. Comm'cl Serv.	0.8	0.0	-0.5	0.3
16. Oth Priv Serv	0.8	0.0	-0.5	0.3

The CET elasticity values reflect the ease of shifting production in a sector between the export and the domestic market. In the rice, corn, coconut, and sugar sectors the CET elasticity value has been specified to be unbounded to reflect the high degree of homogeneity of products exported and produced for the domestic market in these sectors. Non-infinite CET elasticities in the other crops, manufacturing, and services sectors, however, reflect the fact that the diversion of products between domestic and export markets is not as easy in these sectors (i.e., there is substantial differentiation between the product sold to the domestic market and the product sold to the export market). In these sectors, diversion of supplies from one market to another only occurs if an adequate price difference emerges between the two markets.[20]

[20]These bounded CET elasticity values provide the model with less flexibility in responding to increased foreign trade incentives than other Walrasian CGE models of the Philippines found in the literature.

The CES elasticity in the composite product formation (CMP) defines import demand behavior. Infinite elasticities for the rice and corn sectors reflect the fact that imports in these sectors are perfectly substitutable with domestic production. The zero elasticity for composite product formation in the petrol sector reflects the non-substitutability of oil imports which must be imported in fixed proportion to the level of activity in the domestic petrol processing sector.

3.2.2. Income distribution and the generation of demand

Income is generated in the economy through the profitable employment of factors and then directly distributed to the households, the government, and the foreign agent (e.g., rest of the world) in accordance with their ownership of factors. Income is also directly distributed to the government through taxation, and indirectly to the households and the foreign agent by the subsequent income transfers made by the government. Government taxes imports, exports, the domestic product, the incomes of factors, and the income of households.

The demand for composite products comes from the disposition of income by the nine households and by government operations. Hence, they also receive fixed shares of each factor's total income. Aside from receiving income from their ownership of factors, households also receive income transfers from the government.

Table 3 lists the different factor accounts in the model: 18 domestically employed factors and a "factor abroad" account. While there is only one labor account, capital is differentiated into one account that represents mobile capital and 15 accounts that represent a fixed type of capital (e.g., "bolted down" capital) in each sector.[21]

---

[21]One fixed capital (services fixed capital) is actually modeled as mobile between two service sectors, the commercial services and other private services sectors.

Table 3 - Factor Accounts

1. Labor	Mobile
2. Capital	Mobile
3. Rice Fixed Capital	Sector-specific
4. Corn Fixed Capital	Sector-specific
5. Coconut Fixed Capital	Sector-specific
6. Sugar Fixed Capital	Sector-specific
7. Fruits Fixed Capital	Sector-specific
8. Other Crops Fixed Capital	Sector-specific
9. Livestock Fixed Capital	Sector-specific
10. Mining/Forestry Fixed Capital	Sector-specific
11. Fishery Fixed Capital	Sector-specific
12. Food Mfg Fixed Capital	Sector-specific
13. Light Mfg Fixed Capital	Sector-specific
14. Heavy Mfg Fixed Capital	Sector-specific
15. Petrol Fixed Capital	Sector-specific
16. Construction Fixed Capital	Sector-specific
17. Services Fixed Capital	Sector-specific
18. Factor Abroad	Non-market

The "factor abroad" account is to represent the earnings of all factors employed outside of the domestic economy. It is assumed to earn an exogenously determined amount of foreign exchange. Unlike a domestic factor which has a quantity and a price variable, the factor abroad account has only an income variable which is fixed in foreign exchange but can vary in domestic currency according to changes in the foreign exchange rate (Eq. 16). The income of each domestic factor, on the other hand, is its rental rate (the price of factor service) multiplied by the total quantity employed.

Income is distributed by the pattern of factor earnings, factor ownership and by taxation (Eq. 17 and 18). Households receive income from factor earnings according to their factor ownership shares. There are nine types of households differentiated by demography and income class. The demographic groups are the National Capital Region (Metro Manila), the "other urban" area, and the rural area. In each geographic area, households are grouped according to their annual household income: a low income group (less than P20,000 in 1983 pesos), a middle-income group (P20,000 to P60,000), and a high-income group (above P60,000). These nine types of households are each assumed to own a fixed share of each factor endowment, and thus receive an income from government fixed in domestic currency (e.g., pensions). Government, on the other hand, earns income from taxing imports, exports, domestic production, factor incomes (e.g., corporate tax), households, and also from the earnings of its owned factors.

The income of each household is distributed in fixed proportions into income tax payments, savings, and a consumption budget (Eq. 24). The consumption budget is allocated into consumption demand for the composite product of each sector according to an LES (Linear Expenditure System) optimizing behavior.[22] Government, on the other hand, allocates its income into a budget for transfer payments to the households (fixed in domestic currency), a budget for foreign currency payments (fixed in foreign currency), a budget for operating expenditures (i.e., government "consumption"), and, a budget for savings (public investment allocation).

In Version A of the model, government savings is fixed in domestic currency so that the budget for government consumption is residually determined from the level of government income (Eq. 28a). This forces the level of government consumption to be fully constrained by the level of government income. In Model B, however, government savings is the variable assumed to be residually determined while the government consumption budget is determined by a fixed aggregate level of real expenditures and the prices of purchased commodities and services (Eq. 28b). Hence, government consumption is not responsive to changes in the government income in this model version.

Investment demand is driven by the level of aggregate savings and the prices of commodities/services used in capital formation. Aggregate savings is just the sum of the savings of households, the government, and the foreign sector. The latter is modeled as fixed in foreign currency (e.g., a fixed level of balance of payments deficit). Hence, the model is savings-driven. But while it is savings-driven,

---

[22]Thus, the household is maximizing a Stone-Geary utility function subject to the consumption budget constraint.

some components of investment demand are independent of the level of savings. Government investments are modeled as fixed in real terms (fixed quantity), while the level of savings devoted to commodity stocks is fixed in domestic currency. It is private investment demand, therefore, that is residually determined from the level of aggregate savings. The income and final demand equations (Eq. 16 to 42), in addition to determining the new endogenous variables introduced in these equations, also determine the total composite demand that goes into the production equations.

3.2.3. Equilibrium conditions

The 42 production and income equations determine all endogenous variables except the prices of factors and the exchange rate. Given any set of factor prices, exchange rate, and the exogenous variable (e.g., world prices of imports and exports), all the other model variables, like production quantities and domestic commodity prices, can be solved. In a neo-classical model, however, it is the fixed quantities of factors that drive the model, not the prices of factors and the exchange rate. Hence, the model is closed by the material balance equations for factors in (43) and the external balance condition of (45). Since factor demand can not balance factor supply at just any prices, the set of equations in (44) and (46) is needed, together with two types of slack variables (ϵ_r and ϵ_f), to enforce an equilibrium price solving scheme.

Seemingly, all model variables can now be solved for with just equations (1) to (46). However, Walras Law implies that one of the equilibrium condition equations is dependent on the others. For example, the balance of payments equation (Eq. 45) will be automatically satisfied if all factor markets clear for a specific set of factor prices so that there is not enough equations to solve the factor prices and the exchange rate. A price numeraire, therefore, has to be specified by which all other domestic prices can be normalized upon. While the exchange rate seems to be a natural choice, the price index of the real consumption of the NCR-Middle income household was chosen as the price numeraire for this model instead. The exchange rate, factor prices, and the domestic prices of commodities, therefore, are solved in terms of the fixed world prices of exports and imports and the given value of the price numeraire.[23] The static model, thus, is fully identified and an equilibrium solution can now be solved for each period's stock of factors.[24]

3.3. *The Sequencing of the Static Equilibria*

Each static equilibrium is linked to the next period's equilibrium by equations that update the fixed stock of domestic factors and other fixed quantities that are assumed to be systematically changing with time. The updating equations are:

(D1) $Q_{L,t} = Q_{L,t-1} \cdot g_L$,

(D2) $Q_{K,t} = A^* \left(Q^I_{G,\,t-1} + Q^I_{P,\,t-1}\right)$

(D3) $Q_{ri,\,t} = (1\text{-}d) * Q_{ri,\,t-1} + Q_{Ki,\,t-1}$ for $i = 1, \ldots n$,

(D4) $Q^C_{G,t} = Q^C_{G,\,t-1} * g_L$

Equation (D1) defines the growth of labor, while (D2) and (D3) define the growth of capital. Equation (D4) defines the growth of the real level of government consumption expenditures (operational only in Version B).

