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## Rice reforms and poverty in the Philippines: A CGE analysis

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ADB Institute Discussion Paper No.8

Rice Reforms and Poverty in the Philippines: A CGE Analysis

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## Abstract

The quantitative restriction (QR) on rice will last until the end of 2004. The paper employs a computable general equilibrium (CGE) model to analyze the possible poverty and distributional effects of the removal of QR and the reduction in tariff on rice imports. Policy experiments indicate that while market reforms in rice lead to a reduction in the overall headcount poverty index, both the poverty gap and the squared poverty gap indices increase. The Gini coefficient increases as well. In general, these results imply that the poorest of the poor are adversely affected. In particular, while market reforms in rice bring about a reduction in consumer prices that is favorable to all, imports of rice surge and generate displacement effects on poor households that rely heavily on agriculture for factor incomes, particularly on palay rice production and other related activities. Palay production and its output price decline. This translates to lower demand for factor inputs in the sector, lower factor prices in agriculture, and lower factor incomes for these households. Thus, poverty in these groups, as well as the general income inequality, deteriorates. However, the results of the experiments involving various poverty-offsetting measures indicate that an increase in direct government transfers to these household groups can provide a better safety net.

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## I. Introduction

The Philippines is one of the three countries granted exemption in 1995 from the removal of quantitative restriction (QR) on rice under Annex 5 of the World Trade Organization (WTO) agreement. Japan and South Korea are the other two countries. The exemption will expire on December 31, 2004. The primary objective of the paper is to look at the possible poverty and distributional effects of the removal of the QR and the reduction in tariffs on rice imports. In particular, the paper attempts to analyze the following issues: (a) Do the poor share in the potential gains from a freer market for rice? (b) What alternative or accompanying policy measures may be needed to ensure a more equitable distribution of the potential gains from a more liberalized market for rice? (c) What is the transmission mechanism in which the removal of the control may affect the poor? These are some critical issues that the government may have to address as it implements market reform and opens the economy for imported rice.

Rice is the staple food of about 80 percent of Filipinos, and therefore a major item in the consumption basket of consumers. It is the single most important agricultural crop in the Philippines, and therefore a major source of income of millions of Filipino farmers. Because of its political significance, the government is heavily involved both in the supply and distribution of rice to assure consumers sufficient and stable supply of rice at low prices and to maintain a reasonable return to rice farmers with adequate price incentives. One major policy instrument of the government at present is the control on imported rice through QR.

A market reform in general and a removal of QR on rice in particular could have economy-wide effects. In this regard, it is appropriate to analyze these types of issues using a computable general equilibrium (CGE) model calibrated to national accounting data. On the other hand, it is appropriate to study the effects of reforms on poverty and income distribution using individual household data to capture the heterogeneity of households. The paper integrates these two approaches. In particular, it specifies and calibrates an agriculture-focused CGE model to a set of actual data and simulates the effects of the removal of the QR on consumer prices and household income, and applies these results to a set of individual household data in the Family Income and Expenditure Survey (FIES) to compute the poverty and income distribution effects.

A number of studies in the Philippines have looked at policy issues concerning rice, but the methodology applied is mostly partial equilibrium analysis. Partial equilibrium analysis however underestimates the possible effects of the reforms because rice, being a major agricultural crop, has many direct and indirect linkages with the rest of the economy. Furthermore, most of the empirical work done does not extend the analysis to look at the impact on poverty. While existing literature provides estimates of changes in consumer and producer surpluses, as well as the Gini coefficient, it does not provide insights on the effects on poverty and on the depth of poverty. This paper addresses this methodological gap in the literature.

In the CGE literature there are two broad approaches to integrating a CGE model with a national household survey to analyze poverty and distributional issues. One approach is through microsimulation wherein the household categories in the model are the same as the household categories in the national household survey. As such, this approach allows for the heterogeneity of individual households during the numerical computation of the equilibrium of the model. The papers of Cogneau and Robillard (2000), Cockburn (2001), and Cororaton and Cockburn (2004) employed this approach.

The other approach is more of a recursive type. For a given policy shock, a CGE model with representative households is used to estimate the change in the average income for each household category and the change in prices. These changes are then applied to an

assumed income distribution of each household category (either lognormal or beta distribution) to conduct poverty and distributional analyses. The variance and other parameters of the distribution are estimated using data from the national household survey and are assumed fixed in the analyses, while the first moment of the distribution is altered using the results from the CGE model. The papers of De Janvry, Sadoulet and Fargeix (1991) and Decaluwe, Dumot, and Savard (1999) and Decaluwe, Party, Savard, and Thorbecke (2000) employed this approach. The present paper applies this second approach, but uses the actual income distribution from the 1994 FIES.

The paper is organized in seven sections. The second section discusses the government policies in the rice sector and the production structure of the sector, including prices. The third section looks at the current issue on food and poverty. The fourth section discusses in detail the model used in the analysis, including the parameters, the elasticities and the model structure at the base. The fifth section gives a description of the poverty and distribution measures used in the analysis. The sixth section outlines the various policy experiments conducted and discusses the results. The last section summarizes the results of the experiments and draws insights for policy.

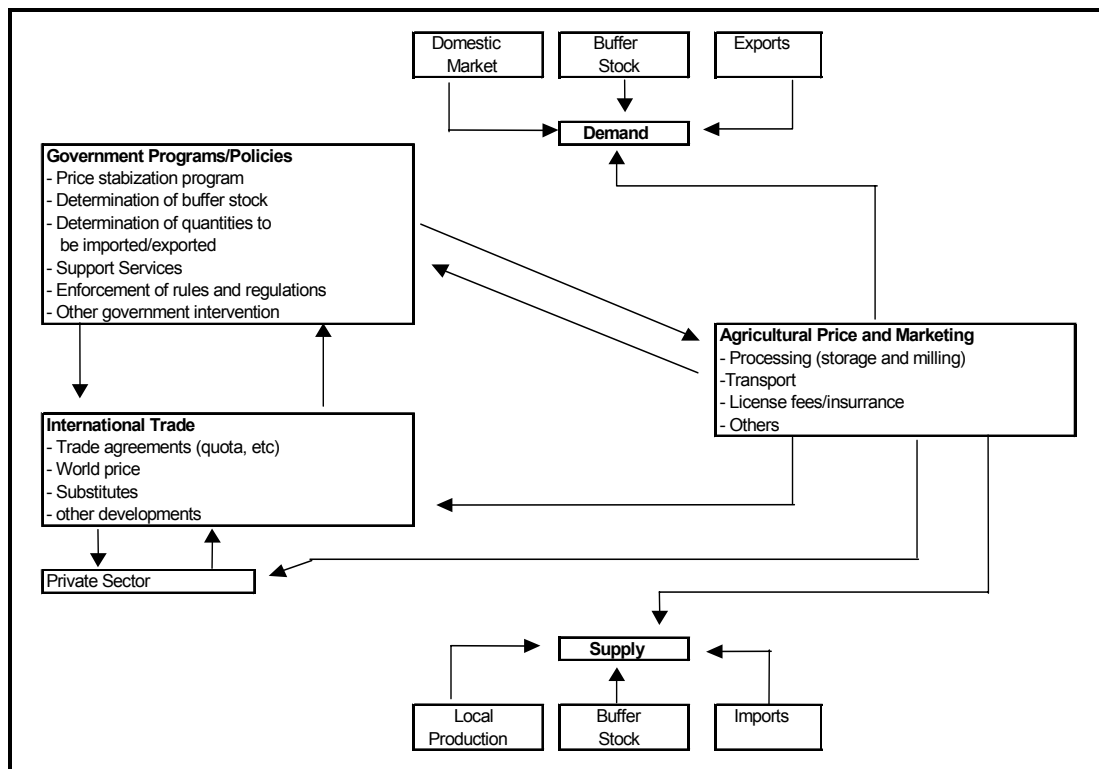
## II. The Rice Sector

### II.A Rice Policy

Because of the political significance of rice, the government is heavily involved both in the supply and distribution to assure consumers sufficient and stable supply at low prices and to maintain reasonable return to rice farmers with adequate price incentives. Figure 1 presents a broad diagram of how government interventions may have influenced activities in rice. Three major components affect the supply of rice: local production, buffer stock, and imports. On the other hand, three factors affect the demand side: domestic market, buffer stock and exports.

The present pricing policy of the government involves the setting and defending of price floor and ceiling. It also minimizes seasonal price variations in the various regions. Furthermore, the government monopolizes the importation and exportation of rice through its various procurement and disbursement operations in order to influence domestic price levels. Currently, government interventions are implemented through the National Food Authority (NFA), which is an attached agency of the Department of Agriculture. The NFA took over the operation of the National Grains Authority (NGA), which was in operation from 1972 to 1981. The administration of NGA in turn succeeded the Rice and Corn Administration, which operated from 1962 to 1972

Figure 1: Rice Activities



Source: Chupungco (1991)

The literature indicates that the government policy on rice is relatively more successful in defending consumer price ceilings than price floors. As a result, farm prices remained below palay support prices because of a number of reasons, which include inadequate NFA procurement budget, delayed timing of NFA purchases, etc. Thus, margins are squeezed, resulting in reduced investment in postharvest facilities and less planting because of unattractive price to farmers. On the other hand, in the long-run the consumer-oriented pricing policy does not benefit consumers because it reduces rice availability.

A partial equilibrium analysis of Roumasset (2000) indicates that the excess burden of the current rice policy amounted to P48.79 billion in 1999. This estimate does not account for the financial cost of subsidies to the NFA.

In 1999 ADB approved a loan facility amounting to US\$75 million to support a grains policy reform in the Philippines, which is called the Grains Sector Development Program (GSDP).<sup>1</sup> The policy framework of GSDP focuses on: (i) liberalizing and instituting more cost effective grains pricing and import policies; (ii) improving the administration of grain buffer stocks; (iii) restructuring the NFA from a grains marketing monopoly into a public regulatory agency and separate private sector marketing corporation; and (iv) implementing a well-targeted and effective food subsidy program for the poor.

## II.B Rice Production Structure and Prices

The contribution of palay (unhusked) rice production to the gross domestic product (GDP) ranges from 2 to 3 percent in the last 10 years, while the share of 'rice and corn milling' is about 2.3 percent (Table 1). Among agricultural crops cereals production,

<sup>1</sup>However, the loan facility was cancelled because of unmet conditionalities.

particularly palay rice, dominates in terms of area planted, volume of production and value of output (Table 2). From 1993 to 2002, more than 50 percent of agricultural area was planted with palay rice and corn. In recent years, the share of palay rice production increased in terms of area planted and quantity produced, as well as in terms of value of output. In 2002, about 38 percent of the value of output of agricultural crops comes from palay rice production.

**Table 1: Contribution of Agriculture to GDP (%)**

|  | 1993         | 1997         | 2003         |
|--|--------------|--------------|--------------|
| <b>1. AGRICULTURE, FISHERY, FORESTRY</b> | <b>21.7</b>  | <b>18.7</b>  | <b>14.5</b>  |
| a. AGRICULTURE                           | 17.4         | 15.8         | 12.3         |
| Palay                                    | 2.9          | 3.0          | 2.2          |
| Corn                                     | 1.2          | 0.9          | 0.6          |
| Coconut including copra                  | 1.3          | 1.0          | 0.7          |
| Sugarcane                                | 0.7          | 0.5          | 0.4          |
| Banana                                   | 0.7          | 0.5          | 0.5          |
| Other crops                              | 5.2          | 4.9          | 3.9          |
| Livestock                                | 2.7          | 2.5          | 1.9          |
| Poultry                                  | 1.9          | 1.5          | 1.3          |
| Agricultural activities & services       | 1.0          | 0.9          | 0.7          |
| b. FISHERY                               | 3.9          | 2.8          | 2.2          |
| c. FORESTRY                              | 0.4          | 0.1          | 0.1          |
| <b>2. INDUSTRY SECTOR</b>                | <b>32.9</b>  | <b>32.2</b>  | <b>32.3</b>  |
| Rice and Corn Milling / a/               |              |              |              |
| <b>3. SERVICE SECTOR</b>                 | <b>45.4</b>  | <b>49.1</b>  | <b>53.2</b>  |
| <b>GROSS DOMESTIC PRODUCT</b>            | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |

Source: Economic and Social Statistics Office, National Statistical Coordination Board

/a/ in 1994 Input-Output Table its contribution to total gross value added was about 2.3%

**Table 2: Agriculture Production (distribution, %)**

|                       | 1993        |             |             | 1997        |             |             | 2002/p      |             |             |
|-----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                       | Area        | Quantity    | Value       | Area        | Quantity    | Value       | Area        | Quantity    | Value       |
| <b>A. Cereals</b>     | <b>51.4</b> | <b>21.7</b> | <b>40.9</b> | <b>51.7</b> | <b>22.8</b> | <b>41.6</b> | <b>50.1</b> | <b>24.2</b> | <b>47.2</b> |
| Palay                 | 26.3        | 14.4        | 28.6        | 30.3        | 16.5        | 31.6        | 31.5        | 18.2        | 37.9        |
| Corn                  | 25.2        | 7.3         | 12.3        | 21.5        | 6.3         | 10.0        | 18.6        | 5.9         | 9.3         |
| <b>B. Major Crops</b> | <b>38.4</b> | <b>64.9</b> | <b>41.9</b> | <b>39.0</b> | <b>68.6</b> | <b>44.9</b> | <b>45.9</b> | <b>71.7</b> | <b>45.5</b> |
| Coconut               | 24.6        | 17.3        | 13.2        | 24.7        | 20.1        | 12.0        | 31.8        | 18.8        | 11.6        |
| Sugarcane             | 3.1         | 34.9        | 5.5         | 3.0         | 32.6        | 5.5         | 2.9         | 37.4        | 7.0         |
| Banana                | 2.6         | 4.8         | 6.0         | 2.7         | 6.5         | 7.0         | 3.1         | 7.2         | 9.4         |
| Pineapple             | 0.3         | 2.0         | 3.1         | 0.3         | 2.4         | 4.0         | 0.4         | 2.2         | 3.3         |
| Mango                 | 0.5         | 0.6         | 3.6         | 1.0         | 1.4         | 5.6         | 1.1         | 1.3         | 4.8         |
| Other major crops     | 7.3         | 5.4         | 10.6        | 7.3         | 5.6         | 10.8        | 6.6         | 4.7         | 9.3         |
| <b>Other Crops</b>    | <b>10.1</b> | <b>13.4</b> | <b>17.2</b> | <b>9.3</b>  | <b>8.6</b>  | <b>13.5</b> | <b>3.9</b>  | <b>4.1</b>  | <b>7.2</b>  |

Source: Philippine Statistical Yearbook

/p: preliminary

There are two varieties of palay rice production: modern variety (MV) and traditional variety (TD). In the last 3 decades, the share of MV production has almost doubled from 55 percent in 1970 to 95 percent in 1999 (Table 3). The production of MV palay rice is more productive than TV in terms of yield per hectare. In 1970, the average productivity of MV production was 1.93 metric tons per hectare, while of TV 1.51. In the last 3 decades, both saw a steady upward trend, with MV's productivity increasing to 3 metric tones per hectare in 1999 and TV's to 2.13.



