PART TWO

Applications of the CGE Modeling Framework for Poverty Impact Analysis

CHAPTER 7

Computable General Equilibrium Model: Can the Poor in Indonesia Benefit from Trade Liberalization?

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Introduction

The latest and ongoing round of trade negotiations under the World Trade Organization (WTO) has become commonly referred to as the Doha Development Agenda (DDA). It was set out in the WTO's Doha Ministerial Declaration in November 2001. Earlier trade negotiation rounds took place under the auspices of the General Agreement on Tariffs and Trade (GATT) but, since 1 January 1995, the WTO has been mandated to discuss international trade issues, including multilateral negotiations to create an open trade environment (Table 7.1). The WTO advocates global free trade to raise standards of living and promote greater employment with a large and steadily growing volume of real income and effective demand.[1]

Table 7.1 **Trade Negotiation Rounds**

Year	*Place/Name*	*Main Subjects*	*Countries*
1947	Geneva	Tariffs	23
1949	Annecy	Tariffs	13
1951	Torquay	Tariffs	38
1956	Geneva	Tariffs	26
1960–1961	Dillon Round	Tariffs	26
1964–1967	Kennedy Round	Tariffs and antidumping measures	62
1973–1979	Tokyo Round	Tariffs, nontariff measures "framework" agreement	102
1986–1994	Uruguay Round	Tariffs, nontariff measures, rules, services, intellectual property, dispute settlement, textiles, agriculture, creation of WTO, etc.	123
2001–present	Doha Development Agenda	Agriculture and services	148

Source: Authors' summary.

The Doha round of WTO negotiations was scheduled to be completed by the end of 2004. When it started in November 2001, members gave

1 WTO is an international trade organization complementing the Bretton Woods institutions of the International Monetary Fund (IMF) and World Bank that were started just after World War II. The 23 founding members of the GATT have expanded into the current 151 members of the WTO.

themselves 3 years to conclude their ambitious agreement to further liberalize trade in goods and services. The agreed emphasis was to help the poorest countries, and most of the benefits were expected to come through agricultural trade liberalization. By mid-2007, a deal was nowhere in sight. The delay is unfortunate but unsurprising, and even predictable given that no global trade round has stuck to its original schedule and that this round faces considerable challenges. The Uruguay Round launched in 1986, for instance, took almost 8 years to complete.

Protectionism is not a monopoly of developing countries, where various kinds of trade barriers are rife. In farm trade, for instance, developing countries have been yearning for better access for their products to developed-country markets, while keeping their domestic markets protected. Various agreements in WTO have achieved significant progress in reducing protection in manufactured products, but a reduction or removal of agricultural protection has been problematic. The existing forms and levels of protection result in a thin international commodity market with a relatively small trade volume and less active agents, making commodity trade flows and world prices volatile. As a result, successful agricultural trade liberalization is a crucial part of the DDA. Reduction in global agricultural trade barriers could improve overall welfare because it would lead to the expansion of markets and efficiency benefits, although the sectoral and distributional effects are difficult to predict beforehand.[2] Another major distortion comes from domestic agricultural and food policies, reflected in the wide gap between international and domestic prices of agricultural products.

The trade liberalization of agricultural products under the DDA is built on the long-term objective of the agreement to establish a fair and market-oriented trading system through a program of fundamental reform. The DDA calls for substantial reductions in trade-distorting domestic support and

[2] International expansion of agricultural markets will make some sectors expand, while others contract. Depending on factor intensities of sectors, factor prices may either increase or decrease following the increasing or decreasing demand for the particular factor, including labor. This in turn will have different effects on different groups of households. Furthermore, factor demands will change, particularly for labor. These will further affect factor incomes of households. Since factor income is a major source of household income, and since household endowments vary considerably within a country, there will be winners as well as losers.

in all forms of export subsidies,[3] as well as improvements in market access. These are the three *pillars* in the agricultural trade liberalization discussions.[4] Potential gains from improvement in market access have been shown to be the most important among the three. Market access is the key to successful liberalization, for it could account for two thirds of the potential global gains and over half of the potential gains to developing countries (Hertel and Keeney 2005). Within the scope for market access, empirical studies have shown that agricultural market access is one of the most potentially significant issues on the DDA (Achterbosch et al. 2005).

Since the start of the Doha round in 2001, the scope for liberalization in agricultural trade has gradually declined. While the intention is clear, the mechanism to attain this goal is vague. This lack of clarity was the main reason for the failure of the trade ministerial meeting in Cancun in September 2003. Since then, developing countries have argued that future progress in negotiations will only be possible with commitments from developed countries to significantly reduce their import barriers and agricultural subsidies, including subsidies on cotton.[5] Fortunately, the consultations in July 2004 resulted in more optimism for DDA success (see footnote 3 below).

The July 2004 package revealed, however, that WTO members agreed on far-reaching exemptions from reforms in individual products (special products for developing countries and sensitive products for developed

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3 Export subsidies have received much criticism from academics and policymakers and are widely believed to be among the most trade-distorting forms of policies. The issue has received high priority in the current Doha round of negotiations. Between the kick-off of the round with the Doha ministerial declaration (WTO 2001) and the general council decision of July 2004 (WTO 2004), the wording on export subsidies changed from "…reductions of, with a view of phasing out …" to a much more ambitious "… ensuring the parallel elimination of all forms of export subsidies." This signals a broad consensus that export subsidies will have to disappear over time. Export subsidies are generally a consequence of domestic policy arrangements that aim at stabilizing and increasing domestic prices in agriculture. The European Union's (EU) Common Agricultural Policy (CAP) provides a case in point. The CAP initially shielded the EU from imports through prohibitive tariffs, allowing the successful implementation of domestic market policies, which subsequently led to excess supply in key commodities. This excess supply had to be removed from the EU market in order to maintain high domestic prices, and this eventually required a disposal of surpluses on world markets at subsidized prices.

4 Domestic support concerns commitments to reduce trade-distorting farm income policies. Export competition concerns the promotion of agricultural exports through direct subsidies, export credits, and subsidy elements in food aid and state trading enterprises, and market access concerns reductions in tariffs and tariff rate quotas.

5 The Special Session of the Committee on Agriculture also aims to ensure appropriate prioritization of the cotton issue independently from other sectoral initiatives, given the importance of this product for some countries.

countries). The ambition to reform domestic support in developed countries has become more moderate and a number of developing countries have become less inclined to open their markets through improved access.

Topics of negotiations for agriculture-sector liberalization in the WTO Ministerial Meeting held in Hong Kong, China, in December 2005 touched on the three core areas of the DDA, namely, domestic support, export competition, and market access. On domestic support, reduction commitments–expressed in Aggregate Measure of Support–is classified into three bands. The European Union will be in the top band, facing the highest linear tariff cuts, the United States and Japan in the middle, and everyone else in the bottom band. Notably, the text specifies that overall cuts in trade-distorting domestic support must at least be equal to or more than the sum of the reductions in *amber-box*, *blue-box,* and *de minimis* (minimal) support. All domestic support measures considered to distort production and trade fall into the amber box, except those in the blue and green boxes which include measures to support prices or subsidies to production (permitted subsidies) that are, however, subject to limits. The *de minimis* supports are allowed up to 5 percent of agricultural production for developed countries and 10 percent for developing countries. Green-box subsidies must not distort trade or, at most, cause minimal distortion. They have to be government-funded, that is, not by charging consumers with higher prices, and must not involve price support. The blue box, on the other hand, is an "amber box with conditions" designed to reduce distortion as subsidies are commonly tied to programs that limit production. Any support that would normally be in the amber box, is placed in the blue box if the support also requires farmers to limit their production.

For export competition, the deadline for the parallel elimination of all forms of export subsidies including food aid, subsidized export credit and insurance, and trading by state enterprises is set for the end of 2013. A substantial part of the elimination is to be realized by the end of the first half of the implementation period. The deadline is, however, tentative–pending the resolution of core modalities, that is, the formula for cutting tariffs and subsidies. There is a clear convergence on a number of elements of disciplines with respect to export credits, export credit guarantees, or insurance programs with repayment periods of 180 days and below.

In the improving market access issue, tariffs reduction within four bands has been structured, ranging from low to high, with a provision that tariffs in the higher band will be subject to deeper cuts. This amounts to the acceptance of a nonlinear approach to agriculture tariff reduction advocated by developed countries.

A series of meetings has been conducted following the WTO meeting in Hong Kong, China, with the main purpose of converging on the drafting and finalization of modalities. Unfortunately, agreements have not been achieved.

For an individual country, the DDA relates directly to the domestic system of protection reflected in (among others) commodity taxation[6] and industrial policy. Subsidies and import tariffs, for instance, are usually employed to protect domestic industry. Accordingly, the DDA can be thought of as part of efforts to make the tax system less distorting, more transparent, and therefore more amenable to the administrative capacity of developing countries. This has been a main reason for past tax reforms (Rao 1993, World Bank 1991a).[7]

As a major agricultural importer and exporter, Indonesia is actively participating in the negotiation process. It has a major stake in global efforts to liberalize agricultural trade. However, given the prevailing, quite liberal, trade regime in Indonesia, the expected overall impacts on national income, trade, and production could be limited. Agricultural liberalization offers

6 Two important aspects of a tax system are the level and structure of taxation. In developing countries, the level of taxation (measured by its share in gross domestic product) varies widely and relates not only to per capita income but also to other factors. On the structure of taxation, the incidence of indirect tax becomes increasingly important, while that of personal income and other direct taxes remains very low. The indirect tax is also characterized by substitution between taxes on international trade and domestic indirect taxes as the economy develops. The role of international trade taxes is usually very important in the early stages of development, but then becomes substituted by domestic indirect taxes. In developing countries, revenue from indirect taxes constitutes on average almost 60 percent of total tax revenue, while the share of personal income taxes remains very small (Rao 1993).

7 Important issues associated with tax reforms in developing countries include how tax (government) revenue is going to be raised and what the consequences of the different options are. This should be perceived in the context of existing government subsidies, import tariffs, and other taxation measures that also reflect domestic protection. A best practice approach to tax reforms includes replacing quantitative restrictions with tariffs, simplifying the tax structure, broadening the tax base, levying lower and uniform tax rates, and exempting taxes on intermediate inputs. A removal of quantitative restrictions avoids rent-seeking activities; a simpler tax structure is easier to administer; a broader tax base yields larger revenues; a lower and uniform tax rate reduces unintended distortions (besides also being easier to administer); and an exemption on intermediate input taxes may encourage domestic production. The best approach to successful tax reform seems to be a pragmatic combination of theory and past reform experience, taking into account administrative, political, and information constraints. "Good" tax reform does not merely change the existing tax system but also includes tax administration and acceptability. These can be the keys to success in tax reform (Bird 1992, Bird and Oldman 1990). Timing and sequencing are also important in designing tax reform. Most successful tax reforms (Japan in 1949/50, Korea in 1962–1965, and Indonesia in 1983–1986) were carried out at a later stage as an integral part of economic reforms (Rao 1993).

positive prospects for externally demanded goods, such as vegetable oils and animal products, while small adverse impacts on the protected rice and sugar sectors can be expected.

Main Purpose

Several important questions arise from the discussion above. First, is there any justifiable reason for agricultural protection in developing countries such as Indonesia? Second, what would be the effects of farm trade liberalization such as what might result from the DDA? Furthermore, as most farm producers are poor farmers, to what extent would the poor benefit from the DDA? Finally, would simultaneous liberalization in other sectors alter the welfare implications of agricultural trade liberalization?

A computable general equilibrium (CGE) model of the Indonesian economy based on the social accounting matrix (SAM) in 1993[8] was developed to answer these important questions by assessing the economy-wide, welfare, and distributional implications of Doha scenarios, especially with respect to different groups of households. The assessment included welfare costs of existing sectoral taxation to view agricultural protection in a broader context. Trade liberalization scenarios were introduced to illuminate the benefits and costs of trade liberalization as in the DDA. This included a complete removal of tariffs on agricultural products, which was then combined with a complete removal of counterpart domestic taxes on agricultural products. The former was to represent a case of complete international access while the latter was to capture the far reaching globalization of agricultural markets. Finally, a full trade liberalization scenario covering all sectors was used to place agricultural liberalization in the broader DDA context.

The next section of this paper provides an overview of Indonesian trade liberalization policies, first highlighting the major developments of Indonesia's foreign trade policy, and then as linked with the DDA. This is followed by a discussion of the main features of the Indonesian CGE model developed in this study. The modeling development itself is presented in Appendix 7.1. The model is then used to measure the welfare costs of existing commodity taxation and marginal excess burden. The former is to assess the sectoral welfare costs due to the commodity taxation imposed, while the latter is to determine if a sector or product is already overtaxed. Effects of removing tariffs on agricultural products are then examined, and combined

8 A more recent SAM has been compiled, but as it still reflects disruptions resulting from the 1997 Asian financial crisis, the 1993 SAM could be more representative of long-term trends in the economy. Real GDP estimates for Indonesia are also based on 1993 data.

with the removal of corresponding domestic taxation. The economic effects and distributional implications of these two policy options, as well as full liberalization, are examined in the last section, which includes conclusions and policy implications.

Trade Liberalization and the Doha Agenda in the Indonesian Context

During the first two decades following Indonesia's independence in 1945, trade taxes continued to be the main source of government revenue, leading to the imposition of devices such as multiple exchange rates and export surcharges. The adoption of a *guided economy* approach at that time led to the government expanding controls over the means of productions by nationalizing foreign companies and introducing various quantitative restrictions. On the fiscal side, it was common for the government to print money to finance its budget deficits. Since 1967, the new government has adopted a "balanced budget"[9] policy, preventing the government from printing money or issuing debt securities to finance its deficits, relying instead on foreign funds to balance the budget. At the same time, the capital account was opened, allowing the private sector to gain access to foreign funds.

In the early 1980s, Indonesia experienced a sharp deterioration in its terms of trade and balance of payments from declining world prices for oil and primary commodities, rising international interest rates, and decreasing foreign capital inflows.[10] These external shocks seriously disrupted development plans and induced extensive structural adjustments. The adjustments were first aimed at restoring external creditworthiness, but then led to changes in the government's development strategy from being public sector–led with an import-substitution industry and repressed financial sector to being private sector–led and export-oriented with a market-based financial sector. The adjustments were also adopted to reduce distortionary threats arising from expansionary policies inherited from the previous oil-boom decade.[11]

9 This "balanced budget" reflects a political meaning since foreign aid and loans for development are counted as government revenue rather than sources of financing.

10 These external shocks severely hit most highly indebted countries, which then led to the international debt crisis in 1982.

11 Oil prices in world markets increased in 1973/74 and 1978/79, bringing a substantial increase in government revenue. This oil boom, however, led to the over allocation of domestic resources to the booming sector. This "Dutch Disease" phenomenon was then accompanied by overoptimistic predictions of oil prices from the government side. This seriously affected government-planned expenditures since more than two thirds of government revenues at that time were from oil.

These voluntary structural adjustments[12] proved successful in restoring the external situation and providing more favorable conditions for the domestic economy. The policy measures taken included massive devaluations, tax reforms, and trade liberalization. Table 7.2 summarizes trade liberalization measures adopted by the Indonesian government since 1945 (the year of independence) up to the present, classified into six stages to reflect the different government policies in those times.

Despite progress, some problems remain. The government has been reluctant to implement economic reforms as most major policy changes in Indonesia have traditionally been linked to major political and economic crises. It seems that only a crisis can be counted on to trigger the necessary political will to embark on economic reform. Furthermore, most of the changes have also been generated by a fall in petroleum prices or other external problems, such as in the balance of payments. Policy reforms in Indonesia can therefore be thought of as an overall restructuring strategy in response to external factors rather than being motivated by the benefits of economic reform (Pangestu 1996, Hill 1996). In many instances, trade and industrial policy reverted to protectionism and hence became distortionary once problems in the external sector were resolved. As a result, export earnings and government revenue are still highly vulnerable to changes in prices of oil and primary commodities in world markets. Progress on removing the existing barriers and other distortions in domestic markets has neither been very successful nor straightforward.[13]

A further examination of government sources of income reveals that, over the period 1985–1993, the government was becoming increasingly reliant on commodity taxation (see Table 7.3). Revenue from these taxes contributed 15 percent of government income in 1985, which then doubled to 30 percent in 1990, and increased further to 36 percent by 1993. More than a quarter of that revenue was derived from import tariffs, implying that foreign trade policies became more protectionist while domestic industry was increasingly distorted. Revenue from tariffs on agricultural products contributed less than 1 percent of government income, making a good case for agricultural product trade liberalization. The role of domestic commodity taxation on agricultural products in generating government revenue was more significant, although it declined from 6.2 percent in 1985 to 2.7 percent in 1993 (Table 7.4). Detailed information on the structure and level of commodity taxation

12 As distinguished from structural adjustments conducted as part of conditional loans provided by the IMF and the World Bank.

13 Up to mid-July 1997 (just before the crisis started), for example, both price and nonprice controls were still prevalent, especially on transport services, public utilities, fuel products, and other basic and strategic commodities.

Table 7.2 **Summary of Trade Liberalization Measures Adopted by the Indonesian Government, 1945–2007**

Trade Liberalization Measures Adopted in Each Period					
The Chaotic Years (1945–1965)	*Stabilization and Rehabilitation (1966–1973)*	*The Oil Windfalls and Boom Years (1974–1981)*	*Adjustment to External Shocks (1982–1984)*	*Further Trade Liberalization (1985-mid–1997)*	*The Economic Crisis and Beyond (1997–to date)*
• High inflation and frequent economic policy/government changes • Dominant role of taxation on trade • Multiple exchange rates, export surcharges, quantitative restrictions on imports and tariffs	• New investment law, development plan and balanced budget • Abolition of multiple exchange rates and peg to US dollar • Adoption of an open capital account	• Dominant role of oil • Nontradable and import-substituting industry • Dutch disease • Ignoring trade liberalization • More protective	• International debt and Mexico crises • Tax and financial reforms • Export promoting measure (TRIMs) • "Approved" importer system • Promoting use of domestic products • Ambivalence toward trade liberalization	• Regionalism of AFTA & APEC • Signing of GATT Code (on subsidies and countervailing duties) • Rationalization tariffs • Deregulation of shipping and custom unions • Duty exemption and duty drawback • Removal of export licenses and converting quota restrictions with tariffs	• The Asian Crisis and IMF package • Further reductions of tariffs • Abolition of export taxes and import restrictions • Liberalization of domestic markets • Post IMF era and new government's commitments to reduce more tariffs and nontariff barriers

Source: Authors' summary.

presented in Tables 7.5 and 7.6 further reveals that not only did the tax rate increase, but so did its dispersion. Increased taxation was applied to both domestic commodities and imports. Note that all taxes and tariffs as well as their dispersion increased over the periods of 1985–1990, 1990–1993, and 1985–1993, except for import tariff dispersion from 1985 to 1990.

Further trade liberalization seems inevitable given the Indonesian government's commitments to the WTO, Asia-Pacific Economic Co-operation (APEC) forum, and Association of South East Asian Nations (ASEAN) to move toward freer international trade. Moreover, tariff reduction, in conjunction with other measures, such as domestic tax reform and the replacement of quantitative restrictions by tariffs, has also been part of the policy package of International Monetary Fund–World Bank conditional loans made to the Indonesian government in the past. The DDA is likely to strengthen trade liberalization in the form of further reductions in tariff and nontariff barriers and all kinds of domestic support such as export subsidies. Foreign or border trade liberalization is likely to be followed by domestic market liberalization,

Table 7.3 **Government Income by Source**

	1985		*1990*		*1993*	
Source of Income	*Value (billion Rp)*	*Share (%)*	*Value (billion Rp)*	*Share (%)*	*Value (billion Rp)*	*Share (%)*
Factor Income/Capital payments	66.9	0.4	1937.8	4.7	4249.8	6.9
Taxation on						
• Households	1817.7	9.7	1997.8	4.8	3848.4	6.2
• Firms/Corporate	13998.3	74.9	24845.3	59.9	31014.8	50.1
• Commodity/Sector	2789.9	14.9	12269.4	29.6	22355.8	36.1
- Domestic	2029.2	10.9	9204.5	22.2	15963.7	25.8
- Import Tariff	760.6	4.1	3064.9	7.4	6392.1	10.3
Rest of the world	29.7	0.2	464.9	1.1	398.5	0.6
Total	18702.4	100.0	41515.2	100.0	61867.2	100.0

Rp = rupiah
Sources: Calculated from the Indonesian SAMs for 1985, 1990, and 1993.

Table 7.4 **Government Revenue from Commodity Taxation (billion Rp)**

Commodity/ Taxation	*1985*		*1990*		*1993*	
	Revenue	*%*	*Revenue*	*%*	*Revenue*	*%*
Agriculture	173.04	6.2	401.34	3.3	610.23	2.7
Nonagriculture	1856.18	66.5	8803.16	71.7	15353.42	68.7
Subtotal	2029.22	72.7	9204.5	75.0	15963.65	71.4
Import Tariff						
Agriculture	13.54	0.5	17.11	0.1	102.98	0.5
Nonagriculture	747.09	26.8	3047.83	24.8	6289.12	28.1
Subtotal	760.63	27.3	3064.94	25.0	6392.1	28.6
Total	2789.85	100.0	12269.44	100.0	22355.75	100.0

Rp = rupiah
Sources: Calculated from the Indonesian SAMs for 1985, 1990, and 1993.

Table 7.5 **Structure and Level of Indirect Commodity Taxation in Indonesia in 1985, 1990, and 1993**

Sector/Commodity	1985			1990			1993			Change in Tax Rate (%)		
	Domestic Commodities (billion Rp)	Revenue (billion Rp)	Tax Rate (%)	Domestic Commodities (billion Rp)	Revenue (billion Rp)	Tax Rate (%)	Domestic Commodities (billion Rp)	Revenue (billion Rp)	Tax Rate (%)	1985–1990	1990–1993	1985–1993
Food Crops	14511.83	97.99	0.68	28510.70	201.23	0.71	35644.84	250.83	0.70	0.03	0.00	0.03
Other Agriculture	13861.25	75.05	0.54	24273.88	200.11	0.82	40866.67	359.40	0.88	0.28	0.06	0.34
Mining	16706.27	20.94	0.13	28375.57	244.44	0.86	35429.98	319.89	0.90	0.74	0.04	0.78
Food Processing	15837.01	677.36	4.28	35298.07	2964.19	8.40	63452.83	6208.18	9.78	4.12	1.39	5.51
Textile	3403.43	32.16	0.94	47156.23	781.87	1.66	80964.10	1363.63	1.68	0.71	0.03	0.74
Construction	20188.33	273.03	1.35	13984.44	191.44	1.37	20336.52	277.75	1.37	0.02	0.00	0.01
Paper and Metals	6504.99	130.84	2.01	20962.82	736.22	3.51	32990.27	1164.09	3.53	1.50	0.02	1.52
Chemicals	19385.74	-682.93	-3.52	40365.52	-484.28	-1.20	61641.10	-771.36	-1.25	2.32	-0.05	2.27
Utilities	1801.91	0.71	0.04	4487.62	19.42	0.43	8252.97	42.92	0.52	0.39	0.09	0.48
Trade	14319.47	877.31	6.13	30874.61	2505.63	8.12	54570.79	3769.46	6.91	1.99	-1.21	0.78
Restaurants	4688.90	135.92	2.90	12028.01	521.78	4.34	18428.32	799.43	4.34	1.44	0.00	1.44
Hotels	933.91	34.82	3.73	2146.18	91.42	4.26	3452.16	147.04	4.26	0.53	0.00	0.53
Land Transport	5614.39	67.12	1.20	11017.22	180.55	1.64	18835.54	313.18	1.66	0.44	0.02	0.47
Other Transport and Communications	3124.32	11.65	0.37	8892.87	74.13	0.83	17047.07	125.76	0.74	0.46	-0.10	0.36
Banking and Insurance	3102.45	17.48	0.56	11420.34	96.69	0.85	19394.18	161.07	0.83	0.28	-0.02	0.27
Real Estate	4831.42	147.71	3.06	9476.41	457.16	4.82	17239.76	802.90	4.66	1.77	-0.17	1.60
Public Services	10547.63	44.58	0.42	18347.00	194.38	1.06	26128.04	304.26	1.16	0.64	0.11	0.74
Personal Services	5030.62	67.48	1.34	11497.83	228.12	1.98	16939.40	325.22	1.92	0.64	-0.06	0.58
Total	*164393.90*	*2029.22*	*1.23*	*359115.30*	*9204.50*	*2.56*	*571614.50*	*15963.65*	*2.79*	*1.33*	*0.23*	*1.56*
Standard deviation			2.08			2.62			2.68			

Sources: Calculated from the Indonesian SAMs for 1985, 1990, and 1993.

reflected in reductions in commodity taxation in the domestic market. This is to make domestically produced goods competitive with imported products. The liberalization of both international and domestic markets for agricultural products is also in line with the DDA on improving market access "behind the border." This liberalization is captured in the modeling simulation.

Main Features of the Model

The CGE model was developed using the Indonesian SAM for 1993. The economy concerned is an open economy, with transactions between the domestic economy and the rest of the world (ROW) in the product (i.e., export and import) markets, factor markets, and capital markets. Production activities are classified into 18 categories, and the commonly used assumption that one sector produces only one good is adopted, so that classifications for sectors and commodities are exactly the same. Each production activity is modeled as a Leontief production function of intermediate inputs and value added. The intermediate input is an Armington aggregation of domestically produced and imported commodities, while the value added is a Cobb-Douglas function of different kinds of labor and capital. Labor is categorized into 8 groups, based on a combination of sector, type of workers, and job status. Some wages (for farmers and production workers) are fixed–allowing for unemployment–to reflect excess supply and various government interventions to control their wages. Wages for other types of workers are allowed to adjust according to their market-clearing levels, which also reflect the marginal productivity of labor. On the capital side, capital is classified into 5 categories based on ownership and the nature of capital.

Households are classified into ten groups, based on a combination of income sources, area of residence, and job status of the head of household (Table 7.7). First, households are divided into agricultural and nonagricultural households. The former is then split into landless employee farmers, small farmers (land size <0.5 hectare), medium farmers (between 0.5 and 1.0 hectare) and large farmers (>1.0 hectare). For the nonfarmers, the disaggregation is based on area of residence (urban and rural), level of income, and a combination of occupation and job status. Based on these variables, the nonfarmers in each area are then classified into low, dependent,[14] and high-income groups. As can be seen, the household classification has been developed based on "real" variables that can easily be identified for policy targeting, which is common in the development of a SAM. Other institutions in the economy are firms, government, and the ROW. Figure 7.1 shows that in terms of per capita income, landless farmers (agricultural employees) and small farmers are among the poorest groups. Their income level is less than one fourth

14 The dependent household group refers to households where the head of the household is not in the labor force, relying instead on income transfers from profit and rental income, relatives, friends, and government.

Table 7.6 **Structure and Level of Import Tariffs in Indonesia in 1985, 1990, and 1993**

Sector/Commodity	1985			1990			1993			Change in Tariff Rate (%)		
	Import (billion Rp)	Revenue (billion Rp)	Tariff Rate (%)	Imports (billion Rp)	Revenue (billion Rp)	Tariff Rate (%)	Imports (billion Rp)	Revenue (billion Rp)	Tariff Rate (%)	1985–1990	1990–1993	1985–1993
Food Crops	421.97	6.92	1.64	632.82	16.26	2.57	1425.18	55.47	3.89	0.93	1.32	2.25
Other Agriculture	391.38	6.62	1.69	198.82	0.85	0.43	449.85	47.51	10.56	-1.26	10.13	8.87
Mining	1157.49	9.53	0.82	2567.25	3.59	0.14	2414.61	38.47	1.59	-0.68	1.45	0.77
Food Processing	211.57	17.86	8.44	1302.65	24.58	1.89	2614.25	310.47	11.88	-6.55	9.99	3.43
Textiles	148.82	15.04	10.11	37.77	1.34	3.55	87.37	20.06	22.96	-6.56	19.41	12.85
Construction	3.53	0.57	16.15	2599.68	226.98	8.73	4901.88	278.18	5.67	-7.42	-3.06	-10.47
Paper and Metals	6393.00	505.20	7.90	23330.13	2202.88	9.44	34970.91	3359.83	9.61	1.54	0.17	1.71
Chemicals	3797.24	195.73	5.15	12317.40	575.91	4.68	18873.12	2242.40	11.88	-0.48	7.21	6.73
Public Services	717.54	0.58	0.08	1587.09	0.07	0.00	2867.21	0.71	0.02	-0.08	0.02	-0.06
Personal Services	246.38	2.48	1.01	964.61	12.46	1.29	1796.20	39.00	2.17	0.29	0.88	1.16
Total	*13488.92*	*760.53*	*5.64*	*45538.22*	*3064.92*	*6.73*	*70400.58*	*6392.10*	*9.08*	*1.09*	*2.35*	*3.44*
Standard deviation (%)			5.27			3.41			6.86			

Sources: Calculated from the Indonesian SAMs for 1985, 1990, and 1993.

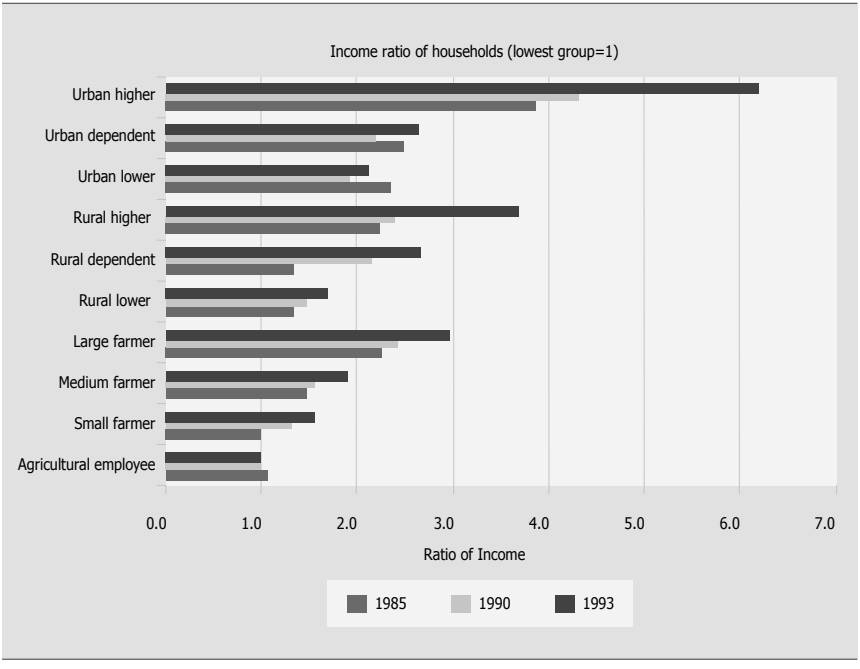
that of the nonagricultural high–income group in urban areas (urban higher). Another group that is relatively poor is the nonfarmer low–income group in rural areas (rural lower). These three groups of poor households, which constitute around 45 percent of total households, are the most important focus in the examination of the poverty impact of the DDA (see Table 7.7 for details).

Table 7.7 **Number of Households by Type and Annual Per Capita Income in 1985, 1990, and 1993**

Types of Household	*1985*			*1990*			*1993*		
	Number (million)	*(%)*	*Income (000 Rp)*	*Number (million)*	*(%)*	*Income (000 Rp)*	*Number (million)*	*(%)*	*Income (000 Rp)*
Agricultural employee	11.5	7.01	255.1	15.7	8.7	441.5	18.7	10.0	508.0
Small farmer	39.1	23.8	242.1	49.7	27.6	575.1	51.3	27.4	798.1
Medium farmer	13.1	8.0	358.9	11.2	6.2	692.5	11.6	6.2	960.1
Large farmer	15.9	9.7	548.6	11.6	6.5	1065.2	12.0	6.4	1507.0
Rural lower	21.9	13.4	323.6	16.2	9.0	650.5	16.6	8.9	862.3
Rural dependent	8.4	5.1	322.3	2.8	1.6	946.3	2.9	1.6	1350.0
Rural higher	13.4	8.2	538.0	23.7	13.2	1061.7	24.3	13.0	1878.3
Urban lower	20.7	12.6	572.1	22.7	12.6	844.9	23.3	12.4	1081.6
Urban dependent	6.3	3.8	600.1	4.7	2.6	967.3	4.8	2.6	1344.7
Urban higher	13.8	8.4	935.3	21.5	12.0	1899.8	22.1	11.8	3138.5
Total	*164.1*	*100.0*	*438.3*	*179.8*	*100.0*	*881.8*	*187.6*	*100.0*	*1303.6*

Sources: Calculated from the Indonesian SAMs for 1985, 1990, and 1993.

Figure 7.1 **Ratios of Income of Different Types of Households: 1985–1993**



Source: Calculated from the Indonesian SAMs for 1985, 1990, and 1993.

Armington specification is employed to introduce imperfect substitutability characteristics between domestically produced and imported commodities. This feature is especially important for trade policy issues, as the assumption of perfect substitutability would systematically exaggerate the power that trade policy has over the domestic price system and economic structure. The assumption of perfect substitutability would also rule out the possibility of two-way trade of the same commodity group. On the other hand, treatment of domestically produced and imported commodities as perfect complements would introduce a great deal of rigidity, because it would imply a tendency toward a high degree of specialization, which mostly contradicts the facts. In this case, trade policy–induced changes in relative prices, such as changes in the exchange rate, would have no direct effect on the structure of the economy. This would create a foreign exchange gap that could not be alleviated by trade and exchange rate policies (Dervis, de Melo, and Robinson 1982).[15]

Production is specified as two-level nesting of Leontief and Cobb-Douglas functions and total production is allocated to domestic demand and exports. On the import side, the "small-country" assumption is adopted, meaning that the domestic economy is a price taker for imports. The final demand in the domestic economy consists of household consumption, government consumption, and investment. Households maximize Cobb-Douglas utility functions, while the government is assumed to have planned consumption, which is not affected by commodity prices or the government's income. Government saving is, accordingly, residual. The government (and domestic firms) also has access to foreign borrowing for balancing its budget. Consistent with the government consumption behavior, aggregate investment is fixed, reflecting the "investment-driven" nature of the economy.

Since it is impossible to determine absolute price levels in a general equilibrium model, it is necessary, therefore, to establish relative prices by setting one price as the numeraire. If the model is going to be used as a tool of policy analyses and formulation: "...it is best to use a price-normalization rule that provides a 'no-inflation' benchmark against which all price changes are relative price changes" (Shoven and Whalley 1992). In this model, the price of the ROW account is used as a numeraire. Accordingly, all prices will be measured relative to the "world price" (the price of the ROW account measured in domestic currency) and the domestic price level then appears based on a real foundation (Drud, Grais, and Pyatt 1986). Given the choice

15 See Greenaway et al. 1993, Shoven and Whalley 1992, and Robinson 1989 for fuller discussions of CGE modeling.

of numeraire, it is also implicitly assumed that the exchange rate is fixed and balance of payment deficits are endogenously determined by the model.[16]

The poor households in the model are affected by trade liberalization through several channels. First, reallocation of resources across sectors triggered by the new relative prices affects overall growth and volume of factor demand. Second, poor countries like Indonesia have generally abundant labor and if resource reallocation takes place in favor of labor, the poor might benefit relatively more in the reform process. Third, the poor households, as consumers, could benefit from availability of cheaper goods, specially the food products, in the market.

Simulation Analysis

The simulation analysis is conducted by: first, calculating welfare costs of the existing commodity taxation; second, the near marginal–tax incidence; and third, DDA simulations. The first calculation indicates the magnitude as well as the share of welfare costs of the existing commodity taxation. As the calculation is conducted for each commodity, the results therefore indicate which sectors and commodities are relatively more distorted than others. The second calculation shows how a small (marginal) increase in the commodity tax will affect total welfare so that one can determine whether the particular commodity is already over- or undertaxed. The last (third) set of simulations explore how the results of the DDA in agriculture might be reflected, first, in complete liberalization of agricultural tariffs, second, combined with complete liberalization of domestic agricultural taxation and, third, with liberalization of other sectors.

16 The assumption of an endogenous balance of payments deficit, however, suffers from the criticism that there will be seemingly unlimited foreign borrowing available to the domestic economy (Robinson 1989). Nevertheless, the empirical situation prior to the Asian crisis suggests this choice is reasonable. As far as foreign borrowing is concerned, the problem for Indonesia is more in limiting than in getting foreign loans. This may be due to the fact that while the position of the government's foreign loans at that time was already high, the loans were mostly in the form of long-term concessional loans with relatively long grace periods. In addition, the government has consistently made debt repayments a priority, thus maintaining credit-worthiness in the international debt market. Pack and Pack (1990), for instance, concluded that the foreign loans have stimulated private investments. Fane (1996) also suggested that the accumulation of Indonesian foreign loans has been reflected more in the growth of investment than in the growth of consumption. In 1994, Indonesia—as the head of the Non-Aligned Movement—was even asked to help manage foreign loans of other low-income highly indebted countries (*Far Eastern Economic Review*, September 1994).