Labor (Q_L) grows at an exogenously specified rate g_L.[25] Such exogenous specification of the labor growth rate is consistent with the neo-classical growth model as expounded in Solow (1956). The real level of government consumption in Version B is specified to be growing at the same rate as population. In Version A, the growth of real government consumption is endogenous, mainly determined by the equilibrium solution in each period solved for by the static CGE model.

---

[23]This may be visualized as something similar to keeping the Manila Consumer Price Index fixed, while all other prices (including wages) adjust.

[24]The solution strategy is to iteratively pick a set of factor prices and exchange rate at which the ϵ's are driven to zero. In terms of a non-linear programming solution procedure, for example, this will be minimizing some linear combination of the quadratic form of the ϵ's subject to the 47 sets of equations, by systematically varying the factor prices and exchange rate.

[25]The rate adopted for this model is 3.041% which was the population growth rate in 1983 as computed from NEDA's 1983 *Statistical Yearbook*.

The growth of capital is a much more involved process that is explained as follows. Capital is composed of a fixed and a mobile component. The growth of the mobile component (Q_K) is defined by (D2), while the growth of the fixed component (Q_Γ) is defined by (D3). The model assumes that mobile capital, once allocated in one period (e.g., $Q_{Ki,t-1}$), is no longer free to move across other sectors in future periods, i.e., it becomes fixed to that sector. It is, however, replenished by the level of capital formation in the preceding period, which is just the aggregation of government investment and private investments in that period. Government investment (Q_G^I) is assumed to be exogenous in the model, but private investment (Q_P^I) is assumed to be driven by the level of aggregate savings.

Fixed capital (Q_Γ), on the other hand, is indirectly augmented by investments through the allocation of mobile capital. As equation (D3) indicates, the fixed capital in each sector i in period t is equal to the quantity of the depreciated fixed capital in that sector in the prior period ($(1-d)*Q_{\Gamma i,t-1}$) plus the quantity of mobile capital ($Q_{Ki,t-1}$) allocated to that sector in the prior period. The accumulation of capital in the model, therefore, essentially follows the more familiar capital formation process described by:

(D5) $K_t = (1\text{-}d) *K_{t-1} + I_{t-1}$

where K and I are real amounts of capital and investment.

But since $K = \Sigma_i Q_{\Gamma i} + Q_K$, equations (D2) and (D3) together merely represent a disaggregated version of equation (D5), because

(D6) $$\sum_{i=1}^{n} Q_{\Gamma i,t} + Q_{K,t} = (1-d)*\left[\sum_{i=1}^{n} Q_{\Gamma i,\,t-1} + Q_{k,\,t-1}\right] + I_{t-1}$$

The scaling factor A in equation (D2) is used to force consistency between the unit of measure used in the base period to measure the quantities of capital and the unit of measure used to measure investment.[26] The value of A in the model is 0.442 and was recovered

---

[26]These units of measure are not equivalent because the process of indexing all prices to one in the base period forces quantities to be expressed in terms of their transaction value. The transaction value for capital is not its price value (i.e., not P_k*Q_k) but rather its rental receipt ($r*Q_k$, where r is the rental rate for capital). For investment, on the other hand, the transaction value is the cost of producing capital - or equivalently P_k*Q_k -- that is indicated. Clearly, these values represent different units of measurements.

by benchmarking the capital rental rates to the output growth rate in the base period.

The parameter *d* in equation (D3) represents the depreciation rate. A uniform depreciation rate of 10 percent was used in the model.

4. The Trade Policy Simulation Results

The effects of seven trade policy regimes representing increasing levels of trade restrictiveness were simulated using both fiscal behavior versions of the model. Each regime imposed a uniform import tariff rate across sectors with no export taxes or subsidies. The balance of payments deficit (e.g., the foreign savings amount) was also kept at zero for all regimes. The uniform tariff rate varied from 0 percent to 50 percent.

The scale and share parameters of the model were recovered by calibrating the model to a 1983 SAM for the Philippines described in Gaspay (1993).[27] From this SAM, the static model was benchmarked to a zero balance of payments deficit (e.g., no foreign savings) condition, and solutions to the seven alternative trade policy regimes found for a sequence of ten periods (e.g., ten years).

All computations were implemented in the GAMS/HERCULES general equilibrium modeling software system popularized by Drud and Kendrick (1986).[28] The static equilibria (e.g., without factor stock growth) obtained under the seven policy regimes are first compared in the next paragraphs. The comparison of the ten-year sequence of equilibria associated with each policy regime then follows.

---

[27]This SAM was constructed from the 127-sector I-O table for 1983, the 1983 National Income accounts, and 1985 FIES (Family and Income Expenditure Survey) data for the Philippines. See Appendix A of Gaspay (1993) for details of the SAM.

[28]GAMS stands for *General Algebraic Modeling System* and is a mathematical programming software developed at the World Bank (see Brooke et al. 1988). HERCULES (*Highlevel Economic Representation for Creating and Using Large Economywide Systems*), on the other hand, is a model generator and solver package for SAM-based models written in GAMS (see Drud and Kendrick, 1988). The GAMS/HERCULES system is available for PC's with equal to or greater than 640K memory.

4.1. *The Static Equilibria*

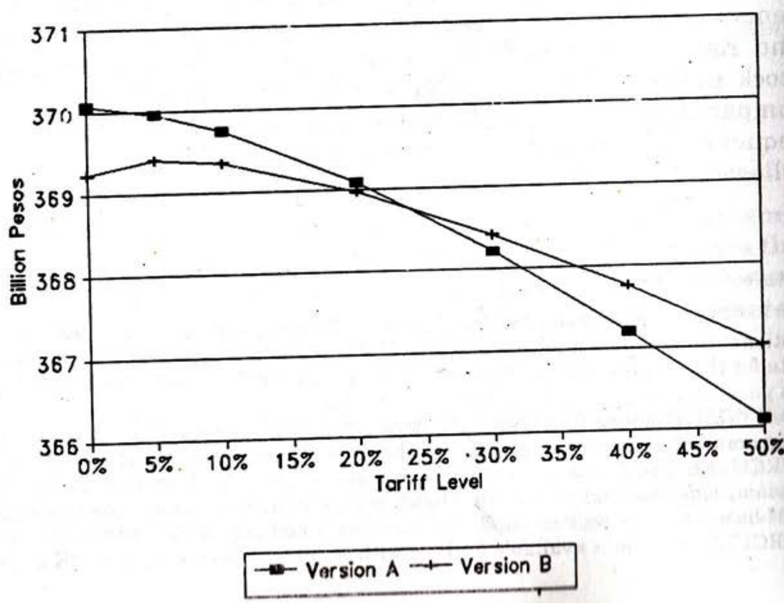
4.1.1. *Aggregate output*

The relationship between the real level of aggregate output and the general level of trade restrictiveness obtained from the simulations is illustrated in Figure 2. The figure graphs the values of the constant price GDP versus the uniform rate of tariff.

The results from Version A of the model confirm the neo-classical claim of a monotonically decreasing relationship between aggregate output and more restrictive trade policies, i.e., higher levels of tariff are less economically efficient. The magnitude of the differences in output performance, however, is modest. There is only a 1.1 percent GDP gain in moving from a 50 percent tariff policy to a free trade policy.

Results from Version B provide a slightly different picture in that some positive level of tariff is optimal given a fixed real level of government operating expenditures. For the case simulated (e.g., 1983 government consumption level) the optimal uniform tariff rate is around 5 percent.

Figure 2 - GDP by Tariff Rate



Another difference in results caused by the difference in fiscal policy behavior is the dampening of the inefficiency effect due to tariff protection, with a stable government spending policy. The differences in GDP between different tariff rates are much smaller in Version B than in Version A. There is barely a 0.7 percent difference between the optimal GDP (e.g., at 5 percent tariff) and the GDP at a 50 percent tariff policy. Furthermore, while the output performance in Version A is superior to that in Version B for tariff rates less than 20 percent, the reverse is true when tariff rates are more than 30 percent. Both versions, however, tend to support the proposition that very high rates of tariff (e.g. greater than 50 percent) cause significant harm to the economy, while modest tariffs incur negligible factor allocation efficiency losses.

