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## Philippine Computable General Equilibrium Model (PCGEM)

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## Philippine Computable General Equilibrium Model (PCGEM)

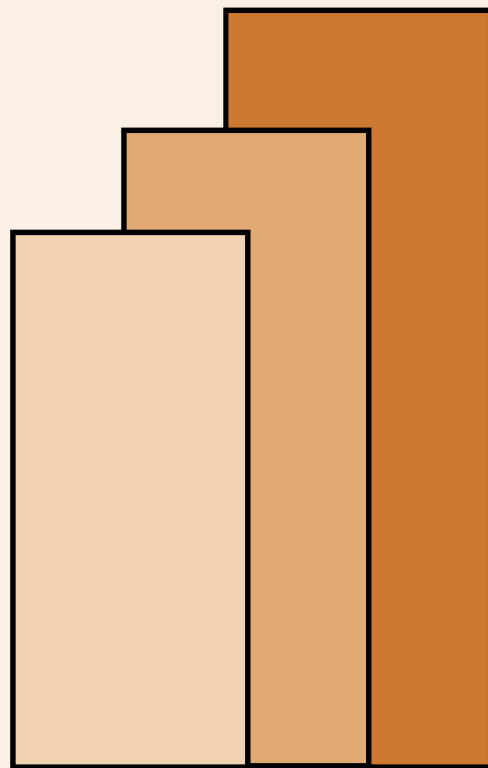
*Caesar B. Cororaton*

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# Philippine Computable General Equilibrium Model (PCGEM)

Caesar B. Cororaton<sup>1</sup>  
July 2000

## Abstract

This paper discusses the structure of the Philippine computable general equilibrium model (PCGEM). The model is a medium-sized CGE model of the Philippine economy. It disaggregates the production sector into 34 sectors. It incorporates 3 types of factor inputs: labor, variable capital and capital. The household sector is grouped in decile. Production differentiation is introduced in imports and exports. PCGEM is a neoclassical CGE model, with price clearing mechanisms. Furthermore, it is a full employment model.

At its present state, the model is closed with fixed current account balance, fixed exchange rate (the numeriare), and endogenous PINDEX, which is the weighted value added price (or the GDP deflator). Also, savings go back into the system in the form of investments.

The model is static and calibrated using the 1990 social accounting matrix and the 1990 sectoral tariff revenue. PCGEM is coded in a software called General Algebric Modelling System (GAMS).

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# Philippine Computable General Equilibrium Model (PCGEM)

Caesar B. Cororaton  
July 2000

The Philippine Computable General Equilibrium Model (PCGEM) is a non-linear general equilibrium of the Philippine economy. The model has 34 production sectors, 3 factor inputs (labor, variable capital, and capital), and 10 household types in decile groupings. Labor and variable capital are endogenous, while capital is fixed.

Armington assumption is imposed in the imports functions, while a CET specification is used in the exports equations. Consumer utility functions are specified as Cobb-Douglas. PCGEM is a neoclassical CGE model wherein prices adjust to clear the markets. Furthermore, it is a full equilibrium model.

The model is closed with the current account balance, or foreign savings, fixed. The exchange rate is the numeraire, while the weighted value added price (GDP deflator) is endogenous. This therefore implies that the value added price level adjusts to clear the foreign account balance. Furthermore, government consumption is fixed. With government revenue being endogenous, government budget balance is endogenous as well. Also, all savings are plowed back into the system in the form of investments.

PCGEM is a medium-sized CGE model of the Philippine economy. It is a square model with 2,272 equations in 2,272 variables (see Appendix A). Furthermore, it has 354 exogenous variables and 2,262 parameters.

At present, the model is static, and is calibrated using the 1990 social accounting matrix and 1990 sectoral tariff revenue. It is coded in a software called General Algebraic Modeling System (GAMS).

This model documentation includes: (i) a discussion of the specification of the model; (ii) a discussion of sensitivity analysis on changes in trade elasticities; (iii) a brief discussion on areas for further development of the model. Furthermore, the documentation has three appendices: (a) the model structure; (b) the PCGEM GAMS codes; and (c) the output file.

## Model Specification: Major Blocks

Figure 1 shows schematically the relationships in PCGEM. The model has 6 blocks. In this section, only major equations in each block are discussed; just to highlight the economic relationships in the model.

### Trade Block

Imports. Standard in CGE specification is the product differentiation between locally produced and imported goods. This differentiation results in imperfect substitutability between imports and domestic goods, and usually, a CES function is used. This is commonly referred to as the Armington assumption which is

$$(1) \quad x(it) = ac(it) * [\delta(it) * imp(it)^{-\rho_m(it)} + \{1 - \delta(it)\} * xxd(it)^{-\rho_m(it)}]^{-1/\rho_m(it)}$$

$x(it)$ , is the composite good,  $imp(it)$  imports,  $xxd(it)$  domestic production available for domestic consumption;  $ac(it)$  and  $\delta(it)$  are constants,  $\sigma_m(it)$  is the elasticity of substitution which is given by  $\sigma_m(it) = 1/[1 + \rho_m(it)]$ . The sectoral index is given by  $it$ . Consumers will choose between imported and domestic goods depending on their relative price. Minimizing the cost of obtaining a "unit of utility"

$$(2) \quad p(it) * x(it) = pd(it) * xxd(it) + pm(it) * imp(it)$$

subject to (1) yields the demand for imports function

$$(3) \quad imp(it) = xxd(it) * \left( \frac{pd(it)}{pm(it)} * \frac{\delta(it)}{\{1 - \delta(it)\}} \right)^{\sigma_m(it)}$$

where  $p(it)$ ,  $pd(it)$ ,  $pm(it)$  are prices of  $x(it)$ ,  $xxd(it)$ , and  $imp(it)$ . Furthermore the local price of imports is given by

$$(4) \quad pm(it) = pwm(it) * er * [1 + tm(it)]$$

where  $pwm(it)$  is the world price of imports,  $er$  is the exchange rate,  $tm(it)$  sectoral tariff rate. From (3) one can observe that as the elasticity substitution gets larger, the sensitivity of imports to the relative price rises.

Exports. Similarly, the quality of domestically consumed and exported commodities may be quite different. This product differentiation may be captured through the use of a constant elasticity of transformation (CET) function between domestically consumed and exported goods. That is,

$$(5) \quad xd(it) = at(it) * [theta(it) * exp(it)^{\kappa_e(it)} + \{1 - theta(it)\} * xxd(it)^{\kappa_e(it)}]^{1/\kappa_e(it)}$$

where  $xd(it)$  is total domestic production,  $exp(it)$  exports;  $at(it)$  and  $theta(it)$ , are constants;  $\tau_e(it)$  is the elasticity of transformation which is given by  $1/[1 - \kappa_e(it)]$ .

Maximizing revenue

$$(6) \quad px(it) * xd(it) = p1(it) * xxd(it) + pe(it) * exp(it)$$

for a given output, (5), gives the export supply function which is

$$(7) \quad exp(it) = xxd(it) * \{pe(it)/p1(it) * [1 - theta(it)]/theta(it)\}^{\tau_e(it)}$$

where  $pe$ , the export price is given by

$$(8) \quad pe(it) = pwe(it) * er / [1 + te(it)]$$

and the domestic price is

$$(9) \quad pd(i) = p1(i) * [1 + itxrdom(i)]$$

where  $te(it)$  is the export tax, and  $itxrdom(it)$  indirect tax.

### Supply and Factor Block

Value Added and factors. Sectoral value added is specified as Cobb-Douglas function of 3 factor inputs: labor, variable capital and capital. With perfect competition and profit maximization, the price of each factor is equal to the value of its marginal product. From this condition, equations for the demand for factor inputs are derived.

### Demand Block

Total demand has 5 components which are: (a) intermediate demand is derived Leontief fixed-coefficient assumption; (b) consumption demand of institutions (except the government) which is derived using Cobb-Douglas specification; (c) investment demand (whose total is equal to total savings); (d) government consumption which is fixed; and (e) change in stocks which is also fixed.

### Price Block

Equations (2), (4), (6), (8) and (9) are part of the price block. Value added price is also introduced into the model, being derived as the difference between the value of output and intermediate inputs. Furthermore, weighted value added price, PINDEX, (can also be referred to as the GDP deflator) is added and is determined endogenously. Lastly, prices of capital goods are assumed to be equal to the composite price in equation (2) above.

### Income Block

Income of the institutions, except the government sector, is derived from factor incomes; secondary incomes (mostly dividends and interest incomes); and grants, aids and transfers (from the government and the rest of the world). Income of the government comes from tariff revenue, indirect tax revenue, direct tax revenue, and grants and transfers from the rest of the world.

### Equilibrium Conditions and Model Closure

The equilibrium conditions have 4 major parts:

(a) Balance of payments is zero. With the current account balance, or foreign savings, fixed, and the

exchange rate,  $er$ , the numeraire, the weighted value added price, or the PINDEX, adjusts to clear the payments account. In other words, instead of a clearing exchange rate, it is the real exchange rate defined as  $er/PINDEX$  which clears the balance of payments.

(b) Total savings is equal to total investment, i.e., savings are plowed back into the system in the form of investments

(c) Total sectoral demand for labor is equal to the total supply of labor. Similarly, the total sectoral demand for variable capital is equal to the total supply. Also, the model imposes zero profit condition.

(d) Sectoral supply is equal to sectoral demand for commodities. Walras law is applied to one of the sectors, namely the general government service sector.

A complete specification of the model is presented in Appendix A. The model uses parameters presented in Table 1. These parameters are the coefficients in the Cobb-Douglas value added equations, the Armington and the CET elasticities.