**Table 3: Palay Production (distribution, %)**

|                  |      | Production |     |     | Area Harvested |    |    | Yield (mt/ha) |      |      |
|------------------|------|------------|-----|-----|----------------|----|----|---------------|------|------|
|                  |      | Total      | MV* | TV* | Total          | MV | TV | Total         | MV   | TV   |
| All Ecosystem    | 1970 | 100        | 55  | 45  | 100            | 48 | 52 | 1.71          | 1.93 | 1.51 |
|                  | 1975 | 100        | 71  | 29  | 100            | 62 | 38 | 1.76          | 1.99 | 1.38 |
|                  | 1980 | 100        | 85  | 15  | 100            | 78 | 22 | 2.20          | 2.42 | 1.45 |
|                  | 1985 | 100        | 92  | 8   | 100            | 89 | 11 | 2.71          | 2.80 | 2.01 |
|                  | 1990 | 100        | 93  | 7   | 100            | 89 | 11 | 2.81          | 2.94 | 1.77 |
|                  | 1995 | 100        | 94  | 6   | 100            | 91 | 9  | 2.80          | 2.89 | 1.97 |
|                  | 1999 | 100        | 95  | 5   | 100            | 94 | 6  | 2.95          | 3.00 | 2.13 |
| Irrigated        | 1970 | 100        | 68  | 32  | 100            | 66 | 34 | 2.06          | 2.12 | 1.94 |
|                  | 1975 | 100        | 82  | 18  | 100            | 80 | 20 | 2.31          | 2.37 | 2.06 |
|                  | 1980 | 100        | 91  | 9   | 100            | 88 | 12 | 2.80          | 2.90 | 2.10 |
|                  | 1985 | 100        | 94  | 6   | 100            | 93 | 7  | 3.17          | 3.21 | 2.65 |
|                  | 1990 | 100        | 95  | 5   | 100            | 93 | 7  | 3.29          | 3.35 | 2.36 |
|                  | 1995 | 100        | 95  | 5   | 100            | 94 | 6  | 3.26          | 3.30 | 2.49 |
|                  | 1999 | 100        | 97  | 3   | 100            | 95 | 5  | 3.35          | 3.38 | 2.59 |
| Rainfed & Upland | 1970 | 100        | 38  | 62  | 100            | 33 | 67 | 1.42          | 1.61 | 1.32 |
|                  | 1975 | 100        | 57  | 43  | 100            | 50 | 50 | 1.37          | 1.56 | 1.18 |
|                  | 1980 | 100        | 77  | 23  | 100            | 69 | 31 | 1.69          | 1.89 | 1.24 |
|                  | 1985 | 100        | 86  | 14  | 100            | 83 | 17 | 2.11          | 2.20 | 1.68 |
|                  | 1990 | 100        | 88  | 12  | 100            | 82 | 18 | 2.07          | 2.21 | 1.43 |
|                  | 1995 | 100        | 89  | 11  | 100            | 85 | 15 | 2.07          | 2.14 | 1.62 |
|                  | 1999 | 100        | 92  | 8   | 100            | 90 | 10 | 2.15          | 2.20 | 1.74 |

Source: Rice Statistics Handbook, PhilRice - Bureau of Agricultural Statistics, Department of Agriculture

\* mt is metric tons, ha is hectares

\*\* MV is modern variety and TV is traditional variety

There are two types of ecosystem in palay rice production: irrigated and non-irrigated (rainfed and upland). The last 3 decades saw significant shift into irrigated palay rice farming from 55 percent in 1970 to 76 percent in 1999 (Table 4). Irrigated palay rice farming is more productive than non-irrigated. In 1999, the former had an average yield of 3.35 metric tons per hectare, while the latter 2.15 (Table 3).

**Table 4: Irrigated & Non-Irrigated (distribution, %)**

|      | Palay Production |           |               | Area Harvested |           |               |
|------|------------------|-----------|---------------|----------------|-----------|---------------|
|      | Total            | Irrigated | Non-Irrigated | Total          | Irrigated | Non-Irrigated |
| 1970 | 100              | 55        | 45            | 100            | 46        | 54            |
| 1975 | 100              | 54        | 46            | 100            | 41        | 59            |
| 1980 | 100              | 59        | 41            | 100            | 46        | 54            |
| 1985 | 100              | 66        | 34            | 100            | 56        | 44            |
| 1990 | 100              | 71        | 29            | 100            | 61        | 39            |
| 1995 | 100              | 72        | 28            | 100            | 62        | 38            |
| 1999 | 100              | 76        | 24            | 100            | 67        | 33            |

Source: Rice Statistics Handbook, PhilRice - Bureau of Agricultural Statistics,

Department of Agriculture

Rice is mainly for food consumption (Table 5). In 1999, about 97 percent of the production was consumed for food. There are two sources of rice: local production and imports. The last 10 years show that, increasingly local production could not cope up to meet local demand because of high population growth. Thus, rice imports increased from 412 thousand metric tons in 1990 to 757 thousand metric tons in 1999. There was, however, a blip in 1998, which was largely due to the sharp drop in palay rice production because of the El Nino. In 1998, imported rice amounted to 1,856 thousand metric tons.

**Table 5: Production and Utilization of Rice**

|      | Production<br>( ' 000 mt) | Production Utilization (' 000 mt) |       |       |                   | Surplus/<br>(Deficit) /a/<br>( ' 000 mt) | Population<br>( '000) |
|------|---------------------------|-----------------------------------|-------|-------|-------------------|--|-----------------------|
|      |                           | Total                             | Food  | Seeds | Feeds &<br>Wastes |  |                       |
| 1970 | 3,246                     | 3,367                             | 3,014 | 142   | 211               | (120)                                    | 36,852                |
| 1975 | 3,988                     | 4,262                             | 3,833 | 170   | 259               | (274)                                    | 42,259                |
| 1980 | 4,970                     | 4,945                             | 4,453 | 169   | 323               | 25                                       | 48,317                |
| 1985 | 5,759                     | 5,693                             | 5,156 | 162   | 374               | 67                                       | 54,257                |
| 1990 | 6,095                     | 6,507                             | 5,949 | 163   | 396               | (412)                                    | 60,910                |
| 1995 | 6,852                     | 7,182                             | 6,553 | 183   | 445               | (330)                                    | 68,349                |
| 1997 | 7,325                     | 7,878                             | 7,214 | 187   | 476               | (553)                                    | 71,550                |
| 1998 | 5,076                     | 6,932                             | 6,722 |       | 210               | (1,856)                                  | 73,239                |
| 1999 | 7,011                     | 7,768                             | 7,532 |       | 236               | (757)                                    | 74,967                |

Source: 1970-97 Rice Statistics Handbook, PhilRice - Bureau of Agricultural Statistics,  
Department of Agriculture, 1998-99 National Statistical Coordination Board  
/a/ Supplied by imports

Data on the disposition of palay rice production by farm households indicate that 22 percent of production was sold to the market in 1970, and 35 percent was used for own food consumption (Table 6). Overtime, the structure changed dramatically. In 1997, 46 percent of palay rice production of farm households was sold to the market, while the share for own food consumption dropped to 29 percent. This trend implies that palay rice activities have intensively become market oriented, and therefore increasingly vulnerable to market changes.

**Table 6 : Relative Distribution of Palay Production Utilization and Disposition of Farm Households, %**

|      | Landlord's<br>Share | Sold | Food | Seeds | Feeds | Others* | total |
|------|---------------------|------|------|-------|-------|---------|-------|
| 1970 | 20                  | 22   | 35   | 3     | 1     | 18      | 100   |
| 1975 | 14                  | 28   | 41   | 3     | 1     | 14      | 100   |
| 1980 | 13                  | 39   | 34   | 3     | 1     | 11      | 100   |
| 1985 | 12                  | 39   | 30   | 4     | 1     | 14      | 100   |
| 1990 | 10                  | 41   | 30   | 4     | 1     | 15      | 100   |
| 1995 | 8                   | 42   | 31   | 0     | 0     | 18      | 100   |
| 1997 | 9                   | 46   | 29   | 0     | 0     | 17      | 100   |

\* Seeds and/or feeds

Source: Rice Statistics Handbook, PhilRice - Bureau of Agricultural Statistics,  
Department of Agriculture

Fertilizer is a critical input into palay rice production. In fact, the use of fertilizer increased significantly over the last 15 years. Of the total area planted for palay rice in 1988 for both ecosystem, about 68 percent was applied with fertilizer (Table 7). In 1997, the ratio increased to 86 percent, translating to an average use of 4.4 bags of 50 kilogram of fertilizer<sup>2</sup> per hectare.

The intensity of fertilizer use in irrigated palay rice farms is higher than in non-irrigated. While almost 95 percent of irrigated palay rice farms were applied with fertilizer in 1997, only 70 percent application is observed for non-irrigated palay rice farms.

<sup>2</sup>Which includes Urea, Ammosul, Complete, Ammopohos, and others.

**Table 7 : Fertilizer Use**

|                 |       | Area<br>Planted<br>( ' 000 hectare) | Area Applied |      | Average<br>Fertilizer Use<br>per hectare<br>(bag of 50 kg) |
|-----------------|-------|-------------------------------------|--------------|------|--|
|                 |       |                                     | Area         | %    |  |
|                 |       |                                     |              |      |  |
| All Philippines | 1988  | 3,571                               | 2,422        | 67.8 | 3.5  |
|                 | 1989  | 3,571                               | 2,772        | 77.6 | 3.6  |
|                 | 1990  | 3,415                               | 2,726        | 79.8 | 3.9  |
|                 | 1991  | 3,488                               | 2,871        | 82.3 | 3.6  |
|                 | 1992  | 3,287                               | 2,610        | 79.4 | 3.9  |
|                 | 1993  | 3,346                               | 2,735        | 81.7 | 4.1  |
|                 | 1994  | 3,735                               | 3,026        | 81.0 | 4.1  |
|                 | 1995  | 3,814                               | 3,191        | 83.7 | 4.0  |
|                 | 1996  | 4,009                               | 3,429        | 85.5 | 4.4  |
| 1997            | 3,902 | 3,362                               | 86.2         | 4.4  |  |
| Irrigated       | 1991  | 2,092                               | 1,894        | 90.5 |  |
|                 | 1992  | 2,020                               | 1,756        | 86.9 |  |
|                 | 1993  | 2,047                               | 1,821        | 89.0 |  |
|                 | 1994  | 2,264                               | 2,058        | 90.9 |  |
|                 | 1995  | 2,366                               | 2,216        | 93.7 |  |
|                 | 1996  | 2,508                               | 2,389        | 95.3 |  |
|                 | 1997  | 2,529                               | 2,397        | 94.8 |  |
| Rainfed         | 1991  | 1,396                               | 977          | 70.0 |  |
|                 | 1992  | 1,267                               | 854          | 67.4 |  |
|                 | 1993  | 1,300                               | 915          | 70.4 |  |
|                 | 1994  | 1,471                               | 968          | 65.8 |  |
|                 | 1995  | 1,448                               | 975          | 67.3 |  |
|                 | 1996  | 1,502                               | 1,039        | 69.2 |  |
|                 | 1997  | 1,373                               | 965          | 70.3 |  |

Source: Rice Statistics Handbook, PhilRice - Bureau of Agricultural Statistics, Department of Agriculture

Government intervention in rice activities is through NFA's procurement of palay rice from the farmers and rice injection to the market. In principle, the former protects farmers from low market prices of palay rice and therefore assures them of adequate income, while the latter protects the general consuming public from high market price for rice. On the procurement side, data would indicate that NFA's intervention has declined through time from 7.2 percent of total production in 1980 to 0.6 percent in 1994 and to 0.1 percent in 1995 (Table 8). It slightly recovered to 1.1 percent in 1996, but declined again to 0.9 percent in 1997. This is largely due to the budgetary problems in NFA's finances<sup>3</sup>. On the other hand, NFA's rice injection into the system is relatively significant. In 1996, NFA's injection of rice into the market was 9.2 percent of the overall supply. It slightly dropped to 8.2 percent in 1997.

<sup>3</sup>To date, NFA is saddled with huge financial losses.

