POLICY ANALYSIS PROJECT, PHASE II

Under contract to the Agency for International Development, Bureau for Science and Technology, Office of Agriculture
Project Office Hampden Square, 4800 Montgomery Lane, Suite 500, Bethesda, MD 20814 • Telephone (301) 913-0500
Telex: 312636 • Fax: (301) 652-7530 • Fax: (301) 652-7791

THE IMPACT OF TRADE LIBERALIZATION ON THE PHILIPPINE ECONOMY:

A CGE MODELING APPROACH

January 1992

APAP II
Collaborative Research Report No. 326

Prepared for

Agricultural Policy Analysis Project, Phase II (APAP II)
A.I.D. Contract No. DAN-4084-Z-00-8034-00

Authors: **Manuel S. Gaspay, Food Research Institute, Stanford University**
Carl H. Gotsch, Food Research Institute, Stanford University

Prime Contractor: **Abt Associates Inc.,** 55 Wheeler Street, Cambridge, MA 02138 • (617) 492-7100

Subcontractors: **Harvard Institute for International Development,** Harvard University, One Eliot Street, Cambridge, MA 02138 • (617) 495-2164
Food Research Institute, Stanford University, Stanford, CA 94305-6084 • (415) 723-3941
North Carolina State University, Department of Economics and Business, Box 7645, Raleigh, NC 27695-7645 • (919) 737-7187
Abt, Daft & Earley, 1410 King Street, Alexandria, VA 22314 • (703) 739-9090
International Science and Technology Institute, 1129 20th Street, NW, Suite 800, Washington, D.C. 20036 • (202) 785-0831
International Food Policy Research Institute, 1776 Massachusetts Avenue, NW, Washington, D.C. 20036 • (202) 862-5600

TABLE OF CONTENTS

ABSTRACT 1

EXECUTIVE SUMMARY 2

1. INTRODUCTION 1
   1.1 Rationale 1
   1.2 Plan of Presentation 2

2. MODELING SECTOR INTERACTIONS IN TRADE POLICY ANALYSIS 3
   2.1 Comparative Advantage and the Neo-Classical Trade Model 3
   2.2 Effective Rates of Protection and Related Concepts 5
   2.3 Income Linkages and Economy-wide Modeling 6

3. CONSTRUCTION OF A CGE MODEL FOR THE PHILIPPINES 9
   3.1 The TV Modeling Approach 9
   3.2 A Single-Period Static Model 10
      3.2.1 The Production System 11
      3.2.2 The System of Factor Accounts 15
      3.2.3 The Household System 16
      3.2.4 The Government System 17
      3.2.5 The System of Savings/Investment 18
      3.2.6 The System of External Accounts 18
      3.2.7 The Closure System 19
   3.3 A Multi-Period Dynamic Extension 19

4. THE TRADE POLICY SIMULATIONS 21
   4.1 Plan of the Simulations 21
   4.2 The Static Model Simulation Results 22
      4.2.1 Trade Restrictiveness 22
      4.2.2 Trade Bias 27
   4.3 The Dynamic Extension Results 31
      4.3.1 Trade Restrictiveness 31
      4.3.2 Trade Bias 33

5. SUMMARY AND RECOMMENDATIONS 45

6. REFERENCES 49

LIST OF TABLES

Table 3.1. Production Sectors 12
Table 3.2. Production Elasticities 15
Table 3.3. Factor Accounts 16

Table 4.1. GDP % Change from Base Run (Static Model) 23
Table 4.2. Production by Tariff Level 24
Table 4.3. Share of Production by Tariff Level (Percent) 25
Table 4.4. Net Trade Levels and Net Trade Ratios By Tariff Level 26
Table 4.5. Production by Protection Bias 29
Table 4.6. Net Trade and Net Trade Ratios By Protection Bias 30
Table 4.7. GDP Growth Rates (Percent) by Tariff Level 31
Table 4.8. Growth of Production (Version A) By Tariff Level 34
Table 4.9. Growth of Production (Version B) By Tariff Level 35
Table 4.10. Changes in Trade Structure by Tariff Level 36
Table 4.11. % Growth of Real Expenditures By Tariff Level 37
Table 4.12. GDP Growth Rates (Percent) by Trade Bias 33
Table 4.13. Production Growth by Protection Bias (Version A) 38
Table 4.14. Production Growth by Protection Bias (Version B) 39
Table 4.15. Changes in Trade Patterns 40
Table 4.16. % Growth of Real Expenditures By Protection Bias 44

LIST OF FIGURES

Figure 2.1. No Trade vs. Free Trade 3
Figure 2.2. Free Trade vs. Trade with Tariff 4
Figure 2.3. The Circular Flow of Income 8

Figure 3.1. Flow of Production 13

Figure 4.1. GDP by Tariff Level 22
Figure 4.2. GDP Difference from Free Trade Policy 27
Figure 4.3. GDP Change from the Base Trade Policy 28
Figure 4.4. GDP Growth Paths (Version A) 32
Figure 4.5. GDP Growth Paths (Version B) 33
Figure 4.6. GDP Growth Paths by Protection Bias (Version A) 41
Figure 4.7. GDP Growth Paths by Protection Bias (Version B) 41
Figure 4.8. Shift of the Production Possibility Frontier 42

ABSTRACT

The paper examines the impact of trade policy on the growth and distribution of income in the Philippines, especially in the agricultural sector. Varying levels of trade restrictiveness and alternative biases in trade protection are simulated in a computable general equilibrium (CGE) model calibrated to the 1983 structure of the Philippine economy. The model disaggregates the economy into 17 production sectors and 9 types of households. There are three types of productive factors: labor, mobile capital, and fixed capital. The model adopts a Walrasian closure that allows it to address issues of trade policy and resource allocation efficiency. The analysis includes a dynamic extension of the static CGE model in which repeated solutions are linked by capital stock updates. The effects of trade liberalization on growth are traced over a ten-year period.

The influence of government behavior on policy performance is examined under two specifications of government spending behavior. In one version, government consumption is assumed to adjust fully to changes in government revenue. In the other, the government maintains a fixed real level of government consumption. All simulations are implemented using the transactions value approach (TV) in a GAMS/HERCULES software system.

The simulations lead to the following findings. First, there are only modest gains in GDP level and growth from the improved allocation of factors that results from the removal of trade distortions. This suggests that to obtain the impressive aggregate income growth rates empirically associated with successful trade liberalization experiences, the government must do more than get prices right.

Second, the most powerful impact of liberalized tariff policy is the shift of income from the government to the households. The implication for policy is that trade liberalization must be accompanied by a corresponding reduction in government consumption expenditure and policies to encourage increased private savings.

Third, a trade protection structure biased in favor of industrial sectors does poorly in comparison with one that is biased in favor of food and agricultural sectors. The government should therefore reverse its policy of liberalizing much faster food and agricultural imports in comparison to the liberalization of industrial imports.

Fourth, income distribution effects are not pronounced between households. This finding must be treated with caution, however, since this is the result of the model's relatively high level of household and factor aggregation.

Fifth, comparative advantage in agriculture declines as the Philippine economy grows. This is due to the higher dependency of agricultural production on fixed factors, i.e., natural resources. The viability of agricultural communities over the long run will require substantial investments in human capital and agricultural technology.

EXECUTIVE SUMMARY

Trade policy has always been a contentious political issue in the Philippines and the recent debates on the extent and timing of liberalization are no exception. Currently, the climate for reform seems to be reasonably positive. Business and political leaders appear to have adopted more favorable attitudes toward the removal of trade restrictions as a result both of pressure from the IMF and the World Bank and the example of other ASEAN countries.[1] Unfortunately, the current implementation of tariff reductions may actually exacerbate previous policy distortions. As Clarete (1989) notes, agriculture, historically the least protected sector, is being liberalized faster than the non-agriculture sector. This increases the distortion in the domestic terms of trade between tradeable agricultural goods and tradable non-agriculture goods, even though it reduces the distortions in the real exchange rate.

The present paper investigates several liberalization scenarios with the help of a computable general equilibrium (CGE) model. The model makes it possible to examine the effect of alternative trade policies on the level, growth, and distribution of income, especially as it effects the agricultural sector. Although the use of a CGE approach is not new in the Philippines, the paper makes two contributions to the present debate. First, it emphasizes the influence of government spending as a determinant of how trade liberalization affects aggregate income. The static economic efficiency of liberal trade policies is ordinarily demonstrated in a CGE model by assuming that government turns over its revenues (e.g., tax collections) to households (Clarete and Waley, 1988), or at least that the government adheres to its income constraint. These assumptions are meant to eliminate or minimize the impact of government behavior on the model's results. In this paper, assuming alternative government spending scenarios underscores the fact that inflexibility in government spending in the face of falling revenues due to trade liberalization will lead to lower aggregate income levels.

The paper also explores the dynamic impact of removing distortions from trade interventions. It is commonly supposed that trade liberalization, by correcting price signals, improves resource allocation and leads to a higher GDP growth path as higher levels of capital accumulation occur in each period. The results of the model suggest that this is not automatic. Trade liberalization, by redistributing income among spending units, e.g. between households and government, changes the aggregate savings rate. If the government has a higher propensity to save than the private sector, trade liberalization may lead to a lower GDP growth rate.

The static model disaggregates the Philippine economy into 17 production sectors and 9 types of households. There are three types of factors: labor, mobile capital, and fixed capital. Production is described in neo-classical fashion. Factors can be substituted in the formation of value-added using a constant elasticity of substitution (CES) functional form. Consumption choice is modeled as a linear expenditure system (LES).

The overall character of the model is neo-classical as it adopts a Walrasian closure, i.e., levels of factors are set exogenously and they are always fully employed. Foreign trade is

---

[1] For a review of the ASEAN experience, see Gaspay and Gotsch (1991)

modeled by assuming that the Philippines is a small country with no power to alter international prices. It is assumed that exports, imports, and domestic goods have some degree of differentiation. Therefore, although the prices of these goods are closely linked, there are some degrees of freedom that are driven by assumptions about trade elasticities. The foreign exchange market is assumed to clear as a result of exchange rate adjustments. Only the real side of the economy is modeled. Parameters of the model are calibrated to a 1983 social accounting matrix of the Philippines.

The dynamic extension of the model consists of repeated solutions linked by capital stock updates. Investments in one period become mobile capital in the next period. Mobile capital, once allocated to a sector according to marginal conditions, augments the stock of fixed capital in that sector in the next period. The impact of an investment response to policy in period t, therefore, has an impact on production in period t + 1. Labor growth is an exogenous parameter calibrated to the 1983 population growth rate.

Two groups of simulations were performed. In one group, tariffs were assumed to be uniform across sectors and varied from 10 percent to 50 percent. In the second group, tariffs were different for the food and agricultural sectors compared to the industrial and services sectors. The differences between runs in this simulation are therefore attributable to differences in trade protection bias. The results of the simulations are analyzed in terms of changes in the GDP, activity levels of the sectors, and real incomes of households.

The simulations lead to the following conclusions:

1. There are modest gains in GDP level and growth from the improved allocation of factors that come with liberal trade policies. According to the model, full trade liberalization in 1983, for example, would have increased the GDP by 0.37%. The order of magnitude of these results are in accordance with most estimates of this type of gain from free trade, though it belongs to the lower range of these estimates. If the empirical observation that liberal trade policies and economic growth are strongly correlated is correct, additional dimensions of growth such as technical change and increasing returns need to be incorporated in the model.

2. The most powerful impact of liberalized tariff policy is the shift of income from the government to households. Growth and the success of liberalized trade policies is highly influenced by the spending behavior of government. The implication for policy is that trade liberalization must be accompanied by a corresponding reduction in government consumption expenditure and policies to encourage increased private savings.

3. A trade protection structure biased in favor of industrial sectors does poorly in comparison with one that is biased in favor of food and agricultural sectors. The government should therefore reverse its policy of liberalizing food and agricultural imports faster than it liberalizes industrial imports.

4. Income distribution effects are not pronounced between households. This finding must be treated with caution, however, since this is the result of the model's relatively high level of household and factor aggregation.

5. Comparative advantage in agriculture declines as the Philippine economy grows. This is due to the higher dependency of agricultural production on fixed factors, i.e., natural resources. Even a protect-agriculture bias will not prevent increasingly rapid movement toward urban industry. Although not derived from the model, the implication of this last finding is that the viability of agricultural communities will depend on heavy investments in human capital and agricultural technology.

1. INTRODUCTION

1.1 Rationale

Trade protection has always been a contentious political issue in the Philippines. Ever since the country was opened to free trade by the United States in the 1920's, competing economic interests in the country have sought to influence the government's trade policy. During the 1920's, the articulation of economic interests in the country was dominated by the rice landowners and the sugar planters who had opposing interests with regard to the new free trade policy.[2] The former stood to lose from liberalized trade due to competition from cheap Indo-Chinese rice, while the latter stood to gain because of their international competitiveness, especially in the protected U.S. sugar market.

The government resolved this conflict of interest by proceeding with generally liberalized foreign trade policy, for example, low export taxes and import tariffs with few quantitative restrictions. The notable exceptions were rice and corn imports which were awarded prohibitive tariff rates. This compromise set the tone for a government approach to trade policy formulation that led to an increasingly complicated trade policy structure, marked by numerous government interventions that offset unwanted indirect effects brought about by prior interventions. Even during the import-substituting, industry-led development policies of the 1950's, the government used high tariffs and import prohibitions to protect certain agricultural products.

The irony in this sectoral approach to trade policy is that it negates or dilutes the power of prior sectoral incentives, while escalating the degree of domestic price distortions. The accumulation of unwieldy distortions, each designed for a particular interest group, creates a patchwork of incentives whose actual incidence is difficult, if not impossible, to untangle. Because of sector interactions, the pursuit of protective incentives in one sector cannot be separated from the welfare effects on another sector and on the economy as a whole.

As shown in a companion paper (Gaspay and Gotsch, 1992), comparing the development experiences of ASEAN countries and their policies affecting agriculture suggests that there are strong links between high economic growth and more liberalized trade policies. This experience has been important in stimulating current efforts at liberalizing trade policies in the Philippines.[3] However, the phased implementation of these liberalization measures has proceeded unevenly. Removal of protective measures has been speeded up for agricultural and food products and delayed for industrial products (Clarete, 1989). As pointed out by Clarete and others (e.g., Bautista, 1987), the existing trade protection structure is, on a net basis, already biased against agricultural sectors. Current trade reforms are worsening the incentives to rural producers relative to urban industrialists and creating potential inefficiences in economy-wide resource allocation.

---

[2] See McCoy and de Jesus (1981) for compiled accounts of pre-war international trade development and its impact on Philippine society.

[3] The ongoing Tariff Reform Program and Import Liberalization Program were began in 1981. Since that time, the average equivalent tariff level has dropped substantially and the trade regulations much simplified (Baldwin, 1990; Medalla, 1990).

The goal of the present study is to examine the impact of trade policy on the growth and distribution of income in the Philippine economy. Different trade policy regimes reflecting varying degrees of trade restrictiveness and sectoral bias are simulated using a computable general equilibrium (CGE) representation of the Philippine economy. The general approach is not new.[4] Clarete (1989), for example, has conducted a number of trade policy simulations for the Philippines also using a CGE modeling approach. There are, however, three aspects of the present study that add to the Philippine CGE literature. First, there is an explicit emphasis on the role of government spending behavior in influencing the effects of trade liberalization on aggregate income level and its growth. Second, the basic static CGE formulation is extended to explore the dynamic effects of trade intervention distortions. Particular attention is given to the impact of trade policy on capital formation and economic growth. The final departure from previous work is in the area of computation. The study introduces, to the Philippine audience at least, an economy-wide model using the transactions value approach (TV) in a GAMS/HERCULES software system.[5]

1.2 Plan of Presentation

Section 2 begins with a discussion of sector interactions and how they have been modeled in both theoretical and applied work on trade policy. The purpose of the review is to provide a justification for the effort required to implement a CGE modeling approach to trade policy analysis.

Section 3 develops the logic of the TV approach to CGE modeling and shows how it can be used to construct static and dynamic models for the Philipines.

Section 4 presents the results of trade policy simulations using two versions of both the static and dynamic formulations of the CGE model. The two versions of each model are differentiated by the specification of government spending behavior. The results underscore the importance of assumptions about government behavior in arriving at conclusions about the gains from more liberal trade policies.

Section 5 summarizes the results of the simulation exercises and makes a series of recommendations for trade policy in the Philippines.

---

[4] Prior CGE modeling applications for the Philippines can be found in Habito (1984), Clarete (1984, 1989), and C. Bautista (1987).

[5] GAMS is a high-level programming language named the General Algebraic Modeling System developed by Brooke, Kendrick, and Meeraus (1988). HERCULES stands for Highlevel Economic Representation for Creating and Using Large Economywide Systems and was developed by Drud and Kendrick (1986). The TV approach in GAMS/HERCULES is associated with work done at the World Bank by Pyatt, Grais, Drud, and Kendrick (Drud, Grais, and Pyatt, 1983: Drud and Kendrick, 1986).The idea is to automate the CGE modeling process in order to easily vary not only model parameters but behavioral specifications as well. A competing approach is Rutherford's MPS/GE software system, developed at the Operations Research Department of Stanford University in 1986, using an activity analysis approach to CGE modeling (Rutherford, 1986).

2. MODELING SECTOR INTERACTIONS IN TRADE POLICY ANALYSIS

2.1 Comparative Advantage and the Neo-Classical Trade Model

The tension between pressures for policy interventions and a country's comparative advantage has been a central theme of economics since its infancy. Classical writers like Ricardo (1817) understood that by protecting one sector, resources would be drawn from other sectors. Ricardo's celebrated trade model, subsequently extended by Hecksher (1919), Ohlin (1933), and Samuelson (1938), to what is now the neo-classical trade model, showed that international prices were the correct signals for allocating domestic resources efficiently, at least for the case of a country with little power to affect international prices.[6] But this has not put an end to various forms of market interventions since objectives such as income distribution, food security, and sustainability are legitimate goals of public policy.

The logic of the simple neo-classical trade model is shown in Figure 2.1. The competition for fixed resources results in a set of production combinations between the two sectors that is delimited by the existing quantity of factors and the production technology, as in the production possibility frontier defined by curve ADCB.

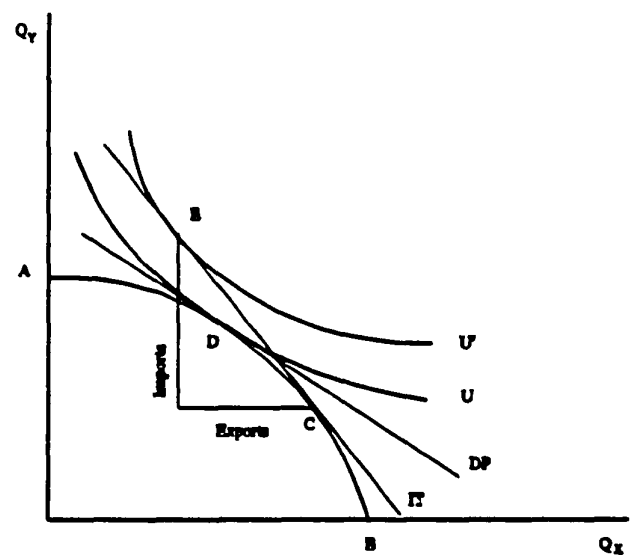


Figure 2.1. No Trade vs. Free Trade

Under autarky, the corresponding consumption possibility choice is also limited to this production possibility frontier. Marginal conditions under autarky are fulfilled at a point D where the social utility indifference curve U is tangent to the production possibility frontier ADCB. The point of tangency defines the domestic price line DP faced by domestic producers and consumers when there is no trade. The possibility of trade relaxes this constraint as it enlarges the possibility of supply combinations beyond what can be produced domestically. This is easily seen in Figure 2.1 where free trade shifts the consumption choice from point D to point E, along a higher level of social utility represented by U'. Trade allows a single point of production such as C to yield a larger set of supply possibilities all lying along the international trade line IT. The consumption choice under free

[6] One difference between the neo-classical model and Ricardo's model is that while Ricardo only has one mobile factor (labor), the neo-classical model has two (labor and capital). Another difference is that while Ricardo's uses production technology as the cause of the variation in domestic and international prices, the neo-classical model uses factor endowments as the cause of the variation in prices. These models are discussed in trade theory books such as Bhagwati (1981).

trade is then a point of tangency between this international trade line IT and a superior social utility curve such as U′. Hence, free trade is optimal compared to autarky.

The analysis of free trade's superiority to trade with tariff can be seen from Figure 2.2. A tariff leads to a domestic price different from the international price IT. Domestic producers face the price line DP where the import price is higher compared to the international price IT. Production shifts to C′ from C and trade takes place at a point along the international trade line IT′ passing through C′. Under the assumption that the tariff revenue collected is immediately turned over to consumers, consumption is at point E′ that is both on the international trade line IT′ and tangent to the social utility preference curve U′ and the domestic price line DP′. The line DP′ has the same slope as the domestic price line DP since consumers face the same domestic prices, and the distance between DP and DP′ represents the value of the import tariff in domestic prices. Note that the utility level U is lower than the utility level U′ achieved under the prior case of free trade when consumption is at point E.[7] Hence, free trade is superior to trade with restrictions if the trade choice does not affect international prices, i.e., does not change the slope of IT.

Figure 2.2 also makes it clear that trade restriction reduces the volume of trade as indicated by the smaller triangle of exports and imports under the case of trade with tariff than under the case of free trade. Furthermore, it reduces the level of production in the exportable sector while increasing the level of production in the importable sector. Thus, protection of the importable sector inevitably draws resources away from the other sector, while it reduces the level of social utility possible under free trade. The principal policy lesson then from this simple model is that trade protection cannot promote the cause of one sector without negatively affecting another sector and at a net cost to society. There are, of course, legitimate objectives other than efficiency that policymakers may want to preserve. However, for a small country without the power to alter international prices, exploiting its comparative advantage requires using international prices as a guide to resource allocation.

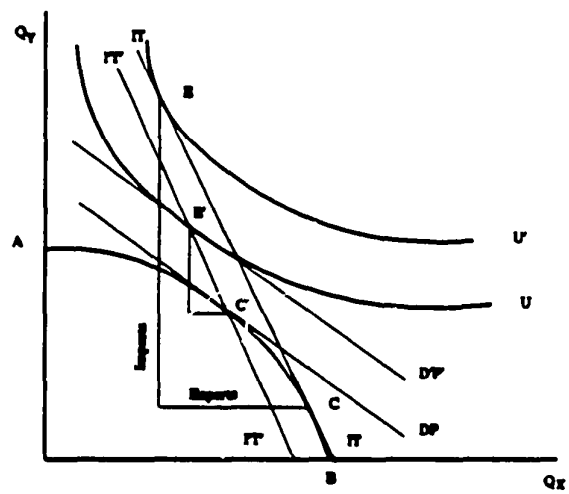


Figure 2.2. Free Trade vs. Trade with Tariff

[7] Note also that if consumers had not been made to face the domestic price with tariff, then their consumption choice would have been along the international line IT' but at a point where it is tangent to a social utility indifference curve. This will obviously lead to a utility level higher than U'. Trade restrictions diminish the gains from trade by distorting both the allocation of factors in production decision, and the allocation of consumption expenditures in the consumption choice.

2.2 Effective Rates of Protection and Related Concepts

The neo-classical general equilibrium model's insights, applied to actual trade policy work, are often best expressed in the calculation and comparison of protection coefficients across sectors. These calculations, frequently referred to as "rates of protection," are made to bolster the case for reforming tariff structures so as to have more uniform and lower rates of tariff. The desirability of uniform rates of protection follows from the argument that domestic relative prices must not deviate from international relative prices.

While uniform rates across all sectors, including export sectors, may indeed correct the potential misallocation of resources, they raise the question of the role of non-traded goods and the distortion that government spending introduces into the economy. A totally uniform rate of protection implies that the government also has to provide equivalent subsidies to exports, making the case for collecting revenues from tariffs a moot issue. The more realistic case is when government has to collect tariffs as a revenue measure, and yet wishes to implement tariff policies that minimize the effect on efficiency of the resulting price distortions.

Toward this end, the comparison of equivalent nominal rates of protection (NRPs) constitutes useful applied trade policy work in helping revise and formulate more efficient tariff structures. A common definition of the NRP is the percentage of deviation of the domestic price from the border price given as:

$$NRP_i = (P_i^D - P_i^W)/P_i^W = t_i/P_i^W, \tag{1}$$

where i is the sector label; P^D, the domestic price; P^W, the border price in domestic currency units; and t, is the import tariff rate.[8] The NRP provide an estimate of protection on output. As such it provides an indication of the direction and relative strength of resource pull towards the production of the output that a tariff induces. In reference to the neo-classical trade model, the NRP also provides a measure of distortion in production effort that trade policy creates. It is a very simple measure to calculate and only needs either the tariff rate and border price data, or the domestic price and border price data. It provides a convenient means of estimating the effects of a sectoral protection policy: the change in production can be approximated by multiplying it with a price elasticity of supply; and, the change in demand can be approximated by multiplying it with a price elasticity of demand.

A refinement of the NRP coefficient is the notion of an effective rate of protection (ERP), which is able to account for the influence of input-output production relationships in the resource pull impact of a tariff structure. Early contributions in this field by Corden (1966) and Johnson (1965) were part of the theoretical examinations of tariff structures. The concept of the ERP focuses on the effect of trade interventions on the protection of value-added, rather than the

[8] An export tax is an equivalent negative tariff.

protection of the output price.[9] While the NRP may accurately portray the impact of trade policy on demand, it may be inaccurate in projecting the impact on production, especially when evaluating the overall system of tariffs. Tariffs are applied on outputs and therefore raise the price of the output. But because tariffs of other products are also being raised, the net return to the value-added in a sector may actually be smaller compared to the before-tariffs case.

While the ERP more accurately measures the protective margin (e.g., resource pull advantage) for tradables, it fails to account for the impact of trade restrictions on the real exchange rate, such as the appreciation of tradables relative to non-tradables brought about by higher tariffs. Toward this end, the concept of a net effective protection rate has been advanced (e.g., Dervis, de Melo, and Robinson, 1984). More current evaluations of tariff systems now recognize this and additionally account for the exchange rate distortion.

The principles of the optimality of international prices (from the neo-classical model), input-output accounting, and exchange rate appreciation, have proven useful not only in measuring resource pull biases, but also in the evaluation of projects (e.g., shadow pricing) and the measurement of the true international competitiveness of domestic sectors (e.g., domestic resource costs calculations or DRC's).

These methods have become popular tools in applied trade policy work because of the ease by which they can be calculated. For instance, there is no need to construct an explicit economywide model to obtain insights useful to policymakers. However, the applicability of ERP's and DRC's in a partial equilibrium framework, to estimate what are otherwise general equilibrium effects, rests on three important simplifying assumptions.

First, it assumes that the change in exchange rate that will be induced by a change in the tariff structure can be estimated separately. Second, it omits the impact of demand considerations, thus allowing the separate treatment of the impact of tariffs on production from the impact of tariffs on consumption.[10] Third, it omits factor price changes. This is, perhaps, the greatest weakness of these methods, as trade interventions change the relative prices of factors (e.g., Stolper and Samulelson, 1941).

2.3 Income Linkages and Economy-wide Modeling

The weaknesses of the ERP/DRC methods in trade policy analysis have motivated efforts to develop economywide models such as the computable general equilibrium (CGE) models. Early applications such as McCarthy and Taylor (1977), Mellor (1978), Adelman and Robinson

---

[9] There are several varations in the definition of an ERP. Corden's version defines it as:

$$ERP_j = \frac{t_j - \Sigma a_{ij}\, t_i}{1 - \Sigma a_{ij}},$$

where t_i is the tariff rate on sector i and a_{ij} is the input-output coefficient in the absence of tariffs (Corden 1966).

[10] The production effect is measured through the net ERP, while the demand effect is through the NPR.

(1978), and Taylor (1979) tended to focus on the role of income linkages in influencing the factor employment impact of trade policy, especially cheap food imports, through different household demand patterns.[11]

The aggregate results of these early models often contradicted those suggested by the neo-classsical trade model, for example, trade liberalization can reduce the aggregate income. It became apparent, later, that these differences in aggregate results were being driven, not by the incorporation of income linkages and demand patterns, but by radically different assumptions about factor markets.[12] The neo-classical model ignored factor employment questions by assuming that factors were always fully employed, i.e., factor markets always clear. It was the level of fixed factors, therefore, that constrained aggregate income. In Mellor's and Taylor's models, factor unemployment was considered a possibility. In this scheme, a mechanism such as autonomous investment demand constrained aggregate income.[13]

These early economywide applications led to CGE modeling applications using neo-classical closure features (e.g., Walrasian factor markets) such as found in Dervis, de Melo, and Robinson (1984). Their high level of economic disaggregation made it possible to incorporate production-detailed production and demand structures (different commodity expenditure shares by type of households) in the analysis. The models retained the aggregate income lesson of the neo-classical trade model about the optimality of free trade, but focused on income distribution and production pattern impacts of trade policy that the two-sector neo-classical trade model could not address. (The CGE models also allowed more empirical analysis as initial economic structures played a role in trade policy simulations.)

The economic structure influences the outcome of policy primarily through income linkages that are forced to consistency by the principle of the circularity of income flow. Figure 2.3 illustrates this circularity of income flow that provides the equilibrating framework for economywide models. All economic activities are accounted for by tracing their accompanying flow of income. Physical goods exchanged in a transaction have corresponding income payment exchanges. Hence, the total value of production is equal to the total value of demand and also to the total value of income in the economy. This framework allows a more comprehensive evaluation of trade policy than can be done using the ERP/DRC method because it forces consistency on closing the chain of linkages between production and demand. Intuitively, while the ERP/DRC methods can account for the first-round effects of trade policy, by adding up all the partial equilibrium results, the economywide models account for the net effects (e.g., first-round and subsequent feedback effects).