The modest magnitude of these static inefficiency effects is consistent with the empirical estimates found in the literature and cited earlier. As mentioned, Harberger (1959) found only a 2.5 percent loss in Chile's national income from a 50 percent tariff protection rate. Johnson (1965) reported an additional 5.4 percent in the cost of maintaining a level of social utility from free trade to a 60 percent rate of protection, and barely 1 percent for a 20 percent tariff rate. Afzal and Guisinger (1974), using the case of Pakistan in the 1960s, found only a half-percent of GNP loss from tariff protection. For the Philippines, Clarete and Whalley (1988), using 1978 data and a seven-sector level of disaggregation, reported that an estimated gain of 3.4 percent of national income was possible for that year if all import tariffs and export taxes were removed. R. Bautista (1986), also using 1978 data, estimated a 2.8 percent gain from reforming the 1978 tariff structure to a 10 percent uniform tariff structure. Clarete (1989), this time using a 25-sector level of disaggregation and 1979 data, estimated that the Aquino government's tariff reform program would have led to a 5 percent improvement in national income if implemented in that year.

The estimates obtained in this paper, however, are more modest compared to those previously reported in the literature. One reason for this is the greater role for fixed capital in this paper's model compared to the ones used in the cited literature estimates.[29] Fixed capital reduces the ability of the economy to adjust the structure of production to price changes, hence, reduces the scope for reallocating factors in response to changes in trade policy. However, given the weakness of capital markets in the Philippines (e.g. no efficient land markets) the assumptions in this paper seem more realistic.

Another reason for the lower efficiency estimates obtained here is the transformation constraint (e.g., bounded CET function elasticities) placed on the distribution of the domestic product between the export and domestic markets. Again, the treatment in this paper is more realistic, especially if the static model is being used to estimate impact or short-run effects (e.g. yearly adjustments).

4.1.2. Income distribution

Trade liberalization should lead to a general increase in household incomes as the aggregate output increases and the level of taxation imposed by the tariffs decreases. The simulations bear out these expected results. However, they tend to emphasize the greater power of the taxation impact of a tariff policy over that of the factor allocation efficiency impact. The real income of all households increase substantially with tariff liberalization, but the real income of government falls by an even greater proportion. In Version A, for example, the poor households of the National Capital Region (e.g., low income Metro Manila households) gain by 4.7 percent (smallest percentage household gain) and the rich National Capital Region (NCR) households gain by 19.5 percent (largest household gain). Government income, however, falls by almost a half when a 50 percent uniform tariff rate structure is eliminated.

Households, however, do exhibit relative gains and losses. Figure 3 to Figure 5 compare the percentage gain of each income-class household by region. They show that rich households in all three regions (e.g., NCR, other urban, rural) gain more proportionately

[29]See Devarajan and Offerdal (1989) who explore the implication of assuming sector-specific capital (typically in CGE models of developing countries) versus flexible capital (typically in CGE models of industrialized countries). Although differences in the change in national income were not estimated, they did compare price responses and quantity adjustments. They found that the mobile capital assumption led to lesser price responses but larger quantity adjustments. They concluded, however, that these differences were not qualitatively substantial.

Figure 3 - NCR Households

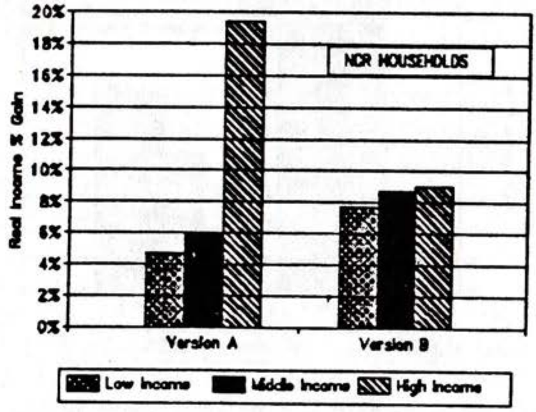


Figure 4 - Other Urban Households

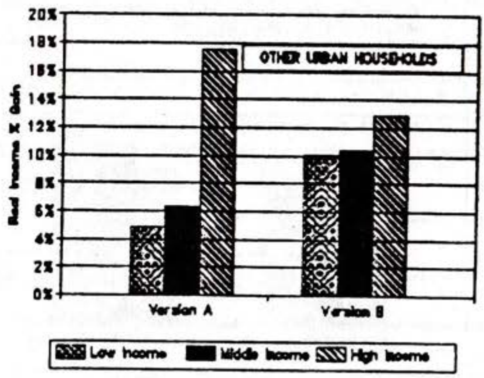


Figure 5 - Rural Households

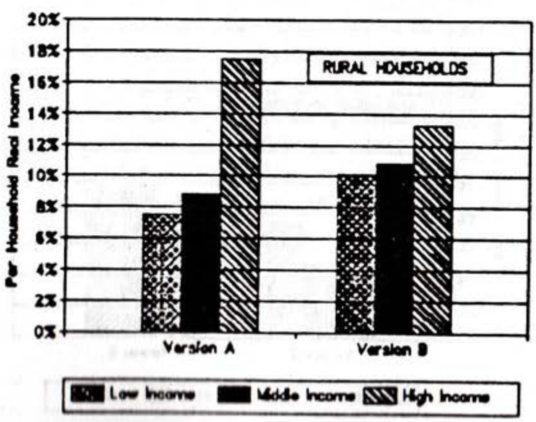


Figure 6 - High-Income Households

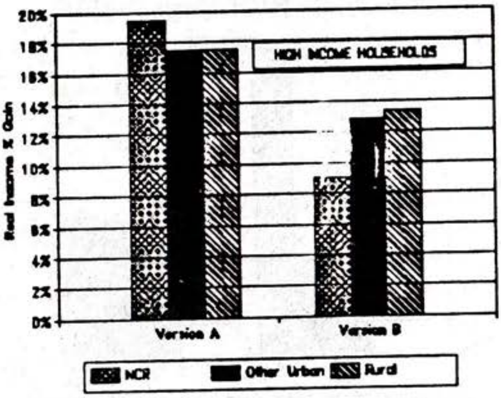


Figure 7 - Middle-Income Households

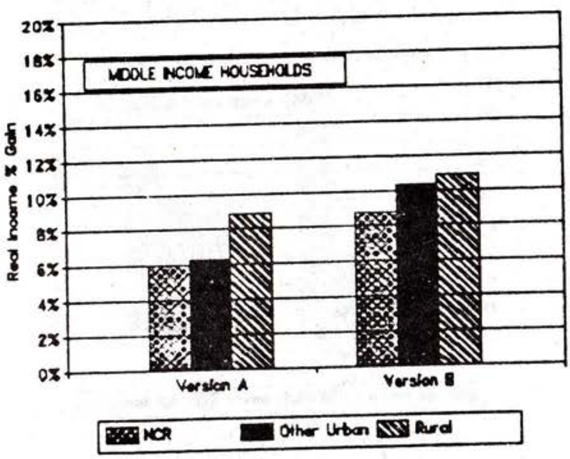
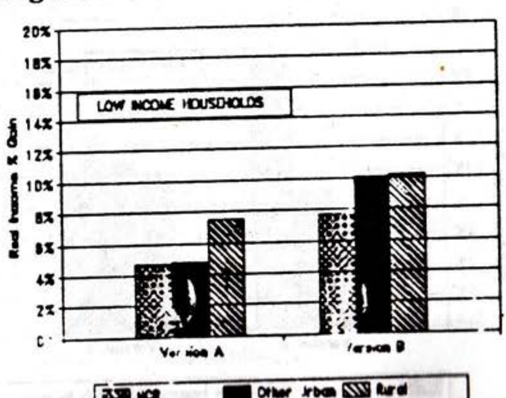


Figure 8 - Low-Income Households



than the poor and middle-income households. These graphs also show that a stable level of government consumption spending (model Version B), tends to dampen these differences in gains.