**Table 8: National Food Authority's Palay Procurement and Rice Injection**

|      | Palay (' 000 mt)   |                   |            | Rice (' 000 mt)  |               |            |
|------|--------------------|-------------------|------------|------------------|---------------|------------|
|      | Procurement<br>(a) | Production<br>(b) | (a)/(b), % | Injection<br>(c) | Supply<br>(d) | (c)/(d), % |
| 1975 | 233                | 6,381             | 3.7        | 227              | 4,262         | 5.3        |
| 1980 | 551                | 7,646             | 7.2        | 280              | 4,945         | 5.7        |
| 1985 | 401                | 8,806             | 4.6        | 365              | 5,693         | 6.4        |
| 1990 | 572                | 9,319             | 6.1        | 667              | 6,095         | 10.9       |
| 1991 | 555                | 9,673             | 5.7        | 158              | 6,196         | 2.6        |
| 1992 | 420                | 9,129             | 4.6        | 521              | 4,965         | 10.5       |
| 1993 | 155                | 9,434             | 1.6        | 489              | 5,357         | 9.1        |
| 1994 | 61                 | 10,538            | 0.6        | 112              | 6,284         | 1.8        |
| 1995 | 8                  | 10,541            | 0.1        | 257              | 7,182         | 3.6        |
| 1996 | 124                | 11,284            | 1.1        | 733              | 7,975         | 9.2        |
| 1997 | 101                | 11,269            | 0.9        | 623              | 7,625         | 8.2        |

Source: Rice Statistics Handbook, PhilRice - Bureau of Agricultural Statistics, Department of Agriculture

Both the wholesale and retail prices of rice are significantly higher than the farmgate prices of palay rice (Table 9). For years where data is available, the gap has more than doubled. For example, in 1988 the farmgate price of ordinary palay rice was P3.2 per kilo, while the wholesale price of the same variety was P7.2 per kilo. The latter is 2.25 times (or 125 percent) higher than the former. There is no data available for the retail price of ordinary rice for the same year, but the data in the following year indicate a price of P7.9 per kilo, which is 2.48 times higher (or 148 percent). In 2001, gap is still more than double. The price gaps are much higher in high rice quality.

The retail price of rice in the local market is largely due to the QR on rice imports, which limits the flow of imported rice and artificially creates a scarcity rent that jacks up the local price as theoretically depicted below. Meanwhile, actual data indicates that the gap between local prices of rice and world prices is large indeed. Take the case of the retail price of ordinary rice and the world price of rice for 35 percent broken, which are comparable in terms of quality. The gap has widened from 20 percent in 1989 to 130 percent in 2001.

### III. Food and Poverty

About half of rural households live below poverty, while one-fifth of urban households fall below the poverty threshold (Table 10). More than 60 percent of expenditure of rural poor households is on food; about half of which is on cereals, which consist of rice and corn, but with the former having a much larger share. An almost similar structure is observed in the expenditure pattern of urban poor households. Furthermore, rural and urban poor households—landless agricultural laborers, small-scale farmers, and urban unskilled workers—are principally net buyers of rice (David and Otsuka, 1994). These indicate that policy reforms on rice may potentially have significant impact on the consumption pattern of both rural and urban poor households, and therefore on poverty.

Table 9: Palay and Rice Prices

|      | Domestic Price, (pesos/kilo)* |          |         |               |                       |          |         |         |                    |          |         |         |           | World Price (pesos/kilo)** |            |                | Ordinary Rice |
|------|-------------------------------|----------|---------|---------------|-----------------------|----------|---------|---------|--------------------|----------|---------|---------|-----------|----------------------------|------------|----------------|---------------|
|      | Palay, Farmgate Price         |          |         |               | Rice, Wholesale Price |          |         |         | Rice, Retail Price |          |         |         |           |                            |            | Retail Price / |               |
|      | Fancy                         | Ordinary | Special | Other Variety | Fancy                 | Ordinary | Special | Premium | Fancy              | Ordinary | Special | Premium | 5% broken | 35% broken                 | 35% broken |                |               |
| 1983 | n.a                           | n.a      | n.a     | n.a           | 3.2                   | 2.8      | 3.0     | n.a     | 3.5                | n.a      | 3.2     | n.a     | 3.1       |                            | 2.7        |                |               |
| 1984 | n.a                           | n.a      | n.a     | n.a           | 5.0                   | 4.5      | 4.8     | n.a     | 6.1                | n.a      | 5.0     | n.a     | 4.2       |                            | 3.9        |                |               |
| 1985 | n.a                           | n.a      | n.a     | n.a           | 6.9                   | 6.0      | 6.5     | n.a     | 8.1                | n.a      | 6.9     | n.a     | 4.0       |                            | 3.7        |                |               |
| 1986 | n.a                           | n.a      | n.a     | n.a           | 6.5                   | 5.4      | 5.8     | n.a     | 7.5                | n.a      | 6.3     | n.a     | 4.3       |                            | 3.7        |                |               |
| 1987 | 3.5                           | n.a      | n.a     | n.a           | 6.5                   | 5.8      | 5.8     | n.a     | 7.8                | n.a      | 6.4     | n.a     | 4.7       |                            | 4.2        |                |               |
| 1988 | n.a                           | 3.2      | 3.2     | 3.2           | 7.7                   | 7.2      | 6.5     | n.a     | 8.2                | n.a      | 7.0     | n.a     | 6.4       |                            | 5.7        |                |               |
| 1989 | 4.6                           | n.a      | n.a     | n.a           | 4.0                   | n.a      | 7.3     | 7.9     | n.a                | 0.0      | 7.9     | 8.5     | n.a       | 6.9                        | 6.3        | 1.2            |               |
| 1990 | 5.1                           | n.a      | n.a     | n.a           | 4.8                   | 10.1     | 8.5     | 8.8     | n.a                | 11.6     | 8.9     | 9.5     | n.a       | 7.0                        | 6.0        | 1.5            |               |
| 1991 | n.a                           | n.a      | n.a     | n.a           | 4.7                   | 10.1     | 8.5     | 9.0     | n.a                | 12.6     | 9.1     | 10.1    | n.a       | 8.6                        | 6.6        | 1.4            |               |
| 1992 | n.a                           | n.a      | n.a     | n.a           | 4.8                   | 10.7     | 8.9     | 9.5     | n.a                | 0.0      | 9.7     | 10.4    | n.a       | 7.3                        | 5.9        | 1.6            |               |
| 1993 | n.a                           | n.a      | n.a     | n.a           | 5.4                   | 11.0     | 9.8     | 10.5    | n.a                | 0.0      | 10.8    | 11.8    | n.a       | 7.3                        | 5.5        | 2.0            |               |
| 1994 | 8.0                           | n.a      | n.a     | n.a           | 5.9                   | n.a      | 11.3    | 12.1    | n.a                | 16.0     | 12.2    | 13.3    | n.a       | 7.1                        | 9.2        | 1.3            |               |
| 1995 | 8.1                           | n.a      | n.a     | n.a           | 7.4                   | n.a      | 14.1    | 15.1    | n.a                | 19.7     | 15.1    | 16.5    | n.a       | 8.2                        | 7.5        | 2.0            |               |
| 1996 | 10.3                          | 7.5      | 8.7     | 8.2           | 21.8                  | 15.8     | 17.4    | 19.5    | 23.9               | 17.1     | 19.0    | 21.3    | 8.9       | 7.2                        | 2.4        |                |               |
| 1997 | 9.9                           | 7.5      | 8.5     | 8.0           | 21.6                  | 15.2     | 16.9    | 19.0    | 24.4               | 16.5     | 18.5    | 20.8    | 9.0       | 7.3                        | 2.3        |                |               |
| 1998 | 10.7                          | 8.1      | 9.0     | n.a           | 22.3                  | 15.8     | 17.4    | 19.7    | 24.9               | 17.1     | 19.0    | 21.4    | 12.4      | 10.2                       | 1.7        |                |               |
| 1999 | 11.1                          | 7.7      | 8.6     | n.a           | 23.0                  | 15.7     | 17.4    | 19.7    | 25.2               | 17.3     | 19.2    | 21.5    | 9.7       | 8.3                        | 2.1        |                |               |
| 2000 | n.a                           | n.a      | n.a     | n.a           | 23.3                  | 16.2     | 17.8    | 19.9    | 25.7               | 17.6     | 19.5    | 21.7    | 8.9       | 7.4                        | 2.4        |                |               |
| 2001 | 11.0                          | 7.9      | 8.6     | n.a           | 23.7                  | 16.0     | 17.6    | 20.0    | 26.9               | 17.5     | 19.4    | 21.8    | 8.8       | 7.6                        | 2.3        |                |               |

\* Source: Bureau of Agricultural Statistics

\*\* Source: World Bank (fob Bangkok; converted into pesos using average nominal exchange rate)

Grains production utilizes most of the agricultural resources. In particular, about 5 million hectares of arable land are devoted to rice and corn production, of which two-thirds are under palay. Furthermore, majority of rural population – about 1.8 million people – depends on the grains sector. This implies that if the government fails to intervene because of budgetary and other administrative problems so that farm palay prices fall below the support price, the impact on farm incomes could be substantial.

Table 10: Food and Poverty

|                   | Rural |       |         |       | Urban |       |         |       |
|-------------------|-------|-------|---------|-------|-------|-------|---------|-------|
|                   | 1997  |       | 2000    |       | 1997  |       | 2000    |       |
| Poverty Incidence |       |       | 50.7%   |       | 21.6% |       | 18.6%   |       |
|                   | Poor  |       | Nonpoor |       | Poor  |       | Nonpoor |       |
| Consumption       | 1997  | 2000  | 1997    | 2000  | 1997  | 2000  | 1997    | 2000  |
| Food Consumption* | 63.6% | 63.6% | 47.6%   | 47.6% | 61.4% | 60.8% | 38.8%   | 38.7% |
| Cereals*          | 29.5% | 28.8% | 15.4%   | 14.6% | 24.5% | 23.0% | 8.6%    | 8.2%  |

\*Percent of Total

Source: 1997 and 2000 Family Income and Expenditure

#### IV. CGE Model

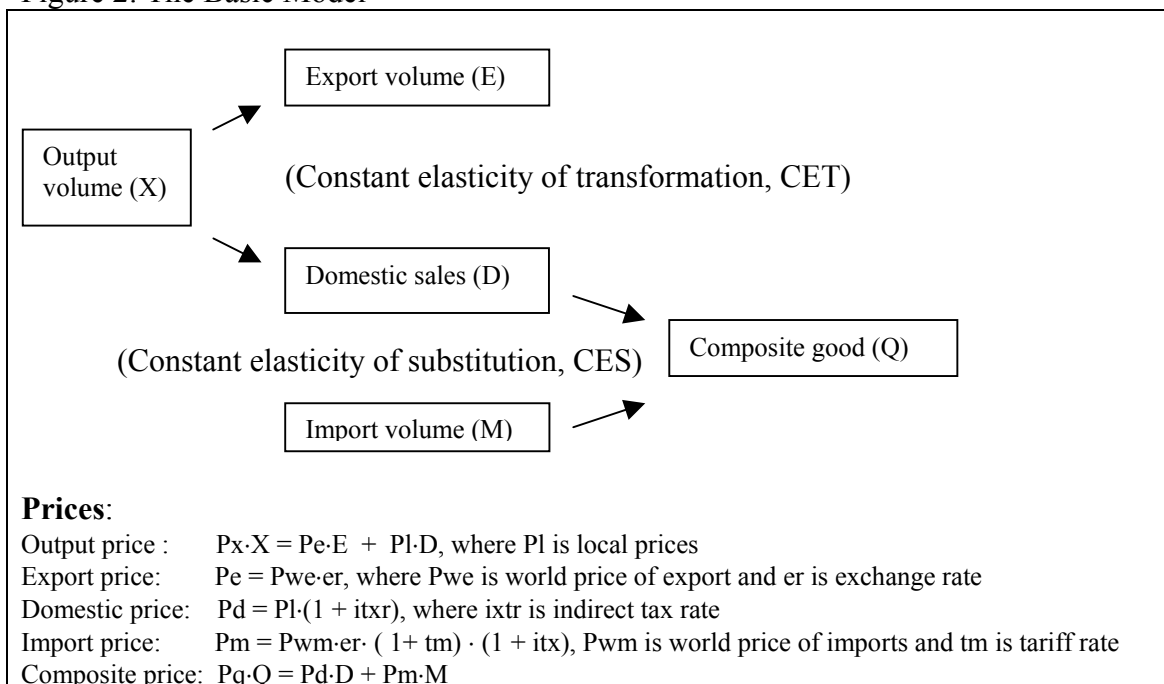
This section discusses the basic structure of the model. It introduces modifications to the basic structure to address the issues in the paper adequately. In particular, the agriculture module is modified to allow the use of land and water in production. Rice importation is augmented to include features of import quota. The fertilizer price formation is modified to allow for a government subsidy. Trading in both palay and rice is expanded to accommodate NFA's buffer stock management that allows the setting of rice price ceiling for the consumers and palay price floor for the farmers.

#### IV.A Basic Structure

A CGE model is used to carry out the analysis in the paper. An overview of the basic structure of the model is given below.

Figure 2 presents the basic price and volume relationships in the model. The model specifies a transformation function between export (E) and domestic sales (D) using constant elasticity of transformation (CET). If export price ( $P_e$ ) increases relative to the local price ( $P_l$ ), then export supply will increase while supply for domestic sales will decline. The supply side of the model assumes profit maximization. The first-order conditions for profit maximization generate the necessary supply functions and input demand functions.

Figure 2: The Basic Model



On the other hand, on the demand side, substitution is specified between imports and domestic goods using a constant elasticity of substitution (CES) function. In the CGE literature, this substitution can also be interpreted as product differentiation, where imports and domestically produced goods are treated as imperfect substitutes. If import price in local currency ( $P_m$ ) declines relative to domestic price ( $P_d$ ), demand for imports will increase while demand for local goods will decline. The first-order conditions for cost minimization generate the import and domestic demand functions.