---

[11] For more on economywide modeling see Blitzer, Clark, and Taylor (1975). A different emerging modeling approach, called "multimarket modeling," to handle the problem of commodity linkages in trade and pricing policy analysis has been taken by Braverman, Hammer, and Gron (1987). This approach limits the modeling of linkages to only a few key markets, and not the whole economy.

[12] For a more in-depth critique of the limitations of economywide modeling results see Taylor and Lysy (1979).

[13] This issue is known as the question of "closure" of the model and was long recognized in earlier debates about economic policy using simpler aggregate models as discussed in Sen (1963).

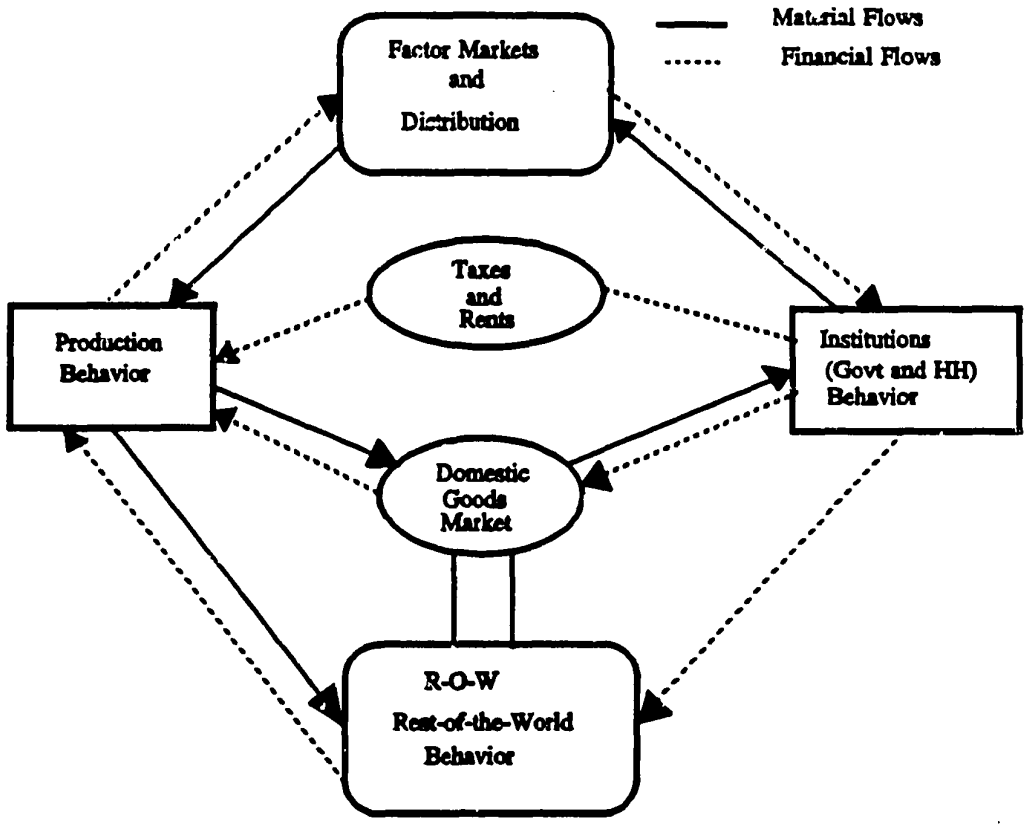


Figure 2.3. The Circular Flow of Income

3. CONSTRUCTION OF A CGE MODEL FOR THE PHILIPPINES

3.1 The TV Modeling Approach

The initial model is a single-period static formulation that is later extended to a multi-period dynamic model through capital accumulation linkages. Both the static and dynamic model formulations are generated using the transactions value (TV) approach, developed by Drud, Grais, Kendrick, and Pyatt at the World Bank in the early 1980's.

A social accounting matrix (SAM) is a necessary starting point for the TV modeling approach. The SAM used in this study, has 59 accounts, including 17 production accounts, 17 factor income accounts, and 9 household accounts. It is constructed around the national income accounts for the Philippines in 1983. Details of the SAM and its construction can be found in Appendix A.

The TV approach proceeds by expanding the SAM into a series of production decision or income allocation accounts. For example, a SAM production account such as the RICE production account may generate six TV accounts (VA-RICE, ACT-RICE, DOM-RICE, CMP-RICE, IMP-RICE, and EXP-RICE) to describe the six levels of production decisions. The first, a VA-RICE account, combines factors like labor and capital to produce an estimate of value-added in rice production. Next, the TV approach combines value-added with other material inputs to produce a domestic good, in this case, rice. The domestic good may be sold for the export market or for the domestic market; hence, the need for an ACT-RICE account, a DOM-RICE account, and an EXP-RICE account to differentiate the three types of activities (i.e., domestic good production, export sales, domestic sales) and two possible points of taxing interventions. IMP-RICE and CMP-RICE are necessary to describe the two other activities before the rice sector's output is ready for the domestic demand. CMP-RICE is the activity of aggregating the imported and the domestic supplies.

The disposal of the household's income also requires a two-level allocation activity; first, to allocate between taxes, savings, and total consumption expenditures; next, to allocate the total consumption expenditures between the different consumption goods. As a result of these expansions, the SAM increases to 159 TV accounts.[14]

The TV approach then proceeds by assigning a "type" to accounts in the new TV-SAM. This is to ensure the generation of variables and equations specific to the account type. For example, household incomes have only an income variable and do not have price and quantity variables, while the household consumption account has all three variables. Factor accounts also have the option of fixing their quantity which is equivalent to specifying one more constraint or equation. This account-specific information is listed in an accounts table that conveniently summarizes assumptions about the different accounts.

---

[14] The two SAM labor accounts were combined into one TV labor account. Each SAM sector-capital account, however, was distributed into a sector-specific capital component and a flexible-capital component using information on the depreciation charges. The TV accounts are then equivalent to a large SAM version of the original SAM.

The next step is to specify the behavior determining the allocation of payments between accounts. The HERCULES software has been coded to recognize several behavioral acronyms so that the model-builder need only write the acronym instead of all the equations associated with a described behavior. For example, the acronym CES (constant elasticity of substitution) in a cell formed by an activity column account and a factor account automatically generates the following equations:

$$Q_{ij} = A_{ij} * Q_j * \left[\frac{P_j}{P_i}\right]^{\sigma_j} \tag{2}$$

and

$$P_j = \sum_{i=1}^{n} A_{ij} * P_i^{* * \left((1-\sigma_j)^{* * \left(\frac{1}{1-\sigma}\right)}\right)} . \tag{3}$$

The first equation is the input demand equation that results from the profit maximizing behavior of a producer facing given prices and constrained by a CES production function. The second equation is the price relationship that is derivable from the payments version of the CES production function constraint. The acronyms defining the behavior of cell transactions are presented in another TV-SAM table that contains the cell behavior acronyms instead of numerical values.[15]

3.2 A Single-Period Static Model

The model used in the present study belongs to the class of CGE models popularized in several World Bank studies (Adelman and Robinson, 1978; Lysy and Taylor, 1980; Dervis, de Melo and Robinson, 1984). It has a more structuralist flavor than models following the examples of Shoven and Whalley (1974), Scarf and Shoven (1984), and others who adhere more closely to the neo-classical Arrow-Debreau model of general equilibrium.[16]

---

[15] CGE modeling appears to be moving toward this automated approach towards model generation. For example, the MPS/GE system introduced by Rutherford (1986) is also a step in this direction. However, each automated system requires its own unique structuring of the general equilibrium problem. While the TV method, for example, builds on the payments version of the flow of the economy, the MPS/GE focuses on the activity flow. Modeling in each system requires familiarity with the system's programming structure.

[16] A point of difference, in particular, is the treatment of the savings/investment identity. A neo-classical treatment would account for savings as an optimizing trade-off between current and future consumption with the translated demand for investment goods coming from this savings decision. The structuralist models have treated savings in several ways. One common treatment is to follow a Keynesian savings function for each household type, and then to have either an autonomous investment demand in the full Keynesian tradition, or have investment be determined by savings much like the neo-classical approach.

The static model is composed of 28 economic agents: 17 production sectors, 9 types of households, the government, and an external agent. It has the following general features:

1. Real

   It satisfies the homogeneity restriction so that only relative prices matter. Multiplying the price numeraire by a factor k results in all prices being scaled by the same factor. No real variables are affected.

2. Small Open Economy

   The model assumes that the economy being modeled is too small to affect the international economy. Hence, import supply and export demand are perfectly elastic.

3. Walrasian

   There is no factor unemployment in the model. Aggregate production in each period is constrained by the fixed stock of factors, and markets are cleared by full price flexibility. This assumption gives the model its neo-classical spirit, which distinguishes it from more structuralist, demand-driven models that have been used to address factor unemployment issues (e.g., Taylor, 1979).

4. Savings-led

   Another neo-classical feature of the model is the assumption that savings is the only free variable in the savings/investment identity equation. The absence of an intertemporal optimizing behavior, however, requires the adoption of a Keynesian savings function for each household to determine the allocation of savings out of income. Government saving is residually determined as the balance between revenues and consumption expenditures. Domestic saving is augmented by exogenous flows of foreign savings (e.g., foreign loan drawdowns).

The dynamic model is defined by the equations for the single-period CGE static submodel and a series of interperiod linkage equations. Within each time period, the model is solved for the endogenous variables (e.g., domestic prices and supply levels) that correspond to the set of exogenous variables and leading variables for that period. The single-period component consists of the production system, the system of factor accounts, the household system, the government system, the savings/investment system, the system of external payments, and the closure system.

3.2.1 The Production System

Production takes place in 17 sectors: eight agricultural, one resource extractive, four manufacturing, one construction, and three services sectors (Table 3.1). Behavior in all sectors, except for government services, is a four level activity in which:

(1) value-added is formed by combining the services of labor and capital factors, and forming an aggregate input by aggregating all composite (combination of imports and domestic supplies) outputs of other sectors used in a sector's production;

(2) combining value-added is combined with the commodity outputs of other sectors;

(3) allocating production output is allocated to the export and domestic markets; and,

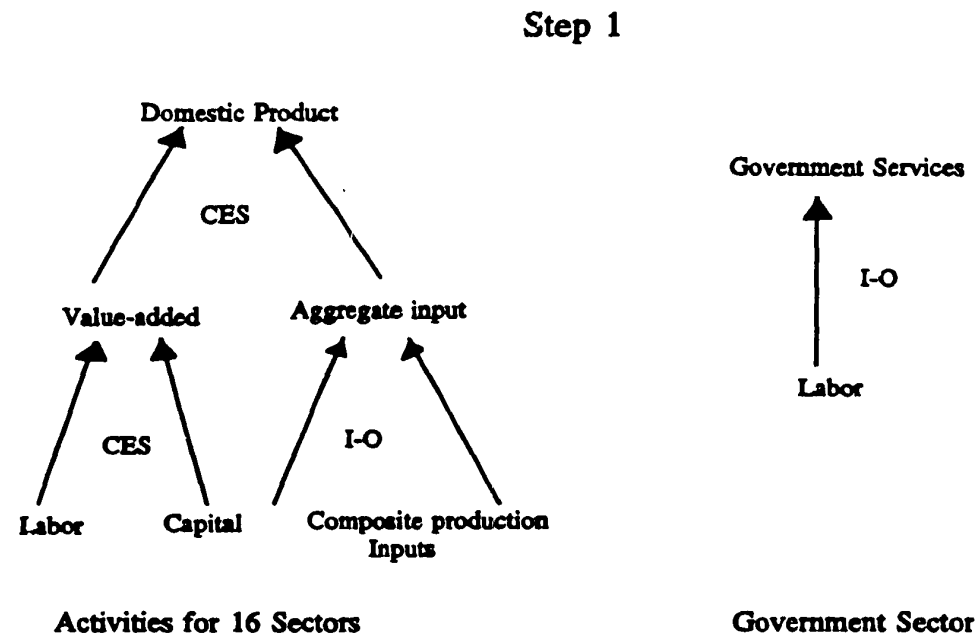
(4) imports combined with the domestically produced supplies form a product for domestic final demand.

Figure 3.1 illustrates the flow of production. For government services, only one activity level is required. Governments are a purely home good with only one factor, labor.

The four levels of activities in the other sectors generate seven types of accounts: a value-added account; an aggregate input account, an activity (or output) account; a domestic product account; an export account; an import account; and a composite product account. The composite product is the good that goes to domestic consumption, capital formation, and input demand. As shown in Figure 3.1, the sector's output is obtained by combining the value-added and aggregating the composite product inputs at the first level. Value-added and aggregate inputs are combined to form the sector's output. The sector's output is then distributed into an export product and a domestic product. Export taxes and domestic taxes are then applied at the two separate points

Table 3.1. 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.



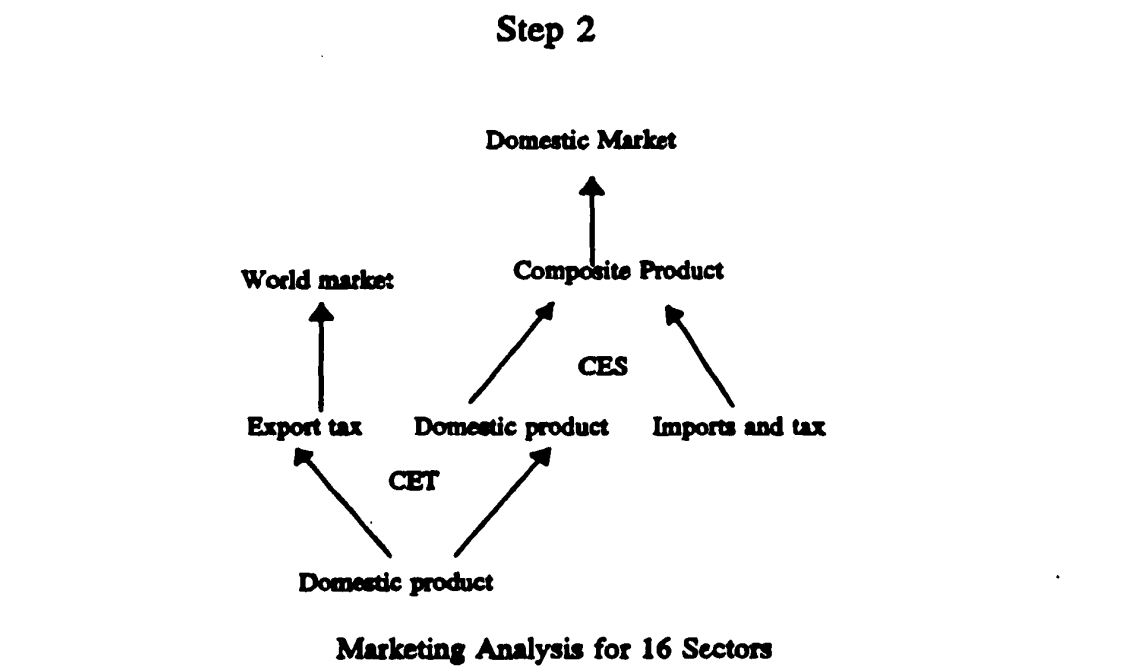


Figure 3.1. Flow of Production

of distribution, thereby altering the valuation of the three products: the activity output, the domestic product, and the export product. The domestic product is subsequnetly combined with the sector's imports to form the composite product which constitutes the sector's domestic supply available for meeting local demand.

Production relations are generally specified as CES production functions. Hence, elasticities need to be specified exogenously. A zero CES elasticity means that the production or aggregation behavior is reduced to a fixed proportion I-O behavior.

The allocation problem is characterized as a CET (constant elasticity of transformation) function. This allows for some degree of freedom between prices in the competing markets, as well as a means of rationing between the competing markets. An infinite CET elasticity, however, means that the markets are perfectly substitutable so that the product must be equally priced in all the competing markets. This also means that at least one market will have to act as a residual market. Table 3.2 shows the elasticities adopted in the model.[17] Non-zero CES elasticities in combining value-added and inputs represent some substitution between value-added and inputs. This is reflected in the rice, corn, and sugar sectors to acknowledge the possibility of fertilizer substitution for factors in these sectors.

Non-infinite CET elasticities in the other crops, manufacturing, and services sectors reflect the fact that diversion of products between domestic and export markets are not costless in these sectors. There is substantial differentiation between the product sold to the domestic market and the product sold to the export market. Diversion of supplies from one market to another only occurs when an adequate price difference emerges between the two markets.

The CES elasticity in the composite product formation (CMP) defines import demand behavior.[18] 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.

The production sub-model dictates the quantity of factors demanded. To meet these demands, factor supplies must either be flexible (e.g. demand-driven) or have a rationing mechanism that feeds back into the production sub-system to adjust the factor demand until market balance is achieved. In this model, the full flexibility of factor and domestic product prices provide such rationing mechanism.

---

[17] For a discussion of the numerical specification of CGE models see Mansur and Whalley (1984). They provide a survey of production elasticities that may be adopted in CGE models. Powell and Gruen (1968) provide elasticity estimates for CET functions, while Stern (1976) provides trade elasticities.

[18] This is the general form the more familiar Armington import specification (Armington, 1969).

Table 3.2. 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. Commercial Serv.	0.8	0.0	-0.5	0.3
16. Other Private Serv.	0.8	0.0	-0.5	0.3

In contrast to the factor demand variables that are determined within a sub-system (locally endogenous variables), factor prices are globally endogenous variables. This means that factor prices are treated as exogenous variables within the sub-models, e.g., their solutions are executed at a level higher than the production sub-system.

3.2.2 The System of Factor Accounts

Table 3.3 lists the different factor accounts: 18 domestic factors and a "factor abroad" account. There is one labor account. Capital is differentiated into one account that represents mobile capital and 16 accounts that represent the fixed capital in each sector. There is one factor abroad account to represent the earnings of all factors employed outside of the domestic economy, and is assumed to earn an exogenously determined amount of foreign exchange.

The quantity of each domestic factor is assumed to be fixed. 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. The total income of each domestic factor is determined by the market-clearing price.

Factors are assumed to be held in fixed proportions by the nine household types, the government, and by the external sector. Factors abroad are only claimed by the nine households. Hence, the distribution of factor incomes is assumed to be determined by a fixed share behavior.

Table 3.3. Factor Accounts

Factor Account	Type
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

3.2.3 The Household System

There are nine household types: three types of households each in the National Capital Region (Metro Manila), an "other urban" area, and the rural area. The three types of households in each geographic area are grouped according to their annual household income: a low income group (less than 20,000 in 1983 pesos), a middle-income group (20,000 to 60,000), and a high-income group (above 60,000). These nine household types are each assumed to hold a fixed share of each total factor endowment. Hence, they also receive fixed shares of each factor's total income.

The income of each household is a two-step allocation process. First, the income is allocated, in fixed shares, between direct taxes, savings, and a consumption budget. The consumption budget is then allocated into expenditures between the different composite products of the 16 production sectors (i.e., the government service sectors are excluded). Households are assumed to allocate consumption expenditures by maximizing their utility subject to their consumption budget. Their utility functions are modeled as a Stone-Geary function. Consumption demand, subsequently, is a linear expenditure system (LES) of demand. The direct taxes go into the government income account, while the savings go into an aggregate savings account.

3.2.4 The Government System

Unlike the producers and the households, government is modeled wit no optimizing behavior. Government earns income from the application of indirect taxes on exports, imports, and domestic sales; direct taxes on the factor incomes and household incomes; and from ownership of some factors (i.e., capital in the petrol and utility industries).

Government spends for an operating budget and a public investment budget. The operating budget is composed of an expenditure account for commodity purchases in support of a level of government activity, an account (fixed in domestic currency) for income transfers to households, and an account (fixed in foreign currency) for payments of foreign debts. In the first version of the model (Version A), government saving (the difference between government expenditures and the amount of the operating budget) is modeled as a fixed variable. For example, government is not allowed to change the size of its deficit. Consequently, in this model version, it is the real level of government expenditures that must adjust to changes in the level of government revenues.

In the second version (Version B), the government's demand for commodities and services is modeled as a fixed consumption bundle composed of fixed proportions of the composite products of the 16 non-government production sectors and the product of the government services production sector. This means that while the real expenditure level of government consumption is fixed, its domestic currency amount is not. However, while this is a global variable, it is not a local variable since it is being determined by the general system of prices outside of the government system of accounts. Hence, to ensure a local balance of equations and variables, the savings account must be residually determined.

The amount of government income transfers to households is fixed in domestic currency under both versions. Hence, while the amount of income transfers to households is fixed in local currency, the amount of consumption expenditures by the government may vary according to the changes in prices of these products. The amount of debt payments valued in domestic currency also varies according to the foreign exchange rate. But as mentioned earlier, while they are globally variable, they do not provide any local degrees of freedom.

The expenditures on public investments are modeled as part of the savings/investment sub-model. These expenditures, though treated separately from private capital formation, form part of an aggregate expenditure account for capital formation.

In summary, the disbursement of government income is therefore distributed into (1) a variable budget for government consumption (locally variable in Version A, and only globally variable under Version B), (2) a budget for the income transfers to households fixed in local currency, (3) a budget for foreign debt payments which is fixed in foreign currency but globally variable in the model due to the endogeneity of the foreign exchange rate, and (4) a savings balance from which the government finances public investments. It is treated as a fixed amount of local currency in Version A and a residual local variable in Version B. The government deficit (the shortfall between total government saving and total government investment

expenditures) is not solved for explicitly. However, it can be derived from the solution values for government earnings, consumption, and investments.

3.2.5 The System of Savings/Investment

The savings/investment sub-model is composed of an aggregate savings account, an account for government investment, and accounts for private investment. Savings funds are aggregated from the savings of households, the government, foreign sources, and depreciation charges against the income of capital.

The savings funds are allocated into expenditures for the fixed quantity of government investments and a residual account for private investments. This means that, in this model, government expenditures crowd out the private sector. The amount of private investment funds are, in turn, allocated into real expenditures for private capital formation and material stocks according to fixed shares. Capital formation and stock expenditures are then allocated into fixed quantity shares (I-O coefficients) of demand for the composite products of the 16 production sectors.

3.2.6 The System of External Accounts

A Rest-of-the-World (R-O-W) account is included as a link between the domestic economy and the external sector. This account receives income from the earnings of foreign-owned but domestically employed factors and payments for imports. Import supply is assumed to be infinitely elastic so that it always accommodates the import demand; the price of imports is the world price multiplied by the foreign exchange rate. These payments are assumed to be converted into domestic currency from foreign currency at a flexible rate.

The external account is debited for the foreign exchange needed to purchase exports, credited with earnings of factors abroad, and credited with foreign savings invested or loaned into the domestic economy. Export payments are determined by export demands that are modeled as functions of the domestic price of the export product and the world price according to (4) below.

$$Q_i = Fq_i * \left[\frac{P_i^{world}}{P_i^{domestic}} \right]^{* * \eta_i} , \qquad (4)$$

where Q_i is the export demand, Fq_i is a scale parameter, and η is the elasticity of export demand. When η is infinite, the export demand equation reduces to a price equation,

$$P_i^{domestic} = P_i^{world} * e , \qquad (5)$$

where e is the foreign exchange rate. When the elasticity of export demand is zero, export demand is a fixed quantity.

Foreign savings, like the earnings of factors abroad, is assumed to be a fixed amount at an exogeneously determined foreign exchange rate.

3.2.7 The Closure System

Some of the closure equations are already part of the system of factor accounts. For example, total factors used in all accounts must equal the fixed quantity of factor supplies. However, because of the Walras Law, the system still needs an equation to fix the price numeraire.[19] In this model, the price of the National Capital Region's middle-income household's aggregate consumption has been chosen as the fixed price numeraire. This choice is based on the fact that the most important aggregate price level watched by Philippine policymakers is the Manila consumer price index (Manila CPI). Being a real model without an explicitly modeled financial sector, only relative prices are determined by the model. An implicit assumption is that monetary policy is neutral and that its sole effect is in defining the level of prices in domestic currency value. Fixing the value of the price numeraire is the equivalent of assuming that monetary policy is being implemented in such a way that the price of the Manila CPI remains constant.

3.3 A Multi-Period Dynamic Extension

The dynamic model is simply a series of equilibriums linked by inter-period updates of factor stocks. All markets clear in each period and reopen again for clearing in the next period. The growth of the labor factor is an exogenously specified parameter, but the growth of capital stocks is determined by the cumulative effect of all past equilibrium solutions. Producers and consumers are assumed to optimize their production and consumption decisions subject only to the information for each period. There is no optimizing behavior across periods (e.g. no rational expectations).

The dynamic linkages between periods are provided by the equations updating the fixed stock of factors, and other fixed quantities that are assumed to be systematically changing with time. Although labor is assumed to be growing at an exogenous rate, flexible capital is assumed to be equal to the prior period's investment adjusted for a scaling factor.[20] Fixed capital in each sector is assumed to be equal to the sector's fixed capital in the prior period less

---

[19] Walras Law refers to the non-independence of one market, i.e., if all markets but one are in equilibrium, then the remaining market also must be in equilibrium. One market clearing condition is therefore redundant. This is why only relative prices can be determined in the model and not the absolute level of prices.

[20] The scaling factor is necessary to force consistency between the unit of measure used in the base period to measure the quantities of flexible capital and the unit of measure used for investment. For example, the unit of measure of flexible capital and that of investment are not equivalent in the base period. This is because all prices have been indexed to one in the base period, so that quantities are expressed in terms of the transaction volume. However, the transaction volume for capital is not its value (not P_k*Q_k) but rather its wage ($r*Q_k$, where r is the wage rate for capital). For investment, it is the cost of producing capital or equivalently P_k*Q_k that matters. Clearly, the value of capital or cost of capital are not equivalent to the wage of capital. Since, arbitrarily, $r=1$ and $P_k=1$ in the base period, the Q_k's will not be the same numerical value although they both refer to the same quantity of capital, i.e., they have different units of measure.

depreciation plus the quantity of flexible capital allocated to the sector in the prior period. The government's consumption bundle is assumed to be growing at a periodic rate equal to the growth of labor. The updating equations are:

$$Labor_t = Labor_{t-1} * g_L \ , \tag{6}$$

$$Capital_t = SF * (I^G_{t-1} + I^{PCF}_{t-1} + Stox_{t-1}), \tag{7}$$

$$Fixed\text{-}Capital^i_t = Dep\text{-}rate * (Fixed\text{-}Capital^i_{t-1}) + Capital^i_{t-1} \ , \Lambda \tag{8}$$

$$Gov\text{-}cons_t = Gov\text{-}cons_{t-1} * g_L \ . \tag{9}$$

The solution and implementation of these models are discussed in detail in Appendix B.

4. THE TRADE POLICY SIMULATIONS

4.1 Plan of the Simulations

The basic plan of the simulations is to run the static CGE model and its dynamic extension under two assumptions about government spending behavior and several alternative trade policy regimes. The version in which government consumption expenditure is assumed to adhere strictly to its income constraint is called Version A. In Version B of the model, the government is assumed to maintain an autonomous level of consumption (e.g., fixed level of government operations) unresponsive to changes in government revenues.

To analyze the relationship between trade restrictiveness and economic performance, seven sets of trade policy regimes are simulated. In five of them, uniform levels of import tariffs (0%, 5%, 10%, 20%, 30%, 40%, 50%) are imposed on imports of all 16 sectors that are tradables, i.e., the government services sector is excluded, and no export taxes are collected.

For analyzing the impact of trade protection bias, two additional trade protection structures are simulated. One, called **Pro-Ind** (pro-industry bias), refers to the case where no tariffs are imposed on imports of all eight agricultural sectors and the food manufacturing sector, while 50% protective tariffs are applied to imports belonging to all other sectors.[21] The **Pro-Ag** (pro-agriculture bias) trade protection structure refers to the opposite case where 50% protective tariffs are applied on imports classified under the eight agricultural sectors and food manufacturing, while imports belonging to the other sectors are completely unrestricted. In all cases, no export taxes are collected.

As an initial step, a base run of each version of the model is computed. The trade protection structure reflected by the reported trade taxes and import tariffs in the 1983 SAM is used as a point of departure. The substantial international balance of payments deficit in 1983, however, is set to zero in order to eliminate distortive interactions created by a considerable external deficit. The solution to this corrected base case is used as the index of comparison for the results of the remainder of the simulations.

For the dynamic simulations, a ten-year period is used. Results are presented in terms of changes in the activity levels of the 17 production sectors, real consumption levels of the 9 households, government real consumption, real investments, and the real level of the gross domestic product (GDP).

---

[21] This means imports of rice, corn, sugar, coconut, fruits, other crops, livestock (meat, poultry, and dairy), fisheries, and food manufactures are fully liberalized.

4.2 The Static Model Simulation Results

4.2.1 Trade Restrictiveness

Figure 4.1 summarizes the impact of various levels of uniform tariff on GDP.[22] The graph for Version A, in which the government is assumed to adjust completely to a decline in tariff receipts, confirms the usual neo-classical claim that there is a monotonically decreasing relationship between levels of tariff and aggregate income. Adoption of a different rule, e.g., completely exogeneous government expenditure (Version B), modifies this result. Free trade (0% tariffs) is no longer the optimal policy. A low, but positive, level of tariffs (5%) produces the highest level of aggregate income.