A comparison of regional income differences by income-class (Figure 6 to Figure 8), meanwhile, shows that rural households generally benefit more than the urban (e.g., NCR, other urban) households from trade liberalization — a result of the relative improvement in agricultural prices which increases the income of factors specific to agricultural production (e.g., riceland rents). An exception is the case when liberalization is accompanied by corresponding cuts in government operating expenditures (e.g., Version A). In this case the rich NCR households benefit the most, because the combined influences of a decreased wage and a relatively cheaper price for nonagricultural products overcome the influence of a relatively higher income for agricultural capital than industrial capital, thus raising the real income of rich NCR households relatively more than other type of households.

These differences in income gains, however, are insufficient to alter the equity in the size distribution of income in a substantial way. Hence, the Gini coefficients barely change between tariff policies as indicated in Table 4.

Table 4 - Gini Coefficients by Tariff Rate

Gini Coefficients	Base	0%	5%	10%	20%	30%	40%	50%
Version A	0.425	0.433	0.431	0.429	0.426	0.423	0.421	0.418
Version B	0.425	0.426	0.426	0.426	0.428	0.429	0.430	0.432

Nevertheless, there is an indication that tariff liberalization slightly worsens the inequity in income distribution if government cuts its level of operating expenditures in response to the loss in tariff revenues, (e.g., Version A). Maintaining a fixed level of expenditures (Version B) reverses this trend.

4.2. The Dynamic Paths

4.2.1. The growth of aggregate output

The simulation results indicate materially different trade policy outcomes with regards the growth of aggregate output, depending on the government fiscal behavior assumed. Figure 9 graphs the GDP's growth paths under different levels of uniform tariff for model Version A. Figure 10 does the same for model Version B.

In Version A, Corden's (1971) argument that a more liberal trade policy should result in a higher output growth path is vindicated. In Version B, however, the opposite result is obtained, i.e., higher levels of tariffs lead to higher output growth paths. This reversal of outcomes is due to the dominant influence of the redistribution of income between the government and the households as tariff rates are changed. Version A's assumption that government consumption spending responds fully to government income changes (e.g., fixed government savings/deficit levels) implies a marginal savings rate of zero for government. Thus, a redistribution of income away from the government and into the households increases aggregate savings. Together with the increase in the aggregate income that comes with lower rates of tariff (e.g., Corden's dynamic effects), these influences produce higher growth rates because of the subsequent increases in the capital stock which come from increased levels of investment.

In Version B, on the other hand, the assumption of an autonomous government consumption level implies a marginal savings rate of unity. Thus, the redistribution of income from the government to the households from lower tariff rates tends to reduce aggregate savings, and consequently, capital formation. This negative effect on output growth dominates the positive tendency to increase output growth coming from Corden's effects, as early as year 2.

Table 5 lists the equivalent GDP growth rates registered for the ten-year period for each trade policy regime. Observe how these differences in growth rates across trade policies are again modest. These results seriously weaken the preference for a trade liberalization policy that relies solely on the factor allocation efficiency argument. In terms of importance, trade policy has a more pronounced effect on the economy through its impact on the aggregate savings rate and, hence, on capital formation, than it does through resource

Figure 9 - GDP Growth by Tariff Rate (Version A)

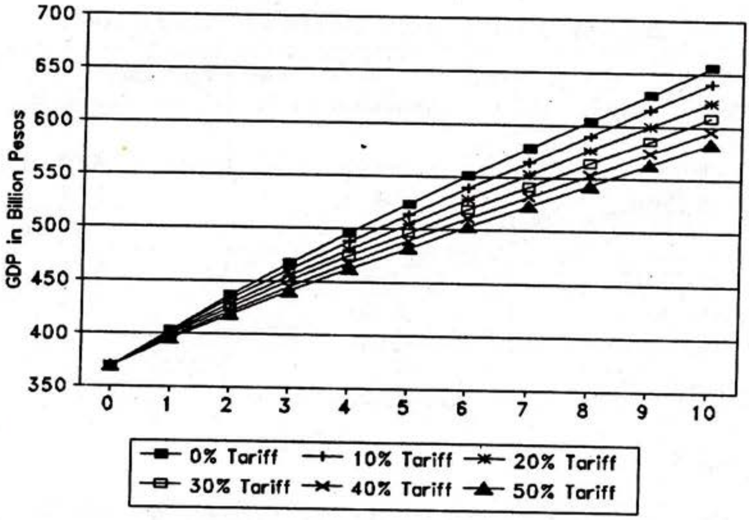
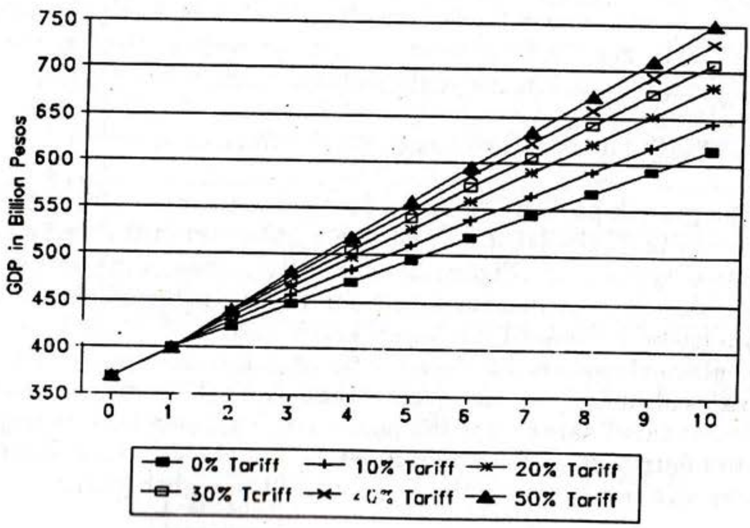


Figure 10 - GDP Growth by Tariff Rate (Version B)



reallocation efficiency. The role of government in the mobilization of aggregate savings through so-called "forced savings" mechanisms (e.g., trade taxation) is critical to the economic growth process.

Table 5 - GDP Growth Rates by Tariff Rate

Trade Policy	Version A	Version B
0% Tariff	6.0%	5.3%
5% Tariff	5.8%	5.6%
10% Tariff	5.7%	5.8%
20% Tariff	5.4%	6.4%
30% Tariff	5.1%	6.8%
40% Tariff	4.9%	7.1%
50% Tariff	4.7%	7.4%

4.2.2. Income distribution over time

The preceding paragraphs discussed how trade liberalization results in contrasting implications regarding the growth of output, depending on the government fiscal policy behavior assumed. The changes in income distribution will now be discussed.

In Version A, lower rates of tariff resulted in higher rates of GDP growth. Consequently, the income of all households also grew much faster with lower tariff rates. In Version B, however, lower rates of tariff resulted in lower rates of growth of the aggregate output. This resulted in the real income of middle-income and poor households growing more slowly with lower tariff rates, while the income of rich households was not much affected.

The growth path of the real income of two contrasting types of households (e.g., the NCR rich vs. the rural poor) in the two model versions (Figure 11 to Figure 14) illustrates these differences. In Version A, the real income levels for higher rates of tariffs are always lower compared to lower tariff rates for both types of households. However, in Version B, real incomes under higher tariff rates ultimately become greater than the real incomes associated with lower tariff rates. For the poor rural households, this begins after the fourth year. For the rich NCR households, the transition happens at a much later period, i.e., after the eighth year.