Output price ( $P_x$ ) is the composite of export price ( $P_e$ ) and local prices ( $P_l$ ). Indirect taxes are added to the local price to determine domestic prices ( $P_d$ ), which together with import price ( $P_m$ ) will determine the composite commodity price ( $P_q$ ). The composite price is the price paid by the consumers.

Import price ( $P_m$ ) is in domestic currency, which is affected by the world price of imports, exchange rate ( $e_r$ ), tariff rate ( $tm$ ), and indirect tax rate ( $itx$ ). The direct effect of tariff reduction, for example, is a reduction in  $P_m$ . If the reduction in  $P_m$  is significant enough, the composite price ( $P_q$ ) will also decline.

Households maximize utility based on a linear expenditure system (LES). The relationship for intermediate demand assumes a set of fixed Leontief coefficients. The model consists of a one-period (static) set of relationships. Sectoral capital, as well as labor supply, is fixed. Furthermore, it assumes total savings is invested.

The macroeconomic closure is as follows:

$$\text{Total (E-M)} = \text{Total (S-I)} + \text{Total (Tx-G)}$$

where E is total exports of goods and services, M is total imports of goods and services, S is total private savings, I is total private investment, Tx is total government income and G is total government expenditure.

Total (E-M), which is the external balance, is assumed fixed. This is also equivalent to assuming constant foreign savings. However, sectoral exports and imports are not fixed. They respond to changes in the relative price ratio between  $P_e$  and  $P_i$ , which is the real exchange rate. Nominal exchange rate,  $e_r$ , is fixed.

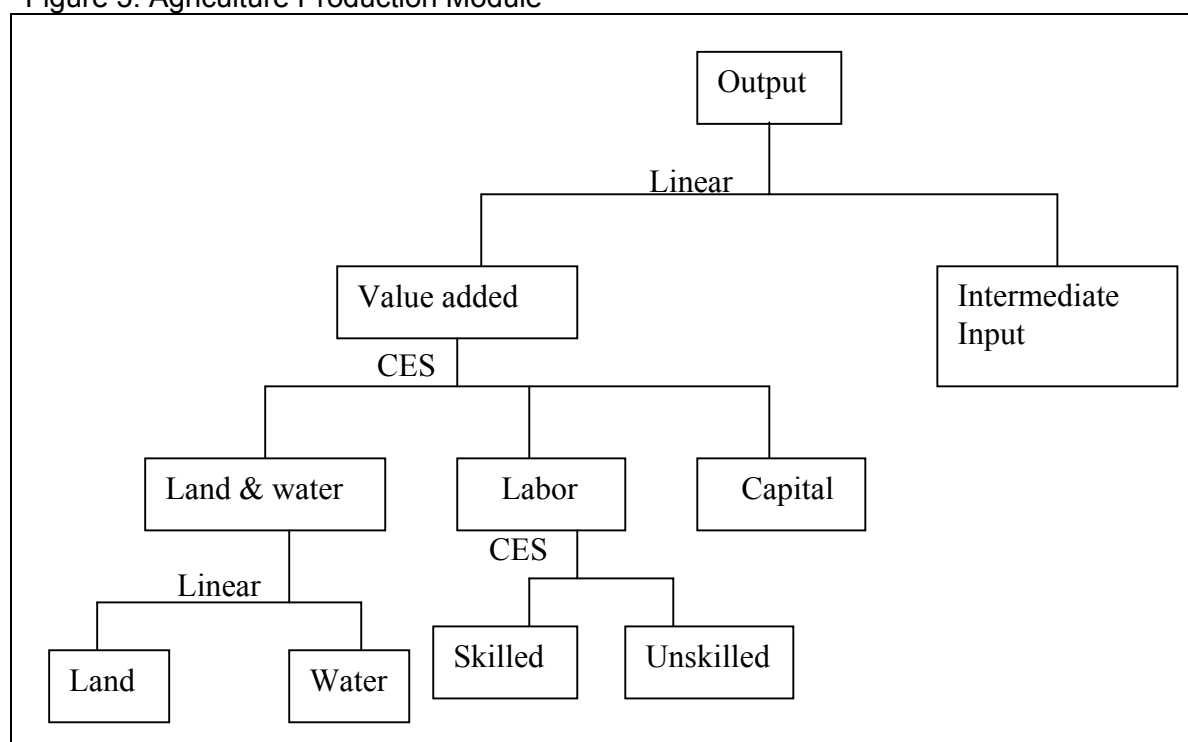
Total (S-I), which represents the private sector balance, is solved in the model. Total (Tx-G), which is the government balance, is closed using various closure rules that will be discussed in detail below. However, in all the macroeconomic closure rules applied, government expenditure remains fixed.

#### IV.B Modifications

Agricultural Production. The basic model just described uses equality constraints. However, this may be inadequate if applied to issues pertaining to agriculture. For example, land and water inputs may not be as substitutable as capital and labor in a well-behaved production function. Often, they are used in fixed proportions. In a number of instances, land and water may not be paid according to their marginal product contribution, or are not even paid at all. Highly seasonal agriculture production results in underutilization of land and water during certain periods of a given year. Thus, inequality constraints are more appropriate in modeling agriculture (Hazell and Norton, 1986).

Figure 3 shows how the agricultural module of the model is re-specified. Similar to the basic model, output is a linear combination of value added and intermediate inputs using a set of fixed coefficients. However, this time value added is a CES combination of three factor inputs: capital, an aggregate labor input, and an aggregate land and water input. Capital is fixed, while aggregate labor is specified as a nested CES function of skilled and unskilled labor. Following Robinson and Gehlar (1996) the aggregate land and water input is specified as a nested linear combination of land and water.

Figure 3: Agriculture Production Module



Source: Robinson and Gehlar (1996)

Following Lofgren and Robinson (1997), the agriculture module is formulated as mixed-complementarity problems (MCP). Basically, a model based on MCP contains a system of simultaneous equations (linear or nonlinear), which are a mixture of strict equalities and inequalities. The system works in such a way that each of the inequalities is linked with a bounded variable in a complementary-slackness relationship (Rutherford, 1995). The basic idea is similar to the Kuhn-Tucker necessary and sufficient conditions for optimality.

The agriculture production sector module in the revised model is specified as MCP. The details of which are presented in Table 11. Equation (1) is the value added (VA) CES function of three factor inputs: an aggregate labor (L), capital (K), and an aggregate input consisting of land and water (LW).  $\rho$  is a substitution parameter,  $\kappa$  is a scale parameter and  $\omega$  are factor weights. Equation (2) is a nested aggregate labor CES function of skilled ( $L_s$ ) and unskilled labor ( $L_u$ ). Similar to (1), this equation has 3 sets of parameters ( $\varphi$ ,  $\beta$ ,  $\psi$ ). Equations (3) and (4) are demand functions for land (LN) and water (WA), respectively, which are linearly related to (LW) using fixed coefficients ( $\alpha$ ).

Equation (5) is the demand for aggregate labor function, which is the first-order condition of profit maximization using the production function in (1).  $P_{va}$  is the value added price. Equation (6) is the first-order condition for cost minimization with (2) as the production constraint. This equation yields the demand functions for the two types of labor. Equation (7) gives the average wage ( $w$ ), which is the average of the wage for skilled labor ( $w_s$ ) and unskilled labor ( $w_u$ ).



Table 11: Agriculture Production Module Specified as MCP

|  |  |
|--|--|
| (1) $VA = \kappa \cdot (\omega_L \cdot L^p + \omega_K \cdot K^p + \omega_{LW} \cdot LW^p)^{-1/p}$                              | : value added                            |
| (2) $L = \varphi \cdot (\psi_s \cdot L_s^\beta + \psi_u \cdot L_u^\beta)^{-1/\beta}$   | : labor aggregation function             |
| (3) $LN = \alpha_{ln} \cdot LW$  | : demand for land                        |
| (4) $WA = \alpha_{wa} \cdot LW$  | : demand for water                       |
| (5) $L = VA \cdot \left( \frac{Pva \cdot \omega_L}{w \cdot \kappa^p} \right)^{1/(1+p)}$  | : demand for aggregate labor             |
| (6) $\frac{L_s}{L_u} = \left[ \left( \frac{w_u}{w_s} \right) \cdot \left( \frac{\psi_s}{\psi_u} \right) \right]^{1/(1+\beta)}$ | : demand for skilled and unskilled labor |
| (7) $w = \left( \frac{w_s \cdot L_s + w_u \cdot L_u}{L} \right)$   | : average wage                           |
| (8) $LW = VA \cdot \left( \frac{Pva \cdot \omega_{LW}}{rlw \cdot \kappa^p} \right)^{1/(1+p)}$                                  | : demand for composite land_water        |
| (9) $rlw = \left[ \frac{(rln + rln\_p) \cdot LN + (rwa + rwa\_p) \cdot WA}{lw} \right]$  | : rent for land_water use                |
| (10) $LNS \cdot rln\_p \geq \sum_i LN_i$   | : land constraint                        |
| (11) $WAS \cdot rwa\_p \geq \sum_i WA_i$   | : water constraint                       |
| (12) $lns \geq \sum_i ln_i$  | : land market                            |
| (13) $was \geq \sum_i wa_i$  | : water market                           |
| (14) $r \cdot K = Pva \cdot va - w \cdot L - (rwa + rwa\_p) \cdot wa - (rln + rln\_p) \cdot ln$                                | : 0-profit condition                     |
| (15) $LS_s = \sum_i L_s$   | : market for skilled labor               |
| (16) $LS_u = \sum_i L_u$   | : market for unskilled labor             |

Equations (8) to (13) are a set of relationships that capture the complementary slackness conditions for optimization involving land and water. In particular, the conditions involve the relationship between the overall rent for the use of land and water, and their demand and supply situation. Similar to (5), Equation (8) is the demand for aggregate LW, which is derived as one of the first order conditions for profit maximization. Equation (9) is the average rent for the use of (LW). It is the weighted average of the rent for land use and the rent for water use. However, both the rents for land use and water use have two components:  $(rln + rln\_p)$  for land use and  $(rwa + rwa\_p)$  for water use. The variables with the suffix  $\_p$  signify the rent when land and water constraints are not binding. In this case these variables will have a value of 1 when the supply of both water (WAS) and land (LNS) are greater than the corresponding demand. These are presented in Equations (10) and (11). When the constraints are binding, however, the overall rent for land use will be  $(rln + rln\_p)$  and for water use  $(rwa + rwa\_p)$ . The economic interpretation for this is that when the constraint is binding the shadow price for the use of the resource is higher. Thus, if in

agriculture the supply of water is binding, the overall cost of production will be higher. If water supply is increased (e.g. improvement in irrigation is carried out), this relaxes the constraints and reduces the cost of production. Equations (12) and (13) are demand for land and water.<sup>4</sup>

Equation (14) is the zero-profit condition, which is required in competitive equilibrium models. This condition shows that value added is fully used to pay for the use of capital ( $r \cdot K$ ), labor ( $w \cdot L$ ) and land and water. Lastly, Equations (15) and (16) determine the market for skilled and unskilled labor.

Import Quota. There are complicated issues to deal with when modeling import quotas (Francois and Reinert, 1997). In the paper the import quota is viewed as a price distortion effect. If the domestic price of a good that is under import quota is compared with its equivalent world price, then the price distortion effect of the quota can be computed. In the literature, this is called the price-gap method of estimating a tariff-equivalent of a quota, which is analogous to an ad valorem tariff rate.

Figure 4 shows the theoretical framework of the modeling of the import quota. The vertical axis shows the local price of imports, while the horizontal axis is the import volume. Import demand is downward sloping. The small country assumption is used in the analysis. This means that supply is perfectly elastic at a given world price of imports. Without import distortion, imports will be at  $M^1$ . The corresponding price of import is  $Pm^1$ , which is the world price ( $P_{wm}$ ) converted into domestic prices using the exchange rate ( $er$ ). If tariff ( $tm$ ) is introduced, then import volume reduces to  $M^2$ . The price of imports will be  $Pm^2$ . When imported goods are sold in the domestic market, they face an additional indirect tax ( $itx$ ) similar to other domestic goods sold in the market. In this case, import volume is reduced to  $M^3$ , while price is increased to  $Pm^3$ .