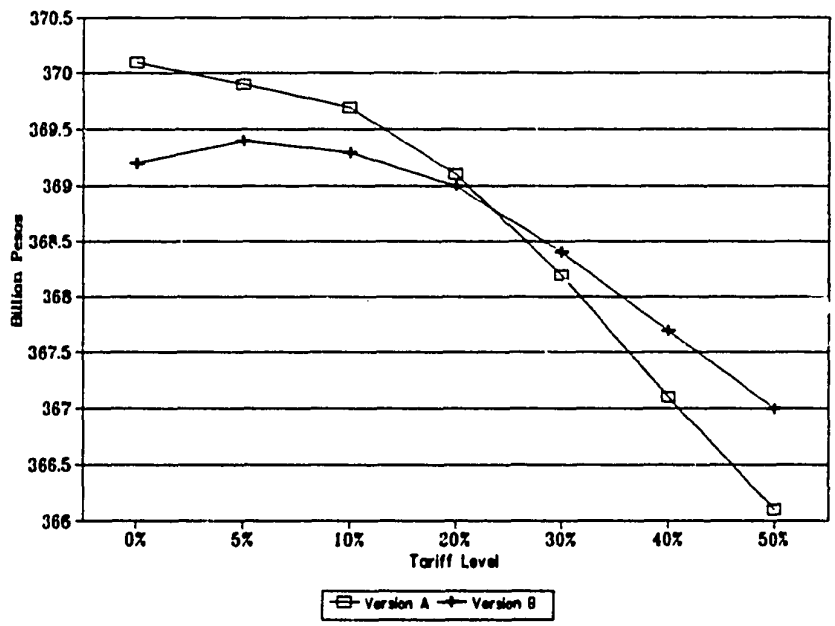


Figure 4.1. GDP by Tariff Level

Another difference in results from Version A and B is the dilution of the inefficiency created by trade restrictions on GDP. Whereas at low levels of tariffs, Version A (complete adjustment) produces a higher GDP performance than Version B, the reverse is true for tariff levels of at least 30%. This phenomenon is due to the interactions of simultaneous policy distortions, a result that has been pointed out in the literature on the theory of "second best"

[22] Real GDP is defined as the value of all consumption (households and government), investments, and net exports valued at the prices of the baserun solution (e.g., 1983 tariff structure with zero BOP deficit).

trade policy.[23] Intuitively, the adherence to a fixed government consumption bundle imposes an additional constraint in the model that reduces its feasible solution space. At low levels of tariffs, Version A performs better than Version B. However, at high tariff levels, this constraint is eased as government revenues increase, and the results are reversed as government increases its contributions to aggregate savings.

In relation to the total economy, these aggregate income differences are modest. Free trade policy improves the real GDP from the base case by less than a percentage point (0.4%), while the GDP difference between free trade and a 50% uniform tariff policy is only 1.1% (Table 4.1).

Table 4.1. GDP % Change from Base Run (Static Model)

Trade Policy	Version A	Version B
Baserun	---	---
0 Tariff	+0.37	+0.14
5 Tariff	+0.34	+0.19
10 Tariff	+0.28	+0.18
20 Tariff	+0.10	+0.07
30 Tariff	-0.13	-0.08
40 Tariff	-0.41	-0.26
50 Tariff	-0.70	-0.45
GDP % Change from Free Trade (Static Model)		
Baserun	-0.37	-0.14
0% Tariff	---	---
5% Tariff	-0.03	+0.05
10% Tariff	-0.09	+0.03
20% Tariff	-0.27	-0.07
30% Tariff	-0.51	-0.22
40% Tariff	-0.78	-0.40
50% Tariff	-1.07	-0.60

The most significant impact of increased levels of trade restrictiveness under Version A, is to shift the deployment of productive resources into the production and government services (Table 4.2 and Table 4.3). In terms of shares in total production, the share of government services (GOV-SERV) rises to 4.3% under a 50% tariff level (Table 4.3), compared to only 2.4% in the base case and 1.2% in the free trade case (0% tariff level). This result is driven by the assumption that each marginal decrease/increase in government revenue (e.g. tariff collections) is absorbed entirely by the real level of government consumption. This assumed government behavior leads to increased levels of protection becoming unattractive to most production sectors, as reflected in their declining levels of production as the tariff level rises.

Under the assumption that government spending does not adjust to changes in income (Version B), increased tariffs shift resources into the production of investment goods (e.g. heavy manufactures and construction services). The share in total production of the manufacturing (as an aggregate) and other industries, therefore, rise to 28.0% and 16.2%,

[23] A more recent example is found in Clarete and Whalley (1988), who observed that the simultaneous existence of distortions other than those caused by trade interventions (e.g., labor market distortions) creates interactive effects with trade policies that substantially change the nature of estimated welfare impacts of these policies.

Table 4.2. Production by Tariff Level

Version A:	Base	0%	5%	10%	20%	30%	40%	50%
CROPS	108.4	107.3	106.5	105.8	104.3	103.1	101.9	100.8
LIV/FISH	69.6	70.0	69.8	69.6	69.3	69.0	68.8	68.7
MFG	188.6	194.0	192.1	190.4	187.3	184.7	182.5	180.5
OTH-IND	109.2	112.7	111.7	110.7	108.8	107.0	105.3	103.7
PRIV-SERV	195.7	201.8	199.9	198.1	194.9	192.1	189.6	187.3
GOV-SERV	16.4	8.7	11.5	14.1	18.5	22.4	25.7	28.6
Version B:	**Base**	**0%**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**
CROPS	107.9	103.2	104.7	104.8	104.6	104.3	104.1	103.9
LIV/FISH	69.6	69.3	69.2	69.3	69.6	69.8	70.0	70.1
MFG	187.8	187.0	186.9	187.4	188.5	189.5	190.5	191.4
OTH-IND	108.2	107.4	107.9	108.3	109.1	109.7	110.2	110.6
PRIV-SERV	195.7	199.3	198.2	197.3	195.7	194.1	192.6	191.2
GOV-SERV	17.3	17.3	17.3	17.3	17.3	17.3	17.3	17.3
% Change in Production from Base:								
Version A:	**Base**	**0%**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**
CROPS	-	-0.99	-1.73	-2.44	-3.74	-4.93	-6.01	-7.02
LIV/FISH	-	0.57	0.29	0.04	-0.39	-0.75	-1.05	-1.31
MFG	-	2.89	1.87	0.95	-0.68	-2.06	-3.25	-4.29
OTH-IND	-	3.20	2.26	1.35	-0.39	-2.02	-3.57	-5.04
PRIV-SERV	-	3.12	2.14	1.23	-0.40	-1.83	-3.11	-4.25
GOV-SERV	-	-46.73	-29.56	-13.96	13.40	36.71	56.89	74.62
Version B:	**Base**	**0%**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**
CROPS	-	-4.36	-3.03	-2.85	-3.11	-3.33	-3.54	-3.72
LIV/FISH	-	-0.45	-0.51	-0.37	-0.04	0.25	0.52	0.77
MFG	-	-0.42	-0.44	-0.21	0.37	0.92	1.45	1.95
OTH-IND	-	-0.70	-0.29	0.12	0.82	1.38	1.84	2.21
PRIV-SERV	-	1.85	1.26	0.81	-0.02	-0.81	-1.57	-2.30
GOV-SERV	-	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 4.3. Share of Production by Tariff Level (Percent)

Version A: Sector	Base	0%	5%	10%	20%	30%	40%	50%
CROPS	15.8	15.5	15.4	15.4	15.3	15.2	15.1	15.1
LIV/FISH	10.1	10.1	10.1	10.1	10.1	10.2	10.2	10.3
MFG	27.4	27.9	27.8	27.6	27.4	27.2	27.1	27.0
OTH-IND	15.9	16.2	16.2	16.1	15.9	15.8	15.6	15.5
PRIV-SERV	28.4	29.1	28.9	28.8	28.5	28.3	28.1	28.0
GOV-SERV	2.4	1.3	1.7	2.0	2.7	3.3	3.8	4.3
Version B: Sector	**Base**	**0%**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**
CROPS	15.7	15.1	15.3	15.3	15.3	15.2	15.2	15.2
LIV/FISH	10.1	10.1	10.1	10.1	10.2	10.2	10.2	10.2
MFG	27.4	27.4	27.3	27.4	27.5	27.7	27.8	28.0
OTH-IND	15.8	15.7	15.8	15.8	15.9	16.0	16.1	16.2
PRIV-SERV	28.5	29.2	29.0	28.8	28.6	28.4	28.1	27.9
GOV-SERV	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5

respectively, from 27.4% and 15.8% in the base case, and 27.4% and 15.7% in the free trade case, as indicated in Table 4.3. This result is again driven by the assumed behavior of government response to each unit of marginal income.[24]

Under both versions of the model, higher tariff levels lead to lower levels of crop production, compared to the base tariff structure. However, compared to the free trade policy, higher tariffs lead to lowered crop production only under Version A. This is because, under Version B, only the export-oriented crop sectors (e.g., sugar, coconut, fruits) are affected negatively by the exchange rate appreciation that accompanies higher tariff levels. The other domestically oriented crop sectors, such as rice and corn, benefit from the higher uniform rate of tariff under Version B. For the private service sectors, increased tariff levels are undesirable under either model version.

[24] In Version B, government's adherence to a fixed consumption bundle gives it, in effect, a value of unity for its propensity to save.

Table 4.4. Net Trade Levels and Net Trade Ratios By Tariff Level

Version A:	Base	0%	5%	10%	20%	30%	40%	50%
CROPS	7.7	7.3	7.1	6.8	6.2	5.7	5.3	4.8
LIV/FISH	0.1	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.1
MFG	-29.7	-30.3	-30.0	-29.6	-29.0	-28.3	-27.7	-27.1
OTH-IND	-16.6	-16.3	-16.2	-16.0	-15.8	-15.6	-15.5	-15.3
PRIV-SERV	20.2	21.6	21.2	20.9	20.4	20.0	19.6	19.2
Version B:	**Base**	**0%**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**
CROPS	7.6	5.0	6.2	6.4	6.4	6.4	6.3	6.3
LIV/FISH	0.0	-0.2	-0.2	-0.1	0.0	0.2	0.3	0.4
MFG	-29.5	-28.7	-29.2	-29.3	-29.1	-28.9	-28.7	-28.5
OTH-IND	-16.5	-15.6	-15.7	-15.8	-15.9	-15.9	-15.9	-16.0
PRIV-SERV	20.1	20.9	20.7	20.6	20.5	20.4	20.3	20.3
Net Trade Ratio (Percent):								
Version A:	**Base**	**0%**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**
CROPS	7.1	6.8	6.6	6.4	6.0	5.6	5.2	4.8
LIV/FISH	0.1	-0.1	-0.1	-0.1	0.0	0.0	0.1	0.1
MFG	-15.7	-15.6	-15.6	-15.6	-15.5	-15.3	-15.2	-15.0
OTH-IND	-15.2	-14.5	-14.5	-14.5	-14.5	-14.6	-14.7	-14.8
PRIV-SERV	10.3	10.7	10.6	10.6	10.5	10.4	10.3	10.3
Version B:	**Base**	**0%**	**5%**	**10%**	**20%**	**30%**	**40%**	**50%**
CROPS	7.0	4.8	5.9	6.1	6.1	6.1	6.1	6.0
LIV/FISH	0.1	-0.4	-0.3	-0.2	0.0	0.2	0.4	0.5
MFG	-15.7	-15.3	-15.6	-15.6	-15.4	-15.2	-15.1	-14.9
OTH-IND	-15.3	-14.5	-14.6	-14.6	-14.6	-14.5	-14.5	-14.4
PRIV-SERV	10.3	10.5	10.4	10.4	10.5	10.5	10.6	10.6

Increased, but uniform, levels of tariff do not radically affect the overall pattern of trade, as reflected in the computed net trade levels and net trade ratios associated with each tariff level (Table 4.4).[25] Manufacturing, and other industries (mining/forestry, petrol processing, construction), remain dependent on imports, while agriculture and the service sectors retain their

[25] Net trade ratio refers to exports less imports over the level of domestic production of a sector, all measured in 1983 constant peso units.

net comparative advantage. Higher levels of protection, however, negatively affect the export competitiveness of the export-oriented crop sectors. Hence, the crop sector, under Version A, drops its trade ratio from 7.1% in the base case, and 6.8% in the free trade case, to 4.8% in the case of a 50% tariff level.

The different trade regimes have only marginal effects on income distribution.[26] Higher levels of tariff protection are shown to favor the poor and middle income classes, but these are minor changes in household income shares. The implication for rural versus urban interests from this type of trade policy variations are even weaker. The only significant income redistribution results from the shift of government income to household income that trade liberalization brings. The real income of all households rise with lower levels of tariff under both model versions. As noted earlier, government spending behavior has strong implications for the allocation of income between consumption and capital formation. Capital formation rises or falls depending on the realized government spending behavior in response to changes in government revenues. A government that finds difficulty in cutting down its operating expenditures in the face of falling revenues will squeeze out private investments during trade liberalization attempts.

4.2.2 Trade Bias

The effects of alternative biases in trade protection policy on the GDP level are illustrated in Figure 4.2 and Figure 4.3. A protection structure biased in favor of agricultural and food processing outperforms a Pro-industry bias in both the free and base trade cases. Again, the differences in aggregate income performance between the two competing protection structure are smaller in the case where government maintains a fixed bundle of consumption (Version B). This result is simply a reflection of the Philippine economy's comparative advantage in agricultural production.

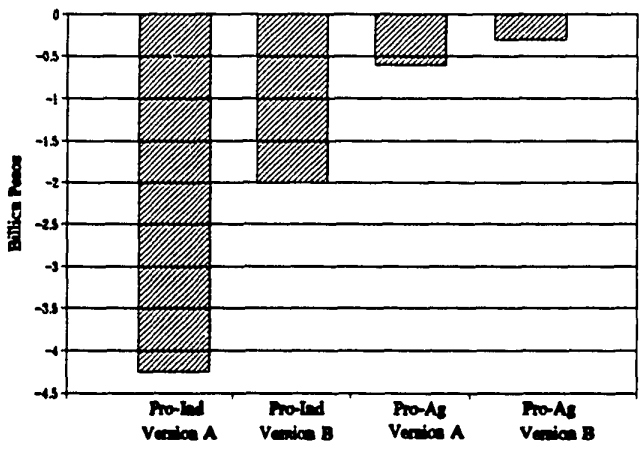


Figure 4.2. GDP Difference from Free Trade Policy

Surprisingly, the sector shares in total production (Table 4.5), except for government services, do not appear to be affected significantly by a bias in trade protection. Government services increase its share under Version A, when the protection structure is biased in favor of the non-agricultural sectors. This is due to the increased revenues for government from the pro-

[26] More disaggregated results are available in Appendix C tables.

industry bias, a result that can be traced to the lower elasticities of import substitution in the non-agricultural sectors. That is, protective tariffs in the industrial sectors lead to higher tariff collections than equivalent tariff rates when applied to the agricultural sectors.

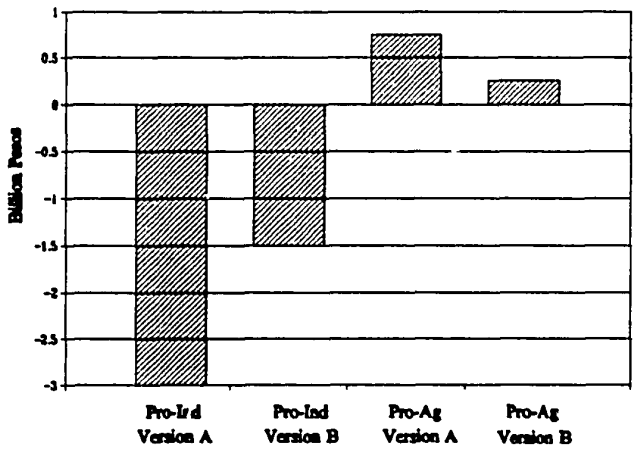


Figure 4.3. GDP Change from the Base Trade Policy

The results in Table 4.5 show that even the non-agricultural sectors do better, in terms of achieving higher production levels, under the pro-agriculture protection structure than under the pro-industry structure, so long as we are in Version A. In Version B, however, a pro-industry protection structure is better for the industrial sectors, as more income shifted to the government, increases the demand for investment goods, thus increasing the demand for industrial sectors like heavy manufacturing and construction.

Table 4.6 presents the impact of alternative protection biases on trading patterns. The pro-agriculture structure, naturally, improves the competitiveness of the crop sectors, while increasing the import-dependence of the industrial sectors, compared to a more neutral structure. The differences, however, are not large.

The income distribution implications of trade protection bias are marginal. A pro-industry structure improves, slightly, the real income share of the poor and middle income households.[27] A pro-agriculture bias even leads to slight gains in income share for Manila (NCR) households in Version A, as the lower prices of manufactured goods, which these households consume more of relative to the other household classes, lead to increased real values of their incomes. Under model Version B, unsurprisingly, the pro-industry bias leads to improved income shares for Manila households, as they benefit from the increased demand for investment goods. As in most of the results obtained so far, the changes registered are not large.

[27] Real consumption share is used as the indicator for real income shares, a simplification justified because of the constant proportions savings behavior in the model.

Table 4.5. Production by Protection Bias

Production Level:				
Version A:	**Base**	**Free Trade**	**Pro-Ind**	**Pro-Ag**
CROPS	108.4	107.3	95.1	107.3
LIV/FISH	69.6	70.0	68.1	70.8
MFG	188.6	194.0	183.1	192.4
OTH-IND	109.2	112.7	104.1	112.3
PRIV-SERV	195.7	201.8	189.3	199.8
GOV-SERV	16.4	8.7	28.3	10.2
Version B:				
CROPS	107.9	103.2	100.7	105.5
LIV/FISH	69.6	69.3	69.4	70.1
MFG	187.8	187.0	192.9	185.9
OTH-IND	108.2	107.4	110.6	107.8
PRIV-SERV	195.7	199.3	192.8	197.6
GOV-SERV	17.3	17.3	17.3	17.3
Share of Total Production (Percent):				
Version A:	**Base**	**Free Trade**	**Pro-Ind**	**Pro-Ag**
CROPS	15.8	15.5	14.2	15.5
LIV/FISH	10.1	10.1	10.2	10.2
MFG	27.4	27.9	27.4	27.8
OTH-IND	15.9	16.2	15.6	16.2
PRIV-SERV	28.4	29.1	28.3	28.8
GOV-SERV	2.4	1.3	4.2	1.5
Version B:				
CROPS	15.7	15.1	14.7	15.4
LIV/FISH	10.1	10.1	10.1	10.2
MFG	27.4	27.4	28.2	27.2
OTH-IND	15.8	15.7	16.2	15.8
PRIV-SERV	28.5	29.2	28.2	28.9
GOV-SERV	2.5	2.5	2.5	2.5

Table 4.6. Net Trade and Net Trade Ratios By Protection Bias

Net Trade Level: Version A:	Base	Free Trade	Pro-Ind	Pro-Ag
CROPS	7.7	7.3	0.3	7.7
LIV/FISH	0.1	-0.1	-0.6	0.6
MFG	-29.7	-30.3	-25.1	-30.5
OTH-IND	-16.6	-16.3	-14.5	-16.3
PRIV-SERV	20.2	21.6	20.1	21.1
Version B:				
CROPS	7.6	5.0	3.6	7.0
LIV/FISH	0.0	-0.2	-0.4	0.5
MFG	-29.5	-28.7	-27.4	-29.8
OTH-IND	-16.5	-15.6	-15.5	-15.8
PRIV-SERV	20.1	20.9	20.8	20.4
Net Trade Ratio (Percent): Version A:				
CROPS	7.1	6.8	0.3	7.2
LIV/FISH	0.1	-0.1	-0.9	0.9
MFG	-15.7	-15.6	-13.7	-15.9
OTH-IND	-15.2	-14.5	-13.9	-14.5
PRIV-SERV	10.3	10.7	10.6	10.6
Version B:				
CROPS	7.0	4.8	3.6	6.6
LIV/FISH	0.1	-0.4	-0.5	0.7
MFG	-15.7	-15.3	-14.2	-16.0
OTH-IND	-15.3	-14.5	-14.0	-14.7
PRIV-SERV	10.3	10.5	10.8	10.3
% Change from Free Trade Version A:	**Base**	**0%**		
CROPS	0.2	0.0	-6.6	0.3
LIV/FISH	0.2	0.0	-0.7	1.0
MFG	-0.1	0.0	1.9	-0.2
OTH-IND	-0.7	0.0	0.6	0.0
PRIV-SERV	-0.3	0.0	-0.1	-0.1
Version B:	**Base**	**0%**		
CROPS	2.2	0.0	-1.2	1.8
LIV/FISH	0.4	0.0	-0.2	1.0
MFG	-0.4	0.0	1.1	-0.7
OTH-IND	-0.8	0.0	0.5	-0.2
PRIV-SERV	-0.2	0.0	0.3	-0.2

4.3 The Dynamic Extension Results

4.3.1 Trade Restrictiveness

Simulations with a multi-period dynamic extension of the basic static model produces the GDP growth paths indicated in Figure 4.4 for Version A, and Figure 4.5 for Version B. Table 4.7 lists the growth rates registered over the ten year period of the simulations for the different tariff regimes.

Table 4.7. GDP Growth Rates (Percent) by Tariff Level

Trade Policy	Version A	Version B
Baserun	5.51	6.23
0% tariff	5.87	5.29
5% Tariff	5.73	5.59
10% Tariff	5.59	5.73
20% Tariff	5.36	6.37
30% Tariff	5.13	6.76
40% Tariff	4.91	7.09
50% Tariff	4.70	7.37

In Version A, the usual claim that more liberal trade policies lead to higher growth paths is reproduced. In Version B, however, the opposite result is obtained, as higher tariff levels lead to higher GDP growth paths. This reversal of results underscores the influence of the redistribution of income away from the government to the households that comes with lower levels of tariffs in determining the GDP growth path. In Version A, the assumption that government consumption responds fully to government income changes implies a marginal savings rate of zero. (In Version B, on the other hand, the assumption of fully autonomous government consumption implies a marginal rate of unity.)

An important lesson of the simulation results is that the government behavior assumption dominates the positive effect on capital formation of improved allocation efficiency of capital and labor that comes with lower levels of tariffs. Growth rates for Version A are higher than growth rates for Version B for tariff levels below 5% (Table 4.7). This implies that, should the government be committed to trade liberalization, it should adopt its expenditure behavior accordingly, e.g., cut its operating budget.

The simulation results point to the weakness of a trade policy analysis that relies solely on allocation efficiency arguments for estimating the impact of trade policy on aggregate income growth. Trade policy may have powerful effects on aggregate savings and hence on capital formation. The extent of the government's role in the mobilization of aggregate savings, be it through so-called "forced savings" mechanisms, is critical.

Another characteristic of the simulation results from the dynamic exercise is the rapid drive toward production specialization in the model. Even with high protection rates, specialization proceeds as mobile capital tends to seek out the sector with the highest comparative advantage. Despite the existence of fixed factors in all sectors, the process of depreciation and the ability of mobile capital to augment these fixed factors after one period brings about a tendency for production to concentrate around a few sectors. After ten years of activity, the

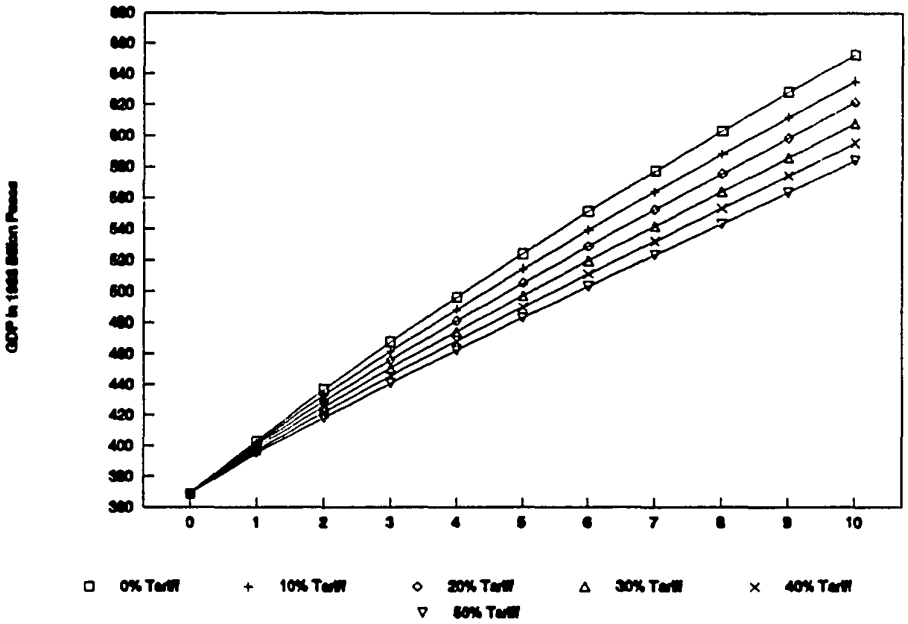


Figure 4.4. GDP Growth Paths (Version A)

private services and "other industry" sectors (specifically the mining/forestry sector) have increased significantly. As shown in Table 4.8 under Version A, the aggregate crop sector exhibits negative growth under all tariff levels in both model versions. The exception within this group is the sugar sector, which shows substantial positive growth.

By assuming an exogenous growth rate for government consumption that is not tied to government revenues, the government service sector grows at the predetermined annual 3.6% growth rate under Version B, invariant with respect to changes in the tariff level. Under Version A, however, government services can grow between 2% per annum for a free trade regime to 48% for a 40% tariff regime.

When government expenditures are not tied to revenues, the economy moves to a trading structure that is more dependent on (a) the extractive sectors (mining and forestry) and the private services sectors for foreign exchange earnings, and (b) on imports in the food crops sectors. Table 4.10 shows that, in the base year, the crop sectors were initially a net earner of foreign exchange earnings. However, over time, the crops sector declines. Simply increasing the uniform rate of tariff protection does not correct this problem.

The income of all households grows fastest, under Version A, when tariff rates are lowest (Table 4.11). However, under Version B, they generally grow faster when protection rates are higher. This result is again due to the effects of trade policy on the distribution of income between households and the government. Similar to the static model results, income distribution among households is only marginally affected at this level of disaggregation by different degrees of uniform protection.

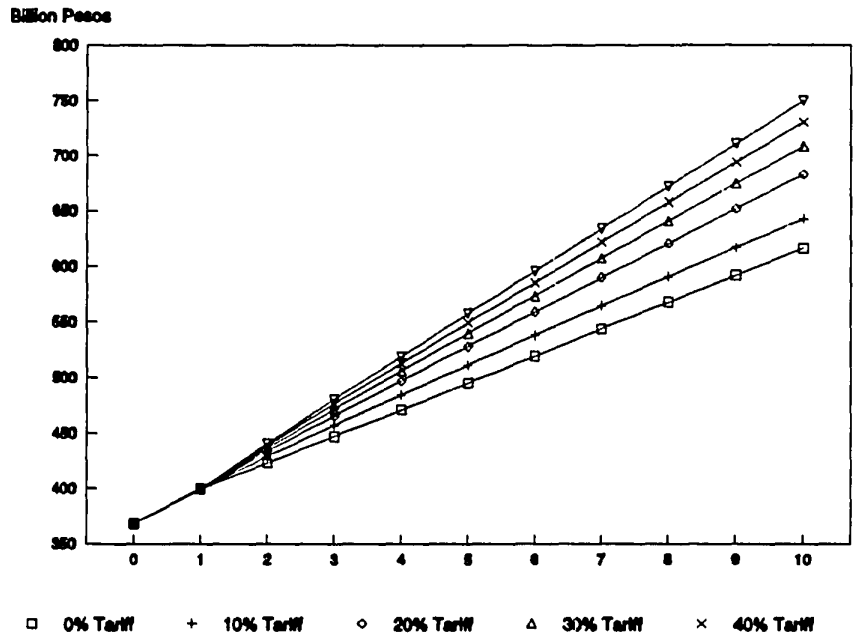


Figure 4.5. GDP Growth Paths (Version B)

4.3.2 Trade Bias

The effect of a trade bias in the dynamic model is illustrated in Figure 4.6 for Version A, and Figure 4.7 for Version B. Table 4.12 lists the rates of growth over a ten-year period for the two competing trade protection paradigms, together with the results obtained from the base tariff (1983) and free trade structures.

Table 4.12. GDP Growth Rates (Percent) by Trade Bias

Trade Bias	Version A	Version B
Baserun	5.51	6.23
Free Trade	5.87	5.29
Pro-Ind	4.51	6.10
Pro-Ag	5.99	5.57

The reversal of results observed in the case of uniform level of tariffs is also observed here. While a pro-agriculture bias in trade protection results in higher GDP growth path compared to a pro-industry structure under a fully adjusting government (Version A), the opposite is true under Version B. A pro-industry protection structure results in higher revenues to government on account of the lower elasticity of substitution for industrial imports in comparison to agricultural imports. Looking at the growth rates of production sectors in Table 4.13 and Table 4.14, the pro-agriculture protection structure is able to prevent a complete stagnation of the crop sector in both versions of the model. Protecting agriculture, therefore, brings about more balanced growth in the economy.