Figure 11 - Real Income Path NCR-High, Version A

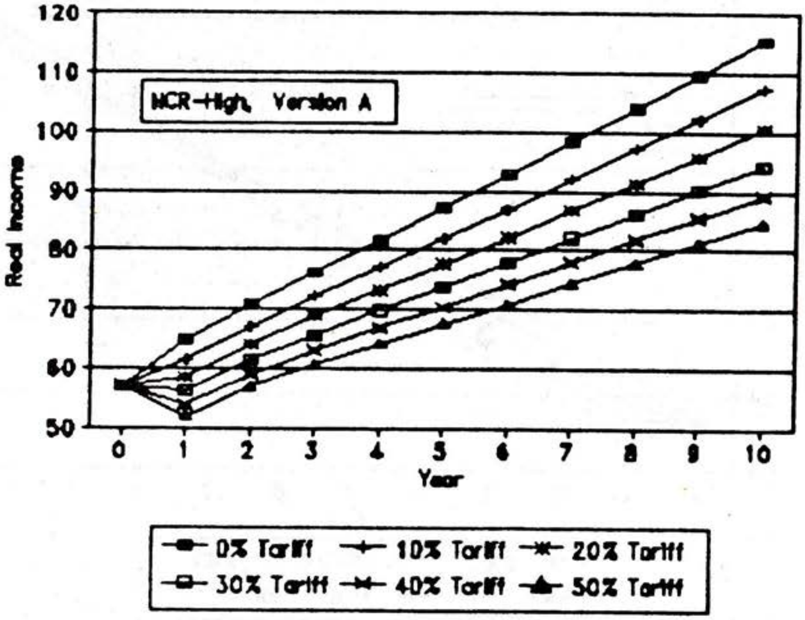


Figure 12 - Real Income Path Rural-Low, Version A

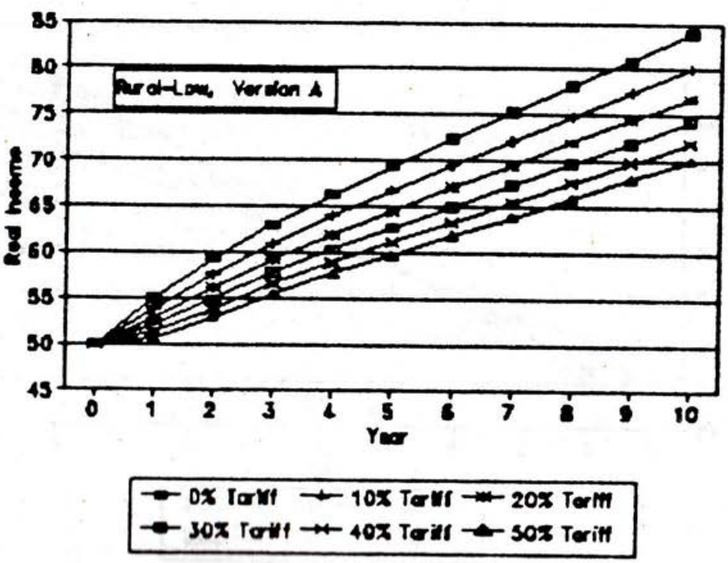


Figure 13 - Real Income Path NCR-High, Version B

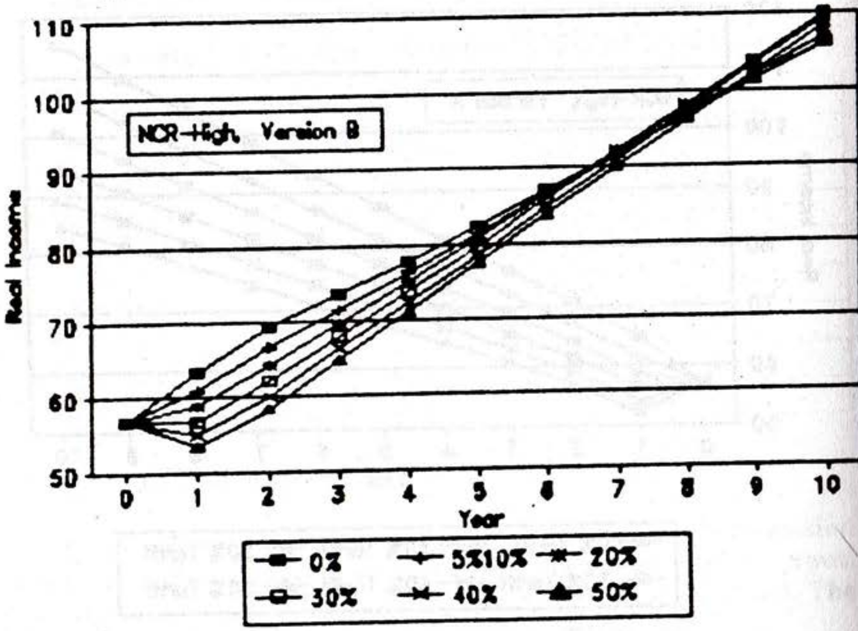
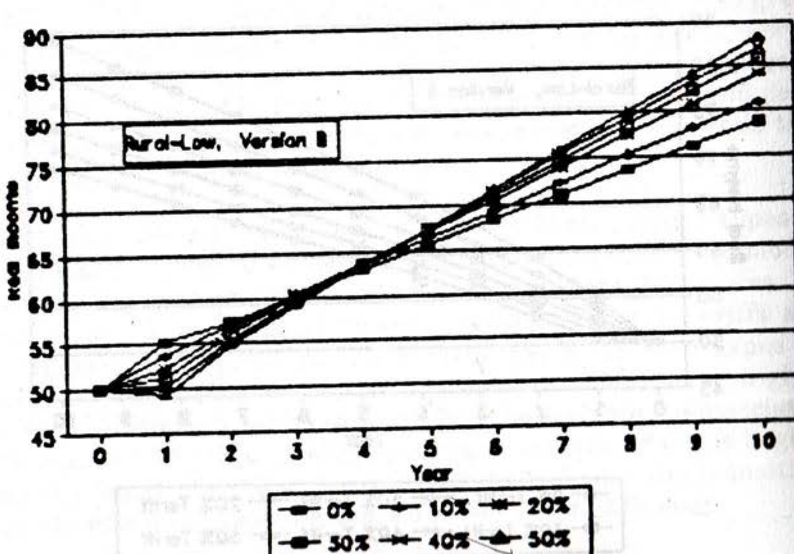


Figure 14 - Real Income Path Rural-Low, Version B



The average growth rates for the ten-year period of each household are all greater for more liberal tariff rates in model Version A, but not so in Version B.

Hence, a comparison of Gini coefficients at the terminal (10th) year between tariff rates (Table 6) shows that higher tariff rates result in slightly more equitable distributions of income for both model versions. These income distribution results also bear out the Kuznets effect that predicts growth may initially lead to a deterioration in the equitableness of the size distribution of income.[30] But again, the magnitude of these changes in income distribution is very modest.

Table 6 - Terminal Values of Gini Coefficients

	Initial Value	Terminal (10th Year) Value by Tariff Rate						
		0%	5%	10%	20%	30%	40%	50%
Version A	0.425	0.449	0.447	0.445	0.441	0.436	0.432	0.428
Version B	0.425	0.447	0.446	0.444	0.440	0.437	0.433	0.429

5. Conclusions

A CGE model has been used in this paper to place in proper perspective the approach to economic policy which calls for "getting prices right." The equilibria without growth for alternative tariff rates were first solved to compare the impact effects of tariff liberalization on output and the distribution of income. The dynamic paths of the equilibria were then estimated to compare their long-run consequences.

The results of the foregoing modeling exercise suggest that the economic output and income distribution influences of the price distortions of tariffs are indeed modest, especially for moderate tariff rates, e.g., tariffs less than 50 percent. They even indicate that because of influences other than comparative advantage, e.g., the labor-intensiveness of government consumption spending, higher

[30]See Kuznets (1955) for the inverted-U hypothesis on the relationship between income growth and distribution.

import-content of the consumption of rich households and changes in the relative price of capital to labor in response to differential rates of capital accumulation, there could be a slight deterioration in the equity of income distribution when tariffs are reduced.

It is the role of tariff as government revenue that significantly affects economic growth rather than improvements in factor allocation. When tariffs are liberalized government revenue falls, and this has a positive or negative effect on growth, depending on fiscal policy, via the change in the aggregate savings rate. In Version A of fiscal policy, tariff liberalization increases the growth rate, not only because a more efficient factor allocation increases aggregate income, but more importantly, because a drop in government revenue increases the aggregate savings rate.[31] In Version B, however, tariff liberalization decreases the growth rate because the drop in government revenue decreases the aggregate savings rate.[32] This finding leads to the conclusion that simply "getting prices right" will not guarantee growth nor improve the equity of income distribution. The trade liberalization program must be consistent with the government's fiscal policy if it is to be successful. Tariffs should not be reduced beyond a level that will seriously erode the government's ability to provide public goods and services.