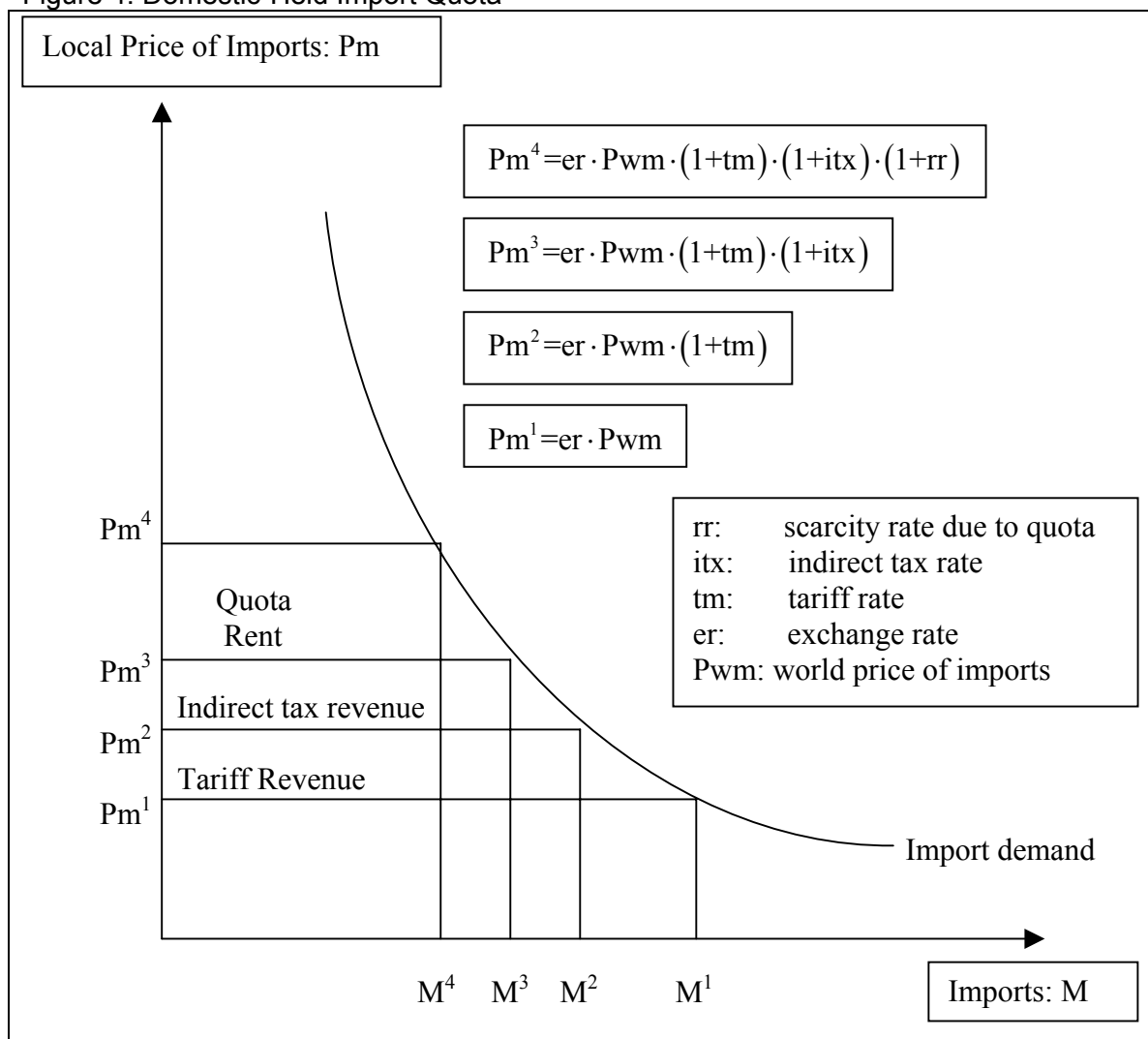
Furthermore, if imports are restricted by quota, say at  $M^4$ , then the corresponding price will be higher. Thus, on top of the tariff rate and the indirect tax rate, there is an additional price mark-up due to the scarcity premium, which we call  $rr$ . The final local market price of imports will be  $Pm^4$ . This distortion will generate three types of revenue. Tariff revenue,  $(Pm^2 - Pm^1) \times M^4$ , and the indirect tax revenue,  $(Pm^3 - Pm^2) \times M^4$ , both of which will go to the government. The quota rent,  $(Pm^4 - Pm^3) \times M^4$ , will go to the holder of the import rights. This analysis of quota is modeled as MCP and is presented in Table 12.

Equation (17) is a CES aggregation of imported ( $M$ ) and domestically produced commodities ( $D$ ). The resulting good is called the composite commodity ( $Q$ ). This equation captures the product differentiation between ( $M$ ) and ( $D$ ). Equation (18) is the first-order condition for cost minimization with (17) as the constraint. This equation yields the demand for imports. Thus, if import price ( $Pm$ ) decreases relative to domestic prices ( $Pd$ ), imports will increase relative to domestically produced goods. Equation (19) gives the domestic price of imports inclusive of tariffs ( $tm$ ), indirect tax ( $itx$ ), and import quota scarcity premium ( $rr$ ).

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<sup>4</sup>For a detailed discussion see Robinson and Gehlhar (1995)

Figure 4: Domestic-Held Import Quota



Equation (20) defines the price of the composite good ( $P_q$ ), which is the weighted average of import and domestic prices. Equation (21) is the domestic price ( $P_d$ ) inclusive of indirect taxes. Local price before indirect tax is ( $P_l$ ), which is the cost of production of domestically produced goods. Equations (22) and (23) give a complementary slackness relationship between the import quota scarcity premium ( $rr$ ) and the quota rent ( $Re$ ). If the quota is not binding, then ( $rr$ ) will be zero; otherwise it will have a positive number.

Equation (24) shows the consumer price ( $P_c$ ) equal to the composite price ( $P_q$ ). Thus, if ( $rr$ ) is positive, ( $P_q$ ) will be higher, and so will be ( $P_c$ ). Equation (25) and (26) allocate the quota rent to the holders of import rights. In the case of the Philippines NFA is the major holder of quota rights. However, NFA issues a very limited amount of import licenses to private importers. Thus, household income (25) will increase by its share in the quota rent, while government income will also increase by its share in the rent. The other components of household income ( $Y_h$ ) consist of factor incomes, transfers and other incomes. The other components of government income ( $Y_g$ ) are revenues from taxation, and other incomes.

Table 12: Import Quota Specified as (MCP)

|      |  |   |
|------|--|---|
| (17) | $Q = \varphi \cdot (\mu_m \cdot M^{-\lambda} + \mu_d \cdot D^{-\lambda})^{-1/\lambda}$                             | : composite good (imported & local goods) |
| (18) | $\frac{M}{D} = \left[ \left( \frac{P_d}{P_m} \right) \cdot \left( \frac{\mu_m}{\mu_d} \right) \right]^{1/\lambda}$ | : demand for imports                      |
| (19) | $P_m = er \cdot P_{wm} \cdot (1 + tm) \cdot (1 + itx) \cdot (1 + rr)$  | : local price of imports                  |
| (20) | $P_q = \left( \frac{P_m \cdot M + P_d \cdot D}{Q} \right)$   | : price of composite good                 |
| (21) | $P_d = P_l \cdot (1 + itx)$  | : price of local goods                    |
| (22) | $Re = er \cdot P_{wm} \cdot (1 + tm) \cdot (1 + itx) \cdot rr \cdot M$   | : quota rent                              |
| (23) | $\left( M^* - M \right) \geq 0$  | : import quota                            |
| (24) | $P_c = P_q$  | : consumer prices                         |
| (25) | $Y_h' = Y_h + v_h \cdot Re$  | : household income + share in quota rent  |
| (26) | $Y_g' = Y_g + v_g \cdot Re$  | : government income + share in quota rent |

Price Ceiling on an Industrial Input into Agriculture. Fertilizer is an industrial input that is used heavily in agricultural production. It is also critical to palay rice production as presented in Table 7. One policy instrument that may be used in supporting agriculture is fertilizer price subsidy. In the model, price subsidy is also specified as MCP as in Robinson, et al (1997). The relationships are presented in Table 13.

Table 13: Price Ceiling on Industrial Input into Agriculture Specified as MCP

|      |  |   |
|------|--|---|
| (27) | $P_{ci} = P_{qi} \cdot (1 + tc - spc)$           | : price of industrial input into agriculture  |
| (28) | $\left( P_{ci}^* - P_{ci} \right) \geq 0$        | : price ceiling                               |
| (29) | $Contax = (1 + tc - spc) \cdot Q_i \cdot P_{qi}$ | : consumption tax, inclusive of price subsidy |
| (30) | $Y_g'' = Y_g' + Contax$                          | : government income with consumption tax      |

Equation (27) gives the price of the industrial input. It is the composite price ( $P_q$ ) of imported and domestically produced inputs. To make it more general, it is further augmented to include consumption tax ( $tc$ ) for the use of the input and price subsidy ( $spc$ ). The ceiling on price is in Equation (28). In this equation, if the input price ( $P_c$ ) exceeds the ceiling price ( $P_c^*$ ), then the price subsidy ( $spc$ ) will be positive. The model will search the value of the price subsidy that will retain the inequality in (28).

One should note that the price subsidy is introduced not in the production side, but in consumption. Furthermore, the subsidy changes the relative sectoral consumption price, i.e.

$$\frac{pc_i}{pc_j} \text{ for sector } i \neq j$$

Equation (29) gives the effect of the price subsidy on income of the government. If the subsidy is positive, this will entail a reduction in government income. Equation (30) is the augmented government income.

Price Ceiling, Price Floor, and Buffer Stock Management. One of the key government interventions in rice activities in the Philippines is the setting of a price ceiling to protect consumers, the setting of price floors to protect rice farmers, and the maintenance of buffer stock to assure adequate supply of rice. All these are done through the NFA. In the model, this mechanism is specified as MCP as in Robinson et al (1997) and presented in Table 14.

Table 14: Price Ceiling, Price Floor, and Buffer Stock Management

|   |                              |
|---|------------------------------|
| (31) $\left( P_x - P_{x_f}^* \right) \geq 0$  | : farm gate price floor      |
| (32) $\left( P_c^* - P_c \right) \geq 0$  | : consumer price ceiling     |
| (33) $\left( N_{stk} - N_{stk_1}^* \right) \geq 0$  | : stock lower bound          |
| (34) $\left( N_{stk_h}^* - N_{stk} \right) \geq 0$  | : stock upper bound          |
| (35) $N_{stk} = N_{stk_0} + N_{buy} - N_{sel} + N_m - N_e$  | : buffer stock management    |
| (36) $Q = C + Inv + Intd - N_{sel} + N_{buy}$   | : product market equilibrium |
| (37) $Cab = Cab' + er \cdot P_{wm} \cdot N_m - er \cdot P_{we} \cdot N_e$   | : current account balance    |
| (38) $Yg''' = Yg'' + P_c \cdot N_{sel} - P_c \cdot N_{buy} + er \cdot P_{we} \cdot N_e - er \cdot P_{wm} \cdot N_m$ | : gov't revenue              |

Equation (31) sets the farmgate price floor, while Equation (32) the consumer price ceiling. Equation (33) sets the lower bound of NFA's buffer stock of rice, while Equation (34) the upper bound. Equation (35) is the buffer stock equation of the NFA. If the farmgate price of palay ( $P_x$ ) goes below the set price floor ( $P_{x_f}^*$ ), then NFA will start buying palay ( $N_{buy}$ ) to support the farmers. The support buying is an artificial demand and will continue until the inequality in (31) is retained. However, these support buying activities will increase the level of the buffer stock<sup>5</sup>. In the product market equilibrium equation in (36), the support buying by the NFA effectively increases the overall demand for the commodity (demand elements come in as positive in the right-hand side of the equation). Also, since NFA is a government agency, the support buying of palay means additional expenditure of the government as shown in Equation (38).

<sup>5</sup>In the model 65% of palay milled comes out as final rice.

On the other hand, if the consumer price of rice exceeds the set price ceiling, NFA will sell rice ( $N_{sel}$ ) to the general public to increase the supply of rice artificially. The selling of rice will persist until the inequality in (32) is retained. However, the selling of rice to the domestic market will drain the buffer stock level of the NFA in (35). If the selling continues and violates (33), i.e., the buffer stock level goes below the critical level set by ( $N_{stk_i^*}$ ), the NFA will start importing rice ( $N_m$ ) to replenish the amount of rice sold to the market. This rice import will get reflected in the current account balance in Equation (37). Furthermore, the government will have to pay for this imported rice as shown in Equation (38). A similar mechanism will occur, but in the reverse direction, if the buffer stock exceeds the upper bound as a result of heavy support buying of palay. The government would have to export the excess stock of rice, which will in turn generate revenue. Exports of rice will get reflected in the current account balance.

The model is programmed in GAMS (General Algebraic Modelling System). The model is solved using the solver called MILES (Mixed Inequality and nonLinear Equation Solver).<sup>6</sup>

#### IV.C Base Model Structure, Parameters, and Elasticities

The production sector is disaggregated into 14 sectors, with 6 agricultural sub-sectors, 6 industrial sub-sectors, and 3 service sectors. Palay rice production is disaggregated into irrigated and non-irrigated. Corn also has a separate sector. In the manufacturing sub-sector, 'rice and corn milling' is a separate sector as well. However, there is no information available to break up these into two separate milling activities. Fertilizer has a separate sector because of its importance to agricultural production. The 1994 Input-Output (IO) table is the source of basic data on sectoral production and production technology.

The model incorporates two types of labor: agriculture and production labor. Agriculture labor is devoted only to the agricultural sector. However, production labor can work in both agriculture and non-agriculture sectors. Furthermore, there are two classes of labor within each type: skilled and unskilled. Skilled labor includes professionals, managerial, and other related workers with at least a high school diploma. The rest are unskilled. The Labor Force Survey (LFS) is the source of basic information on labor types and classes.

**Table 15: Definition of Household Groups**

|              |      |   |
|--------------|------|---|
| <b>Urban</b> | urb1 | worked for private household and private establishment; zero education up to third year high school   |
|              | urb2 | worked for private household and private establishment; high school graduate and up   |
|              | urb3 | worked for government/ government corporation   |
|              | urb4 | self-employed without employee; zero education up to third year high school; including unemployed during 1994 survey.   |
|              | urb5 | self-employed without employee; high school graduate and up; including unemployed during 1994 survey.   |
|              | urb6 | employed in own family-operated farm or business; worked with pay in own family-operated farm or business; and worked without pay in own family-operated farm or business |
| <b>Rural</b> | rur1 | worked for private household and private establishment; zero education up to third year high school   |
|              | rur2 | worked for private household and private establishment; high school graduate and up   |
|              | rur3 | worked for government/ government corporation   |
|              | rur4 | self-employed without employee; zero education up to third year high school; including unemployed during 1994 survey.   |
|              | rur5 | self-employed without employee; high school graduate and up; including unemployed during 1994 survey.   |
|              | rur6 | employed in own family-operated farm or business; worked with pay in own family-operated farm or business; and worked without pay in own family-operated farm or business |

Source: 1994 Family Income and Expenditure Survey

The household sector is broken into 12 socio-economic groups (Table 15). There are 6 urban household groups and 6 rural household groups, each category is broken down

<sup>6</sup>The model is coded in GAMS and is available from the author upon request.

according to the type of occupation and the level of education of the head of the family, which is consistent with the classes and types of labor described above. The 1994 Family Income and Expenditure Survey (FIES) is the source of information on households.