Welfare Costs of the Existing Commodity Taxation

The welfare costs (loss) of the existing commodity taxation can be calculated for both tariffs and indirect taxes on domestic commodities. The results are then compared with sectoral outputs and tax revenues.[17] Table 7.8 shows that some sectors are much more distorted than others. For example, the three sectors of textiles, food processing, and chemicals each contribute more than 10 percent of total output (i.e., 14.2, 11.1, and 10.8 percent, respectively), but their contributions to the tax revenue amounted to 38.90, 8.54, and even –4.83 percent (i.e., the net subsidized chemical sector). Another sector that contributes nearly 10 percent of output but has more significant contribution in tax revenues is the trade sector. Its output share is about 9.6 percent but it contributes 23.6 percent of total indirect taxes from domestic commodities. This sectoral imbalance is made worse by its impacts on welfare. Roughly two thirds of the welfare loss originated from the food processing industry (52 percent) and the trade sector (15 percent).

The sectoral imbalance is also recorded on the import side, as most government revenues from tariffs were collected from paper and metal products (about 53 percent) and chemicals (35 percent). The latter results from protecting the domestic chemicals sector. Note that the welfare impact of tariffs differs from that of domestic taxation. Welfare costs of sectoral tariffs are in line with the value of sectoral imports, making them more predictable. Welfare loss of commodity taxation is also predictable since it is in line with value of tax collection.

The welfare-cost impacts show that the existing indirect taxes and tariffs generate relatively high distortions in the economy. For every unit of indirect tax collected, there are 1.3 units of welfare costs, while for imports the ratio is 0.8. This suggests that the existing tax system is not an efficient mechanism for collecting revenues. Sectors with the ratio of welfare cost to revenue collected more than unity are food crops, other agriculture, food processing, construction, utilities, restaurants, banking and insurance, real estate, and public and personal services.

On the import side, the most distortionary tariffs are those on food processing and construction, (118 and 101 percent, respectively). Food processing is also among the most highly taxed sectors in the domestic market, amounting to 39 percent of total indirect tax on domestic commodities.[18]

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17 See Shoven and Whalley (1984) and Ballard et al. (1985) for detailed discussions on this topic.

18 Food processing contributed around 11 percent of the total output in 1993 (CBS 1996).

Table 7.8 **Welfare Costs of the Existing Commodity Taxation, 1993**

Indirect Taxation

Sector / Commodity	Output		Tax Revenue		Welfare Costs		Welfare Costs as % of			
	Value (billion Rp)	(%)	Value (billion Rp)	(%)	Value (billion Rp)	(%)	Sector Output	Total Output	Sector Tax	Total Tax
Food Crops	35,644.8	6.24	250.80	1.57	485.8	2.41	1.36	0.08	193.66	3.04
Other Agriculture	40,866.7	7.15	359.40	2.25	499.6	2.48	1.22	0.09	139.00	3.13
Mining	35,430.0	6.20	319.89	2.00	145.9	0.72	0.41	0.03	45.62	0.91
Food Processing	63,452.8	11.10	6208.18	38.89	10427.7	51.75	16.43	1.82	167.97	65.32
Textiles	80,964.1	14.16	1363.63	8.54	741.3	3.68	0.92	0.13	54.37	4.64
Construction	20,336.5	3.56	277.75	1.74	282.2	1.40	1.39	0.05	101.61	1.77
Papers and Metals	32,990.3	5.77	1164.09	7.29	1018.8	5.06	3.09	0.18	87.52	6.38
Chemicals	61,641.1	10.78	-771.36	-4.83	-620.2	-3.08	-1.01	-0.11	80.41	-3.89
Utilities	8,253.0	1.44	42.92	0.27	45.7	0.23	0.55	0.01	106.46	0.29
Trades	54,570.8	9.55	3769.46	23.61	2959.4	14.69	5.42	0.52	78.51	18.54
Restaurants	18,428.3	3.22	799.43	5.01	1025.1	5.09	5.56	0.18	128.23	6.42
Hotels	3,452.2	0.60	147.04	0.92	138.5	0.69	4.01	0.02	94.18	0.87
Land Transport	18,835.5	3.30	313.18	1.96	279.8	1.39	1.49	0.05	89.34	1.75
Other Transportation and Communication	17,047.1	2.98	125.76	0.79	114.4	0.57	0.67	0.02	90.94	0.72
Banking and Insurance	19,394.2	3.39	161.07	1.01	168.6	0.84	0.87	0.03	104.70	1.06
Real Estate	17,239.8	3.02	802.90	5.03	839.2	4.16	4.87	0.15	104.52	5.26
Public Services	26,128.0	4.57	304.26	1.91	322.6	1.60	1.23	0.06	106.04	2.02
Personal Services	16,939.4	2.96	325.22	2.04	401.5	1.99	2.37	0.07	123.45	2.52
Total	*571,614.5*	*100.00*	*15963.70*	*100.00*	*20151.1*	*100.00*	*3.53*	*3.53*	*126.23*	*126.23*

Imports

Sector / Commodity	Imports		Tariff Revenue		Welfare Costs		Welfare Costs as % of			
	Value (billion Rp)	(%)	Value (billion Rp)	(%)	Value (billion Rp)	(%)	Sector Import	Total Import	Sector Tariff	Total Tariff
Food Crops	1425.2	2.02	55.47	0.87	13.93	0.28	0.98	0.02	25.11	0.22
Other Agriculture	449.9	0.64	47.51	0.74	40.12	0.80	8.92	0.06	84.44	0.63
Mining	2414.6	3.43	38.47	0.60	30.97	0.61	1.28	0.04	80.50	0.48
Food Processing	2614.2	3.71	310.47	4.86	365.03	7.24	13.96	0.52	117.57	5.71
Textiles	87.4	0.12	20.06	0.31	2.70	0.05	3.09	0.00	13.45	0.04
Construction	4901.9	6.96	278.18	4.35	280.93	5.58	5.73	0.40	100.99	4.39
Paper and Metals	34970.9	49.67	3359.83	52.56	2408.84	47.81	6.89	3.42	71.70	37.68
Chemicals	18873.1	26.81	2242.40	35.08	1870.88	37.13	9.91	2.66	83.43	29.27
Total	*70400.6*	*100.00*	*6392.10*	*100.00*	*5038.63*	*100.00*	*7.16*	*7.16*	*78.83*	*78.83*

Rp = rupiah
Sources: Output and tax revenue were calculated from the Indonesian SAMs for 1993, while the welfare costs were from simulation results.

Furthermore, using a ratio of sectoral welfare loss to revenue of one half as a cutoff point for the possibility of raising taxes to increase revenue, it seems that this can only be done through increasing taxation in mining and textiles. On the import side, this can be made possible with increasing tariffs on food crops and textile products.

Total welfare losses associated with the implementation of indirect taxation on domestic commodities is nearly four percent of the total production. The actual welfare loss could be much higher, should the effects of the subsidy be more fully incorporated. On the import side, the total welfare loss is more than seven percent of total import value.

Near Marginal–Tax Incidence

Literature on marginal-tax incidence (Newbery and Stern 1987, Ahmad and Stern 1991) is concerned on how a very small change in a tax (T) has impacts on welfare (W). Defining λ as the ratio of changes between the two:

$$\lambda = \frac{\delta W}{\delta T}$$

It then follows that a positive (negative) λ means that welfare can still be improved (reduced) by increasing tax. Accordingly, the value of λ can be used as an indicator of whether a particular sector or commodity is already over- or undertaxed. A positive λ means that an increase in tax results in a welfare improvement, showing that the sector or commodity is still undertaxed, and vice versa.[19] Table 5.9 summarizes the results of this simulation (introducing a one percent increase in the tax rate), with sectors ranked by the value of λ.

The results show that nearly all sectors and commodities have already been overtaxed, except for the utility sector, implying that the existing tax system has generated distorted industrial and domestic markets. The results also highlight the costly method of collecting and possibly raising further revenue through taxation as any increase in the tax rate will reduce welfare. The distortions are very significant, such that every unit of revenue collected from the commodity taxation actually creates more welfare loss.

The value of λ in the utility sector (consisting of electricity, water, and gas) should be interpreted carefully as there is direct government provision

[19] In the CGE context this "near marginal" concept can be simulated by introducing a small increase in the tax rate while maintaining fiscal neutrality with offsetting transfers to ensure constant real government consumption. As the marginal increase in welfare is compared with the marginal increase in the tax revenue, the value of λ also reflects the marginal excess burden (MEB) per additional unit of tax revenue collected.

and intervention in this sector. The same caution should also be applied to the chemical sector, which is a net subsidized sector which can be seen from the net negative transaction between government and this sector in the SAM or the negative tax revenue of Rp771.36 billion[20] (Table 7.8). Table 7.9 also shows that the negative values of λ vary from 32 percent (mining) to 203 percent (food crops), implying that any project should produce benefits of at least 1.32 per unit cost if the project is to be welfare improving.[21]

Table 7.9 **Near Marginal–Tax Incidence**

Sector/Commodity	*Marginal Change in*		
	Welfare	*Tax Revenue*	*λ*
Food Crops	-4.262	2.092	-2.037
Food Processing	-95.570	47.301	-2.020
Other Agriculture	-4.402	3.020	-1.458
Restaurants	-9.375	6.468	-1.449
Personal Services	-3.400	2.735	-1.243
Real Estate	-7.629	6.780	-1.125
Chemicals	6.823	-6.584	-1.036
Construction	-2.203	2.170	-1.015
Paper and Metals	-9.313	9.361	-0.995
Public Services	-2.607	2.672	-0.976
Trades	-26.870	29.631	-0.907
Land Transport	-2.192	2.664	-0.823
Banking and Insurance	-1.105	1.407	-0.785
Hotels	-0.761	1.199	-0.635
Textiles	-6.686	11.103	-0.602
Other Transportation and Communication	-0.565	1.096	-0.516
Mining	-0.875	2.698	-0.324
Utilities	0.116	0.401	0.289
Total	*-180.429*	*125.518*	*-1.437*

λ = ratio between the change of its tax and welfare
Source: Simulation results.

Simulations of Trade Liberalization

Three scenarios are simulated here, namely: a complete removal of tariffs on agricultural products (Doha Partial), the same combined with a complete removal of domestic taxes (Ag Complete), and full (border) trade liberalization (Total Trade Liberalization, or TTL). The first is to capture the increasing access for agricultural products demanded by the DDA, while the second is to show the effects if government is proactive in agricultural product liberalization by also removing domestic taxation to level the playing field, and the third is to reflect broader cross-sectoral implications.

20 Rp stands for rupiah

21 Ballard et al. (1985) found that the MEB for the US is in the range of 17–56 cents per dollar of extra revenue, much lower than the Indonesian case.

The results of introducing the three scenarios are summarized in Table 7.10 and Table 7.11. The assessment is based on key variables such as macroeconomic aggregates, external performance, welfare, household income and consumption, and variables for the poor household groups. The economic indicators, summarized in Table 7.10, are calculated as percentage changes from the benchmark (business as usual) data. In most cases, a positive number reflects an increase or improvement, and vice versa.

Table 7.10 **Economy-Wide Effects of the Doha Development Agenda and Total Trade Liberalization**

Indicators	*Doha-Partial*	*Ag-Complete*	*Total Trade Liberalization*
GDP	-0.03	0.15	3.41
Employment	-0.10	0.24	5.75
Real exports	0.10	-0.05	-1.03
Real imports	0.23	0.43	10.54
Trade balance	-1.39	-5.52	-133.19
Domestic absorption	-0.01	0.24	5.79
Household income	-0.12	0.33	9.55
Household real consumption	-0.02	0.51	10.77
Agriculture household income	-0.21	0.45	9.94
Rural household income	-0.10	0.30	9.11
Urban household income	-0.05	0.25	9.52

Doha-Partial = complete removal of tariffs on agricultural products; Ag-Complete = removal of tariffs on a agricultural products and domestic taxes
Source: Simulation results.

The Doha Partial results indicate that increasing agricultural border market access alone would generate additional adverse effects on the domestic economy when all other distortions are maintained. Notably, the poor and other farmers are worse off in this scenario. Urban income groups improve their welfare from availability of food at cheaper rates. But, the majority of people residing in rural areas and dependent on agricultural income lose. The tariff removal increases imports but does not stimulate domestic production, bringing repercussions to the domestic economy in such forms as reductions in gross domestic product (GDP), lower employment levels, less total domestic absorption, and a loss of household welfare.[22] This helps to explain the reluctance of many developing countries to embrace agricultural trade liberalization when it is applied to their own markets as well as their export markets.

However, if the agricultural tariff removal is combined with similar removal of domestic agricultural taxes, i.e., the Ag-Complete scenario, the results are very different. The removal of taxes in both border and domestic

22 Note that agricultural trade liberalization considered here is not multilateral but unilateral on the part of Indonesia. Hence, market access by Indonesia to other countries is not considered here.

Table 7.11 **Welfare Effects of the Doha Development Agenda and Total Trade Liberalization on Different Household Groups**

Household Equivalent Variation	*Doha-Partial*			*Ag-Complete*			*Total Trade Liberalization*		
	billion Rp	*% of Income*	*% of Consumption*	*billion Rp*	*% of Income*	*% of Consumption*	*billion Rp*	*% of Income*	*% of Consumption*
Agriculture employee (landless farmer)	-9.137	-0.10	-0.10	56	0.59	0.62	946	9.96	9.69
Small farmer	-41.135	-0.10	-0.11	269	0.66	0.73	4636	11.32	11.41
Medium farmer	-12.502	-0.11	-0.14	85	0.76	0.92	1537	13.80	14.76
Large farmer	-15.532	-0.09	-0.11	132	0.73	0.97	2308	12.76	15.04
Rural low-income group	0.801	0.01	0.01	72	0.50	0.59	1427	9.97	10.67
Rural dependent–income group	0.812	0.02	0.02	9	0.23	0.27	68	1.75	2.02
Rural high-income group	-0.980	0.00	0.00	230	0.50	0.73	5276	11.56	15.11
Urban low-income group	5.055	0.02	0.02	82	0.33	0.38	1900	7.54	8.31
Urban dependent–income group	0.313	0.00	0.01	28	0.43	0.53	600	9.30	10.41
Urban high-income group	28.355	0.04	0.06	260	0.37	0.55	7816	11.27	14.92
	-43.949			1223			26515		

Doha-Partial = complete removal of tariffs on agricultural products; Ag-Complete = removal of tariffs on a agricultural products and domestic taxes
Source: Simulation results.

markets reduces production costs and stimulates domestic production, which is then followed by its ramifications on the economy as reflected in increased GDP, higher employment levels, more total domestic absorption, and greater household welfare. The poor (landless farmers, small farmers, and rural low-income group) get clear benefits from the complete removal of agricultural tax barriers. Indeed, the Ag-Complete scenario is a Pareto-optimal situation in so far as household groups considered in the model are concerned. In addition, contrasting the first two simulation results confirms that the existing domestic commodity taxation is an expensive way of collecting revenue, as shown by its associated welfare costs and the benefits from its removal.[23]

However, liberalizing one sector alone can also send false signals to resource allocation in the broader economy. This, together with different relative interests in different sectors by different countries, underlies the more comprehensive nature of negotiations under the auspices of the WTO, where trade-offs between sectors are incorporated.

In the TTL scenario, in which border trade is liberalized for all sectors, the results are substantially superior for GDP, employment, domestic absorption, household income, and household real consumption. Even more striking, household welfare is improved for all household groups. The trade balance deteriorates from a surplus to a deficit, but the deficit is small (less than one percent of GDP).

Conclusions and Policy Implications

The CGE model developed in this study has been employed to shed some light on issues related to trade liberalization by simulating what the likely effects of the DDA would be for a developing country such as Indonesia. The assessment is conducted at the economy-wide level, including welfare and distributional implications for different household groups. Moreover, to view agricultural protection in a broader context, the assessment includes the welfare costs of existing sectoral taxes.

The near marginal–tax incidence results indicate that nearly all sectors have already been overtaxed, except for the utility sectors. The existing tax system has distorted the economy so that a unit of revenue collected

23 In the model results, government consumption is found to be lower in the Doha-Partial scenario than in the baseline, but higher in the Ag-Complete scenario, and higher still under TTL. Note, however, that residual government financing is assumed to be readily available from international sources. Therefore, a reduction in government revenues due to trade liberalization may increase transfers from the ROW to the government, which can take the form of increased foreign borrowing.

increases welfare loss. The analysis then suggests that any project financed by new tax money should produce benefits of at least 1.32 times its cost if the tax collection is to be welfare-improving.

A further elaboration of the welfare costs of the existing commodity taxation reveals that some sectors are much more distorted than others. This applies for both tariffs and domestic indirect taxes, even though the welfare costs of tariffs are relatively less than those of domestic taxes. Domestic agricultural commodity taxation as it currently exists, however, is associated with relatively high welfare costs and removing them would be more beneficial.

The simulation of Doha-Partial (only removing agricultural border taxes) indicates that increasing market access alone will generate more adverse effects for the domestic economy, since all other distortions remain. Doha-Partial does not stimulate domestic production, increase employment, or improve welfare. Perhaps, most importantly, the result is not pro-poor.

In the Ag-Complete scenario, however, the results are very promising. The removal of both agricultural tariffs and domestic taxes boosts domestic production, which has positive effects on the economy. Welfare is improved and the poor benefit.

The detailed results also show that full benefits of trade liberalization cannot be obtained by piecemeal trade liberalization. Liberalizing one sector alone will generate misleading signals for resource allocation in the economy. The TTL scenario yields the greatest benefits for the poor and for the economy as a whole. This calls for more comprehensive trade liberalization, aligned with domestic industrial and other policies. The government could expand the benefits of the DDA by further liberalizing both international and domestic markets. This, however, requires strong commitments as well as collaboration with other trading-partner countries. Collaborating with partners is essential since unilateral trade liberalization is not as desirable a course of action.

Appendix 7.1

Modeling Development

Production/Supply Side

In the model, output was specified as an input-output function of intermediate input and value added. The intermediate input consumption $(INT)_i$ was set as a constant elasticity of substitution (CES) aggregation of domestically produced and imported commodities (allowing imperfect substitution between the two commodities, with a different degree of substitution for each type of commodity as reflected by the value of elasticity used) in the form:

$$INT_i = A\left[\alpha_d D_i^{(\sigma_i - 1)/\sigma_i} + (1 - \alpha_d) M_i^{(\sigma_i - 1)/\sigma_i}\right]^{\sigma_i/(\sigma_i - 1)} \qquad \text{(S.1)}$$

where $A =$ scale parameter, α_d share parameter for domestically produced commodities as a share of total commodities available in the domestic economy $(0 < \alpha_d < 1)$, and D_i and M_i are domestically produced and imported commodities, respectively. The elasticity of substitution between domestically produced and imported commodities is represented by σ_i.

The value added was set as a Cobb-Douglas function of different types of labor and capital. Total production was allocated to domestic demand and exports.

Demand Side

Total final demand in the domestic economy consists of demand for consumption and for investment purposes. Consumption is the sum of household and government consumption, while the demand for investment is generated by the aggregated saving-investment (capital) account. The figure below shows a schematic representation of the demand system of the model. A Cobb-Douglas utility function is assumed for the households, while the government is assumed to have planned consumption reflected in a Leontief specification, which is not affected by commodity prices or the government's income. Aggregate investment is fixed to reflect the investment-driven nature of the economy. In addition to the main functional specifications for production and final demand, there are other equations in the model to define prices (for activities, commodities, and factors); incomes and expenditures (by institutions); and to balance the model.

Price Equations

The domestic price of each composite commodity (P_i) can be written as a CES function of the domestic prices of imported (PM_i) and domestically produced goods (PD_i):

$$P_i = \left[\alpha_d \, PD_i^{(\sigma_i - 1)/\sigma_i} + (1-\alpha_d) PM_i^{(\sigma_i - 1)/\sigma_i}\right]^{\sigma_i/(\sigma_i - 1)} \qquad \text{(P.1)}$$

On the import side, the adoption of the small-country assumption implies that the domestic economy is a price taker and there is unlimited supply from the rest of the world (ROW) at the given world price. The domestic price of imports is given by

$$PM_i = \overline{PW_i}\,(1 + tm_i)\,\overline{ER} \qquad \text{(P.2)}$$

where $\overline{PW_i}$ is the world price, $\overline{ER}$ is the exchange rate, and *tm* is the tariff rate on imported commodities. The bar sign indicates that the variable is fixed. Assuming that domestic products sold in the international market face a downward sloping demand curve, the export price *(PWE)* can be represented as

$$PWE_i = PD_i / (1 + te_i)\,\overline{ER} \qquad \text{(P.3)}$$

where *te* is the export-subsidy rate.

Income and Expenditure Equations

Household incomes (Y_h) consist of factor incomes (i.e., wages and rent payments for factors used domestically and abroad, expressed by the first two parts on the right-hand side) of equation I.1 and transfer incomes from the government $(TGH)_h$, domestic firms $(TFH)_h$, other households $(THH)_h$, and the ROW $(TWH)_h$. These incomes can be written as:

$$Y_h = \begin{bmatrix} \sum_i \sum_k W_k L_{kih} + \sum_i (PN_i X_i - \sum_k W_k L_{ki})_h \\ + (TGH)_h + (TFH)_h + (THH)_h + (\overline{TWH})_h \overline{ER} \end{bmatrix} \qquad \text{(I.1)}$$

Firms' incomes (YF) include payments for capital used in production, transfers from other firms *(TFF)*, and transfers from the ROW $(TWF)_f$, which is set as a residual. It is given by:

$$YF = \left[\sum_i (PN_i X_i - \sum_k W_k L_{ki})_f + (TFF) + (TWF)\ \overline{ER}\right] \qquad \text{(I.2)}$$

Government income (YG) can be categorized into payments for capital used in production activities, income taxes from domestic institutions (households, domestic firms, and government-owned companies), income from indirect taxes levied on commodities, and transfers from the ROW *(TWG)*, which is endogenously determined by the model. It is given by:

$$YG = \begin{bmatrix} \sum_i (PN_i X_i - \sum_k W_k L_{ki})_g + \sum_h t_h Y_h + \sum_f t_f Y_f + \\ + \sum_i td_i X_i^S PD_i + (TWG)\ \overline{ER} \end{bmatrix} \quad \text{(I.3)}$$

Transfer payments from the ROW to households are set exogenously (as shown by a bar sign on the variables in the equations), while transfers to government and firms are set endogenously (as residuals). This is consistent with the behavior of domestic firms as well as the fiscal policy of the government; both rely on foreign sources for funding their deficits. These transfer payments consist of foreign loans, grants, and other transfers.

Household expenditure (E_h) consists of consumption of composite commodities, direct tax payments to the government, transfers to other household groups, and savings:

$$E_h = (\sum_i CH_i)\ + (\sum_h t_h Y_h)\ + (THH)_h + S_h \quad \text{(E.1)}$$

The expenditures of firms (EF) consist of transfers to households, direct tax payments to the government, transfers to other firms (retained profit), transfers to the ROW *(TFW)*, and savings:

$$EF = (TFH)_h + (\sum_f t_f Y_f)\ + (TFF)\ + (TFW) + SF \quad \text{(E.2)}$$

Government expenditure (EG) consists of consumption of composite commodities, transfers to households $(TGH)_h$, transfers to the government *(TGG)*, transfers to the ROW *(TGW)*, and savings:

$$EG = (\sum_i CG_i)\ + (TGH)_h + (TGG)\ + (TGW)\ + SG \quad \text{(E.3)}$$

Saving-Investment Equations

Total savings in the domestic economy consists of household savings (S_h), firms' savings (SF), government savings (SG), and capital injections from the ROW (SW):

$$S = \sum_h S_h + SF + SG + \overline{SW} \quad \text{(S-I.1)}$$

In equilibrium, total saving equals total investment, which is distributed to each sector based on fixed shares.

$$S = I$$
$$I_i = \sum_i \overline{\delta_i} I \quad and \quad \sum_i \overline{\delta_i} = 1 \tag{S-I.2}$$

Aggregate final demand (total final consumption of composite commodities) is accordingly given by

$$C_i = \sum_i CH_i + \sum_i CG_i + I_i \tag{S-I.3}$$

where

$$C_{ij} = \delta_{ij} \ (1 - \overline{MPS}_j)(1 - t_h)Y_j, \quad j = h, g$$

Employment and Wages

For nonagricultural and nonproduction workers in Indonesia, wages are set in competitive markets and reflect the marginal product of the workers:

$$PN_i (\partial X_i / \partial L_{ki}) = W_k \ with \quad L_k^D = \sum_{i=1}^{n} L_{ki} \quad and \quad L_k^D = \overline{L_k^S} \multimap \tag{L.1}$$

For labor in the agricultural sector and production workers, wages are fixed and the last part of the equation above becomes

$$L_k^D = L_k^S \ \ where \ \ L_k^S < L_k^{*S} \ \ and \ \ W_k = \overline{W_k} \tag{L.2}$$

thus allowing for unemployment in the agricultural sector and among production workers. D and S in the equations above refer to demand and supply while W_k is the wage at equilibrium level. L_k^{*S} is the optimum labor supply.

Foreign Trade

The export demand equation is

$$\mathrm{E_i} = \overline{\mathrm{E_i}} (\mathrm{AVE_i} / \mathrm{PWE_i})^{\eta_i} \tag{F.1}$$

where $\overline{E_i}$ = exports when $AVE_i = PWE_i$, PWE = supply price of domestic exports in foreign currency, AVE = average world price of the commodity, η = the export demand elasticity.

The import demand equation is

$$M_i = (\delta_i / 1 - \delta_i)^{\sigma_i} (PD_i / PM_i)^{\sigma_i} D_i \tag{F.2}$$

where: δ = share parameter and D_i = total demand for domestic use The balance of payments equilibrium equation is given by:

The balance of payments equilibrium equation is given by:

$$\left[\sum_i \overline{PW_i} M_i + (TGW) + (TFW) + \sum_k (RMTW)_k\right] = \left[\sum_i PWE_i E_i + \sum_k (\overline{RMFW})_k + \sum_h (\overline{TWH})_h + (TWF) + (TWG)\right] \tag{F3}$$

The left-hand side of the equation above is the ROW revenue that consists of imports, capital flight, transfers from government and firms, and capital payment from foreign capital used in domestic production for the ROW. On the right-hand side is the ROW total expenditure, covering exports, capital payments, and transfers to domestic households, firms, and government. Since the transfers from the ROW to domestic firms and government are set as residuals, the current account–deficit equation is given by

$$[(TWF) + (TWG)] = \left[\sum_i \overline{PW_i} M_i + (TGW) + (TFW) + \sum_k (RMTW)_k\right] - \left[\sum_i PWE_i E_i + \sum_k (\overline{RMFW})_k + \sum_h (\overline{TWH})_h\right] \tag{F4}$$

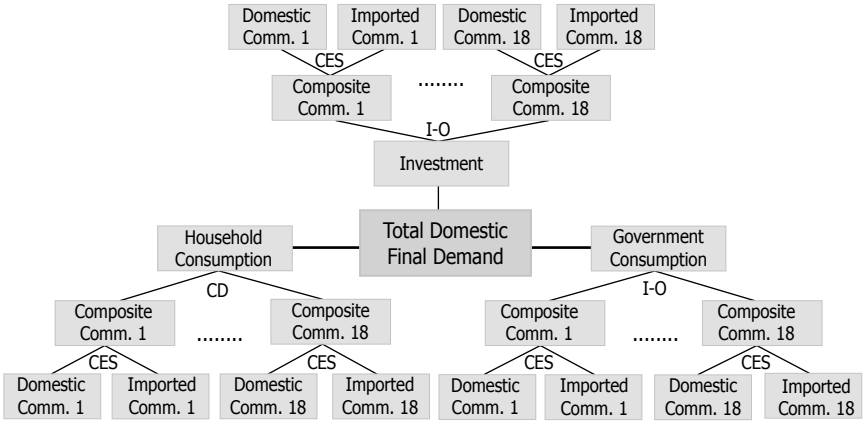
The model provided by the equations above is then used to examine the welfare costs of the existing import tariff, and various trade liberalization scenarios.

Appendix 7.2

Calculation of the Welfare Costs of the Existing Import Tariffs

In a CGE context (see Shoven and Whalley 1984), the calculation of welfare loss of the existing import tariff is conducted by simulating the removal of import tariffs individually in the context of maintaining government revenue from taxation. The result is summarized in Table 6. Notice that most government revenue from tariffs is collected from Papers & Metal Products (about 53%) and Chemicals (35%). The latter is actually a net subsidized sector, implying that this sector is the most protected one (in 1993, the net subsidy of this sector amounted to 771 billion rupiah or about 5% of total revenue from indirect taxation on domestic commodities). From the welfare loss calculation, it shows that the existing tariff generates relatively high distortions, i.e., 0.8 for every single unit of currency collected from the import tariff. This suggests that the existing import tariff is an inefficient mechanism for collecting revenues. For some sectors, namely Food Processing and Construction, the ratios of welfare cost to revenue collected are even more than unity (i.e., 118% and 101%, respectively), implying the distortionary nature of these tariffs. Moreover, food processing is also among the most highly taxed sectors in the domestic market, accounting for around 39% of the total tax on the domestic commodities, while this sector contributed around 11% of the total output in 1993 (CBS 1996).

Schematic Representation of Final Demand



Comm = Commodity
Source: Authors' framework

CHAPTER 8

Computable General Equilibrium Model: Infrastructure Development and Poverty Alleviation in the People's Republic of China

Li Shantong

Introduction

This study assesses the contribution of infrastructure development to reducing poverty in the People's Republic of China (PRC) using a computable general equilibrium (CGE) model with disaggregated households, segmented urban and rural labor markets, and endogenous labor supply of households. It extends an existing economy-wide CGE model of the PRC by further disaggregating the households and including labor migration. The extensions enable the CGE model to examine the poverty alleviation and distributional implications of infrastructure development.

Unlike other commonly used econometric methods and case-study techniques of analyzing the linkages between infrastructure development and poverty alleviation, the CGE model is comprehensive, covering the essential features of the economy, its institutions, and their economic interdependencies. The optimization process inherent in the CGE model enables it to provide quick feedback for any policy changes in or shocks to the economy. Therefore, the results not only indicate the magnitude of the influences of infrastructure and economic growth on each other, but also reveal comprehensively how additional infrastructure facilities enhance economic growth. These results highlight the importance of more and better-quality infrastructure in eliminating the problem of poverty.

This chapter consists of six sections. The next section provides an overview of the situation and trends of rural poverty in the PRC. This is followed with an analysis of how infrastructure construction impacts poverty reduction. The fourth section describes the structure of the CGE model of the PRC economy, especially including resident grouping, labor migration, and issues related to infrastructure construction. The fifth section focuses on the design, implementation, and interpretation of the results of the various policy simulations using the CGE model. In the sixth and last section of this

paper, the main implications and observations of the study, as well as the implications of this study's findings on the directions of related research in the future, are summarized.

Rural Poverty in the PRC: Situation and Alleviation Programs

Poverty Situation

Poverty, particularly in rural areas, is one of the most serious challenges confronting human society, and how to eliminate it is a common concern all over the world. The PRC is the largest developing country with the largest population, so its achievements in poverty alleviation will have a critical impact on this worldwide effort. Since the PRC started making major reforms and opening up to the rest of the world in 1978, it has devoted considerable efforts and achieved dramatic progress in the fight against poverty. The number of its poor has been reduced from 250 million in 1978 to 26 million in 2004.

According to the National Bureau of Statistics (NBS; RSO 2004), the incidence of absolute poverty in rural areas dropped to 26.1 million at the end of 2004, or 2.9 million fewer than in 2003. This accounted for 2.8 percent of the entire rural population, which declined by 0.3 percentage points from the preceding year. In 2004, those in rural areas, who have access to food and clothing but nonetheless continue to be vulnerable to hunger and deprivation of other basic needs, had decreased to 49.8 million, which is 0.7 percent fewer than in 2003. This gain was 5.3 percent of the entire rural population or 6.4 million fewer poor households compared with the preceding year.

Table 8.1 and Figure 8.1 illustrate the remarkable accomplishment of the PRC in reducing the rural poverty rate, based on the official rural poverty line, since 1978. World Bank estimates, which were assessed using World Bank poverty threshold income levels, also show a drop in poverty rates in the PRC from 1990 onward. However, when comparing the statistics on poverty estimated by NBS with those using international poverty lines, the poverty alleviation gains suggested by the official statistics in Figure 8.1 are greater. International estimates using the $1-a-day per capita poverty line indicate that poverty alleviation has been modest. The rural poverty rate remains high before 1993 and then declines gradually from 1993 to 1996. After completing its decline in 1996, the poverty rate stabilized at about its 1996 level.

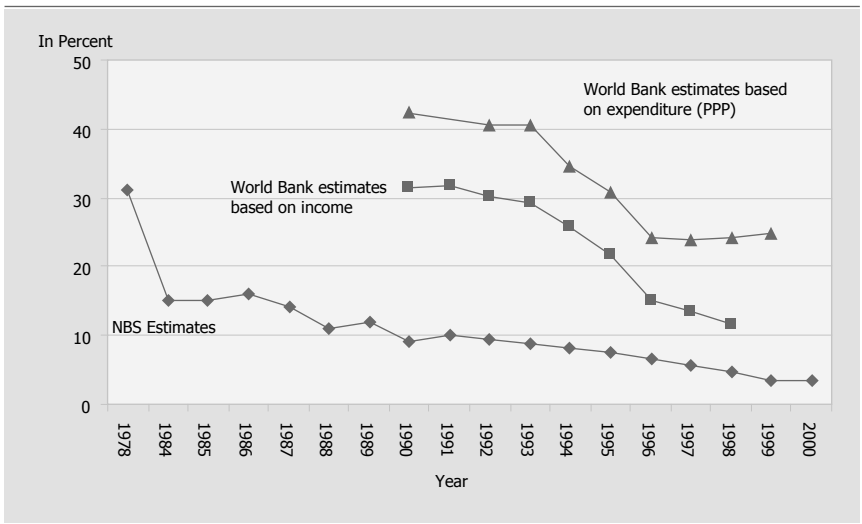
The Chinese government has modified its rural poverty line in terms of the annual consumption price index applicable to rural areas. However, the

Table 8.1 **Rural Poverty Rate in the Peoples' Republic of China, 1978–2000**

		World Bank Estimates	
Year	*NBS Estimates*	*Income PPP* [a]	*Consumption PPP* [b]
1978	31.0	...	...
1984	15.0	...	...
1985	15.0	...	...
1986	16.0	...	...
1987	14.0	...	...
1988	11.0	...	...
1989	12.0	...	...
1990	9.0	31.3	42.5
1991	10.0	31.7	...
1992	9.4	30.1	40.6
1993	8.8	29.1	40.6
1994	8.2	25.9	34.6
1995	7.6	21.8	30.8
1996	6.7	15.0	24.1
1997	5.8	13.5	24.0
1998	4.6	11.5	24.1
1999	3.4	...	24.9
2000	3.5	...	...

NBS = National Bureau of Statistics
a A dollar a day per capita as the poverty line at purchasing power parity (PPP) rates
b A dollar of expenditures per day as the poverty line converted at PPP rates
Sources: Rural Survey Organization (2000 and 2001); World Bank (2001); Chen and Wang (2001).

Figure 8.1 **Estimates of Rural Poverty in the Peoples' Republic of China, 1978–2000**



Sources: Rural Survey Organization; NBS (2000 and 2001); World Bank (2001); Chen and Wang (2001).

line is still far below the per capita poverty line of a $1-a-day used by the World Bank. Table 8.2 portrays the changes in the rural poverty line, size, and proportion of the poor population in the PRC since 2000.

Table 8.2 **Rural Poverty Rate in the Peoples' Republic of China, 2000–2004**

	Absolute Poor			*Low–Income*		
Year	*Threshold (CNY per capita per year)*	*Individuals ('000)*	*Rate (%)*	*Threshold (CNY per capita per year)*	*Individuals (in '000)*	*Rate (%)*
2000	625	32,090	3.5	865	62,130	6.7
2001	630	29,270	3.2	872	61,020	6.6
2002	627	28,200	3.0	869	58,250	6.2
2003	637	29,000	3.1	882	56,170	6.0
2004	668	26,100	2.8	924	49,770	5.3

Source: Rural Survey Organization (2004).

The serious consequences of rural poverty in the PRC are manifested in the hard living conditions of its poor. From national survey data of rural households in 2002, the Rural Survey Organization of the NBS identified the prominent features of the rural poor: They tend to be less educated, live in isolated communities exposed to harsh environmental conditions, have relatively large families, and are severely resource-constrained. Table 8.3 compares the natural and social living environment, demography, and economic status of the rural poor and nonpoor.

Table 8.3 **Comparison of the Poor and Nonpoor in Rural Areas of the Peoples' Republic of China** by Selected Attributes in 2002

Comparative Index	*Poor*	*Low Income*	*Others*
Location and Access to Infrastructure (%)			
Proportion of households living in mountainous areas	50.4	46.8	23.0
Proportion of villages with highways	93.1	94.5	97.3
Proportion of villages with telephones	77.6	84.4	94.5
Proportion of households with access to electricity	85.1	90.8	94.2
Proportion of households using safe drinking water	55.2	56.1	69.4
Family Size, Human Resource Development, and Employment (% except where indicated)			
Family size (individual members)	5.3	4.8	4.1
Education (years of schooling)	6.6	7.0	7.9
Illiteracy rate of the labor force	16.3	13.6	6.4
Rate of employment in rural areas	90.9	89.2	84.6
Enrolment rate of children 7 to 12 years old	91.8	94.5	97.1
Enrolment rate of children 13 to 15 years old	79.7	85.6	91.7
Economic Situation (CNY except when indicated)			
Per capita net income	531.0	813.1	2,773.9
Per capita expenditure	559.0	760.0	1,968.5
Engel coefficient (percent)	69.2	64.4	45.2
Per capita expenditure for purchasing productive fixed assets	44.3	44.7	90.6
Per capita deposit and cash on hand at the end of the year	373.9	500.3	1,962.4

Source: Rural Survey Organization (2003).