#### Other Indicators

The model also generates Gini coefficient as the indicator of income inequality. Also, the model generates 2 welfare indicators: the Hicksian compensating variations (CV), and the Hicksian equivalent variations (EV). CV takes the new equilibrium prices and incomes (i.e. after the world price change is introduced), and asks how much income must be taken away or added in order to return the households to their pre-change utility level. EV, on the other hand, takes the old equilibrium incomes and prices and computes the change needed to achieve new equilibrium utilities.<sup>2</sup> Computationally, these measures are given by the following formula:

(10) Compensating Variations

$$CV = [(U^n - U^0)/U^n] * I^n$$

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<sup>2</sup>Shoven and Whalley, 1984. "Applied General-Equilibrium Models of Taxation and International Trade: An Introduction and Survey" Journal of Economic Literature.



## (11) Equivalent Variations

$$EV = [(U^n - U^0)/U^0]*I^0$$

where  $U^n$ ,  $U^0$ ,  $I^n$ ,  $I^0$  denote the new and old levels of utility and income, respectively

### **Structure of the GAMS Codes of PCGEM**

PCGEM is coded in GAMS. Appendix B presents the complete codes of the model. There are - parts in the set of codes which define: (a) sets containing the sectors, factors, and institutions; (b) data set; (c) model calibration; (d) variables in the model; (e) equations of the model; and (f) model initialization which sets which variables are endogenous and exogenous. Furthermore, the last part of the program is a set of GAMS codes which writes out, in summary form, results of every run of PCGEM into another file called RESULTS.PRN. This output file can be imported into excel for easy analysis of the results of various scenarios.

### **Sensitivity Analysis**

So far, only the APEX model<sup>3</sup>, another CGE model with 50 sectors of the Philippine economy, utilizes econometrically estimated parameters. One set of econometrically estimated parameters used is the sectoral Armington elasticities. These parameters are shown in Table 2. Note that there are 50 sectors in the APEX model, while there are only 34 sectors in the PCGEM. To derive the Armington elasticities for PCGEM, sectoral weighted average were computed. In cases where the elasticities are zero, a parameter value of 0.2 was used. This is because PCGEM does not run with very small value for  $\sigma_m(it)$  or zero.

Sensitivity analysis was conducted to determine how the results of PCGEM are affected by changes in the trade elasticities. Experiments involving +20% and -20% changes in the trade elasticities were conducted in different combinations using a shock wherein foreign savings or the current account balance was increased by 10,000,000. Below is a list of the different experiments. Note that

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<sup>3</sup>Clarete and Warr, 1991. "The Structure of the Agriculture Policy Experiment Model". Manuscript.

as  $\sigma_m$ , the Armington elasticity, increases, the sensitivity of imports to changes in the relative price increases. The same effect holds for  $\tau_e$ , the export elasticity.

<b>Experiments</b>	<b>Changes in trade elasticities</b>
Elas0	Old values of $\sigma_m$ and $\tau_e$
Elas1	-20% $\sigma_m$ & -20% $\tau_e$
Elas2	-20% $\sigma_m$ & +20% $\tau_e$
Elas3	+20% $\sigma_m$ & -20% $\tau_e$
Elas4	+20% $\sigma_m$ & +20% $\tau_e$

The different values of trade elasticities are shown in Table 3. The results of the sensitivity analysis are presented in Tables 4 to 8. The results for experiments Elas1 to Elas4 were compared with the results for Elas0.

In the results, the effects of changes in trade elasticities are not very significant, except for the welfare indicators. The effects on macroeconomic analysis (Table 4), income analysis (table 5), sectoral prices (Table 7), and sectoral output (Table 8) are very small relative to the change in the elasticities, +20% and -20%. There are however, significant effects on the results for the welfare indicators, compensating variations (CV) and equivalent variations (Table 6). Welfare indicators for the poorer households respond favorably for a higher export elasticities and lower Armington elasticities (under the experiment Elas2). The richer households are worse off under lower elasticities for both the exports and imports (under the experiment Elas1).

### **Areas for Improvement**

Modelling of the PCGEM is an ongoing process. At the moment it is undergoing changes for further improvements. Areas for improvement that are being thought of are:

(1) update from 1990 to 1994 data base using the most recent 1994 input-output (IO) table, the 1994 Family and Expenditure survey (FIES), and other relevant economic data for 1994.

(2) re-specification of the household categories from the present decile groupings to socio-economic groupings that are not so sensitive to changes in incomes.

(3) re-specification of the consumption function from the present one which is derived from a Cobb-Douglas utility function into a more general Cobb-Douglas specification like the commonly used linear expenditure system (LES).

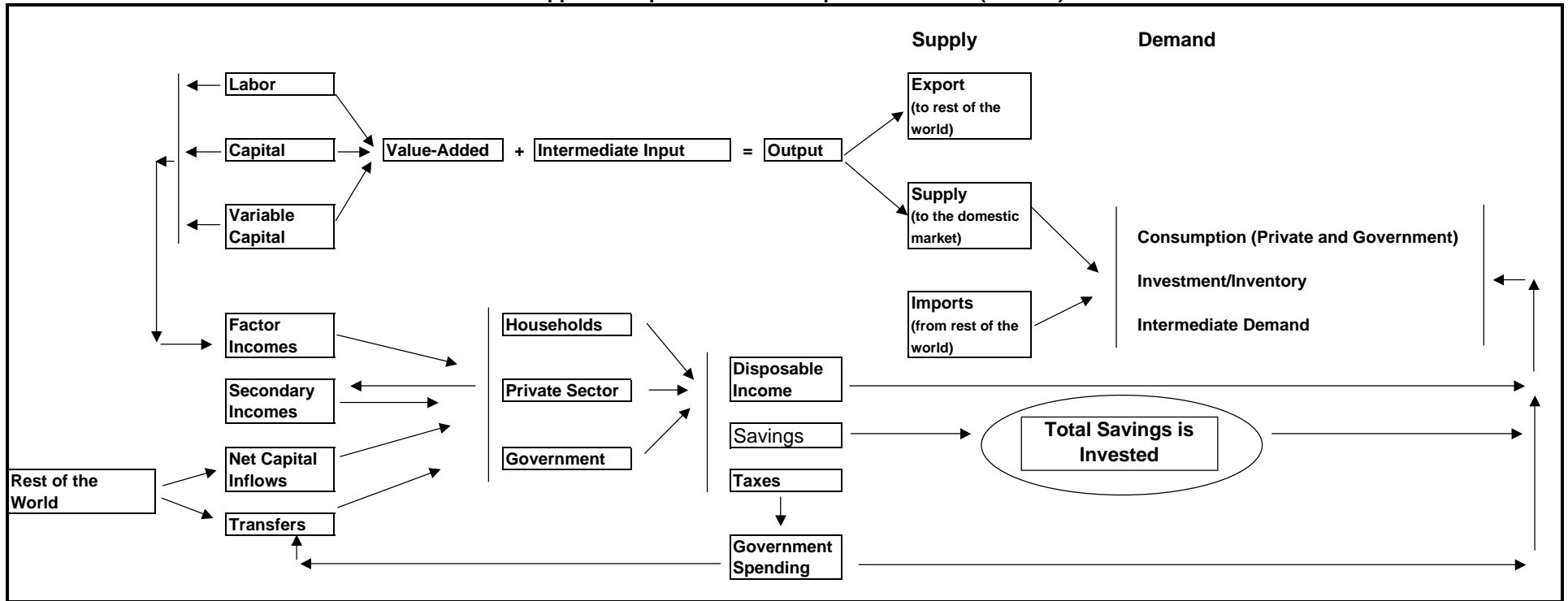
(4) re-specification of the value added equations from a simple Cobb-Douglas into a more general function like the constant elasticity of substitution (CES).

(5) incorporate time element that would make PCGEM a dynamic CGE model

(6) incorporate financial variables, quantity clearing mechanisms, and mark-up rules, instead of price clearing, in some of the markets like labor and oligopolistic industries, to reflect the real structure of the Philippine economy. This will eventually convert PCGEM into a financial CGE model.

(7) micro simulations with very detailed household categories whose information are derived from household surveys.

Philippine Computable General Equilibrium Model (PCGEM)



<b>Table 1: Elasticities Used in PCGEM</b>					
<b>Sectors</b>	<b>Production</b>			<b>Armington</b>	<b>CET</b>
	<b>alpha</b>	<b>beta</b>	<b>gamma</b>	<b>sigma_m</b>	<b>tau_e</b>
1 Palay & Corn	0.051	0.935	0.014	3.70	0.30
2 Fruits & Vegetables	0.178	0.751	0.071	0.85	1.50
3 Coconut & Sugar	0.377	0.214	0.409	1.30	2.00
4 Livestock & poultry	0.140	0.811	0.049	1.40	0.30
5 Fishing	0.117	0.676	0.207	1.10	1.50
6 Other Agriculture	0.373	0.308	0.320	0.90	0.30
7 Forestry	0.212	0.087	0.701	0.80	0.30
8 Mining	0.407	0.069	0.524	1.10	1.50
9 Rice & Corn milling	0.115	0.266	0.619	3.70	0.30
10 Milled Sugar	0.218	0.000	0.782	4.10	0.80
11 Meat Manufacturing	0.209	0.181	0.610	1.50	0.80
12 Fish Manufacturing	0.153	0.458	0.389	1.10	2.00
13 Beverage & Tobacco	0.190	0.053	0.757	0.30	1.50
14 Other Food Manufacturing	0.189	0.184	0.627	0.20	0.70
15 Textile Manufacturing	0.484	0.229	0.286	0.70	0.70
16 Garments & Leather	0.319	0.438	0.243	0.20	2.50
17 Wood Manufacturing	0.254	0.344	0.402	0.50	1.50
18 Paper & Paper products	0.326	0.191	0.483	0.60	0.90
19 Chemicals Manufacturing	0.247	0.079	0.674	0.60	1.30
20 Petroleum Refining	0.081	0.000	0.919	0.60	0.30
21 Non-Metal Manufacturing	0.308	0.247	0.446	0.60	1.50
22 Metal Manufacturing	0.346	0.189	0.465	1.80	1.50
23 Electrical Equipment Manufacturing	0.552	0.000	0.448	1.80	3.00
24 Transport & other machinery manufacturing	0.528	0.000	0.472	2.00	1.30
25 Other Manufacturing	0.183	0.268	0.549	1.10	0.60
26 Construction	0.536	0.108	0.356	0.20	0.30
27 Electricity gas and water	0.228	0.000	0.772	0.20	0.30
28 Financial Sector	0.357	0.018	0.625	0.20	0.30
29 Private Education	0.619	0.209	0.172	0.20	0.30
30 Private Health	0.253	0.616	0.132	0.20	0.30
31 Public Education	0.974	0.000	0.026		
32 Public Health	0.951	0.000	0.049		
33 General Government	0.960	0.000	0.040		
34 Other Services	0.164	0.498	0.338	0.20	0.30