A number of critical comments about the limitations of the model adopted for the analysis are in order. A more fully dynamic framework is clearly needed. The dynamic model used in the paper only partly endogenized the capital accumulation process. Household savings behavior was still characterized as shortsighted and unresponsive to investment incentives. A better model would have made the individual savings decisions of households more forward-looking.

Even with the limitations of the model, however, the results suggest that policymakers should be cautious about the ideological bent for trade liberalization driven by a neo-classical argument based on static efficiency. Trade liberalization is fast becoming

---

[31]Version A is the model version where government fiscal policy is fully constrained by the tariff revenue collection, e.g., a fixed deficit spending.

[32]Version B is the model version where the level of government spending is autonomous of the tariff revenue collection, e.g., a drop in tariff collection is fully accommodated by an increase in the government deficit.

codified into formal legislation in a number of countries (Globerman, 1990). Yet, as the paper demonstrates, the neo-classical argument that trade liberalization leads to economic development needs a substantial number of qualifications. Philippine policymakers would do well to be pragmatic in their approach to a trade liberalization program.

Despite some success in implementing trade liberalization, the Philippine economy has not performed as expected. The paper does not suggest that this should be blamed on the liberalization approach, but its does suggest that there is not much to expect, to begin with, from merely liberalizing the economy. It certainly is now painfully obvious that a preoccupation with liberalization and privatization has led the government to neglect some of its fundamental economic development functions — like the failure to implement a national energy development program in the past administration. The results of the simulations done in this paper certainly point to the limited economic push that can be expected from further tariff liberalization alone. The paper cautions that while trade liberalization may be a necessary component for a rapid and equitable growth development strategy, it is an insufficient component.

Appendix A - The Static Equilibrium Model

Production:

(1) $$Q_{fi} = A_{fi} * Q_i^{VA} * \left(P_i^{VA} / P_f\right)^{** \sigma_i^{VA}}$$

(2) $$P_i^{VA} = \left[\sum_{f=1}^{F} \left(A_{fi} * \; P_f^{**} (1 - \sigma_i^{VA})\right)\right]^{** 1/(1-\sigma_i^{VA})} \quad for\ \sigma_i^{VA} \neq 1$$

(3) $$Q_{ij}^{CMP} = A_{ij}^{INP} * \; Q_{ij}^{INP}$$

(4) $$P_i^{INP} = \sum_{j=1}^{N} (A_{ij}^{INP} * P_j^{CMP})$$

(5) $$Q_i^{INP} = A_i^{VA} * Q_i^{ACT} * \left(P_i^{ACT} \; / P_i^{VA}\right)^{**} \sigma_i^{ACT}$$

$$(6) \quad Q_i^{INP} = A_i^{INP} * Q_i^{ACT} * \left(P_i^{ACT} / P_i^{INP}\right) ** \sigma_i^{ACT}$$

$$(7) \quad P_i^{ACT} = \left[A_i^{VA} *(P_{i,}^{VA})^{**(1-\sigma_i^{ACT})} + A_i^{INP} *(P_i^{INP})^{**(1-\sigma_i^{ACT})}\right]^{**(1/(1-\sigma_i^{ACT}))} \quad \text{for } \sigma_i^{ACT} \neq 1$$

$$(8) \quad Q_i^{ACT} = (1/B_i^D) * Q_i^D *(P_i^{ACT} / P_i^D)^{**(1-\theta_i)} \quad \text{for } \theta_i \neq -\infty$$

$$(9) \quad Q_i^E = B_i^E * Q_i^{ACT} *(P_i^{ACT} / P_i^E)^{**(\theta_i - 1)} \quad \text{for } \theta_i \neq -\infty$$

$$(10) \quad P_i^E = P_i^{WE} * e * (1 - t_i^E)$$

$$(11) \quad P_i^D = \left[(1/B_i^D) * \left((P_i^{ACT})^{**(1-\theta_i)} - B_i^E *(P_i^E)^{**(1-\theta_i)}\right)\right]^{**(1/(1-\theta_i))}$$

$$(12) \quad Q_i^D = A_i^D * Q_i^{CMP} * \left(P_i^{CMP} / (P_i^D * (1 + t_i^D))\right)^{**\sigma_i^{CMP}}$$

$$(13) \quad Q_i^M = A_i^M * Q_i^{CMP} * \left(P_i^{CMP} / P_i^M\right)^{**\sigma_i^{CMP}}$$

$$(14) \quad P_i^M = P_i^{WM} * e * (1 + t_i^M)$$

$$(15) \quad P_i^{CMP} = \left[A_i^M *(P_i^M)^{1-\sigma_i^{CMP}} + A_i^D * \left(P_i^D (1 + t_i^D)\right)^{**(1-\sigma_i^{CMP})}\right]^{**(1/(1-\sigma_i^{CMP}))} \quad \text{for } \sigma_i^{CMP} \neq 1$$

when $\sigma_i^{VA} = 1$, then (2) becomes

$$(2a) \quad P_i^{VA} = \prod_{f=1}^{F} P_f^{**A_{fi}},$$

when $\sigma_i^{ACT} = 1$, then (7) becomes

$$(7a) \quad P_i^{ACT} = (P_i^{VA})^{**A_i^{VA}} * (P_i^{INP})^{**A_i^{INP}},$$

when $\sigma_i^{CMP} = 1$, then (15) becomes

$$(15a) \quad P_i^{CMP} = (P_i^M)^{**A_i^M} * \left(P_i^D(1+t_i^D)\right)^{**A_i^D},$$

when $\theta_i = -\infty$, then (8), (9), and (11) are replaced by

$$(8a) \quad P_i^D = P_i^E,$$

$$(9a) \quad P_i^{ACT} = P_i^D,$$

$$(11a) \quad Q_i^E = Q_i^{ACT} - Q_i^D.$$

Income Distribution and Demand Generation:

$$(16) \quad Y_f = P_f * \overline{Q_f} \quad \textit{for } f \neq \textit{Factor Abroad}$$
$$= \overline{Y_{FA}} * e \quad \textit{otherwise}$$

$$(17) \quad Y_h = \sum_{f=1}^{F} (H_{fh} * Y_f) + \overline{Y}_{Gh} + (H_{Fh} * \overline{Y}_{FA} * e)$$

$$(18) \quad Y_G = T_M + T_E + + T_D + + T_F + T_H + \sum_{h=1}^{H} (H_{fG} * Y_f)$$

$$(19) \quad T_H = \sum_{h=1}^{F} (Y_h * t_h^H)$$

$$(20) \quad T_F = \sum_{f=1}^{F} (Y_f * t_f^F)$$

$$(21) \quad T_D = \sum_{i=1}^{N} (Q_i^D * P_i^D * t_i^D)$$

$$(22) \quad T_E = \sum_{i=1}^{N} (Q_i^E * \overline{P_i^{WE}} * e * t_i^E)$$

$$(23) \quad T_M = \sum_{i=1}^{N} (Q_i^M * \overline{P_i^{WM}} * e * t_i^M)$$

(24) $$Y_h^C = Y_h * (1 - t_h^H - S_h)$$

(25) $$Q_{ih}^{CMP} = \alpha_{ih} + \left[\frac{\beta_{ih}}{P_i^{CMP}} * \left(Y_h^C \sum_{k=1}^{N} \alpha_{ih} * P_i^{CMP} \right) \right]$$

(26) $$Q_h^C = \sum_{i=1}^{N} Q_{ih}^{CMP}$$

(27) $$P_h^C = Y_h^C / Q_h^C$$

(28a) $$Y_G^C = Y_G - \sum_{h=1}^{H} \overline{Y}_{Gh} - \overline{Y}_{GF} * e - \overline{S}_G \text{, for Version A}$$

(28b) $$S_G = Y_G - \sum_{h=1}^{H} \overline{Y}_{Gh} - \overline{Y}_{GF} * e - Y_G^C \text{, for Version B}$$