Most of the rural poor live in the mid-western and southwestern areas of the PRC, where transportation and communication with the rest of the world are very difficult to access. Many residents lack basic production tools, housing, access to education, and other personal needs. Consequently, they have very limited career and livelihood options. Despite all efforts, these harsh conditions continue to endure and require drastic improvement (RSO 2003). The Chinese government remains confronted with the paramount challenge of helping the PRC's rural population escape poverty.

Poverty Reduction Policies

Since 1978, the Chinese government has set policies aimed at reducing rural poverty. Before 1978, the task of reducing rural poverty was subsumed under the national effort of promoting economic development. As indicated in the summary of the China Rural Poverty Reduction Development Outline, the overall work in the PRC of reducing the incidence of rural poverty has been carried out since 1978 largely in three stages (State Council Leading Group Office of Poverty Alleviation and Development 2003).

In the first stage of this poverty reduction work program from 1978 to 1985, the Chinese government introduced incentives—particularly in agriculture—by assigning land-management rights to households. The government implemented a contract-responsibility system with remuneration at the household level. Within the system, peasants were sufficiently motivated to increase agricultural production. The government followed this reform with a series of policies and measures, such as deregulating the prices of agricultural products and developing township enterprises. These reforms freed up the productive forces and made it possible to reduce rural poverty in new ways.

From 1986 to 1993, the government set in motion the second stage of its poverty reduction program, which involved a large-scale development-oriented poverty relief drive. Working under the motto of "turning blood transfusion into blood production," the government encouraged rural residents and poor communities to be more self-reliant, to make use of local natural resources, and to create income-generating opportunities by and for themselves. The Work Relief project was implemented during this period.

With the promulgation of its seven-year Priority Poverty Alleviation Program (PPAP) in 1994, the Chinese government set into motion the third stage of its development-oriented poverty relief work by tackling key problems. The government implemented poverty-relief measures that targeted 592 poor national counties. The different provinces assumed responsibility for implementing these measures within their respective territories. In addition, the government encouraged rural residents to increase

their incomes by looking for jobs in nonagricultural industries. By the end of 2000, the government attained the basic objectives of its Seven-Year PPAP. The number of rural poor fell to 30 million in 2000, and the poverty incidence rate dropped to about three percent (see Table 8.2).

In 2001, the central government officially issued its *Outline for Poverty Alleviation and Development of China's Rural Areas (2001–2010).* It pointed out in the plan that PRC's poverty alleviation work is a long-term and arduous process. The plan also emphasized the importance of the coordinated development of the economy and society in poor areas, highlighting sustainable development as one principle of poverty reduction.

In summary, rural poverty reduction in the PRC underwent a process from promotion by system and government aid to development-oriented poverty relief and self-development. During this process, the government played a dominant role throughout: setting up development funds for poor areas, encouraging exploratory production and construction, and extending access to work in nonagricultural sectors. Particularly, the long-term investment in infrastructure construction has improved the production and living conditions in poor areas, and thus has been very helpful for the alleviation of rural poverty.

Work Relief is one of the most effective projects for reducing poverty. This project employs residents from poverty-stricken areas to work in useful capital construction activities in these areas. The workers are paid for the work they render under the program, instead of obtaining cash transfers from the government. For example, in the year of 2000, the central government invested CNY6 billion[1] in work-relief funds. With these resources, the work-relief program built 3 million *mu*[2] of basic farmland, irrigated 7 million *mu* to raise the land's productivity, prevented water and soil loss in 6.8 million *mu*, and constructed 0.38 million kilometers of village roads. All of these accomplishments not only improved agricultural production conditions and productivity, but also directly supplemented farmers' incomes (RSO 2003).

In addition, the economic development and poverty alleviation of western PRC also benefited from the improvement of infrastructure to a considerable degree. With the adoption of the Great Western Development Strategy, the government put in place a series of small- and medium-scale projects that were directly related to farmers' benefits, while undertaking the construction of key infrastructure projects. By 2000, under the project, the

1 CNY stands for yuan

2 A *mu* is a Chinese land measure equivalent to 1/15th of a hectare.

construction of bituminous macadam in each county had been designed, and 20,000 kilometers of blacktop highway and 17,000 kilometers of highway which connect poor counties with national highways had been constructed.

With the implementation of another project to transmit electricity to the countryside, about 700 villages and towns gained access to electricity. The project also provided villages with access to radio and TV. The residents of about 8,000 newly electrified administrative villages gained radio and TV facilities. All these projects have undoubtedly played an active role in the growth of productivity and nonagricultural employment. The World Bank (1994) reported that one of the key factors for township enterprises' success in the PRC is their access to needed transportation, telecommunication, and power services.

The rapid development of infrastructure facilities in recent years has had favorable social and economic benefits. This affirms the effectivity of the government's development-oriented strategy for poverty alleviation based on infrastructure development in rural areas. With international organizations ready to provide long-term funding for infrastructure projects, there have been excellent successive opportunities for making the strategy succeed.

At present, most of the PRC's rural poor are distributed in the less-developed middle and western regions of the country. Enhancing local productivity and the export of labor services are two important approaches to poverty alleviation. Realizing the integration in terms of physical accessibility and communication of the poor regional areas of the PRC with the outside world is indispensable. Continuing to accelerate rural infrastructure construction is crucial but arduous. It will play a vital role in future economic growth and poverty alleviation.

Contribution of Infrastructure Improvement to Poverty Alleviation

Analytical Framework

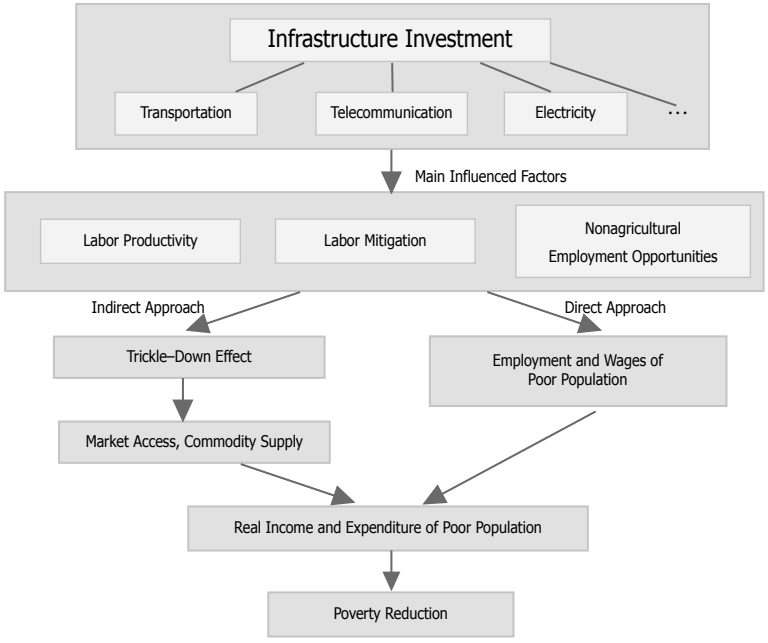
This study highlights two aspects of infrastructure development. On one hand, infrastructure development includes the processes of financing and building infrastructure facilities. On the other hand, it means the activation of various infrastructure facilities such as those providing transportation, telecommunication, electricity, and irrigation services.

Figure 8.2 presents a simple framework for analyzing the contribution of infrastructure development to poverty alleviation. Infrastructure improvement

has three direct consequences that alleviate rural poverty, namely, improving productivity, reducing the cost of labor migration from rural to urban areas, and enhancing opportunities for nonagricultural employment of the rural poor. These consequences are channeled through two effects. Its direct distribution effect is indicated by more of the rural poor becoming employed and increasing their respective incomes. The other channel is the trickle-down effect, that is, the rural poor benefit indirectly from economic progress in rural areas and elsewhere in the economy, resulting in higher aggregate real disposable income and expenditure.

In the process of infrastructure construction, vast capital construction investment stimulates production and final demands of related industries, such as of construction, mining and quarrying, and building-materials manufacturing. These induced economic activities directly push the growth of the national economy. In Wuhan City, for example, a CNY100 increase of infrastructure-related investment tends to generate CNY172 of added value (Wuhan Bureau of Statistics 2004). In addition, the trickle-down effect tends to ameliorate the welfare of the rural poor to a certain degree. If agriculture is mainly responsible for economic growth, the effects on rural poverty alleviation are more evident (Huang, Rosselle, and Zhang 2004).

Figure 8.2 **Framework for Infrastructure Development and for Poverty Reduction**



Source: Author's framework.

The effects of infrastructure investment on poverty reduction are more directly reflected in employment. Infrastructure construction and the development of related industries create more jobs, especially for unskilled rural migrants. Labor migration from rural to urban areas and from agricultural to nonagricultural sectors is an important channel for poverty alleviation. According to some studies on this subject, the proportion of households in the poorest villages engaged in agriculture-related work tends to be very high. In contrast, rural households with medium or low income are more likely to migrate out and seek jobs in cities, while those with high income tend to work in manufacturing companies or be self-employed (Mohapatra 2001).

In recent years, with the rapid development of township enterprises and urbanization in eastern coastal areas, the gaps of employment opportunities and income levels among PRC's different regions, particularly between urban and rural areas, have progressively widened. Most of the surplus rural labor in the middle and western areas moves into coastlands and into mid-sized to large cities.

In 2004, Beijing had 2.9 million rural migrants–90.4 percent more than in 1999–who accounted for nearly two thirds of the city's total immigrant population. Among Beijing's rural immigrants, a little over a fourth of them worked in the construction industry, which topped other industries in terms of providing employment (Population and Employment Section of Beijing Bureau of Statistics 2005). Therefore, expanding the level of investments in infrastructure construction would tend to be very useful in reducing rural poverty by creating more nonagricultural employment opportunities and directly increasing the incomes of the poor population in rural areas.

The completed infrastructure would also contribute to poverty reduction. Facilities for supplying clean drinking water and environmental sanitation equipment significantly improve people's health and reduce incidence of disease. Advanced irrigation systems result in higher and more stable income for farmers and strengthen their capability to manage risk.

The development of transportation and telecommunication systems enhances labor productivity and improves lifestyles. Presently, the lack of transportation and telecommunication facilities comprises two major bottlenecks, slowing down the PRC's effort at reducing rural poverty. The export to cities of labor services from rural areas represents a viable and important way of reducing poverty in inland areas. Therefore, the improvement of transportation and telecommunication facilities has an extraordinary contribution to poverty alleviation. Consistent with this observation, the study selected these two infrastructure sectors for analysis.

Transportation and communication infrastructure facilities open new opportunities for poor areas to integrate with the outside world. The linkages would facilitate the employment of local resources by reducing the cost of labor movements and thus allowing the rural poor to avail of better opportunities elsewhere in the country. A case study involving seven poor counties from Zhumadian City and Xinyang City in Henan province finds that better transportation infrastructure significantly increased tourist visits in the province, facilitated the adjustment of agricultural industries, and sharply increased farmers' incomes. With access to a better transportation system, farmers tended to be more mobile, as the cost of rural-urban migration fell. The improved system created more employment opportunities in nonagricultural sectors for the poor population in rural areas. In contrast to the experience of the control regions in this case study, i.e., regions where the level and quality of transportation infrastructure remained unchanged, the regions with better transportation facilities achieved higher regional gross domestic product (GDP) growth, rural industrialization, higher incomes for farmers, and more effective poverty reduction (Dong and Fan 2004).

Telecommunication infrastructure such as telephones, TV cables, and networks establishes communication channels, which provide more information about employment in urban areas and reduce information-searching costs. With the establishment of modern mass media, traditionally pessimistic ideas among the poor population particularly in rural areas would gradually be replaced with modern ideas such as self-dependency, gender equity, and having fewer and healthier children, which would help in reducing poverty.

The contribution of transportation and telecommunication infrastructure construction to reducing poverty in rural areas is also embodied in labor productivity gains. Higher labor productivity would not only increase production directly, but would also strengthen the migrants' competency in job markets. Thus, the poor in rural areas would have more access to knowledge and information, and acquire greater chances to learn about the outside world and broaden their horizons. Besides formal schools, they could also be educated or trained in other formal or informal ways. Previous studies show that in the 1980s, one more year of schooling could stimulate a 10 percent increase in out-migration of peasants and an increase by 6 percent of the number of available jobs in the nonagricultural sectors. Interestingly, the impact more than doubled in the 1990s, wherein one extra year of schooling could translate into an 18 percent increase in out-migration of peasants and an increase of 17 percent in the number of nonagricultural jobs (Huang and Rozelle 1996). Currently, nonagricultural wages are much higher than those in agriculture and, thus, the export of labor is the key to increasing peasants' incomes.

A point worth noting is that the improvement of infrastructure would be beneficial to both workers and employers. For any production sector, transportation and information collection are two indispensable factors in the production process and supply chain, and the development of transportation and telecommunication infrastructure will necessarily reduce the cost of production and logistics. In addition, improved infrastructure facilitates labor migration and intensifies the competition in labor markets, thus making it possible for employers to reduce labor costs. Therefore, infrastructure construction would play an active role in poverty alleviation, benefit both employers and workers, and would contribute to the overall development of the economy.

Accomplishments in Infrastructure Development

Since the implementation of its large-scale development-oriented poverty reduction program, PRC's government has focused on transportation infrastructure development. Under the PPAP, the government invested CNY700 million each year in highway construction to alleviate rural poverty. After nearly 20 years of continuous investment, a relatively comprehensive transportation system has been set up in the poor western regions consisting of highways, railways, inland river channels, flight routes, and underground oil pipelines.

In the 1990s, the PRC's telecommunication industry sustained relatively rapid growth. Telecommunications investments rose sharply producing, among other results, a significant improvement of telecommunication facilities in the country's rural areas. By the end of 2003, the number of telephone subscribers in rural areas reached 91.7 million, 62 times the number in 1990. Of these, 83.9 million or 91.5 percent were residential telephone subscribers. Their number was 27,300 percent of the total residential subscribers in rural areas in 1990 (NBS 2004).

Average national broadcasting and TV coverage rates by the end of 2003 reached 93.7 percent and 94.9 percent, respectively. In the western regions, the number of households with access to national broadcasting and TV increased by 90 percent over its coverage in 1990 (Data Center of DRC Net 2003). All of these remarkable achievements have enabled farmers to learn more about the outside world and obtain ideas about how they may improve their living conditions.

Tables 8.4 and 8.5 describe the trends of infrastructure investments and improvements in the transportation and telecommunication sectors since 1999. The ratio of investments between transportation and telecommunication was about 7 to 1 in 1990, as shown in Table 8.4. This ratio fell to about 4

to 1 in 2000 because of the relatively rapid increase of investment in the telecommunication sector. Within the transportation sector, railways and highways are the two major facilities–accounting in the 1990s for 80 percent of total investments in the sector. Investments in highway construction have risen more rapidly than those in railways since 1996. The investments in the remaining three transportation subsectors have been relatively stable over time.

Table 8.4 **Investments in Infrastructure Construction, 1990–2000**

Year	Transportation and Telecommunications (100 million CNY)	Transportation (%)						Post & Telecommunication
		All Facilities	Railways	Highways	Water	Aviation Routes	Pipelines	
1990	207.16	87.1	32.20	26.60	22.20	5.60	0.50	12.9
1991	330.62	90.7	36.40	24.30	18.90	10.60	0.40	9.3
1992	448.25	87.7	25.70	37.80	15.40	7.90	0.80	12.3
1993	886.08	84.8	35.80	17.80	6.90	11.20	0.60	15.2
1994	1,353.68	82.9	33.70	21.00	5.70	8.30	0.10	17.1
1995	1,563.65	82.2	29.60	23.80	4.30	7.70	0.30	17.8
1996	1,810.46	82.7	25.80	27.60	2.20	7.10	0.80	17.3
1997	2,150.70	84.0	23.10	31.10	1.90	6.30	0.30	16.0
1998	3,186.39	85.0	19.90	33.30	1.30	5.40	0.20	15.0
1999	3,304.83	85.8	20.60	34.10	1.40	6.30	0.20	14.2
2000	3,557.98	80.9	18.90	37.00	1.30	5.90	0.70	19.1

Source: Department of Statistics (2002).

These investments translated into real improvements in the physical transportation, post, and telecommunication infrastructure sector, as shown in Table 8.5. The development indicator for the transportation infrastructure sector is the actual length of railways, highways, waterways, civil aviation routes, and petroleum and gas pipelines that are available for use. There are three development indicators in post and telecommunication infrastructure: capacity of long-distance telephone exchanges, capacity of local office telephone exchanges, and length of long-distance optical cable lines.

In the transportation infrastructure sector, highways and civil aviation are two subsectors with the most rapid growth. The length of highways in operation increased by 76 percent from 1990 to 2003. Impressive as it was, the performance of the highways subsector was overtaken by that of the civil aviation routes, which expanded by a multiple of 2.45, and by the petroleum and gas pipelines that doubled in length in the same period. On average, the length of highways increased by 5.4 percent per year, while those of civil aviation routes as well as gas and pipelines increased by 17.5 and 7.5 percent, respectively. To the poor in rural areas, railways and highways are more economical and convenient facilities to use to move around and in transporting goods and, thus, would tend to have a more pronounced effect on poverty reduction rather than waterways and civil aviation routes.

Table 8.5 **Indicators of Infrastructure Development, 1990–2003**

	Transportation (in 10,000 kilometers)					*Post and Telecommunications*		
Year	*Railways*	*Highways*	*Waterways*	*Civil Aviation Routes*	*Petroleum and Gas Pipelines*	*Capacity of Long-distance Telephone Exchanges (in circuits)*	*Capacity of Local Office Telephone Exchanges (in 10,000 lines)*	*Length of Long-distance Optical Cable Lines (in kilometers)*
1990	5.78	102.83	10.92	50.68	1.59	161,370	1,232	3,334
1991	5.78	104.11	10.97	55.91	1.62	286,325	1,492	6,490
1992	5.81	105.67	10.97	83.66	1.59	521,885	1,915	14,388
1993	5.86	108.35	11.02	96.08	1.64	1,206,091	3,041	38,666
1994	5.90	111.78	10.27	104.56	1.68	2,416,296	4,926	73,290
1995	5.97	115.70	11.06	112.90	1.72	3,518,781	7,204	106,882
1996	6.49	118.58	11.08	116.65	1.93	4,162,009	9,291	130,159
1997	6.60	122.64	10.98	142.50	2.04	4,368,305	11,269	150,754
1998	6.64	127.85	11.03	150.58	2.31	4,491,595	13,824	194,100
1999	6.74	135.17	11.65	152.22	2.49	5,032,026	15,346	239,735
2000	6.87	140.27	11.93	150.29	2.47	5,635,498	17,826	286,642
2001	7.01	169.80	12.15	155.36	2.76	7,035,769	25,566	399,082
2002	7.19	176.52	12.16	163.77	2.98	7,730,133	28,657	487,684
2003	7.30	180.98	12.40	174.95	3.26	8,693,998	35,083	594,303

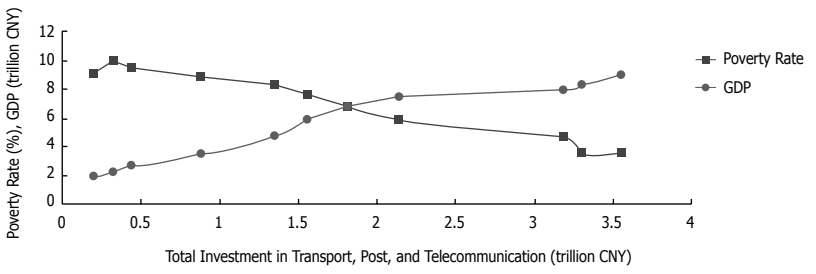
Source: National Bureau of Statistics (2004).

The growth of infrastructure in post and telecommunication facilities exceeded that of the transportation infrastructure sector. A basic medium for communication, the telephone, has been increasingly used in the PRC. By the end of 2003, the capacity of local office telephone exchanges had increased to 350 million lines, while that of long-distance telephone exchanges was close to 8.7 million circuits. Both capacities are 28 and 53 times their respective levels in 1990. The total length of long-distance optimal cable lines increased by a multiple of 12.7 annually, reaching nearly 594,300 kilometers in 2003 from 3,334 kilometers in 1990. All these remarkable accomplishments have laid a solid foundation for further development of telecommunication infrastructure.

Figure 8.3 illustrates a key relationship between GDP and poverty alleviation, or between total infrastructure investments and GDP. GDP correlates positively with total investments in transportation as well as post and telecommunications infrastructure; while rural poverty correlates negatively with both. There is a clear basis for this relationship and it is encouraging to note that the empirical record appears to support it.

This empirical relationship is further explored in Figures 8.4 and 8.5, wherein rural poverty incidence is correlated with the components of transportation infrastructure as well as with those of telecommunications. In Figure 8.4, all components of transportation infrastructure are measured on the primary vertical axis while that the poverty measurement is indicated on

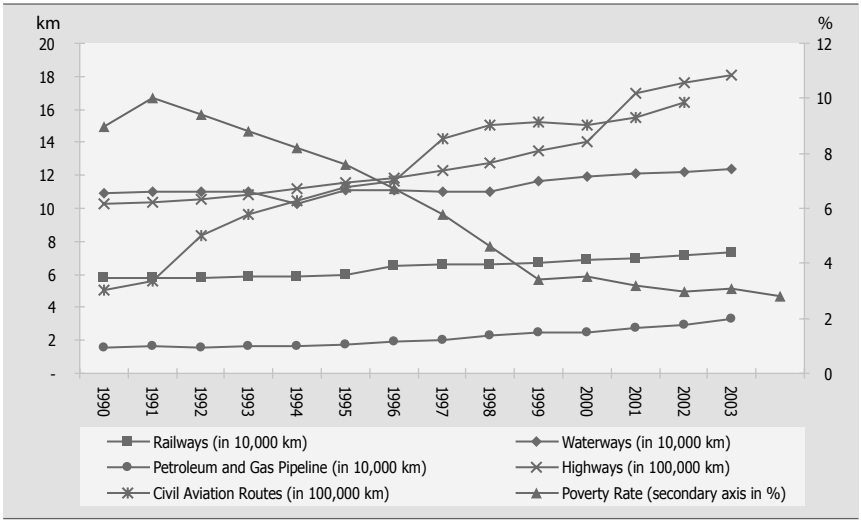
Figure 8.3 **Infrastructure Investments, Poverty Rate, and Gross Domestic Product**



Source: Author's calculation.

the secondary axis. It is interesting to note that, among all items in Figure 8.4, it is the highways which appeared to have the clearest positive impact on rural poverty alleviation.

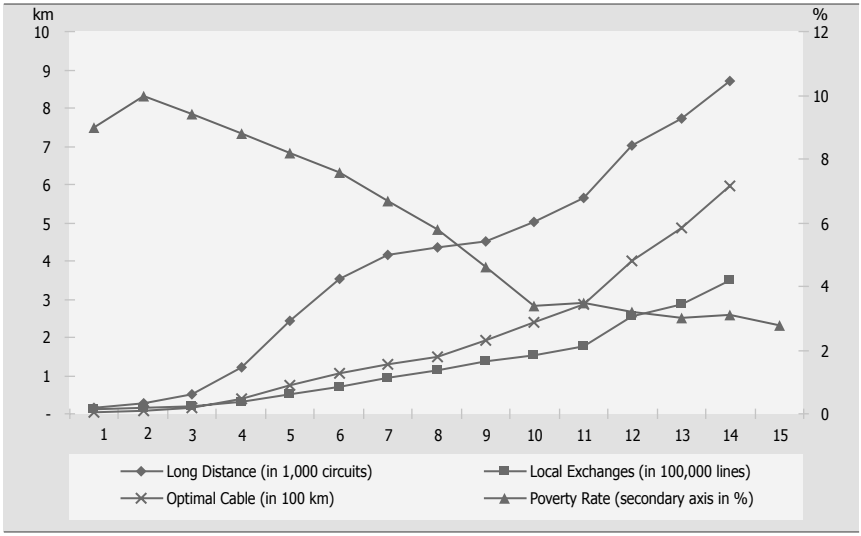
Figure 8.4 **Transportation Infrastructure Development and Poverty Incidence**



Source: Author's calculation.

A similar theme is portrayed in Figure 8.4, which shows the relationship between poverty alleviation and improvements in telecommunication-related infrastructure facilities. Poverty is negatively correlated with these improvements. Of the three components, long-distance telephone facilities apparently contributed substantially to poverty alleviation. The information in Figures 8.4 and 8.5 support the key theme, which is that continuously improving transportation and telecommunication infrastructure has the potential of stimulating and sustaining poverty alleviation.

Figure 8.5 **Post and Telecommunications Infrastructure Development and Poverty Rate**



Source: Author's calculation.

These results are consistent with expectations. Thus, it would be more useful to further assess the role of the improvement of infrastructure in reducing poverty and the magnitude of the effect using a CGE model. One advantage of the model is that it is designed to capture in some useful detail the constraints and relationships between institutions and sectors. With the help of this linkage mechanism, policy simulation would produce results that reflect the chain of effects from external shocks to poverty alleviation, which help in understanding more deeply the relationship between infrastructure development and poverty. The simulation results elaborate further the above discussion on the analytical and empirical aspects of this relationship. The study first assesses, in the next subsection, the related literature to be able to come up with a useful design of the policy scenarios for the simulations. The more detailed features of the model are introduced in the next section.

Empirical Assessment

The contribution of investment in infrastructure development to poverty alleviation particularly in rural areas has been studied extensively as it involves the problems of direction of capital flow and capital efficiency. Summers and Heston (1991) find that some infrastructure facilities such as for telecommunication, electricity, highways, and potable water are closely associated with per capita GDP growth. The mix of infrastructure varies with the level of economic development. In poor countries, rudimental infrastructures like water supply and irrigation are most important; for

medium- or low-income countries, transportation infrastructure becomes increasingly important with the decline of agriculture's share in the country's GDP; and telecommunication facilities tend to receive the largest proportion of infrastructure investment in rich countries. However, most current studies on the relationship of infrastructure and poverty reduction focus on water supply, irrigation, and transportation sectors, rather than on electricity and telecommunication sectors.

Even for countries with similar levels of economic development, the packages of infrastructure facilities that they invest in vary because of their different socioeconomic characteristics. The International Food Policy Research Institute observed this variance based on the samples of infrastructure projects they selected in the PRC, India, and Thailand. The results of its assessment demonstrated that in the PRC and India, road construction in rural areas is more useful for poverty reduction than investments in irrigation facilities. In Thailand, a rural electricity network was found to be the most effective approach to poverty alleviation (Weiss 2003).

Many studies have explored the effects of transportation infrastructure construction on economic growth and poverty reduction in developing countries and have provided some useful observations. These studies can be grouped into two categories based on the methodology they use: econometric analysis and case studies. With case studies, researchers evaluate the adoption of certain policies by comparing indicators of different regions or during different time periods. Using econometric models, researchers estimate elasticities of dependent variables to independent factors.

In a case study of road construction in rural areas of Viet Nam; Glewwe, Gragnolati, and Zaman (2000) found that the likelihood of reducing poverty in rural areas with a better-developed road system was 67 percent higher than in those areas with a deficient road system. In another case study, Van de Walle and Cratty (2002) evaluated a road maintenance project in Viet Nam with World Bank funding. They observed that the project was most beneficial to the poorest rural households. With the project completed, 40 percent of rural poor households saved a substantial amount of their traveling time and improved to a good extent their capability to communicate with the outside world.

Compared with case studies that tended to focus on the poverty alleviation outcomes of policy implementation, econometric studies paid more attention to quantifying the linkages between the adoption of policies and poverty reduction. Kwon (2000) explored the direct and indirect channels through which infrastructure contributed to poverty alleviation, and found that the improvement of road status will benefit the poor through economic growth.

For provinces with better road systems, an increase of 1 percent of GDP decreases the poverty rate by 0.33 percent. In contrast, those provinces with inferior road networks had lower GDP elasticity of poverty alleviation of 0.09 percent. At the same time, the improvement of road facilities also benefited the poor population by increasing their wages and creating more job opportunities. An increase of investments in road construction by 1 percent translates into a 0.30 percent decline in the poverty rate.

Balisacan and Pernia (2002) used provincial data to examine the effects of road construction on poverty in Philippines. Their results revealed that if the construction is accompanied by an improvement in educational facilities, then a 1-percent increase of the length of the road system increased the average income of the poor by 0.11 percent, and induced a further increase of the same by 0.32 percent through the trickle-down effect of economic growth.

Fan, Zhang, and Zhang (2002) measured the effects of different types of government expenditures on economic growth and rural poverty alleviation in the PRC. They found that road facilities significantly reduced poverty incidence through agricultural productivity growth and nonagricultural employment opportunities. The estimated elasticities with respect to road density were 0.08 for per capita agricultural GDP, 0.10 for nonagricultural employment, and 0.15 for nonagricultural wages in rural areas. In similar research, Jalan and Ravallion (2002) estimated that an increase of 1 percent in road density induced a rise by 0.08 percent in household consumption expenditures.

Other studies explored the influence of infrastructure construction on productivity. The authors of some of these studies argued that the variance of economic development in various regions within the same country was partly due to differences in infrastructure development. Poor infrastructure development would not only directly dampen productivity growth, but would also deny the poor access to medical treatment, education, and communication with developed areas. By analyzing a time series survey data from 17 states of India; Nagaraj, Varoudakis, and Veganzones (2000) found that agricultural productivity kept growing with the increase of road length. An increase of 10 percent in productivity increased average income by 3.4 percent.

The improvement of road facilities was closely correlated with electrical consumption and residents' health status. Using the panel data of India's rural areas, Zhang and Fan (2001) estimated the influence of road construction on agricultural total factor productivity (TFP) in India. The growth elasticity of agricultural TFP to road density ranged between 0.043 and 0.078, depending on the specific econometric method used. In a similar study, Deichmann et al.

(2000) compared productivities of manufacturing in northern and southern areas of Mexico. They found that good road construction extended the potential and opportunity of market entry and that an increase of 10 percent in market channels translated into a 6 percent increase in productivity.

All of the above studies did not indicate the specific nature of the cause-and-effect relationships among economic variables. Moreover, the empirical results depended on selected methods, definitions of specified equations, and the data used in the analysis. However, these results can help clarify the important role of infrastructure construction in poverty reduction and to identify the relevant parameters of the CGE model.

On the other hand, not all studies provided similar results regarding the positive contribution of infrastructure development to poverty alleviation. In a study on Nepal's rural road facilities, Jacoby (1998) found that although the construction and improvement of rural road networks brought about substantial benefits, the poor captured only a small share of the gains. This is an important finding since without the poor obtaining more gains from infrastructure investments than the rich, the construction and improvement of rural road networks would hardly reduce poverty.

Besides quantitative methods, a number of scholars employed qualitative research techniques, such as concentrated interviews. In one such study in two provinces of the Central Highlands of Viet Nam, Songco (2002) noted that the social benefits from the improvement of rural roads were generally perceived as larger than economic ones. The surveys conducted by the World Bank (2002) and the Asian Development Bank (2002) also showed that the rural poor generally regarded roads as the necessary facility with the lowest construction cost. Roads can facilitate their access to medical treatment, education, and communication with developed areas, which they need for their personal development.

There are only a few studies that have examined the effects of telecommunication infrastructure on poverty reduction or economic growth. Uchimura and Gao (1993) analyzed the effects of infrastructure development as represented by the expansion and improvement of transportation, water supply, and telecommunication facilities on sectoral outputs. The elasticity of output[3] to infrastructure level in Korea was 0.19, while this figure was 0.24 in Taipei,China. Shah (1988, 1992) aggregated electricity, telecommunication, and transportation, and examined the effect of composite infrastructure on outputs. He estimated an elasticity of 0.05 in Mexico. Another study (Easterly

[3] This elasticity is defined as the influence of 1 percent change of infrastructure stock on percentage of output.

and Rebelo 1993) involving multiple countries showed that the average output elasticity was 0.16.

In summary, the literature is replete with empirical support to the proposition that infrastructure development alleviates poverty. This study takes the analysis further and explores the nature of the specific relationships among variables using a CGE model. In building the model, the framework described in Figure 8.2 above is followed. The study explores as well the influences of infrastructure development on labor migration, nonagricultural employment, and households' incomes and expenditures.

A CGE Model of the PRC's Economy

The CGE model used in this study is the latest version of the CGE model developed and maintained by the Development Research Center of the State Council in Beijing. Earlier versions of the model had been used to analyze the effects of the PRC's accession to the World Trade Organization (WTO) on economic growth (Development Research Center 1998) and urban unemployment (Zhai and Wang 2002), and the potential implications of trade and tax reform on income distribution (Wang and Fan 1998). After disaggregating households and labor, Hertel, Zhai, and Wang (2004) applied the model to examine the impact of the PRC's accession to the WTO on poverty alleviation. This study extends the model by improving the description of trade and tax policies and incorporating appropriable variables of investment in infrastructure construction.

Model Structure

In this part of the section, the basic structure and assumptions of the model is described. The discussion about the features of the model, which allow it to capture the effects of infrastructure development on poverty reduction is taken up in the last part of this section.

Model Dimensions. The model has 49 production sectors, 3 production factors (labor, capital, and land), and 2 households–one representing urban households and the other rural households. Of the 49 sectors, 6 are agriculture-related sectors, 36 are industrial and construction sectors, and 7 are service sectors. Labor and capital are mobile across sectors subject to restrictions mentioned below, while land is restricted to moving among the six agricultural sectors. There are three types of labor; namely, urban labor, rural nonagricultural labor, and rural agricultural labor. Each of type of labor is further disaggregated into three categories: unskilled labor (illiterate or semiliterate), semiskilled workers (with a middle or high school education),

and skilled workers (schooling above high school). Both rural and urban households are each disaggregated into 100 subgroups according to their main sources and levels of income. The disaggregation would allow a better tracking of the effects of policy shocks on the economic status of each of these households and is further discussed below.

Production and Factor Markets. All sectors in the model are assumed to operate under constant returns to scale and it is also assumed that firms maximize profits of their respective production activities. The technologies of the production activities are represented by a nesting of constant elasticity of substitution production functions. The market is assumed to be perfectly competitive. Each type of labor resource is assumed to be fully mobile across sectors, except for agricultural labor which works only in the six agricultural sectors and rural nonagricultural workers who are employed only in nonfarm sectors in rural areas. Agricultural labor and production workers are not substitutable with one another. The PRC presently maintains significant barriers for rural workers to migrate to urban areas. The model captures this segmented labor market by incorporating partial mobility of agricultural laborers and production workers into the cities. The conversion between different types of labor is determined by the relative wage and the transformation elasticity.

Foreign Trade. The PRC exports and imports goods to and from the rest of the world. The amount that the PRC exports of a given locally produced good to the rest of the world is a constant elasticity of transformation function of the volume of the local good produced. Locally produced goods are imperfectly substitutable with imported goods. Thus, Chinese products are assumed to be differentiated from imported products, and exported merchandise are assumed to be qualitatively different from those sold in domestic markets. The demand for exports is a constant-elasticity function of their respective own prices. The price elasticities are high but less than infinite. Therefore, the terms of trade for the PRC are endogenous in the simulation. In the case of imports, the PRC is assumed to be a price taker in these markets, considering the country's small share in global import markets. Since foreign trade is not the focus of this research, this model does not differentiate the foreign trade regime. The taxes and subsidies of both imports and exports are also not further described.

Income Distribution and Demands. Factor incomes accrue to four institutions: enterprises, households, government, and the off-budget public sector. Household income comprises incomes from ownership of capital, labor, and land resources. Additionally, households receive distributed enterprise profits and transfers from the government and rest of the world. The model assumes that all the land endowments in the model belong to

the rural households. Rural households earn their labor income from selling both agricultural labor and rural nonagricultural labor services. The urban households obtain their wages as urban workers. Returns to capital services are distributed among households and enterprises. Enterprise earnings are equal to the gross returns to capital services net of corporate income taxes. A part of enterprise earnings is allocated to households as distributed profits based on fixed shares, which are the assumed shares of capital ownership by households. Another part of these earnings is used to pay for fees to off-budget public sectors. The residual enterprise earnings are assumed to be the retained earnings, i.e., corporate savings for new investment and capital depreciation replacement. Household disposable income is allocated to final consumption of goods and services and to savings. Households maximize utility using the extended linear expenditure system which is an extension of the Stone-Geary demand system. The utility function involves saving as a covariate, which is evaluated using the consumer price index.

The government derives revenues from corporate income taxes, import tariffs, and two types of indirect internal taxes. The value-added tax is modeled as a tax levied on production factors. Other indirect taxes, including various agricultural taxes and business taxes on construction and services, are treated as a production tax levied on sector outputs. Government expenditure is mainly spent on purchasing public goods, providing subsidies for enterprises (treated as negative income of government), and providing transfers to households. Extra-budget public sectors collect fees from enterprises and households. Their incomes are allocated to consumption and saving. The consumption of extra-budget public sectors and government spending compose a type of final demand, i.e., the social consumption.

Macroeconomic Closure. Macroeconomic, or simply macro closure, determines the manner in which the following three accounts are brought into balance: government budget, aggregate savings and investment, and balance of payments. Real government spending is exogenous in the model. All tax rates and transfers are fixed, while real government savings is endogenous. The macro closure of the balance of payments requires that the value of imports at world price must equal the sum of the value of exports at border prices, net transfers and factor payments, and net capital inflows. An exchange rate is specified to convert world prices into domestic prices. Either this exchange rate or total foreign capital inflow can be fixed, while the other is allowed to adjust to provide alternative closure rules. With foreign savings set exogenously, equilibrium would be achieved through changing the relative price of the tradable to the non-tradable or changing the real exchange rate.