Table 2: Armington Used In APEX Model		Armington
Sectors		
1	Irrigated Palay	3.70
2	Non-irrigated palay	3.70
3	Corn	3.70
4	Coconut, incl copra	2.00
5	Sugarcane	0.00
6	Banana & other fruits & nuts	1.00
7	Vegetables	0.10
8	Rootcrops	0.00
9	Other commercial crops	0.00
10	Hogs	0.00
11	Chicken & poultry products	1.40
12	Other livestock	1.30
13	Agricultural Services	0.00
14	Marine fishing	1.10
15	Inland fishing	0.00
16	Forestry and logging	0.80
17	Crude oil, coal and natural gas	0.70
18	Other mining	1.10
19	Rice and corn milling	3.70
20	Sugar milling and refining	4.10
21	Milk and dairy products	0.80
22	Oils and fats	1.40
23	Meat and meat products	0.00
24	Flour milling	0.70
25	Animal feeds	3.70
26	Other foods	0.10
27	Beverages and tobacco	0.30
28	Textile and knitting mills	0.70
29	Other made-up textile goods	0.70
30	Garments, footwear, leather and rubber footwear	0.20
31	Wood products	0.00
32	Paper products	0.60
33	Fertilizer	0.60
34	Other rub. plastic & chem, products, except rub footwear	0.00
35	Products of coal and petroleum	0.60
36	Non-ferrous basic metal products	1.00
37	Cement, basic metals & non-metalic mineral products	0.60
38	Semi-conductors	5.00
39	Metal products and non-electrical machineries	1.80
40	Electrical machinery, equipment and parts	1.80
41	Motor vehicles (Transport Equipment)	2.00
42	Other manufacturing	1.00
43	Construction	0.00
44	Electricity, gas and water	0.00
45	Transportation and communication services	0.00
46	Trade, storage and warehousing	0.00
47	Banks and non-banks	0.00
48	Life and non-life insurance and real estate	0.00
49	Government services	0.00
50	Other services	0.00

Source: "The Theoretical Structure of the APEX Model of the Philippine Economy"  
Ramon L. Clarete and Peter G. Warr, August 1992

Table 3: Elasticities for Sensitivity Analysis						
Sectors	Armington			CET		
	-20%	sigma_m	+20%	-20%	tau_e	+20%
1 Palay & Corn	2.96	3.70	4.44		0.30	
2 Fruits & Vegetables	0.68	0.85	1.02	1.20	1.50	1.80
3 Coconut & Sugar	1.04	1.30	1.56	1.60	2.00	2.40
4 Livestock & poultry	1.12	1.40	1.68		0.30	
5 Fishing	0.88	1.10	1.32	1.20	1.50	1.80
6 Other Agriculture	0.72	0.90	1.08		0.30	
7 Forestry	0.64	0.80	0.96		0.30	
8 Mining	0.88	1.10	1.32	1.20	1.50	1.80
9 Rice & Corn milling	2.96	3.70	4.44		0.30	
10 Milled Sugar	3.28	4.10	4.92	0.64	0.80	0.96
11 Meat Manufacturing	1.20	1.50	1.80	0.64	0.80	0.96
12 Fish Manufacturing	0.88	1.10	1.32	1.60	2.00	2.40
13 Beverage & Tobacco	0.24	0.30	0.36	1.20	1.50	1.80
14 Other Food Manufacturing		0.20		0.56	0.70	0.84
15 Textile Manufacturing	0.56	0.70	0.84	0.56	0.70	0.84
16 Garments & Leather		0.20		2.00	2.50	3.00
17 Wood Manufacturing	0.40	0.50	0.60	1.20	1.50	1.80
18 Paper & Paper products	0.48	0.60	0.72	0.72	0.90	1.08
19 Chemicals Manufacturing	0.48	0.60	0.72	1.04	1.30	1.56
20 Petroleum Refining	0.48	0.60	0.72		0.30	
21 Non-Metal Manufacturing	0.48	0.60	0.72	1.20	1.50	1.80
22 Metal Manufacturing	1.44	1.80	2.16	1.20	1.50	1.80
23 Electrical Equipment Manufacturing	1.44	1.80	2.16	2.40	3.00	3.60
24 Transport & other machinery manufacturing	1.60	2.00	2.40	1.04	1.30	1.56
25 Other Manufacturing	0.88	1.10	1.32	0.48	0.60	0.72
26 Construction		0.20			0.30	
27 Electricity gas and water		0.20			0.30	
28 Financial Sector		0.20			0.30	
29 Private Education		0.20			0.30	
30 Private Health		0.20			0.30	
31 Public Education						
32 Public Health						
33 General Government						
34 Other Services		0.20			0.30	

**Table 4: Macroeconomic Analysis**

	Base Run	Elas0	Elas1	Elas2	Elas3	Elas4
Real GDP	989,341	1,004,008	1,005,660.6	1,003,771.8	1,004,329.1	1,002,808.3
Pindex	1.00000	1.01480	1.01650	1.01460	1.01510	1.01360
Real Exchange Rate	1.00000	0.98540	0.98380	0.98570	0.98510	0.98660
Balance of Trade	(59,650)	(69,648)	(69,647)	(69,648)	(69,648)	(69,648)
Exports	298,933	291,882	291,811	291,503	292,283	291,952
Imports	358,583	361,530	361,458	361,150	361,931	361,600
Budget Deficit	(7,564)	(7,741)	(7,740)	(7,748)	(7,734)	(7,741)
Total Expenditure	233,252	235,799	236,073	235,757	235,856	235,602
Consumption Expenditure*	108,835	108,835	108,835	108,835	108,835	108,835
Revenue	225,688	228,058	228,333	228,009	228,122	227,862
of which:						
Tariff	25,532	25,706	25,693	25,669	25,747	25,718
Direct Tax	77,299	78,296	78,409	78,282	78,317	78,215
Indirect Tax	62,341	63,141	63,268	63,149	63,139	63,051
Average Wage Rate	1.00000	1.01920	1.02110	1.01890	1.01960	1.01790
Average Return to Variable Capital	1.00000	1.01270	1.01420	1.01240	1.01310	1.01160

\*Exgoneously fixed

**Change (Relative to Elas0)**

Elas1	Elas2	Elas3	Elas4
0.16%	-0.02%	0.03%	-0.12%
0.17%	-0.02%	0.03%	-0.12%
-0.16%	0.03%	-0.03%	0.12%
0.00%	0.00%	0.00%	0.00%
-0.02%	-0.13%	0.14%	0.02%
-0.02%	-0.10%	0.11%	0.02%
-0.01%	0.09%	-0.09%	0.00%
0.12%	-0.02%	0.02%	-0.08%
0.00%	0.00%	0.00%	0.00%
0.12%	-0.02%	0.03%	-0.09%
-0.05%	-0.15%	0.16%	0.04%
0.14%	-0.02%	0.03%	-0.10%
0.20%	0.01%	0.00%	-0.14%
0.19%	-0.03%	0.04%	-0.13%
0.15%	-0.03%	0.04%	-0.11%



**Table 5: Income Analysis**

	Base Run	Elas0	Elas1	Elas2	Elas3	Elas4
hh1	18,171	18,405	18,434	18,401	18,409	18,383
hh2	30,481	30,877	30,926	30,871	30,885	30,841
hh3	38,720	39,230	39,292	39,223	39,241	39,185
hh4	47,844	48,482	48,558	48,472	48,495	48,425
hh5	56,516	57,281	57,370	57,269	57,297	57,215
hh6	69,164	70,103	70,210	70,088	70,124	70,025
hh7	83,314	84,457	84,583	84,439	84,482	84,366
hh8	106,159	107,581	107,735	107,558	107,613	107,470
hh9	145,824	147,806	148,016	147,772	147,851	147,654
hh10	330,962	335,376	335,849	335,296	335,483	335,036

**Change (Relative to Elas0)**

Elas1	Elas2	Elas3	Elas4
0.16%	-0.02%	0.02%	-0.12%
0.16%	-0.02%	0.03%	-0.12%
0.16%	-0.02%	0.03%	-0.12%
0.16%	-0.02%	0.03%	-0.12%
0.16%	-0.02%	0.03%	-0.11%
0.15%	-0.02%	0.03%	-0.11%
0.15%	-0.02%	0.03%	-0.11%
0.14%	-0.02%	0.03%	-0.10%
0.14%	-0.02%	0.03%	-0.10%
0.14%	-0.02%	0.03%	-0.10%

**Gini Coefficient**

Base Run	Elas0	Elas1	Elas2	Elas3	Elas4
0.439924	0.439949	0.439915	0.439940	0.439959	0.439978

**Change (Relative to Elas0)**

Elas1	Elas2	Elas3	Elas4
-0.01%	0.00%	0.00%	0.01%

**Table 6: Welfare Analysis**

<b>CV: Compensating Variations</b>					
	<b>Elas0</b>	<b>Elas1</b>	<b>Elas2</b>	<b>Elas3</b>	<b>Elas4</b>
hh1	2.347	2.729	3.301	0.822	1.871
hh2	7.870	8.310	10.150	5.912	7.430
hh3	18.121	17.922	20.082	15.288	17.235
hh4	29.356	29.734	31.873	26.723	28.641
hh5	47.015	46.155	49.310	43.802	47.084
hh6	61.291	57.655	63.602	59.095	64.124
hh7	85.600	78.206	88.351	82.958	90.926
hh8	75.885	59.753	79.115	71.955	88.062
hh9	134.075	112.377	136.906	131.477	151.839
hh10	230.432	178.570	231.686	228.330	271.256
Total	691.993	591.411	714.375	666.362	768.469