(29a) $$Q_G^C = Y_G^C / P_G^C \text{, for Version A}$$

(29b) $$Y_G^C = \overline{Q_G^C} * P_G^C \text{, for Version B}$$

(30) $$P_G^C = \prod_{i=1}^{N} (P_i^{CMP})^{**A_{iGC}}$$

(31) $$Q_{iG}^{CMP} = A_{iGC} * Q_G^C$$

(32a) $$S = \sum_{h=1}^{H} (S_h * Y_h) + \overline{S}_G + \overline{S}_F * e, \text{ for Version A}$$

(32b) $$S = \sum_{h=1}^{H} (S_h * Y_h) + S_G + \overline{S}_F * e, \text{ for Version A}$$

(33) $$S = I_s + I_G + I_p$$

(34) $$I_s = \sum_{i=1}^{N} (P_i^{CMP} * Q_{iSI}^{\overline{CMP}})$$

(35) $$I_G = P_G^I * Q_G^{\overline{I}}$$

(36) $$P_G^I = \prod_{i=1}^{N} (P_i^{CMP})^{**A_{iGI}}$$

(37) $$Q_{iGI}^{CMP} = A_{iGI} * Q_G^{\overline{I}}$$

(38) $$Q_P^I = I_p / P_P^I$$

(39) $$P_P^I = \prod_{i=1}^{N} (P_i^{CMP})^{**A_{iPI}}$$

(40) $$Q_{iPI}^{CMP} = A_{iPI} * Q_P^I$$

(41) $$Q_{iI}^{CMP} = Q_{iSI}^{\overline{CMP}} + Q_{iGI}^{CMP} + Q_{iPI}^{CMP}$$

(42) $$Q_i^{CMP} = \sum_{j=1}^{N} Q_{ij}^{CMP} + \sum_{h=1}^{H} Q_{ih}^{CMP} + Q_{iG}^{CMP} + Q_{iI}^{CMP}$$

Equilibrium Conditions:

(43) $$\overline{Q_f} = \sum_{f=1}^{F} Q_{fi} + \epsilon_f$$

(44) $$P_f * \epsilon_f = 0$$

$$(45)\quad \left[\sum_{i=1}^{N}(P_i^{WE} * Q_i^{E})\right] + \overline{Y}_{FA} + S_F = \left[\sum_{i=1}^{N}(P_i^{WM} * Q_i^{M})\right] + \left[(\sum_{f=1}^{F} H_{fP} * Y_f)/e\right] + \overline{Y}_{GF} + \epsilon_F$$

$$(46)\quad e * \epsilon_f = 0$$

$$(47)\quad P_h^{C} = 1, \textit{for } h = NCR - \textit{Middle Income}$$

Endogenous Variables:

1) Q_{fi}	quantity of factor *f* allocated to sector *i*
2) Q_i^{VA}	quantity of value-added formed in sector *i*
3) Q_i^{INP}	quantity of aggregate input in sector *i*
4) Q_i^{ACT}	quantity of activity output in sector *i*
5) Q_i^{D}	quantity of output sold domestically in sector *i*
6) Q_i^{E}	quantity of output exported in sector *i*
7) Q_i^{M}	quantity of import in sector *i*
8) Q_i^{CMP}	quantity of composite commodity supplied by sector *i*
9) Q_{ij}^{CMP}	quantity of composite commodity *j* used as input in sector *i*
10) P_i^{VA}	price of value-added in sector *i*
11) P_i^{INP}	price of aggregate input in sector *i*
12) P_i^{ACT}	price of activity output of sector *i*
13) P_i^{D}	price of domestic output of sector *i*
14) P_i^{E}	price of export of sector *i*
15) P_i^{M}	price of import of sector *i*
16) P_i^{CMP}	price of composite commodity of sector *i*
17) P_f	price of use of factor *f*
18) e	the exchange rate
19) Y_f	income of factor *f*
20) Y_h	income of household *h*
21) Y_G	income of government
22) T_H	household income tax payments
23) T_F	factor income tax payments
24) T_D	domestic sales tax payments
25) T_M	import tax payments
26) T_E	export tax payments
27) Y_h^{C}	consumption expenditure of household *h*
28) Q_h^{C}	quantity of aggregate consumption of household *h*
29) P_h^{C}	consumption price index for household *h*
30) Q_{ih}^{CMP}	quantity of commodity *i* consumed by household *h*
31) Y_G^{C}	consumption expenditure of government

32) Q_G^C	quantity of aggregate consumption of government (endogenous in Version A)
33) P_G^C	consumption price index for government
34) Q_{iG}^{CMP}	quantity of commodity i consumed by government
35) S	the aggregate savings
36) S_G	the government savings (endogenous in B)
37) I_S	the cost of commodity stocks
38) I_G	the cost of public investment
39) Q_{iGI}^{CMP}	the quantity of commodity i consumed by public investment
40) P_G^I	the price index for public investment
41) I_P	the cost of private investment
42) Q_P^I	the quantity of aggregate private investment
43) P_P^I	the price index for private investment
44) Q_{iPI}^{CMP}	the quantity of commodity i consumed by private investment
45) Q_{iI}^{CMP}	the total quantity of commodity i consumed by investments
46) ϵ_f	the slack variable in the factor market equation
47) ϵ_f	the slack variable in the balance of payments equation

Exogenous Variables:

Environmental

1) P_i^{WE}	the world price for the export of sector i
2) P_i^{WM}	the world price for the import of sector i
3) Q_f	the quantity of factor f
4) Y_{FA}	the value of receipts from factors abroad
5) Q_{iSI}^{CMP}	the quantity of commodity i stored as stock

Policy

6) t_i^E	the export tax rates
7) t_i^M	the import tax rates
8) t_i^D	the domestic sales tax rates
9) t_f^F	the factor income tax rates
10) t_h^H	the household income tax rates
11) Y_{Gh}	the household transfer payments by government
12) Y_{GF}	the international payment by government
13) Q_G^C	the real level of government consumption (exogenous in Version B)
14) S_G	the savings of government (exogenous in Version A)
15) S_F	the balance of payments deficit (foreign savings or reserve drawdown)
16) Q_G^I	the real level of public investment

Model Parameters:

σ_{iVa}, σ_i^{ACT}, σ_i^{CMP} are the CES substitution elasticities for the formation of value-added, activity output, and composite commodity, respectively.
A_{fi}, A_i^{VA}, A_{ij}^{INP}, A_i^{INP}, A_i^{M}, A_i^{D} are the share coefficients in the CES functions,
θ_i is the CET transformation elasticity in sector i, while B_i^D and B_i^E are the share coefficients, H_{fh}, H_{fg}, H_{fF} are the ownership shares of factor f by household h, government, and foreigners, while H_{Fh} is the ownership share of factors abroad by household h,
s_h is the savings rate while α_{ih} and β_{ih} are the LES parameters for household h,
A_{iGC}, A_{iGI} and A_{iPI} are the fixed shares of commodity i in the formation of aggregate

References

Adelman, Irma and Robinson, S. (1978), *Income Distribution Policies in Developing Countries: A Case Study of South Korea*, Stanford: Stanford University Press.

Afzal, M. and Guisinger, S. (1974) "Measuring Gains from Trade — A Case Study of Pakistan's Trade with India," *Pakistan Development Review*, 18(1):13-25.

Ahammed, Chowdhury and Herdt, Robert (1981), "A General Equilibrium Analysis of the Effects of Rice Farm Mechanization in the Philippines," The Consequences of Small Rice Farm Mechanization Project Working Paper No. 19, IRRI, Los Baños, Laguna.

Ahluwalia, Montek, and Lysy, Frank (1979), "Welfare Effects of Demand Management Policies: Impact Multiplier Under Alternative Model Structures," *Journal of Policy Modeling*, 1(3).

Alam, Shahid (1991),"Trade Orientation and Macroeconomic Performance in LDC's: An Empirical Study," *Economic Development and Cultural Change*, 39(4).

Armington, P.S. (1969), "A Theory of Demand for Products Distinguished by Place of Production," *IMF Staff Papers*, 16:159-76.