Finally, the total value of investment expenditure must equal total resources allocated to the investment sector: retained corporate earnings, total household savings, government savings, extra-budget savings, and foreign capital flows. In this model, different macro closures were selected for different experiments. In the first simulation, investment in infrastructure increases, the model assumes that the total investment is exogenously determined and the investment-savings balance is realized by the endogenous labor supply (i.e., unemployment exists). This specification corresponds to the Keynesian macroeconomic closure in CGE literature. Therefore, output is determined by demand. In the second simulation, the infrastructure improvement promotes labor migration and productivity growth, which is a relatively long process. Therefore, the model supposes that the aggregate investment is endogenously determined by the sum of the separate savings components that is, the model is savings-driven, which is a feature generally referred to as the neoclassical macro closure in CGE-related literature.

Data. The model is calibrated to the 1997 two-region Chinese social accounting matrix (SAM) developed from the 1997 national input-output table and other macroeconomic data. Some key parameters of the model, such as substitution and income elasticities, are obtained from earlier versions of the model and from the literature. All other parameters such as shift and share parameters are calibrated to the base year using the key parameters and the base data.

Modeling Household Behavior and Labor Migration

To improve the model's capability of assessing the effects of infrastructure on poverty, the number of households in the model is disaggregated to the highest extent possible, as permitted by the sampling design of the survey and the availability of other relevant data. The aggregations of the data from the rural and urban household surveys for three provinces[4] in the year 2000 were obtained from the NBS.

Respondent households in the surveys were grouped into five levels or strata according to their respective primary sources of income. The five household groups were: agriculture-specialized rural households, income-diversified rural households, transfer-specialized urban households, labor-specialized urban households, and income-diversified urban households. Within each stratum, households were ranked from poorest to richest, based

[4] The three provinces are Guangdong, Sichuan, and Liaoning. Guangdong represents the relatively wealthy coastal region. Sichuan represents the populous, relatively poor inland region in which agriculture plays a more important role in the economy. Liaoning is a typical "old industrial base," which is heavily urban and highly dependent on state-owned enterprises. Together, these provinces are fairly representative of the diversity within the PRC as a whole.

on their respective per capita income. From the ranking, the stratum was then divided into 20 groups, each layer containing 5 percent of the stratum population. Thus, the model has a total of 100 household groups: 40 rural (20 groups × 2 strata) and 60 urban (20 groups × 3 strata) representative households. By incorporating the data structure into the national SAM, the model reflects the diversity of household earnings and spending. The income variance of the 10 groups of representative households belonging to middle to low income within each stratum provides useful information for studying the poverty problem.

Each household is endowed with three types of labor, namely unskilled, semiskilled, and skilled.[5] The capability of allocating labor to off-farm activities is one of the most important features of this model. Since the middle of the 1990s, agricultural workers have shifted to nonagricultural sectors or have migrated to urban areas. However, because of certain institutional reasons and practical difficulties, the mobility is greatly restricted. For example, households that ceased to farm would lose their property rights over these farm lands. Thus, they had a strong incentive to continue farming at some scale, even if the profitability to do so was quite low (Zhao 1999a). To the low-skilled agricultural workers, access to most of the urban amenities, such as housing and education, is limited and relatively expensive because they are unable to obtain an appropriate registration (*hukou*) to reside legally in an urban area. In addition, higher transport costs and the prospect of not finding a job in the cities deter large-scale rural-to-urban migration. All the above factors impede the flow of migrants from rural to urban areas. On the other hand, the growth in rural nonfarm activities is only modest, which limits the possibility of rural households obtaining local off-farm jobs (Chan and Zhang 1999).

Changes in the supplies of the various types of labor in the model are triggered by induced availability of nonfarm labor and the migration of rural labor to urban areas.

The off-farm labor supply is modeled using results from the econometric work of Sicular and Zhao (2002). They estimated a household labor supply function using labor survey data from the 1997 Chinese Health and Nutrition Survey of nine central provinces. Their research calculated the implicit (shadow) wage of each individual in the sample and the corresponding nonagricultural wage they could obtain if that individual were to work in agriculture or nonagricultural self-employment sectors. Thus Sicular and Zhao estimated labor supply equations for self-employed agricultural labor, self-employed nonagricultural labor, and wage labor.

[5] In the model, labor skill is determined by educational attainment.

Based on the estimates of the parameters of the labor supply functions, the labor-transfer elasticities between agricultural and nonagricultural sectors were calculated. These elasticities depict the underlying constraints on labor migration in the system. The results showed that a 1-percent decrease of the shadow wage in agriculture induced 2.67 percent labor migration from farming to nonfarm activities in the model. The transfer elasticity from farm to nonfarm sectors in the case of a wage increase in the nonagriculture sectors was only 0.60. In the benchmark scenario of the model, the latter estimate of labor migration elasticity is used in this study as it apparently better reflects Chinese reality.

The basic equation of nonfarm labor supply is as follows:

$$\begin{cases} \dfrac{\sum_{rh} ls^{rlag}_{sk,rh}}{\sum_{rh}\left(ls^{rl}_{sk,rh}+ls^{ul}_{sk,rh}\right)} = \dfrac{\sum_{rh} als^{rlag}_{sk,rh}}{\sum_{rh} als^{rl}_{sk,rh}} * \left(\dfrac{w_{ag,sk}}{\overline{w}_{nag,sk}}\right)^{\omega^{l}_{ag,sk}} & (1) \\ \overline{w}_{nag,sk} = \dfrac{\sum_{rh} ls^{rl}_{sk,rh} * w_{nag,sk} + \sum_{rh} ls^{ul}_{sk,rh} * w_{sk} * w^{d}_{sk}}{\sum_{rh}\left(ls^{rl}_{sk,rh}+ls^{ul}_{sk,rh}\right)} & (2) \end{cases}$$

where

$ls^{rlag}_{sk,rh}$ Final agricultural labor supply by rural households

$ls^{rlag}_{sk,rh}$ Final nonagricultural rural labor supply by rural households

$ls^{rl}_{sk,rh}$ Final nonagricultural urban labor supply by rural households

$als^{rlag}_{sk,rh}$ Initial agricultural labor supply by rural households

$als^{rl}_{sk,rh}$ Initial nonagricultural rural labor supply by rural households

$w_{ag,sk}$ Agricultural wages by different skill levels

$\overline{w}_{nag,sk}$ Nonagricultural average wages of rural labor

$\omega^{l}_{ag,sk}$ Elasticity of labor transfer from agricultural to nonagricultural sectors

$w_{nag,sk}$ Nonagricultural average wages of rural labor on different skilled levels

w_{sk} Urban wages by skill levels

μ Urban unemployment rate of rural migrant labor

w_{sk}^{d} Coefficient of wage distortion between urban and rural areas

From a long-term perspective, all of the labor resources in the economy are fully employed. However, in the short run, when it is costly to move to other sectors, migration decisions are based on the net benefit of moving. The model depicts the problem by introducing an endogenous unemployment rate of migrants. We assume that urban labor is fully employed. However, migrant rural labor going to cities or seeking jobs in off-farm activities may possibly be unemployed because of the *hukou* restriction or because they lack the skills required by the available jobs. Therefore, it is not the wage difference between rural and urban areas, but the expected income after migration that farmers assess in deciding whether to migrate or not. By introducing $(1 - \mu)$ as the unemployment rate of rural migrants, Equation 2 is modified to obtain the following short-term expression:

$$\overline{w}_{nag,sk} = \frac{\sum_{rh} ls_{sk,rh}^{rl} * w_{nag,sk} + \sum_{rh} (ls_{sk,rh}^{ul} * (1-\mu)) * w_{sk} * w_{sk}^{d}}{\sum_{rh} \left(ls_{sk,rh}^{rl} + ls_{sk,rh}^{ul} * (1-\mu) \right)}$$

Most of the nonfarm labor provided by rural households migrate to urban areas. Based on existing statistics from the Family Planning Committee of China, the volume of the "floating population"[6] in the PRC has risen to 0.14 billion in 2003 from 70 million in 1993. Within the decade, the quantity has doubled and exceeded 10 percent of the total national population. At the end of 2003, the floating population accounted for about 30 percent of the entire rural labor force (Xinhua Net 2005). However, the labor migration from rural to urban areas is far from free in the PRC. Although the relatively significant wage difference is attractive, labor migrants from rural areas continue to face the very high social costs of moving to the cities, such as transport costs, unemployment, housing unavailability, and other uncertainties. Some of these transaction costs are invisible, but, they constitute heavy burdens for migrant rural workers and their families.

Zhao (1999b) claimed that the average annual wage gap between rural and urban areas of unskilled workers of comparable background and ability

6 Chinese demographers classify them as temporary settlers from rural to urban areas in search of work and better life. These people are not officially registered in their temporary abode and are considered "illegal migrants" or "floating population" since they are expected to eventually return to their villages.

in Sichuan Province was CNY2,387.60 in 1995. Most of this gap may be explained by the social costs associated with migration as mentioned above. Shi, Sicular, and Zhao (2002) studied the phenomenon of rural-urban income inequality in greater detail using data from the Chinese Health and Nutrition Survey involving nine provinces of the PRC. The authors observed that the apparent labor market distortion accounted for 42 percent of the rural-urban labor income differential and 48 percent of the hourly earnings differential. When applied to the average wage differential, this distortion plays a role as an ad valorem "tax" accounting for 81 percent of rural wages. In this model, we treat these transaction costs as real costs that are borne by the temporary migrants.

The transaction cost function is postulated as an increasing function of migrants' quantity with fixed elasticity. The cost increases proportionately with the number of rural residents engaged in temporary work. When labor migration reaches a certain level, any further increase in the number of migrants would have only limited effects.

In the long term, with all labor resources fully employed, the equations of household labor supply including rural-urban labor migration are as follows:

$$\begin{cases} ls^{l}_{sk,h} = als^{l}_{sk,h} + lag^{l}_{sk,h} - migl^{l}_{sk,h} & (3) \\ w_{sk} * w^{d}_{sk} = c^{d}_{sk} + (1+\tau^{C_{ind}}_{sk}) * w_{nag.sk} & (4) \\ \tau^{C_{ind}}_{sk} = \alpha^{C_{ind}}_{sk} * \left(\dfrac{tmigl_{sk}}{\sum_{rh,l} ls^{l}_{sk,rh}} \right)^{\omega^{mig}} & (5) \end{cases}$$

where

$ls^{l}_{sk,h}$ Final labor supply by households

$als^{l}_{sk,h}$ Initial labor supply by households

$lag^{l}_{sk,h}$ Off-farm labor transfer by households

$migl^{l}_{sk,h}$ Migrant labor from rural to urban areas by households

c^{d}_{sk} Direct cost of labor migration

$\tau^{C_{ind}}_{sk}$ Tax-equivalent indirect cost of labor migration

$\alpha_{sk}^{C_{ind}}$ Initial transfer factor of labor migration costs

$tmigl_{sk}$ Total rural-urban labor migration

ω^{mig} Indirect cost elasticity of labor migration

In the short-term scenario, it is important to consider the unemployment problem of rural migrants. The model assumes that migrants would decide to move to the cities when their expected income of doing so exceeds their respective costs of moving. Equation 4 is modified accordingly by the following:

$$w_{sk} * w_{sk}^{d} * (1-\mu) = c_{sk}^{d} + (1+\tau_{sk}^{C_{ind}}) * w_{nag,sk}$$

With nonfarm transfer and rural-urban migration of rural labor featured in the model, the final equilibrium condition of labor markets comprises three components: the supply-and-demand equilibrium of rural agricultural labor, rural nonagricultural labor, and urban labor. The equilibrium equations are as follows:

$$\begin{cases} \sum_{inag} ld_{sk,inag}^{u} = \sum_{uh} ls_{sk,uh}^{ul} + \sum_{rh} ls_{sk,rh}^{ul} * w_{sk}^{d} & (6) \\ \sum_{iag} ld_{sk,iag}^{r} = \sum_{rh} ls_{sk,rh}^{rlag} & (7) \\ \sum_{inag} ld_{sk,inag}^{r} = \sum_{rh} ls_{sk,rh}^{rl} & (8) \end{cases}$$

where $ld_{sk,inag}^{u}$ and $ld_{sk,inag}^{r}$ respectively represent the demand of producers in non-agriculture sectors for urban and rural labor by skill levels. The variable $ld_{sk,iag}^{r}$ is the corresponding demand of producers in agriculture industries.

For the short-term analysis, Equation 1 above is modified in the following form:

$$\sum_{inag} ld_{sk,inag}^{u} = \sum_{uh} ls_{sk,uh}^{ul} + \sum_{rh} ls_{sk,rh}^{ul} * (1-\mu) * w_{sk}^{d}$$

In this study, the transaction costs relating to rural-to-urban migration significantly influence migration decisions and, thus, labor markets. Infrastructure investment and construction have the potential of improving the demand for low-skilled labor and providing more job opportunities for agricultural labor to participate in off-farm activities. Moreover, infrastructure development in urban areas would tend to attract more rural migrants.

However, migrant workers may come from rural areas with less favorable social circumstances, and moving into the cities entails costs, including higher transport fees, living costs, and other indirect transaction costs. Infrastructure improvement would reduce these costs to a certain degree, but, for different types of labor and households, the net gains are not equal. The simulation results in the next section of this chapter, further reveal the nature and mechanism of the influence of infrastructure development on poverty reduction.

Simulations Design and Main Results Analysis

Simulations Design

This study analyzes the contribution of transportation and telecommunications infrastructure improvements, which associate closely with production and household living standards, to poverty alleviation. In doing this, it focuses on two aspects of infrastructure improvements, namely, the increase of infrastructure investment and the improvement of physical infrastructure. These relate to the short- and long-term effects of infrastructure improvements, which are elaborated below.

With regard to the short-term effects of infrastructure investment, this study assumes a 10 percent increase of infrastructure investments and incorporates the increase in the model by increasing total investment in economy.[7] In 1997, which is the base year of the model, the total investment in capital construction of the transportation, post, and telecommunication sector was CNY215.07 billion; the total investment in fixed assets in the sector was CNY2,494.11 billion. With a 10 percent increase of infrastructure investments, the investment reaches about CNY236.58 billion. This translates into a 0.86 percent rise of the total investments in the economy, assuming investments in other sectors remain the same. For this scenario, the model uses *Keynesian closure*, in which the unemployment rate is determined endogenously.

From a long-term perspective, the improvement in infrastructure facilities would substantially reduce transportation, communication, and labor-migration costs. The ensuing enhancement of mobility and access to information of the population accelerates the diffusion of knowledge and technology. This result then stimulates productivity improvements.

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[7] Because of the lack of detailed statistical data on infrastructure investments and total investments in the economy, this research selects the index of investment in capital construction and total investment in fixed assets instead to reflect the changes of the above two aspects.

In capturing these long-term results in the simulations, the study assesses first the effects on poverty reduction of infrastructure improvements through reduced migration costs. Then the link of improvements of infrastructure conditions to productivity is examined through their effects on agricultural labor productivity.

The model assumes that a 10 percent improvement of infrastructure conditions would reduce migration costs by 1 percent. The share of the rural poor in the benefits from infrastructure improvement depends not only on the availability of the physical infrastructure itself, but also on the conditions of the use of the infrastructure such as traffic fees and telecommunication service tariffs. The assumed discounted impact on migration costs reflects the state of use by the poor of the infrastructure facilities. If the government adopts specific pro-poor measures, such as lowering the telecommunication fees in poor areas and reducing the traffic fees for migrant workers from poor rural areas, then the benefit of infrastructure improvement would be more widely shared by the poor population in rural areas. In such a case, the model assumes that the 10 percent improvement of infrastructure conditions would result in a 5 percent reduction of migration costs.

With regard to the effects of infrastructure improvement on productivity, the empirical literature[8] provides information that in developing countries, the elasticity with respect to road density ranges from 0.043 to 0.080 for agricultural GDP per worker or for agricultural TFP. The estimate produced by Fan, Zhang, and Zhang (2002) based on the regional data of the PRC is used in this study, that is, the elasticity of agricultural labor productivity with respect to road density is 0.080.

However, when it comes to telecommunications infrastructure facilities, the literature is apparently without any elasticity parameter estimations that may be used in the simulation. The PRC is a developing country and its agricultural production technology continues to be traditional. Thus, in contrast to transportation infrastructure, which plays a more basic role in national economy, the telecommunications infrastructure is expected to have a smaller influence on agricultural development. Thus, in the model, the elasticity of agriculture labor productivity with respect to telecommunications infrastructure improvements is 0.040 or half of the transportation infrastructure.

The growth rate of labor productivity in agricultural sectors is described by the following equation:

$$\Delta_{lag} = 0.08\Delta_{trn} + 0.04\Delta_{cmn}$$

8 See the literature review in the subsection on the analytical framework.

where Δ_{trn} stands for the percentage increase of road density and Δ_{cmn} is the corresponding variable for telecommunications infrastructure, including the expansion of telephone-exchanges capacity, enlargement of broadcasting and television networks, and improvement of network coverage rates. Following the equation, the agricultural labor productivity rises by 1.2 percent over its base year level if both transportation and telecommunications infrastructure stock increases by 10 percent.

For the latter simulation on the long-term effects of infrastructure improvement, the model uses *neoclassical* macroeconomic closure. Table 8.6 summarizes the simulations that were done in this study.

Table 8.6 **Summary of Simulations Design**

Experiment	*Description*
1. Infrastructure investment increases	— Total investments in transport and telecommunication infrastructure construction are exogenously increased by 10% while those in other sectors are held constant. Total investment in national economy exogenously increases by 0.85%.
	— The labor force in urban areas is fully employed, while the unemployment rate of rural migrants is endogenously determined.
2. Physical infrastructure improves	— The migration costs are reduced by 1% due to the improvement of infrastructure facilities by 10% and by 5% if the improvement is accompanied by relevant pro-poor measures.
	— The migration costs are reduced by 5% and the labor productivity in agricultural sectors go up by 1.2% through the improvement of infrastructure conditions with relevant pro-poor measures.

Note: Base year = 1997
Source: Author's design.

Analysis of Simulation Results on Poverty Reduction

Short-term Effects of Infrastructure Investments. Table 8.7 shows the percentage changes of the values of selected macroeconomic indicators from their respective base-year levels. The results show that a 10 percent increase of infrastructure investment increases GDP and the aggregate economic welfare by 0.371 percent and 0.365 percent, respectively. More investments provide more employment opportunities, increasing the employment rate of rural migrant workers by 3.8 percent. The number of migrant workers from rural to urban areas rises by 4.57 percent.

Based on the changes of the production activities of various sectors, the increase of infrastructure investments increases the production of related sectors and creates more job opportunities. Table 8.8 lists the top 15 out of the total 49 sectors of the model in terms of output and labor demand increases, respectively. Except for the construction sector, all the other sectors in the table engaged in manufacturing and most of these are labor intensive. These industries are among the top 15 sources of nonagricultural jobs for rural migrant workers. The electronic components sector, which is capital intensive, does not provide as many new jobs as the other sectors listed in Table 8.8.

Table 8.7 **Economic Effects of a 10% Increase of Infrastructure Investment**

Factors	*Change*	*Factors*	*Change*
Macroeconomic Variables		*Unskilled Wages*	
GDP	0.37	Urban	-3.94
Consumption	-0.08	Nonagricultural Including Migrants	1.60
Investment	0.85	Rural Nonagricultural	-0.41
Welfare (EV)	0.37	Agricultural Without Land Return	0.27
Employment Rate of Rural Migrants	3.81	*Semiskilled Wages*	
Inequality Measurement [a]		Urban	-1.81
Gini coefficient	-0.00160	Nonagricultural Including Migrants	1.19
Urban	0.00017	Rural Nonagricultural	1.78
Rural	0.00003	Agricultural Without Land Return	0.91
Labor Migration		*Skilled Wages*	
Agricultural-Nonagricultural	1.66	Urban	0.50
Rural-Urban	4.57	Nonagricultural Including Migrants	2.60
		Rural Nonagricultural	4.32
		Agricultural Without Land Return	1.23

EV = Economic value, GDP = Gross domestic product
[a] Change of original value, not percentage change.
Source: Author's calculation.

Table 8.8 **Effects of a 10% Increase of Infrastructure Investment on Output and Demand for Nonagricultural Labor**

Sectors	*Percentage Change of Output*	*Rank*	*Percentage Change of Demand for Nonagricultural Labor*	*Rank*
Metal Ore Mining	1.013	1	3.140	1
Metal Smelting	0.887	2	2.874	2
Instruments & Meters	0.886	3	2.859	3
Coal Mining	0.884	4	2.843	4
Construction	0.835	5	2.820	5
Nonmetal Products	0.788	6	2.802	6
Special Equipment	0.780	7	2.793	7
Nonferrous Ore Mining	0.770	8	2.643	8
Machinery	0.741	9	2.817	9
Transport Machinery	0.733	10	2.740	10
Mining	0.713	11	2.742	11
Metal Products	0.678	12	2.662	12
Building Materials	0.644	13	2.651	13
Electric Equipment	0.621	14	2.636	14
Electronic Components	0.581	15	a	a
Other Manufacturing	a	a	2.615	15

[a] Implies this sector was not ranked 15 or better under this category.
Source: Author's calculation.

The workers in the top 15 sectors stand to earn higher wages considering that, with a 10 percent increase in infrastructure investment, the average wage of semiskilled and skilled nonagricultural labor increases by 1.19 and 2.60 percent, respectively, as shown in Table 8.7. On the other hand, migration also alleviates rural employment pressure. The number of rural-to-urban migrant workers increases by 4.57 percent. Those rural workers

shifting to off-farm jobs also increase in number by 1.66 percent. Migration increases agricultural incomes. The average wages of semiskilled and skilled agricultural labor increases by 0.91 and 1.23 percent, respectively. All these factors improve the well-being of rural households.

With the increase in infrastructure investments, rural households with medium- and low-income levels are generally better off, as shown in Table 8.9. Urban households, however, have reduced real incomes, except for transfer-specialized urban households, whose incomes rise moderately. The decline of incomes of urban households may be traced to lower wages of unskilled and semiskilled urban workers as portrayed in Table 8.7. In Table 8.9, the cuts in incomes are regressively distributed, i.e., poorer households obtained larger losses of incomes. It is understandable since low income is often linked with low-skilled labor.

Table 8.9 **Effects of a 10% Increase of Infrastructure Investment on the Welfare of Medium and Low Income Households**

	Urban			*Rural*	
Groups (Poorest=1)	*Transfer Specialized*	*Labor Specialized*	*Diversified*	*Agriculture Specialized*	*Diversified*
1	0.115	-1.517	-1.13	0.214	0.261
2	0.233	-1.406	-1.047	0.265	0.317
3	0.201	-0.985	-0.909	0.268	0.298
4	0.224	-1.330	-0.929	0.319	0.282
5	0.244	-0.996	-0.704	0.266	0.290
6	0.256	-0.904	-0.694	0.349	0.304
7	0.272	-0.817	-0.628	0.327	0.296
8	0.188	-0.923	-0.632	0.258	0.320
9	0.204	-0.737	-0.490	0.238	0.297
10	0.201	-0.642	-0.371	0.251	0.305

Source: Author's calculation.

The general improvement of incomes of rural households and the income cuts suffered by a number of urban households have the effect of reducing income inequality. The national Gini coefficient reduces by 0.0016. For urban areas, the coefficient rises by 0.0017, reflecting the result that poorer households suffer relatively larger income losses. However, the coefficient for rural areas hardly changes.

To summarize, the short-term effects of a 10 percent increase of infrastructure investments generally confirm that infrastructure development in transportation and telecommunication helps reduce poverty. Higher outputs and thus more demand for nonagricultural labor provide new job opportunities for rural migrants. This is the most important and direct way by which infrastructure construction helps alleviate poverty.

Long-term Effects of Improvement in Infrastructure Conditions–Lower Migration Costs. Table 8.10 shows the long-term effects of a 10 percent improvement in infrastructure facilities. The results demonstrate that the reduction of migration costs has limited effects on macroeconomic variables like gross output and investment. However, reduced migration costs promotes labor migration. The migration between agriculture and nonagriculture improves by 0.06 percent and the rural-urban migration improves by 0.73 percent. If migration costs are reduced further with complementary pro-poor measures, the number of migrants increases by 0.28 percent and 3.68 percent, respectively. More rural workers find jobs which pay more by migrating to urban areas or working in off-farm production activities. This not only increases the income of the migrants, but mitigates as well the oversupply of rural labor. The respective wages of rural workers with varying skill levels are generally increased. However, under the background of full employment and limited economic growth, the urban workers are adversely affected by the influx of rural migrants in the cities, pulling down urban wages of unskilled and semiskilled workers.

Table 8.10 **Long-Term Economic Effects of a 10% Increase of Infrastructure Investment, by Alternative Migration Cost Reductions**

	Migration Costs Reduced by			*Migration Costs Reduced by*	
Factors	*1%*	*5%*	*Factors*	*1%*	*5%*
Macroeconomic Variables			*Unskilled Wages*		
GDP	0.02	0.11	Urban	-0.24	-1.17
Consumption	0.00	0.01	Nonagricultural Including Migrants	0.04	0.20
Investment	0.06	0.32	Rural Nonagricultural	0.15	0.76
Welfare (EV)	0.02	0.11	Agricultural Without Land Return	0.05	0.22
Inequality Measurement [a]			*Semiskilled Wages*		
Gini coefficient	-0.00025	-0.00124	Urban	-0.17	-0.85
Urban	0.00016	0.00078	Nonagricultural Including Migrants	0.17	0.82
Rural	0.00003	0.00015	Rural Nonagricultural	0.19	1.00
Labor Migration			Agricultural Without Land Return	0.15	0.73
Agricultural-Nonagricultural	0.06	0.28	*Skilled Wages*		
Rural-Urban	0.73	3.68	Urban	0.04	0.20
			Nonagricultural Including Migrants	0.04	0.20
			Rural Nonagricultural	0.04	0.20
			Agricultural Without Land Return	0.05	0.23

EV = Economic value, GDP = Gross domestic product
[a] Change of original value, not percentage change.
Source: Author's calculation.

Rural households with medium or low incomes are generally better off (Table 8.11). This is particularly true for households with diverse sources of incomes. The well-being of transfer-specialized urban households hardly changes, while those of urban households that are dependent on wage income and those with several sources of income are adversely affected,

likely because of the influx of rural migrant workers to the cities. The more migrants, the bigger the welfare loss to the two types of urban households. Overall, welfare improves by 0.02 and 0.10 percent corresponding to the extent of the reduction of migration costs, and similarly the Gini coefficient decreases by 0.0003 and 0.0012, respectively, implying an alleviation of inequality of income distribution between rural and urban areas.

Table 8.11 **Income Effects of a 10% Increase of Infrastructure Investment on Medium to Low Incomes Households, by Alternative Migration Costs Reductions**

Groups (Poorest=1)	*Urban*				*Rural*			
	Labor Specialized Migration Costs Reduced by		*Diversified Migration Costs Reduced by*		*Agriculture Specialized Migration Costs Reduced by*		*Diversified Migration Costs Reduced by*	
	1%	*5%*	*1%*	*5%*	*1%*	*5%*	*1%*	*5%*
1	-0.23	-1.15	-0.20	-0.98	0.05	0.25	0.12	0.62
2	-0.30	-1.49	-0.27	-1.34	0.04	0.17	0.21	1.05
3	-0.24	-1.18	-0.31	-1.55	0.03	0.15	0.23	1.14
4	-0.41	-2.01	-0.32	-1.59	0.04	0.20	0.23	1.17
5	-0.29	-1.43	-0.30	-1.47	0.03	0.17	0.26	1.33
6	-0.32	-1.59	-0.31	-1.53	0.04	0.17	0.30	1.52
7	-0.31	-1.54	-0.32	-1.57	0.03	0.13	0.33	1.66
8	-0.39	-1.94	-0.38	-1.86	0.03	0.17	0.37	1.89
9	-0.36	-1.75	-0.33	-1.61	0.03	0.13	0.38	1.90
10	-0.33	-1.61	-0.28	-1.40	0.03	0.17	0.42	2.13

Source: Author's calculation.

The simulation results above indicate that the improvement of infrastructure, working through lower migration costs, has limited influence on economic growth and employment. It could, however, improve its contribution to poverty alleviation through its effects on income distribution.

Long-term Effects of Improvement in Infrastructure Conditions–Lower Migration Costs and Higher Labor Productivity. The improvement of infrastructure conditions not only reduces migration costs, it also improves productivity. The network of infrastructure facilities strengthens the connection between undeveloped rural areas of the PRC and the outside world. The growth of agricultural labor productivity has a pronounced role in reducing poverty. Under this long-term assessment, new and improved infrastructure facilities would influence poverty through both productivity and distributive effects. Table 8.12 shows the results of the simulations involving both lower migration costs and higher productivity.

In simulating the effects of both shocks, the study assumes that the 10 percent improvement of physical infrastructure facilities would reduce migration costs by 5 percent and increase agricultural labor productivity by 1.2 percent, which in turn causes GDP to rise by 0.32 percent. The results of the simulation indicate that agricultural sectors attain a larger expansion

Table 8.12 **Long-Term Overall Economic Effects of a 10% Improvement of Physical Infrastructure, 5% Reduction of Migration Cost, and 1.2% Agricultural Labor Productivity Growth, by Alternative Migration Elasticity**

	Labor Migration Elasticity			*Labor Migration Elasticity*	
Factors	*Low (0.60)*	*High (2.67)*	*Factors*	*Low (0.60)*	*High (2.67)*
Macroeconomic Variables			*Unskilled Wages*		
GDP	0.32	0.35	Urban	-1.60	-1.76
Consumption	0.25	0.20	Nonagricultural Including Migrants	-0.24	-0.41
Investment	0.57	0.70	Rural Nonagricultural	0.10	0.12
Welfare (EV)	0.31	0.34	Agricultural Without Land Return	-1.01	-0.66
Inequality Measurement [a]			*Semiskilled Wages*		
Gini Coefficient	0.00102	-0.00072	Urban	-0.64	-1.00
Urban	0.00031	0.00069	Nonagricultural Including Migrants	1.10	0.77
Rural	-0.00006	-0.00003	Rural Nonagricultural	1.25	0.80
Labor Migration			Agricultural Without Land Return	-0.74	-0.01
Agricultural-Nonagricultural	2.00	4.04	*Skilled Wages*		
Rural-Urban	4.19	4.84	Urban	0.53	0.56
			Nonagricultural Including Migrants	0.53	0.56
			Rural Nonagricultural	0.53	0.56
			Agricultural Without Land Return	-1.02	0.19

EV = Economic value, GDP = Gross domestic product
[a] Change of original value, not percentage change.
Source: Author's calculation.

of their respective outputs than nonagricultural industries. Moreover, the demands for off-farm labor in rural areas of various sectors also expand.

Higher agricultural labor productivity induces an excess supply of rural labor, which tends to dampen wages in agriculture. While lower migration costs help cause agricultural labor productivity to grow, they also increase the number of rural-urban migrants by 4.19 percent; which mitigates the adverse effects on rural household incomes of agricultural labor productivity growth. When the number of migrants is inadequate to offset the adverse effects of an oversupply of rural labor, the remuneration for rural agricultural labor would tend to decline in the case of full employment. In such a case, the benefits of economic growth are shared more proportionately by urban households. The Gini coefficient between rural and urban areas increases by 0.001, assuming a low migration elasticity of 0.6.

If the government relaxes its restrictions on labor migration, such as the permanent residence registration system, and provides flexibility to the farmers with respect to the land property system, then the number of migrant workers would expectedly increase. These reforms may be reflected in higher elasticity of rural labor migration to nonagricultural sectors, which is assumed to be 2.67, thus increasing even more the available nonagricultural labor in the model. With this elasticity, the 10 percent improvement of infrastructure conditions causes GDP to rise by 0.35 percent and the number of rural

migrants to cities to rise by 4.84 percent as shown in Table 8.12. The induced additional migration alleviates the downward pressure on rural wages caused by an excess supply of rural labor, which agricultural labor productivity growth causes to happen. At the same time, these migrant workers have the potential to earn higher incomes in nonagricultural activities. Thus, the rural households can benefit more from the economic growth and the overall Gini coefficient goes down by 0.00072 units.

These effects are reflected in the changes of household incomes as shown in Table 8.13. The well-being of the transfer-specialized urban households hardly changes, while the effects for the other households vary depending on the migration elasticities. With a small number of migrants, the benefits of economic growth brought by productivity improvement are generally enjoyed by urban households. In rural areas, only the households that have the opportunities to work in nonfarm sectors can improve their welfare to a certain degree. The agriculture-specialized households suffer a welfare loss because the agricultural wage falls due to an excess supply of labor. If there are more migrants, then the real incomes of agriculture-dependent and income-diversified rural households improve, with the latter enjoying more gains compared to the former. However, at a high level, labor migration would induce adverse effects on incomes of the low-income urban households.

Table 8.13 **Long-Term Income Effects on Medium to Low Income Households of a 10% Improvement of Physical Infrastructure, 5% Reduction of Migration Cost, and a 1.2% Agricultural Labor Productivity Growth, by Alternative Migration Elasticity**

	Urban				Rural			
	Labor Specialized Labor Migration Elasticity		Diversified Labor Migration Elasticity		Agriculture Specialized Labor Migration Elasticity		Diversified Labor Migration Elasticity	
Groups (Poorest=1)	Low (0.60)	High (2.67)	Low (0.60)	High (2.67)	Low (0.60)	High (2.67)	Low (0.60)	High (2.67)
1	0.15	-0.72	0.18	-0.34	-0.09	0.20	0.53	0.74
2	0.11	-0.88	0.31	-0.44	-0.07	0.13	0.82	1.21
3	0.38	-0.32	0.70	-0.18	-0.08	0.09	0.76	1.21
4	0.03	-1.09	0.63	-0.27	-0.15	0.09	0.84	1.27
5	0.22	-0.57	0.90	-0.01	-0.12	0.08	0.84	1.33
6	0.57	-0.35	0.87	-0.02	-0.14	0.06	1.06	1.53
7	0.55	-0.35	1.20	0.24	-0.11	0.04	1.21	1.69
8	0.38	-0.70	1.29	0.15	-0.14	0.06	1.28	1.83
9	0.96	-0.13	1.66	0.61	-0.11	0.05	1.21	1.76
10	1.19	0.16	1.80	0.84	-0.12	0.08	1.68	2.12

Source: Author's calculation.

The effects on the welfare of households suggest that the government may cause incomes to be better distributed between rural and urban areas by calibrating the system reforms. With reforms implemented, the rural households may benefit more from economic growth without the urban households being made worse off in the process.

Conclusions and Policy Implications

By including possible poverty reduction channels in the CGE model framework, this study quantitatively analyzed the influences of infrastructure on the macro economy, income distribution, and poverty reduction, and identified the key factors that effectively contribute to poverty reduction.

Higher infrastructure investments promote the growth of the economy and improve the welfare of all rural households by spurring the generation of more off-farm and urban job opportunities. On the other hand, as more and more rural migrants try to work in urban areas, the competition in labor markets in the cities becomes more intense, which has adverse effects on the income and well-being of households in urban areas. Income inequality is thus moderately improved.

The most direct benefit brought to the poor by infrastructure improvements is the reduction of migration costs, which in the long run stimulates further labor productivity growth. Lower migration costs alone have limited effects on economic growth and alleviate rural poverty through their effects on income distribution. The lower the migration costs, the more the rural households benefit. The improvement of agricultural labor productivity strongly promotes economic growth, but the distribution of the benefits is determined by the scale of labor migration.

In closing, infrastructure construction confers both economic growth and social development benefits, but this intervention on its own is not sufficient to ensure poverty reduction. Infrastructure's full contributions to poverty reduction depend on other related policies and measures. These measures may include micro pro-poor measures, such as lowering the telecommunication and traffic fees to reduce the costs of moving to the cities. System reforms, such as the in labor market and in the residence registration system, may also be considered to relax the restrictions on labor migration to a greater extent. Decreasing migration costs and promoting nonfarm employment in urban areas of rural labor are the key approaches through which infrastructure makes contributions to poverty reduction.

CHAPTER 9

Computable General Equilibrium—Microsimulation Model: Economic and Poverty Impacts of Trade Liberalization in Indonesia

Guntur Sugiyarto, Erwin Corong, and Douglas H. Brooks

Introduction

The Indonesian government has actively pursued unilateral, bilateral, regional, and multilateral trade liberalization for the last two decades. All liberalization was done in the context of Indonesia's membership in the World Trade Organization (WTO), Asia-Pacific Economic Cooperation (APEC), Association of Southeast Asian Nations (ASEAN) Free Trade Area, ASEAN–China Free Trade Area, and ASEAN–China, Japan, Korea (ASEAN+3). Indonesia has also played an active role in the WTO by coleading the Group of 33 (G33) countries in the ongoing negotiations for the Doha Development Agenda (DDA).[1] The main objective of the DDA is to help developing countries by removing distorting tariffs and subsidies and improving market access to help promote economic development and reduce poverty.

The government's involvement in these various trade agreements, as well as in structural adjustment programs with the World Bank and the International Monetary Fund, has intensified the country's trade liberalization process. As a result, Indonesia has, in some instances, unilaterally hastened the liberalization pace beyond its commitments with the WTO (WTO 2003).