<b>EV: Equivalent Variations</b>					
	<b>Elas0</b>	<b>Elas1</b>	<b>Elas2</b>	<b>Elas3</b>	<b>Elas4</b>
hh1	2.318	2.691	3.260	0.812	1.849
hh2	7.771	8.193	10.025	5.836	7.345
hh3	17.894	17.669	19.835	15.091	17.038
hh4	28.988	29.315	31.481	26.378	28.314
hh5	46.426	45.504	48.703	43.238	46.547
hh6	60.522	56.842	62.820	58.335	63.393
hh7	84.527	77.104	87.266	81.892	89.890
hh8	74.934	58.911	78.143	71.030	87.059
hh9	132.398	110.796	135.226	129.790	150.112
hh10	227.556	176.066	228.849	225.406	268.175
Total	683.333	583.090	705.608	657.808	759.723

**Change (Relative to Elas0)**

<b>CV: Compensating Variations</b>				
	<b>Elas1</b>	<b>Elas2</b>	<b>Elas3</b>	<b>Elas4</b>
	16.3%	40.6%	-65.0%	-20.3%
	5.6%	29.0%	-24.9%	-5.6%
	-1.1%	10.8%	-15.6%	-4.9%
	1.3%	8.6%	-9.0%	-2.4%
	-1.8%	4.9%	-6.8%	0.1%
	-5.9%	3.8%	-3.6%	4.6%
	-8.6%	3.2%	-3.1%	6.2%
	-21.3%	4.3%	-5.2%	16.0%
	-16.2%	2.1%	-1.9%	13.2%
	-22.5%	0.5%	-0.9%	17.7%
	-14.5%	3.2%	-3.7%	11.1%

**Change (Relative to Elas0)**

<b>CV: Compensating Variations</b>				
	<b>Elas1</b>	<b>Elas2</b>	<b>Elas3</b>	<b>Elas4</b>
	16.1%	40.7%	-65.0%	-20.2%
	5.4%	29.0%	-24.9%	-5.5%
	-1.3%	10.8%	-15.7%	-4.8%
	1.1%	8.6%	-9.0%	-2.3%
	-2.0%	4.9%	-6.9%	0.3%
	-6.1%	3.8%	-3.6%	4.7%
	-8.8%	3.2%	-3.1%	6.3%
	-21.4%	4.3%	-5.2%	16.2%
	-16.3%	2.1%	-2.0%	13.4%
	-22.6%	0.6%	-0.9%	17.9%
	-14.7%	3.3%	-3.7%	11.2%

**Table 7: Sectional Price**

Sectors	Base Run	Elas0	Elas1	Elas2	Elas3	Elas4
Palay and Corn	1.00000	1.01210	1.01360	1.01180	1.01240	1.01100
Fruits and Vegetables	1.00000	1.01330	1.01490	1.01310	1.01370	1.01220
Coconut & Sugar	1.00000	1.01290	1.01470	1.01260	1.01320	1.01160
Livestock & Poultry	1.00000	1.01300	1.01460	1.01280	1.01340	1.01190
Fishing	1.00000	1.01200	1.01360	1.01170	1.01240	1.01090
Other Agriculture	1.00000	1.01310	1.01480	1.01300	1.01320	1.01180
Forestry	1.00000	1.02230	1.02420	1.02220	1.02250	1.02090
Mining	1.00000	1.00680	1.00850	1.00700	1.00660	1.00560
Rice & Corn Milling	1.00000	1.01220	1.01380	1.01210	1.01240	1.01100
Milled Sugar	1.00000	1.00650	1.00820	1.00650	1.00660	1.00540
Meat Manufacturing	1.00000	1.01370	1.01520	1.01340	1.01400	1.01250
Fish Manufacturing	1.00000	1.01190	1.01350	1.01150	1.01230	1.01070
Beverage & Tobacco	1.00000	1.01260	1.01440	1.01240	1.01300	1.01140
Other Food Manufacturing	1.00000	1.01310	1.01470	1.01280	1.01340	1.01190
Textile manufacturing	1.00000	1.00830	1.00980	1.00790	1.00870	1.00720
Garments & Leather	1.00000	1.00670	1.00820	1.00610	1.00740	1.00560
Wood Manufacturing	1.00000	1.01380	1.01550	1.01340	1.01430	1.01250
Paper & Paper Products	1.00000	1.01070	1.01240	1.01040	1.01100	1.00940
Chemical Manufacturing	1.00000	1.00830	1.00990	1.00830	1.00840	1.00710
Petroleum Refining	1.00000	1.00590	1.00700	1.00610	1.00570	1.00500
Non-metal manufacturing	1.00000	1.01170	1.01320	1.01160	1.01190	1.01060
Metal Manufacturing	1.00000	1.00680	1.00800	1.00700	1.00670	1.00600
Electrical Equipment Manufacturing	1.00000	1.00350	1.00460	1.00340	1.00370	1.00280
Transport & Other Machinery Manufacturing	1.00000	1.01160	1.01310	1.01180	1.01150	1.01050
Other Manufacturing	1.00000	1.00830	1.00990	1.00820	1.00840	1.00710
Construction	1.00000	1.02070	1.02220	1.02050	1.02090	1.01960
Electricity, Gas and Water	1.00000	1.01030	1.01180	1.01010	1.01050	1.00920
Financial Sector	1.00000	1.01470	1.01640	1.01440	1.01500	1.01340
Private Education	1.00000	1.01490	1.01660	1.01470	1.01530	1.01380
Private Health	1.00000	1.01230	1.01380	1.01210	1.01260	1.01120
Public Education	1.00000	1.01810	1.01990	1.01780	1.01850	1.01680
Public Health	1.00000	1.01500	1.01670	1.01480	1.01530	1.01380
General Government	1.00000	1.01690	1.01860	1.01660	1.01720	1.01560
Other Services	1.00000	1.01300	1.01450	1.01280	1.01330	1.01190

**Change (Relative to Elas0)**

Elas1	Elas2	Elas3	Elas4
0.15%	-0.03%	0.03%	-0.11%
0.16%	-0.02%	0.04%	-0.11%
0.18%	-0.03%	0.03%	-0.13%
0.16%	-0.02%	0.04%	-0.11%
0.16%	-0.03%	0.04%	-0.11%
0.17%	-0.01%	0.01%	-0.13%
0.19%	-0.01%	0.02%	-0.14%
0.17%	0.02%	-0.02%	-0.12%
0.16%	-0.01%	0.02%	-0.12%
0.17%	0.00%	0.01%	-0.11%
0.15%	-0.03%	0.03%	-0.12%
0.16%	-0.04%	0.04%	-0.12%
0.18%	-0.02%	0.04%	-0.12%
0.16%	-0.03%	0.03%	-0.12%
0.15%	-0.04%	0.04%	-0.11%
0.15%	-0.06%	0.07%	-0.11%
0.17%	-0.04%	0.05%	-0.13%
0.17%	-0.03%	0.03%	-0.13%
0.16%	0.00%	0.01%	-0.12%
0.11%	0.02%	-0.02%	-0.09%
0.15%	-0.01%	0.02%	-0.11%
0.12%	0.02%	-0.01%	-0.08%
0.11%	-0.01%	0.02%	-0.07%
0.15%	0.02%	-0.01%	-0.11%
0.16%	-0.01%	0.01%	-0.12%
0.15%	-0.02%	0.02%	-0.11%
0.15%	-0.02%	0.02%	-0.11%
0.17%	-0.03%	0.03%	-0.13%
0.17%	-0.02%	0.04%	-0.11%
0.15%	-0.02%	0.03%	-0.11%
0.18%	-0.03%	0.04%	-0.13%
0.17%	-0.02%	0.03%	-0.12%
0.17%	-0.03%	0.03%	-0.13%
0.15%	-0.02%	0.03%	-0.11%

**Table 8: Sectional Output: Major sectors**

**Change (Relative to Elas0)**

Sectors	Base Run	Elas0	Elas1	Elas2	Elas3	Elas4	Elas1	Elas2	Elas3	Elas4
Agriculture	306,352	306,168	306,203	306,199	306,131	306,133	0.01%	0.01%	-0.01%	-0.01%
Mining	24,330	24,056	24,058	24,070	24,040	24,055	0.01%	0.06%	-0.06%	0.00%
Manufacturing	811,517	804,070	804,113	804,032	804,120	804,054	0.01%	0.00%	0.01%	0.00%
Food Manufacturing	348,532	348,143	348,157	348,162	348,119	348,128	0.00%	0.01%	-0.01%	0.00%
Other Manufacturing	462,985	455,927	455,956	455,870	456,001	455,925	0.01%	-0.01%	0.02%	0.00%
Construction	140,711	144,553	144,525	144,552	144,553	144,573	-0.02%	0.00%	0.00%	0.01%
Utilities	44,061	43,968	43,967	43,968	43,968	43,968	0.00%	0.00%	0.00%	0.00%
Services	703,086	703,350	703,306	703,351	703,350	703,388	-0.01%	0.00%	0.00%	0.01%