Table 4.8. Growth of Production (Version A) By Tariff Level

Production Level: Sector:	Baseyear	Base Tariff 10th Year	0% Tariff 10th Year	20% Tariff 10th Year	50% Tariff 10th Year
CROPS	108.4	105.8	102.7	97.8	99.1
LIV/FISH	69.6	88.2	88.1	86.3	83.6
MFG	188.6	292.9	293.0	281.9	264.3
OTH-IND	109.2	271.3	314.7	273.3	228.7
PRIV-SERV	195.7	360.5	375.8	352.6	324.9
GOV-SERV	16.4	32.8	20.0	34.6	48.5
Sector Growth Rate (Percent):					
CROPS		-0.2	-0.5	-1.0	-0.9
LIV/FISH		2.4	2.4	2.2	1.8
MFG		4.5	4.5	4.1	3.4
OTH-IND		9.5	11.2	9.6	7.7
PRIV-SERV		6.3	6.7	6.1	5.2
GOV-SERV		7.2	2.0	7.8	11.5
% Share in Total Production: Sector:	**Baseyear**	**Base Tariff 10th Year**	**0% Tariff 10th Year**	**20% Tariff 10th Year**	**50% Tariff 10th Year**
CROPS	15.8	9.2	8.6	8.7	9.4
LIV/FISH	10.1	7.7	7.4	7.7	8.0
MFG	27.4	25.4	24.5	25.0	25.2
OTH-IND	15.9	23.6	26.4	24.3	21.8
PRIV-SERV	28.4	31.3	31.5	31.3	31.0
GOV-SERV	2.4	2.9	1.7	3.1	4.6

Table 4.13 and Table 4.14 also show that agriculture's total production share decreases over time, even in a pro-agriculture trade policy. As a result, comparative advantage is changing over time in the model. The wider implications of this finding are shown in Table 4.15 where the crop sector becomes a net importer after ten years, despite agricultural protection.

The loss of comparative advantage in the agricultural sectors is the result of the sector-specific factor accumulation process assumed in the model. The outward shift of the production possibility frontier, defined by resource availability, is occuring more rapidly in the non-

Table 4.9. Growth of Production (Version B) By Tariff Level

Production Level: Sector:	Baseyear	Base Tariff 10th Year	0% Tariff 10th Year	20% Tariff 10th Year	50% Tariff 10th Year
CROPS	107.9	111.2	103.7	102.2	105.2
LIV/FISH	69.6	91.1	85.8	90.4	94.4
MFG	187.8	316.0	274.8	314.6	355.9
OTH-IND	108.2	307.6	283.4	324.0	361.8
PRIV-SERV	195.7	389.0	352.7	392.3	432.5
GOV-SERV	17.3	24.5	24.6	24.6	24.6
Sector Growth Rate (Percent):					
CROPS		0.3	-0.4	-0.5	-0.3
LIV/FISH		2.7	2.1	2.6	3.1
MFG		5.3	3.9	5.3	6.6
OTH-IND		11.0	10.1	11.6	12.8
PRIV-SERV		7.1	6.1	7.2	8.3
GOV-SERV		3.6	3.6	3.6	3.6
% Share of Total Production: Sector:	**Baseyear**	**Base Tariff 10th Year**	**0% Tariff 10th Year**	**20% Tariff 10th Year**	**50% Tariff 10th Year**
CROPS	15.7	9.0	9.2	8.2	7.7
LIV/FISH	10.1	7.4	7.6	7.2	6.9
MFG	27.4	25.5	24.4	25.2	25.9
OTH-IND	15.8	24.8	25.2	26.0	26.3
PRIV-SERV	28.5	31.4	31.4	31.4	31.5
GOV-SERV	2.5	2.0	2.2	2.0	1.8

Table 4.10. Changes in Trade Structure by Tariff Level

Net Trade Level Version A:	Baseyear	Base Tariff 10th Year	0% Tariff 10th Year	20% Tariff 10th Year	50% Tariff 10th Year
CROPS	7.8	-16.2	-23.9	-19.3	-11.2
LIV/FISH	0.1	0.1	-1.0	-0.3	0.2
MFG	-29.7	-67.7	-89.1	-70.4	-55.7
OTH-IND	-16.6	35.0	57.0	40.4	22.6
PRIV-SERV	20.2	34.4	34.6	33.6	31.7
Net Trade Ratio (Percent):					
CROPS	7.2	-15.3	-23.3	-19.8	-11.3
LIV/FISH	0.1	0.1	-1.1	-0.3	0.2
MFG	-15.7	-23.1	-30.4	-25.0	-21.1
OTH-IND	-15.2	12.9	18.1	14.8	9.9
PRIV-SERV	10.3	9.3	9.2	9.5	9.8
Net Trade Level: Version B:	**Baseyear**	**Base Tariff 10th Year**	**0% Tariff 10th Year**	**20% Tariff 10th Year**	**50% Tariff 10th Year**
CROPS	7.6	-16.4	-19.7	-21.4	-18.9
LIV/FISH	0.0	-0.1	-0.9	-0.5	-0.1
MFG	-29.5	-79.1	-80.7	-84.9	-90.3
OTH-IND	-16.5	43.6	47.8	53.7	55.2
PRIV-SERV	20.1	36.7	32.5	36.9	41.5
Net Trade Ratio (Percent):					
CROPS	7.0	-14.8	-19.0	-21.0	-18.0
LIV/FISH	0.1	-0.1	-1.1	-0.5	-0.1
MFG	-15.7	-25.0	-29.4	-27.0	-25.4
OTH-IND	-15.3	14.2	16.9	16.6	15.3
PRIV-SERV	10.3	9.4	9.2	9.4	9.6

Table 4.11. % Growth of Real Expenditures By Tariff Level

Version A: Expenditure Growth	Base Tariff	0% Tariff	10% Tariff	20% Tariff	30% Tariff	50% Tariff
Poor HH	4.7	5.4	5.0	4.6	4.2	3.5
Middle HH	4.7	5.4	5.0	4.6	4.2	3.6
Rich HH	5.5	6.7	6.0	5.3	4.7	3.7
NCR HH	5.7	6.7	6.1	5.5	4.9	4.0
Oth Urban	5.0	5.9	5.4	4.9	4.4	3.6
Rural HH	4.6	5.3	4.8	4.4	4.0	3.4
HH-Cons	4.9	5.8	5.3	4.8	4.3	3.6
Gov-Cons	7.2	2.0	5.3	7.8	9.4	11.5
Cap-Inv	6.0	6.9	6.2	5.6	5.0	4.0
Version B: Expenditure Growth						
Poor HH	5.4	4.8	5.1	5.5	5.7	6.0
Middle	5.4	4.8	5.1	5.5	5.7	6.1
Rich HH	6.1	6.1	6.0	6.5	6.1	5.9
NCR HH	6.4	6.1	6.2	6.5	6.6	6.7
Oth Urban	5.7	5.3	5.4	6.1	5.9	6.0
Rural HH	5.2	4.7	4.9	5.3	5.5	5.7
HH-Cons	5.6	5.2	5.3	5.8	5.8	6.0
Gov-Cons	3.6	3.6	4.5	3.6	3.6	3.6
Cap-Inv	8.6	5.6	7.0	9.0	23.0	12.1

Table 4.13. Production Growth by Protection Bias (Version A)

Production Level: Sector:	Baseyear	Base Tariff 10th Year	Free Trade 10th Year	Pro-Ind 10th Year	Pro-Ag 10th Year
CROPS	108.4	105.8	102.7	82.2	118.1
LIV/FISH	69.6	88.2	88.1	83.0	88.2
MFG	188.6	292.9	293.0	262.2	293.8
OTH-IND	109.2	271.3	314.7	238.7	300.3
PRIV-SERV	195.7	360.5	375.8	319.5	378.2
GOV-SERV	16.4	32.8	20.0	46.8	23.8
Sector Growth (Percent):					
CROPS		-0.2	-0.5	-2.7	0.9
LIV/FISH		2.4	2.4	1.8	2.4
MFG		4.5	4.5	3.4	4.5
OTH-IND		9.5	11.2	8.1	10.6
PRIV-SERV		6.3	6.7	5.0	6.8
GOV-SERV		7.2	2.0	11.1	3.8
% Share in Total Production:					
CROPS	15.8	9.2	8.6	8.0	9.8
LIV/FISH	10.1	7.7	7.4	8.0	7.3
MFG	27.4	25.4	24.5	25.4	24.4
OTH-IND	15.9	23.6	26.4	23.1	25.0
PRIV-SERV	28.4	31.3	31.5	30.9	31.5
GOV-SERV	2.4	2.9	1.7	4.5	2.0

Table 4.14. Production Growth by Protection Bias (Version B)

Production Level: Sector:	Baseyear	Base Tariff 10th Year	Free Trade 10th Year	Pro-Ind 10th Year	Pro-Ag 10th Year
CROPS	107.9	111.2	103.7	46.6	119.4
LIV/FISH	69.6	91.1	85.8	90.8	86.8
MFG	187.8	316.0	274.8	300.3	283.5
OTH-IND	108.2	307.6	283.4	376.2	280.6
PRIV-SERV	195.7	389.0	352.7	373.4	361.8
GOV-SERV	17.3	24.5	24.6	24.2	24.6
Sector Growth (Percent):					
CROPS		0.3	-0.4	-8.0	1.0
LIV/FISH		2.7	2.1	2.7	2.2
MFG		5.3	3.9	4.8	4.2
OTH-IND		11.0	10.1	13.3	10.0
PRIV-SERV		7.1	6.1	6.7	6.3
GOV-SERV		3.6	3.6	3.4	3.6
Share in Total Production (Percent):					
CROPS	15.7	9.0	9.2	3.8	10.3
LIV/FISH	10.1	7.4	7.6	7.5	7.5
MFG	27.4	25.5	24.4	24.8	24.5
OTH-IND	15.8	24.8	25.2	31.1	24.3
PRIV-SERV	28.5	31.4	31.4	30.8	31.3
GOV-SERV	2.5	2.0	2.2	2.0	2.1

Table 4.15. Changes in Trade Patterns

Version A: Net Trade Level:	Base year	Base Tariff 10th Year	Free Trade 10th Year	Pro-Ind 10th Year	Pro-Ag 10th Year
CROPS	7.8	-16.2	-23.9	-29.8	-4.0
LIV/FISH	0.1	0.1	-1.0	-0.8	0.1
MFG	-29.7	-67.7	-89.1	-54.8	-88.2
OTH-IND	-16.6	35.0	57.0	33.5	45.6
PRIV-SERV	20.2	19.1	19.3	16.9	19.9
Net Trade Ratio (Percent):					
CROPS	7.2	-15.3	-23.3	-36.2	-3.4
LIV/FISH	0.1	0.1	-1.1	-0.9	0.2
MFG	-15.7	-23.1	-30.4	-20.9	-30.0
OTH-IND	-15.2	12.9	18.1	14.0	15.2
PRIV-SERV	10.3	5.3	5.1	5.3	5.3
Version B: Net Trade Level:	**Baseyear**	**Base Tariff 10th Year**	**0% Tariff 10th Year**	**Pro-Ind 10th Year**	**Pro-Ag 10th Year**
CROPS	7.6	-16.4	-19.7	-49.9	-50.2
LIV/FISH	0.0	-0.1	-0.9	-1.9	-1.0
MFG	-29.5	-79.1	-80.7	-76.5	-60.7
OTH-IND	-16.5	43.6	47.8	94.9	173.4
PRIV-SERV	20.1	36.7	32.5	29.0	35.9
Net Trade Ratio (Percent):					
CROPS	7.0	-14.8	-19.0	-106.9	-42.0
LIV/FISH	0.1	-0.1	-1.1	-2.1	-1.1
MFG	-15.7	-25.0	-29.4	-25.5	-21.4
OTH-IND	-15.3	14.2	16.9	25.2	61.8
PRIV-SERV	10.3	9.4	9.2	7.8	9.9

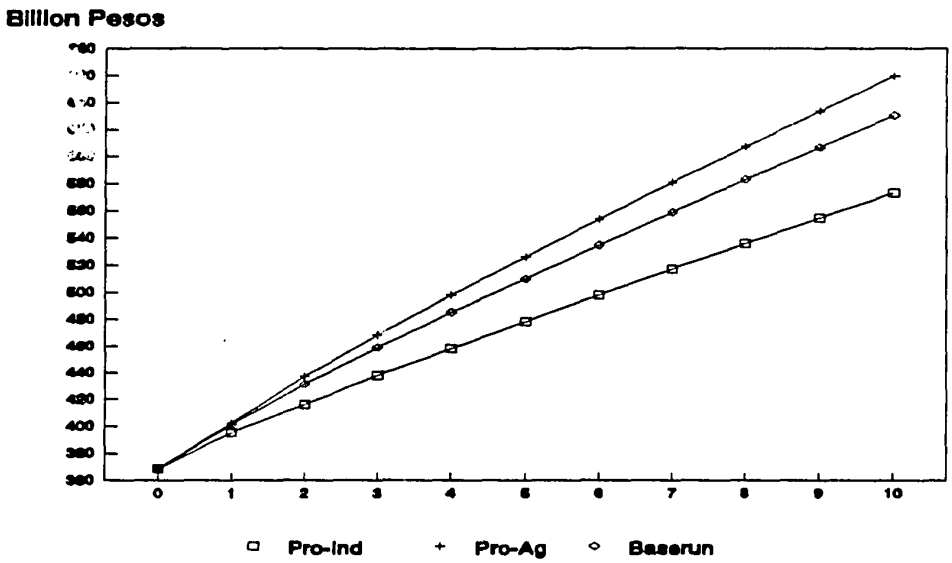


Figure 4.6. GDP Growth Paths by Protection Bias (Version A)

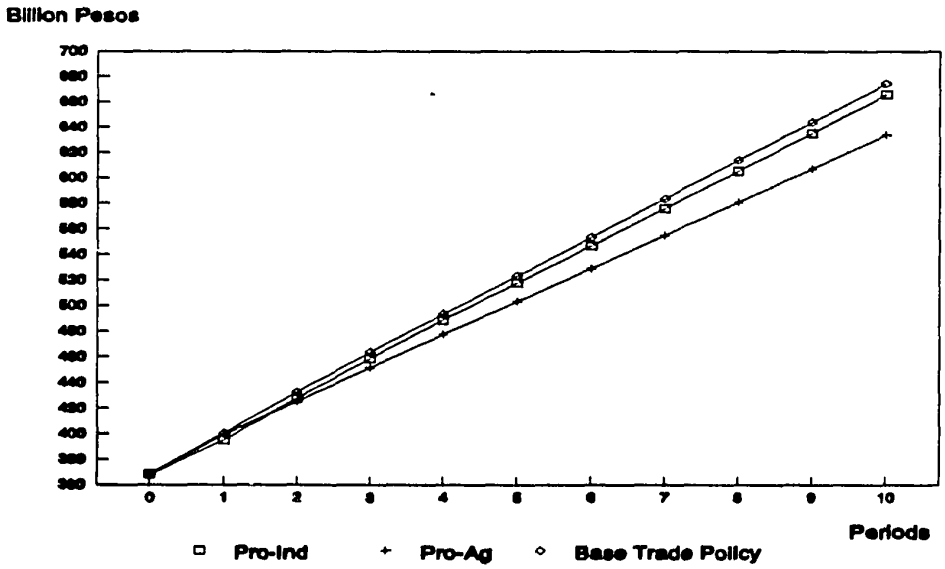


Figure 4.7. GDP Growth Paths by Protection Bias (Version B)

agricultural sector than in the agricultural sector (Figure 4.8). As a result, the autarkic price relation (domestic terms of trade) between agriculture and non-agriculture is tilting in favor of the agricultural sector. With a constant international terms of trade, this means, in turn, that the domestic economy's comparative advantage is shifting in favor of the non-agricultural sectors.

The model results show that more non-agricultural products are being exported over time, while more agricultural products are being imported.

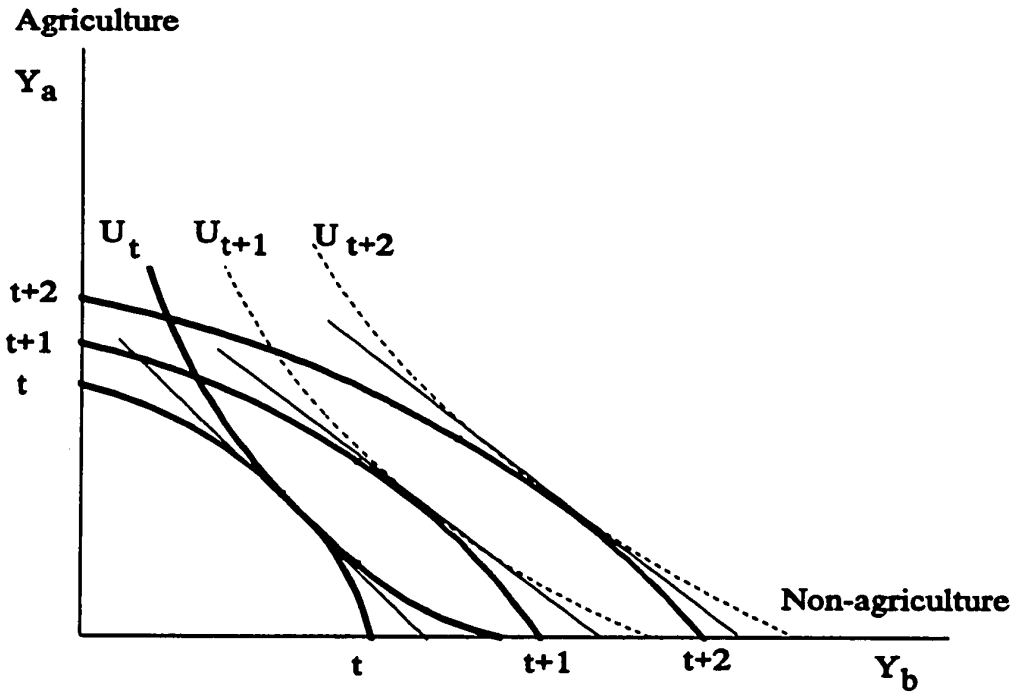


Figure 4.8. Shift of the Production Possibility Frontier

What is driving this skewed productivity growth in the CGE model? The answer lies in the slower rate of augmentation of fixed capital in the agricultural sectors than in the non-agricultural sectors. With a constant elasticity of substitution (CES) production function, the rate of growth of output is the weighted sum of the growth of factors. The weights are the corresponding elasticities of output with respect to each input. In a CES production function, this weighting parameter is $s_{fi}(Y_i/F_{fi})^{rho}$ where i is the sector subscript, f is the factor subscript, s is the share parameter, Y the quantity of output, F the quantity of input, and rho is the elasticity of factor substitution parameter (Henderson and Quandt, 1980, pp. 111-114). The quantity of labor and mobile capital along the sector axes are identical in each axis, i.e., all mobile factors are being devoted to the production of only one good. The growth of labor and mobile capital, therefore, does not cause disproportionality in the growth of the production possibility frontier because of changes in the weighting parameters. The property of homogeneity of degree one means that the smallness of a share parameter in one sector is compensated by the sum of the other two share parameters. To repeat, sectoral differences in values of share parameters, acting through the weighting parameters, are not the cause of the differences in sector growth rates.

The key parameter accounting for the more rapid growth in the non-agricultural sectors is the difference in the growth rates of fixed factors.[28] The slower rate of capital augmentation in agriculture is caused by the relatively smaller role of mobile capital compared to stocks of fixed capital in the agricultural sector.

The mechanism of the CGE model described above is consistent with the usual characterization that production in the agricultural sectors is more dependent on fixed factors, such as land, compared to non-agricultural sectors. Agricultural protection has little effect on the incomes of rural and low-income households. As shown in Table 4.16, the low-income households actually fare better under a pro-industry protection policy. This result is straightforward and derives from the greater role of food prices in the real income of the poorer households. The result emphasizes the offsetting tendencies of biased economic policies when these are analyzed in a general equilibrium context.

[28] The fixed factors are diminished by identical rates of depreciation. Consequently, depreciation does not account for the different rates of growth of fixed factors.

Table 4.16. % Growth of Real Expenditures By Protection Bias

Version A: Expenditure Growth	Base Tariff	Free Trade	Pro-Ind	Pro-Ag
Poor HH	4.7	5.4	3.6	5.2
Middle	4.7	5.4	3.5	5.4
Rich HH	5.5	6.7	4.0	6.1
NCR HH	5.7	6.7	4.2	6.3
Oth Urban	5.0	5.9	3.7	5.6
Rural HH	4.6	5.3	3.3	5.2
HH-Cons	4.9	5.8	3.6	5.6
Gov-Cons	7.2	2.0	11.1	3.8
Cap-Inv	6.0	6.9	3.6	7.2
Version B: Expenditure Growth				
Poor HH	5.4	4.8	4.7	4.9
Middle	5.4	4.8	4.9	4.9
Rich HH	6.1	6.1	6.2	5.6
NCR HH	6.4	6.1	7.0	6.0
Oth Urban	5.7	5.3	5.4	5.2
Rural HH	5.2	4.7	4.3	4.6
HH-Cons	5.6	5.2	5.2	5.1
Gov-Cons	3.6	3.6	3.6	3.4
Cap-Inv	8.6	5.6	9.0	4.8

5. SUMMARY AND RECOMMENDATIONS

The simulation results in the preceding section suggest the following summary and recommendations for trade policy.

1. There are modest net gains possible from more liberal trade policies, both in terms of raising the real GDP level of the economy and increasing its annual growth rate, because of the improved allocation of labor and capital that result from undistorted prices. Full trade liberalization, for example, would have pushed up the GDP of 1983 by 0.37% so long as government controlled its deficit.

The simulations have shown that higher levels of protection lead to lower levels of aggregate income. The presence of other policy constraints, e.g., inability of government to cut real expenditures despite falling government revenues, leads to some perversion of the efficiency effect of liberal trade policies, but they only figure at very low levels of protection. Therefore, high levels of protection (higher than 30%) are unequivically undesirable for the overall economy.

The findings of the study are consistent with prior work on estimating the general equilibrium gains from free trade policies. While the estimated gains have all been positive, authors of these estimation efforts have generally been disappointed with the magnitude of the gains. Harberger (1959), who was the first to publish such estimates, was disappointed with his estimate of a 15% improvement in the level of national income of Chile or what translates to a one to two percentage point increase in the economic growth rate. Yet that is perhaps the largest estimate in the literature from models that rely only on the allocative efficiency effect of trade liberalization.

Johnson (1965) reported a difference of 5.4% in the cost of maintaining a level of social utility between a 60% level of tariff and free trade regime, and barely a 1% gain between a 20% average level of tariff and free trade. Afzal and Guisinger (1974), using the case of Pakistan in the 1960's, reported gains on the order of half a percentage point of GNP.[29] For the Philippine case, Clarete and Whalley (1988), using 1978 data and a seven-sector level of disaggregation, report an estimated gain of 3.4% of national income from removing all import tariffs and export taxes. Clarete (1989), this time using a 25-sector level of disaggregation and 1979 data, estimated the impact of the tariff reform program and found a 5% improvement in the 1979 GNP in comparison with the existing tariff structure for that year.

[29] Surprisingly, these authors claim that their measured results are larger than what can be obtained by Harberger and Johnson's estimation methods.

The estimates obtained in the present study appear to be at the lower end of reported findings. This may be the result of treating a portion of capital in each sector as fixed.[30] Fixed capital reduces the ability of the economy to adjust to price changes and hence reduces the possibilities of adjusting to changes in trade policy. However, given the lack of capital markets in the Philippines (e.g., no efficient land markets) the assumptions of the model seem realistic.

The consistently low general equilibrium estimates of the impact of trade liberalization poses problems for policy analysts who put forward simple arguments for reforms based on static comparative advantage. However, comparative country studies (World Bank, 1987, pp. 83-87; Gaspay and Gotsch, 1992) have consistently shown a positive association between liberal trade policies and higher economic growth that is more than that explained by improved factor allocation. The low response to static price changes suggests that such dynamic effects as technological change and economies of scale should be given more attention when advocating liberalized trade policies. The findings underline the need, in the design of aggressive growth-oriented policy packages, to do more than "get prices right."

2. The influence of distorted tradable prices due to trade interventions on the economic growth process depends critically on how they redistribute income between spending units with different marginal propensities to save. In particular, the role of government spending behavior in response to revenue shocks is crucial.

The simulations with the dynamic model show clearly how the positive influence on GNP growth from lower tariff levels is reversed with an alternative assumption on government consumption behavior. A change in the assumption of the marginal rate government savings from zero in Version A to unity in Version B reverses many results. Actual behavior is likely in between the two. But the effect of the government spending assumption on capital formation may overwhelm the positive effects that come from an improvement in the allocation of existing resources in each period.

This finding raises an important qualification about the earlier recommendation for a trade liberalization program. This is that government spending behavior must also be reformed to be consistent with a more private-oriented economy.

First, the government must reduce its level of real consumption expenditures. High government consumption distorts the allocation of resources and leads to decreased levels of aggregate income, as the simulations demonstrate. In Version A, GDP levels and GDP growth are much lower when government consumption expands, even if the expansion is adequately supported by increased government revenues coming from higher tariff collections. In Version

[30] See Devarajan and Offerdal (1989) who tackle this question of the implication of assuming sector-specific capital, typically in CGE models of developing countries, versus flexible capital, typically in CGE models of industrialized countries. They conclude that the differences in results attributable to this difference in capital mobility assumption are not qualitatively substantial. Although they did not report the differences in estimating the change in national welfare, they did mention the tendency for lesser price response and larger quantity adjustments with the mobile capital assumption.

B, GNP growth is much lower when government fails to cut its real consumption level (e.g., the government deficit increases) as government revenues decline due to decreased levels of tariff.

Second, to ensure the success of a trade liberalization program, the government must also embark on a financial liberalization program. The higher GDP growth paths associated with higher levels of tariff under Version B merely indicate the power of forced savings measures that government may exercise through trade policy in order to raise the level of capital formation. With underdeveloped financial markets, such forced savings measures may be justified. The pitfall of such an approach, however, is that it also represses the development of private financial markets. Without clear signals for gradually abandoning the temporary reliance on government forced savings measures, these markets will never develop. Four decades of heavy Philippine government intervention in capital formation should now be phased out.

As trade liberalization shifts more income to households, government can only indirectly increase overall savings. A promising way to do this is by reducing the considerable difference between the interest paid to savings deposits and the interest paid on loans from these deposits. Studies of the Philippines financial structure have pointed out that the size of this difference is directly related to restrictive government financial policies (Lamberte, 1989).

Meanwhile, the role of government in capital formation should concentrate on providing the public infrastructure (e.g., improved transportation and communications systems) and public research programs necessary for increasing the overall productivity of private enterprise.

3. Trade protection biased in favor of industrial sectors can worsen the efficiency of allocation of existing production factors, especially in comparison with protection biased in favor of food and agricultural sectors.

This result is due to the lower elasticities of substitution for imports of industrial goods in the domestic market compared to agricultural and food imports. Therefore, more income is distributed to the government and away from the households in the pro-industry trade protection policy. Such diversion of income to government leads to more distortions of economic allocative efficiency as described earlier.

There is a second qualification to the recommendation for a trade liberalization program. It is that the government must either adopt a uniformly phased liberalization process across all sectors, or liberalize industrial sectors much faster. Clarete (1989) reports that the process of liberalization underway in the Philippines is in fact proceeding in exactly the opposite manner. Food and agricultural sectors are actually being liberalized much faster than industrial sectors. This process should be corrected.

4. Income distribution effects between households have not been very pronounced in the simulation results obtained. The most significant income distribution consequence of liberal trade policies has been in the redistribution of income from the government to households. Therefore, trade liberalization tends to benefit all households.

The high degree of aggregation in household types and the limited distinction between types of factors accounts for the failure of the model to uncover strong income distribution effects between households. What this suggests is that the income distribution conflicts raised by trade liberalization policies are rooted in short-run problems of adjustment. The model's assumption of perfect mobility for labor and portions of capital hide significant differences in labor skills and capital types. These differences, however, are usually surmounted by the ability of the economy to adjust in the long run.

The hardships imposed by short term adjustments suggest that the government should accompany the trade liberalization program with other programs designed to improve the mobility of labor and capital. Skills training and other programs aimed at removing entry barriers to specific business activities should also be implemented.

5. Growth is accompanied by a shift in comparative advantage from agriculture to the non-agricultural sectors. Whereas, agriculture as a whole remain competitive in spite of liberalization in the static model, it eventually becomes a net importer in the dynamic simulations. Raising the nominal protection rates of agriculture over non-agriculture by 50% is not sufficient to prevent this dynamic decline in agricultural comparative advantage.

This result is explained by the fact that growth in the model is created only by capital accumulation and labor growth, i.e., no technical progress. Since agricultural production depends more on fixed resources, the growth of capacity is much slower in the agricultural sectors. Agricultural imports, therefore, increase faster than agricultural exports.

This result leads to the following policy conclusion: technical innovation is much more needed in agriculture. Merely increasing investment incentives, for example by artificially increasing profit rates in agriculture, will not be sufficient to raise agricultural productivity to prevent this imbalance in economic growth.

6. REFERENCES

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

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

Armington, P.S., 1969. "A Theory of Demand for Products Distinguished by Place of Production," IMF Staff Papers, 16:159-176.

Bacharach, Michael, 1970. Biproportional Matrices and Input-Output Change, Cambridge University Press, Cambridge, Ma.

Baldwin, Robert, 1975. Foreign Trade Regimes and Economic Development: The Philippines, Columbia University Press, New York.

___, March, 1990. "Philippine Trade Liberalization: Options for the 1990's," Paper for the USAID Mission in Manila, Manila.

___, 1991. "Exporting from the Philippines: Problems and Prospects," Paper for the USAID Mission at Manial, Manila.

Bautista, Carlos, 1987. "Macroeconomic Adjustment: An Applied General Equilibrium Approach," Ph.D. Thesis, School of Economics, University of the Philippines, Quezon City.

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.