The rapid pace of unilateral trade liberalization and the imminent agricultural liberalization resulting from the DDA have been the subject of policy debates. Questions have been raised, such as: What are the economy-wide and poverty impacts of trade liberalization? Is there any justifiable reason for still protecting the agricultural sector? What are the effects of farm trade liberalization that might result from the DDA? Since most farm workers are among the very poor, will they benefit from the DDA and, if so, how?

[1] G33 was co-led by Indonesia and the Philippines during the 2001 WTO ministerial meeting.

The objective of this study is to shed light on these issues by examining the economy-wide and poverty impacts of unilateral, but DDA-consistent, trade liberalization in Indonesia using a computable general equilibrium (CGE) microsimulation model (or CGE macro-micro model) for Indonesia. Clarity on these issues is important as further liberalization may bring about different economy-wide and poverty impacts on different households.

Literature Review

Trade liberalization of agricultural products under the DDA is aimed at achieving a long-term objective of establishing a fair and market-oriented trading system through fundamental reform. The DDA calls for substantial reductions in trade-distorting domestic supports, all forms of export subsidies, and improvements in market access. These are the three *pillars* in agricultural trade liberalization.

Improvement in market access is the key to successful liberalization. The potential gains from improvement in market access have been shown to be the most important among the three pillars, accounting for two thirds of the potential global gains. Moreover, over half of the potential gains will go to developing countries (Hertel and Keeney 2005). Within the scope for market access, empirical studies have shown that agricultural market access is one of the most potentially significant issues in the DDA (Sugiyarto and Brooks 2005).

Hertel and Winters (2006) led a team of researchers in analyzing the possible poverty impacts of DDA on a number of developing countries, including Indonesia. The study concluded that a more ambitious DDA would lead to significant poverty reductions in the long run and that developing countries must not only allow for deeper tariff cuts, they must also implement complementary policies aimed at helping households take advantage of greater opportunities arising from the DDA.

For Indonesia, Robillard and Robinson (2005) analyzed the economy-wide and poverty impacts of the DDA and found that full liberalization under the DDA results in a reduction in poverty, as the wage and employment gains outweigh the changes in commodity prices critical to poor households. More importantly, they warned that the poverty impacts of DDA crucially depend on households gains in the labor market. Similarly, Sugiyarto and Brooks (2005) analyzed the economic and welfare impacts of the DDA using a conventional CGE model with representative household groups (RHGs). They observed that the removal of only agricultural tariffs would generate adverse effects, whereas the removal of agricultural tariffs in combination with

the elimination of agricultural commodity taxes would marginally benefit the economy. Comprehensive tariff elimination–involving all sectors–appeared to be even more beneficial.

Trade and Poverty Linkage

Winters (2001), Winters et al. (2004), and Hertel and Reimer (2004) stressed the need to investigate possible channels through which trade liberalization may affect households and poverty. These channels include:

- price and availability of goods;
- factor prices, income, and employment;
- government taxes and transfers influenced by changes in revenue from trade taxes;
- incentives for investment and innovation affecting long-run economic growth;
- external shocks, in particular, changes in terms of trade; and
- short-run risk and adjustment costs.

CGE modeling frameworks, because they involve counterfactual analysis, have been the preferred tool in identifying channels through which a certain policy change affects the economy. The models act as policy laboratories by providing numerical evaluation of the economy-wide impacts of a policy shift in a controlled environment, free from influences of other policies.

The use of CGE models to analyze poverty and income distribution can be traced to the initial work of Adelman and Robinson (1978) and Lysy and Taylor (1980). Since then, different approaches have emerged. A popular but restrictive approach is to assume a lognormal distribution of household income within each category where the variance is estimated from the base-year data (De Janvry, Sadoulet, and Fargeix 1991a). Meanwhile, Decaluwé et al. (2000) argued that a beta distribution is preferable to other distributions because it can be skewed to the left or right and thus may better represent the types of intra-category income distributions commonly observed among households. Regardless of the distribution, the CGE model is used to provide the changes in average income for each household category, while the variance of this income is assumed to be fixed.

Robillard and Robinson (2005) employed a sophisticated approach to analyzing the poverty impacts of the DDA for Indonesia. Considering the importance of the labor market, the model employed a CGE-microsimulation model containing a microsimulation of labor allocation. In this case, the CGE model produces price, wage, and aggregate employment vectors, and these vectors are then fed to the microsimulation model to generate changes in individual wages, incomes, employment status, and poverty. Overall

consistency is achieved by ensuring that the changes in the microsimulation module correspond to the macro variables generated by the CGE model.

An alternative approach is to use the actual distribution of income among different household categories based on the household survey results without imposing any functional forms. Cororaton, Cockburn, and Corong (2005) used this approach to analyze the poverty impacts of the DDA for the Philippines. Under this framework, the CGE model and the household module are linked in a sequential manner, that is, the CGE model generates the economic, sectoral, volume, and price effects. In turn, the changes in average household income and the cost of the household consumer basket (weighted consumer prices) for each RHG in the CGE model are then applied to all households under the same category in the household survey data. Thus, after each policy change, the corresponding changes in individual household welfare and poverty characteristics can be captured.

The Model

Following Cororaton, Cockburn, and Corong (2005) work on the Philippines, this paper utilized a CGE model developed for the Indonesian economy which is then linked to data of the Indonesian National Socioeconomic Survey (SUSENAS).[2]

Basic Structure of the Model

The model was developed using the 1999 Social Accounting Matrix (SAM)–selected for its correspondence to the 1999 SUSENAS–which has a comprehensive module on income and expenditures on which the poverty indicators can be constructed. The SAM used in the model has 23 production sectors and commodities composed of: 5 in agriculture, fisheries, and forestry; 9 in industry; and 9 in services (Table 9.1). The factors of production are distinguished by categorizing them as either capital (including land) or labor–which are further classified into 7 and 16 categories, respectively (Table 9.2). Labor is classified by location (urban or rural) and by types of work such as agricultural, production, clerical, and managerial. Capital inputs are classified into land, urban, rural, private, government, and foreign capital.

[2] The CGE model for Indonesia was adapted from one constructed by Caesar Cororaton for the Philippines in 2004, and extended for poverty analysis by Erwin Corong in 2005 as part of ADB's work on the poverty reduction integrated simulation model initiated and supervised by Guntur Sugiyarto.

The production structure of the model assumes a constant return to scale and is depicted in Figure 9.1. Sectoral output is produced through a three-stage process. The first stage involves a simultaneous determination of optimal capital and labor input. At the second stage, the optimal capital and labor inputs are aggregated through a Cobb-Douglas function to form a capital-labor composite. Finally, the intermediate inputs and the capital-labor composite are combined through a Leontief function to produce sectoral outputs.

Table 9.1 **Description of Production and Commodity Accounts**

Accounts	Description
	Production and Commodity
Agriculture	Food Crops Other Crops Livestock Forestry Fisheries
Industry	Oil and Gas mining Other mining Food processing Textiles Wood and Wood Products Papers and Metal products Chemical Industry Utilities, Electricity, Gas, and Water Construction
Services	Trade Restaurants Hotels Land Transport Other Transport and Communication Banking and Insurance Real Estate Personal Services Public Services

Source: 1999 Indonesian Social Accounting Matrix (SAM).

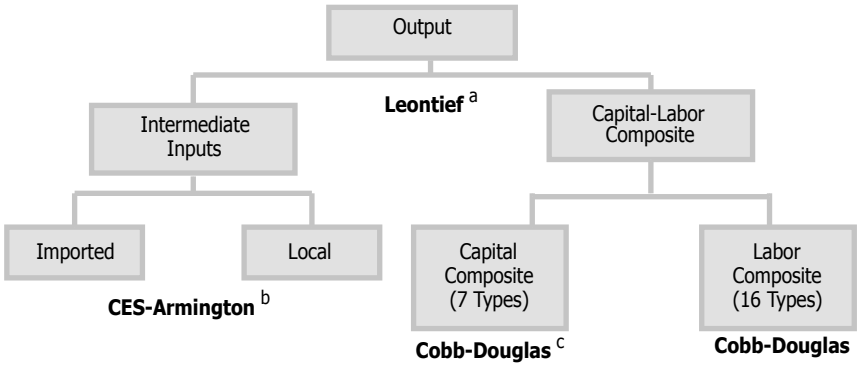
Figure 9.2 illustrates the price relationships in the CGE model. Contrary to the fixed price input-output and SAM multiplier models; in the CGE model, prices are flexible and all prices adjust to clear the factor and product markets. Output price (px), affects export price (pe), and local prices (pl). Indirect taxes are added to the local price to determine domestic prices (pd) which, together with import price (pm), results in the composite price (pq). The transaction cost is then added to the composite price to determine the consumer price (pc). The import price (pm) in domestic currency is affected by the world price of imports, exchange rate (er), tariff rate (tm), and indirect tax rate (itx).

Table 9.2 **Description of Factors of Production**

Accounts	Description
Capital	Land and agricultural capital Own occupied house Others rural Others urban Private domestic Government capital Foreign capital
Labor	Agriculture employee – rural Agriculture employee – urban Agriculture self-employed – rural Agriculture self-employed – urban Production employee – rural Production employee – urban Production self-employed – rural Production self-employed – urban Clerical employee – rural Clerical employee – urban Clerical self-employed – rural Clerical self-employed – urban Management professional employee – rural Management professional employee – urban Management professional self-employed – rural Management professional non-employee – urban

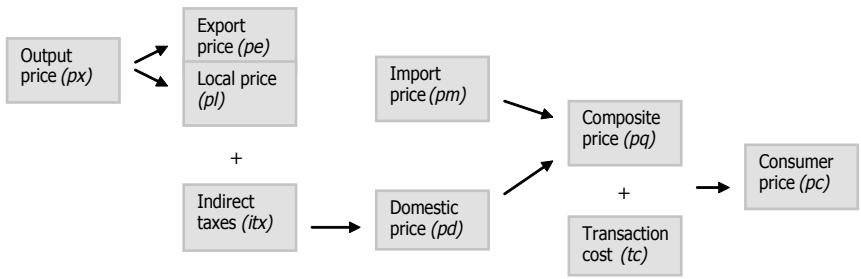
Source: 1999 Indonesian Social Accounting Matrix (SAM).

Figure 9.1 **Production Structure**



a Leontif: Fixed proportion of intermediate input and value added.
b CES-Armington is the constant elasticity of substitution function that allows for a possibility of substitution between imported and local products.
c Cobb-Douglas: Fixed share of two components used in the production to inputs.
Source: Authors' framework.

Figure 9.2 **Basic Price Relationship in the Model**

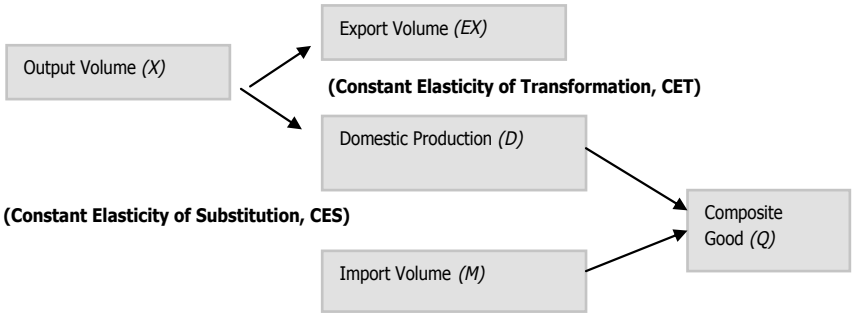


Source: Authors' framework.

Figure 9.3 presents the volume relationships in the model. On the supply side, output (X) is specified as a constant elasticity of transformation between export (E) and domestic sales (D). The allocation between export and domestic sales depends on the export price (pe), the local price (pl), and the elasticity of substitution between exports and domestic goods. For instance, an increase in the export price relative to the local price results in an increased export allocation, and a corresponding reduction in allocation for domestic sales. The magnitude of reallocation depends on the value of the elasticity of substitution.

The demand side is specified as a constant elasticity of substitution function between imports (M) and domestic goods (D), otherwise known as

Figure 9.3 **Basic Structure of the Model**



Source: Authors' framework.

the Armington assumption, to account for product differentiation between imported and domestically produced goods. The allocation between imports and domestic goods depends on the import price (*pm*), the domestic price (*pd*), and the elasticity of substitution between domestically produced and imported commodities. That is, a decrease in the local import price relative to the domestic price gives rise to higher import demand vis-à-vis domestically produced goods. Once again, the magnitude of reallocation depends on the value of the elasticity of substitution.

The supply side of the model assumes profit maximization, while the demand side assumes cost minimization. Thus, the first-order conditions on the supply side generate the necessary supply and input demand functions, while the first-order conditions on the demand side provide the necessary import and domestic demand functions.

Households. There are 10 RHGs in the SAM used as a basis for the CGE model (Table 9.3). The households are classified according to agriculture and nonagriculture, and household head participation in the labor market (i.e., dependent or active). In addition, the nonagriculture households are further differentiated by location–urban or rural.

Table 9.3 **Summary Description of Representative Households**

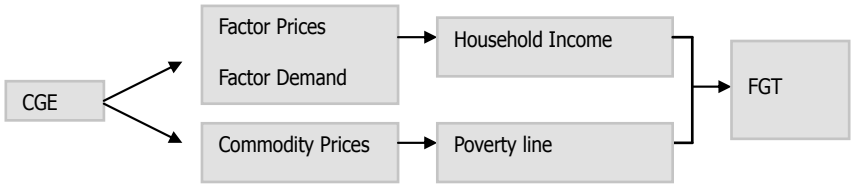
Households	Description
Agriculture	Landless farmers Small farmers Medium farmers Large farmers Rural low-income group Rural dependent-income group Rural high-income group
Nonagriculture	
	Urban low-income group Urban dependent-income group Urban high-income group

Source: 1999 Indonesian Social Accounting Matrix (SAM).

Using the RHGs in the model to assess the household poverty impacts arising from a policy shift is sometimes deemed inadequate. To address this, the 1999 SUSENAS was linked directly to the CGE model. To ensure consistency between the RHGs in the SAM used in the model and the households in the SUSENAS, the households in the latter were classified in the same categories as the RHGs of the SAM. This involved a mapping of household attributes in the SUSENAS to be consistent with the RHGs in the SAM.[3] Therefore, the microsimulation traces the impact of income and price changes at the household in the SUSENAS.[4]

Figure 9.4 provides a stylized illustration of the link between the CGE model and the SUSENAS data set. The CGE model generates economic, sectoral, volume, and price effects of a policy simulation. Then, the changes in disposable income and household consumer basket price (weighted consumer prices) of the 10 RHGs in the CGE model are applied to all households with the same characteristics in the SUSENAS data set. This allows the model to capture the changes in individual household poverty characteristics such that the Foster-Greer-Thorbecke (FGT) class of poverty measures–headcount ratio (HCR), poverty gap index (PGI), and poverty severity index (PSI)–can be calculated.

Figure 9.4 **Development of Poverty Indicators Based on CGE and Household Survey Data**



CGE = Computable General Equilibrium
FGT = Foster, Greer, and Thorbecke
Source: Authors' framework.

3 The use of RHGs is not without its problems: "… simply put, income or employment shocks do not affect all individuals or households belonging to the same RH group in the same way. Occupational changes, transitions across labor-force status, and migrations from rural to urban areas typically are individual- or household-specific and are likely to be extremely income selective" (Bourguignon and Pereira da Silva 2003a, 342). The procedure described in this section, applied to the SUSENAS data, attempts to overcome such difficulties.

4 It is important to note that each household in the sample survey represents a group of households with the same characteristics in the population. Therefore, microsimulation using survey data is actually still operating at a group level, although a lower one.

Poverty Measures. Poverty is measured through FGT, a Pα class of additively decomposable measures (Foster, Greer, and Thorbecke 1984). The FGT poverty measure is[5]

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

Where:

α is the poverty aversion parameter

n is population size

q is the number of people below the poverty line

y_i is income and

z is the poverty line or poverty threshold.

The poverty line used to calculate the poverty indicators is the official poverty line, which consists of food and nonfood components. The threshold is defined as the cost of basic food and nonfood commodities corresponding to the cost of 2,100 calories per capita plus some basic nonfood expenditures.[6]

The poverty indicators are measured before and after the policy changes using the actual distribution of income among the 10 household categories in the SUSENAS. As seen in the equation above, the FGT poverty measure depends on the parameter values of α. At $\alpha = 0$, the poverty headcount is calculated by measuring the proportion of the population that falls below the poverty threshold. At $\alpha = 1$, the poverty gap is measured, indicating how far on average the poor are from the poverty threshold. Finally, at $\alpha = 2$, the PSI is obtained. The PSI is more sensitive to the distribution among the poor as more weight is given to the poorest below the poverty threshold. This is because the PSI corresponds to the squared average distance of income of the poor from the poverty line.

Model Closure. Nominal government consumption is equal to exogenous real government consumption multiplied by its (endogenous) price. Fixing real government spending neutralizes any possible welfare and poverty effects of variations in government spending. The only variations are due to changes in the nominal price of government consumption.

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5 See Ravallion (1992) for detailed discussion on this issue.

6 See Badan Pusat Statistik (BPS) Statistics Indonesia for detailed calculation of the Indonesian official poverty line (http://www.bps.go.id).

Total nominal investment is equal to exogenous total real investment multiplied by its price. Total real investment is held fixed to account for intertemporal welfare and poverty effects. The price of total real investment is endogenous. The propensities to save of the various household groups in the model adjust proportionately to accommodate the fixed total real investment assumption. This is undertaken through a factor in the household saving function that adjusts endogenously. The macro closure used here is of the classical Johansen (1960) type. Such a closure implicitly assumes that government has sufficient control over the savings and consumption behavior of the people to generate savings required to finance exogenously given investment. One could, for example, think of the operation of a fiscal policy outside the model that helps maintain the investment-savings equilibrium (Rattso 1984).

The current account balance (foreign savings) is held fixed and the nominal exchange rate is the model's numeraire. The foreign trade sector is effectively cleared by changes in the real exchange rate, which is the ratio of the nominal exchange rate multiplied by world export prices, divided by the domestic price index.

The labor market assumes a neoclassical closure in which labor supply is equal to labor demand across all labor categories. Labor is fully mobile across sectors, but is limited within the specific category, whereas capital is sector specific.

Basic Structure of the Economy at the Base

Table 9.4 presents the Indonesian economic structure based on the 1999 SAM. The trade pattern shows the dominance of the industrial and services sectors, accounting for over 90 percent of total exports and imports in the country. In particular, industrial exports and imports comprise more than half of total trade (i.e., 74 and 51 percent, respectively). Meanwhile, services exports and imports contribute to 20 and 42 percent, respectively. In contrast, agriculture contributes the least to exports and imports, with only 5 and 7 percent, respectively. Nevertheless, total agricultural exports share is roughly one fourth of total exports when agricultural-related food processing is included.

The principal exporters are the chemical industry (20 percent), food processing (20 percent), hydrocarbon mining (14 percent), and trade (12 percent). These four sectors generate a combined share of 66 percent of total exports. The primary importers are the chemical industry (23 percent), other transportation and communication (12 percent), and paper and metal products (11 percent).

Table 9.4 **Economic Structure at the Base Period**

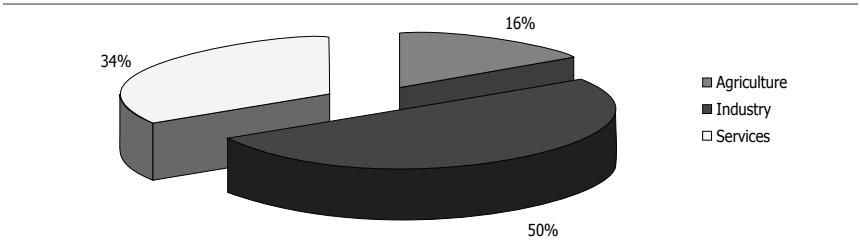
SECTORS	International Trade (%)					Value Added (VA)		
	Exports		Imports		Export-Import Ratio	VA/ Output	VA Share	Labor-Capital Ratio
	Share	Intensities*	Share	Intensities**				
Agriculture	**5.0**	**8.2**	**7.2**	**8.28**	**98.61**	**81.2**	**20.3**	**232.7**
Food Crops	1.3	4.4	3.4	8.15	51.81	87.2	10.1	4.5
Other Crops	1.8	13.8	3.2	17.00	78.20	71.8	3.7	2.9
Livestock	0.4	4.5	0.4	3.16	145.04	69.5	2.5	0.6
Forestry	1.0	19.9	0.2	2.46	982.23	81.1	1.7	0.3
Fisheries	0.5	9.1	0.0	0.31	3216.20	89.7	2.2	4.0
Industry	**74.7**	**38.1**	**51.0**	**23.0**	**206.33**	**52.5**	**41.9**	**63.34**
Oil and Gas Mining	14.3	40.7	2.6	8.19	767.87	88.9	12.7	0.2
Other Mining	1.3	40.9	0.6	18.17	311.98	92.0	1.2	2.2
Food Processing	20.0	28.1	6.6	8.33	429.74	38.6	11.2	1.1
Textiles	5.8	40.3	6.0	33.47	134.11	31.7	1.8	1.3
Wood and Wood Products	3.3	48.2	0.8	14.57	544.89	37.4	1.0	1.1
Paper and Metal Products	9.7	62.3	11.0	57.10	124.19	37.1	2.4	0.7
Chemicals Industry	20.4	59.1	23.3	53.92	123.32	49.8	7.0	0.6
Utilities, Electricity, Gas, and Water	0.0	0.0	0.0	0.00	16.98	52.8	1.4	0.5
Construction	0.0	0.0	0.0	0.00	0.00	88.9	3.2	3.1
Services	**20.3**	**15.1**	**41.8**	**20.7**	**68.43**	**69.3**	**37.9**	**149.58**
Trade	12.1	27.3	3.0	6.26	561.59	77.7	14.0	2.6
Restaurants	0.0	0.1	2.3	11.58	0.71	42.1	2.1	2.4
Hotels	0.0	0.6	2.6	32.82	1.27	79.2	1.2	0.4
Land Transport	2.4	26.3	4.0	29.72	84.52	67.2	2.5	0.9
Other Transportation & Communication	3.4	29.4	12.0	51.27	39.50	48.1	2.2	0.7
Banking and Insurance	1.0	9.3	4.8	25.47	29.92	73.9	3.3	0.7
Real Estate	1.0	8.7	4.4	22.39	33.20	77.6	3.8	0.3
Personal Services	0.0	0.0	1.6	13.39	0.10	75.4	2.2	0.9
Public Services	0.4	1.7	7.1	18.38	7.77	69.4	6.4	4.5
Total	**100**		**100**			**62.8**	**100**	

Note: * Export intensity = Export Supply/Domestic Sales; ** Import intensity = Import demand/Composite demand.
Source: Authors' calculation based on the 1999 Indonesian SAM.

Agricultural imports combined with food processing account for roughly 14 percent of total imports. Fisheries, forestry, and main (hydrocarbon) mining have the highest export-to-import ratio, which may be a reflection of Indonesia's enormous fish, forest, and petroleum resources.

In terms of the value added–to-output ratio, the agricultural sector has the highest ratio (81 percent), compared to industry (53 percent) and services (68 percent). This means that the agricultural sector uses the least amount of intermediate inputs to produce one unit of output. In spite of this, agriculture's contribution to the overall value added is relatively small, only about 20 percent of gross domestic product (GDP), which shows the total domestic value added. The contributions of industry and services sectors, on the other hand, are around 42 and 38 percent, respectively. Labor intensity is uniformly higher in agriculture–implying surplus labor is employed and being absorbed by the sector. Overall, industry has the highest output share with 50 percent, followed by services with 34 percent, and agriculture with 16 percent (Figure 9.5).

Figure 9.5 **Output Share at the Base**



Source: Authors' calculation.

Household Income and Poverty Profile

Income from labor and capital is the major earning source for the entire population. Other income sources include transfers from other institutions in the economy, including inter-household transfers. Total wages paid to laborers account for 70 percent of total household income, while returns to capital account for about 28 percent. Wages paid by the services sector and returns to capital in the industrial sector account for the largest share in total household earnings. On the contrary, wages and return to capital in agriculture have the lowest share. Table 9.5 presents the household income sources in the base or benchmark period, which shows the significant role of wages in household earnings. Landless agricultural households, for instance, receive 90 percent of their total income from wages, while the high-income nonagricultural households in rural areas have the lowest wage-to-income ratio of 50 percent. This household group also has the highest income share from capital, with 47 percent.

Table 9.5 **Household Income Sources at the Base Period**
(Percent share)

	Income					
					Transfers	
Households	**Employee**	**Capital**	**Dividend**	**Foreign**	**Household**	**Government**
Agriculture						
Landless farmers	90.6	5.6	0.1	0.7	1.6	1.4
Small farmers	85.0	13.3	0.0	0.2	0.2	1.2
Medium farmers	83.9	15.0	0.0	0.4	0.2	0.5
Large farmers	75.5	20.4	0.0	3.7	0.1	0.2
Nonagriculture (Rural)						
Low-income group	68.6	30.3	0.1	0.2	0.1	0.6
Dependent-income group	73.5	21.3	0.0	0.5	3.7	1.0
High-income group	49.7	46.6	0.0	3.3	0.3	0.1
Nonagriculture (Urban)						
Low-income group	76.7	23.0	0.1	0.1	0.0	0.1
Dependent-income group	77.5	19.2	0.1	0.2	1.3	1.7
High-income group	55.8	41.8	0.0	2.3	0.1	0.0

Source: Authors' calculation based from 1999 Indonesian Social Accounting Matrix (SAM).

Income from abroad is not a significant source of household earnings. Large agriculture and high-income nonagricultural households in rural areas have the highest income shares from abroad with 3.7 and 3.3 percent, respectively. On the other hand, dependent nonagricultural households in rural areas benefit the most from inter-household transfers.

Table 9.6 presents the poverty indexes in the base period calculated from the SUSENAS. It shows that about 33 million people representing 18.2 percent of the entire population are living below the poverty line. In general, agricultural households are more susceptible to poverty compared to their nonagricultural counterparts. Moreover, among dependent nonagricultural households, rural inhabitants appear to be more prone to poverty relative to their urban counterparts.

Table 9.6 **Poverty Indices at the Base Period**
(Percent)

Households	Poverty		
	Headcount	Gap	Severity
Indonesia	**18.2**	**3.5**	**1.1**
Agriculture			
Landless farmers	28.4	5.1	1.4
Small farmers	27.3	5.2	1.6
Medium farmers	30.5	7.2	2.6
Large farmers	25.0	5.0	1.6
Nonagriculture (Rural)			
Low-income group	18.7	3.1	0.8
Dependent-income group	13.6	2.6	0.8
High-income group	10.5	1.8	0.5
Nonagriculture (Urban)			
Low-income group	10.1	1.7	0.5
Dependent-income group	4.7	0.8	0.2
High-income group	3.0	0.4	0.1
Number of Poor People			**32,843,216**

Source: Authors' calculation based from 1999 Social Accounting Matrix (SAM) and SUSENAS.

Medium farmers have the highest poverty incidence, followed by landless farmer households. High-income nonagricultural and dependent nonagricultural households in urban areas have the lowest poverty headcount with 3.0 and 4.7 percent, respectively.

Policy Experiments

Three policy experiments in line with the DDA were undertaken in this study. These were:

- AGLIB: Full elimination of tariffs on agricultural imports

- AGLIBPRO: Full elimination of tariffs and indirect taxes on agricultural imports as well as agricultural products
- TOTLIB: Full elimination of all tariffs on imported products

AGLIB captures the increasing access for agricultural products demanded by the DDA, which is reflected in tariff elimination on imported agricultural products. AGLIBPRO depicts the impact of a more proactive agricultural-product liberalization, in which the Indonesian government removes not only the agricultural tariffs but also the agricultural domestic taxes to level the playing field. Finally, TOTLIB reflects full tariff elimination in all sectors for broader cross-sectoral trade liberalization. The three simulations are in line with the DDA from the Indonesian perspective. The set of simulations examined in this chapter is consistent with simulations conducted in Chapter 7 of this book, in which the issues were examined using the standard CGE model with RHGs. Results from the model used in this chapter, however, are more complete with the model's greater disaggregation by level of sectors and factors, and the link to the household survey data set, i.e., microsimulation. As a result, estimates of poverty indicators of FGT can be calculated.

Role of Model Closures in Computable General Equilibrium Models

The study discussed in this chapter involves three experiments related to trade liberalization in Indonesia. Chapter 7 of this book also describes similar experiments. These experiments capture effects of resource reallocation and corresponding efficiency increases due to trade liberalization. The results in these two chapters, however, are different in terms of the magnitude of the changes. For example, the gross domestic product increase from trade liberalization in all sectors is 3.4 percent (Table 7.10) in Chapter 7 while it is 0.3 percent in this chapter (Table 9.19). Differences in the Social Accounting Matrix that provides most of the parameters for the CGE framework can explain a part, but not all, of such divergences in results.

The two models operate under different closure rules and, hence, capture more than just trade liberalization effects. It has been the experience of many countries that trade liberalization leads to a loss in tax revenue by the government. This loss could be significant if all tariffs are reduced to zero. The revenue loss is overcome by an implicit assumption that tariff reduction is compensated by capital inflows from abroad in Chapter 7 and by an indirect tax increase in this chapter. Capital flows are costless in a static model, while an indirect tax increase has a demand contraction effect through the price system. This explains why the two models would give different results. This example shows how the approach of the model maker to close the possible income and expenditure gap in a CGE model affects a model's results.

Moreover, it is important to note that the two models adopt different closure rules, which that make the magnitude of the change of the same simulations from the two models not strictly comparable. The directions of the changes should, however, be consistent.

With its link to the household data set, the CGE model used in the CGE microsimulation is less complicated than the CGE model in Chapter 7 of this book. The Box further explains the role of model closure in CGE models.

Simulation Results

AGLIB: Elimination of Agricultural Tariffs

Macro Effects. Tariff elimination on agricultural imports leads to a 0.15 percent reduction in the local price of imported products. As a result, consumption increases by 0.003 percent (Table 9.7). Similarly, the decline in agricultural import prices reduces the domestic production cost by 0.15 percent,[7] raising the real exchange rate (depreciation) by 0.05 percent. This enhances producers' competitiveness of domestic products in the international market as exports become relatively cheaper.

Domestic sales allocation decreases by 0.01 percent, while exports increase by 0.09 percent as producers reallocate resources for the international market. The higher increase in exports relative to that of imports (0.08 percent) sustains the trade surplus which exists at the base. Overall, the decline in local import prices coupled with the reduction in domestic cost of production results in a marginal increase in output and real GDP.

Sectoral Effects. Agricultural tariff elimination produces varying impacts among the three major sectors of agriculture, industry, and services (Table 9.8). Agricultural and services' outputs contract, while industrial output expands. This prompts a decline in agriculture's share in total output, i.e., from 16 to 15 percent (Figure 9.6). In contrast, industry's share in total output increases from 50 to 51 percent, while services' share remains constant at about 34 percent.

Table 9.7 **Macro Effects of Full Elimination of Tariffs on Agriculture Imports**
(Percentage change from base)

Real Gross Domestic Product	0.01
Prices	
Import prices in local currency	-0.15
Consumer prices	-0.15
Local cost of production	-0.15
Real exchange rate	0.05
Import volume	0.08
Export volume	0.09
Domestic production for local sales	-0.01
Consumption (composite) goods	0.003

Source: Simulation results of the model.

The contraction in agriculture stems from the decline in the local price of agricultural imports which induces consumers to substitute imported products for the locally produced agricultural products. The output expansion in industry arises from the reduction in domestic cost of production–mainly from cheap imported intermediate agricultural inputs. Thus, the expansion in industrial output

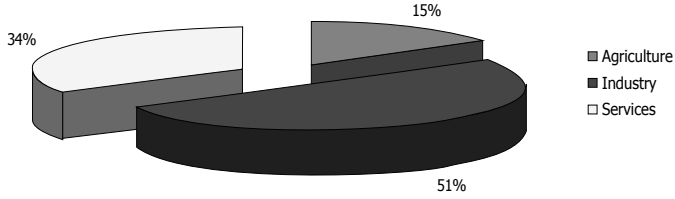
7 Owing to the decline in prices of imported intermediate agricultural inputs.

Table 9.8 **Sectoral Effects of Full Elimination of Tariffs on Agriculture Imports**
(Percentage change from base)

Sectors	Price Changes (%)					Volume Changes (%)				
	Import	Domestic	Composite	Output	Local	Import	Export	Domestic Sales	Output	Composite Demand
Agriculture	**-1.89**	**-0.40**	**-0.53**	**-0.38**	**-0.40**	**2.95**	**0.38**	**-0.05**	**0.21**	**-0.01**
Food Crops	-2.49	-0.42	-0.59	-0.41	-0.42	4.21	0.37	-0.09	0.27	-0.07
Other Crops	-1.16	-0.41	-0.54	-0.38	-0.41	1.37	0.34	-0.14	0.12	-0.07
Livestock	-3.18	-0.37	-0.46	-0.36	-0.37	5.90	0.36	-0.01	0.18	0.01
Forestry	-0.26	-0.35	-0.34	-0.31	-0.35	-0.11	0.38	0.07	0.06	0.13
Fisheries	-4.48	-0.41	-0.42	-0.40	-0.41	8.92	0.52	0.21	0.23	0.24
Industry	**0.00**	**-0.11**	**-0.08**	**-0.08**	**-0.11**	**-0.16**	**0.09**	**0.00**	**-0.03**	**0.04**
Oil and Gas Mining	0.00	-0.05	-0.05	-0.04	-0.05	-0.14	0.04	-0.03	-0.04	-0.01
Other Mining	0.00	-0.09	-0.07	-0.05	-0.09	-0.35	0.00	-0.18	-0.21	-0.11
Food Processing	0.00	-0.17	-0.16	-0.15	-0.17	-0.27	0.21	0.07	0.04	0.11
Textiles	0.00	-0.11	-0.07	-0.09	-0.11	-0.15	0.14	0.06	-0.01	0.09
Wood and Wood Products	0.00	-0.15	-0.13	-0.11	-0.15	-0.31	0.14	-0.01	-0.06	0.06
Paper and Metal Products	0.00	-0.04	-0.02	-0.02	-0.04	-0.13	0.02	-0.05	-0.10	-0.01
Chemicals	0.00	-0.05	-0.02	-0.03	-0.05	-0.13	0.03	-0.04	-0.09	0.00
Utilities, Electricity, Gas, and Water	0.00	-0.07	-0.07	-0.07	-0.07	-0.17	0.05	-0.04	-0.04	-0.04
Construction	—	-0.06	-0.06	-0.06	-0.06	—	—	-0.17	-0.17	-0.17
Services	**—**	**-0.07**	**-0.06**	**-0.07**	**-0.07**	**-0.14**	**0.05**	**-0.02**	**-0.01**	**-0.01**
Trade	—	-0.08	-0.07	-0.06	-0.08	-0.21	0.05	-0.05	-0.06	-0.02
Restaurants	—	-0.16	-0.14	-0.16	-0.16	-0.24	0.20	0.08	0.04	0.08
Hotels	—	-0.08	-0.05	-0.08	-0.08	-0.17	0.07	-0.01	-0.07	-0.01
Land Transport	—	-0.05	-0.03	-0.04	-0.05	-0.15	0.02	-0.05	-0.08	-0.03
Other Transportation & Communication	—	-0.05	-0.02	-0.04	-0.05	-0.12	0.04	-0.02	-0.07	-0.01
Banking and Insurance	—	-0.06	-0.05	-0.06	-0.06	-0.15	0.05	-0.03	-0.06	-0.02
Real Estate	—	-0.07	-0.05	-0.06	-0.07	-0.15	0.06	-0.02	-0.04	-0.01
Personal Services	—	-0.06	-0.05	-0.06	-0.06	-0.16	0.04	-0.04	-0.06	-0.04
Public Services	—	-0.05	-0.04	-0.05	-0.05	-0.09	0.05	0.00	-0.01	0.00
Total	**-0.15**	**-0.15**	**-0.15**	**-0.13**	**-0.15**	**0.08**	**0.09**	**-0.01**	**0.003**	**0.01**

Source: Simulation results of the model.

Figure 9.6 **Output Share after Full Elimination of Tariffs on Agriculture Imports**



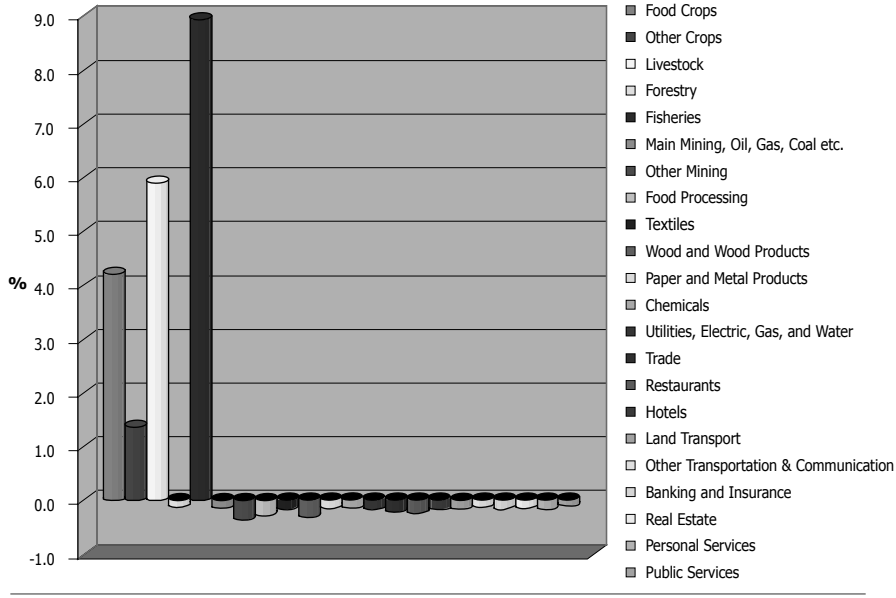
Source: Simulation results of the model.

leads to higher factor utilization in that sector as the industry absorbs displaced workers from other sectors. However, given the greater labor intensity in agriculture, the increase in employment in industry is insufficient to offset the decline in agriculture.