**Sectional Output**

**Change (Relative to Elas0)**

Sectors	Base Run	Elas0	Elas1	Elas2	Elas3	Elas4	Elas1	Elas2	Elas3	Elas4
Palay and Corn	66,889	66,777	66,795	66,811	66,740	66,762	0.03%	0.05%	-0.05%	-0.02%
Fruits and Vegetables	59,112	59,123	59,128	59,113	59,133	59,118	0.01%	-0.02%	0.02%	-0.01%
Coconut & Sugar	20,326	20,223	20,225	20,224	20,222	20,221	0.01%	0.00%	-0.01%	-0.01%
Livestock & Poultry	70,737	71,000	70,997	71,006	70,992	71,001	0.00%	0.01%	-0.01%	0.00%
Fishing	50,509	50,337	50,341	50,323	50,351	50,332	0.01%	-0.03%	0.03%	-0.01%
Other Agriculture	25,931	25,811	25,818	25,825	25,797	25,805	0.03%	0.05%	-0.06%	-0.03%
Forestry	12,848	12,897	12,898	12,898	12,896	12,895	0.01%	0.01%	-0.01%	-0.01%
Mining	24,330	24,056	24,058	24,070	24,040	24,055	0.01%	0.06%	-0.06%	0.00%
Rice & Corn Milling	89,213	89,146	89,161	89,173	89,118	89,134	0.02%	0.03%	-0.03%	-0.01%
Milled Sugar	22,853	22,716	22,716	22,719	22,712	22,717	0.00%	0.01%	-0.02%	0.00%
Meat Manufacturing	88,640	88,608	88,605	88,612	88,603	88,610	0.00%	0.01%	-0.01%	0.00%
Fish Manufacturing	15,870	15,805	15,806	15,799	15,811	15,804	0.01%	-0.04%	0.04%	-0.01%
Beverage & Tobacco	26,775	26,749	26,750	26,748	26,749	26,748	0.00%	0.00%	0.00%	0.00%
Other Food Manufacturing	105,181	105,118	105,119	105,111	105,125	105,117	0.00%	-0.01%	0.01%	0.00%
Textile manufacturing	35,028	33,752	33,753	33,702	33,811	33,755	0.00%	-0.15%	0.17%	0.01%
Garments & Leather	52,838	50,247	50,218	50,083	50,441	50,278	-0.06%	-0.33%	0.39%	0.06%
Wood Manufacturing	25,755	25,741	25,750	25,721	25,762	25,733	0.03%	-0.08%	0.08%	-0.03%
Paper & Paper Products	19,398	19,254	19,264	19,252	19,255	19,245	0.06%	-0.01%	0.01%	-0.04%
Chemical Manufacturing	55,067	54,772	54,787	54,784	54,759	54,762	0.03%	0.02%	-0.02%	-0.02%
Petroleum Refining	61,764	61,703	61,704	61,709	61,697	61,703	0.00%	0.01%	-0.01%	0.00%
Non-metal manufacturing	39,903	40,110	40,117	40,109	40,110	40,103	0.02%	0.00%	0.00%	-0.02%
Metal Manufacturing	49,431	49,039	49,067	49,096	48,979	49,017	0.06%	0.12%	-0.12%	-0.04%
Electrical Equipment Manufacturing	46,734	44,566	44,463	44,558	44,563	44,659	-0.23%	-0.02%	-0.01%	0.21%
Transport & Other Machinery Manufacturing	35,010	35,533	35,603	35,612	35,454	35,473	0.20%	0.22%	-0.22%	-0.17%
Other Manufacturing	42,058	41,210	41,231	41,244	41,171	41,197	0.05%	0.08%	-0.10%	-0.03%
Construction	140,711	144,553	144,525	144,552	144,553	144,573	-0.02%	0.00%	0.00%	0.01%
Electricity, Gas and Water	44,061	43,968	43,967	43,968	43,968	43,968	0.00%	0.00%	0.00%	0.00%
Financial Sector	50,377	50,282	50,282	50,284	50,281	50,282	0.00%	0.00%	0.00%	0.00%
Private Education	16,626	16,601	16,599	16,602	16,601	16,603	-0.02%	0.00%	0.00%	0.01%
Private Health	18,806	18,814	18,813	18,814	18,814	18,815	-0.01%	0.00%	0.00%	0.00%
Public Education	28,147	28,145	28,145	28,145	28,145	28,145	0.00%	0.00%	0.00%	0.00%
Public Health	7,637	7,637	7,637	7,637	7,637	7,637	0.00%	0.00%	0.00%	0.00%
General Government	73,738	74,419	74,497	74,405	74,437	74,364	0.10%	-0.02%	0.02%	-0.07%
Other Services	507,755	507,452	507,334	507,464	507,436	507,542	-0.02%	0.00%	0.00%	0.02%

## **Appendix A:**

### **Philippine CGE Model (PCGEM): Model Structure**

# Philippine CGE Model (PCGEM): Model Structure<sup>4</sup>

(Caesar B. Cororaton)

(Note: elements in the brackets ( ) are domains of the variables/operators. For example, pm(it) is defined over it. Also,  $\Sigma_{(j)}$  is the sum over j.

## I. Index of Sectors and Institutions

### 1.A Sectoral Index (i) or (j)

<u>Sector No.</u>	<u>Name</u>	<u>Description</u>
1.	palay-corn	Palay & Corn
2.	fruit-veg	Fruits & Vegetables
3.	coco-suga	Coconut & Sugar
4.	live-poul	Livestock & poultry
5.	fishing--	Fishing
6.	oth-ag-pr	Other Agriculture
7.	forestry-	Forestry
8.	mining---	Mining
9.	Ric-Cn-Mi	Rice & Corn milling
10.	Mill-suga	Milled Sugar
11.	Meat--mfg	Meat Manufacturing
12.	fish--mfg	Fish Manufacturing
13.	bev-tb-mf	Beverage & Tobacco
14.	oth-fd-mf	Other Food Manufacturing
15.	textile-m	Textile Manufacturing
16.	gar-lr-mf	Garments & Leather
17.	wood--mfg	Wood Manufacturing
18.	paper--mf	Paper & Paper products
19.	chem--mfg	Chemicals Manufacturing
20.	petro--re	Petroleum Refining
21.	n-metal-m	Non-Metal Manufacturing
22.	metal-mfg	Metal Manufacturing
23.	elec-eq-m	Electrical Equipment Manufacturing
24.	trans--mf	Transport & other machinery mfg
25.	other-mfg	Other Manufacturing
26.	construc-	Construction
27.	elec-gas-	Electricity gas and water
28.	financial	Financial Sector
29.	pr-edu-se	Private Education
30.	pr-heal-s	Private Health
31.	pub-edu-s	Public Education
32.	pub-heal-	Public Health

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<sup>4</sup>The specification of the model is based on the models of Decaluwé, Dumot and Robichaud (2000), "MIMAP Training Session on CGE Modeling, Volume II". Special thanks goes to Véronique Robichaud who carefully examined the model and suggested ways of improving it. The usual disclaimer applies.

33.	gen-gv-se	General Government
34.	other-ser	Other Services

## **I.B Other Sectoral Indices**

1. (it) - all sectors in (i) except 31, 32, and 33
2. (in) - only sectors 31, 32, and 33
3. (ag) - sectors 1 to 7
4. (nag) - sectors 8 to 34
5. (w\_vk) - all sectors except 10, 20, 23, 24, 27, 31, 32, 33
6. (n\_vk) - sectors 10, 20, 23, 24, 27, 31, 32, 33
7. (ag\_vk)- same as (ag)
8. (nag\_vk)- all (nag) except 10, 20, 23, 24, 27, 31, 32, 33
9. (alxpubhlt) - all sectors except 32

## **I.C Index of Institutions**

- i Index (inst)
  1. hh1 - first decile
  2. hh2 - second decile
  3. hh3 - third decile
  4. hh4 - fourth decile
  5. hh5 - fifth decile
  6. hh6 - sixth decile
  7. hh7 - seventh decile
  8. hh8 - eighth decile
  9. hh9 - ninth decile
  10. hh10 - tenth decile
  11. un - unincorporated enterprises
  12. pr - private corporations
  13. gv - government
- ii. Index (inst1) - all institutions except government.
- iii. Index (inst2) - same as index (inst1)

## **II. Equations**

### **II.A Prices**

	<b><u>No. of Equations</u></b>
(1) Import prices $pm(it) = pwm(it) *er* [1 + tm(it)]$	(31)
(2) Export prices $pe(it)* [1 + te(it)] = pwe(it)*er$	(31)
(3) Composite price, tradables $p(it) *x(it) = pd(it) *xxd(it) + pm(it) *imp(it)$	(31)
(4) Composite price, non-tradables	

$$p(in) = pd(in) \quad (3)$$

(5) Sales prices, tradables  
 $px(it)*xd(it) = p1(it)*xxd(it) + pe(it)*exp(it) \quad (31)$

(6) Sales prices, non-tradables  
 $px(in) = p1(in) \quad (3)$

(7) Domestic prices  
 $pd(i) = p1(i)*[1 + itxrdom(i)] \quad (34)$

(8) Value added prices  
 $pva(i)*va(i) = px(i)*xd(i) - \sum_{(j)} [id(j,i)*p(j)] \quad (34)$

(9) Capital good prices  
 $pk(i) = p(i) \quad (34)$

(10) GDP deflator  
 $pindex = \sum_{(i)} [pwts(i)*pva(i)] \quad (1)$

## II.B Output and Factors of Production

(11) Supply  
 $xd(i)*vt(i) = va(i) \quad (34)$

(12) Vector sums of intermediate inputs  
 $ri(i) = inp(i)*xd(i) \quad (34)$

(13) Matrix of intermediate inputs  
 $id(i,j) = aij(i,j)*ri(j) \quad (1,156)$

(14) Production in sectors with variable capital  
 $va(w\_vk) = ad(w\_vk)*l(w\_vk)^{\alpha(w\_vk)}*v(w\_vk)^{\beta(w\_vk)}*k(w\_vk)^{\gamma(w\_vk)} \quad (26)$

(15) Production in sectors without variable capital  
 $va(n\_vk) = ad(n\_vk)*l(n\_vk)^{\alpha(n\_vk)}*k(n\_vk)^{\gamma(n\_vk)} \quad (8)$

(16) Demand for labor  
 $l(i)*wage = va(i)*pva(i)*\alpha(i) \quad (34)$

(17) Demand for variable capital  
 $v(w\_vk)*rvk = va(w\_vk)*pva(w\_vk)*\beta(w\_vk) \quad (26)$

(18) Return to capital in sectors with variable capital  
 $rkap(w\_vk)*k(w\_vk) = pva(w\_vk)*va(w\_vk) - wage*l(w\_vk) - rvk*v(w\_vk) \quad (26)$