Bhagwati, Jagdish, ed., 1981. International Trade: Selected Readings, The MIT Press, New York.

Blitzer, C., P. Clark and L. Taylor, 1975. Economywide Models and Development Planning, Oxford University Press, London.

Braverman, Avishay, J.S. Hammer and A. Gron, 1987. "Multimarket Analysis of Agricultural Price Policies in an Operational Context: The Case of Cyprus," The World Bank Economic Review, 1(January).

Brooke, Anthony, David Kendrick and Alexander Meeraus, 1988. GAMS: A User's Guide. The Scientific Press, Redwood City, Ca.

Bureau of Customs, 1982. 1981 Customs Collection Report, Manila.

Bureau of Internal Revenue, 1984. 1983 B.I.R. Annual Report, Quezon City.

Business Day Corporation, 1984. 1,000 Top Corporations in the Philippines, 1984, Vol. 16. Business Day Corporation, Quezon City.

Central Bank of the Philippines, 1974. 25th Anniversary Report, 1949-1974, Manila.
___, Various Years. Annual Report, Manila.

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, Honolulu, Ha.

___, 1989. "Trade Liberalization and Philippine Agriculture," Paper for the Secretaty of Agriculture, Department of Agriculture, Quezon City.

Clarete, Ramon and John Whalley, 1988. "Interactions Between Trade Policies and Domestic Distortion in a Small Open Developing Country," Journal of International Economics, 24(3):345-358.

Corden, Max, 1966. "The Structure of Tariff Systems and the Effective Protection Rate," Journal of Political Economy, 74(3):221-237.

Dervis, Kemal, J. de Melo and S. Robinson, 1984. General Equilibrium Models for Development Policy, Cambridge University Press, Cambridge, Ma.

Devarajan, Shantayana and E. Offerdal, 1989. "Capital Markets and Computable General Equilibrium Models," Journal of Policy Modeling, 11(2):131-121.

Drud, Arne, W. Grais and G. Pyatt, 1983. "The Transaction Value Approach," Proceedings of the 4th IFAC/IFORS/IIASA Conference on Economic Dynamics and Control, Washington, D.C.

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

Gaspay, Manuel S. and C. H. Gotsch, 1992. "Sector Policies and Economic Performance in the ASEAN Region". Food Research Institute, Stanford University, Stanford, CA.

Habito, Cielito, 1984. "Equity and Efficiency Trade-offs in Philippine Tax Policy Analysis," Ph.D. Thesis, Department of Economics, Harvard University, Cambridge, Ma.

Harberger, Arnold, 1959. "The Fundamentals of Economic Progress in Underdeveloped Countries," American Economic Review, 49(2):134-146.

Hecksher, Eli, 1919. "The Effects of Foreign Trade on the Distribution of Income," Reprinted and translated from the original in the American Economic Association's Readings in the Theory of International Trade, Blakiston and Co., Philadelphia, 1949.

Henderson, James and Richard Quandt, 1980. Microeconomic Theory, McGraw-Hill Book Company, New York.

Johnson, Harry, 1965. "Costs of Protection and Self-Sufficiency," Quarterly Journal of Economics, 79(3): 356-372.

King, Benjamin, 1982. "What is a SAM? A Layman's Guide to Social Accounting Matrices," World Bank Staff Working Paper No. 463, The World Bank, Washington, D.C.

Kunio, Yoshihara, 1985. Philippine Industrialization: Foreign and Domestic Capital, Ateneo de Manila University Press, Quezon City.

Lamberte, Mario, 1991. "Financial and Trade Liberalization and the Agricultural Sector," Draft of a Paper for APAP-II, Philippine Institute for Development Studies, Makati, Philippines.

___, 1989. "Assessment of the Problems of the Financial System: The Philippine Case," Working Paper Series No. 89-18, Philippine Institute for Development Studies, Makati, Philippines.

Lysy, Frank, and Lance Taylor, 1980. "The General Equilibrium Income Distribution Model," in Models of Growth and Distribution for Brazil, L.Taylor, E. Bacha, E. Cardoso, and F. Lysy, eds., Oxford University Press, New York.

Manne, Alan, 1977. "ETA-MACRO: A MOdel of Energy-Economy Interactions," In Modeling Enrgy-Economic Interactions, C.J. Hirsch, ed., Resources for the Future, Washington, D.C.

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

McCarthy, F.D. and L. Taylor, 1977. "Macro Food Policy Planning: A General Equilibrium Model for Pakistan," M.I.T. International Nutrition Planning Program Discussion Paper, M.I.T., Cambridge, Ma.

McCoy, Alfred and C. De Jesus, eds., 1981. Philippine Social History: Global Trade and Local Transformations, Ateneo de Manila University Press, Quezon City.

Medalla, Erlinda, 1990. "An Assessment of Trade and Industrial Policy, 1986-1988," PIDS Working Paper Series No. 90-07, Philippine Institute for Development Studies (PIDS), Makati, Philippines.

Mellor, John, 1978. "Food Price Policy and Income Distribution in Low-Income Countries," Economic Development and Cultural Change, 27:1(1-26).

National Economic Development Authority (NEDA), 1989. Medium Term Development Plan 1988-1992 , Makati, Philippines.

___, 1988. 1983 Interindustry Accounts of the Philippines, An Unpublished Version, Makati, Philippines.

___, Various Years. Philippine Statistical Yearbook, Makati, Philippines.

___, 1984. Philippine Food Balance Series, Makati, Philippines.

___, 1981. 1979 Inter-Industry Accounts of the Philippines, Makati, Philippines.

National Census and Statistics Office, 1986. 1985 Family Income and Expenditure Survey, Manila.

National Food Authority, 1984. 1983 N.F.A. Annual Report, Quezon City, Philippines.

Ohlin, Bertil, 1933. Interegional and International Trade, Harvard University Press, Cambridge, Ma.

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

Power, John and Gerardo Sicat, 1971. The Philippines, Industrialization, and Trade Policies, Oxford University Press, London.

Ricardo, David, 1817. Principles of Political Economy, Reprinted by Penguin Press, New York, 1971.

Rutherford, Thomas, 1986. "Applied General Equilibrium Modeling," Ph.D. Thesis, Operations Research Department, Stanford University, Stanford, Ca.

Samuelson, Paul, 1938. "Welfare Economics and International Trade," American Economic Review, 28(2):261-268.

Samson, Pablo and Angeles Buenaventura, 1979. "Social Accounting Matrices: The Philippine Experience," Proceedings of the First National Convention on Statistics, Manila.

Scarf, Herbert and John Shoven, eds., 1984. Applied General Equilibrium Analysis, Cambridge University Press, Cambridge, Ma.

Sen, Amartya, 1963. "Neo-classsical and Neo-Keynesian Theories of Distribution," Economic Record, 39(March).

Shoven, John and John Whalley, 1974. "On the Computation of Competitive Equilibria on International Markets with Tariffs," Journal of International Economics, 4:341-354.

Stern, Robert et.al., 1976. Price Elasticities in International Trade, MacMillan Press, London.

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

Taylor, Lance, 1979. Macro Models for Developing Countries, Basic Books Inc., New York.

Taylor, Lance and Frank Lysy, 1979. "Vanishing Income Redistribution: Keynesian Clues About Model Surprises in the Short-Run," Journal of Development Economics, 6(1):11-29.

World Bank, 1987. World Development Report 1986, Published for the World Bank by Oxford University Press, New York.

APPENDIX A: CONSTRUCTION OF THE SAM

Figure A.1 is a flowchart for constructing the 1983 Philippine SAM. The process started by aggregating the 1983 127-Sectors Philippine Input-Output Table[1] into the 17 production accounts.

Step 1: Aggregating the 1983 Input-Output Table

Table A.1

PRODUCTION AGGREGATION SCHEME

SAM NO. CODE	SAM ACCOUNT NAME	127-SECTOR I-O NO. CODES
01	RICE	001 + 002 + part of 028*
02	CORN	003 + part of 028
03	COCONUT	004 + 043
04	SUGAR	005 + 029
05	FRUITS	006 + 007 + 012
06	OTHER CROPS	SUM@(008..011) + 013
07	LIVESTOCK	SUM@(014..017) + 034 + 037
08	FISHERIES	019 + 020
09	MINING/FORESTRY	SUM@(021..026) + 056
10	FOOD MFG	SUM@(030..033) + 035 + 036 + SUM@(038..042) + SUM@(044..050)
11	LIGHT & CHEM MFG	SUM@(051..055) + SUM@(057..075) + 092 + 094
12	HEAVY MFG	SUM@(077..091)
13	PETROL PROC	027 + 076
14	CONSTRUCTION	097 + 116 + 117
15	COMMERCE	SUM@(112..115) + 127
16	OTHER SERVICES	018 + SUM@(098..111) + SUM@(119..126)
17	GOV SERVICES	118

* I-O code 028 is for rice and corn milling: hence, it has to be separated into rice milling which is to be accounted for under RICE (SAM Code 01) and corn milling to be accounted under CORN (SAM Code 02).

The aggregation scheme is outlined in Table A.1 and involved the adding-up of the rows of all the accounts classified under an aggregate account, then adding-up the resulting columns. For rice and corn milling (Code 028)[2], its column entries were segregated into the rice (Code 01) and corn (Code 02) accounts according to the nature of these cost entries. For example, purchases of rice and corn milling (Code 028) from the irrigated palay (Code 002) account were obviously for rice milling, hence got charged to the rice account (Code 01). Common cost items were distributed into the rice (Code 01) and corn (Code 02) accounts in proportion to the palay

[1] This is an unpublished version from the NCSO office of NEDA.

[2] Two digit codes represent the 17-Sectors aggregation, while three digit codes are for sectors in the original 127-Sectors accounts.

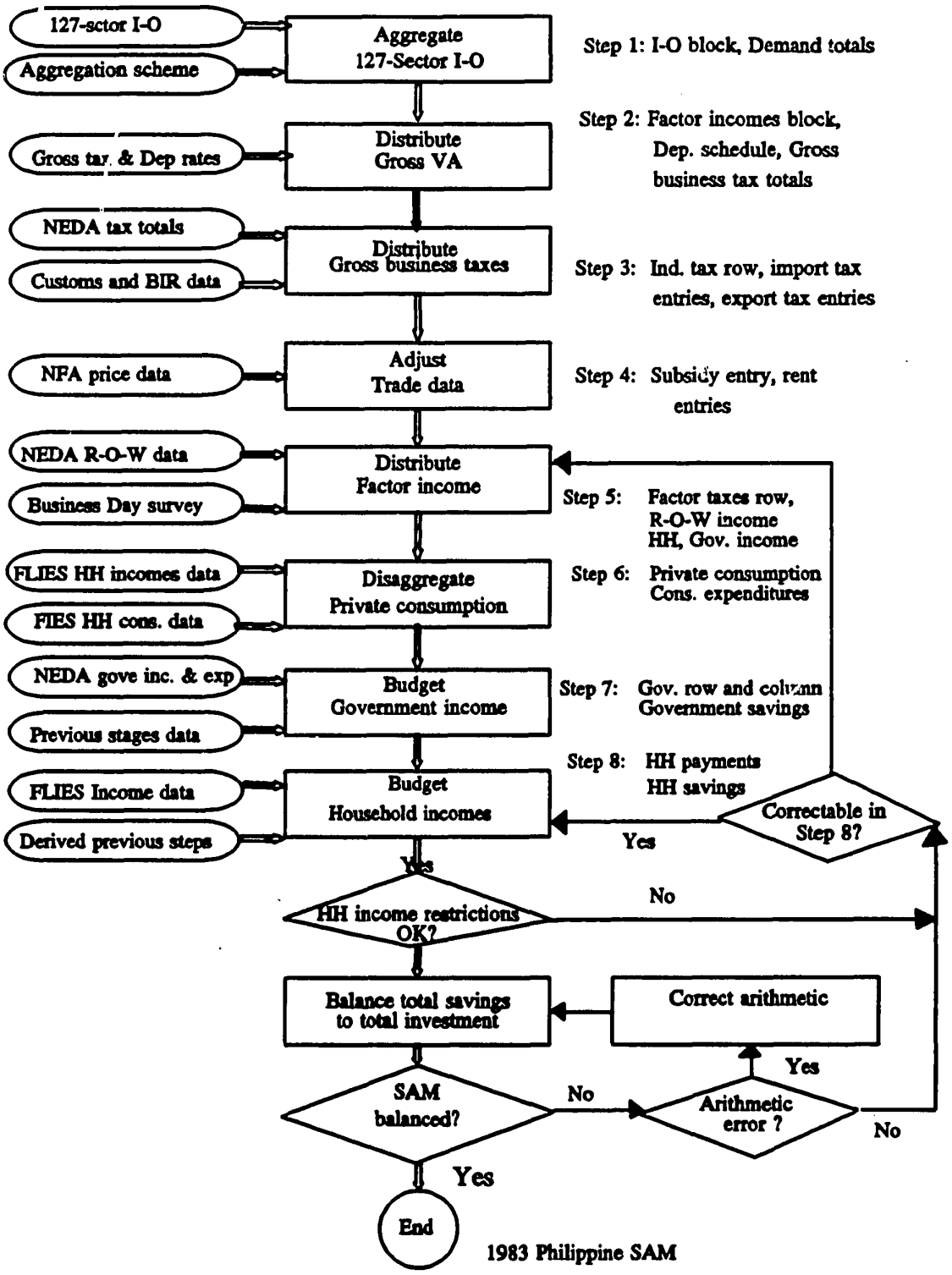


Figure A.1: Flowchart for Constructing the SAM

(Codes 001 and 002) and corn purchases by the rice and corn milling account[3]. For the row entries of rice and corn milling (Code 028), clearly identifiable sales were either charged to the rice account or corn account. When not identifiable, the share coefficients computed from the proportion of palay to corn purchases of rice and corn milling were used to distribute the sales entry into the rice and corn accounts.

One adjustment made to the entries of the 17-sector aggregated input-output (I-O) table was the removal of the cell entry for purchases of heavy manufacturing (Code 12) from the fisheries sector (Code 08). This was made because the entry was the total of purchases of scrap from the rusted boats and other salvageable items of condemned fishing vessels by the metal foundry shops. In order to keep the accounting balance, an equivalent value had to be deducted from the profits of the fishery sector. Purchases of scrap were treated as reductions in the inventory of heavy manufacturing.

The 17-sector input-output table was the backbone of the emerging SAM. This meant that the value-added totals and final demand totals (e.g. private consumption total) given by this aggregation are considered as the control totals for the succeeding computation of the other SAM cell entries. Gross domestic product (GDP) in market prices, as computed from this 17-sector I-O table, was P379,749 million, which was 1.1% less than the published GDP for 1983 in NEDA's national income accounts.

Completion of the I-O table made it possible to fill out the SAM input-output block [(1,1),(17,17)][4], the government consumption block [(1,50),(17,50)], the investment composition block [(1,52),(17,53)], the export structure block [(1,50),(17,50)], the import structure block [(1,55),(17,55)], the row totals for the private consumption block, and the gross value-added per sector. The next steps involved distributing the gross value-added totals into the factor incomes, and disaggregating the row totals for the private consumption block into expenditures per households.

Step 2: Distributing Gross Value-Added

The original 127-sector I-O table was constructed by activity and cost analysis surveys of business establishments per sector category. The cost shares were then scaled by the production estimate for that sector to produce a column-wise construction of the table[5]. Gross value-added was defined to be composed of payments for wages and salaries, business taxes (including import and export taxes), depreciation, and the residual operating surplus. Interest payments are included in this residual account. The 1983 I-O table's gross value-added per sector was decomposed only into a wages/salaries account and a residual account called "other value-added". It was therefore

---

[3] The share coefficient for rice was 0.8908.

[4] The two paired numbers identify the northwest-most and the southeast-most cell addresses of the block; the coordinates of these cell addresses are the SAM account codes.

[5] See discussion on the methodology of constructing the Philippine Input-Output table in the 1979 Inter-Industry Accounts of the Philippines.

necessary to further decompose this residual account into components of taxes, depreciation, and all other capital payments. The depreciation and gross business taxation structure implied in the 1979 Inter-Industry Accounts classification was used to decompose the 1983 "other value-added" account. The resulting gross tax and depreciation figures were then adjusted to conform with the total business taxes and depreciation reported in the 1983 national income accounts published by NEDA. This assumed that the 1979 business tax structure and depreciation schedule were similar to that of 1983. The resulting net value-added derived from subtracting the estimated gross business taxes from the "other value-added" account was then treated as the gross payments to capital factors. Capital factors were classified such that each sector (except the commercial and other services sectors) used a distinct aggregate capital form, i.e. there was no possibility of shifting capital types between sectors. When the above computations were completed, the factor income distribution block [(18,1),(33,17)] and the gross business tax totals for each sector were identified.

Step 3: Distributing Gross Business Taxes

Because of the convention of lumping all trade taxes, including import and export taxes, into the operating surplus of each sector in the I-O table, the gross business taxes computed sector must be disaggregated into indirect taxes, import taxes, and export taxes.

The total amount of indirect taxes, import taxes, and export taxes collected in 1983 was reported in NEDA's publication of annual national income accounts. These totals were the most reliable data on taxes and were consistent with the Input-Output accounts available. They were, therefore, used as control totals in this study[6]. Customs collection data disaggregated by commodity were available only for export taxes for the year 1983. The nearest year for which a similar disaggregated customs report was available for import taxes at the time of this study was for 1981. The tax rates indicated by the Philippine Tariff Code[7] was of little help and inconsistent with the rest of the data used in constructing the SAM. (If they were actually applied in 1983 to the volume of trade and business flows reported for that year, collections should have been much higher than the actual totals appearing in NEDA's reports.)

Since export taxes were the ones available in disaggregated form for 1983, they were the ones considered most accurate for disaggregating business taxes. Export taxes are therefore taken as the starting point. The Customs data was grouped using the SAM classification of 17-commodity accounts and then adjusted to reflect the NEDA total.

Next, the implied enforced import tax rates in the 1981 Customs report are used to compute an import tax collected for each of the SAM commodity accounts. As expected, the total

---

[6] NEDA collects this information from the reports of the Department of Finance, who in turn assembles these data from reports of the Bureau of Internal Revenue for domestic business taxes, and the Bureau of Customs for foreign trade taxes.

[7] This was used in estimating the tax rates in C. Habito's (1984) and R. Clarete's (1987) CGE models for the Philippines.

of these implied import taxes in 1983 was higher than NEDA's total import tax collection[8]. Adjustment was forced by a proportionate shrinking of the individual import taxes so that their total exactly equaled the NEDA total. This adjustment brought with it, of course, the assumption that the decrease in tariff rates from 1981 to 1983 was uniform across sectors.

Indirect taxes then became residuals from the subtraction of export and import taxes from the gross business taxes for each sector. Collection reports by the Bureau of Internal Revenue for 1983 were examined to detect and eliminate glaring discrepancies.[9] For the identifiable items of oil and gasoline, cigarettes and liquor, and forestry and mining fees, the BIR reported figures were consistent with the residually computed figures. The exception was the negative indirect tax rate for heavy manufacturing. This was because the Philippine government extended tax credits as incentives for industries under this classification. One use of these tax credits was to offset collectible duties on importation of equipment and machinery capital.

Import and export taxes were presented in a somewhat non-traditional way. Export taxes, for example, were shown as negative entries along the export tax column. This emphasized that the transaction values were deductions from the recorded export payments of foreign buyers. There were, therefore, adjustments to the border-priced receipts of the exporting production accounts rather than cost items[10].

Import taxes, on the other hand, were first classified as to whether they were import taxes for competing imports or for non-competing imports. Import taxes for non-competing imports were treated as costs added to the border-priced value of non-competing imports which appeared as positive entries along the import row. Import taxes for competing goods were added to the border-priced values that appeared as negative entries along the import column.

Step 4: Adjusting the Trade Data

Step 1 produced the SAM export and import columns as border-priced transactions. The presentation of import and export taxes in Step 4 served to make the net receipts (or payments) of the external trade production accounts consistent with domestic producer pricing. One more adjustment procedure was needed, however, to account for the fact that some trade items were subjected to quantity restrictions or other non-tariff government trade intervention. Import restricted items must have been sold at a premium above the border-priced value plus import tax of these items. For example, imports of corn, wheat, and soybeans were specifically known to have been controlled and undertaken only by a government agency, the National Food Authority

---

[8] The higher total using 1981 import tax rates is to be expected since a program of gradually lowering tariff rates and liberalizing trade was in progress from 1981-1983.

[9] The BIR report could not be used to come up with a disaggregated computation of indirect taxes since the disaggregation did not focus on a commodity classification but on tax types.

[10] The trade transaction entries in the Input-Output table indicate CIF values for imports and FOB values for exports, hence are valued at border prices. The rest of the sale entries, however (e.g. intermediate use sales), are priced at domestic producer prices.

(NFA). This agency used the "rents" generated by this trade monopoly to offset its operating losses in supporting its rice price targets[11]. Rice which could not be traded except by this agency was sold for exports in 1983 at prices much lower than the price at which it was acquired from the rice farmers[12]. The export subsidy implicit in this transaction must therefore be accounted for.

Rents from the control of corn, wheat, and soybean imports were estimated using the NFA data on acquisition cost and selling prices for these items[13]. Subsidies for rice exports were also estimated from similar data. Rent for corn was presented as a negative entry along the rent column while wheat and soybean rents were aggregated and presented as positive entries in the cell defined by the rent row and the "other crops" column in the SAM.

Step 5: Distribution of Factor Incomes

Factor income totals coming from the value-added distribution computations in Step 2 were distributed in sequence to factor taxes, depreciation, foreign-owners, government (to account for government-owned factors), and then households. For the labor factors, only non-agricultural labor was considered to be paying in to the Social Security System (SSS contributions) as agricultural laborers were rarely formally employed. Corporate taxes were treated as tax on capital factors and subtracted from the income of each capital type. The dispersion ratios of incorporated businesses recoverable from the 1983 survey data of Business Day for the top 1,000 corporations in the Philippines was applied to NEDA's report of total corporate taxes collected in 1983 to produce the capital tax by capital type.[14]

The next step deducted the depreciation allocations already computed in [illegible] (distributing gross value-added) from the remaining factor income totals. The residuals, therefore, represented the profits distributed to the owners of these factors of production[15]. These residuals were then distributed to the foreign owners, government, then households. The share of foreign owners of factor income was computed again using the Business Day data for 1983 and

---

[11] The 1983 NFA Annual Report indicated positive earnings from its wheat trade activities.

[12] The accumulation of rice stocks by NFA from 1980, due to bountiful harvests and NFA procurement to support the palay (paddy rice) floor price, forced the agency to export stocks at a loss in 1983.

[13] These data were made available from the NFA's MIS office through the kindness of Mr. Romy Zabala.

[14] The Business Day data (Top 1,000 Corporations in the Philippines, 1983) reported the volume of businesses and earnings of these corporations. These corporations were then classified as to what capital type it was likely using and then their earnings (also done for sales volume) were added-up for each of the SAM classification. This, in effect, produced a dispersion of businesses by capital type.

[15] This assumes that corporate retained earnings are claimed as savings by some households, and hence part of the income of these households.

the dispersion scheme described earlier[16]. From the Business Day data, government-owned firms were also identifiable, and hence the accounting of the NEDA total for government income from government-owned factors per factor type was possible. The data suggested that government factors were mostly in the petrol business and other services, e.g. transport and utilities.

The next task involved allocating the remaining claims on factor incomes to the different households For this, the 1985 FIES data on sources of income by household groups was used. The classification of sources of income in the FIES was translated (as well as could be done based on the FIES documentation of descriptions) into the SAM classification of factor types. A matrix of coefficients of shares by each SAM household type of the total income for each factor was then constructed from this FIES tabulation. This matrix was applied to the vector of remaining factor incomes to produce the matrix of household incomes by domestic factor in 1983. (Block [(42,18),(50,34)] in the SAM.)

Step 6: Disaggregating Private Consumption

The private consumption totals by sector for the 17-sector I-O table was disaggregated into consumption expenditures per household type using the household shares of total private consumption per sector/commodity implied by the 1985 FIES surveys. To do this, the itemized expenditures on 63 items by each household income group type for each urban-rural classification by region had first to be aggregated into expenditures on the 63 items according to the nine SAM household types. The resulting table of expenditures by the nine SAM household types on the 63 FIES commodities was then transformed into a table of shares of total expenditures by FIES item by each household.

The next step involved mapping the 127-sectors in the 1983 I-O classification of production accounts into these 63 FIES commodities. This mapping resulted in a correspondence of shares of total expenditures by each household for each of the 127 sector accounts in the 1983 I-O. This matrix of shares was then applied on the total private consumption expenditures by sector that appeared in the 1983 I-O table to obtain the matrix of consumption expenditures by each household for each of the 127 production accounts.

For the retail trade sector (Code 113), the ratio of total consumption expenditures per household to total consumption expenditures of all households that appeared in the FIES aggregation, was used since household expenditures are in retail prices. This assumed that retail sales margins were uniform across FIES items. An aggregation using the 17-sector classification of production accounts of the SAM was then performed on the matrix of consumption expenditures per household for each of the 127-sector account to produce the private consumption block in the SAM, block [1,41),(17,49)].

The procedures used assumed that the share coefficients revealed in the 1985 consumption expenditure patterns were not substantially different from the shares that could have been

[16] Kunio's (1985) study of 250 foreign-owned businesses in the Philippines was also utilized for comparison of the dispersion and identification of foreign-owned firms.

observed from a similar survey of household consumption expenditures survey in 1983. This assumption was commonly used in the numerical specification of CGE models as discussed in Scarf and Shoven (1984), or Dervis, de Melo, and Robinson (1984).

Step 7: Budgeting Government Income

The entries for the government account row represent the sources of income for government. Since the NEDA accounts for government income and expenditures were reliable and consistent with the NEDA totals previously used in the earlier steps of figuring out the total of business taxes, the NEDA figures were used also for establishing the entries for the government income. Business taxes, factor taxes, and income from government-owned factors have been determined earlier, so the only entry left to identify was the income of government from household taxes. The total was again available from the NEDA accounts.

The next step was to budget this income into components of government expenditures and savings. Total government consumption expenditures computed from Step 1, the aggregation of the I-O table, was first budgeted out of the total government income receipts. The budget items reflected in the NEDA accounts were then entered -- these were transfers to households and external payments -- leaving savings as the residual. The percentage difference between this residually determined figure and the NEDA government savings figure was only 5.9%.

Step 8: Budgeting Household Incomes

First, the total income for each household was computed by distributing across households the other two sources of household incomes not considered in Step 5, namely, government transfers to households and receipts of households from factors employed abroad. The share coefficient for each household constructed in Step 5 was applied to the NEDA totals for government transfers to households and income from factors abroad.

After deriving the total income for each household, it was budgeted into three components: total consumption expenditures for each household computed in Step 3, personal taxes paid, and a residual savings. Personal taxes paid per household was determined by applying the per household share rates of total personal taxes paid in 1985 to the NEDA reported total for personal taxes collected in 1983[17]. Savings per household was computed as a residual from the subtraction of consumption expenditures and personal taxes from the total income per household type. This was a point for counter-checking as the savings rates and savings comparison per households derivable from these residually computed savings figures must satisfy certain reasonable restrictions:

1. The total income of all households must at least satisfy the consumption expenditures computed earlier in Step 3, i.e. no negative saving rates.

[17] Personal taxes include land taxes and other property taxes. These taxes were not classified under factor taxes since their payments are not tied to the productive employment of these properties.

2. The residually derived saving rates per households must satisfy the well-known property that higher incomed households exhibit higher average propensities to save.

If the restrictions were not satisfied, an adjustment process proceeded to either Step 8 or Step 5. Only when the restrictions were satisfied could the SAM construction procedure proceed to the next step.