Figure 9.7 shows the changes in sectoral imports. Clearly, agricultural imports increase, whereas imports of industry and services products fall–and the reduction in industrial imports is higher than that of services. On the

other hand, the change in export volume is minimally higher in agriculture relative to industry and services.

Figure 9.7 **Change in Import Volume after Full Elimination of Tariffs on Agriculture Imports**



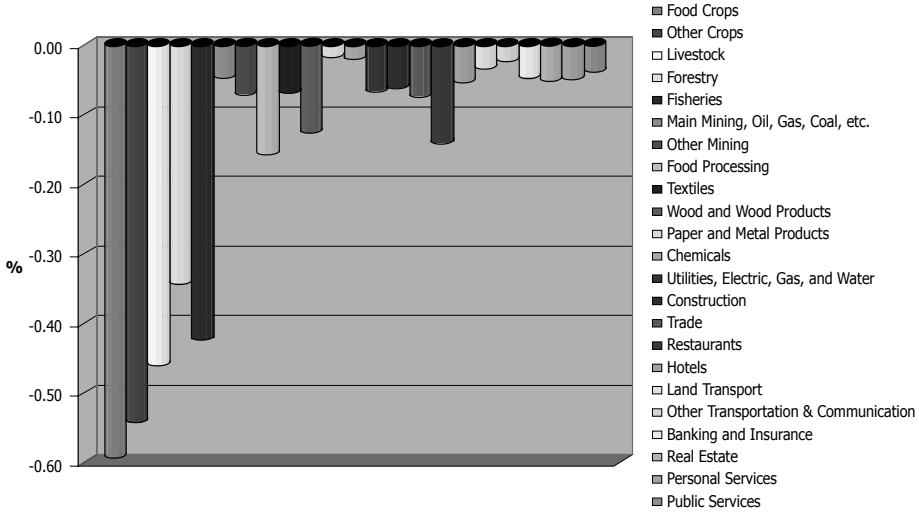
Source: Simulation results of the model.

Overall, the reduction in consumer prices is deeper in agriculture as a result of the significant reduction in agricultural import prices because tariffs were eliminated for only agricultural products. Therefore, consumers pay relatively less for agricultural products (Figure 9.8).

Agriculture. The decline in agricultural import prices induces consumers to substitute toward cheaper imported agricultural products. Total agricultural imports go up by 3 percent, resulting in a marginal reduction in agricultural output (0.01 percent). Fisheries, food crops, and livestock register the highest increase in imports (8, 4, and 6 percent, respectively). Overall, agricultural exports increase by 0.38 percent with fisheries generating the highest increase in output and exports.

Industry. Tariff elimination on agricultural products favors the industrial sector. Indeed, total industrial output and exports increase by 0.04 percent and 0.09 percent, respectively, while imports dip by 0.16 percent. Food processing benefits the most with a decline in the domestic cost of production–

Figure 9.8 **Change in Consumer Prices after Full Elimination Tariffs on Agriculture Imports**



Source: Simulation results of the model.

the result of cheaper imported agricultural imports. Thus, food processing's output, domestic sales, and exports increase.

Services. At first glance, it seems that agricultural tariff elimination does not benefit the services sector as the entire sector's output, consumer demand, and domestic sales decrease. However, closer examination reveals that these decreases are marginal. In addition, total exports increase (0.05 percent), whereas total imports drop (0.14 percent), indicating that the sector gains modestly from the international market.

Factor Market. Table 9.9 summarizes the factor market impacts of AGLIB. Factor returns diminish as the value-added price decreases by 0.10 percent–owing to the decline in both return to capital and overall wage rates. The reduction in wages however is higher (0.13 percent) than the decline in capital (0.02 percent), suggesting that wage workers bear most of the impact of declining factor returns. Self-employed rural workers experience the largest reduction in wages, while self-employed urban production workers bear the lowest wage reduction (Table 9.10 and Figure 9.9). In contrast, both urban and rural production employees attain wage increases, mainly from the expansion of the industrial sector.

Household Income and Commodity Basket Cost. The changes in households' disposable income are presented in Table 9.11. Evidently, factor

Table 9.9 **Factor Market Effects of Full Elimination of Tariffs on Agriculture Imports**
(Percentage change from base)

Sectors	Value Added		Capital Return	Wage
	Volume	Price		
Agriculture	**-0.01**	**-0.40**	**-0.36**	**-0.42**
Food Crops	-0.07	-0.42	-0.49	-0.43
Other Crops	-0.07	-0.40	-0.47	-0.40
Livestock	0.01	-0.38	-0.37	-0.38
Forestry	0.13	-0.34	-0.21	-0.31
Fisheries	0.24	-0.41	-0.18	-0.42
Industry	**0.02**	**0.01**	**0.02**	**0.00**
Oil and Gas Mining	-0.01	-0.04	-0.04	0.00
Other Mining	-0.11	-0.05	-0.16	0.00
Food Processing	0.11	0.10	0.21	0.00
Textiles	0.09	0.08	0.17	0.01
Wood and Wood Products	0.06	0.06	0.12	0.01
Papers and Metal Products	-0.01	-0.01	-0.02	0.00
Chemicals	0.00	0.00	0.00	0.00
Utilities, Electricity, Gas, and Water	-0.04	-0.08	-0.12	-0.01
Construction	-0.17	-0.06	-0.23	-0.01
Services	**-0.01**	**-0.06**	**-0.07**	**-0.05**
Trade	-0.02	-0.07	-0.09	-0.06
Restaurants	0.08	-0.02	0.06	-0.05
Hotels	-0.01	-0.07	-0.08	-0.04
Land Transport	-0.03	-0.04	-0.07	0.00
Other Transportation & Communication	-0.01	-0.03	-0.04	-0.03
Banking and Insurance	-0.02	-0.06	-0.08	-0.04
Real Estate	-0.01	-0.07	-0.08	-0.04
Personal Services	-0.04	-0.06	-0.11	-0.02
Public Services	0.00	-0.03	-0.03	-0.04
Total	**—**	**-0.1**	**-0.02**	**-0.13**

Source: Simulation results of the model.

income of all households declines. Households dependent on agriculture suffer the greatest income reduction (Figure 9.10), mainly because of lower factor returns in agriculture. In contrast, nonagriculture households, both urban and rural, experience a lower reduction in factor income. Overall, high-income nonagriculture households in urban areas suffer the lowest decline in factor income.

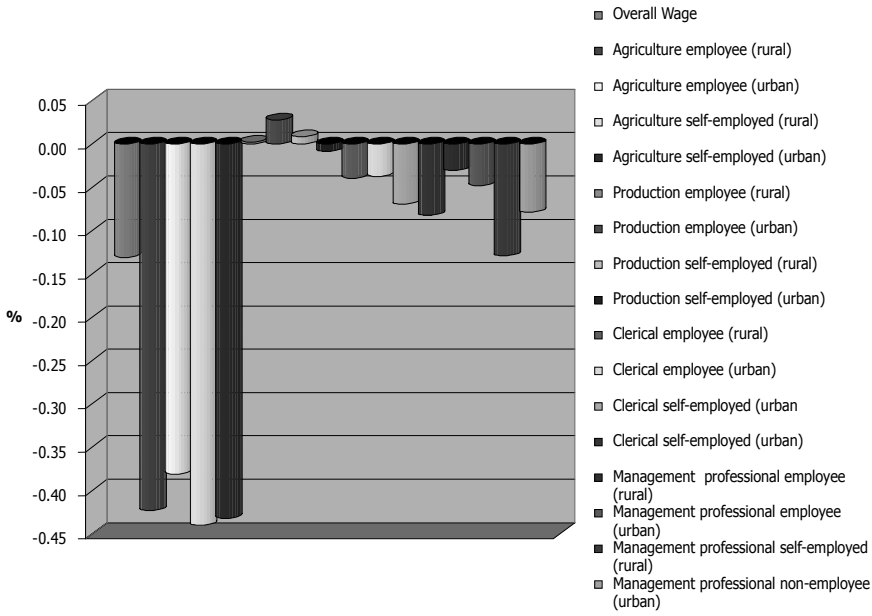
Table 9.11 presents the changes in the cost of the commodity basket or consumption for each RHG. Notably, agricultural households experience the greatest reduction in the cost of the commodity basket followed by rural nonagricultural households (except the high-income group). This is not surprising given that both these household groups consume more agricultural products than the rest.

Table 9.10 **Labor Market Effects of Full Elimination of Tariffs on Agriculture Imports**
(Percentage change from base)

Sectors	Labor Demand																
	L	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16
Food Crops	-0.06	-0.07	-0.11	-0.05	-0.06	-0.49	-0.52	-0.50	-0.48	-0.45	-0.45	-0.42	-0.41	-0.46	-0.44	-0.36	-0.41
Other Crops	-0.07	-0.05	-0.09	-0.03	-0.04	-0.48	-0.50	-0.48	-0.46	-0.43	-0.44	-0.40	-0.39	-0.44	-0.43	-0.34	-0.39
Livestock	0.01	0.06	0.01	0.07	0.06	-0.37	-0.40	-0.38	-0.36	-0.33	-0.33	-0.30	-0.29	-0.34	-0.32	-0.24	-0.29
Forestry	0.10	0.21	0.17	0.23	0.22	-0.22	-0.24	-0.22	-0.21	-0.18	-0.18	-0.14	-0.13	-0.18	-0.17	-0.09	-0.14
Fisheries	0.25	0.25	0.21	0.26	0.26	-0.18	-0.20	-0.18	-0.17	-0.14	-0.14	-0.11	-0.09	-0.15	-0.13	-0.05	-0.10
Oil and Gas Mining	-0.04	—	—	—	—	-0.04	-0.07	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.01	0.00	0.00
Other Mining	-0.15	—	—	—	—	-0.16	-0.18	-0.17	-0.15	-0.12	-0.12	-0.09	-0.07	-0.13	-0.11	-0.03	-0.08
Food Processing	0.21	—	—	—	—	0.21	0.18	0.20	0.22	0.25	0.25	0.28	0.29	0.24	0.26	0.34	0.29
Textiles	0.16	—	—	—	—	0.17	0.14	0.16	0.18	0.21	0.21	0.24	0.25	0.20	0.22	0.30	0.25
Wood and Wood Products	0.11	—	—	—	—	0.12	0.09	0.11	0.13	0.16	0.16	0.19	0.20	0.15	0.17	0.25	0.20
Paper and Metal Products	-0.02	—	—	—	—	-0.02	-0.05	-0.03	-0.01	0.02	0.02	0.05	0.06	0.01	0.03	0.11	0.06
Chemicals	0.00	—	—	—	—	0.00	-0.03	-0.01	0.01	0.04	0.04	0.07	0.08	0.03	0.05	0.13	0.08
Utilities, Electricity, Gas, and Water	-0.12	—	—	—	—	-0.13	-0.15	-0.13	-0.11	-0.08	-0.09	-0.05	-0.04	-0.09	-0.07	0.01	-0.04
Construction	-0.23	—	—	—	—	-0.24	-0.26	-0.24	-0.22	-0.19	-0.20	-0.16	-0.15	-0.20	-0.18	-0.10	-0.15
Trade	-0.03	—	—	—	—	-0.10	-0.12	-0.10	-0.09	-0.05	-0.06	-0.02	-0.01	-0.06	-0.05	0.04	-0.02
Restaurants	0.11	—	—	—	—	0.05	0.03	0.05	0.07	0.10	0.09	0.13	0.14	0.09	0.10	0.19	0.14
Hotels	-0.04	—	—	—	—	-0.08	-0.11	-0.09	-0.07	-0.04	-0.05	-0.01	0.00	-0.05	-0.03	0.05	0.00
Land Transport	-0.07	—	—	—	—	-0.08	-0.10	-0.08	-0.06	-0.03	-0.04	0.00	0.01	-0.04	-0.03	0.06	0.01
Other Transportation & Communication	-0.01	—	—	—	—	-0.04	-0.07	-0.05	-0.03	0.00	0.00	0.03	0.04	-0.01	0.01	0.09	0.04
Banking and Insurance	-0.04	—	—	—	—	-0.09	-0.11	-0.09	-0.07	-0.04	-0.05	-0.01	0.00	-0.05	-0.03	0.05	0.00
Real Estate	-0.04	—	—	—	—	-0.08	-0.10	-0.08	-0.07	-0.04	-0.04	-0.01	0.01	-0.05	-0.03	0.05	0.00
Personal Services	-0.09	—	—	—	—	-0.11	-0.13	-0.11	-0.10	-0.07	-0.07	-0.04	-0.02	-0.08	-0.06	0.02	-0.03
Public Services	0.01	—	—	—	—	-0.03	-0.06	-0.04	-0.02	0.01	0.01	0.04	0.05	0.00	0.02	0.10	0.05
Change in Average Employee, %	-0.13	-0.42	-0.38	-0.44	-0.43	0.002	0.03	0.01	-0.01	-0.04	-0.04	-0.07	-0.08	-0.03	-0.05	-0.13	-0.08

L = Aggregate labor; L1 = Agriculture employee (rural); L2 = Agriculture employee (urban); L3 = Agriculture self-employed (rural); L4 = Agriculture self-employed (urban); L5 = Production employee (rural); L6 = Production employee (urban); L7 = Production self-employed (rural); L8 = Production self-employed (urban); L9 = Clerical employee (rural); L10 = Clerical employee (urban); L11 = Clerical self-employed (rural); L12 = Clerical self-employed (urban); L13 = Management professional employee (rural); L14 = Management professional employee (urban); L15 = Management professional self-employed (rural); L16 = Management professional non-employee (urban)
Source: Simulation results of the model.

Figure 9.9 **Change in Wage Per Labor Category after Full Elimination of Tariffs on Agriculture Imports**



Source: Simulation results of the model.

Poverty. Changes in poverty indicators arise from changes in household income and in the nominal value of the poverty line as a result of the changes in the weighted price or cost of the household's commodity basket, reflected also in the changes in consumer prices.

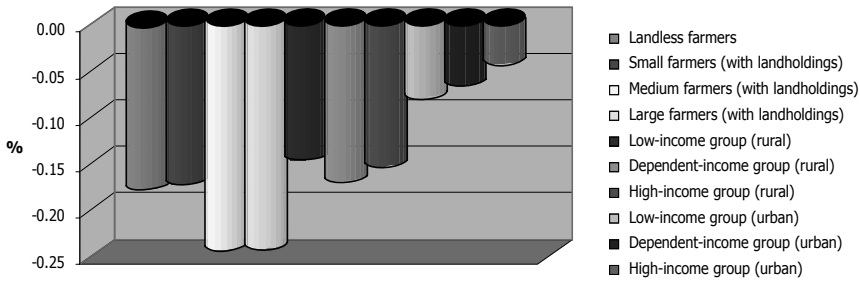
Table 9.11 **Household Income Effects of Full Elimination of Tariffs on Agriculture Imports** (Percentage change from base)

	Household Income	Consumption Price
Agriculture		
Landless farmers	-0.178	-0.180
Small farmers	-0.172	-0.166
Medium farmers	-0.243	-0.136
Large farmers	-0.241	-0.141
Nonagriculture (Rural)		
Low-income group	-0.145	-0.170
Dependent-income group	-0.169	-0.166
High-income group	-0.153	-0.149
Nonagriculture (Urban)		
Low-income group	-0.078	-0.132
Dependent-income group	-0.066	-0.157
High-income group	-0.042	-0.151

Source: Simulation results of the model.

The percentage changes in the three poverty indicators of HCR, PGI, and PSI are presented in Table 9.12. Overall, the poverty headcount increases marginally by 0.03 percent (also illustrated in Figure 9.11). This is equivalent to roughly 10,308 additional people falling into

Figure 9.10 **Change in Disposable Income of Households after Full Elimination of Tariffs on Agriculture Imports**



Source: Simulation results of the model.

poverty. The national poverty gap and poverty severity increase as well, implying that the already poor, especially agricultural households, become even poorer. Medium farmers experience the highest increase in poverty headcount (0.23 percent), while large farmers suffer the largest increase in poverty gap and severity.

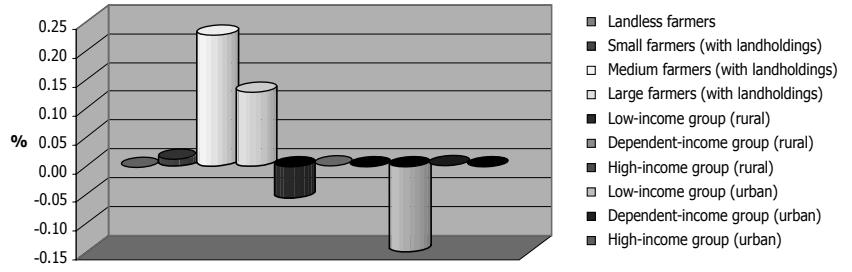
Table 9.12 **Poverty Effects of Full Elimination of Tariffs on Agriculture Imports**
(Percentage change from base)

	Head Count Ratio	Poverty Gap	Poverty Severity
All Indonesia	**0.03**	**0.07**	**0.11**
Agriculture			
Landless farmers	0.00	-0.01	-0.01
Small farmers	0.01	0.02	0.02
Medium farmers	0.23	0.35	0.37
Large farmers	0.13	0.39	0.44
Nonagriculture (Rural)			
Low-income group	-0.06	-0.12	-0.13
Dependent-income group	0.00	0.01	0.01
High-income group	0.00	0.02	0.02
Nonagriculture (Urban)			
Low-income group	-0.15	-0.27	-0.30
Dependent-income group	0.00	-0.46	-0.46
High-income group	0.00	-0.79	-0.78
Additional Poor People (All Indonesia)			**10,308**

Source: Simulation results of the model.

In contrast, low-income nonagricultural households in urban and rural areas benefit from the decline in poverty for two reasons. First, they are able to take advantage of the increase in production wage rates (as a result of the industrial sector expansion). Second, the reduction in the cost of their commodity basket is higher than the decline in their disposable income. This

Figure 9.11 **Change in the Poverty Headcount after Full Elimination of Tariffs on Agriculture Imports**



Source: Simulation results of the model.

is true for dependent and high-income households in urban areas as well, since poverty gap and poverty severity decrease among them.

AGLIBPRO: Eliminations of Agriculture Tariff and Indirect Tax

Macro Effects. The elimination of tariffs and indirect taxes in agriculture to ensure market access for agricultural imports leads to a 0.20 percent reduction in the local price of imported products (Table 9.13). The magnitude of the change in this simulation is higher than in the previous simulation (AGLIB). The elimination of indirect taxes permits a larger reduction in domestic prices. Thus, consumer prices decrease by 0.24 percent, leading to an increase in consumption of 0.02 percent.

Table 9.13 **Macro Effects of Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**
(Percentage change from base)

Real Gross Domestic Product	0.04
Prices	
Import prices in local currency	-0.20
Consumer prices	-0.24
Local cost of production	-0.06
Real exchange rate	0.09
Import volume	0.10
Export volume	0.14
Domestic production for local sales	0.01
Consumption (composite) goods	0.02

Source: Simulation results of the model.

As expected, cheaper agricultural imports flood the domestic market, as total import volume increases by 0.10 percent. This effectively reduces the cost of domestic production by 0.06 percent, paving the way for a real exchange rate depreciation (0.09 percent). The depreciation makes exports cheaper in the international market and thus exports increase by 0.14 percent. The fall in the domestic cost of production allows the industrial sector's output to expand, raising domestic production for local sales by 0.01 percent. The national output rises by 0.04 percent, accordingly.

Sectoral Effects. The output of the three major sectors expands (Table 9.14), with industry experiencing the largest increase (0.07 percent),

followed by services (0.02 percent). Agriculture registers the lowest increase (0.01 percent), as the tariff and indirect-tax elimination in the sector allows imported agricultural products to compete in the local market–resulting in consumer substitution toward cheaper agricultural imports. On the other hand, industrial imports go down as the real exchange rate depreciation makes industrial imports relatively more expensive compared with the base.

Agriculture. The decline in import prices brings about an increase in import volume (4.0 percent) of agricultural products. Fisheries, livestock, and food crops subsectors generate the largest increase in import demand with 11.0, 7.6, and 5.6 percent, respectively. However, the decline in agricultural import prices does not translate into a reduction in the domestic cost of production as the price of value added in agriculture increases.[8] Indeed, domestic agricultural producers lose their competitiveness as the weighted agricultural domestic prices and output prices increase (0.22 and 0.23 percent, respectively), resulting in a 0.22 percent reduction in exports. In spite of this, overall agricultural output goes up marginally by 0.01 percent. Livestock, fisheries, and forestry output expands, while food crops and other crops contract.

Industry. The elimination of tariffs and indirect taxes in agriculture benefit the industrial sector as both output and exports increase by 0.07 percent and 0.20 percent respectively. The foremost gainers are wood products, food processing, and textiles, while construction and other mining are the major losers. It is worth noting that the outward-oriented industrial sector benefits from the elimination of tariffs and indirect taxes in agriculture as the sector experiences a decline in the domestic cost of production. This is the reason behind the increase in exports of the industrial sector.

Services. The expansion in both industrial and agricultural outputs stimulates greater demand for service infrastructure. With this, the services sector's output, domestic sales, and exports increase.

Factor Market. The value-added price increases by 0.09 percent, as both capital returns and overall wages increase by 0.01 percent and 0.10 percent, respectively (Table 9.15). The rise in wages is higher than the increase in capital return, implying that benefits accrue more to wage workers. Resources are reallocated to agriculture and services as the price of value added increases in both sectors.

Table 9.16 presents the labor market impacts of AGLIBPRO. Wages of agricultural laborers in the urban area register the highest increase,

8 This will be discussed under factor remuneration. See Table 9.15.

Table 9.14 **Sectoral Effects of Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**
(Percentage change from base)

Sectors	Price Changes (%)					Volume Changes (%)				
	Import	Domestic	Composite	Export	Local	Import	Export	Domestic sales	Output	Composite Demand
Agriculture	**-2.65**	**-0.75**	**-0.91**	**0.22**	**0.23**	**4.06**	**-0.22**	**0.03**	**0.37**	**0.01**
Food Crops	-3.12	-0.39	-0.62	0.26	0.27	5.60	-0.33	-0.12	0.35	-0.13
Other Crops	-1.88	-0.65	-0.86	0.10	0.09	2.04	-0.32	-0.47	-0.04	-0.45
Livestock	-4.68	-1.42	-1.53	0.12	0.13	7.66	0.20	0.65	0.88	0.63
Forestry	-2.49	-1.87	-1.88	0.32	0.38	1.69	-0.17	0.41	0.44	0.29
Fisheries	-5.61	-0.86	-0.87	0.31	0.34	11.02	-0.03	0.62	0.65	0.56
Industry	**0.00**	**-0.21**	**-0.16**	**-0.17**	**-0.21**	**-0.39**	**0.20**	**-0.02**	**-0.11**	**0.07**
Oil and Gas Mining	0.00	-0.34	-0.31	-0.25	-0.34	-0.92	0.23	-0.23	-0.29	-0.05
Other Mining	0.00	-0.46	-0.37	-0.26	-0.46	-1.88	-0.04	-0.98	-1.15	-0.60
Food Processing	0.00	-0.17	-0.15	-0.16	-0.17	-0.10	0.29	0.24	0.21	0.25
Textiles	0.00	-0.12	-0.08	-0.12	-0.12	-0.02	0.23	0.22	0.14	0.23
Wood and Wood Products	0.00	-0.67	-0.57	-0.53	-0.67	-1.20	0.75	0.15	-0.06	0.44
Papers and Metal Products	0.00	-0.10	-0.04	-0.05	-0.10	-0.33	0.03	-0.13	-0.25	-0.03
Chemicals	0.00	-0.17	-0.07	-0.10	-0.17	-0.47	0.10	-0.14	-0.33	0.00
Utilities, Electricity, Gas, and Water	0.00	0.00	0.00	0.00	0.00	0.11	0.05	0.10	0.10	0.10
Construction	—	-0.31	-0.31	-0.31	-0.31	—	—	-0.93	-0.93	-0.93
Services	—	**-0.04**	**-0.03**	**-0.03**	**-0.04**	**0.01**	**0.01**	**0.03**	**0.03**	**0.02**
Trade	—	-0.07	-0.07	-0.06	-0.07	-0.26	0.02	-0.12	-0.13	-0.08
Restaurants	—	-0.25	-0.22	-0.25	-0.25	-0.14	0.44	0.36	0.31	0.37
Hotels	—	0.06	0.04	0.06	0.06	0.15	-0.04	0.04	0.07	0.03
Land Transport	—	-0.01	-0.01	-0.01	-0.01	-0.04	0.01	-0.01	-0.02	-0.01
Other Transportation & Communication	—	-0.01	0.00	-0.01	-0.01	0.00	0.01	0.01	0.00	0.01
Banking and Insurance	—	0.05	0.03	0.04	0.05	0.12	-0.03	0.02	0.05	0.02
Real Estate	—	0.05	0.04	0.05	0.05	0.13	-0.04	0.02	0.05	0.02
Personal Services	—	0.01	0.01	0.01	0.01	0.03	0.00	0.02	0.02	0.02
Public Services	—	-0.01	-0.01	-0.01	-0.01	0.04	0.04	0.06	0.06	0.06
Total	**-0.20**	**-0.25**	**-0.24**	**-0.06**	**-0.06**	**0.10**	**0.14**	**0.01**	**0.02**	**0.04**

Source: Simulation results of the model.

Table 9.15 **Factor Market Effects of Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**
(Percentage change from base)

Sectors	Value Added		Capital Return	Wage
	Volume	Price		
Agriculture	**0.01**	**0.42**	**0.61**	**0.33**
Food Crops	-0.13	0.38	0.25	0.33
Other Crops	-0.45	0.37	-0.09	0.32
Livestock	0.63	0.55	1.18	0.34
Forestry	0.29	0.57	0.86	0.30
Fisheries	0.56	0.40	0.97	0.34
Industry	**-0.01**	**-0.01**	**-0.03**	**0.02**
Oil and Gas Mining	-0.05	-0.25	-0.30	0.03
Other Mining	-0.60	-0.27	-0.86	0.01
Food Processing	0.25	0.26	0.52	0.02
Textiles	0.23	0.20	0.43	0.03
Wood and Wood Products	0.44	0.40	0.84	0.01
Papers and Metal Products	-0.03	-0.01	-0.04	0.03
Chemicals	0.00	0.02	0.02	0.02
Utilities, Electricity, Gas, and Water	0.10	0.25	0.35	0.04
Construction	-0.93	-0.31	-1.24	-0.01
Services	**0.01**	**0.02**	**0.04**	**0.00**
Trade	-0.08	-0.06	-0.14	-0.03
Restaurants	0.37	0.17	0.54	0.02
Hotels	0.03	0.12	0.15	0.04
Land Transport	-0.01	0.00	-0.01	0.01
Other Transportation & Communication	0.01	0.05	0.06	0.04
Banking and Insurance	0.02	0.06	0.08	0.04
Real estate	0.02	0.09	0.11	0.03
Personal Services	0.02	0.03	0.05	0.01
Public Services	0.06	0.05	0.10	0.03
Total	**0.00**	**0.09**	**0.01**	**0.10**

Source: Simulation results of the model.

followed by agricultural laborers in the rural area. On the other hand, urban management professionals (nonemployees) experience the greatest reduction in wages (0.30 percent) because of the decline in factor incomes from the industrial sector (Figure 9.12).

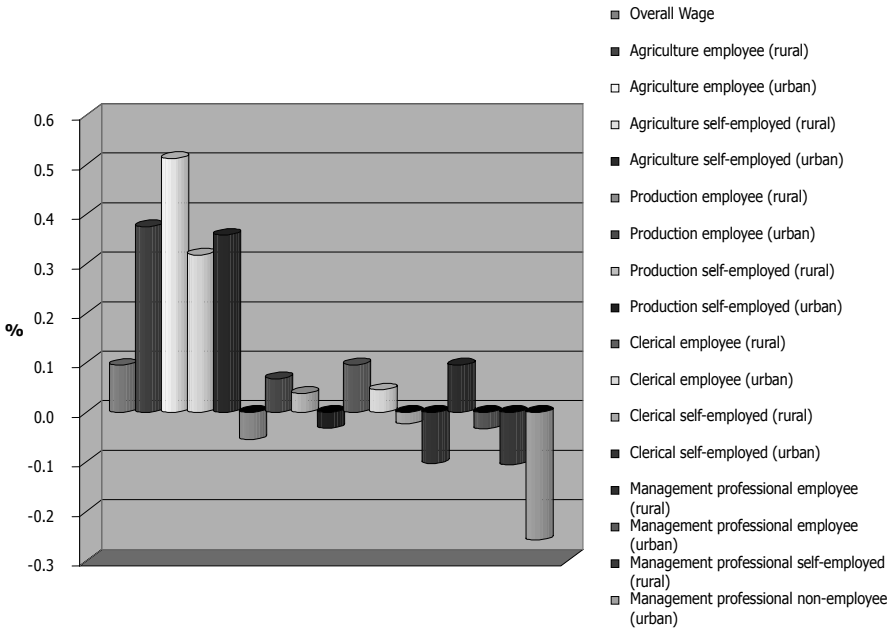
Household Income and Commodity Basket Cost. The increase in factor returns resulting from the rise in wages and capital returns increases all household groups' disposable income (Table 9.17). Large farmers experience the highest increase, while high-income households in urban areas have the lowest increase (Figure 9.13). Accordingly, all households have more ability to purchase goods and services as the cost of the commodity basket declines. Dependent and high-income households in urban areas experience the highest reduction in their commodity basket cost, while medium and large farmers bear the lowest decrease (Figure 9.14). The fall in the commodity basket

Table 9.16 **Labor Market Effects of Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**
(Percentage change from base)

Sectors	Labor Demand																
	L	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16
Food Crops	-0.1	-0.1	-0.3	-0.1	-0.1	0.3	0.2	0.2	0.3	0.2	0.2	0.3	0.3	0.2	0.3	0.4	0.5
Other Crops	-0.4	-0.5	-0.6	-0.4	-0.4	0.0	-0.2	-0.1	-0.1	-0.2	-0.1	-0.1	0.0	-0.2	-0.1	0.0	0.2
Livestock	0.8	0.8	0.7	0.9	0.8	1.2	1.1	1.1	1.2	1.1	1.1	1.2	1.3	1.1	1.2	1.3	1.4
Forestry	0.6	0.5	0.3	0.5	0.5	0.9	0.8	0.8	0.9	0.8	0.8	0.9	1.0	0.8	0.9	1.0	1.1
Fisheries	0.6	0.6	0.5	0.6	0.6	1.0	0.9	0.9	1.0	0.9	0.9	1.0	1.1	0.9	1.0	1.1	1.2
Oil and Gas Mining	-0.3	—	—	—	—	-0.2	-0.4	0.0	0.0	-0.4	-0.3	0.0	0.0	-0.4	-0.3	0.0	0.0
Other Mining	-0.9	—	—	—	—	-0.8	-0.9	-0.9	-0.8	-1.0	-0.9	-0.8	-0.8	-1.0	-0.8	-0.8	-0.6
Food Processing	0.5	—	—	—	—	0.6	0.4	0.5	0.5	0.4	0.5	0.5	0.6	0.4	0.5	0.6	0.8
Textiles	0.4	—	—	—	—	0.5	0.4	0.4	0.5	0.3	0.4	0.5	0.5	0.3	0.5	0.5	0.7
Wood and Wood Products	0.8	—	—	—	—	0.9	0.8	0.8	0.9	0.7	0.8	0.9	0.9	0.7	0.9	0.9	1.1
Paper and Metal Products	-0.1	—	—	—	—	0.0	-0.1	-0.1	0.0	-0.1	-0.1	0.0	0.1	-0.1	0.0	0.1	0.2
Chemicals	0.0	—	—	—	—	0.1	-0.1	0.0	0.0	-0.1	0.0	0.0	0.1	-0.1	0.0	0.1	0.3
Utilities, Electricity, Gas, and Water	0.3	—	—	—	—	0.4	0.3	0.3	0.4	0.3	0.3	0.4	0.5	0.3	0.4	0.5	0.6
Construction	-1.2	—	—	—	—	-1.2	-1.3	-1.3	-1.2	-1.3	-1.3	-1.2	-1.1	-1.3	-1.2	-1.1	-1.0
Trade	-0.1	—	—	—	—	-0.1	-0.2	-0.2	-0.1	-0.2	-0.2	-0.1	0.0	-0.2	-0.1	0.0	0.1
Restaurants	0.5	—	—	—	—	0.6	0.5	0.5	0.6	0.4	0.5	0.6	0.6	0.4	0.6	0.6	0.8
Hotels	0.1	—	—	—	—	0.2	0.1	0.1	0.2	0.1	0.1	0.2	0.3	0.1	0.2	0.3	0.4
Land Transport	0.0	—	—	—	—	0.0	-0.1	0.0	0.0	-0.1	-0.1	0.0	0.1	-0.1	0.0	0.1	0.3
Other Transportation & Communication	0.0	—	—	—	—	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.0	0.1	0.2	0.3
Banking and Insurance	0.0	—	—	—	—	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.0	0.1	0.2	0.3
Real Estate	0.1	—	—	—	—	0.2	0.0	0.1	0.1	0.0	0.1	0.1	0.2	0.0	0.1	0.2	0.4
Personal Services	0.0	—	—	—	—	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.0	0.1	0.2	0.3
Public Services	0.1	—	—	—	—	0.2	0.0	0.1	0.1	0.0	0.1	0.1	0.2	0.0	0.1	0.2	0.4
Change in average employee, %	0.1	0.4	0.5	0.3	0.4	-0.1	0.1	0.0	0.0	0.1	0.0	0.0	-0.1	0.1	0.0	-0.1	-0.3

L = Aggregate Labor; L1 = Agriculture employee (rural); L2 = Agriculture employee (urban); L3 = Agriculture self-employed (rural); L4 = Agriculture self-employed (urban); L5 = Production employee (rural); L6 = Production employee (urban); L7 = Production self-employed (rural); L8 = Production self-employed (urban); L9 = Clerical employee (rural); L10 = Clerical employee (urban); L11 = Clerical self-employed (rural); L12 = Clerical self-employed (urban); L13 = Management Professional employee (rural); L14 = Management Professional employee (urban); L15 = Management Professional self-employed (rural); L16 = Management Professional non- employee (urban)
Source: Simulation results of the model.

Figure 9.12 **Change in Wage per Labor Category after Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**



Source: Simulation results of the model.

costs stems not only from the decline in local import prices but more importantly from the elimination of indirect taxes in agriculture that further brings down the price. Therefore, all households benefit as agricultural products constitute a significant part of their consumption basket.

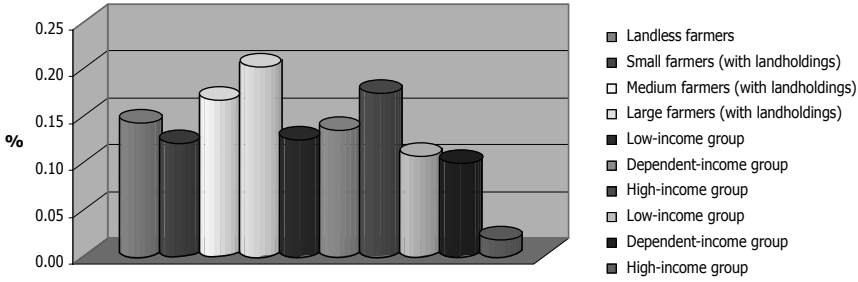
Table 9.17 **Household Income Effects of Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**
(Percentage change from base)

	Household Income	Price
Agriculture		
Landless farmers	0.144	-0.213
Small farmers	0.123	-0.203
Medium farmers	0.169	-0.156
Large farmers	0.203	-0.162
Nonagriculture (Rural)		
Low-income group	0.127	-0.216
Dependent-income group	0.137	-0.209
High-income group	0.176	-0.176
Nonagriculture (Urban)		
Low-income group	0.109	-0.165
Dependent-income group	0.101	-0.234
High-income group	0.019	-0.223

Source: Simulation results of the model.

Poverty. The national poverty headcount decreases by 1.20 percent, representing more than 394,000 people lifted out of poverty (Table 9.18 and Figure 9.15). Low-income households in rural areas achieve the highest reduction in poverty headcount (1.54 percent), whereas high-income households in rural areas attain the smallest reduction (0.76 percent). Notably, the decrease in the poverty gap and poverty severity

Figure 9.13 **Change in Disposable Income of Households after Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**



Source: Simulation results of the model.