(19) Return to capital in sectors without variable capital  
 $rkap(n\_vk)*k(n\_vk) = pva(n\_vk)*va(n\_vk) - wage*l(n\_vk) \quad (8)$



## II.C Exports and Imports

(20) CET (exports and domestic)  

$$xd(it) = at(it) * [theta(it) * exp(it)^{kappa_e(it)} + \{1 - theta(it)\} * xxd(it)^{kappa_e(it)}]^{1/kappa_e(it)} \quad (31)$$

(21) Sectors with zero exports  

$$xd(in) = xxd(in) \quad (3)$$

(22) Export supply  

$$exp(it) = xxd(it) * \{pe(it)/p1(it) * [1 - theta(it)]/theta(it)\}^{tau_e(it)} \quad (31)$$

(23) Armington assumption  

$$x(it) = ac(it) * [\delta(it) * imp(it)^{-rho_m(it)} + \{1 - \delta(it)\} * xxd(it)^{-rho_m(it)}]^{-1/rho_m(it)} \quad (31)$$

(24) Sectors with zero imports  

$$x(in) = xxd(in) \quad (3)$$

(25) Demand for imports  

$$imp(it) = xxd(it) * ([pd(it)/pm(it)] * [\delta(it)/\{1 - \delta(it)\}])^{sigma_m(it)} \quad (31)$$

## II.D Income and Savings

(26) Labor income in agriculture  

$$ylbag = wage * \sum_{(ag)} l(ag) \quad (1)$$

(27) Labor income in non-agriculture  

$$ylbnag = wage * \sum_{(nag)} l(nag) \quad (1)$$

(28) Variable capital income in agriculture  

$$yvkag = rvk * \sum_{(ag\_vk)} [v(ag\_vk)] \quad (1)$$

(29) Variable capital income in non agriculture  

$$yvk nag = rvk * \sum_{(nag\_vk)} [v(nag\_vk)] \quad (1)$$

(30) Total capital income; net of depreciation  

$$ykap = \sum_{(i)} [rkap(i) * k(i) - depr(i) * k(i) * pk(i)] \quad (1)$$

(31) Income of institutions except government  

$$\begin{aligned} pri\_inc(inst1) = & dylbag(inst1) * ylbag + dylbnag(inst1) * ylbnag \\ & + dylbocw(inst1) * er * ww * ocw + dyvkag(inst1) * yvkag \\ & + dyvknag(inst1) * yvknag + dykap(inst1) * ykap \\ & + \sum_{(inst2)} [secdinc(inst1, inst2) * pri\_inc(inst2)] \\ & + gv\_tran(inst1) + er * for\_tran(inst1) \end{aligned} \quad (12)$$

(32) Income of government  

$$\begin{aligned} gv\_inc = & \sum_{(it)} [tm(it) * imp(it) * pwm(it) * er] \\ & + \sum_{(it)} [te(it) * exp(it) * pe(it)] + \sum_{(i)} [itxrdom(i) * p1(i) * xxd(i)] \\ & + dykap("gv") * ykap + \sum_{(inst1)} [dtaxr(inst1) * pri\_inc(inst1)] \\ & + gv\_dtax + er * for\_tran("gv") \end{aligned} \quad (1)$$

(33) Disposable income of institutions except government  

$$\text{dispy}(\text{inst1}) = \text{pri\_inc}(\text{inst1}) * [1 - \text{dtaxr}(\text{inst1})] \quad (12)$$

(34) Savings of institutions except government  

$$\begin{aligned} \text{pri\_save}(\text{inst1}) &= \text{pri\_inc}(\text{inst1}) * [1 - \text{dtaxr}(\text{inst1})] - \\ &\Sigma_{(i)} [\text{pri\_cc}(\text{inst1}, i) * p(i)] - \Sigma_{(\text{inst2})} [\text{secdinc}(\text{inst2}, \text{inst1}) * \text{pri\_inc}(\text{inst1})] \\ &- \text{er} * \text{for\_pay}(\text{inst1}) \end{aligned} \quad (12)$$

(35) Savings of government or government budget account  

$$\begin{aligned} \text{gv\_save} &= \text{gv\_inc} - \Sigma_{(i)} [\text{gv\_cc}(i) * p(i)] - \text{er} * \text{for\_pay}(\text{"gv"}) \\ &- \text{gv\_dtax} - \Sigma_{(\text{inst2})} [\text{secdinc}(\text{inst2}, \text{"gv"}) * \text{gv\_inc}] \end{aligned} \quad (1)$$

## II.E Demand

(36) Intermediate demand  

$$\text{int}(i) = \Sigma_{(j)} [\text{id}(i, j)] \quad (34)$$

(37) Consumption of institutions except government  

$$\text{pri\_cc}(\text{inst1}, i) * p(i) = \text{dccmt}(\text{inst1}, i) * \text{apc}(\text{inst1}) * \text{dispy}(\text{inst1}) \quad (408)$$

(38) Sectoral investment  

$$\text{inv}(i) * p(i) = \text{dinv}(i) * \{ \text{tinv} - \Sigma_{(j)} [\text{chstk}(j) * p(j)] \} \quad (34)$$

## II.F Equilibrium conditions

### II.F.1 Macroeconomic equilibrium conditions

(39) Balance of payments  

$$\begin{aligned} \text{cab} &= \Sigma_{(it)} [\text{pwm}(it) * \text{imp}(i) - \text{pwe}(it) * \text{exp}(it)] - \text{ww} * \text{ocw} + (1/\text{er}) * \text{wage} * \text{for\_lb} \\ &+ \Sigma_{(\text{inst})} \text{for\_pay}(\text{inst}) - \Sigma_{(\text{inst})} \text{for\_tran}(\text{inst}) \end{aligned} \quad (1)$$

(40) Total savings is total investible funds  

$$\begin{aligned} \text{tinv} &= \Sigma_{(\text{inst1})} \text{pri\_save}(\text{inst1}) + \text{gv\_save} + \text{cab} * \text{er} \\ &+ \Sigma_{(i)} [\text{depr}(i) * k(i) * \text{pk}(i)] \end{aligned} \quad (1)$$

### II.F.2 Factor market equilibrium conditions

(41) Labor market equilibrium  

$$\text{suplbg} + \text{suplbnag} + \text{for\_lb} = \Sigma_{(i)} l(i) \quad (1)$$

(42) Variable capital market equilibrium  

$$\text{supvkag} + \text{supvknag} = \Sigma_{(w\_vk)} v(w\_vk) \quad (1)$$

### II.F.3 Product market equilibrium conditions

(43) Product market equilibrium except in general government service sector  

$$\text{x}(\text{alxpubhlt}) = \text{int}(\text{alxpubhlt}) + \Sigma_{(\text{inst1})} [\text{pri\_cc}(\text{inst1}, \text{alxpubhlt})]$$

$$+gv\_cc(alxpubhlt) + inv(alxpubhlt) + chstk(alxpubhlt) \quad (33)$$

- (44) (44) Walras law applied to general government service sector  
 $walras = x("gen-gv-se") - int("gen-gv-se ") - \sum_{(inst1)} pri\_cc(inst1, "gen-gv-se ") - gv\_cc("gen-gv-se ") - inv("gen-gv-se ") - chstk("gen-gv-se ") \quad (1)$

**Total No. of Equations: 2,272**

### III. Endogenous Variables

		<b>No. of Variables</b>
<b>III.A Output and Input Prices</b>		
pm(it)	domestic price of imports for tradables	31
pe(it)	domestic price of exports	31
p(i)	composite prices	34
pd(i)	domestic prices	34
p1(i)	domestic prices without domestic indirect taxes	34
px(i)	sales prices	34
pk(i)	capital good prices	34
pva(i)	value added prices	34
pindex	price index also called GDP deflator	1
wage	average wage rate	1
rvk	average return to variable capital	1
rkap(i)	sectoral return to capital	34
<b>III.B Output, Value Added, and Trade Variables</b>		
x(i)	composite commodities	34
xxd(i)	xd less exports	34
xd(i)	column sums in the SAM less imports	34
va(i)	value added	34
ri(i)	vector sums of intermediate inputs	34
id(i,j)	matrix of intermediate inputs	1,156
imp(it)	imports	31
exp(it)	exports	31
<b>III.C Factor Inputs</b>		
l(i)	demand for labor	34
v(w_vk)	demand for variable capital	26
k(i)	demand for capital	34
<b>III.D Income and Savings</b>		
ylbag	labor income in agriculture	1
ylbnag	labor income in non agriculture	1
yvkag	variable capital income in agriculture	1
yvknag	variable capital income in agriculture	1
ykap	capital income except govt	1
pri_inc(inst1)	income of institutions	12
gv_inc	income of govt	1
dispy(inst1)	disposable income of institutions	12

pri_save(inst1)	savings of institutions except govt	12
gv_save	savings of government	1
tinv	total investible funds equal to total savings	1

### III.E Demand

int(i)	intermediate demand	34
pri_cc(inst1,i)	consumption demand of institutions except govt	408
inv(i)	sectoral investments	34

### III.F Walras Law

walras	variable to capture walras law	1
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**Total No. of Endogenous Variables: 2,272**

## IV. Exogenous Variables

### No. of Variables

### IV.A Prices

pwm(it)	world prices of imports	(31)
pwe(it)	world prices of exports	(31)
ww	international wage rate	(1)

### IV.B Taxes

tm(it)	tariff rates	(31)
te(it)	export tax or subsidies	(31)
itxrdom(i)	domestic indirect tax rates	(34)
dtaxr(inst1)	direct income tax rates	(12)
gv_dtax	value of direct income tax	(1)

### IV.C Factors of Production

k(i)	demand for capital	(34)
suplbag	total supply of agriculture labor	(1)
suplbnag	total supply of non agriculture labor	(1)
ocw	overseas contract workers	(1)
supvkag	total supply of variable capital in agriculture	(1)
supvknag	total supply of variable capital in non agriculture	(1)
for_lb	foreigners working in the Philippines	(1)