Step 9: Balancing Total Savings and Total Investments

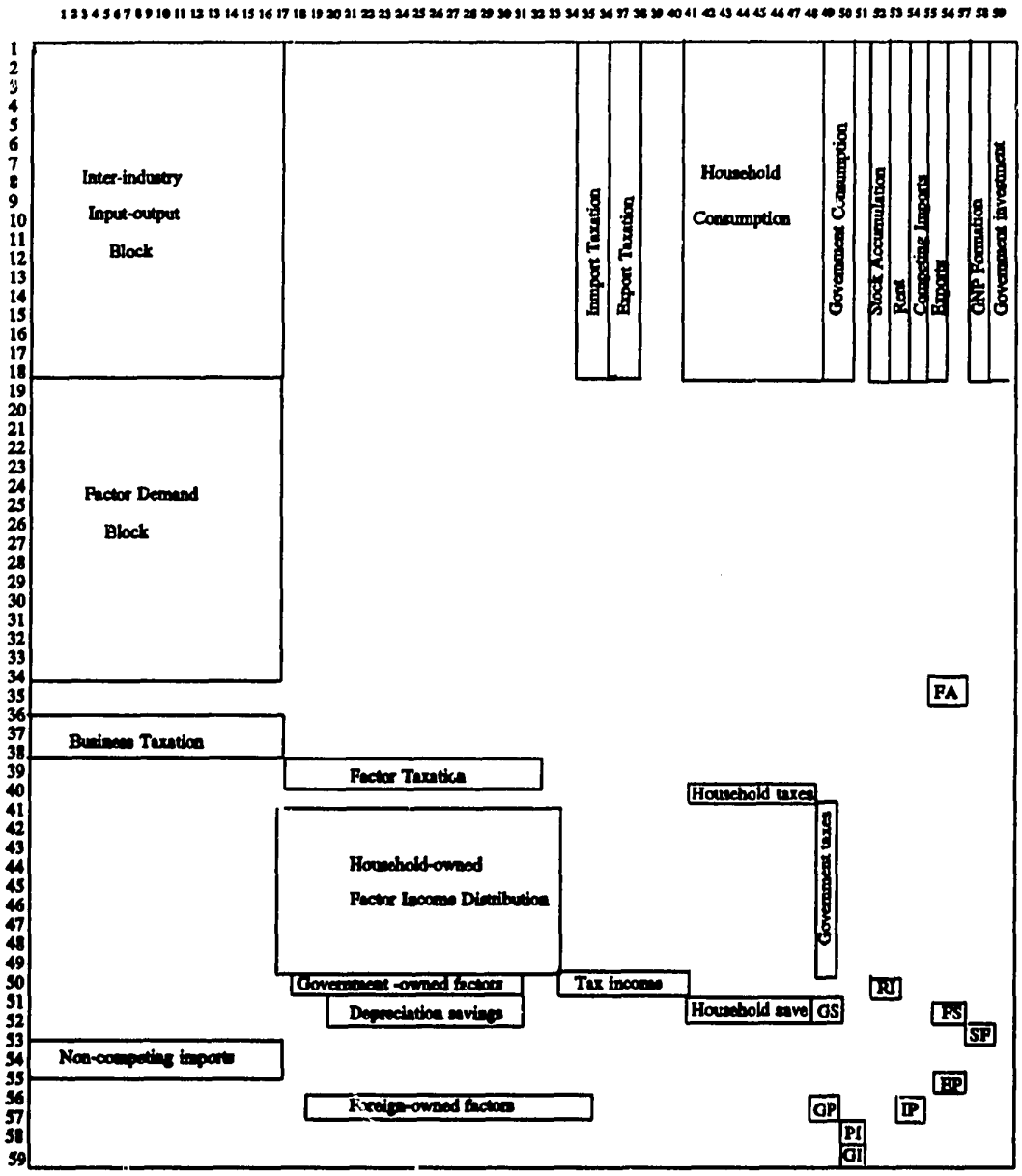
The total savings that came from the government, the nine households, the depreciation funds, and the savings from foreign sources, must equal the total investment expenditures earlier derived from the 17-sectors aggregation of the 1983 Input-Output table in Step 1. The government savings had been residually computed in Step 7, the households' savings in Step 8, and the depreciation in Step 2. The savings from foreign savings was simply the sum of the trade deficit, derivable from Step 1, and the external payments deficit, which was the difference between non-trade payments from abroad and payments made to foreign accounts available from the 1983 NEDA accounts[18]. If this balances, the SAM should be completely specified and should be balanced. The row totals for each account were compared with its corresponding column total. Discrepancies were checked and if the error was due to arithmetic operations, then adjustments would only have involved the cell for which the error was committed. If the discrepancy was due to income versus expenditure inconsistencies, then an inspection and adjustment iteration was done through the income distribution and income budgeting loop. Convergence was achieved by a judicious dispersion of adjustments taking into account (1) preservation of the proportionality of the elements of the matrix and (2) the reliability of the various estimates.

The SAM construction procedure placed the burden of the consistency adjustments on the income distribution and savings estimates. This was justifiable given that the input-output data and the NEDA national income accounts were reasonably consistent with each other, having been gathered for the same year. There was also a good deal of similarity in accounts definitions and classifications between these two sources.

Figure A.2 presents the structural diagram of the resulting SAM. There were 59 accounts including 17 production accounts to represent production, and 9 household accounts to represent private consumption. There were 18 factor accounts including one account for factors deployed abroad, two labor accounts, and 15 capital accounts.

The SAM itself is presented in Table A.2.

[18] Payments from abroad were payments received for factors employed abroad and other remittances, while non-trade payments to foreign accounts were the payments for foreign-owned factors domestically employed as well as the governments foreign debt payments.



FA = Factors abroad
GS = Government savings
FS = Foreign savings
SF = Stocks fund
EP = Exports payment
IP = Imports payment
RI = Rent income to government
GP = Government payment to R-O-W
PI = Private investment
GI = Government investment

Figure A.2: Structure of the SAM

Table A.2. 1983 Philippine SAM (In 1,000 Pesos Producer Prices)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17		18	19	20
	RICE	CORN	COCONUT	SUGAR	FRUIT	OTHCROP	LIVSTOCK	FISHERY	MINFOR	FOODMFG	LTMFG	HVMFG	PETROL	CONST	COMMER	OTHSERV	GOVSERV	SUB-TOTA	AGLAB	NONAGLA	RICECAP
ICE	15260000						134166	151520		75467						1270622		16895775			
		1886389					3425850			1056724	154					35508		6404625			
NUT			1385132				5613	1420		5805594	884					057		7199300			
				4080085			1112			665087	155869					176247		5078400			
					887360					2424640						36500		3348500			
						343280	229974	26940		3444129	2221672					173405		6439400			
							21805313	39280		3258770	221453					2395784		27760600			
							10948	291320		3267532		0				1055585		4633345			
	200		7980			800	5605	65730	4057603	48492	2845285	1658551	18010	4227294	135546	184704		13256600			
			31973				399962	548940		19214186	2551948					1940091		24687100			
	1648474	380715	123782	361826	516550	303270	560056	267750	427635	1064960	20667886	2663503	495588	4146951	3074571	3932783		40636300			
	59408	5768	33168	10549	1090	40770	7734	135210	583560	894995	1981230	18847900	197919	11763755	854448	4523511		39940115			
	640120	88250	48450	344520	55340	67530	432597	1511920	1723090	2411046	2662634	3584232	19787856	1337300	657700	15480515		50833180			
	74	9	235	2643	4040	1510	31460	9930	58327	9855	55318	91548	28149	329729	2374495	721278		3718600			
C	2218092	356922	361415	651056	393260	222680	3357324	1044760	1240791	5453183	4650644	4109552	3584084	2594875	10864971	5362691		46695700			
	1448393	243286	183265	291221	197259	[illegible]	1550386	660980	1090294	2825040	3766823	3677414	2038394	2685696	11459969	11909819		44115500			
																		0			
	8511117	2889683	314900	2381000	4764300	6733200	7886500	6727200										43107900			
									4846000	6298900	9270900	7051200	744400	10361400	25667800	27417400	17539000	109197000			
	9041132																0	9041132			
		1976908																1976908			
			2734190															2734190			
				2140547														2140547			
					4816885													4816885			
						5360189												5360189			
							9672031											9672031			
								8842477										8842477			
									9482422									9482422			
										11641661								11641661			
											12172621							12172621			
												9795773						9795773			
													5396863					5396863			
														30949506				30949506			
															43298151	24892329		68190480			
OAD																					
	502922	119838	152275	191537	294491	149996	408795	675362	892863	3330911	371479	-2752185	3103290	1868226	5542596	2767604		18610000			
			666	1625	0	47866	0	3255	65054	0	3320016	5277793	4322369	12491	21981	0		13072716			
	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
																		0		1461000	
X																		0			
AX																		0			
LOW																				1825299	0
MID																				16700993	10187
HI																				18439969	33513
LOW																			2437698	5007967	223561
MID																			3357820	29446763	563775
HI																			347176	14478472	524719
LOW																			20157422	6238060	2261915
MID																			14809753	19784401	3660994
HI																			1998031	4014077	584913
V																					
NGS																					1177555
											0	0									
						398254															
	300	0	2500	6100	0	2750800	0	14100	282600	0	17454400	39632900	24343700	93800	247600	0		84828000			
T																					
W																					

Table A.2. 1983 Philippine SAM (continued)

	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
	CORNCAP	COCOCAP	SUGCAP	FRTCAP	OTHCRPC	LIVCAP	FISHCAP	MINFORC	FOODCAP	LTCAP	HVCAP	PETCAP	CONSCAP	SERVCAP	SUB-TOTA	FAC-ABRO	BUS-TAX	IMP-TAX	EXP-TAX	SSS-TAX	CORP-TAX
ICE																			27494		
																			0		
NUT																			-3869		
																			-1192		
																		-65401	-54523		
																			-8349		
																		-287259	-316		
																			-91		
																			-248161		
U																		-956840	-3388		
																			-4384		
																			-5019		
																			-676		
																			-377		
CE																			-3772		
																		-1334784	-7843		
																			0		
AP																					
AD																					
															1461000						
Y		24000	24006	58000				427000	523000	605000	504000	129000	58000	2447000	4799000						
AX																					
LOW	0						9988		61267	23478	0		451733	484836	2857004	46000					
CR MID	2258	2972	1435	5104	6583				186919	302874	590201		3403643	3315998	25010564	1694000					
CR HI	7427	9777	4720	16781	21655			539675	586408	563758	860094		13204493	5331167	39616437	5293800					
RB-LOW	49547	65221	31488	111942	144458	232808	635117	136187	390085	128647	0		562263	1802011	11899000	212000					
RB-MID	124945	164473	79407	282256	364293	1184463	514189	150777	1086368	545845	314174		2756759	5549874	37486221	2329000					
RB-HI	116289	153078	73906	262740	339056	219027	189427	265190	1328269	704592	479591		3063750	8268716	31613997	5082000					
UR-LOW	501294	659880	318588	1132596	1461578	2409942	3410095	1557233	1464825	570899	0		899056	4745612	47790595	212000					
UR-MID	811362	1068040	515646	1833148	2365617	2528402	2776647	1523348	1853910	722540	0		1440633	6063569	61758010	2752000					
UR-HI	129631	170640	82384	292880	378952	842536	299569	156335	861579	335789	0		789599	3021260	14797375	3599000					
OV												1341429		4459571	5801000		10610000	15737000	314506	1461000	4799000
S	234155	290169	820063	317641	278997	7214853	1006645	3173217	2372501	3491789	3269513	463086	3240377	16287826	30638387						
T																					
O-W		125940	188910	503760				1553260	986530	4177010	3776200	3463350		6213040	20980000						

Table A.2. 1983 Philippine SAM (continued)

	41		42	43	44	45	46	47	48	49	50		51	52	53	54	55	56	57	58	59		
	HH-TAX	SUB-TOTA	NCR-LOW	NCR-MID	NCR-HI	URB-LOW	URB-MID	URB-HI	RUR-LOW	RUR-MID	RUR-HI	SUB-TOTA	GOV	SAVINGS	GOV-INV	PRIV-INV	STOX	RENT	IMPORT	EXPORT	R-O-W	ROW TOTAL	
F			286683	1722941	1005877	1400354	3135205	1230638	5853151	6050857	870323	21596029	96736				619498		0	94700		39330232	39330232
			296	6196	3856	269656	176497	20466	1597726	533222	30456	2638371	9364				-160173	-63519	-881500	600		7947768	7947768
NUT			1742	9793	10517	15331	26485	13413	101441	60707	10471	249900	0				-94500		0	929100		8279931	8279931
			34665	207473	135856	137053	325783	157271	585058	594613	95829	2273601	48500				169200		0	2894200		10462709	10462709
			80603	683489	737865	345676	1005242	780802	1507275	1656818	322430	7120200	51800				66500		-175400	1628900		11920576	11920576
			103487	809206	665586	465297	1157940	692535	2443933	2144114	360602	8842700	70600				540454		0	622400		16507205	16507205
			238051	2469133	2715711	806168	3301404	2723775	3025615	4833763	1240081	21353701	232300				1381900		-1244500	767000		49963426	49963426
			219154	1468004	1109497	1043930	2584737	1330730	3807729	3773845	709274	16046900	112000				3900		0	222000		21018094	21018094
			8103	124237	188112	48759	267574	410626	275799	555943	264947	21441[illegible]	47600				1345500			8204600		24750239	24750239
U			467841	4010186	3699433	1965832	6365591	4328274	6981780	9606909	2159148	39584800	354400				4419800		-3079400	8224700		73231172	73231172
			271115	2480020	3328795	1117702	4235239	3801929	4381453	6685592	2027256	28329101	2282400		169111	797089	1518300			10642699		84370616	84370616
			59078	688908	1471253	148399	948582	1404016	454124	1167182	627058	6968600	1318700		6032161	28432039	-1231913			12183500		93638181	93638181
			124621	969407	1172281	471424	1246157	950289	1872199	1814634	368888	8989900	830200		0	0	1766300			1641700		64060524	64060524
			162689	1733144	3106900	403044	1611087	1883068	1245062	1864562	683344	12692900	1569900		8937064	42124036	414700			914200		70371023	70371023
CE			641161	3207066	3239370	2248488	5456969	3353975	9666939	9868951	1896681	39379600	2352400		1158258	5459342	0			9158300		104199828	104199828
			407811	4709198	9732215	1332647	6318396	8109286	4297793	8582676	3411578	46981600	3974100		518149	2442251	0		-10326400	19138300		105480833	105480833
			0	0	0	0	0	0	0	0	0	0	17539000				0			0		17539000	17539000
																						43107900	43107900
																						109197600	109197600
																						9041132	9041132
																						1976908	1976908
																						2734190	2734190
																						2140547	2140547
																						4816885	4816885
P																						5360189	5360189
																						9672031	9672031
																						8842477	8842477
																						9482422	9482422
																						11641661	11641661
																						12172621	12172621
																						9795773	9795773
																						5396865	5396865
																						30949506	30949506
																						68190480	68190480
AD																					21219000	21219000	21219000
																						18610000	18610000
																						13072716	13072716
																						0	0
X																						1461000	1461000
																						4799000	4799000
AX			5901	227591	1413554	49240	424232	1393614	141518	553456	430894	4640000										4640000	4640000
LOW													10000									2913008	2913008
MID													236000									26940564	26940564
HI													394000									45303437	45303437
LOW													158000									12269000	12269000
MID													473000									40288221	40288221
HI													1498000									38193997	38193997
LOW													236000									40238395	40238395
MID													513000									65023010	65023010
HI													434000									18830375	18830375
	4640000	45561506																461773				51824279	51824279
			0	1414572	11566759	0	1701295	5329290	0	4635166	3321115	28168197	15628279								24394101	106829964	106829964
														16814743								16814743	16814743
														90014221								90014221	90014221
																10759464						10759464	10759464
																			0			398254	398254
RT																						84828800	84828800
RT																					77266899	77266899	77266899
V													1354000						100536000			122880800	122880800

APPENDIX B: IMPLEMENTATION OF THE MODEL

B.1 USING THE GAMS/HERCULES SOFTWARE

Implementation of a CGE model can now be done with CGE modeling software. These software packages separate the tasks of model formulation and model solution, thereby freeing model-builders from the tedious task of writing model-specific function evaluation sub-routines. Typically the software is a system of programs where one program generates the model equations and benchmark numerical conditions from an input file that the CGE model-builder writes. These model equations and benchmark data are then fed by the "generator" file to the solver program, after which a solution report file is outputted by the system. To be able to use these CGE software packages, all the user has to learn are the format and writing conventions for the input file, and understand how the model is generated in order to be able to interpret the model results.

There are two well-known fully developed software packages for CGE modeling. One is the MPS/GE system developed by Thomas Rutherford at Stanford University in 1986[1]. The other is the GAMS/HERCULES system written by Arne Drud and David Kendrick at the World Bank in 1986[2]. The MPS/GE program is based on the activity analysis approach to CGE modeling approach associated with Herbert Scarf (1973) and Alan Manne (1977) and is written in FORTRAN. The solution algorithm is a generalized Newtonian method with "switching" features known as Mathiesen's SLCP Algorithm (Sequence of Linear Complimentarity Problems)[3]. An MPS/GE user simply writes a model in one of the more popular high-level languages such as BASIC, PASCAL, C, or FORTRAN in a format that satisfies the rules of MPS/GE. A model "generator" program provided in the MPS/GE system then translates the user's input file into instructions for the mathematical modeling, model solution, and reporting.

GAMS/HERCULES uses the transactions value approach to CGE modeling, and models are written in the GAMS programming language. The GAMS/HERCULES system comes with a model "generator" file that instructs the computer to generate the model equations and check its consistency, after which the solution algorithm is called to solve the model. The system uses Newton's algorithm and the implicit function theorem to search for the general equilibrium

---

[1] See G.E. Modeling With MPS/GE by T. Rutherford, 1988.

[2] GAMS stands for General Algebraic Modeling System, while HERCULES is an acronym for Highlevel Economic Representation for Creating and Using Large Economywide Systems. For more on the GAMS program see "GAMS: A User's Guide" by A. Brooke, et. al. (1988). For HERCULES refer to the HERCULES: A System for Large Economywide Models by Drud and Kendrick (1986).

[3] Mathiesen's SLCP converts the G.E. system of equations into a series of linear complimentarity problems through Newton's approach of taking a first-order Taylor expansion around an initial solution to the system of non-linear equations. The linear complimentarity problems are then solved by Lemke's algorithm, after which another application of Newton's method is made and another round of LCP iterations ensues. Within the LCP iteration, a price numeraire switching can occur if the solution process encounters problems in which the price numeraire is close to zero.

solution. Both MPS/GE and GAMS/HERCULES have versions that are implementable on a personal computer.

The modeling capabilities of the MPS/GE system appear to be more powerful with its ability to switch regimes and hence handle radical structural transformations, as is the case when some sectors stop producing and their relative prices approach zero. The GAMS/HERCULES modeling capabilities are seriously limited by the algorithm's dependence on the evaluation of Jacobians and lack of switching capability. This weakness is offset by the ease with which anyone familiar with the GAMs language can write down the CGE model.

B.2 AN OUTLINE OF A GAMS/HERCULES CGE PROGRAM

The typical CGE program written in the GAMS/HERCULES structure would be composed of 9 basic blocks of program lines organized as follows:

Block 1: The Account List

The complete list of accounts composing the expanded SAM are declared in this block. For Model B, there are 159 accounts explicitly declared in this block. Accounts are like indices by which variables of the model are identified.

Block 2: The Declaration of Acronyms

This is the statement of HERCULES code words that is used in the program to identify the type of equations to be generated. The specifications of the equations are entered in the following cell arrays. For example, the HERCULES code word "CES", when declared, instructs the computer to generate automatically the associated CES input demand functions, price equations, and variables.

Block 3: The Array of Cell Tables

Cells in table formats are the way in which information about the model is fed to the computer. The table format is consistent with the SAM format. These cell tables form a stack so that each cell in a table is referenced by three indices: the two table dimensions of rows and columns, and the table name. There are five cell tables in both Model B and C's programs.

Block 3.1: The Base SAM Table

The table of initial SAM transaction values is extracted from the base-year SAM and reflects the model's benchmark data. Row and column accounts are those declared in the Accounts List.

Block 3.2: The Specifications Table

The table of behavioral specifications for the base SAM cells contains the actual numerical entries. The cell entries in this table will be the acronyms for cell behavioral specifications declared earlier in Block 2.

Block 3.3: The Tables of Other Exogenous Parameters

The parameters associated with cell transactions that can not be calculated from the base SAM calibration are entered explicitly in separate cell tables. For example, Model B has a table for the substitution elasticity parameters at the first level of value-added formation and also for the aggregate input formation. The export demand elasticities of substitution are also entered in another separate table.

Block 3.4: The Accounts Table

The behavioral specifications and external parameters associated with accounts are entered in the Accounts Table. Each account will have an associated row and column equation which will depend on the type of the account. The type of account also must be declared in this table.

Block 4: The Model Statement

These lines declare the model name and initiate the generation of the model equations from the accounts list and the array of cell tables.

Block 5: The Solve Statement

This statement tells the computer to start the solution algorithm and generate the equilibrium solution.

Block 6: The Experiment Statements

These statements define the new set of exogenous variables for which a comparative statics solution will be computed. Another solve statement therefore follows these experiment statements.

These are only the basic elements of the program. Comments, report statements, and other output enhancing lines may be found in a typical program.

B.3 THE BASIC STATIC MODEL PROGRAM

The basic program for the static model is shown in the next 41 pages. It follows the structure described earlier. First, all the accounts that will be used in an expanded SAM is declared[4]. Then the expanded SAM is entered as a table of numerical values. Afterward, the SAM table is given behavioral content by assigning some acronym to each of the cell entries of the SAM.

[4] The 1983 SAM presented in Appendix A has to be expanded so that economic behavior that is summarized in a transaction between accounts can be modeled. For example, a household account in the original SAM has to be expanded into two accounts to describe separately the allocation of household income between savings, consumption expenditures, and taxes, and then the allocation of consumption expenditures itself into purchases of different goods. See Drud and Kendrick (1986), HERCULES Manual.

```
$TITLE: A 1983 CGE MODEL OF THE PHILIPPINES
*STATIC MODEL # 1 STATMODS file:

*INPUT SAM ACCOUNT NAMES

SET ACC   MODEL ACCOUNTS /
    ACT-RICE       ACTIVITY OF PRODUCING RICE
    ACT-CORN                              CORN
    ACT-COCO                              COCONUT
    ACT-SUG                               SUGAR
    ACT-FRT                               FRUIT and VEGES
    ACT-OTHC                              OTHER CROPS
    ACT-LIV                               LIVESTOCK
    ACT-FISH                              FISHERY
    ACT-EXTR                              FORESTRY and MINING PRODUCTS
    ACT-FM                                FOOD MANUFACTURES
    ACT-LTIN                              LIGHT INDUSTRIAL PRODUCTS
    ACT-HVIN                              HEAVY INDUSTRIAL PRODUCTS
    ACT-PET                               PETROLEUM PRODUCTS
    ACT-CONS                              CONSTRUCTION SERVICES
    ACT-COMM                              COMMERCIAL SERVICES
    ACT-GS                                GOVERNMENT SERVICES
    ACT-OPS                               OTHER PRIVATE SERVICES
    DOM-RICE       DOMESTIC PRODUCT OF RICE
    DOM-CORN                            CORN
    DOM-COCO                            COCONUT
    DOM-SUG                             SUGAR
    DOM-FRT                             FRUIT AND VEGES
    DOM-OTHC                            OTHER CROPS
    DOM-LIV                             LIVESTOCK
    DOM-FISH                            FISHERY
    DOM-EXTR                            FORESTRY AND MINING
    DOM-FM                              FOOD MANUFACTURES
    DOM-LTIN                            LIGHT INDUSTRY
    DOM-HVIN                            HEAVY INDUSTRY
    DOM-PET                             PETROLEUM
    DOM-CONS                            CONSTRUCTION SERVICES
    DOM-COMM                            COMMERCIAL SERVICES
    DOM-OPS                             OTHER PRIVATE SERVICES
    CMP-RICE       COMPOSITE PRODUCT OF RICE
    CMP-CORN                             CORN
    CMP-COCO                             COCONUT
    CMP-SUG                              SUGAR
    CMP-FRT                              FRUIT AND VEGES
    CMP-OTHC                             OTHER CROPS
    CMP-LIV                              LIVESTOCK
    CMP-FISH                             FISHERY
    CMP-EXTR                             FORESTRY AND MINING
    CMP-FM                               FOOD MANUFACTURES
    CMP-LTIN                             LIGHT INDUSTRY
    CMP-HVIN                             HEAVY INDUSTRY
    CMP-PET                              PETROLEUM
    CMP-CONS                             CONSTRUCTION SERVICES
    CMP-COMM                             COMMERCIAL SERVICES
    CMP-OPS                              OTHER PRIVATE SERVICES
    IMP-RICE       IMPORTED RICE PRODUCT
    IMP-COR-ER               CORN EXCLUDING RENT
    IMP-COCO                 COCONUT
    IMP-SUG                  SUGAR
    IMP-FRT                  FRUIT AND VEGES
    IMP-OTH-ER               OTHER CROPS EXCLUDING RENT
    IMP-LIV                  LIVESTOCK
```

IMP-FISH	FISHERY
IMP-EXTR	FORESTRY AND MINING
IMP-FM	FOOD MANUFACTURING PRODUCT
IMP-LTIN	LIGHT INDUSTRIAL PRODUCT
IMP-HVIN	HEAVY INDUSTRIAL PRODUCT
IMP-PET	PETROLEUM
IMP-CONS	CONSTRUCTION SERVICES
IMP-COMM	COMMERCE
IMP-OPS	OTHER PRIVATE SERVICES
EXP-RICE	EXPORTED RICE PRODUCT
EXP-CORN	CORN
EXP-COCO	COCONUT
EXP-SUG	SUGAR
EXP-FRT	FRUIT AND VEGES
EXP-OTHC	OTHER CROP
EXP-LIV	LIVESTOCK
EXP-FISH	FISHERY
EXP-EXTR	FORESTRY AND MINING
EXP-FM	FOOD MANUFACTURES
EXP-LTIN	LIGHT INDUSTRIAL
EXP-HVIN	HEAVY INDUSTRIAL
EXP-PET	PROCESSED PETROLEUM
EXP-CONS	CONSTRUCTION SERVICES
EXP-COMM	COMMERCIAL SERVICES
EXP-OPS	OTHER PRIVATE SERVICES

LABOR	LABOR FACTOR
CAPITAL	CAPITAL FACTOR
RICECAPF	RICE AGRICULTURAL FIXED CAPITAL
CORNCAPF	CORN AGRICULTURAL CAPITAL
COCOCAPF	COCONUT AGRIC CAPITAL
SUGCAPF	SUGAR AGRIC CAPITAL
FRTCAPF	FRUIT AGRIC CAPITAL
OTHCRPCAPF	OTHER CROPS AGRIC CAPITAL
LIVCAPF	LIVESTOCK CAPITAL
FISHCAPF	LIVESTOCK AND FISHERIES CAPITAL
EXTRCAPF	FORESTRY AND MINING CAPITAL(EXTRACTIVE ACTIVITIES)
FOODCAPF	FOOD MANUFACTURE CAPITAL
LTINCAPF	LIGHT INDUSTRTIAL CAPITAL
HVINCAPF	HEAVY INDUSTRIAL CAPITAL
PETCAPF	PETROLEUM CAPITAL
CONSCAPF	CONSTRUCTION CAPITAL
SERVCAPF	SERVICES CAPITAL
FACABR	PHILIPPINE-OWNED FACTORS ABROAD

NCRLO-INC	INCOME ACCOUNT, LOW-INCOMED HOUSEHOLDS IN METRO MLA
NCRMID-INC	INCOME OF MIDDLE-INCOMED
NCRHI-INC	INCOME OF HIGH-INCOMED
URBLO-INC	INCOME OF LOW-INCOMED HOUSEHOLDS IN OTHER URBAN AREAS
URBMID-INC	INCOME OF MIDDLE-INCOMED
URBHI-INC	INCOME OF HIGH-INCOMED
RURLO-INC	LOW-INCOMED HOUSEHOLDS IN RURAL AREAS
RURMID-INC	MIDDLE-INCOMED
RURHI-INC	HIGH-INCOMED
NCRLO-CON	CONSUMPTION ACCOUNT, LOW-INCOMED HH IN METRO MANILA
NCRMID-CON	CONSUMPTION OF MIDDLE-INCOMED HH
NCRHI-CON	CONSUMPTION OF HIGH-INCOMED
URBLO-CON	CONSUMPTION OF LOW-INCOMED HH IN OTHER URBAN AREAS
URBMID-CON	CONSUMPTION OF MIDDLE-INCOMED HH
URBHI-CON	CONSUMPTION OF HIGH-INCOMED
RURLO-CON	CONSUMPTION OF LOW-INCOMED HH IN RURAL AREAS
RURMID-CON	CONSUMPTION OF MIDDLE-INCOMED HH

```
    RURHI-CON     CONSUMPTION OF HIGH-INCOMED  HH

    GOV-INC       INCOME ACCOUNT OF GOVERNMENT
    GOV-TRAN      GOVERNMENT TRANSFERS TO HH
    GOV-CON       CONSUMPTION ACCOUNT OF GOV

    INDR-TAX      INDIRECT TAXES
    DIR-TAX       DIRECT TAXES

    SAVINGS       SAVING ACCOUNT
    GOV-INV       GOVENMENT INVESTMENT
    PRIV-INV      PRIVATE INVESTMENT
    CAP-INV       PRIVATE FIXED CAPITAL INVESTMENT
    STOX          STOCKS BUILD-UP

    R-O-W         REST OF THE WORLD ACCOUNT /

*DIFFERENTIATE ROW VERSUS COLUMN OF SAM ACCOUNTS

 ALIAS (ACC,ACCP);

*DEFINE ACRONYMS USED

ACRONYMS   AC        ACTIVITY OR COMMODITY ACCOUNT
           MF        MARKET FACTOR ACCOUNT
           NMF       NON-MARKET FACTOR ACCOUNT
           INST      INSTITUTIONS INCOME ACCOUNT
           INSTC     INSTITUTIONS CONSUMPTION ACCOUNT
           TAX       INDIRECT TAX ACCOUNT
           ROW       REST OF THE WORLD ACCOUNT

           NP        PRICE EXOGENOUS NUMERAIRE
           P         PRICE EXOGENOUS
           Q         QUANTITY EXOGENOUS

           CD        COBB-DOUGLAS PRODUCTION FUNCTION SPECS
           CES       CES PRODUCTION FUNCTION SPECS
           CES2      TWO-LEVEL CES PRODUCTION FUNCTION SPECS
           CET       CET OUTPUT DISTRIBUTION SPECS
           CETO      CET SPECS WITH ZERO ELASTICITY
           CETINF    CET SPECS WOTH INFINITE ELASTICITY
           SUBST     PERFECTLY SUBSTITUTABLE AGGREGATION FUNCTION SPECS
           IO        INPUT-OUTPUT SPECIFICATION
           LES       LINEAR EXPENDITURE CONSUMPTION SYSTEM SPECS
           QSHR      FIXED QUANTITY SHARE CONSUMPTION SYSYTEM SPECS
           VSHR      VALUE SHARE CONSUMPTION SYSTEM SPECS
           QEXO      FIXED QUANTITY CONSUMPTION SPECS
           VEXO      EXOGENOUS VALUE SPEC
           UNSPEC    UNSPECIFIED OR RESIDUAL SPECS
           IDIST     INCOME DISTRIBUTION SPECS
           RENT      RENT SPECIFICATION
           IMPORT    PAYMENTS FOR IMPORT SPECS
           EXPORT    EXPORT DEMAND FROM THE REST OF THE WORLD
           FEXO      EXOGENOUS IN FOREIGN EXCHANGE
           ITAX      INDIRECT TAX SPECS
           DTAX      DIRECT TAX SPECS
           TEXO      EXOGENOUS IN DOMESTIC CURRENCY

*INPUT THE SAM CELL TRANSACTION BASE VALUES (1983)

TABLE  SAM(ACC,ACC)  SOCIAL ACCOUNTING MATRIX
```