Table 9.18 **Poverty Effects of Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**
(Percentage change from base)

	Headcount Ratio	Poverty Gap	Poverty Severity
ALL Indonesia	**-1.2**	**-1.4**	**-1.5**
Agriculture			
Landless farmers	-1.27	-1.62	-1.89
Small farmers	-1.22	-1.37	-1.49
Medium farmers	-0.89	-1.05	-1.13
Large farmers	-1.52	-1.43	-1.59
Nonagriculture (Rural)			
Low-income group	-1.54	-1.68	-1.87
Dependent-income group	-0.77	-1.49	-1.62
High-income group	-0.76	-1.69	-1.74
Nonagriculture (Urban)			
Low-income group	-0.90	-1.33	-1.47
Dependent-income group	-1.10	-1.70	-1.71
High-income group	-1.34	-1.74	-1.68
Poor People Lifted Out of Poverty (All Indonesia)			**394,125**

Source: Simulation results of the model.

is higher than that of the HCR, suggesting an improvement in the poverty status among those who remain poor. The highest reduction in the poverty gap accrues to high-income households in rural areas, while landless farmers benefit the most from reduced poverty severity.

TOTLIB: Elimination of All Tariffs

Macro Effects. Full tariff elimination results in a 3.0 percent decline in the local price of imported goods, a 1.7 percent increase in import volume, and a 1.9 percent fall in local import prices (Table 9.19). Despite the fall in consumer prices, total domestic consumption decreases minimally (0.1 percent) as producers sell less in the domestic market and reallocate toward the international market. This arises from the reduction in domestic costs of

production, causing the real exchange rate to depreciate by 1.3 percent. With this, total exports go up (1.7 percent), while allocation for domestic sales shrinks by 0.4 percent. On the whole, total Indonesian output and real GDP increases by 0.1 and 0.3 percent, respectively, with the higher increase in real GDP as a result of export expansion.

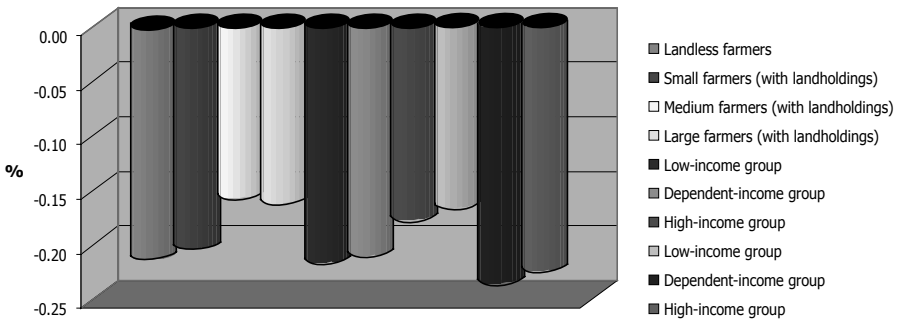
Table 9.19 **Macro Effects of Full Elimination of All Tariffs on Imported Products**
(Percentage change from base)

Real Gross Domestic Product	0.3
Prices	
Import prices in local currency	-3.0
Consumer prices	-1.9
Local cost of production	-1.7
Real exchange rate	1.3
Import volume	1.5
Export volume	1.7
Domestic production for local sales	-0.4
Consumption (composite) goods	-0.1

Source: Simulation results of the model.

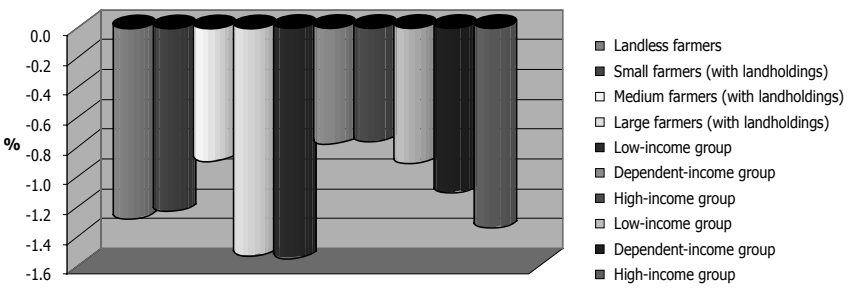
Sectoral Effects. Tariff elimination brings about an output expansion in industry and services (0.11 percent and 0.17 percent, respectively), and a marginal contraction in agricultural output (0.03 percent). Industrial exports and imports increase, while agricultural and service imports fall (Table 9.20). Overall, the price reduction in industry is greater since the sector's weighted

Figure 9.14 **Change in the Cost of the Household Commodity Basket after Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**



Source: Simulation results of the model.

Figure 9.15 **Change in the Poverty Headcount after Full Elimination of Tariffs and Indirect Taxes on Agriculture Imports and Agriculture Products**



Source: Simulation results of the model.

Table 9.20 **Sectoral Effects of Full Elimination of All Tariffs on Imported Products**
(Percentage change from base)

Sectors	Price Changes (%)					Volume Changes (%)				
	Imports	Domestic	Composite	Export	Local	Import	Export	Domestic	Composite	Local
Agriculture	**-1.89**	**-1.88**	**-1.88**	**-1.80**	**-1.88**	**-0.25**	**1.76**	**-0.19**	**-0.20**	**-0.03**
Food Crops	-2.49	-1.80	-1.86	-1.76	-1.80	1.36	1.81	-0.05	0.07	0.03
Other Crops	-1.16	-1.97	-1.83	-1.81	-1.97	-2.16	1.74	-0.53	-0.81	-0.22
Livestock	-3.18	-1.87	-1.91	-1.82	-1.87	2.83	1.94	0.09	0.17	0.17
Forestry	-0.26	-2.21	-2.16	-1.92	-2.21	-5.18	1.56	-1.36	-1.46	-0.78
Fisheries	-4.48	-1.84	-1.84	-1.76	-1.84	5.88	2.00	0.25	0.27	0.41
Industry	**-5.19**	**-2.11**	**-2.87**	**-1.65**	**-2.11**	**4.09**	**1.85**	**-0.97**	**0.24**	**0.11**
Oil and Gas Mining	-2.04	-1.95	-1.96	-1.44	-1.95	-0.98	1.40	-1.17	-1.15	-0.12
Other Mining	-1.47	-2.69	-2.47	-1.80	-2.69	-5.68	1.06	-3.30	-3.74	-1.50
Food Processing	-8.50	-1.82	-2.46	-1.54	-1.82	14.78	1.70	-0.31	1.01	0.26
Textiles	-7.37	-3.16	-4.69	-2.45	-3.16	8.54	2.90	-0.70	2.50	0.76
Wood and Wood Products	-4.94	-2.63	-2.99	-1.85	-2.63	3.61	2.06	-1.24	-0.51	0.36
Paper and Metal Products	-4.46	-2.90	-3.82	-1.85	-2.90	2.28	2.49	-0.98	0.91	1.19
Chemicals	-4.50	-2.73	-3.71	-1.62	-2.73	1.63	1.75	-2.05	-0.03	0.20
Utilities, Electricity, Gas, and Water	0.00	-1.12	-1.12	-1.12	-1.12	-2.05	1.23	0.18	0.18	0.18
Construction	—	-2.06	-2.06	-2.06	-2.06	—	—	-3.10	-3.10	-3.10
Services	**—**	**-1.06**	**-0.84**	**-0.98**	**-1.06**	**-1.67**	**1.03**	**0.02**	**0.23**	**0.17**
Trade	—	-1.38	-1.30	-1.14	-1.38	-3.49	1.02	-0.76	-0.93	-0.27
Restaurants	—	-1.43	-1.26	-1.43	-1.43	-2.14	1.81	0.71	0.38	0.71
Hotels	—	-0.71	-0.48	-0.71	-0.71	-1.37	0.74	0.04	-0.42	0.05
Land Transport	—	-1.20	-0.85	-1.05	-1.20	-2.33	1.25	0.06	-0.66	0.37
Other Transportation & Communication	—	-0.96	-0.47	-0.85	-0.96	-1.57	1.15	0.35	-0.64	0.59
Banking and Insurance	—	-0.63	-0.47	-0.60	-0.63	-1.26	0.62	-0.01	-0.33	0.05
Real Estate	—	-0.63	-0.49	-0.61	-0.63	-1.26	0.64	0.01	-0.28	0.06
Personal Services	—	-1.13	-0.98	-1.13	-1.13	-2.00	1.27	0.25	-0.05	0.25
Public Services	—	-0.82	-0.67	-0.82	-0.82	-1.09	1.10	0.55	0.25	0.56
Total	**-3.00**	**-1.66**	**-1.90**	**-1.44**	**-1.66**	**1.48**	**1.68**	**-0.43**	**-0.06**	**0.11**

Source: Simulation results of the model.

tariff rate is higher at the base. Hence, local import prices for industrial products fall more than import prices for agricultural products.

Agriculture. Contrary to AGLIB and AGLIBPRO, the decline in local import prices does not induce consumer substitution toward imported agricultural products. Indeed, consumption falls by 0.20 percent. At first glance, it seems that the decline in consumption, despite the fall in agricultural commodity prices, is counter intuitive. However, the decline in consumption arises from agricultural producers' reaction to the real exchange rate depreciation. As Indonesian agricultural exports become cheaper, producers reallocate toward the international market, thereby selling less in the domestic market.

Industry. Full tariff elimination favors the industrial sector as import protection walls collapse. The proliferation of cheap imports brings down the cost of intermediate inputs, resulting in a reduction in the domestic cost of production. With this, total industry output, exports, and imports increase by 0.11 percent, 1.85 percent, and 4.00 percent respectively. Paper production and textiles benefit the most from tariff elimination as both their output and exports expand the most.

Services. The services sector benefits the most from full tariff elimination. This is traceable to the increase in vital service infrastructure demand by both agriculture and industry. Thus, total consumption for services increases by 0.23 percent. The restaurant subsector registers the highest increase in exports and output.

Factor Market. Table 9.21 presents the factor market impacts of TOTLIB. The economy-wide price of value added decreases by 0.9 percent as both the return to capital and overall wage falls. The reduction in wage rate (1.0 percent) is higher than the decline in return to capital (0.7 percent), implying that wage workers endure the greater impact of lower factor returns. Moreover, the reduction in wages under TOTLIB is higher when compared with AGLIB and AGLIBPRO. Agriculture registers the highest reduction in the price of value added, making agricultural laborers experience the largest decline in wage.

Household Income and Commodity Basket Cost. Table 9.22 shows the changes in households' the disposable income and the cost of the household consumer basket. Clearly, disposable income of all households declines, with agricultural households enduring the highest reduction in factor income. Nonagriculture households based in urban areas experience the lowest decline in disposable income (Figure 9.16).

The cost of the commodity basket of all households falls as a result of tariff elimination (Table 9.23 and Figure 9.17). The removal of import protection

Table 9.21 **Factor Market Effects of Full Elimination of All Tariffs on Imported Products**
(Percentage change from base)

Sector	Value added	Price	Capital Return	Wages
Agriculture	**-0.03**	**-1.71**	**-1.97**	**-1.65**
Food Crops	0.03	-1.69	-1.66	-1.66
Other Crops	-0.22	-1.69	-1.90	-1.63
Livestock	0.17	-1.73	-1.56	-1.60
Forestry	-0.78	-1.85	-2.62	-1.50
Fisheries	0.41	-1.68	-1.27	-1.65
Industry	**-0.10**	**-0.85**	**-0.85**	**-0.84**
Oil and Gas Mining	-0.12	-1.40	-1.52	-0.66
Other Mining	-1.50	-1.70	-3.18	-1.01
Food Processing	0.26	-0.63	-0.38	-0.88
Textiles	0.76	-0.22	0.54	-0.80
Wood and Wood Products	0.36	-0.68	-0.33	-1.00
Papers and Metal Products	1.19	0.92	2.11	-0.74
Chemicals	0.20	-0.44	-0.24	-0.80
Utilities, Electricity, Gas, and Water	0.18	-0.30	-0.12	-0.68
Construction	-3.10	-1.95	-4.99	-0.93
Services	**0.12**	**-0.59**	**-0.39**	**-0.73**
Trade	-0.27	-1.03	-1.30	-0.93
Restaurants	0.71	-0.43	0.28	-0.73
Hotels	0.05	-0.43	-0.38	-0.53
Land Transport	0.37	-0.53	-0.16	-0.92
Other Transportation & Communication	0.59	0.27	0.86	-0.57
Banking and Insurance	0.05	-0.45	-0.41	-0.52
Real Estate	0.06	-0.36	-0.29	-0.57
Personal Services	0.25	-0.55	-0.31	-0.82
Public Services	0.56	-0.28	0.28	-0.41
Total	**0.00**	**-0.9**	**-0.7**	**-1.0**

Source: Simulation results of the model.

generates a decline in all commodity prices, thereby benefiting households indirectly. Indeed, the reduction in the cost of all RHGs' commodity baskets is greater than the fall in disposable income, implying an improvement in the living status of all household groups.

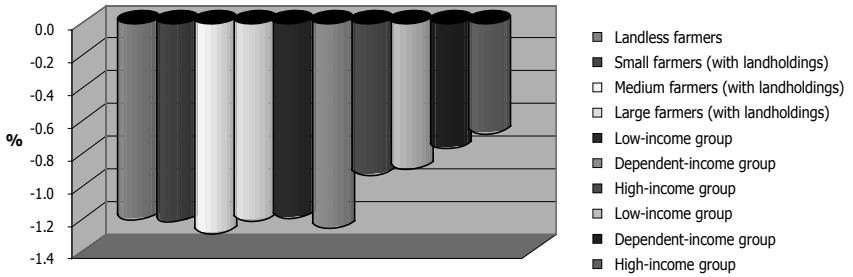
Poverty. Table 9.24 shows the changes in poverty indexes. Poverty headcount falls by 2.6 percent, suggesting that 857,754 people are escaping poverty. In general, poverty reduction favors, relatively, the nonagricultural households–particularly those residing in urban areas. High-income households in urban areas experience the largest reduction in poverty, while medium farmers and dependent households in rural areas experience the smallest reduction in poverty (Figure 9.18). Notably, the decline in the poverty gap and severity is higher than the reduction in poverty headcount, implying an improvement in the status of those who remain poor. As pointed out above, this is because

Table 9.22 **Labor Market Effects of Full Elimination of All Tariffs on Imported Products**
(Percentage change from base)

Sectors	Labor Demand																
	L	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	L12	L13	L14	L15	L16
Food Crops	0.00	0.09	0.02	-0.01	-0.03	-0.39	-1.03	-0.48	-0.63	-1.22	-1.15	-0.64	-0.45	-1.77	-1.26	-0.43	-0.18
Other Crops	-0.27	-0.16	-0.23	-0.25	-0.27	-0.64	-1.28	-0.73	-0.88	-1.47	-1.39	-0.88	-0.70	-2.01	-1.50	-0.68	-0.43
Livestock	0.04	0.18	0.12	0.09	0.07	-0.29	-0.94	-0.38	-0.54	-1.13	-1.05	-0.54	-0.36	-1.67	-1.16	-0.34	-0.09
Forestry	-1.13	-0.89	-0.95	-0.98	-1.00	-1.36	-2.00	-1.45	-1.60	-2.18	-2.11	-1.60	-1.42	-2.72	-2.22	-1.40	-1.15
Fisheries	0.38	0.48	0.41	0.39	0.37	0.00	-0.65	-0.09	-0.24	-0.83	-0.76	-0.25	-0.06	-1.38	-0.87	-0.04	0.21
Oil and Gas Mining	-0.86	—	—	—	—	-0.25	-0.89	0.00	0.00	-1.08	-1.00	0.00	0.00	-1.63	-1.12	0.00	0.00
Other Mining	-2.19	—	—	—	—	-1.93	-2.56	-2.02	-2.17	-2.75	-2.67	-2.17	-1.99	-3.29	-2.78	-1.97	-1.72
Food Processing	0.50	—	—	—	—	0.91	0.25	0.82	0.66	0.07	0.14	0.66	0.84	-0.49	0.03	0.86	1.12
Textiles	1.35	—	—	—	—	1.83	1.17	1.74	1.59	0.98	1.06	1.58	1.77	0.42	0.95	1.79	2.05
Wood and Wood Products	0.67	—	—	—	—	0.96	0.31	0.87	0.71	0.12	0.19	0.71	0.89	-0.44	0.08	0.92	1.17
Paper and Metal Products	2.87	—	—	—	—	3.43	2.76	3.34	3.18	2.57	2.65	3.18	3.36	2.00	2.53	3.39	3.65
Chemicals	0.57	—	—	—	—	1.05	0.39	0.95	0.80	0.20	0.28	0.80	0.98	-0.35	0.17	1.00	1.26
Utilities, Electricity, Gas, and Water	0.56	—	—	—	—	1.17	0.51	1.08	0.92	0.33	0.40	0.92	1.10	-0.23	0.29	1.13	1.38
Construction	-4.09	—	—	—	—	-3.76	-4.38	-3.85	-3.99	-4.56	-4.49	-4.00	-3.82	-5.09	-4.60	-3.80	-3.56
Trade	-0.38	—	—	—	—	-0.03	-0.68	-0.12	-0.27	-0.86	-0.79	-0.28	-0.10	-1.41	-0.90	-0.07	0.18
Restaurants	1.02	—	—	—	—	1.57	0.92	1.48	1.33	0.73	0.80	1.32	1.51	0.17	0.69	1.53	1.79
Hotels	0.16	—	—	—	—	0.91	0.25	0.82	0.66	0.07	0.14	0.66	0.84	-0.49	0.03	0.86	1.12
Land Transport	0.77	—	—	—	—	1.13	0.48	1.04	0.89	0.29	0.37	0.88	1.07	-0.27	0.25	1.09	1.34
Other Transportation & Communication	1.44	—	—	—	—	2.16	1.50	2.07	1.91	1.31	1.39	1.91	2.10	0.75	1.27	2.12	2.38
Banking and Insurance	0.11	—	—	—	—	0.88	0.23	0.79	0.63	0.04	0.12	0.63	0.81	-0.52	0.00	0.84	1.09
Real Estate	0.28	—	—	—	—	0.99	0.34	0.90	0.75	0.15	0.23	0.75	0.93	-0.40	0.12	0.95	1.21
Personal Services	0.52	—	—	—	—	0.98	0.33	0.89	0.74	0.14	0.22	0.73	0.92	-0.42	0.10	0.94	1.19
Public Services	0.69	—	—	—	—	1.57	0.92	1.48	1.33	0.73	0.80	1.32	1.51	0.17	0.69	1.53	1.79
Change in average employee, %	-1.01	-1.74	-1.68	-1.65	-1.64	-1.27	-0.63	-1.19	-1.03	-0.44	-0.52	-1.03	-1.21	0.11	-0.41	-1.23	-1.48

L = Aggregate Labor; L1 = Agriculture employee (rural); L2 = Agriculture employee (urban); L3 = Agriculture self-employed (rural); L4 = Agriculture self-employed (urban); L5 = Production employee (rural); L6 = Production employee (urban); L7 = Production self-employed (rural); L8 = Production self-employed (urban);L9 = Clerical employee (rural); L10 = Clerical employee (urban); L11 = Clerical self-employed (rural); L12 = Clerical self-employed (urban); L13 = Management Professional employee (rural); L14 = Management Professional employee (urban); L15 = Management Professional self-employed (rural); L16 = Management Professional nonemployee (urban)
Source: Authors' calculation from simulation results.

Figure 9.16 **Change in Disposable Income of Households after Full Elimination of All Tariffs on Imported Products**



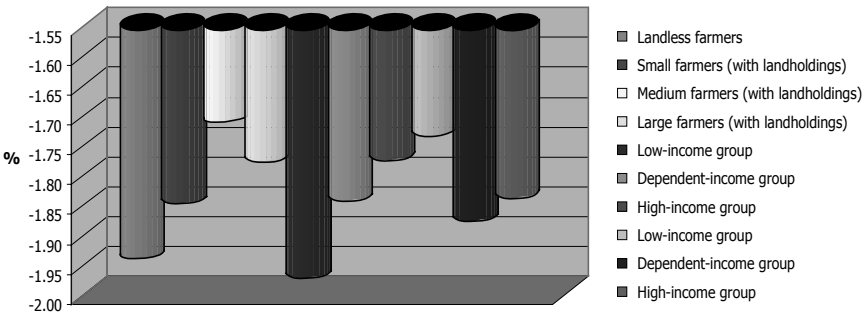
Source: Simulation results of the model.

Table 9.23 **Household Income Effects of Full Elimination of All Tariffs on Imported Products** (Percentage change from base)

	Household Income	Price
Agriculture		
Landless farmers	-1.19	-1.94
Small farmers	-1.21	-1.85
Medium farmers	-1.28	-1.71
Large farmers	-1.21	-1.77
Nonagriculture (Rural)		
Low-income group	-1.19	-1.97
Dependent-income group	-1.25	-1.84
High-income group	-0.93	-1.77
Nonagriculture (Urban)		
Low-income group	-0.89	-1.73
Dependent-income group	-0.76	-1.87
High-income group	-0.67	-1.84

Source: Simulation results of the model.

Figure 9.17 **Change in the Cost of the Household Commodity Basket after Full Elimination of All Tariffs on Imported Products**



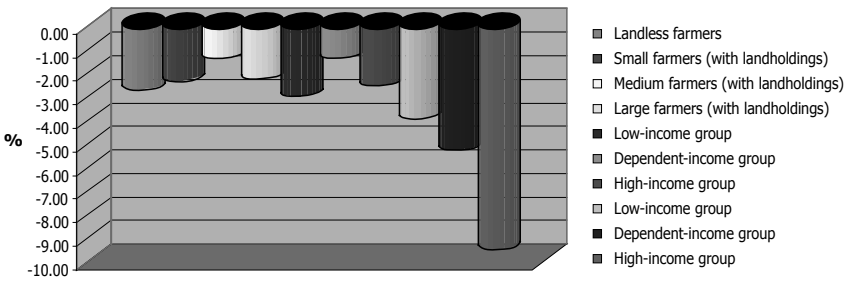
Source: Simulation results of the model.

Table 9.24 **Poverty Effects of Full Elimination of All Tariffs on Imported Products**
(Percentage change from base)

	Headcount Ratio	Poverty Gap	Poverty Severity
All Indonesia	**-2.6**	**-2.9**	**-3.0**
Agriculture			
Landless farmers	-2.7	-3.4	-4.0
Small farmers	-2.3	-2.7	-2.9
Medium farmers	-1.4	-1.4	-1.5
Large farmers	-2.2	-2.3	-2.5
Nonagriculture (Rural)			
Low-income group	-2.9	-3.9	-4.3
Dependent-income group	-1.4	-2.6	-2.8
High-income group	-2.5	-4.1	-4.2
Nonagriculture (Urban)			
Low-income group	-3.9	-4.1	-4.5
Dependent-income group	-5.2	-5.6	-5.6
High-income group	-9.4	-8.2	-8.4
Poor People Lifted Out of Poverty (All Indonesia)			**857,754**

Source: Simulation results of the model.

Figure 9.18 **Change in the Poverty Headcount after Full Elimination of All Tariffs on Imported Products**



Source: Simulation results of the model.

the decline in the cost of the household commodity basket outweighs the decline in disposable income.

The significant change in the HCR compared with those of household income (Table 9.23 and 9.24) indicate that there is better income improvement among the poor households for each group. This means that income distribution also improves following the policy introduction.

Concluding Remarks

The general trend of tariff reduction as part of trade liberalization in Indonesia is in line with the DDA and is economically desirable. Further trade liberalization in the future, however, should be conducted cautiously–especially if its impact on poverty is also to be taken into account. The CGE model developed in this study sheds light on the economy-wide impact of unilateral, but DDA-consistent, trade liberalization in Indonesia. The general results seem to indicate that the existing tariff structure is not only distorting the economy but is also not pro-poor.

The prevalence of agricultural protection may not be beneficial to the Indonesian economy in the long run, as can be seen from the simulation results of eliminating agricultural tariffs only. The presence of cheap agricultural imports as a result of the policy will induce consumers to substitute toward them, resulting in agricultural output contraction and a reduction in the income of farm workers. National poverty headcount, poverty gap, and poverty severity all increase. This implies that the already poor, especially agricultural households, would become poorer.

In contrast, a more proactive stance of adopting complete farm trade liberalization, in which tariffs and indirect taxation of agricultural products are removed, appears more promising. The policy is consistent with the DDA and seems beneficial to the economy and to the poor. Agriculture, industry, and service outputs expand, resulting in an increase in factor returns. In particular, wages of agricultural laborers increase substantially, suggesting that they benefit the most from the resource reallocation effects, especially compared to other workers. To a large extent, the abolition of domestic agricultural taxes allows domestic agriculture producers to compete with agricultural imports. The disposable income of all household groups increases, while the cost of the commodity basket falls, leading to poverty reduction. As a result, HCR, poverty gap, and poverty severity all fall, indicating a clear improvement in the overall poverty condition.

The last alternative of full tariff elimination in all sectors appears to be the best poverty-reducing policy. Industrial and service outputs expand, while agricultural output contracts. Industrial exports and imports increase while agriculture and service imports fall, thereby sustaining the trade surplus. Resources are reallocated from agriculture to industry and services. The adjustment impact is a decline in wages and, consequently, a decline in income for almost all households. However, this fall is outweighed by the reduction in consumer prices as a result of tariff elimination. Hence, poverty decreases substantially. Note that in terms of poverty headcount, poverty severity, and poverty gap, every household group comes out ahead compared

with both of the other scenarios and the baseline. This is clearly the dominant strategy of the three for reduction in absolute poverty. Nonetheless, the decline in poverty is higher among nonagricultural households, especially those residing in urban areas, where poverty incidence is already the lowest. This benefit may stem from the ability of nonfarm workers to take advantage of additional opportunities as a result of the expansions of industrial and services sectors. Accordingly, the main challenge for the government is to implement complementary policies especially targeted to farm workers and the poor. Through improved access to labor markets, they would then be able to take advantage of the opportunities being offered by trade liberalization and the DDA.

CHAPTER 10

Poverty Reduction Integrated Simulation Model: Trade Liberalization in the Philippines, The Need for Further Reform

Caesar Cororaton,[1] Erwin Corong, Guntur Sugiyarto, and Eric B. Suan

Introduction

In the 1980s, significant strides were made in Philippine trade policy reform. Tariff rates were reduced, the tariff structure was simplified, and imports of nonessentials, unclassified, or semi-classified products were prohibited. The government initiated three measures: the 1981–1985 Tariff Reform Program (TRP), the Import Liberalization Program (ILP), and the complementary realignment of indirect taxes in 1983–1985. Under the TRP, the peak tariff rate was reduced from 100 percent to 50 percent, while the floor tariff rate was raised from 0 to 10 percent. Indirect taxes were modified such that sales tax rates imposed on imports and their locally manufactured counterparts were equalized. Also, the mark up applied on the value of imports (for purposes of computing the sales tax) was reduced and eventually eliminated (Manasan and Querubin 1997).

When the Aquino administration came into power in 1986, it abolished the export tax on all products except logs. Thus, the number of regulated items liberalized across sectors was reduced significantly from 1,802 items in 1985 to 609 items in 1988 (De Dios 1995). In 1991, the government embarked on another major tariff reform program with the issuance of Executive Order (EO) No. 470. Under this EO, the number of commodity lines with high tariffs was reduced, while the number of commodity lines with low tariff rates was increased. It aimed at clustering the commodity line at the 10–30 percent rate range by 1995. However, about 10 percent of the total number of commodity lines continued to be subjected to 0–5 percent and 50 percent tariff rates by

[1] The author acknowledged the International Development Research Center (IDRC; http://www.idrc.ca) and the Poverty and Economic Policy (PEP; http://www.pep-net.org) research network for providing financial support in the development of the CGE micro-simulation model, which was used as the basis for the development of the PRISM. The model was first introduced in Cororaton and Cockburn 2005. See related article in Cororaton and Cockburn 2007.

the end of 1995. These developments were expected to intensify with the introduction of the Doha Development Agenda (DDA) that would further liberalize trade.

However, the impact of all these developments on the poor is not very clear and is the subject of intense discussion. Do the poor share in the gains from free trade? What alternative or accompanying policies may be used to ensure a more equitable distribution of the gains? What are the channels through which these reforms may affect the poor? These are examples of very challenging policy issues that occupy the ongoing debate on trade reforms.

Given the economy-wide nature of trade reform, this study uses a tool called the Poverty Reduction Integrated Simulation Model (PRISM) to provide insights on how changes in trade policies may affect poverty. The PRISM for the Philippine economy is developed using a computable general equilibrium (CGE) microsimulation model that is calibrated to the 1994 Social Accounting Matrix (SAM). This approach allows researchers to comprehensively and consistently models the link between trade reforms and individual household responses, and their feedback to the entire economy. Moreover, the integration of household data into the CGE model allows changes to be tracked in household income, consumption, and poverty for a given policy change (Cockburn 2002 and Cororaton 2003b). In particular, with PRISM, it is possible to investigate the transmission mechanisms or channels through which households may be affected by changes in factor incomes as a result of factor and output price changes, and by changes in consumer prices.

Therefore, the effects of tariff reform on households may be traced through the income and consumption channels. Through the income channel, tariff reform generates a series of changes in sectoral imports, exports, production, demand for factors and factor payments, and, ultimately, household income. Households which are endowed with factors that are used intensively in the expanding sectors may benefit from the tariff reform. Through the consumption channel, tariff reform may change consumer prices, benefiting those households which consume more goods with declining prices as a result of the tariff reform.

Survey of Literature

A number of researchers, such as Winters, McCulloch, and McKay (2004) and Hertel and Reimer (2004), have investigated the link between trade and poverty through surveys. Both surveys analyze the theoretical link and cite

the empirical evidence available so far. In summary, the link between trade and poverty may be found in:

- price and availability of goods;
- factor prices, income, and employment;
- government taxes and transfers influenced by changes in revenue from trade taxes;
- incentives for investment and innovation, which affect long-run economic growth;
- external shocks, in particular, changes in the terms of trade; and
- short-run risk and adjustment costs.

Various methods of analysis can be used to examine the link between trade and poverty, such as partial equilibrium and cost-of-living analysis, general equilibrium models, and econometric models on trade, growth, and poverty. Regardless of the methods used, the empirical evidence indicates that there is no simple general conclusion about the relationship between trade liberalization and poverty.

This paper uses a general equilibrium framework in addressing the issue. There have been many attempts to adopt CGE models for analyzing the poverty issue. The simplest approach is to increase the number of categories of households or representative household groups (RHGs) and examine how different households (rural versus urban, landholders versus sharecroppers, region A versus region B, etc.) are affected by a given shock. However, in this approach nothing can be said about the relative impacts on households within any given category because the model only generates information on the RHGs (or the "average" household). There is increasing evidence that households within a given category may be affected quite differently according to their asset profiles, location, household composition, education, etc. Although this problem of intra-category variation may decrease with a greater disaggregation of households (see, for example, the work of Piggott and Whalley (1985), where over 100 household categories were considered), one still has to impose strong assumptions concerning the income distribution among households within each category in order to conduct conventional poverty and income distribution analysis.

A popular approach is to assume a lognormal distribution of income within each category where the variance is estimated with base-year data (De Janvry, Sadoulet, and Fargeix 1991a). In this approach, the change in income of the representative household in the CGE model is used to estimate the change in the average income for each household category, while the variance of this income is assumed fixed. Decaluwé et al. (2000) argue that a beta distribution is preferable to other distributions such as the lognormal because it can be

skewed left or right and thus may better represent the types of intra-category income distributions commonly observed. Cockburn (2002) use the actual incomes from a household survey, rather than assume any given functional form, and apply the change in income of the representative household in the CGE model to each individual household in that category.

Regardless of the distribution chosen, one must further assume that all but the first moment in each RHG is fixed and unaffected by the shock analyzed. This assumption is hard to defend given the heterogeneity of income sources and consumption patterns of households even within much disaggregated categories. Indeed, it is often found that intra-category income variance amounts to more than half of total income variance.

The alternative approach is to model each household individually. As demonstrated by Cockburn (2002), this poses no particular technical difficulties because it involves constructing a standard CGE model with as many household categories as there are households in the household survey providing the base data.

Cororaton (2000) attempted to analyze the effects of tariff reform on household welfare using a CGE model. However, the analysis suffers from two weaknesses: the CGE model used in the simulation was calibrated to the 1990 SAM, which is outdated since much of the tariff reform took place in the mid-1990s; and the household disaggregation was done in deciles. As a result, it is conceptually difficult to pin down the effects of a policy shock at the household level if the groupings are in deciles because households can move in and out of a particular decile group after a policy change. To address these weaknesses, Cororaton (2003a, 2003b) specified a CGE model on the updated 1994 SAM using household groupings in socioeconomic classes that were characterized by household resource endowments such as educational attainment. However, while these socioeconomic household groupings represent a significant improvement over the previous model because the degree of household mobility across groups was much less, it was still inadequate in capturing the effects of tariff reform on poverty. Thus, to address the concern, Cororaton (2003b) applied a CGE-microsimulation approach by incorporating detailed individual household information from the Family Income and Expenditure Survey (FIES). In particular, the approach incorporates the 24,797 households in the 1994 FIES. This approach replaces the usual representative household assumption in a traditional CGE model with individual households in the FIES to capture the interaction between policy reforms and individual household responses, and their feedback to the general economy. This paper is a further extension of Cororaton (2003b). It presents the different scenarios that would be described in the improvement of the poor through trade liberalization.

Trade Reforms

As mentioned earlier, the Philippine government introduced three major trade reforms–the TRP, ILP, and the complementary realignment of indirect taxes–with the view of implementing comprehensive tariff reforms that would reduce the trade imbalance and government deficit. The reform was initially carried out in 14 sectors: food processing, textiles and garments, leather and leather products, pulp and paper, cement, iron and steel, automotive, wood and wood products, motorcycles and bicycles, glass and ceramics, furniture, domestic appliances, machineries and other capital equipment, and electrical and electronics. The reform brought about a reduction in the average nominal tariff rate from 34.6 percent in 1981 to 27.9 percent in 1985 (Table 10.1). In 1983–1985, sales taxes on imports and locally produced goods were unified, removing protection from the differentiated sales tax rates. Also in 1985, the markup[2] applied on the value of imports (for sales tax valuation purposes) was reduced and eventually eliminated in 1986.

Table 10.1 **Average Nominal Tariffs by Sector**
(Percent)

Sector	*1982*	*1985*	*1990*	*1991*	*1995*	*1998*	*2000*
Agriculture	43.2	34.6	34.8	36.0	28.0	18.9	14.4
Mining	16.5	15.3	14.0	11.5	6.3	3.6	3.3
Manufacturing	33.7	27.1	27.5	24.6	14.0	9.4	6.9
Overall	**[illegible]**	**[illegible]**	**[illegible]**	**[illegible]**	**[illegible]**	**[illegible]**	

Source: The Philippine Tariff Commission.

However, because of the balance of payments, economic, and political crises in the mid-1980s, the import liberalization program was suspended. In fact, some of the items that were deregulated earlier were reregulated in this period, as earlier mentioned.

A reversal of the reforms followed in early 1990s. The government launched a major program in 1991 with the issuance of EO No. 470, which was also called the TRP-II. This was an extension of the previous program, in which tariff rates were realigned over a 5-year period, involving narrowing tariff rates through a series of tariff reductions of commodity lines with high tariffs and an increase in tariffs in commodity lines with low tariffs. In particular, the program was aimed at clustering tariffs within the 10–30 percent range by 1995. Despite the program, about 10 percent of the total number of commodity lines was still subjected to 0–5 percent and 50 percent tariff rates by the end of the program in 1995.

Converting quantitative restrictions (QRs) into tariff equivalents (tariffication) started in 1992 with the implementation of EO No. 8. There

2 The markup effectively increased the total import duties paid because of increases in the tax base of imports.

were 153 commodities subjected to this program. In a number of cases, tariff rates were set up over 100 percent, especially in the initial years of the conversion. However, some sensitive agricultural products continued to be protected by a built-in program that was put into effect in the phase down of tariff rates over a 5-year period. Furthermore, this also realigned tariff rates on 48 commodities.

The tariffication program continued on another 286 items. As a result, by the end of 1992, only 164 commodities were covered under QRs. However, the implementation of the Memorandum Order (MO) 95 in 1993 reversed the deregulation process. QRs were reimposed on 93 items, increasing the number of regulated items under the QRs to 257. This reregulation came largely as a result of the Magna Carta for Small Farmers in 1991.

Major reforms were implemented under the TRP-III under the following EOs:

- EO No. 189 implemented on 1 January 1994 to reduce tariffs on capital equipment and machinery;
- EO No. 204 on 30 September 1994 to reduce tariffs on textiles, garments, and chemical inputs;
- EO No. 264 on 22 July 1995 to reduce tariffs on 4,142 harmonized lines in the manufacturing sector; and
- EO No. 288 in 1 January 1996 to reduce tariffs on nonsensitive components of the agricultural sector.

The tariff restructuring under these EOs refers to reduction in both the number of tariff tiers and the maximum tariff rates. In particular, the program was aimed at establishing a four-tier tariff schedule, namely: a 3 percent rate for raw materials and capital equipment not available locally; 10 percent for raw materials and capital equipment available from local sources; 20 percent for intermediate goods; and 30 percent for finished goods.

Another major component of the overall tariff design was to implement a uniform tariff of 5 percent (this is still under discussion). This scheme was envisioned to eliminate cascading tariff structures, which favors finished or final products over intermediate goods.

Table 10.2 shows the weighted average tariff rates in 1994 and in 2000 across various sectors. The overall rate declined by 65.0 percent over these years, i.e., from 23.9 percent in 1994 to 7.9 percent in 2000. The tariff decline in industry (65.3 percent) was much higher than in agriculture (48.8 percent).