### IV.D Income and Savings

depr(i)	depreciation rate	(34)
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### IV.E Demand

chstk(i)	sectoral change in stocks	(34)
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### IV.F Transfers

for_tran(inst)	foreign transfers to institutions	(13)
for_pay(inst)	interest payments to ROW	(13)
gv_tran(inst1)	government transfers to institutions	(12)

#### IV.G Closure

er	nominal exchange rate is numeraire:	(1)
gv_cc(i)	government consumption is fixed and government budget balance is endogenous:	(34)
cab	current account balance is fixed	(1)

**Total Number of Exogenous Variables: 354**

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#### V. Parameters

		No. of Parameters
pwts(i)	gross value added weights	(34)
vt(i)	value added coefficients	(34)
inp(i)	intermediate input coefficients	(34)
aij(i,j)	leontief Input-Output coefficients	(1156)
ad(i)	shift parameters in production function	(34)
alpha(i)	share of labor	(34)
beta(i)	share of variable capital in agriculture	(34)
sigma(l )	share of capital in agriculture	(34)
at(it)	shift parameter in CET	(31)
gamma(it)	share parameter in CET	(31)
rhot(it)	elasticity of transformation	(31)
ac(it)	shift parameter in armington function	(31)
delta(it)	share parameter in armington function	(31)
rhoc(it)	elasticity of substitution: imports and local goods	(31)
dylbag(inst1)	distribution of agriculture income	(12)
dylbnag(inst1)	distribution of non agriculture income	(12)
dylbocw(inst1)	distribution of ocw income	(12)
dyvkag(inst1)	distribution of variable capital income in agri	(12)
dyvknag(inst1)	distribution of variable capital income in non agri	(12)
dykap(inst1)	distribution of capital income	(12)
secdinc(inst1,inst)	distribution of secondary income	(156)
dccmt(inst1,i)	distribution of consumption goods	(408)
apc(inst1)	average propensity consumption to	(12)
dinv(i)	distribution of investment	(34)

**Total No. of Parameters: 2,262**

## **Appendix B:**

### **Philippine CGE Model (PCGEM): GAMS Codes**

**(See Author)**

## **Appendix C:**

### **Philippine CGE Model (PCGEM): Output File**

\*\*PCGEM Model (scenario: base run)\*\*

\*\*\* output variables \*\*\*

	x	xd	xxd	va
palay-c	68.9321	66.8889	66.8594	52.1220
fruit-v	56.4363	59.1119	54.1586	47.6420
coco-su	20.2515	20.3262	19.8936	17.9580
live-po	71.5935	70.7370	70.1092	45.0930
fishing	45.4950	50.5091	44.0644	40.2910
oth-ag-	30.9280	25.9310	23.2206	18.6110
forestr	13.3772	12.8482	12.3603	8.6890
mining-	53.5326	24.3302	17.7159	16.0390
Ric-Cn-	92.8818	89.2128	89.0459	22.6560
Mill-su	20.1975	22.8530	19.7031	7.7480
Meat--m	89.7698	88.6400	88.6193	22.0740
fish--m	14.0678	15.8701	13.7542	6.4520
bev-tb-	31.4949	26.7752	25.5843	15.3290
oth-fd-	113.2357	105.1810	97.9618	39.6890
textile	45.4653	35.0280	27.6380	5.7080
gar-lr-	30.2828	52.8375	14.7094	14.1590
wood--m	21.1783	25.7551	20.1413	9.3490
paper--	20.5241	19.3982	14.8770	4.9300
chem--m	80.9576	55.0671	49.5467	15.1010
petro--	68.9099	61.7638	56.1538	13.5910
n-metal	44.0618	39.9028	36.8582	8.7390
metal-m	75.0782	49.4309	41.2863	7.9710
elec-eq	50.0313	46.7342	11.6231	7.0770
trans--	72.1256	35.0098	31.5460	4.1850
other-m	31.5143	42.0575	14.7962	4.3730
constru	141.4707	140.7110	140.4913	64.1420
elec-ga	42.5458	44.0611	42.1387	21.8970
financi	59.9004	50.3772	47.3694	35.8050
pr-edu-	16.7814	16.6259	16.6154	10.0910
pr-heal	19.0488	18.8056	18.3597	9.3860
pub-edu	28.1468	28.1468	28.1468	24.0520
pub-hea	7.6371	7.6371	7.6371	4.2350
gen-gv-	73.7383	73.7383	73.7383	48.7340
other-s	525.9886	507.7553	394.4014	315.4230

\*\*\* trade variables \*\*\*

	imports	exports	pm	pe
palay-c	1.3337	0.0295	1.2497	1.0000
fruit-v	1.2456	4.9533	1.3725	1.0000
coco-su	0.0459	0.4326	4.0588	1.0000
live-po	0.6038	0.6278	1.6575	1.0000
fishing	0.9972	6.4447	1.1955	1.0000
oth-ag-	6.9521	2.7104	1.0489	1.0000
forestr	0.8574	0.4879	1.0840	1.0000
mining-	34.9338	6.6143	1.0114	1.0000
Ric-Cn-	3.5379	0.1669	1.0379	1.0000
Mill-su	0.0538	3.1499	4.6989	1.0000
Meat--m	0.5702	0.0207	1.4577	1.0000
fish--m	0.1184	2.1159	1.7432	1.0000
bev-tb-	1.4011	1.1909	2.4481	1.0000
oth-fd-	10.6915	7.2192	1.1928	1.0000
textile	13.1284	7.3900	1.1611	1.0000
gar-lr-	9.8235	38.1281	1.2634	1.0000
wood--m	0.4270	5.6138	1.6440	1.0000
paper--	4.6884	4.5212	1.0921	1.0000
chem--m	27.9517	5.5204	1.0557	1.0000
petro--	4.3349	5.6100	1.8743	1.0000



n-metal	5.3980	3.0446	1.1506	1.0000
metal-m	30.1212	8.1446	1.0548	1.0000
elec-eq	34.2834	35.1111	1.0541	1.0000
trans--	35.6524	3.4638	1.0622	1.0000
other-m	14.2129	27.2613	1.0793	1.0000
constru	0.2015	0.2197	1.0000	1.0000
elec-ga	0.0026	1.9224	1.0000	1.0000
financi	9.8724	3.0078	1.0000	1.0000
pr-edu-	0.0049	0.0105	1.0000	1.0000
pr-heal	0.3417	0.4459	1.0000	1.0000
other-s	104.7958	113.3539	1.0000	1.0000

\*\*\* price variables \*\*\*

	p	pd	px	pl	pva
palay-c	1.0000	1.0061	1.0000	1.0000	1.0000
fruit-v	1.0000	1.0105	1.0000	1.0000	1.0000
coco-su	1.0000	1.0086	1.0000	1.0000	1.0000
live-po	1.0000	1.0069	1.0000	1.0000	1.0000
fishing	1.0000	1.0054	1.0000	1.0000	1.0000
oth-ag-	1.0000	1.0179	1.0000	1.0000	1.0000
forestr	1.0000	1.0071	1.0000	1.0000	1.0000
mining-	1.0000	1.0274	1.0000	1.0000	1.0000
Ric-Cn-	1.0000	1.0018	1.0000	1.0000	1.0000
Mill-su	1.0000	1.0123	1.0000	1.0000	1.0000
Meat--m	1.0000	1.0036	1.0000	1.0000	1.0000
fish--m	1.0000	1.0078	1.0000	1.0000	1.0000
bev-tb-	1.0000	1.0970	1.0000	1.0000	1.0000
oth-fd-	1.0000	1.0257	1.0000	1.0000	1.0000
textile	1.0000	1.0935	1.0000	1.0000	1.0000
gar-lr-	1.0000	1.2150	1.0000	1.0000	1.0000
wood--m	1.0000	1.0166	1.0000	1.0000	1.0000
paper--	1.0000	1.0354	1.0000	1.0000	1.0000
chem--m	1.0000	1.0384	1.0000	1.0000	1.0000
petro--	1.0000	1.0825	1.0000	1.0000	1.0000
n-metal	1.0000	1.0269	1.0000	1.0000	1.0000
metal-m	1.0000	1.0489	1.0000	1.0000	1.0000
elec-eq	1.0000	1.1952	1.0000	1.0000	1.0000
trans--	1.0000	1.0859	1.0000	1.0000	1.0000
other-m	1.0000	1.0931	1.0000	1.0000	1.0000
constru	1.0000	1.0055	1.0000	1.0000	1.0000
elec-ga	1.0000	1.0096	1.0000	1.0000	1.0000
financi	1.0000	1.0561	1.0000	1.0000	1.0000
pr-edu-	1.0000	1.0097	1.0000	1.0000	1.0000
pr-heal	1.0000	1.0189	1.0000	1.0000	1.0000
pub-edu	1.0000	1.0000	1.0000	1.0000	1.0000
pub-hea	1.0000	1.0000	1.0000	1.0000	1.0000
gen-gv-	1.0000	1.0000	1.0000	1.0000	1.0000
other-s	1.0000	1.0679	1.0000	1.0000	1.0000

\*\*\* factor inputs and rent to capital \*\*\*

	labor	var_cap	capital	rkap
palay-c	2.6510	48.7220	0.7490	1.0000
fruit-v	8.4740	35.7880	3.3800	1.0000
coco-su	6.7620	3.8500	7.3460	1.0000
live-po	6.2890	36.5790	2.2250	1.0000
fishing	4.7160	27.2430	8.3320	1.0000
oth-ag-	6.9400	5.7250	5.9460	1.0000
forestr	1.8440	0.7520	6.0930	1.0000
mining-	6.5330	1.0980	8.4080	1.0000
Ric-Cn-	2.6080	6.0350	14.0130	1.0000
Mill-su	1.6910	0.0000	6.0570	1.0000