Balassa, Bela (1978), "Exports and Economic Growth: Further Evidence," *Journal of Development Economics*, 5(2):181-89.

Ballard, Charles, Fullerton, Don *et al.* (1985), *A General Equilibrium Model for Tax Policy Evaluation*, Chicago: The University of Chicago Press.

Bautista, Carlos (1987), "Macroeconomic Adjustment: An Applied General Equilibrium Approach," Ph.D Dissertation, School of Economics, University of the Philippines.

Bautista, Romeo (1986), "Multisectoral Analysis of Trade Liberalization: The Philippines, 1978," *Philippine Economic Journal*, 25(3 & 4).

Bautista, Romeo (1987), "Production Incentives in Philippine Agriculture: Effects of Trade and Exchange Rate Policies," *Research Report No. 59*, International Food Policy Research Institute, Washington, D.C.

Brooke, Anthony, Kendrick, D. and Meeraus, A. (1988), *GAMS: A User's Guide*, Redwood City, Ca.: Scientific Press.

Clarete, Ramon (1984), "The Cost and Consequences of Trade Distortions in a Small-Open Economy: A General Equilibrium Model of the Philippines," Ph.D. Thesis, Economics Department, University of Hawaii.

Clarete, Ramon (1989), "Trade Liberalization and Philippine Agriculture," Paper for the Secretary of Agriculture, Department of Agriculture, Manila.

Clarete, Ramon and Whalley, John (1988), "Interaction Between Trade Policies and Domestic Distortion in a Small Open Developing Country," *Journal of International Economics,* 24(3):345-58.

Corden, Max (1971), "The Effects of Trade on the Rate of Growth," In Jagdish Bhagwati, *et al*. (eds.), *Trade, Balance of Payments, and Growth*, Amsterdam: North-Holland Publishing Company.

Corden, Max (1974), *Trade Policy and Economic Welfare*, Oxford: Oxford University Press.

Coxhead, Ian and Warr, Peter (1991), "Technical Change, Land Quality, and Income Distribution: A General Equilibrium Analysis," *American Journal of Agricultural Economics,* 73(2):345-60.

Dahl, Hendrick, Devarajan, S. and van Winbergen, S. (1986), "Revenue-Neutral Tariff Reform: Theory and an Application to Cameroon," Discussion Paper No. 1986-25, Country Policy Department, Washington, D.C.: World Bank.

Dervis, Kemal, de Melo, J. and Robinson, S. (1985), *General Equilibrium Models for Development Policy*, Cambridge: Cambridge University Press.

Devarajan, Shantayana and Offerdal, E. (1989), "Capital Markets and Computable General Equilibrium Models...," *Journal of Policy Modeling*, 11(2):131-212.

Drud, Arne and Kendrick, David (1986), "HERCULES: A System for Large Economywide Models," *A World Bank Manual*, Washington, D.C.: World Bank.

Emery, Robert (1967), "The Relation of Exports and Economic Growth," *Kyklos*, 20:470-86.
Feder, Gershon (1983), "On Export and Economic Growth," *Journal of Development Economics*, 10(1).
Gaspay, Manuel (1993), "Trade Liberalization in the Philippines and the Fiscal Policy Constraint: A CGE Modeling Approach," Ph.D. Thesis, Food Research Institute, Stanford University.
Globerman, Steven (1990), "Trade Liberalization and Competitive Behavior," *Journal of Policy Analysis and Management*, 9(1):80-88.
Greenway, David and Milner, Chris (1991), "Fiscal Dependence on Trade Taxes and Trade Policy Reform," *Journal of Development Studies*, 27(3).
Habito, Cielito (1984), "Equity and Efficiency Trade-offs in Philippine Tax Policy Analysis," Ph.D. Thesis, Department of Economics, Harvard University.
Habito, Cielito (1986), "Intersectoral Linkages and Agricultural Policies: A General Equilibrium Analysis," University of the Philippines at Los Baños.
Harberger, Arnold (1959), "Using the Resources at Hand More Effectively," *American Economic Review*, 49(2):134-46.
Hecksher, Eli (1919), "The Effects of Foreign Trade on the Distribution of Income," reprinted and translated from the original in the American Economic Society's *Readings in the Theory of International Trade* (Philadelphia: Blakiston and Co., 1949).
Johnson, Harry (1960), "The Cost of Protection and the Scientific Tariff," *Journal of Political Economy*, 68(4).
Johnson, Harry (1965), "Costs of Protection and Self-Sufficiency," *Quarterly Journal of Economics*, 79(3):356-72.
Johnson, Harry (1971), "The Theory of Trade and Growth: A Diagrammatic Analysis," In Jagdish Bhagwati *et al.* (eds.), *Trade, Balance of Payments, and Growth*, Amsterdam: North-Holland Publishing Company.
Krueger, Anne (1974), "The Political Economy of the Rent-Seeking Society," *American Economic Review*, 64(3):291-303.
Krueger, Anne (1980), "Trade Policy as an Input to Development," *American Economic Review*, 70(2):288-92.
Kuznets, Simon (1955), "Economic Growth and Income Inequality," *American Economic Review*, 45(1):1-28.
Lysy, Frank and Taylor, Lance (1980), "A Computable General Equilibrium Model for the Functional Distribution of Income: Experiments for Brazil, 1959-71", In L. Taylor *et al.* (eds.), *Models for Growth and Distribution for Brazil*, London: Oxford

University Press.

Maizels, Alfred (1968), *Exports and Economic Growth of Developing Countries*, Cambridge, Ma.: Cambridge University Press.

Mansur, Ahsan and Whalley, J. (1984), "Numerical Specification of Applied General Equilibrium Models...", In H. Scarf and J. Shoven, *Applied General Equilibrium Analysis*, Cambridge: Cambridge University Press.

Michaely, Michael (1977), "Exports and Growth: An Empirical Investigation," *Journal of Development Economics*, 4(1):49-53.

Michalopoulos, C., and Jay, K. (1975), "Growth of Exports and the Income in the Developing World: A Neo-Classical View," Discussion Paper No. 28, U.S.A.I.D., Washington, D.C.

NCSO (National Census and Statistics Office), Republic of the Philippines, *1983 Interindustry Accounts of the Philippines.*

NCSO, *1985 Family Income and Expenditure Survey*.

NEDA (National Economic Development Authority), Republic of the Philippines, *Philippine Statistical Yearbook*, various years.

Ohlin, Bertil (1933), *Interregional and International Trade*, Cambridge, Ma.: Harvard University Press.

Paukert, F. (1973), "Income Distribution at Different Levels of Development: A Survey of Evidence," *International Labor Review*, (Aug.-Sept.): 97-125.

Pletcher, James (1991), "Regulations with Growth: The Political Economy of Palm Oil in Malaysia," *World Development*, 19(6):623-36.

Powell, Alan and Gruen, F. (1968), "The Constant Elasticity of Transformation Production Function...", *International Economic Review*, 9(3).

Ricardo, David (1817), *Principles of Political Economy*, reprinted by Penguin Press, New York, 1971.

Robinson, Sherman (1990), "Analyzing Agricultural Trade Liberalization with Single-Country Computable General Equilibrium Models," Paper presented at the OECD/World Bank Symposium on "Agricultural Trade Liberalization: Implications for Developing Countries", Paris.

Rodrik, Dani (1992), "Conceptual Issues in the Design of Trade Policy for Industrialization," *World Development*, 20(3).

Samuelson, Paul (1938), "Welfare Economics and International Trade," *American Economic Review*, 28(2):261-68.

Sherwood, Joyce (1956), "Revenue Features of Multiple Exchange Rate Systems: Some Case Studies," *IMF Staff Papers*, 5(1).

Solow, Robert (1956), "A Contribution to the Theory of Economic Growth," *The Quarterly Journal of Economics*, 57(1):65-94.

Stolper, W. and Samuelson, P. (1941), "Protection and Real Wages," *Review of Economic Studies*, 9(1):58-73.

World Bank (1982, 1988 and 1991), *World Development Report*, Washington, D.C.: World Bank.

World Bank (1990), *The Philippine Country Economic Memorandum: Issues in Adjustment and Competitiveness*, Washington, D.C.: World Bank.