Table 16 presents some of the characteristics of the household groups. Among urban household groups, urb1 has the lowest per capita income, followed by urb4. While both groups have a low level of education, the former is employed while the latter is self-employed. Households in the informal urban sector and unemployed are included in the latter. The highest poverty indicators (headcount, gap, and severity) among urban households are found in these two groups.

**Table 16: Household Income, Poverty Line and Poverty Indices (1994 prices)**

| Households  | Per capita<br>Income (p) | Poverty<br>Line (p) | Poverty<br>Headcount,% | Poverty<br>Gap,% | Poverty<br>Severity,% |
|-------------|--------------------------|---------------------|------------------------|------------------|-----------------------|
| Philippines | 15,730                   | 8,897               | 40.7                   | 13.7             | 6.2                   |
| urb1        | 13,000                   | 9,688               | 41.7                   | 12.9             | 5.6                   |
| urb2        | 26,954                   | 10,181              | 15.5                   | 3.7              | 1.3                   |
| urb3        | 26,468                   | 9,665               | 10.2                   | 2.5              | 0.9                   |
| urb4        | 14,472                   | 9,584               | 42.3                   | 14.9             | 6.9                   |
| urb5        | 27,980                   | 10,138              | 16.9                   | 4.8              | 2.1                   |
| urb6        | 35,650                   | 9,647               | 18.2                   | 6.0              | 2.8                   |
| rur1        | 8,247                    | 7,827               | 58.7                   | 19.7             | 8.8                   |
| rur2        | 13,723                   | 8,177               | 31.3                   | 9.7              | 4.3                   |
| rur3        | 18,123                   | 8,106               | 22.4                   | 6.8              | 2.9                   |
| rur4        | 8,559                    | 7,984               | 61.0                   | 21.9             | 10.3                  |
| rur5        | 13,756                   | 8,259               | 37.5                   | 12.0             | 5.0                   |
| rur6        | 13,641                   | 7,607               | 39.9                   | 12.0             | 5.2                   |

Source: 1994 Family Income and Expenditure Survey

A similar pattern is observed in rural households, although the numbers are higher for poverty and lower for income. The lowest per capita income is in rur1, followed by rur4. The worse poverty indicators among rural households are observed in these groups. Furthermore, among all households, rur4 has the highest headcount ratio of 61.0 percent, followed by rur1 with a ratio of 58.7 percent.

**Table 17: Consumption Shares of Household Groups, %**

|                       | urb1         | urb2         | urb3         | urb4         | urb5         | urb6         | rur1         | rur2         | rur3         | rur4         | rur5         | rur6         |
|-----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Irrigated Palay       | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            |
| Non_Irrigated Palay   | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            |
| Corn                  | 0.2          | 0.2          | 0.1          | 0.2          | 0.1          | 0.1          | 0.3          | 0.2          | 0.2          | 0.3          | 0.2          | 0.2          |
| Sugarcane             | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          |
| Livestock             | 8.7          | 6.3          | 5.8          | 7.6          | 6.0          | 4.8          | 11.0         | 8.9          | 7.7          | 10.5         | 8.7          | 9.3          |
| Other Agriculture     | 4.0          | 2.9          | 2.7          | 3.5          | 2.8          | 2.2          | 5.1          | 4.2          | 3.6          | 4.9          | 4.0          | 4.3          |
| <b>AGRICULTURE</b>    | <b>12.9</b>  | <b>9.4</b>   | <b>8.6</b>   | <b>11.3</b>  | <b>8.9</b>   | <b>7.2</b>   | <b>16.3</b>  | <b>13.3</b>  | <b>11.5</b>  | <b>15.7</b>  | <b>13.0</b>  | <b>13.9</b>  |
| Food Processing       | 9.3          | 6.7          | 6.1          | 8.1          | 6.4          | 5.2          | 11.7         | 9.5          | 8.2          | 11.2         | 9.3          | 9.9          |
| Rice and Corn Milling | 11.1         | 8.0          | 7.3          | 9.6          | 7.7          | 6.2          | 14.0         | 11.4         | 9.8          | 13.4         | 11.1         | 11.9         |
| Sugar Milling         | 1.2          | 0.8          | 0.8          | 1.0          | 0.8          | 0.6          | 1.5          | 1.2          | 1.0          | 1.4          | 1.2          | 1.2          |
| Fertilizer            | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          | 0.0          |
| Other manufacturing   | 26.4         | 23.7         | 23.1         | 24.5         | 23.3         | 22.5         | 29.3         | 27.4         | 25.6         | 27.4         | 26.6         | 27.2         |
| Other industry        | 1.6          | 2.0          | 1.9          | 1.6          | 1.8          | 2.2          | 1.2          | 1.3          | 1.4          | 1.2          | 1.3          | 1.3          |
| <b>INDUSTRY</b>       | <b>49.5</b>  | <b>41.3</b>  | <b>39.3</b>  | <b>44.8</b>  | <b>40.0</b>  | <b>36.7</b>  | <b>57.7</b>  | <b>50.9</b>  | <b>46.2</b>  | <b>54.7</b>  | <b>49.6</b>  | <b>51.6</b>  |
| Transportation        | 3.1          | 3.8          | 4.6          | 3.7          | 4.0          | 4.6          | 1.9          | 2.6          | 3.4          | 2.2          | 2.8          | 2.5          |
| Other Services        | 34.5         | 45.5         | 47.5         | 40.3         | 47.0         | 51.5         | 24.1         | 33.2         | 39.0         | 27.5         | 34.7         | 32.0         |
| Government Services   | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            | -            |
| <b>SERVICES</b>       | <b>37.6</b>  | <b>49.3</b>  | <b>52.1</b>  | <b>43.9</b>  | <b>51.0</b>  | <b>56.1</b>  | <b>26.0</b>  | <b>35.8</b>  | <b>42.3</b>  | <b>29.7</b>  | <b>37.5</b>  | <b>34.5</b>  |
| <b>TOTAL</b>          | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> | <b>100.0</b> |

Source: 1994 Social Accounting Matrix (Cororaton, 2003). The source of basic data is 1994 FIES

The structure of household consumption according to the production sector classification in the model is presented in Table 17. The source of basic information is the 1994 FIES. While 'other services' and 'other manufacturing' have the highest shares in the household consumption basket, the share of 'rice and corn milling' is also significant, especially for household groups rur1 and rur4.

**Table 18: Sources of Household Income,%**

|                        | urb1  | urb2  | urb3  | urb4  | urb5  | urb6  | rur1  | rur2  | rur3  | rur4  | rur5  | rur6  |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Labor type 1 /a/       | -     | 4.6   | 0.9   | -     | 0.9   | 0.2   | -     | 20.0  | 4.7   | -     | -     | 1.8   |
| Labor type 2           | 17.4  | -     | -     | 8.6   | -     | 0.8   | 29.8  | -     | -     | 19.5  | 5.6   | 9.0   |
| Labor type 3           | -     | 75.9  | 91.5  | -     | 45.4  | 23.4  | -     | 67.4  | 88.8  | -     | 50.7  | 11.6  |
| Labor type 4           | 42.0  | -     | -     | 5.6   | -     | -     | 14.2  | -     | -     | 17.1  | -     | 5.7   |
| Capital in Agriculture | 10.7  | 0.9   | 0.3   | 4.9   | 0.3   | 0.6   | 20.1  | 3.6   | 1.2   | 11.2  | 3.5   | 6.1   |
| Capital in Industry    | 3.3   | 1.1   | 0.8   | 23.3  | 7.0   | 41.3  | 2.0   | 0.5   | 0.9   | 15.4  | 11.9  | 33.1  |
| Capital in Service     | 9.5   | 3.6   | 6.1   | 39.9  | 17.5  | 24.7  | 3.5   | 1.9   | 2.8   | 16.4  | 19.5  | 18.0  |
| Land                   | 3.1   | 0.3   | 0.1   | 1.4   | 0.1   | 0.2   | 5.7   | 1.0   | 0.3   | 3.2   | 1.0   | 1.7   |
| Dividends              | -     | 12.3  | -     | 3.2   | 25.4  | 2.3   | -     | 1.3   | 0.0   | -     | -     | -     |
| Govtment transfers     | 12.3  | 1.1   | 0.3   | 5.6   | 0.3   | 0.7   | 23.2  | 4.1   | 1.3   | 13.0  | 3.9   | 7.0   |
| Foreign Income         | 1.7   | 0.2   | 0.1   | 7.4   | 3.1   | 5.9   | 1.6   | 0.2   | 0.0   | 4.2   | 3.8   | 5.9   |
| Total                  | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: 1994 Social Accounting Matrix (Cororaton, 2003). The sources of basic data are: 1994 FIES and Labor Force Survey

/a/ Type 1 is agriculture labor high school graduate and up; Type 2 agriculture labor below high graduate

Type 3 is production labor high school graduate and up; Type 4 production labor below high graduate

On the other hand, the structure of the sources of household income is presented in Table 18. Income sources include labor income (broken down into the types and classes of labor), capital used in agriculture, industry, and service sector, land, and other sources, which include dividends, transfers and foreign income.



The trade and production elasticities used in the model were derived from another CGE model of the Philippines (Clarete and Warr, 1992). They are presented in Table 19. Other features of the structure of the model at the base, like trade shares and intensities, value added and output shares, are also presented in the table. One may observe that 'other manufacturing' dominates both the export and import flows of the economy.

Table 19: Elasticities and Parameters

| Sectors               | Elasticities /a/ |       |        |       | Exports (%)  |               | Imports (%)  |               | Value Added (%) |                 | Output       |
|-----------------------|------------------|-------|--------|-------|--------------|---------------|--------------|---------------|-----------------|-----------------|--------------|
|                       | Sig_m            | Sig_e | Sig_va | Sig_l | Share        | Intensity /b/ | Share        | Intensity /c/ | Share           | Ratio to Output | Share (%)    |
| Irrigated Palay       | 3.7              | 0.20  | 0.8    | 0.50  | 0.00         | -             | 0.0          | 0.014         | 2.0             | 78.8            | 1.28         |
| Non_Irrigated Palay   | 3.7              | 0.30  | 0.8    | 0.50  | 0.00         | -             | 0.0          | 0.00          | 0.8             | 78.6            | 0.55         |
| Corn                  | 3.7              | 0.35  | 0.8    | 0.50  | 0.01         | 0.2           | 0.2          | 4.55          | 1.1             | 76.3            | 0.74         |
| Sugarcane             | 0.2              | 0.30  | 0.8    | 0.50  | 0.00         | -             | 0.0          | 0.00          | 0.6             | 71.9            | 0.41         |
| Livestock             | 1.4              | 0.60  | 0.8    | 0.50  | 3.38         | 8.4           | 0.7          | 1.75          | 8.3             | 68.2            | 6.19         |
| Other Agriculture     | 1.1              | 1.50  | 0.8    | 0.50  | 3.07         | 10.8          | 0.6          | 2.30          | 7.2             | 85.9            | 4.31         |
| <b>AGRICULTURE</b>    |                  |       |        |       | <b>6.46</b>  | <b>7.5</b>    | <b>1.5</b>   | <b>1.79</b>   | <b>20.0</b>     | <b>75.8</b>     | <b>13.5</b>  |
| Food Processing       | 1.1              | 1.50  | 1.1    | 0.30  | 2.21         | 9.0           | 1.3          | 5.50          | 2.2             | 29.4            | 3.90         |
| Rice and Corn Milling | 3.7              | 0.60  | 1.1    | 0.29  | 0.04         | 0.2           | 0.3          | 1.19          | 2.5             | 32.0            | 3.93         |
| Sugar Milling         | 3.7              | 1.50  | 1.1    | 0.49  | 0.40         | 8.9           | 0.2          | 5.36          | 0.4             | 31.3            | 0.71         |
| Fertilizer            | 0.6              | 1.37  | 1.1    | 0.41  | 0.53         | 43.0          | 1.3          | 65.10         | 0.1             | 20.5            | 0.34         |
| Other manufacturing   | 0.8              | 2.50  | 1.1    | 0.40  | 53.62        | 30.8          | 78.3         | 39.15         | 16.9            | 26.4            | 32.81        |
| Other industry        | 0.8              | 0.90  | 1.1    | 0.30  | 2.91         | 5.4           | 7.3          | 12.36         | 9.4             | 49.2            | 9.73         |
| <b>INDUSTRY</b>       |                  |       |        |       | <b>59.71</b> | <b>21.2</b>   | <b>88.8</b>  | <b>28.33</b>  | <b>31.6</b>     | <b>31.4</b>     | <b>51.4</b>  |
| Transportation        | 0.25             | 0.60  | 1.2    | 0.30  | 4.44         | 15.7          | 0.9          | 3.52          | 3.9             | 48.8            | 4.10         |
| Other Services        | 0.25             | 1.30  | 1.2    | 0.25  | 29.39        | 16.9          | 8.8          | 5.73          | 36.9            | 74.4            | 25.34        |
| Government Services   |                  |       |        |       |              | -             | 0.0          | 0.00          | 7.7             | 69.0            | 5.68         |
| <b>SERVICES</b>       |                  |       |        |       | <b>33.83</b> | <b>14.3</b>   | <b>9.7</b>   | <b>4.54</b>   | <b>48.5</b>     | <b>70.5</b>     | <b>35.1</b>  |
| <b>TOTAL</b>          |                  |       |        |       | <b>100.0</b> | <b>16.5</b>   | <b>100.0</b> | <b>16.4</b>   | <b>100.0</b>    | <b>51.1</b>     | <b>100.0</b> |

/a/ Based on estimates of Clarete and Warr (1992). Sig\_m is Armington elasticity in the import function; Sig\_e is the constant elasticity of transformation in the export function, Sig\_va is the production elasticity in the value added function, and Sig\_l is the labor elasticity in the labor aggregation function; /b/ ratio to output; /c/ ratio to total supply

## V. Poverty and Distribution Measures

The income distribution effects are measured in terms of the change in the Gini coefficient before and after the policy shift. The formula for the Gini coefficient used is

$$\text{Gini coefficient} = \left( \frac{1}{2 \times n^2} \right) \times \left[ \sum_i w_i \times \sum_j w_j |y_i - y_j| \right]$$

where n is the overall population; i and j are household indices; w<sub>i</sub> and w<sub>j</sub> are the number of people in household i and j, respectively (note that  $\sum_i w_i = n$  and  $\sum_j w_j = n$ ), and y<sub>i</sub> and y<sub>j</sub> are income of household i and j, respectively.