	ACT-RICE	ACT-CORN	ACT-COCO	ACT-SUG	ACT-FRT	ACT-OTHC
CMP-RICE	15260000					
CMP-CORN		1886389				
CMP-COCO			1385132			
CMP-SUG				4080085		
CMP-FRT					887360	
CMP-OTHC						343280
CMP-EXTR	200		7980			800
CMP-FM			31973			
CMP-LTIN	1648474	380715	123782	361826	516550	303270
CMP-HVIN	59408	5768	33168	10549	1090	40770
CMP-PET	640120	88250	48450	344520	55340	67530
CMP-CONS	74	9	235	2643	4040	1510
CMP-COMM	2218092	356922	361415	651056	393260	222680
CMP-OPS	1448393	243286	183265	291221	197260	87460
LABOR	8511117	2889683	3214900	2381000	4764300	6733200
CAPITAL	1177555	234155	290169	820063	317641	278997
RICECAPF	7863577					
CORNCAPF		1742753				
COCOCAPF			2444021			
SUGCAPF				1320484		
FRTCAPF					4499244	
OTHCRPCAPF						5081192

+	ACT-LIV	ACT-FISH	ACT-EXTR	ACT-FM	ACT-LTIN	ACT-HVIN
CMP-RICE	134166	151520		75467		
CMP-CORN	3425850			1056724	154	
CMP-COCO	5613	1420		5805594	884	
CMP-SUG	1112			665087	155869	
CMP-FRT	0	0	0	2424640	0	
CMP-OTHC	229974	26940	0	3444129	2221672	
CMP-LIV	21805313	39280		3298770	221453	
CMP-FISH	18948	291320		3267532		
CMP-EXTR	5605	65730	4057603	48492	2845285	1658551
CMP-FM	399962	548940		19214186	2551948	
CMP-LTIN	560056	267750	427635	1064960	20667886	2663503
CMP-HVIN	7734	135210	583560	894995	1981230	18847900
CMP-PET	432597	1511920	1723090	2411046	2662634	3584232
CMP-CONS	31460	9930	58327	9855	55318	91548
CMP-COMM	3387324	1044760	1240791	5453183	4650044	4109552
CMP-OPS	1550386	660980	1090294	2825040	3766823	3677414
LABOR	7886500	6727200	4846000	6298900	9270900	7051200
CAPITAL	2214853	1006645	3173217	2372501	3491789	3269513
LIVCAPF	7457178					
FISHCAPF		7835832				
EXTRCAPF			6309205			
FOODCAPF				9269160		
LTINCAPF					8680832	
HVINCAPF						6526260

+	ACT-PET	ACT-CONS	ACT-COMM	ACT-OPS	ACT-GS
CMP-RICE				1274622	
CMP-CORN				35508	
CMP-COCO				657	
CMP-SUG				176247	
CMP-FRT				36500	
CMP-OTHC				173405	
CMP-LIV				2395784	
CMP-FISH				1055585	
CMP-EXTR	18810	4227294	135546	184704	
CMP-FM				1940091	
CMP-LTIN	495588	4146951	3074571	3932783	

CMP-HVIN	197019	11763755	854448	4523511	
CMP-PET	19787636	1337300	657700	15480515	
CMP-CONS	28149	329729	2374495	721278	
CMP-COMM	3584084	2594875	10864971	5562691	
CMP-OPS	2038394	2685696	11459969	11909619	
LABOR	744400	10361400	25667800	27417400	17539000
CAPITAL	463086	3240377	10342101	5945727	
PETCAPF	4933779				
CONSCAPF		27709129			
SERVCAPF			32956050	18946602	

+	DOM-RICE	DOM-CORN	DOM-COCO	DOM-SUG
ACT-RICE	38704816			
ACT-CORN		7827330		
ACT-COCO			7199259	
ACT-SUG				7370439
INDR-TAX	502922	119838	152275	191537

+	DOM-FRT	DOM-OTHC	DOM-LIV	DOM-FISH
ACT-FRT	10061708			
ACT-OTHC		12546638		
ACT-LIV			48787947	
ACT-FISH				20103468
INDR-TAX	284491	149996	408795	675362

+	DOM-EXTR	DOM-FM	DOM-LTIN	DOM-HVIN	DOM-PET
ACT-EXTR	15553283				
ACT-FM		61678949			
ACT-LTIN			52586406		
ACT-HVIN				39301192	
ACT-PET					30650141
INDR-TAX	892863	3330911	371479	-2752185	3103290

+	DOM-CONS	DOM-COMM	DOM-OPS
ACT-CONS	67482683		
ACT-COMM		89233123	
ACT-OPS			82582812
INDR-TAX	1868226	5542596	3767604

+	CMP-RICE	CMP-CORN	CMP-COCO	CMP-SUG
DOM-RICE	39207738			
DOM-CORN		7947168		
DOM-COCO			7351534	
DOM-SUG				7561976
IMP-RICE	300			
IMP-COR-ER		1105192		
IMP-COCO			97666	
IMP-SUG				7725

+	CMP-FRT	CMP-OTHC	CMP-LIV	CMP-FISH	CMP-EXTR
DOM-FRT	10346199				
DOM-OTHC		12696634			
DOM-LIV			49196742		
DOM-FISH				20778830	
DOM-EXTR					16446146
IMP-FRT	240801				
IMP-OTH-ER		3196520			
IMP-LIV			1531759		
IMP-FISH				17355	
IMP-EXTR					347654

+	CMP-FM	CMP-LTIN	CMP-HVIN	CMP-PET	CMP-CONS
DOM-FM	65009860				
DOM-LTIN		52957885			
DOM-HVIN			36549007		
DOM-PET				33753431	
DOM-CONS					69350909
IMP-FM	4036240				
IMP-LTIN		20774416			
IMP-HVIN			46142608		
IMP-PET				28666069	
IMP-CONS					106291

+	CMP-COMM	CMP-OPS
DOM-COMM	94775719	
DOM-OPS		86350416
IMP-COMM	269581	
IMP-OPS		11681184

+	IMP-RICE	IMP-COR-ER	IMP-COCO	IMP-SUG	IMP-FRT
INDR-TAX		63519	666	1625	65401
R-O-W	299	1041673	97000	6100	175400

+	IMP-OTH-ER	IMP-LIV	IMP-FISH	IMP-EXTR	IMP-FM
INDR-TAX	445720	287259	3255	65054	956840
R-O-W	2750800	1244500	14100	282600	3079400

+	IMP-LTIN	IMP-HVIN	IMP-PET	IMP-CONS	IMP-COMM	IMP-OPS
INDR-TAX	3320016	5277793	4322369	12491	21981	1354784
R-O-W	17454400	40864815	24343700	93800	247600	10326400

+	EXP-RICE	EXP-CORN	EXP-COCO	EXP-SUG	EXP-FRT
ACT-RICE	122194				
ACT-CORN		600			
ACT-COCO			925231		
ACT-SUG				2893008	
ACT-FRT					1574377
INDR-TAX	-27494		3869	1192	54523

+	EXP-OTHC	EXP-LIV	EXP-FISH	EXP-EXTR	EXP-FM
ACT-OTHC	614051				
ACT-LIV		766684			
ACT-FISH			221909		
ACT-EXTR				7956439	
ACT-FM					8221312
INDR-TAX	8349	316	91	248161	3388

+	EXP-LTIN	EXP-HVIN	EXP-PET	EXP-CONS	EXP-COMM	EXP-OPS
ACT-LTIN	10638315					
ACT-HVIN		12178481				
ACT-PET			1641024			
ACT-CONS				913823		
ACT-COMM					9154528	
ACT-OPS						19130417
INDR-TAX	4384	5019	676	377	3772	7883

+	LABOR	RICECAPF	COCOCAPF	SUGCAPF
DIR-TAX	1461000		24000	24000
NCRLO-INC	1825299			

NCRMID-INC	16700993	10187	2972	1435
NCRHI-INC	18439969	33513	9777	4720
URBLO-INC	7445665	223561	65221	31488
URBMID-INC	23804583	563775	164473	79407
URBHI-INC	14825647	524719	153078	73906
RURLO-INC	26395482	2261915	659880	318588
RURMID-INC	34594154	3660994	1068040	515646
RURHI-INC	6812108	584913	170640	82384
R-O-W			125940	188910

+	FRTCAPF	OTHCRPCAPF	LIVCAPF	FISHCAPF	EXTRCAPF
DIR-TAX	58000				427000
NCRLO-INC	0	0	0	9988	0
NCRMID-INC	5101	6583	0	0	0
NCRHI-INC	16781	21655	0	0	539675
URBLO-INC	111942	144458	232808	635117	136187
URBMID-INC	282296	364293	1184463	514189	150777
URBHI-INC	262740	339056	219027	189427	265190
RURLO-INC	1132596	1461578	2409942	3410895	1557233
RURMID-INC	1833148	2365617	2528402	2776647	1523348
RURHI-INC	292880	377952	882536	299569	156535
R-O-W	503760				1553260

* POOR HH RESTRICTED TO ZERO HVINCAP SHARE, ALLOCATED TO RICH HH AND
* FOODCAP SHARE

+	FOODCAPF	LTINCAPF	HVINCAPF	PETCAPF	CONSCAPF
DIR-TAX	523000	605000	504000	129000	58000
NCRLO-INC	61267	23878	0	0	451733
NCRMID-INC	186919	302874	590201	0	3685043
NCRHI-INC	586408	563758	860094	0	13201493
URBLO-INC	330085	128647	0	0	562263
URBMID-INC	1086368	545845	314174	0	2756759
URBHI-INC	1328269	704592	479591	0	3863750
RURLO-INC	1464825	570899	0	0	899856
RURMID-INC	1853910	722540	0	0	1440633
RURHI-INC	861579	335789	0	0	789599
GOV-INC				1341429	
R-O-W	986530	4177010	3778200	3463350	0

+	SERVCAPF	FACAPR	CORNCAPF	CAPITAL
DIR-TAX	2447000			
NCRLO-INC	484836	46000	0	
NCRMID-INC	3515998	1694000	2258	
NCRHI-INC	5331167	5293000	7427	17845525
URBLO-INC	1802011	212000	49547	
URBMID-INC	5549874	2329000	124945	
URBHI-INC	8268716	5082000	116289	14063600
RURLO-INC	4745612	212000	501294	
RURMID-INC	6063569	2752000	811362	
RURHI-INC	3021260	3599000	129631	6729262
GOV-INC	4459571			
R-O-W	6213040			

+	INDR-TAX	DIR-TAX
GOV-INC	35123279	10900000

+	NCRLO-INC	NCRMID-INC	NCRHI-INC	URBLO-INC	URBMID-INC
DIR-TAX	5901	227591	1413554	49240	424232
NCRLO-CON	2907100				
NCRMID-CON		25298401			

NCRHI-CON			32323124		
URBLO-CON				12219760	
URBMID-CON					38162694
SAVINGS	0	1414572	29412284	0	1701295

+	URBHI-INC	RURLO-INC	RURMID-INC	RURHI-INC
DIR-TAX	1393614	141518	553456	430894
URBHI-CON	31271093			
RURLO-CON		48097077		
RURMID-CON			59834388	
RURHI-CON				15078366
SAVINGS	19592890	0	4635166	10050377

+	NCRLO-CON	NCRMID-CON	NCRHI-CON	URBLO-CON	URBMID-CON
CMP-RICE	286683	1722941	1005877	1400354	3135205
CMP-CORN	296	6196	3856	269656	176497
CMP-COCO	1742	9793	10517	15331	26485
CMP-SUG	34665	207473	135856	137053	325783
CMP-FRT	80603	683489	737865	345676	1005242
CMP-OTHC	103487	809206	665586	465297	1157940
CMP-LIV	238051	2469133	2715711	806168	3301404
CMP-FISH	219154	1468004	1109497	1043930	2584737
CMP-EXTR	8103	124237	188112	48759	267574
CMP-FM	467841	4010186	3699433	1965832	6365397
CMP-LTIN	271115	2480020	3328795	1117702	4235239
CMP-HVIN	59078	688908	1471253	148399	948582
CMP-PET	124621	969407	1172281	471424	1246157
CMP-CONS	162689	1733144	3106900	403044	1611087
CMP-COMM	441161	3207066	3239370	2248488	5456969
CMP-OPS	407811	4709198	9732215	1332647	6318396

+	URBHI-CON	RURLO-CON	RURMID-CON	RURHI-CON
CMP-RICE	1230638	5853151	6090857	870323
CMP-CORN	20466	1597726	533222	30456
CMP-COCO	13413	101441	60707	10471
CMP-SUG	157271	585058	594613	95829
CMP-FRT	780802	1507275	1656818	322430
CMP-OTHC	692535	2443933	2144114	36[illegible]02
CMP-LIV	2723775	3025615	4833763	1240081
CMP-FISH	1330730	3807729	3773845	709274
CMP-EXTR	410626	275799	555943	264947
CMP-FM	4328274	6981780	9606909	2159148
CMP-LTIN	3801929	4381453	6685592	2027256
CMP-HVIN	1404016	454124	1167182	627058
CMP-PET	95[illegible]289	1872199	1814634	368888
CMP-CONS	18[illegible]003	1245062	1864562	683344
CMP-COMM	3353975	9666939	9868951	1896681
CMP-OPS	8189286	4297793	8582676	3411578

+	GOV-INC	GOV-TRAN
NCRLO-INC		10000
NCRMID-INC		236000
NCRHI-INC		394000
URBLO-INC		158000
URBMID-INC		473000
URBHI-IN[illegible]		1498000
RURLO-INC		236000
RURMID-INC		513000
RURHI-INC		434000
GOV-TRAN	3952000	
GOV-CON	30890000	
SAVINGS	15628279	

R-O-W 1354000

+	GOV-CON	SAVINGS	GOV-INV	PRIV-INV	CAP-INV	STOX
ACT-GS	17539000					
CMP-RICE	96736					619498
CMP-CORN	9364					
CMP-SUG	48500					169200
CMP-FRT	51800					66500
CMP-OTHC	70600					540454
CMP-LIV	232300					1381900
CMP-FISH	112000					3900
CMP-EXTR	47600					1345500
CMP-FM	354400					4419800
CMP-LTIN	2282400		169111		797089	1518300
CMP-HVIN	1318700		6032161		28432039	0
CMP-PET	830200					1766300
CMP-CONS	1569900		8937064		42124036	414700
CMP-COMM	2352400		1158258		5459342	
CMP-OPS	3974100		518149		2442251	
GOV-INV		16814743				
PRIV-INV		91500809				
CAP-INV				79254757		
STOX				12246052		

+	R-O-W
EXP-RICE	94700
EXP-CORN	600
EXP-COCO	929100
EXP-SUG	2894200
EXP-FRT	1628900
EXP-OTHC	622400
EXP-LIV	767000
EXP-FISH	222000
EXP-EXTR	8204600
EXP-FM	8224700
EXP-LTIN	10642699
EXP-HVIN	12183500
EXP-PET	1641700
EXP-CONS	914200
EXP-COMM	9158300
EXP-OPS	19138300
FACABR	21219000
SAVINGS	25880689

*INPUT THE SAM CELL SPECIFICATIONS

TABLE SPEC(ACC,ACC) SPECIFICATION TABLE

	ACT-RICE	ACT-CORN	ACT-COCO	ACT-SUG	ACT-FRT	ACT-OTHC
CMP-RICE	CES2					
CMP-CORN		CES2				
CMP-COCO			CES2			
CMP-SUG				CES2		
CMP-FRT					CES2	
CMP-OTHC						CES2
CMP-EXTR	CES2		CES2			CES2
CMP-FM			CES2			
CMP-LTIN	CES2	CES2	CES2	CES2	CES2	CES2
CMP-HVIN	CES2	CES2	CES2	CES2	CES2	CES2
CMP-PET	CES2	CES2	CES2	CES2	CES2	CES2

79

CMP-CONS	CES2	CES2	CES2	CES2	CES2	CES2
CMP-COMM	CES2	CES2	CES2	CES2	CES2	CES2
CMP-OPS	CES2	CES2	CES2	CES2	CES2	CES2
LABOR	CES2	CES2	CES2	CES2	CES2	CES2
CAPITAL	CES2	CES2	CES2	CES2	CES2	CES2
RICECAPF	CES2					
CORNCAPF		CES2				
COCOCAPF			CES2			
SUGCAPF				CES2		
FRTCAPF					CES2	
OTHCRPCAPF						CES2

+	ACT-LIV	ACT-FISH	ACT-EXTR	ACT-FM	ACT-LTIN	ACT-HVIN
CMP-RICE	CES2	CES2		CES2		
CMP-CORN	CES2			CES2	CES2	
CMP-COCO	CES2	CES2		CES2	CES2	
CMP-SUG	CES2			CES2	CES2	
CMP-FRT				CES2		
CMP-OTHC	CES2	CES2		CES2	CES2	
CMP-LIV	CES2	CES2		CES2	CES2	
CMP-FISH	CES2	CES2		CES2		
CMP-EXTR	CES2	CES2	CES2	CES2	CES2	CES2
CMP-FM	CES2	CES2		CES2	CES2	
CMP-LTIN	CES2	CES2	CES2	CES2	CES2	CES2
CMP-HVIN	CES2	CES2	CES2	CES2	CES2	CES2
CMP-PET	CES2	CES2	CES2	CES2	CES2	CES2
CMP-CONS	CES2	CES2	CES2	CES2	CES2	CES2
CMP-COMM	CES2	CES2	CES2	CES2	CES2	CES2
CMP-OPS	CES2	CES2	CES2	CES2	CES2	CES2
LABOR	CES2	CES2	CES2	CES2	CES2	CES2
CAPITAL	CES2	CES2	CES2	CES2	CES2	CES2
LIVCAPF	CES2					
FISHCAPF		CES2				
EXTRCAPF			CES2			
FOODCAPF				CES2		
LTINCAPF					CES2	
HVINCAPF						CES2

+	ACT-PET	ACT-CONS	ACT-COMM	ACT-OPS	ACT-GS
CMP-RICE				CES2	
CMP-CORN				CES2	
CMP-COCO				CES2	
CMP-SUG				CES2	
CMP-FRT				CES2	
CMP-OTHC				CES2	
CMP-LIV				CES2	
CMP-FISH				CES2	
CMP-EXTR	CES2	CES2	CES2	CES2	
CMP-FM				CES2	
CMP-LTIN	CES2	CES2	CES2	CES2	
CMP-HVIN	CES2	CES2	CES2	CES2	
CMP-PET	CES2	CES2	CES2	CES2	
CMP-CONS	CES2	CES2	CES2	CES2	
CMP-COMM	CES2	CES2	CES2	CES2	
CMP-OPS	CES2	CES2	CES2	CES2	
LABOR	CES2	CES2	CES2	CES2	IO
CAPITAL	CES2	CES2	CES2	CES2	
PETCAPF	CES2				
CONSCAPF		CES2			
SERVCAPF			CES2	CES2	

+	DOM-RICE	DOM-CORN	DOM-COCO	DOM-SUC

90

```
ACT-RICE      IO
ACT-CORN                IO
ACT-COCO                          IO
ACT-SUG                                        IO
INDR-TAX      ITAX      ITAX      ITAX       ITAX

* WE ARE TREATING RICE,CORN,COCO,AND SUGAR AS PRIMARILY HOMEGENOUS PRODUCTS
* SUCH THAT THERE IS NO DIFFERENCE BETWEEN THE EXPORTED AND DOMESTICALLY
* SUPPLIED PRODUCT FORMS;  FOR THE REST OF THE PRODUCTS, WE
* CONSIDER THE EXPORT PRODUCT AND PRODUCT FOR THE DOMESTIC MARKET AS
* DIFFERENTIATED

            +  DOM-FRT  DOM-OTHC  DOM-LIV   DOM-FISH
ACT-FRT        CET
ACT-OTHC                CET
ACT-LIV                           CET
ACT-FISH                                       CET
INDR-TAX       ITAX     ITAX       ITAX      ITAX


            +  DOM-EXTR  DOM-FM  DOM-LTIN  DOM-HVIN  DOM-PET
ACT-EXTR       CET
ACT-FM                    CET
ACT-LTIN                          CET
ACT-HVIN                                       CET
ACT-PET                                                     IO
INDR-TAX       ITAX       ITAX    ITAX       ITAX      ITAX

            +   DOM-CONS  DOM-COMM  DOM-OPS
ACT-CONS        CET
ACT-COMM                  CET
ACT-OPS                           CET
INDR-TAX        ITAX      ITAX      ITAX

          +  CMP-RICE  CMP-CORN  CMP-COCO  CMP-SUG
DOM-RICE     CES
DOM-CORN               CES
DOM-COCO                          CES
DOM-SUG                                        CES
IMP-RICE     CES
IMP-COR-ER             CES
IMP-COCO                          CES
IMP-SUG                                        CES

        +   CMP-FRT   CMP-OTHC  CMP-LIV  CMP-FISH   CMP-EXTR
DOM-FRT     CES
DOM-OTHC              CES
DOM-LIV                         CES
DOM-FISH                                  CES
DOM-EXTR                                             CES
IMP-FRT     CES
IMP-OTH-ER            CES
IMP-LIV                         CES
IMP-FISH                                  CES
IMP-EXTR                                             CES

       +   CMP-FM   CMP-LTIN   CMP-HVIN   CMP-PET   CMP-CONS
DOM-FM     CES
DOM-LTIN             CES
DOM-HVIN                        CES
DOM-PET                                   CES
DOM-CONS                                             CES
```

91

IMP-FM	CES					
IMP-LTIN		CES				
IMP-HVIN			CES			
IMP-PET				CES		
IMP-CONS					CES	

	+	CMP-COMM	CMP-OPS
DOM-COMM		CES	
DOM-OPS			CES
IMP-COMM		CES	
IMP-OPS			CES

	+	IMP-RICE	IMP-COR-ER	IMP-COCO	IMP-SUG	IMP-FRT
INDR-TAX			ITAX	ITAX	ITAX	ITAX
R-O-W		IMPORT	IMPORT	IMPORT	IMPORT	IMPORT

	+	IMP-OTH-ER	IMP-LIV	IMP-FISH	IMP-EXTR	IMP-FM
INDR-TAX		ITAX	ITAX	ITAX	ITAX	ITAX
R-O-W		IMPORT	IMPORT	IMPORT	IMPORT	IMPORT

	+	IMP-LTIN	IMP-HVIN	IMP-PET	IMP-CONS	IMP-COMM	IMP-OPS
INDR-TAX		ITAX	ITAX	ITAX	ITAX	ITAX	ITAX
R-O-W		IMPORT	IMPORT	IMPORT	IMPORT	IMPORT	IMPORT

	+	EXP-RICE	EXP-CORN	EXP-COCO	EXP-SUG	EXP-FRT
ACT-RICE		IO				
ACT-CORN			IO			
ACT-COCO				IO		
ACT-SUG					IO	
ACT-FRT						CET
INDR-TAX		ITAX		ITAX	ITAX	ITAX

	+	EXP-OTHC	EXP-LIV	EXP-FISH	EXP-EXTR	EXP-FM
ACT-OTHC		CET				
ACT-LIV			CET			
ACT-FISH				CET		
ACT-EXTR					CET	
ACT-FM						CET
INDR-TAX		ITAX	ITAX	ITAX	ITAX	ITAX

	+	EXP-LTIN	EXP-HVIN	EXP-PET	EXP-CONS	EXP-COMM	EXP-OPS
ACT-LTIN		CET					
ACT-HVIN			CET				
ACT-PET				IO			
ACT-CONS					CET		
ACT-COMM						CET	
ACT-OPS							CET
INDR-TAX		ITAX	ITAX	ITAX	ITAX	ITAX	ITAX

	+	LABOR	RICECAPF	COCOCAPF	SUGCAPF
DIR-TAX		DTAX	DTAX	DTAX	DTAX
NCRLO-INC		IDIST			
NCRMID-INC		IDIST	IDIST	IDIST	IDIST
NCRHI-INC		IDIST	IDIST	IDIST	IDIST
URBLO-INC		IDIST	IDIST	IDIST	IDIST
URBMID-INC		IDIST	IDIST	IDIST	IDIST
URBHI-INC		IDIST	IDIST	IDIST	IDIST
RURLO-INC		IDIST	IDIST	IDIST	IDIST
RURMID-INC		IDIST	IDIST	IDIST	IDIST
RURHI-INC		IDIST	IDIST	IDIST	IDIST

R-O-W			IDIST	IDIST	

+	FRTCAPF	OTHCRPCAPF	LIVCAPF	FISHCAPF	EXTRCAPF
DIR-TAX	DTAX	DTAX	DTAX	DTAX	DTAX
NCRLO-INC	IDIST	IDIST	IDIST	IDIST	IDIST
NCRMID-INC	IDIST	IDIST	IDIST	IDIST	IDIST
NCRHI-INC	IDIST	IDIST	IDIST	IDIST	IDIST
URBLO-INC	IDIST	IDIST	IDIST	IDIST	IDIST
URBMID-INC	IDIST	IDIST	IDIST	IDIST	IDIST
URBHI-INC	IDIST	IDIST	IDIST	IDIST	IDIST
RURLO-INC	IDIST	IDIST	IDIST	IDIST	IDIST
RURMID-INC	IDIST	IDIST	IDIST	IDIST	IDIST
RURHI-INC	IDIST	IDIST	IDIST	IDIST	IDIST
R-O-W	IDIST				IDIST

+	FOODCAPF	LTINCAPF	HVINCAPF	PETCAPF	CONSCAPF
DIR-TAX	DTAX	DTAX	DTAX	DTAX	DTAX
NCRLO-INC	IDIST	IDIST	IDIST	IDIST	IDIST
NCRMID-INC	IDIST	IDIST	IDIST	IDIST	IDIST
NCRHI-INC	IDIST	IDIST	IDIST	IDIST	IDIST
URBLO-INC	IDIST	IDIST	IDIST	IDIST	IDIST
URBMID-INC	IDIST	IDIST	IDIST	IDIST	IDIST
URBHI-INC	IDIST	IDIST	IDIST	IDIST	IDIST
RURLO-INC	IDIST	IDIST	IDIST	IDIST	IDIST
RURMID-INC	IDIST	IDIST	IDIST	IDIST	IDIST
RURHI-INC	IDIST	IDIST	IDIST	IDIST	IDIST
GOV-INC				IDIST	
R-O-W	IDIST	IDIST	IDIST	IDIST	

+	SERVCAPF	FACABR	CORNCAPF	CAPITAL
DIR-TAX	DTAX			
NCRLO-INC	IDIST	IDIST	IDIST	
NCRMID-INC	IDIST	IDIST	IDIST	
NCRHI-INC	IDIST	IDIST	IDIST	IDIST
URBLO-INC	IDIST	IDIST	IDIST	
URBMID-INC	IDIST	IDIST	IDIST	
URBHI-INC	IDIST	IDIST	IDIST	IDIST
RURLO-INC	IDIST	IDIST	IDIST	
RURMID-INC	IDIST	IDIST	IDIST	
RURHI-INC	IDIST	IDIST	IDIST	IDIST
GOV-INC	IDIST			
R-O-W	IDIST			

+	INDR-TAX	DIR-TAX
GOV-INC	IDIST	IDIST

+	NCRLO-INC	NCRMID-INC	NCRHI-INC	URBLO-INC	URBMID-INC
DIR-TAX	DTAX	DTAX	DTAX	DTAX	DTAX
NCRLO-CON	IDIST				
NCRMID-CON		IDIST			
NCRHI-CON			IDIST		
URBLO-CON				IDIST	
URBMID-CON					IDIST
SAVINGS	IDIST	IDIST	IDIST	IDIST	IDIST

+	URBHI-INC	RURLO-INC	RURMID-INC	RURHI-INC
DIR-TAX	DTAX	DTAX	DTAX	DTAX
URBHI-CON	IDIST			
RURLO-CON		IDIST		
RURMID-CON			IDIST	
RURHI-CON				IDIST
SAVINGS	IDIST	IDIST	IDIST	IDIST

+	NCRLO-CON	NCRMID-CON	NCRHI-CON	URBLO-CON	URBMID-CON
CMP-RICE	LES	LES	LES	LES	LES
CMP-CORN	LES	LES	LES	LES	LES
CMP-COCO	LES	LES	LES	LES	LES
CMP-SUG	LES	LES	LES	LES	LES
CMP-FRT	LES	LES	LES	LES	LES
CMP-OTHC	LES	LES	LES	LES	LES
CMP-LIV	LES	LES	LES	LES	LES
CMP-FISH	LES	LES	LES	LES	LES
CMP-EXTR	LES	LES	LES	LES	LES
CMP-FM	LES	LES	LES	LES	LES
CMP-LTIN	LES	LES	LES	LES	LES
CMP-HVIN	LES	LES	LES	LES	LES
CMP-PET	LES	LES	LES	LES	LES
CMP-CONS	LES	LES	LES	LES	LES
CMP-COMM	LES	LES	LES	LES	LES
CMP-OPS	LES	LES	LES	LES	LES