Meat--m	4.6200	3.9990	13.4550	1.0000
fish--m	0.9870	2.9570	2.5080	1.0000
bev-tb-	2.9090	0.8110	11.6090	1.0000
oth-fd-	7.5160	7.2890	24.8840	1.0000
textile	2.7650	1.3080	1.6350	1.0000
gar-lr-	4.5230	6.1960	3.4400	1.0000
wood--m	2.3770	3.2130	3.7590	1.0000
paper--	1.6080	0.9430	2.3790	1.0000
chem--m	3.7250	1.1940	10.1820	1.0000
petro--	1.0990	0.0000	12.4920	1.0000
n-metal	2.6880	2.1560	3.8950	1.0000
metal-m	2.7580	1.5080	3.7050	1.0000
elec-eq	3.9060	0.0000	3.1710	1.0000
trans--	2.2110	0.0000	1.9740	1.0000
other-m	0.8020	1.1700	2.4010	1.0000
constru	34.3980	6.9140	22.8300	1.0000
elec-ga	4.9980	0.0000	16.8990	1.0000
financi	12.7730	0.6460	22.3860	1.0000
pr-edu-	6.2430	2.1110	1.7370	1.0000
pr-heal	2.3730	5.7790	1.2340	1.0000
pub-edu	23.4340	0.0000	0.6180	1.0000
pub-hea	4.0290	0.0000	0.2060	1.0000
gen-gv-	46.7910	0.0000	1.9430	1.0000
other-s	51.8020	157.0720	106.5490	1.0000

\*\*\* other components of demand \*\*\*

	int	pri_cc	inv	gv_cc	chstk
palay-c	68.5636	0.3685	0.0000	0.0000	0.0000
fruit-v	9.6084	42.1832	4.6503	0.0000	-0.0056
coco-su	19.0088	1.2072	0.0285	0.0000	0.0070
live-po	50.1917	13.7675	7.9787	0.0000	-0.3444
fishing	7.9874	37.5076	0.0000	0.0000	0.0000
oth-ag-	24.9490	5.8632	0.1189	0.0000	-0.0031
forestr	9.1909	3.5836	0.3462	0.0000	0.2565
mining-	51.8944	1.3033	0.1922	0.0000	0.1427
Ric-Cn-	19.0138	74.4545	0.0000	0.0000	-0.5865
Mill-su	11.9601	8.2644	0.0282	0.0000	-0.0552
Meat--m	13.3108	76.3282	0.1280	0.0000	0.0028
fish--m	1.7171	12.3085	0.0115	0.0000	0.0307
bev-tb-	6.0421	24.9654	0.0000	0.0000	0.4874
oth-fd-	32.6538	80.1819	0.1400	0.0000	0.2600
textile	42.4764	2.7235	0.0852	0.0000	0.1802
gar-lr-	8.2819	21.5900	0.0027	0.0000	0.4082
wood--m	12.5192	8.0055	0.2090	0.0000	0.4446
paper--	16.6448	3.3336	0.0014	0.0000	0.5443
chem--m	69.8791	10.0872	0.0742	0.0000	0.9171
petro--	63.0831	1.9005	0.0001	0.0000	3.9262
n-metal	33.5147	10.0944	0.1371	0.0000	0.3156
metal-m	71.7446	2.3585	0.3261	0.0000	0.6490
elec-eq	25.4256	13.6310	10.6517	0.0000	0.3230
trans--	21.5037	3.2221	47.0718	0.0000	0.3280
other-m	18.8811	7.7271	4.6053	0.0000	0.3008
constru	9.0426	2.0956	130.3310	0.0000	0.0015
elec-ga	32.1727	9.9792	0.3930	0.0000	0.0009
financi	53.1933	6.7060	0.0000	0.0000	0.0011
pr-edu-	0.2273	16.5539	0.0000	0.0000	0.0002
pr-heal	2.5006	16.5417	0.0000	0.0000	0.0065
pub-edu	0.0000	0.3780	0.0000	27.7688	0.0000
pub-hea	0.0000	0.3040	0.0000	7.3331	0.0000
gen-gv-	0.0000	0.0050	0.0000	73.7333	0.0000
other-s	233.5342	248.3418	41.4411	0.0000	2.6715

\*\*\* savings and consumption of institutions except government \*\*\*

	savings	consumption
hh1	-1.3030	19.3330
hh2	1.7950	28.4418
hh3	2.4280	35.9901
hh4	5.1160	42.2869
hh5	6.1290	49.7946
hh6	7.6400	60.4287
hh7	8.1180	73.1850
hh8	9.5620	92.9307
hh9	14.0060	124.4689
hh10	57.1760	238.3260
un	-3.4280	2.6799
pr	26.3270	0.0000

\*\*\* income of institutions except government \*\*\*

	pri_inc	dispy	ylbag	ylbnag	ylbocw
hh1	18.1710	18.0470	2.3120	0.9610	0.1640
hh2	30.4808	30.2668	3.9840	2.4090	0.4120
hh3	38.7201	38.4891	4.6170	4.3310	0.7400
hh4	47.8439	47.4679	5.1540	6.6210	1.1310
hh5	56.5156	56.0096	4.5620	10.3970	1.7760
hh6	69.1637	68.1997	4.7870	16.0820	2.7470
hh7	83.3140	81.5080	3.8100	24.6950	4.2180
hh8	106.1587	102.8097	3.6470	34.1060	5.8250
hh9	145.8239	138.9939	2.4500	49.6670	8.4830
hh10	330.9620	299.9280	2.3530	92.7770	15.8470
un	143.0499	141.1019	0.0000	0.0000	0.0000
pr	172.0750	142.1580	0.0000	0.0000	0.0000

\*\*\* other components of income of institutions \*\*\*

	yvkag	yvknag	ykap	secondinc	othinc
hh1	8.5540	1.8610	0.0000	3.6700	0.6490
hh2	13.1220	3.3490	0.0000	6.1360	1.0688
hh3	15.1650	4.8590	0.0000	7.7550	1.2531
hh4	17.9420	6.5240	0.0000	9.0050	1.4669
hh5	18.7230	8.6570	0.0000	10.6190	1.7816
hh6	18.4490	12.7440	0.0000	11.3340	3.0207
hh7	16.8930	15.0810	0.0000	13.9900	4.6270
hh8	14.7140	20.6030	0.0000	17.9870	9.2767
hh9	14.2560	32.9230	0.0000	26.8640	11.1809
hh10	20.8410	105.7980	0.0000	69.4400	23.9060
un	0.0000	0.0000	135.6190	5.2270	2.2039
pr	0.0000	0.0000	92.0190	63.2580	16.7980

\*\*\* components of government revenue \*\*\*

gv_inc	225.6880
tm_rev	25.5324
itx_rev	62.3406
dtx_rev	77.2990
gv_save	-7.5640

\*\*\* other relevant variables \*\*\*

rgdp	989.3410
pindex	1.0000
wage	1.0000
rvk	1.0000
rer	1.0000
bot	-59.6500
walras	0.0000

\*\*\* definition of terms \*\*\*

\*\*\* sectors \*\*\*

palay-corn	Palay & Corn
fruit-veg	Fruits & Vegetables
coco-suga	Coconut & Sugar
live-poul	Livestock & poultry
fishing--	Fishing
oth-ag-pr	Other Agriculture
forestry-	Forestry
mining---	Mining
Ric-Cn-Mi	Rice & Corn milling
Mill-suga	Milled Sugar
Meat--mfg	Meat Manufacturing
fish--mfg	Fish Manufacturing
bev-tb-mf	Beverage & Tobacco
oth-fd-mf	Other Food Manufacturing
textile-m	Textile Manufacturing
gar-lr-mf	Garments & Leather
wood--mfg	Wood Manufacturing
paper--mf	Paper & Paper products
chem--mfg	Chemicals Manufacturing
petro--re	Petroleum Refining
n-metal-m	Non-Metal Manufacturing
metal-mfg	Metal Manufacturing
elec-eq-m	Electrical Equipment Manufacturing
trans--mf	Transport & other machinery manufacturing
other-mfg	Other Manufacturing
construc-	Construction
elec-gas-	Electricity gas and water
financial	Financial Sector
pr-edu-se	Private Education
pr-heal-s	Private Health
pub-edu-s	Public Education
pub-heal-	Public Health
gen-gv-se	General Government
other-ser	Other Services

\*\*\* institutions \*\*\*

hh1	first decile
hh2	second decile
hh3	third decile
hh4	fourth decile
hh5	fifth decile
hh6	sixth decile
hh7	seventh decile
hh8	eight decile
hh9	ninth decile
hh10	tenth decile
un	unincorporated enterprises
pr	private corporations
gv	government

\*\*\* variables \*\*\*

pm	domestic price of imports for tradables
pe	domestic price of exports
rer	real exchange rate (base value is 1)

p composite prices  
pd domestic prices  
pl domestic prices without domestic indirect taxes  
px sales prices  
pva value added prices  
pindex price index also called GDP deflator  
wage average wage rate  
rvk average returns to variable capital  
rkap sectoral returns to capital  
itx\_rev govt revenue from domestic indirect tax  
dtx\_rev govt revenue from direct income tax  
x composite commodities - domestic production and imports  
xxd xd less exports  
xd domestic production  
va value added  
rgdp real gdp  
imports imports  
exports exports  
bot balance of trade (exports less imports)  
labor labor  
var-cap variable capital  
capital capital  
ylbag labor income in agriculture  
ylbnag labor income in non agriculture  
ylbocw labor income from ocw  
yvkag variable capital income in agriculture  
yvknap variable capital income in agriculture  
ykap capital income except govt  
pri\_inc income of institutions except government  
secondinc secondary income of institutions except govt  
othinc other incomes of institutions except govt  
gv\_inc income of govt  
dispy disposable income of institutions  
savings savings of institutions except govt  
consumption consumption of institutions except government  
gv\_save savings of government or government balance  
int intermediate demand  
pri\_cc sectoral consumption demand of institutions except govt  
gv\_cc consumption of government  
inv sectoral investment  
chstk sectoral change in stocks  
walras walras variable

\*\*\* end of file \*\*\*