On the other hand, the effects on poverty are measured using the change in the Foster-Greer-Thorbecke (FGT) indices before and after the policy shift. In general, the FGT poverty measure is<sup>7</sup>

$$P_\alpha = \frac{1}{n} \sum_{i=1}^q \left( \frac{z - y_i}{z} \right)^\alpha$$

<sup>7</sup>See Ravallion (1992) for detailed discussion.

where  $n$  is population size,  $q$  number of people below poverty line,  $y_i$  is income,  $z$  is the poverty threshold. Poverty threshold is equal to the food threshold plus the non-food threshold, where threshold refers to the cost of basic food and non-food requirements. The parameter  $\alpha$  can have three values, each one indicating a measure of poverty. The headcount index of poverty has  $\alpha = 0$ . This is the common index of poverty, which measures the proportion of the population whose income (or consumption) falls below the poverty threshold. The poverty gap index has  $\alpha = 1$ . This measures the depth of poverty in the sense that it indicates how far below on average the poor are from the poverty threshold. The poverty severity index has  $\alpha = 2$ . This measure is sensitive to the distribution among the poor as more weight is given to the poorest below the poverty threshold. This is because the poverty severity index corresponds to the squared average distance of income of the poor from the poverty line, hence gives more weight to the poorest of the poor in the population.

To capture the extent of poverty before the policy experiment on rice reform, actual household income and poverty line from the 1994 FIES were used to compute the FGT indices. These indices serve as the base in the analysis. Households were grouped according to the classification in Table 15.

The policy experiment using the CGE model generates the change in the average income of the representative household groups defined in Table 15. These average income changes are applied to the actual household income in the FIES to determine the impact of the policy on household income.

The CGE simulation also generates the change in the consumer price of goods defined in the model. The consumption weights of each household group in Table 17 were used to calculate the weighted consumer price of each of the groups. The computed change in the weighted consumer price was used to compute the nominal change in the poverty line after the policy experiment. In particular, let the actual poverty threshold at the base be  $Z_0 = P_0 \times \bar{X}_0$ , where  $Z_0$  is the poverty threshold,  $P_0$  the consumer price, and  $\bar{X}_0$  is the 'minimum basic needs'. The 'minimum basic needs' is assumed fixed before and after the policy experiment.

The new poverty threshold is computed by replacing  $P_0$  with a new price that is derived using the results for the weighted consumer price from the CGE model. That is,  $Z_1 = P_1 \times \bar{X}_0$  where  $Z_1$  is the new poverty threshold and  $P_1$  is the new price derived using the results from the CGE simulation. Since the 'minimum basic needs' is assumed fixed, in effect this process changes the nominal value of the poverty threshold.

The change in household income and the change in the nominal value of the poverty threshold after the policy experiment generate a new set of FGT indices. These are compared with the FGT at the base to determine whether a policy change is poverty-improving or not.

## VI. Policy Simulation

### VI.A Definition of Policy Experiments

Table 20 summarizes the policy experiments conducted in the paper. The first experiment involves a trade policy reform in rice consisting of a zero import quota and a reduced tariff on rice imports to 10 percent without poverty-offsetting measures. The rest of the experiments involve various combinations of the policy reform and poverty-reducing measures.

**Table 20: Definition of Policy Experiments**

| Experiment | Policy Change  | Poverty-Offsetting Measure  | Government Balance       | Compensatory Tax    |
|------------|--|---|--------------------------|---------------------|
| SIM_1      | zero import quota on rice;<br>tariff rate on rice imports<br>reduced to 10 % | none  | government income fixed  | indirect output tax |
| SIM_2      | -same-   | 50 % reduction in the direct<br>income tax rate of the following<br>household groups: urb1, rur1,<br>and rur4 | government income fixed  | indirect output tax |
| SIM_3      | -same-   | 10% increase in government<br>transfers to the following household<br>groups: urb1, rur1, and rur4            | government balance fixed | indirect output tax |
| SIM_4      | -same-   | 50% fertilizer price subsidy  | government income fixed  | direct income tax   |
| SIM_5      | -same-   | 50% fertilizer price subsidy  | government income fixed  | indirect output tax |

Experiment **SIM\_1** is carried out in two steps. The first step is the setting of QR on imported rice. QR is set so that the resulting local price of imported rice is 2.2 times (or 120 percent) the price without QR. This is the average price gap over the period 1995-2001 (Table 9). The second step is the complete elimination of the QR and the reduction in the tariff rates of palay and rice imports from 40 percent to 10 percent. The solutions of the model in the first and second steps are compared to get the impact on resource allocation, household income and consumer prices.

Government income is fixed in the experiment. Thus, any loss in government revenue from the implementation of the policy reform is compensated by an additional indirect output tax. The compensatory indirect output tax is applied in the following manner

$$Pd_i = Pl_i \times (1 + itx_i \times [1 + ntaxr])$$

where  $Pd_i$  is domestic price of sector  $i$ ,  $Pl_i$  the local prices before taxes,  $itx_i$  the indirect tax rate at the base, and  $ntaxr$  the endogenously determined compensatory tax. Note that  $ntaxr$  in this case introduces two effects: (a) it creates an additional wedge between domestic and local prices, and (b) it changes the relative sectoral domestic price, i.e.  $\frac{Pd_i}{Pd_j}$  for sector  $i \neq j$ .

Both will generate inefficiency effects.

Experiment **SIM\_2** is similar to the first except that the direct income tax rates of the following household groups: urb1, rur1 and rur4, are reduced by 50 percent as a poverty-offsetting measure. The loss in government revenue is offset by a compensatory indirect output tax similar to SIM\_1.

Experiment **SIM\_3** is also similar to the first except that government transfers to following household groups: urb1, rur1 and rur4, are increased by 10 percent as a poverty-offsetting measure. Overall government balance is held fixed by introducing an offsetting compensatory indirect output tax similar to SIM\_1.

Experiment **SIM\_4** is also similar to the first except that the price of fertilizer is subsidized by 50 percent by the government as a poverty-offsetting measure. The price subsidy specification is given in Table 13. The subsidy is financed by a compensatory direct income tax, which is applied in the following manner

$$Dy_h = Y_h \times (1 - dtxr_h \times [1 + ntaxr])$$

where  $Dy_h$  is disposable of household  $h$ ,  $Y_h$  is income,  $dtxr_h$  is direct income tax rate at the base, and  $ntaxr$  is the compensatory tax<sup>8</sup>. Price subsidy is negative government income. When the subsidy is implemented,  $ntaxr$  will have a positive value until total government income is maintained as a specified level. A positive  $ntaxr$  will increase the direct income tax rate, which in turn will lead to higher government direct tax revenue and lower household disposable income. Note further that by design, the compensatory tax is progressive in the sense that the increase in the direct income tax is higher for those households with higher direct income tax rate,  $dtxr_h$ . Thus, in this system there is a built-in redistribution effect of the compensatory direct income tax.<sup>9</sup>

Experiment **SIM\_5** is similar to SIM\_4 except that the subsidy is financed by a compensatory indirect output tax similar to SIM\_1.

## VI.B Simulation Results

### VI.B.1 Removal of QR and Reduction in Tariff

**SIM\_1.** Import price of 'rice and corn milling' in local currency ( $\square pm_i$ ) drops significantly by -64 percent as a result of the removal of QR (Table 21). This translates to a surge in rice imports ( $\square m_i$ ) by 3,676 percent<sup>10</sup>. On the other hand, the consumer price ( $\square pc_i$ ) for irrigated palay, non-irrigated palay, and 'rice and corn milling' decline by -4.1 percent, -3.2 percent, and -4.9 percent, respectively. Domestic demand ( $\square d_i$ ) in these sectors also decline. From Equation (18) in Table 12, these results depend upon the parameter  $1/(1+\lambda)$  for these commodities, which is the elasticity of substitution<sup>11</sup>.

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<sup>8</sup> Note that labor supply is fixed. Therefore, the compensatory direct income tax is not distortive in the sense that it does not affect relative commodity prices.

<sup>9</sup> Alternatively, one can specify a compensatory direct income tax that is neutral with respect to distribution.

<sup>10</sup> Although the increase is large, the share of rice imports remains relatively small compared to the share of domestic rice.

<sup>11</sup> The elasticity of substitution for these commodities is high at 3.7 (Table 19). This parameter came from the APEX model (Agricultural Policy Experiment Model, Clarete and Warr, 1002) whose parameters were estimated econometrically using Philippine data.

**Table 21: Effects on Prices and Volume (SIM\_1)**

| Sectors                 | Price Changes (%) |                 |                 |                 |                 | Volume Changes (%) |              |              |              |              |
|-------------------------|-------------------|-----------------|-----------------|-----------------|-----------------|--------------------|--------------|--------------|--------------|--------------|
|                         | $\delta p_{mi}$   | $\delta p_{ci}$ | $\delta p_{di}$ | $\delta p_{li}$ | $\delta p_{xi}$ | $\delta m_i$       | $\delta d_i$ | $\delta q_i$ | $\delta e_i$ | $\delta x_i$ |
| Irrigated Palay         | -26.68            | -4.13           | -4.13           | -4.18           | -4.18           | 164                | -1.93        | -1.90        | 0.00         | -1.93        |
| Non_Irrigated Palay     |                   | -3.20           | -3.20           | -3.24           | -3.24           | 0.00               | -1.56        | -1.56        | 0.00         | -1.56        |
| Corn                    | 0.00              | -1.74           | -1.86           | -1.88           | -1.88           | -7.38              | -0.68        | -1.06        | -0.02        | -0.68        |
| Sugarcane               |                   | -1.07           | -1.07           | -0.99           | -0.99           | 0.00               | 0.34         | 0.34         | 0.00         | 0.34         |
| Livestock               | 0.00              | -0.88           | -0.88           | -0.90           | -0.90           | -1.06              | 0.18         | 0.16         | 0.72         | 0.23         |
| Other Agriculture       | 0.00              | -1.06           | -1.07           | -1.19           | -0.99           | -1.08              | 0.15         | 0.12         | 1.84         | 0.33         |
| <b>AGRICULTURE</b>      | <b>-0.06</b>      | <b>-1.39</b>    | <b>-1.40</b>    | <b>-1.46</b>    | <b>-1.36</b>    | <b>-1.84</b>       | <b>-0.15</b> | <b>-0.18</b> | <b>1.25</b>  | <b>-0.04</b> |
| Food Processing         | 0.00              | -0.38           | -0.49           | -0.40           | -0.40           | -0.40              | 0.10         | 0.06         | 0.00         | 0.16         |
| Rice & Corn Milling /a/ | -64.16            | -4.89           | -3.87           | -3.82           | -3.82           | 3,676              | -1.99        | 1.88         | 0.00         | -1.99        |
| Sugar Milling           | 0.00              | -0.48           | -0.49           | -0.50           | -0.50           | -1.60              | 0.29         | 0.13         | 0.00         | 0.35         |
| Fertilizer              | 0.00              | -0.10           | -0.20           | -0.20           | -0.10           | -0.24              | -0.12        | -0.20        | 0.00         | 0.00         |
| Other manufacturing     | 0.00              | -0.09           | -0.20           | -0.20           | -0.20           | -0.08              | 0.07         | 0.00         | 0.00         | 0.20         |
| Other industry          | 0.07              | -0.19           | -0.20           | -0.20           | -0.10           | -0.23              | -0.10        | -0.12        | 0.00         | -0.09        |
| <b>INDUSTRY</b>         | <b>-0.46</b>      | <b>-0.51</b>    | <b>-0.61</b>    | <b>-0.60</b>    | <b>-0.50</b>    | <b>0.61</b>        | <b>-0.18</b> | <b>0.13</b>  | <b>0.00</b>  | <b>-0.04</b> |
| Transportation          | 0.00              | -0.10           | -0.10           | -0.10           | -0.10           | -0.02              | 0.01         | 0.01         | 0.08         | 0.02         |
| Other Services          | 0.00              | 0.00            | 0.00            | 0.00            | 0.00            | 0.08               | 0.07         | 0.07         | 0.04         | 0.07         |
| Government Services     |                   |                 |                 |                 | 0.10            | 0.00               | 0.00         | 0.00         | 0.00         | -0.01        |
| <b>SERVICES</b>         | <b>0.00</b>       | <b>-0.01</b>    | <b>-0.01</b>    | <b>-0.01</b>    | <b>0.00</b>     | <b>0.07</b>        | <b>0.06</b>  | <b>0.06</b>  | <b>0.05</b>  | <b>0.05</b>  |
| <b>TOTAL</b>            | <b>-0.41</b>      | <b>-0.48</b>    | <b>-0.53</b>    | <b>-0.54</b>    | <b>-0.43</b>    | <b>0.52</b>        | <b>-0.09</b> | <b>0.06</b>  | <b>0.10</b>  | <b>-0.01</b> |

where

$m_i$  : imports

$e_i$  : exports

$d_i$  : domestic sales

$x_i$  : total output

$q_i$  : composite commodity

$p_{di}$  : domestic prices

$p_{li}$  : local prices

$p_{xi}$  : output prices

$p_{qi}$  : composite commodity prices

$p_{mi}$  : import (local) prices

As expected, the general equilibrium impact of this policy change is negative on agriculture, particularly irrigated and non-irrigated palay in terms of price and volume effects. The output price ( $\Delta p_{xi}$ ) of irrigated palay, non-irrigated palay and 'rice and corn milling' drops by -4.2 percent, -3.2 percent, and -3.8 respectively, while the volume of output ( $\Delta x_i$ ) declines by -1.9 percent, -1.6 percent, and -2 percent, respectively.