+	URBHI-CON	RURLO-CON	RURMID-CON	RURHI-CON
CMP-RICE	LES	LES	LES	LES
CMP-CORN	LES	LES	LES	LES
CMP-COCO	LES	LES	LES	LES
CMP-SUG	LES	LES	LES	LES
CMP-FRT	LES	LES	LES	LES
CMP-OTHC	LES	LES	LES	LES
CMP-LIV	LES	LES	LES	LES
CMP-FISH	LES	LES	LES	LES
CMP-EXTR	LES	LES	LES	LES
CMP-FM	LES	LES	LES	LES
CMP-LTIN	LES	LES	LES	LES
CMP-HVIN	LES	LES	LES	LES
CMP-PET	LES	LES	LES	LES
CMP-CONS	LES	LES	LES	LES
CMP-COMM	LES	LES	LES	LES
CMP-OPS	LES	LES	LES	LES

+	GOV-INC	GOV-TRAN
NCRLO-INC		IDIST
NCRMID-INC		IDIST
NCRHI-INC		IDIST
URBLO-INC		IDIST
URBMID-INC		IDIST
URBHI-INC		IDIST
RURLO-INC		IDIST
RURMID-INC		IDIST
RURHI-INC		IDIST
GOV-TRAN	TEXO	
GOV-CON	unspec	
SAVINGS	texo	
R-O-W	FEXO	

+	GOV-CON	SAVINGS	GOV-INV	PRIV-INV	CAP-INV	STOX
ACT-GS	QSHR					
CMP-RICE	QSHR					QSHR
CMP-CORN	QSHR					QSHR
CMP-COCO	QSHR					QSHR
CMP-SUG	QSHR					QSHR
CMP-FRT	QSHR					QSHR
CMP-OTHC	QSHR					QSHR
CMP-LIV	QSHR					QSHR
CMP-FISH	QSHR					QSHR
CMP-EXTR	QSHR					QSHR

64

```
CMP-FM      QSHR                                          QSHR
CMP-LTIN    QSHR                QSHR              QSHR    QSHR
CMP-HVIN    QSHR                QSHR              QSHR    QSHR
CMP-PET     QSHR                                          QSHR
CMP-CONS    QSHR                QSHR              QSHR    QSHR
CMP-COMM    QSHR                QSHR              QSHR
CMP-OPS     QSHR                QSHR              QSHR
GOV-INV             UNSPEC
PRIV-INV            UNSPEC
CAP-INV                                   IDIST
STOX                                      IDIST

        +       R-O-W
EXP-RICE        EXPORT
EXP-CORN        EXPORT
EXP-COCO        EXPORT
EXP-SUG         EXPORT
EXP-FRT         EXPORT
EXP-OTHC        EXPORT
EXP-LIV         EXPORT
EXP-FISH        EXPORT
EXP-EXTR        EXPORT
EXP-FM          EXPORT
EXP-LTIN        EXPORT
EXP-HVIN        EXPORT
EXP-PET         EXPORT
EXP-CONS        EXPORT
EXP-COMM        EXPORT
EXP-OPS         EXPORT
FACABR          FEXO
SAVINGS         FEXO

*INPUT A TABLE OF SPECIFICATION OF ACCOUNT BEHAVIOR

TABLE  AT(ACC,*)  ACCOUNT TABLE

                TYPE    FIX     SIGMA  SIGMAR
ACT-RICE        AC              0.4
ACT-CORN        AC              0.4
ACT-COCO        AC              EPS
ACT-SUG         AC              0.4
ACT-FRT         AC              EPS     -1.5
ACT-OTHC        AC              EPS     -1.5
ACT-LIV         AC              EPS     -1.5
ACT-FISH        AC              EPS     -1.5
ACT-EXTR        AC              EPS     -INF
ACT-FM          AC              EPS     -1.5
ACT-LTIN        AC              EPS     -0.5
ACT-HVIN        AC              EPS     -0.5
ACT-PET         AC              EPS
ACT-CONS        AC              EPS     -0.2
ACT-COMM        AC              EPS     -0.2
ACT-OPS         AC              EPS     -0.2
ACT-GS          AC
DOM-RICE        AC
DOM-CORN        AC
DOM-COCO        AC
DOM-SUG         AC
DOM-FRT         AC
DOM-OTHC        AC
DOM-LIV         AC
DOM-FISH        AC
```

DOM-EXTR	AC		
DOM-FM	AC		
DOM-LTIN	AC		
DOM-HVIN	AC		
DOM-PET	AC		
DOM-CONS	AC		
DOM-COMM	AC		
DOM-OPS	AC		
IMP-RICE	AC		
IMP-COR-ER	AC		
IMP-COCO	AC		
IMP-SUG	AC		
IMP-FRT	AC		
IMP-OTH-ER	AC		
IMP-LIV	AC		
IMP-FISH	AC		
IMP-EXTR	AC		
IMP-FM	AC		
IMP-LTIN	AC		
IMP-HVIN	AC		
IMP-PET	AC		
IMP-CONS	AC		
IMP-COMM	AC		
IMP-OPS	AC		
CMP-RICE	AC		EPS
CMP-CORN	AC		INF
CMP-COCO	AC		EPS
CMP-SUG	AC		EPS
CMP-FRT	AC		2.0
CMP-OTHC	AC		1.0
CMP-LIV	AC		2.0
CMP-FISH	AC		2.0
CMP-EXTR	AC		EPS
CMP-FM	AC		1.5
CMP-LTIN	AC		1.5
CMP-HVIN	AC		0.5
CMP-PET	AC		EPS
CMP-CONS	AC		0.3
CMP-COMM	AC		0.3
CMP-OPS	AC		0.3
EXP-RICE	AC		
EXP-CORN	AC		
EXP-COCO	AC		
EXP-SUG	AC		
EXP-FRT	AC		
EXP-OTHC	AC		
EXP-LIV	AC		
EXP-FISH	AC		
EXP-EXTR	AC		
EXP-FM	AC		
EXP-LTIN	AC		
EXP-HVIN	AC		
EXP-PET	AC		
EXP-CONS	AC		
EXP-COMM	AC		
EXP-OPS	AC		
LABOR	MF	Q	
CAPITAL	MF	Q	
RICECAPF	MF	Q	
CORNCAPF	MF	Q	
COCOCAPF	MF	Q	
SUGCAPF	MF	Q	

96

```
FRTCAPF        MF      Q
OTHCRPCAPF     MF      Q
LIVCAPF        MF      Q
FISHCAPF       MF      Q
EXTRCAPF       MF      Q
FOODCAPF       MF      Q
LTINCAPF       MF      Q
HVINCAPF       MF      Q
PETCAPF        MF      Q
CONSCAPF       MF      Q
SERVCAPF       MF      Q
FACABR         NMF
INDR-TAX       TAX
DIR-TAX        TAX
NCRLO-INC      INST
NCRMID-INC     INST
NCRHI-INC      INST
URBLO-INC      INST
URBMID-INC     INST
URBHI-INC      INST
RURLO-INC      INST
RURMID-INC     INST
RURHI-INC      INST
NCRLO-CON      INSTC
NCRMID-CON     INSTC   NP
NCRHI-CON      INSTC
URBLO-CON      INSTC
URBMID-CON     INSTC
URBHI-CON      INSTC
RURLO-CON      INSTC
RURMID-CON     INSTC
RURHI-CON      INSTC
GOV-INC        INST
GOV-TRAN       INST
GOV-CON        INSTC
SAVINGS        INST
GOV-INV        INSTC   Q
PRIV-INV       INST
CAP-INV        INSTC
STOX           INSTC
R-O-W          ROW

*INPUT THE ELASTICITY OF DEMAND FOR EXPORTS

SET    ACCEX(ACC)  EXPORTED COMMODITIES /
                    EXP-RICE
                    EXP-CORN
                    EXP-COCO
                    EXP-SUG
                    EXP-FRT
                    EXP-OTHC
                    EXP-LIV
                    EXP-FISH
                    EXP-EXTR
                    EXP-FM
                    EXP-LTIN
                    EXP-HVIN
                    EXP-PET
                    EXP-CONS
                    EXP-COMM
                    EXP-OPS    /
```

87

```
PARAMETER  ETAS(ACCEX) /

EXP-RICE    =     INF
EXP-CORN    =     EPS
EXP-COCO    =     INF
EXP-SUG     =     INF
EXP-FRT     =     INF
EXP-OTHC    =     INF
EXP-LIV     =     INF
EXP-FISH    =     INF
EXP-EXTR    =     INF
EXP-FM      =     INF
EXP-LTIN    =     INF
EXP-HVIN    =     INF
EXP-PET     =     EPS
EXP-CONS    =     INF
EXP-COMM    =     INF
EXP-OPS     =     INF    /


* INPUT THE SIGMAC CES2 PARAMETERS

SET      INP(ACC)  INPUTS INTO CES2 PRODUCTION /
         CMP-RICE
         CMP-CORN
         CMP-COCO
         CMP-SUG
         CMP-FRT
         CMP-OTHC
         CMP-LIV
         CMP-FISH
         CMP-EXTR
         CMP-FM
         CMP-LTIN
         CMP-HVIN
         CMP-PET
         CMP-CONS
         CMP-COMM
         CMP-OPS
         LABOR
         CAPITAL
         RICECAPF
         CORNCAPF
         COCOCAPF
         SUGCAPF
         FRTCAPF
         OTHCRPCAPF
         LIVCAPF
         FISHCAPF
         EXTRCAPF
         FOODCAPF
         LTINCAPF
         HVINCAPF
         PETCAPF
         CONSCAPF
         SERVCAPF /

SET  CESTAC(ACC)  ACTIVITIES WITH CES2 FUNCTIONS  /
    ACT-RICE
    ACT-CORN
    ACT-COCO
    ACT-SUG
```

```
ACT-FRT
ACT-OTHC
ACT-LIV
ACT-FISH
ACT-EXTR
ACT-FM
ACT-LTIN
ACT-HVIN
ACT-PET
ACT-CONS
ACT-COMM
ACT-OPS    /
```

TABLE SIGMAC(INP,CESTAC) TABLE OF CES2 SIGMAC PARAMETERS

	ACT-RICE	ACT-CORN	ACT-COCO	ACT-SUG	ACT-FRT	ACT-OTHC
CMP-RICE	EPS					
CMP-CORN		EPS				
CMP-COCO			EPS			
CMP-SUG				EPS		
CMP-FRT					EPS	
CMP-OTHC						EPS
CMP-EXTR	EPS		EPS			EPS
CMP-FM			EPS			
CMP-LTIN	EPS	EPS	EPS	EPS	EPS	EPS
CMP-HVIN	EPS	EPS	EPS	EPS	EPS	EPS
CMP-PET	EPS	EPS	EPS	EPS	EPS	EPS
CMP-CONS	EPS	EPS	EPS	EPS	EPS	EPS
CMP-COMM	EPS	EPS	EPS	EPS	EPS	EPS
CMP-OPS	EPS	EPS	EPS	EPS	EPS	EPS
LABOR	0.4	0.4	0.4	0.4	0.4	0.4
CAPITAL	0.4	0.4	0.4	0.4	0.4	0.4
RICECAPF	0.4					
CORNCAPF		0.4				
COCOCAPF			0.4			
SUGCAPF				0.4		
FRTCAPF					0.4	
OTHCRPCAPF						0.4

+	ACT-LIV	ACT-FISH	ACT-EXTR	ACT-FM	ACT-LTIN
CMP-RICE	EPS	EPS		EPS	
CMP-CORN	EPS			EPS	EPS
CMP-COCO	EPS	EPS		EPS	EPS
CMP-SUG	EPS			EPS	EPS
CMP-FRT				EPS	
CMP-OTHC	EPS	EPS		EPS	EPS
CMP-LIV	EPS	EPS		EPS	EPS
CMP-FISH	EPS	EPS		EPS	
CMP-EXTR	EPS	EPS	EPS	EPS	EPS
CMP-FM	EPS	EPS		EPS	EPS
CMP-LTIN	EPS	EPS	EPS	EPS	EPS
CMP-HVIN	EPS	EPS	EPS	EPS	EPS
CMP-PET	EPS	EPS	EPS	EPS	EPS
CMP-CONS	EPS	EPS	EPS	EPS	EPS
CMP-COMM	EPS	EPS	EPS	EPS	EPS
CMP-OPS	EPS	EPS	EPS	EPS	EPS
LABOR	0.4	0.4	0.4	0.5	0.6
CAPITAL	0.4	0.4	0.4	0.5	0.6
LIVCAPF	0.4				
FISHCAPF		0.4			

99

```
EXTRCAPF                          0.4
FOODCAPF                                     0.5
LTINCAPF                                                 0.6

        +   ACT-HVIN  ACT-PET  ACT-CONS  ACT-COMM  ACT-OPS
CMP-RICE                                          EPS
CMP-CORN                                          EPS
CMP-COCO                                          EPS
CMP-SUG                                           EPS
CMP-FRT                                           EPS
CMP-OTHC                                          EPS
CMP-LIV                                           EPS
CMP-FISH                                          EPS
CMP-EXTR    EPS       EPS       EPS       EPS     EPS
CMP-FM                                            EPS
CMP-LTIN    EPS       EPS       EPS       EPS     EPS
CMP-HVIN    EPS       EPS       EPS       EPS     EPS
CMP-PET     EPS       EPS       EPS       EPS     EPS
CMP-CONS    EPS       EPS       EPS       EPS     EPS
CMP-COMM    EPS       EPS       EPS       EPS     EPS
CMP-OPS     EPS       EPS       EPS       EPS     EPS
LABOR       0.5       0.5       0.6       0.8     0.8
CAPITAL     0.5       0.5       0.6       0.8     0.8
HVINCAPF    0.5
PETCAPF               0.5
CONSCAPF                        0.6
SERVCAPF                                  0.8     0.8


* INPUT THE LES ALPHA PARAMETERS

SET  ACCON(ACC) LES COMMODITIES WITH NONZERO ALPHAS /
                CMP-RICE
                CMP-CORN
                CMP-COCO
                CMP-SUG
                CMP-FRT
                CMP-OTHC
                CMP-LIV
                CMP-FISH
                CMP-FM  /

SET  CONIST(ACC) INSTITUTIONS WITH LES CONSUMPTION SYSTEMS /
     NCRLO-CON
     NCRMID-CON
     NCRHI-CON
     URBLO-CON
     URBMID-CON
     URBHI-CON
     RURLO-CON
     RURMID-CON
     RURHI-CON   /


TABLE  ALPHA(ACCON,CONIST)  LES ALPHA PARAMETER TABLE

            NCRLO-CON  NCRMID-CON  NCRHI-CON  URBLO-CON  URBMID-CON
CMP-RICE    282339     1696836     978691     1376702    2992696
CMP-CORN    296        1294        621        46320      64882
CMP-COCO    1584       8903        8812       13937      24077
CMP-SUG     31514      188612      113825     124594     296166
CMP-FRT     70833      600642      578327     288063     837702
```

CMP-OTHC	92511	723381	539664	415947	1035128
CMP-LIV	201983	2095022	1981735	671807	2751170
CMP-FISH	202551	1356792	959565	964844	2388924
CMP-FM	411133	3524103	2899556	1638193	5304497

+	URBHI-CON	RURLO-CON	RURMID-CON	RURHI-CON
CMP-RICE	1150379	5498415	5721714	794643
CMP-CORN	20466	506378	282031	30456
CMP-COCO	11663	90682	54268	8878
CMP-SUG	136757	523006	531548	81246
CMP-FRT	594088	1210388	1330475	231308
CMP-OTHC	587149	2221757	1949195	313567
CMP-LIV	2072437	2475503	3954897	916582
CMP-FISH	1186085	3403879	3373589	601341
CMP-FM	3293252	5606581	7714639	1548954

```
*DEFINE AND FILL CELL TABLE SETS

PARAMETER  CT(ACC,ACC,*)  CELL TABLE;
           CT(ACC,ACCP,"TBASE") = SAM(ACC,ACCP);
           CT(ACC,ACCP,"SPECS") = SPEC(ACC,ACCP);
           CT(ACCEX,"R-O-W","ETA") = ETAS(ACCEX);
           CT(INP,CESTAC,"SIGMAC") = SIGMAC(INP,CESTAC);
           CT(ACCON,CONIST,"ALPHA") = ALPHA(ACCON,CONIST);

* CHECK FOR BALANCE OF BASE SAM;

PARAMETER  TOTALS(ACC,*) ACCOUNT TOTALS AND IMBALANCES FOR SAM;

    TOTALS(ACC,"ROW-TOTAL") = SUM(ACCP,SAM(ACC,ACCP));
    TOTALS(ACCP,"COL-TOTAL") = SUM(ACC,SAM(ACC,ACCP));
    TOTALS(ACC,"DIFFERENCE") = TOTALS(ACC,"ROW-TOTAL") -
                               TOTALS(ACC,"COL-TOTAL");

DISPLAY "CHECK FOR BALANCE OF BASE SAM:",TOTALS;


MODEL PHILSTAT "PHILIPPINE CGE MODEL: WALRASIAN STATIC"
      /ACC,AT,CT/;


SOLVE PHILSTAT USING HERCULES;

DISPLAY CT;

* END OF BASIC MODEL PROGRAM;
```

B.4: THE SIMULATION PROGRAM

Simulations are run by attaching more statements to this basic program, statements that basically change some parameters in the model. For example, the following statements represent a simulation of a uniform 50% tariff on all imports:

```
* CASE OF 50% UNIFORM TARIFFS;
* SOLVE FOR BASE CASE (WITHOUT BOP DEFICIT) SAM FIRST;
      CT("SAVINGS","R-O-W","FV") = EPS;

*ACCOUNT FOR CORN AND OTHCROPS QUOTA EFFECTS;
      CT("INDR-TAX","IMP-COR-ER","THETA") = EPS;
      CT("INDR-TAX","IMP-OTH-ER","THETA") = 0.10068;

SOLVE PHILSTAT USING HERCULES;
         DISPLAY CT;

* CHARGE A UNIFORM 50% IMPORT TARIFF AND ZERO EXPORT TAX;

* NOW UPDATE THE BASE SAM WITH VALUES FOR NEW SOLN;
          CT(ACC,ACCP,"TBASE") = CT(ACC,ACCP,"TSOL");

   SET  IMP(ACC)  IMPORTS  / IMP-COCO, IMP-SUG, IMP-FRT
                     IMP-LIV, IMP-FISH, IMP-EXTR, IMP-FM
                     IMP-LTIN, IMP-HVIN, IMP-PET, IMP-CONS
                     IMP-COMM, IMP-OPS  /
        EXP(ACC)  EXPORTS  / EXP-RICE,  EXP-COCO, EXP-SUG
                       EXP-FRT, EXP-OTHC, EXP-LIV, EXP-FISH
                       EXP-EXTR, EXP-FM, EXP-LTIN, EXP-HVIN
                       EXP-PET, EXP-CONS,  EXP-COMM, EXP-OPS / ;

    CT("INDR-TAX",IMP,"THETA") = 0.5;
    CT("INDR-TAX",EXP,"THETA") = EPS;
    CT("EXP-RICE","R-O-W","ETA") = EPS;
    CT("R-O-W","IMP-RICE","WP") = 1.1625;
    CT("EXP-RICE","R-O-W","FQ") = 300;
    AT("CMP-RICE","SIGMA") = 4;
    AT("CMP-CORN","SIGMA") = 35;
      CT("INDR-TAX","IMP-COR-ER","THETA") = 0.5;
      CT("INDR-TAX","IMP-OTH-ER","THETA") = 0.5;

SOLVE PHILSTAT USING HERCULES;
         DISPLAY CT;

* END OF PROGRAM;
```

These statements may be added to the basic program, such that another solve routine will be run using the updated parameters. Notice that the model is first forced to solve for the SAM values when there is no Balance of Payments deficit. This is to remove the distortion of a balance of payment deficit, as was the case for the 1983 base SAM. Also, there are statements redefining the elasticity of substitution in the import aggregation function for rice and corn. This is necessary because the model, as such, can not handle zero values in the SAM, e.g. the SAM collapses. Hence, we artificially introduce a threshold elasticity at which importing becomes very small, yet do not entirely disappear.

B.5: The Dynamic Extension Program

The dynamic model is implemented by sequentially updating the stock of factors from the basic static model. Several runs correponding to the number of time periods will then be executed. Labor is updated by an exogenous growth parameter[5]. Mobile capital is updated by the amount of capital formation in the prior period, with the units of measure calibrated to the base SAM. Fixed capital in each sector is updated by adding the ampunt of mobile capital allocated in the prior period to the sector and subtracting the depreciation to the capital in place in the prior period.

Statements representing a ten-year dynamic simulation of a trade regime with uniform 50% tariffs follows:

```
*DYNAMIC EXTENSION, 50% TARIFFS;
*SOLVE FOR BASE CASE (WITHOUT BOP DEFICIT) SAM FIRST
      CT("SAVINGS","R-O-W","FV") = EPS;
*ACCOUNT FOR CORN AND OTHCROPS QUOTA EFFECTS;
      CT("INDR-TAX","IMP-COR-ER","THETA") = EPS;
      CT("INDR-TAX","IMP-OTH-ER","THETA") = 0.10068;
SOLVE PHILSTAT USING HERCULES;
         DISPLAY CT;

*RESET THE BASE SAM VALUES;
         CT(ACC,ACCP,"TBASE") = CT(ACC,ACCP,"TSOL");
*DYNAMIC BASEYEAR CASE;
* UPDATE STOCK VARIABLES: FIRST UPDATE;

*UPDATE LABOR FORCE;
  PARAMETER GLAB; GLAB = 1.0341;
  AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                     + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
  PARAMETER DEPCOEF; DEPCOEF = 0.10;
  PARAMETER CTOFCCOEF; CTOFCCOEF = 1.0;
   AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
   AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
   AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
   AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
   AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
   AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
   AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
   AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
   AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                           CTOFCCCEF*CT("CAPITAL","ACT-EXTR","QCSOL");
   AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                           CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
   AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
```

[5] The labor growth rate adopted was 3.041, representing the growth rate in population in 1983.

```
                          CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
   AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
   AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
   AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
   AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                          CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                     CT("CAPITAL","ACT-OPS","QCSOL"));

*TRADE POLICY OPTION;
*CHARGE A UNIFORM 50% IMPORT TARIFF AND ZERO EXPORT TAX;
   SET  IMP(ACC)  IMPORTS  / IMP-COCO, IMP-SUG, IMP-FRT
                       IMP-LIV, IMP-FISH, IMP-EXTR, IMP-FM
                       IMP-LTIN, IMP-HVIN, IMP-PET, IMP-CONS
                       IMP-COMM, IMP-OPS  /
        EXP(ACC)  EXPORTS  / EXP-RICE,  EXP-COCO, EXP-SUG
                          EXP-FRT, EXP-OTHC, EXP-LIV, EXP-FISH
                          EXP-EXTR, EXP-FM, EXP-LTIN, EXP-HVIN
                          EXP-PET, EXP-CONS,  EXP-COMM, EXP-OPS / ;
    CT("INDR-TAX",IMP,"THETA") = 0.5;
    CT("INDR-TAX",EXP,"THETA") = EPS;
    CT("R-O-W","IMP-RICE","WP") = 1.1625;
      CT("INDR-TAX","IMP-COR-ER","THETA") = 0.5;
      CT("INDR-TAX","IMP-OTH-ER","THETA") = 0.5;

*RICE NO LONGER EXPORTED;
    CT("EXP-RICE","R-O-W","ETA") = EPS;
    CT("EXP-RICE","R-O-W","FQ") = 300;
    AT("CMP-RICE","SIGMA") = INF;
*COCO NO LONGER EXPORTED;
    CT("EXP-COCO","R-O-W","ETA") = EPS;
    CT("EXP-COCO","R-O-W","FQ") = 300;
    AT("CMP-COCO","SIGMA") = 100;


SOLVE PHILSTAT USING HERCULES;
 DISPLAY QTAB;

*UPDATE STOCK VARIABLES: SECOND UPDATE;
*UPDATE LABOR FORCE;
  AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                       + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
```

```
                          CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                          CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                     CT("CAPITAL","ACT-OPS","QCSOL"));

*COCO NO LONGER EXPORTED;
    CT("EXP-COCO","R-O-W","ETA") = EPS;
    CT("EXP-COCO","R-O-W","FQ") = 300;
    AT("CMP-COCO","SIGMA") = 442;

SOLVE PHILSTAT USING HERCULES;


*UPDATE STOCK VARIABLES: THIRD UPDATE;

*UPDATE LABOR FORCE;
 AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                       + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
```

```
                          CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                     CT("CAPITAL","ACT-OPS","QCSOL"));

*COCO-EXPORTS STOP;
    CT("EXP-COCO","R-O-W","ETA") = EPS;
    CT("EXP-COCO","R-O-W","FQ") = 200;
    AT("CMP-COCO","SIGMA") = INF;

SOLVE PHILSTAT  USING HERCULES;


*UPDATE STOCK VARIABLES: FOURTH UPDATE;
*UPDATE  BASE SAM;
*          CT(ACC,ACCP,"TBASE") = CT(ACC,ACCP,"TSOL");

*UPDATE LABOR FORCE;
  AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                       + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
  AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
  AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
  AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
  AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
  AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
  AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
  AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
  AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
  AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
  AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
  AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
  AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
  AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
  AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                          CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
  AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                          CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                     CT("CAPITAL","ACT-OPS","QCSOL"));

SOLVE PHILSTAT  USING HERCULES;


*UPDATE STOCK VARIABLES: FIFTH UPDATE;

*UPDATE LABOR FORCE;
 AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
```

```
                        + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                         CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                    CT("CAPITAL","ACT-OPS","QCSOL"));

SOLVE PHILSTAT  USING HERCULES;


*UPDATE STOCK VARIABLES: SIXTH UPDATE;
*UPDATE LABOR FORCE;
 AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                        + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
```

```
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                         CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                    CT("CAPITAL","ACT-OPS","QCSOL"));

SOLVE PHILSTAT  USING HERCULES;

*UPDATE STOCK VARIABLES: SEVENTH UPDATE;

*UPDATE LABOR FORCE;
 AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                       + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                         CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                    CT("CAPITAL","ACT-OPS","QCSOL"));

SOLVE PHILSTAT  USING HERCULES;


*UPDATE STOCK VARIABLES: EIGHTH UPDATE;
```

```
*UPDATE LABOR FORCE;
 AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                       + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                         CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                    CT("CAPITAL","ACT-OPS","QCSOL"));

SOLVE PHILSTAT  USING HERCULES;


*UPDATE STOCK VARIABLES: NINTH UPDATE;

*UPDATE LABOR FORCE;
 AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                       + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                         CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
```

```
                                CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                                CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                           CT("CAPITAL","ACT-OPS","QCSOL"));

SOLVE PHILSTAT  USING HERCULES;


*UPDATE STOCK VARIABLES: TENTH UPDATE;

*UPDATE LABOR FORCE;
 AT("LABOR","QFIX") = AT("LABOR","QSOL")*GLAB;
*UPDATE FLEXIBLE CAPITAL;
  AT("CAPITAL","QFIX") = 0.442*(AT("GOV-INV","QSOL") + AT("CAP-INV","QSOL")
                       + AT("STOX","QSOL"));
*UPDATE FIXED CAPITAL;
 AT("RICECAPF","QFIX") = (1-DEPCOEF)*AT("RICECAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-RICE","QCSOL");
 AT("CORNCAPF","QFIX") = (1-DEPCOEF)*AT("CORNCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-CORN","QCSOL");
 AT("COCOCAPF","QFIX") = (1-DEPCOEF)*AT("COCOCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-COCO","QCSOL");
 AT("SUGCAPF","QFIX") = (1-DEPCOEF)*AT("SUGCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-SUG","QCSOL");
 AT("FRTCAPF","QFIX") = (1-DEPCOEF)*AT("FRTCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-FRT","QCSOL");
 AT("OTHCRPCAPF","QFIX") = (1-DEPCOEF)*AT("OTHCRPCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-OTHC","QCSOL");
 AT("LIVCAPF","QFIX") = (1-DEPCOEF)*AT("LIVCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-LIV","QCSOL");
 AT("FISHCAPF","QFIX") = (1-DEPCOEF)*AT("FISHCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-FISH","QCSOL");
 AT("EXTRCAPF","QFIX") = (1-DEPCOEF)*AT("EXTRCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-EXTR","QCSOL");
 AT("FOODCAPF","QFIX") = (1-DEPCOEF)*AT("FOODCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-FM","QCSOL");
 AT("LTINCAPF","QFIX") = (1-DEPCOEF)*AT("LTINCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-LTIN","QCSOL");
 AT("HVINCAPF","QFIX") = (1-DEPCOEF)*AT("HVINCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-HVIN","QCSOL");
 AT("PETCAPF","QFIX") = (1-DEPCOEF)*AT("PETCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-PET","QCSOL");
 AT("CONSCAPF","QFIX") = (1-DEPCOEF)*AT("CONSCAPF","QSOL") +
                                CTOFCCOEF*CT("CAPITAL","ACT-CONS","QCSOL");
 AT("SERVCAPF","QFIX") = (1-DEPCOEF)*AT("SERVCAPF","QSOL") +
                                CTOFCCOEF*(CT("CAPITAL","ACT-COMM","QCSOL") +
                                           CT("CAPITAL","ACT-OPS","QCSOL"));
```

```
SOLVE PHILSTAT  USING HERCULES;
```