Incidentally, these results can be reversed to argue that the distortive effects of the QR on rice imports attract resources into palay production and away from other agricultural crops. This movement of resources creates inefficiency in resource allocation within the agriculture sector as well as in the rest of the economy.

One result that ought to be highlighted is the overall decline in consumer prices ( $\Delta p_{ci}$ ) by -0.5 percent. This should be favorable to all consumers in two ways: it increases real consumption and it reduces the nominal value of the poverty threshold as discussed earlier.

**Table 22: Effects on Factors, % (SIM\_1)**

| Sectors               | Value Added Changes (%) |                  | Return to Capital (%) | Labor Demand (%) |             |              |              |
|-----------------------|-------------------------|------------------|-----------------------|------------------|-------------|--------------|--------------|
|                       | $\delta p_{vai}$        | $\delta v_{vai}$ | $\delta r_i$          | L1*              | L2*         | L3*          | L4*          |
| Irrigated Palay       | -4.93                   | -1.93            | -7.27                 | -4.56            | -4.56       | -5.39        | -5.17        |
| Non_Irrigated Palay   | -3.81                   | -1.56            | -5.71                 | -3.29            | -3.29       | -4.13        | -3.90        |
| Corn                  | -2.17                   | -0.68            | -2.95                 | -1.10            | -1.10       | -1.96        | -1.73        |
| Sugarcane             | -1.29                   | 0.34             | -0.89                 | 0.63             | 0.63        | -0.24        | -0.01        |
| Livestock             | -1.09                   | 0.23             | -0.70                 | 0.67             | 0.67        | -0.21        | 0.03         |
| Other Agriculture     | -1.19                   | 0.33             | -0.70                 | 0.69             | 0.69        | -0.18        | 0.05         |
| <b>AGRICULTURE</b>    | <b>-1.68</b>            | <b>-0.07</b>     | <b>-1.61</b>          | <b>0.00</b>      | <b>0.00</b> | <b>-0.41</b> | <b>-0.14</b> |
| Food Processing       | 0.10                    | 0.16             | 0.30                  |                  |             | 0.43         | 0.57         |
| Rice and Corn Milling | -6.11                   | -1.99            | -7.79                 |                  |             | -8.45        | -8.32        |
| Sugar Milling         | 0.20                    | 0.35             | 0.50                  |                  |             | 0.67         | 0.90         |
| Fertilizer            | -0.20                   | 0.00             | -0.20                 |                  |             | -0.06        | 0.13         |
| Other manufacturing   | 0.10                    | 0.20             | 0.30                  |                  |             | 0.38         | 0.57         |
| Other industry        | -0.30                   | -0.09            | -0.30                 |                  |             | -0.28        | -0.14        |
| <b>INDUSTRY</b>       | <b>-0.50</b>            | <b>-0.06</b>     | <b>-0.70</b>          |                  |             | <b>-0.19</b> | <b>-0.06</b> |
| Transportation        | -0.10                   | 0.02             | -0.10                 |                  |             | -0.02        | 0.12         |
| Other Services        | 0.10                    | 0.07             | 0.20                  |                  |             | 0.19         | 0.30         |
| Government Services   | 0.00                    | -0.01            |                       |                  |             | -0.01        |              |
| <b>SERVICES</b>       | <b>0.07</b>             | <b>0.05</b>      | <b>0.18</b>           |                  |             | <b>0.10</b>  | <b>0.20</b>  |
| <b>TOTAL</b>          | <b>-0.46</b>            | <b>-0.01</b>     | <b>-0.43</b>          |                  |             | <b>0.00</b>  | <b>0.00</b>  |
|                       | Average wage -->        |                  |                       | -1.68            | -1.68       | 0.00         | -0.50        |

where

$p_{vai}$  : value added prices

$r_i$  : return to capital

$v_{vai}$  : value added

\*L1, L2, L3, & L4: Labor type 1, 2, 3, & 4

The effects on the factors of production are critical in completing the analysis of the impact on poverty and distribution. Because of the drop in output and price of palay and rice, the demand for factors and the factor prices drop as well. For example, the return to capital used in palay production and in 'rice and corn milling' drops significantly relative to the other sectors (Table 22). The demand for labor also drops in those sectors. Wages for agriculture labor and unskilled production workers decline by  $-1.7$  and  $-0.5$  percent, respectively. Put together the effects on value added are unfavourable to the palay rice sector in general.

The effects on income, weighted consumer prices, poverty and distribution across household groups are summarized in Table 23. Largely because of the drop in factor prices, overall household income declines as QR is removed and tariff on rice imports is reduced. Because this drop is mainly caused by the surge in rice imports, this can thought of as the displacement effect. The largest drop is observed in households in **rur1** ( $-1.4$  percent), followed by **rur4** ( $-0.97$  percent), and **ur1** ( $-0.94$  percent). These households are highly dependent on factor incomes derived from agriculture (Table 18). Furthermore, these household groups have the lowest per capita income (Table 16). Thus, the impact worsens the income inequality problem as indicated by the increase of  $0.24$  percent in the Gini coefficient.

**Table 23: Effects on Household Income, Consumer Prices, and Poverty, % (SIM\_1)**

|                                       | Disposable<br>Income | Consumer<br>Prices /a/ | Poverty   |       |          |
|---------------------------------------|----------------------|------------------------|-----------|-------|----------|
|                                       |                      |                        | Headcount | Gap   | Severity |
| <b>Philippines</b>                    | -0.23                | -0.65                  | -0.08     | 0.04  | 0.08     |
| urb1                                  | -0.94                | -0.73                  | 0.11      | 0.46  | 0.53     |
| urb2                                  | -0.10                | -0.54                  | -1.54     | -1.40 | -1.56    |
| urb3                                  | 0.00                 | -0.50                  | 0.00      | -1.51 | -1.74    |
| urb4                                  | -0.50                | -0.64                  | -0.27     | -0.27 | -0.35    |
| urb5                                  | -0.04                | -0.52                  | -0.97     | -1.18 | -1.26    |
| urb6                                  | -0.32                | -0.42                  | 0.00      | -0.22 | -0.25    |
| rur1                                  | -1.41                | -0.92                  | 0.30      | 0.97  | 1.21     |
| rur2                                  | -0.48                | -0.76                  | -0.98     | -0.63 | -0.70    |
| rur3                                  | -0.11                | -0.66                  | -1.36     | -1.24 | -1.50    |
| rur4                                  | -0.97                | -0.88                  | 0.15      | 0.16  | 0.20     |
| rur5                                  | -0.29                | -0.74                  | -0.55     | -0.95 | -1.22    |
| rur6                                  | -0.69                | -0.79                  | 0.00      | -0.23 | -0.27    |
| <b>Change in<br/>Gini Coefficient</b> | <b>0.243</b>         |                        |           |       |          |

/a/ sectoral consumer prices weighted by household consumption weights

The drop in consumer prices faced by the various household groups mitigated the negative effects on income as indicated by the overall drop in the headcount index of –0.08 percent. However, the drop in consumer prices is not significant enough to counter the negative income effects in critical households with a very high incidence of poverty or the poorest of the poor. For example, the headcount index for **rur1** increases by 0.3 percent, for **rur4** by 0.15 percent, and for **urb1** by 0.11 percent. The worsening of poverty in these groups can also be observed from the larger increases in the poverty gap and severity indices. As these indices give more distributional weight to the poorest below the poverty threshold, this means that the average income of the poor in those household groups has deteriorated further away from the poverty threshold. This also means that the degree of their being poor has increased as the QR on rice is eliminated and tariff on rice imports is reduced.

On the whole, while the overall poverty headcount drops, the elimination of the QR and the reduction in tariff on rice imports can be described as generally not pro-poor. It also worsens the income inequality problem. The drop in consumer prices is not significant enough to mitigate the negative effect on income, especially in household groups where the problem of poverty is severe. The next four experiments implement policy measures that can offset the negative poverty effects on households that are adversely affected, particularly urb1, rur1, and rur4.

#### VI.B.2 QR Removal, Tariff Reduction, and Poverty-Offsetting Measures

Table 24 summarizes the results of the experiments wherein the removal of the QR and the reduction in tariff on rice imports are accompanied by various poverty-offsetting measures. The results for the Philippines and for the three poorest households that are negatively affected by the reform are presented in the table.

**Table 24: Poverty Effects under Various Scenarios (% from base)**

|       |             | Poverty   |        |          | Change in Gini Coefficient |
|-------|-------------|-----------|--------|----------|----------------------------|
|       |             | Headcount | Gap    | Severity |                            |
| SIM_2 | Philippines | -0.450    | -0.608 | -0.761   | 0.032                      |
|       | Urb1        | -1.818    | -2.197 | -2.557   |                            |
|       | Rur1        | 0.000     | 0.142  | 0.181    |                            |
|       | Rur4        | -0.575    | -0.953 | -1.209   |                            |
| SIM_3 | Philippines | -0.674    | -1.194 | -1.523   | -0.144                     |
|       | Urb1        | -1.365    | -1.508 | -1.758   |                            |
|       | Rur1        | -2.062    | -3.136 | -3.901   |                            |
|       | Rur4        | -0.797    | -1.596 | -2.028   |                            |
| SIM_4 | Philippines | -0.398    | -0.579 | -0.761   | -0.056                     |
|       | Urb1        | -0.247    | -0.565 | -0.657   |                            |
|       | Rur1        | -0.680    | -0.714 | -0.893   |                            |
|       | Rur4        | -0.528    | -0.780 | -0.995   |                            |
| SIM_5 | Philippines | -0.209    | -0.300 | -0.373   | 0.095                      |
|       | Urb1        | 0.000     | -0.093 | -0.107   |                            |
|       | Rur1        | -0.167    | -0.238 | -0.294   |                            |
|       | Rur4        | -0.152    | -0.337 | -0.429   |                            |

SIM\_2 involves a 50 percent reduction in the direct income tax rate of the three household groups that is financed by a compensatory indirect output tax. It shows a favorable effect on the overall poverty situation as the three poverty indices indicate negative changes. However, no improvement is observed for rur1, which is the poorest household. This is because this group has almost zero direct tax rate, thus a 50 percent reduction in the rate would not make any difference. Thus, the poverty situation for this group deteriorates. Income distribution also worsens as indicated by the increase in the Gini coefficient because the poorest household group cannot be favorably affected while the other groups can.

SIM\_3 involves a 10 percent increase in government transfers to the three groups that is financed by a compensatory indirect output tax. The overall improvement in poverty is better here than in the previous case as indicated by a larger reduction in all poverty indices. The largest improvement is observed in rur1 because, being the poorest group, it has a larger amount of government transfer. Thus, a 10 percent increase would have greater benefit to this group than to the other two. Also, there is an improvement in the distribution as indicated by a reduction in the Gini coefficient.

SIM\_4 involves a 50 percent fertilizer price subsidy by the government that is financed by a progressive compensatory direct income tax. This experiment also brings about a favorable poverty effect as the three indices show reduction for the three groups. Income distribution also improves. However, the improvement in poverty and distribution is lower compared to SIM\_3.

SIM\_5 also involves a 50 percent fertilizer price subsidy by the government. However, the subsidy is financed by a compensatory indirect output tax, which as shown earlier creates distortionary effects. The results indicate that while the overall poverty as well as the poverty for the three groups improves, the effect is lower compared to SIM\_4. This is because the increase in the indirect tax creates an additional wedge between the Pd and PI in all commodities. Thus, it reduces the full price effects of the removal of the QR, the reduction in tariff, and the fertilizer price subsidy. This additional price wedge is not created in SIM\_4.



Thus, the results of the experiments indicate that the policy that would lead to higher poverty-offsetting effects for the three poorest household groups that are adversely affected by the market reforms in rice is an increase in the direct government transfers to these groups.

## VII. Conclusion and Policy Recommendation

QR on rice will be phased out by the end of 2004. While this policy reform may be justified for efficiency purposes<sup>12</sup>, the displacement effects of the expected surge in rice imports will translate into larger negative income effects for household groups where the problem of poverty is severe. This is because these groups rely heavily on agriculture, particularly palay rice production, which is expected to contract when QR is removed and tariff is reduced. As a result, factor demand and factor prices in agriculture drop. Factor incomes derived from agricultural production decline as well. While all household groups enjoy reduced prices of rice as QR is removed and tariff reduced, the drop in consumer prices is not significant enough to mitigate the decline in income for those groups that are adversely affected. Thus, all poverty indicators for these groups show higher values, which means a worsening of their poverty situation. Furthermore, the overall Gini coefficient increases, which indicates worsening of income inequality.

The policy lesson that may be drawn from the exercise is that while market reform is generally necessary, it has to be carried out carefully, especially if implemented in a critical commodity such as rice. Although market reforms in rice can potentially have favorable effects on consumer prices in general, some household groups may be adversely affected by the expected surge in rice imports. Policy measures may have to be designed to counter these effects. Among the various poverty-offsetting measures experimented in the paper, the results indicate that an increase in direct government transfers to these adversely affected household groups can provide a better safety net. However, this is more of a short-run policy measure. Other policy measures that may have favorable longer-term implications would include productivity improvement through a vigorous program of intensified use of high-yielding rice varieties, irrigation, better farm-to-market roads, as well as measures to encourage the growth of other non-rice crops.

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<sup>12</sup>It has been established numerically in the paper that resource allocation favors palay and rice production over 'other agricultural crops' under a regime of rice protection.

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