In terms of specific sectors, the largest tariff drop was in the mining sector (88.9 percent), while the lowest decline was in other agriculture (19.9 percent).

Tariff rates in 2000 show that food manufacturing still has the highest rate of 16.6 percent, while other agriculture has the lowest tariff of 0.2 percent. Tariff changes in 1994–2000, are examined in the simulation analysis.

In line with existing foreign trade policies, the Philippine government has reduced import levies to zero on about 60 percent of its products included in the list of the Common Effective Preferential Tariff scheme of the Association of Southeast Asian Nations (ASEAN) Free Trade Area. Rounds of discussions were also undertaken in the People's Republic of China and Japan under the Philippine Economic Partnership Agreement.

Table 10.2 **Weighted Average Nominal Tariff Rates** (Percent)

Sector	*1994*	*2000*	*Change*
Agriculture	8.8	4.5	-48.8
Crops	15.9	8.7	-45.5
Livestock	0.7	0.3	-57.6
Fishing	34.1	8.0	-76.4
Other agriculture	0.3	0.2	-19.9
Industry [a]	24.1	8.4	-65.3
Mining	44.1	4.9	-88.9
Food manufacturing	37.3	16.6	-55.4
Nonfood manufacturing	21.1	7.6	-64.0
Services [b]	—	—	—
Total	23.9	7.9	-65.0

a includes construction, electricity, gas, and water
b includes trade, government services, and other services
Source: Manasan and Querubin 1997.

Tariff Reform and Government Revenue

Revenue from import tariffs is one of the major sources of government income. Table 10.3 shows government revenue by sources. In 1990, the share of revenue from import duties and taxes to total revenue was 26.4 percent. This increased marginally to 27.7 percent in 1995. However, the share dropped significantly to 19.3 percent in 2000. One of the major factors behind the decline was the tariff reduction program.

The share of direct taxes, a combination of income and profit direct taxes, increased consistently from 27.3 percent in 1990 to 30.7 percent in 1995, and then to 38.6 percent in 2000. On the other hand, the share of government revenue from excise and sales taxes dropped, i.e., from 27.2 percent in 1990 to 23.4 percent in 1995. The share, however, recovered to 28.1 percent in 2000.

Table 10.3 **Sources of National Government Revenue**
(Percent)

	1990	*1995*	*2000*	*2005*
Tax Revenue	83.9	86.0	89.4	86.1
Taxes on net income and profits	27.3	30.7	38.6	—
Excise and sales taxes	27.2	23.4	28.1	—
Import duties and other import taxes	26.4	27.7	19.3	—
Other taxes	3.0	3.9	3.1	—
Nontax revenue	14.9	13.8	10.4	13.9
Grants	1.3	0.3	0.3	0.0
Total	100.0	100.0	100.0	100.0
(Deficit)/Surplus (billion pesos)	(37.2)	11.1	(134.2)	(146.8)
(Deficit)/Surplus (% of GDP)	-3.5	0.6	-4.0	-2.7

Note: Breakdown of tax revenue is taken from Selected Philippine Indicators, Bangko Sentral ng Pilipinas.
Source: ADB (2007).

Since tariffs are a major source of government income, a tariff reduction could therefore have substantial government budget implications especially if it is not accompanied by compensatory tax financing. In this context, a tariff reduction could pose a major policy challenge, especially in the situation of a growing government budget deficit. In 1995–2000, the government budget deficit grew. From a surplus of 0.6 percent of gross national product in 1995, the budget balance flipped to a deficit of 4.0 percent in 2000 (which shrunk to 2.7 percent in 2005). This persistent government imbalance, if unchecked, could create undesirable macroeconomic effects that make the viability of a continued tariff reduction program uncertain. Therefore, other compensatory tax financing measures such as income tax and other excise and indirect taxes are always subject for amendment from any shortfall on budget target.

Structure of the Philippine Economy

The impact of tariff reduction would also depend on the initial conditions of the economy in the base year (which is 1994 in the present context) in terms of the structure of foreign trade (imports and exports), production, household consumption, factor endowments, and sources of income. A brief discussion of these is given in this section. The discussion is based on the constructed 1994 SAM (Cororaton 2003a).

Table 10.4 shows the structure of production. Industry contributes 46.7 percent to the overall gross value of output of the economy. Of the total contribution of industry, 23 percent comes from the nonfood manufacturing sector and another 14.7 percent from food manufacturing. The output contribution of the entire service sector is 39.1 percent, of which 22.1 percent comes from government services, which accounts for 22.1 percent and 11.3 percent from wholesale and retail trade, respectively. Total agriculture contributes 14.3 percent to the total, of which 6.8 percent comes from crops and another 4 percent from livestock.

Table 10.4 **Structure of Production and Factors Used in the Model**

Sector	Total output	Value Added (%)		Factor Shares in VA (%)		Sectoral Factor Shares (%)	
	Share (%)	VA/X	Share	Labor	Capital	Labor	Capital
Agriculture	**14.3**	**71.4**	**20.0**	**47.7**	**52.3**	**21.2**	**19.0**
Crops	6.8	77.7	10.3	50.6	49.4	11.6	9.3
Livestock	4.0	58.1	4.5	50.4	49.6	5.1	4.1
Fishing	2.7	71.7	3.7	35.8	64.2	3.0	4.4
Other agriculture	0.9	82.3	1.4	50.1	49.9	1.5	1.2
Industry	**46.7**	**34.5**	**31.6**	**40.6**	**59.4**	**28.5**	**34.0**
Mining	0.9	55.0	1.0	46.6	53.4	1.1	1.0
Food manufacturing	14.7	30.8	8.8	36.5	63.5	7.2	10.2
Nonfood manufacturing	23.0	29.7	13.4	44.8	55.2	13.3	13.4
Construction	5.3	52.8	5.5	43.8	56.2	5.4	5.6
Electricity, gas, and water	2.7	53.0	2.8	25.2	74.8	1.6	3.8
Services	**39.1**	**63.3**	**48.5**	**46.5**	**53.5**	**50.2**	**47.0**
Trade	11.3	64.1	14.2	34.0	66.0	10.8	17.1
Government	22.1	61.4	26.6	37.9	62.1	22.4	30.0
Other services	5.7	69.0	7.7	100.0	0.0	17.1	0.0
Total	**100.0**	**51.0**	**100.0**	**44.9**	**55.1**	**100.0**	**100.0**

VA = value added; X = output
Source: Cororaton (2005).

The agricultural and service sectors have high value-added content. The value-added shares to their respective outputs are 71.4 percent and 63.3 percent, respectively. Industry has a far smaller value-added ratio of 34.5 percent. Within industry, manufacturing has the smallest value-added ratio: 30.8 percent for food manufacturing and 29.7 percent for nonfood manufacturing. Incidentally, nonfood manufacturing has the lowest ratio among all sectors.

In terms of sectoral contribution to the overall value added, the service sector contributes the largest share at 48.5 percent, followed by the industry sector with a share of 31.6 percent. Of the total industry share, nonfood manufacturing contributes 13.8 percent. About 55.1 percent of the overall value added is payment to capital, while the remaining 44.9 percent is payment to labor. Agriculture has the highest labor payment of 47.7 percent, while industry has 40.6 percent.

Table 10.5 shows the structure of sectoral exports and imports of merchandise and non-merchandise trade. On the import side, industry, particularly the nonfood manufacturing sector, imports the most. Total industry imports 88.8 percent of total imports, of which 76.1 percent is for nonfood manufacturing. The export side is similarly structured with industry exporting almost 60 percent of total exports, in which 48.2 percent is nonfood manufacturing exports.

The dominance of industry, particularly the nonfood manufacturing sector, is largely due to the phenomenal rise of the semiconductor industry in the 1990s. This is seen in Table 10.6, where the breakdown of merchandise export is presented. The export share of electrical and electrical equipment (including electronic products), which is largely dominated by exports of semiconductors, surged from 24.0 percent in 1990 to 59.5 percent in 2000.

Garments used to be a major export item of the country before the 1990s. However, its share dropped significantly in the last decade from 21.7 percent in 1990 to only 6.9 percent in 2000. Over the same period, the same downward trend is also observed in agriculture-based exports. In 1990, agriculture-based exports had a combined share of 18.2 percent, which then dropped to 4.6 percent in 2000.

Table 10.5 **Shares of Imports and Exports**

Sector	*merchandise and nonmerchandise (%)*	
	Imports	*Exports*
Agriculture	**1.5**	**6.5**
Crops	0.7	3.1
Livestock	0.6	0.0
Fishing	0.0	3.4
Other agriculture	0.1	0.0
Industry	**88.8**	**59.7**
Mining	6.5	2.5
Food manufacturing	5.4	8.6
Nonfood manufacturing	76.1	48.2
Construction	0.9	0.3
Electricity, gas, and water	0.0	0.2
Services	**9.7**	**33.8**
Trade	0.0	14.3
Government	9.7	19.5
Other services	0.0	0.0
Total	**100.0**	**100.0**

Source: Official 1994 Input-Output Table and 1994 Social Accounting Matrix (SAM) of the Philippines.

Table 10.6 **Merchandise Exports**

	Value (million US$)			*Shares (%)*		
	1990	*1995*	*2000*	*1990*	*1995*	*2000*
Agriculture-based	**1,487**	**2,134**	**1,710**	**18.2**	**12.2**	**4.6**
Coconut products	503	989	595	6.1	5.7	1.6
Sugar and products	133	74	57	1.6	0.4	0.2
Fruits and vegetables	326	458	528	4.0	2.6	1.4
Other agro-based products	431	575	486	5.3	3.3	1.3
Forest products	94	38	44	1.1	0.2	0.1
Industry-based	**669**	**15,313**	**35,577**	**81.8**	**87.8**	**95.4**
Mineral products	723	893	650	8.8	5.1	1.7
Petroleum products	155	171	436	1.9	1.0	1.2
Manufacturers	5,707	13,868	33,989	69.7	79.5	91.2
Electrical/electrical equipment	1,964	7,413	22,178	24.0	42.5	59.5
Garments	1,776	2,570	2,563	21.7	14.7	6.9
Textile yarns/fabrics	93	208	249	1.1	1.2	0.7
Others	1,874	3,677	8,999	22.9	21.1	24.1
Other exports	114	381	502	1.4	2.2	1.3
Total merchandise exports	**8,186**	**17,447**	**37,287**	**100.0**	**100.0**	**100.0**

Source: Official 1994 Input-Output Table and 1994 Social Accounting Matrix (SAM) of the Philippines.

The semiconductor industry has an extremely small value-added contribution as it is dominated by assembly-type operations; almost all of its input requirements are imported and labor is practically the only local contribution. Furthermore, the sector has a very small link with the rest of the economy. Thus, while the share of the sector's output in the total output is large, its contribution to the total value added is small.

Sources of Income and Structure of Consumption

Table 10.7 shows the sources of household income. The income sources are grouped according to the specification of the CGE model used, which is discussed at length in the next section. The major sources of household income are from skilled production labor and capital in industry and in agriculture, and there are significant differences in various locations in the country.

Table 10.7 **Sources of Household Income in the Philippines** (Percent)

	Philippines	*NCR*	*Urban*	*Rural*
Labor				
Skilled agriculture	1.7	0.2	1.2	2.9
Unskilled agriculture	7.4	0.1	3.0	19.5
Skilled production	35.1	40.7	39.8	22.2
Unskilled production	7.5	4.9	6.8	9.4
Capital				
Agriculture	6.2	0.2	2.4	16.8
Industry	11.2	9.5	11.3	10.9
Services	15.5	19.6	17.9	8.8
Income				
Dividends	6.7	18.3	9.2	0.0
Transfers	5.6	3.6	5.2	6.8
Foreign remittances	3.1	2.9	3.2	2.7
Total	100.0	100.0	100.0	100.0

Source: 1994 Family Income and Expenditure Survey (FIES).

For example, while 39.8 percent of urban households' total income depends on skilled production labor, 22.2 percent of rural households' income is from skilled production labor and 19.5 percent is from unskilled agricultural labor. In terms of capital income, there are also wide differences. Rural households get 16.8 percent of their income from returns to capital in agriculture, while urban households get only 2.4 percent. Urban households depend heavily on returns to capital in industry and other services.

Another noticeable difference is in dividend incomes. Households in the National Capital Region (NCR) source 18.3 percent of their income from dividends, while for rural households the ratio is zero. Thus, based on these

wide differences in household income sources, changes in factor price ratios as a result of the tariff reforms will have different effects across households in various locations.

Table 10.8 presents the structure of household consumption in various locations in the country. There are also differences in the pattern of consumption in urban and rural households, but the differences are not as significant as in the sources of household income. On the whole, 30.4 percent of household consumption comes from the food manufacturing sector. About the same percentage comes from other services. Nonfood manufacturing contributes an average of 14.6 percent to household consumption.

Table 10.8 **Structure of Household Consumption in the Philippines** (Percent)

	Philippines	*NCR*	*Urban*	*Rural*
Crops	3.9	3.6	4.4	3.3
Livestock	4.4	4.1	5.1	3.8
Fishing	3.5	3.2	4.0	3.0
Mining	0.1	0.1	0.1	0.1
Food manufacturing	30.4	27.8	35.4	25.2
Nonfood manufacturing	14.6	15.2	13.4	15.7
Construction	0.3	0.4	0.2	0.5
Utilities	1.2	1.3	1.1	1.4
Trade and retail	12.5	14.0	9.5	16.0
Other services	29.1	30.3	26.6	31.0
Total	100.0	100.0	100.0	100.0

Source: 1994 Family Income and Expenditure Survey (FIES).

Unemployment, Distribution, and Poverty Profile

Table 10.9 presents the unemployment rate by level of education. One can observe that there is a relatively higher unemployment rate in labor categories with higher levels of education. In fact, for unskilled labor, defined loosely as those with zero education up to third-year high school, the unemployment rate was 5.97 percent in 1990 compared with 11.39 percent for those with an educational level of at least fourth-year high school. The gap in the unemployment rates continued in 2000. For purposes

Table 10.9 **Philippine Unemployment Rate** (Percent)

Educational Level	*1990*	*1995*	*2000*
No grade completed	6.36	5.82	7.69
Elementary	5.06	5.32	6.51
1st to 5th grade	4.8	5.20	6.00
Graduate	5.30	5.43	6.97
High School	10.11	9.95	11.82
1st to 3rd year	8.94	8.65	10.81
Graduate	10.94	10.81	12.38
College	11.66	11.76	13.16
Undergraduate	12.84	13.29	13.91
Graduate	10.74	10.20	12.46
Not reported	36.00	24.14	25.68
Overall	8.13	8.36	10.14
Unskilled [a]	5.97	6.12	7.62
Skilled [b]	11.39	11.36	12.91

a No grade completed up to third year high school.
b High school graduate and up.
Source: Labor Force Surveys (various years).

of analysis in the paper, the numbers for 1995 are used, i.e., for unskilled workers in agricultural and nonagricultural sectors, the unemployment rate applied is 6.12 percent, while for skilled workers it is 11.36 percent.

To set poverty in the Philippines in a historical perspective, Table 10.10 presents official poverty incidence from 1985 to 2000. Poverty incidence declined by about 10 percentage points in the last 15 years from 49.3 percent in 1985 to 39.4 percent in 2000. However, through the years the gap between urban (particularly, the NCR) and rural poverty incidence widened. While urban areas saw significant decline in poverty incidence from 37.9 percent in 1985 to 24.3 percent in 2000, rural areas experienced stable poverty incidence of more than 50 percent. The largest improvement in the poverty situation is in the NCR, with the incidence dropping from 27.2 percent in 1985 to 11.4 percent in 2000. In 1997, poverty incidence in the NCR even dropped to single digits (8.5 percent).

Table 10.10 **Poverty and Income Inequality Indicators in the Philippines, 1985–2000**

	1985	*1988*	*1991*	*1994*	*1997*	*2000*
Gini Ratio	0.446	—	0.468	0.464	0.487	0.451
Poverty Incidence (headcount ratio)						
Philippines	49.3	49.5	45.3	40.6	36.8	39.4
Urban	37.9	34.3	35.6	28.0	21.5	24.3
Rural	56.4	52.3	55.1	54.3	50.7	54.0

Source: National Statistical Coordination Board (NSCB).

Income distribution indicators did not show favorable signs either. Over the past decade, there was a marked deterioration. In the 12-year period beginning 1985, the top quintile exhibited an increase in its income share, while the other quintiles showed a reduction. The income share of the poorest (first quintile), fell from 5.2 percent in 1985 to 4.9 percent in 1994, before going down further to 4.4 percent in 1997. In contrast, the share of the wealthiest income group improved from 52.1 percent in 1985 to 55.8 percent in 1997.

From 1961 until the mid-1980s, there were very small movements in the income shares of the different income groups. The deterioration in income distribution occurred only in the last two decades. In the period of relatively "stable inequality," the share of the richest income group remained substantially large while that of the poorest income group remained substantially small.

Since 1961, except for the years 1988–1991, the Gini ratio showed slow but steady decline. From 1994 to 1997, however, the Gini ratio worsened from 0.468 to 0.487. The latter represented the highest figure in 35 years. In 2000, the Gini coefficient slid down to 0.451. In 1985, the average income of a

family from the top decile was 18 times the income of a family from the lowest decile. In 1997, this ratio went up to 24. In terms of spatial income disparity, the ratio of the average family income in the poorest region increased from 3.2 in 1995 to 3.6 in 1997.

The detailed poverty profile in the Philippine in 1994 is shown in Table 10.11 in which poverty was disaggregated into household head and level of education, urban-rural areas, and regions. The poverty line used was the official poverty line of the Philippines which was different from the $1-a-day poverty line.

Table 10.11 **Philippine Poverty Profile, 1994**

Population		67,430,864
Number of people under poverty thresholds		27,372,971
Poverty incidence (%)		40.6
	Number of people (% distribution)	*Poverty incidence (%)*
Poverty by family head and level of education		
Female, low education [a]	7.1	38.7
Female, high education [b]	0.9	11.2
Male, low education [a]	76.8	55.4
Male, high education [b]	15.1	22.4
	100.0	
Poverty by urban/rural		
Urban	30.7	35.5
Rural	65.7	54.3
Poverty by regions		
National Capital Region	3.5	10.4
Region 1, Ilocos	7.2	54.0
Region 2, Cagayan Valley	4.0	42.3
Region 3, Central Luzon	7.5	31.3
Region 4, Southern Luzon	11.2	35.4
Region 5, Bicol	10.6	60.7
Region 6, Western Visayas	11.0	49.8
Region 7, Central Visayas	6.6	39.8
Region 8, Eastern Visayas	5.7	44.7
Region 9, Western Mindanao	5.0	50.3
Region 10, Northern Mindanao	7.9	54.2
Region 11, Southern Mindanao	8.0	45.2
Region 12, Central Mindanao	4.7	59.0
Region 13, Cordillera Administrative Region	2.7	56.4
Region 14, Autonomous Region of Muslim Mindanao	4.2	65.3

Note: a low education = zero schooling to third year high.
b high education = high school graduate and up.
Source: National Statistical Coordination Board; National Statistics Office.

Of the people living below the poverty threshold in 1994, 76.8 percent belonged to families headed by a male with low education. The poverty incidence of this group was 55.4 percent. The share of the poor among families headed by a female with high education was only 0.9 percent of the total. This group has the lowest poverty incidence of 11.2 percent.

Of the total poor people, 3.5 percent resided in the NCR where poverty incidence was 10.4 percent. In contrast, 65.7 percent were located in the rural areas, where the poverty incidence was 54.3 percent.

The regions with the largest number of poor people were Regions 4, 5, and 6, comprising more than 30 percent of the total. However, in terms of poverty incidence, the Autonomous Region of Muslim Mindanao (Region 14) had the highest rate with poverty incidence of 65.3 percent; followed by Region 5, the Bicol Region, with poverty incidence of 60.7 percent. Outside NCR, the region with the lowest poverty incidence was Region 3, the Central Luzon Region, with poverty incidence of 31.1 percent.

Main Features of the Model

The PRISM used was developed using a CGE-microsimulation model.[3] At present, PRISM only presents the Philippine economy but it can be scaled up to include individual models of other countries. The basic structure of the Philippine model and its price relationship, as well as the other key components of the model, is described in the following subsections.

Basic Structure

The CGE model used in the analysis was calibrated to the 1994 SAM of the Philippine economy. It has 12 production sectors, composed of: 4 agriculture, fishing, and forestry sectors; 5 industries; and 3 services including government services. The model distinguishes two factor inputs, labor and capital, which determine sectoral value added using a constant elasticity of substitution (CES) production function. There are 4 types of labor: skilled agricultural, unskilled agricultural, skilled production, and unskilled production. Agricultural labor is devoted only to the agricultural sector; production labor can move across all sectors; skilled production workers include professionals, managers, and other related workers with at least a high school diploma.

Other features of the model's basic structure are as follows:

- Sectoral capital is fixed. Value added, together with sectoral intermediate input (which is determined using fixed coefficients), determine total output per sector. In both product and factor markets, prices adjust to clear all markets.
- The Armington-CES[4] function is assumed to combine local and imported goods into a composite good consumed on the domestic market, while constant elasticity of transformation (CET) allocates domestic production according to exports and local sales.

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3 A detailed description of PRISM including how to use it is presented in Appendix 10.2.

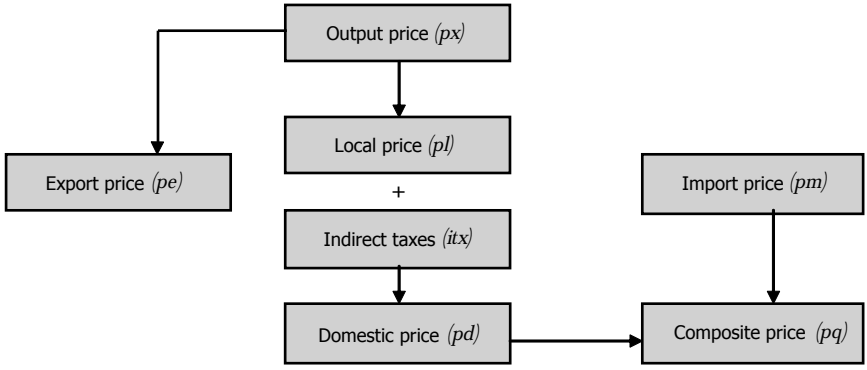
4 See Appendix 10.3 for the implementation of CES function.

- Consumer demand is based on Cobb-Douglas utility functions.
- The model integrates the whole 1994 FIES, which consists of 24,797 households.

Therefore, instead of using RHGs, as in the CGE model, this CGE-microsimulation model uses the complete household samples in the FIES. Accordingly, all macro-variable changes such as prices and factor incomes are transferred directly to the household units. Consumer demand is also derived at the household-unit level.

On price relationships, Figure 10.1 shows the basic price relationships in the model. Output price (*px*) affects export price (*pe*) and local prices (*pl*). Indirect taxes are added to the local price to determine domestic prices (*pd*), which together with import prices (*pm*) will determine the composite price (*pq*). The composite price is the price paid by the consumers.

Figure 10.1 **Basic Price Relationship in the Model**



Note: $pm = pwm * er * (1+tm) * (1+itx)$; Where pwm = world price of imports; er = exchange rate; tm = tariff rate; itx = indirect tax.
Source: Authors' framework.

Import price is in domestic currency, which is affected by the world price of imports, exchange rate (*er*) tariff rate (*tm*), and indirect tax rate (*itx*). Therefore, the direct effect of tariff reduction is a reduction in import prices. If the reduction in import price is significant, the composite price will also decline.

Model Closure

The model closure has the following features:

Investment. Total nominal investment is real total investment multiplied by its price. Total real investment is fixed to avoid any possible intertemporal

welfare effects that may arise from the interaction between trade policies and growth by changes in the level of real investment. The price of total real investment is flexible.

Savings and Exchange Rate

- *Foreign Savings.* The current account balance is held fixed to avoid any influence of international resources financing on domestic policy changes. The nominal exchange rate is fixed and the foreign trade sector is cleared by the real exchange rate, which is the ratio of the nominal exchange rate multiplied by the world export prices over domestic prices. Accordingly, exports and imports respond to movements in the real exchange rate.
- *Private Savings.* The propensities to save of the various household groups in the model adjust proportionately to accommodate the fixed total real investment. In this sense, the model is investment driven.

Government

- *Government Budget Balance.* Nominal government consumption is real government consumption multiplied by its price. The former is held fixed, while the latter is flexible. The budget balance is flexible due to the endogenously determined price of total real government consumption. Government transfers to households are held fixed in real terms, while nominal government transfers received by households vary with consumer prices.
- *Government Income.* Total government income is also held fixed. Any reduction in government income from tariff reduction is compensated endogenously by an indirect tax on goods and services.

Model Determinants

The exchange rate, consumer prices, and overseas remittances can be summarized as follows:

Exchange Rate. The nominal exchange rate is fixed and plays the role of a numeraire. The real exchange rate is the ratio of the nominal exchange rate multiplied by the world export prices and divided by the local prices. The real exchange rate can be interpreted as a positive value (real exchange rate depreciation) or a negative value (real exchange rate appreciation).

Consumer Prices. The composite price is the price paid by the consumers. There is no inflation in the model; the weighted change in composite price accounts for the variation in prices paid by consumers relative to the numeraire. Under PRISM, the composite price can be interpreted as a positive value (consumer prices in the local economy increase) or as a negative value (consumer prices in the local economy decrease).

Overseas Remittance. Overseas remittance is held fixed.

Poverty Measurements

The paper assesses the effects of tariff reduction on poverty through the use of poverty measures based on the Foster–Greer–Thorbecke (FGT) poverty indices. In general, the FGT poverty index is given by[5]

$$p_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z-y}{z}\right]^\alpha$$

where n is population size, q is the number of people below the poverty line, y_i is income, z is the poverty line or poverty threshold. The poverty line is equal to the food poverty line plus the nonfood poverty line, which refers to the cost of basic food and nonfood requirements. The parameter α can have several possible values but the following three values, corresponding to three different measures of poverty, are normally used in the literature:

- Headcount index or headcount ratio ($\alpha = 0$). This is the common index of poverty which measures the proportion of the population whose income (or consumption) is below the poverty line.
- Poverty gap ($\alpha = 1$). This index measures the depth of poverty, indicating the distance of the poor below the poverty line to poverty.
- Poverty severity ($\alpha = 2$). This index measures the severity of poverty.

Thus, poverty is affected by household income y and by the poverty threshold z. A change in household income is as a result of changes originating from factor incomes, while poverty threshold change is as a result of changes in consumer prices. To carry out the analysis, the following adjustments were made:

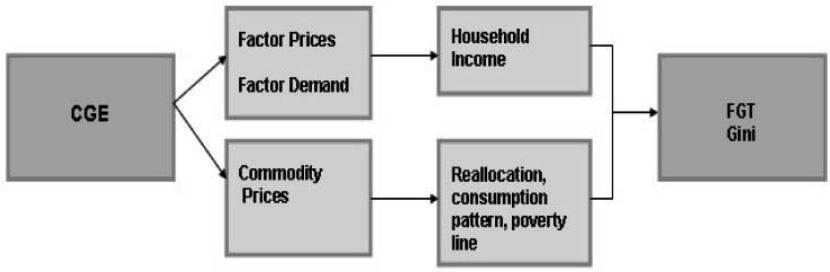
- All results on households were converted to results on individuals by using the household family size and the household-adjusted weighting factor of the 1994 FIES. This converted the 24,797 households in the FIES to 67,430,864 individuals.
- All official poverty thresholds in 1994 were adjusted by deflating them with the results of the consumer price index derived from the simulation. Poverty thresholds are available for the whole Philippines, urban and rural, and for the 14 regions' urban and rural areas. The consumer price index is derived as the weighted composite price (pq_i), where the weights are the shares of the households' consumption basket from the various areas and regions.

[5] See Ravallion (1992) for detailed discussion on this issue.

- The results on nominal household income were used in the computation of the various poverty indices instead of nominal disposable income from the compensatory tax imposed on household income.
- To draw more insights from the results, the poverty indices were summarized in four broad groupings of households, namely: households headed by females with low education; households headed by females with high education; households headed by males with low education; and households headed by males with high education. Low education means those with zero education up to third-year high school education, while high education implies those who are at least high school graduates. The results were aggregated for the whole Philippines, the NCR, urban areas excluding the NCR, and rural areas.

The stylized structure below illustrates how poverty impacts at the individual household level can be analyzed within the PRISM framework. After every simulation, a new set of factor and commodity price vectors were derived, thereby affecting households' income and consumer prices, respectively. These changes, in turn, affect households' poverty characteristics and distribution structure (measured through the FGT index and Gini coefficient) as presented in Figure 10.2.

Figure 10.2 **Schematic Representation of CGE-Microsimulation Analysis**



CGE = Computable General Equilibrium
FGT = Foster, Greer, and Thorbecke
Source: PRISM (http://prism/adb_prism).

Scenarios and Simulation Results

Scenarios

This section discusses the simulations results of three scenarios: partial trade liberalization or the application of a low uniform tariff, actual tariff reduction, and full tariff reduction.[6]

The first scenario involved the application of a uniform tariff rate of 5 percent on all sectors.[7] The simulations were expected to result in improved allocations and technical efficiency, greater access to cheaper prices, better quality inputs and superior technologies, and greater domestic competition through a more rational market structure (Tecson 1992).

The second scenario involved actual changes in the nominal tariff rates from 1994 to 2000. Weighted by the value of domestic output and imports, the average tariff rates for each sector were based on the different harmonized nominal tariff rates of all commodities in the sector. As such, the 1994 benchmark in the overall weighted nominal tariff declined by 65 percent in 2000 (see Table 10.2). The decline in industry (65.3 percent) was much greater than in agriculture (48.8 percent), while the smallest decline was in other agriculture (19.9 percent). Tariff rates were successively reduced on the following goods: capital equipment and machinery; textiles, garments, and chemical inputs; manufactured goods; and nonsensitive components of the agricultural sectors.

The third scenario involved total tariff elimination or free trade that would lead to decreased import prices and increased export demand. Full liberalization could also result in reduced poverty if wage and employment gains outweigh the changes in commodity prices critical to poor households (Sugiyarto, Oey-Gardiner, and Triaswati 2006). The impact of full liberalization depends on the mechanism that the government uses to compensate for the foregone revenue derived from tariff rates. For instance, in the study by Cororaton (2005), in the context of indirect taxes as replacement tax, the incidence of poverty falls marginally while the poverty gap and severity increases substantially. He added that if the income tax mechanism is used, all measures of poverty increase.

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6 In the CGE framework, one can predict the impact of shocks and policies on poverty by simply using the unit record data drawn directly from a household survey to represent the size of distribution of economic welfare (Ravallion and Lokshin 2004; Bourguignon, Robillard, and Robinson 2002; Nssah 2005).

7 This means that sectors with tax rates of more than 5 percent are reduced to 5 percent, while sectors with existing tax rates lower than 5 percent are increased to 5 percent, e.g., livestock and other agricultural products.

The Partial or Low Uniform Tariff Scenario

Macro Effects. Table 10.12 presents the simulation results, which involved reducing import tariffs on all commodities to 5 percent. On average, the application of a low uniform tariff results in a decline in the domestic price of imports by 12.1 percent, which causes the composite and domestic price to decline by 3.8 and 3.3 percent, respectively.

Table 10.12 **Macro Effects in the Low Tariff Scenario** (Percent)

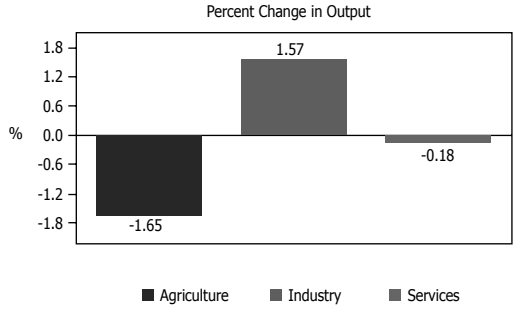
Change in Prices	
Import prices in local currency	-12.08
Consumer prices	-3.84
Local cost of production	-3.31
Real exchange rate change	4.94
Change in import volume	6.36
Change in export volume	6.42
Change in domestic production for local sales	-0.84
Change in consumption (composite) goods	0.53
Change in overall output	0.44

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The application of a low uniform tariff results in changes in the relative domestic import price ratios, which trigger substitution effects between imports and domestically produced goods. When import volume increases by 6.36 percent, domestic production declines by 0.80 percent. These changes, taken together, result in a marginal improvement in the total supply of goods available in the market–as shown by the increase in the supply of composite goods by 0.50 percent.

The overall decline in local prices creates an effective real exchange depreciation, which in turn increases export competitiveness. The real exchange rate depreciates by almost 5 percent, making Philippine products cheaper abroad. This leads to an overall export growth of 6.4 percent, which in turn increases total output marginally by 0.4 percent. Figure 10.3 further shows that the tariff reduction increases the output of the industry sector by 1.6 percent, while the output of the agricultural and services sectors decline by 1.7 and 0.2 percent, respectively.

Figure 10.3 **Percentage Change in the Volume of Output of the Low Tariff Scenario**



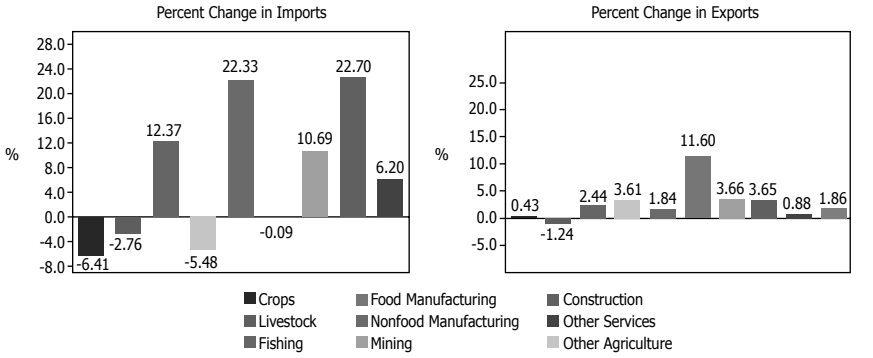
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Sectoral Effects. The sectoral effects vary considerably, triggering the reallocation of output across sectors. The effects are largely due to the differences in the sectoral structure of imports and exports, initial tariff rates, and trade elasticities (Armington and CET elasticities).[8]

The industrial sector experiences the largest drop in import prices (12.1 percent), while the drop in agricultural import prices is only 4.2 percent. In terms of specific sectors, the largest drop in import prices is observed in mining (25.6 percent), followed by food manufacturing (21.4 percent), fishing (20.4 percent), and nonfood manufacturing (12.1 percent). The different effects on sectoral price affect import volumes, showing large increases in import volumes of food manufacturing (22.7 percent), fishing (22.3 percent), and crops (12.4 percent), as shown in Figure 10.4. The import volume of the nonfood manufacturing sector registers an increase of only 6.2 percent. However, since the nonfood manufacturing sector is the largest importer,[9] the increase in the overall import volume comes largely from this sector.

The effect on the nonfood manufacturing sector's imports, domestic production, and composite good should be of concern since this sector is a major contributor to the total output. The decline in its import prices (12.1 percent) is significantly larger than that of its domestic prices (3.3 percent). The relative price change favoring imports should lead to a reduction in domestic production of 0.8 percent.

Figure 10.4 **Percentage Change in the Volume of Imports and Exports of the Low Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

8 The Armington and the CET elasticities used in the model are based on the values of elasticities used in another CGE model of the Philippines called the Agriculture Policy Experiments, or APEX, model (Clarete and Warr 1992), which were estimated econometrically; the initial tariff rates were based on the estimates of Manasan and Querubin (1997).

9 Nonfood manufacturing accounts for 76.1 percent of total imports (see Table 10.4).

Except for livestock, exports in all sectors increase. This rise in exports could be attributed largely to the improvement in export competitiveness across sectors as a result of the local price drop (Figure 10.4). Export competitiveness increases most in nonfood manufacturing (11.6 percent) and mining (3.6 percent). Results from the mining sector, however, may be of less interest because its share of total exports is very small. But the result from the nonfood manufacturing sector is critical as it contributes greatly to total exports (48.2 percent, see Table 10.13). This result, together with the increase in domestic production, brings about an overall 0.4 percent increase in the sector's total production. Other increases are observed in other agriculture (0.1 percent) and utilities[10] (0.4 percent). Tariffs reductions under this scenario seem to mostly favor the nonfood manufacturing sector, which includes semiconductors and textiles, as the overall output of the sector increases by 4.71 percent.

Table 10.13 **Effects of Low Tariff Scenario on Prices and Volumes**

	Price Changes (%)					*Volume Changes (%)*				
Sector	*Imports*	*Domestic demand*	*Composite demand*	*Output*	*Local*	*Imports*	*Exports*	*Domestic demand*	*Composite demand*	*Outputs*
Agriculture	**-4.23**	**-2.09**	**-2.14**	**-1.93**	**-2.09**	**3.60**	**1.47**	**-1.90**	**-1.79**	**-1.65**
Crops	-8.57	-1.92	-2.06	-1.77	-1.92	12.37	0.43	-2.01	-1.74	-1.83
Livestock	0.00	-2.41	-2.35	-2.40	-2.41	-5.48	-1.24	-2.20	-2.29	-2.20
Fishing	-20.39	-2.78	-2.83	-2.19	-2.78	22.33	2.44	-1.81	-1.76	-0.91
Other Agriculture	0.00	-0.18	-0.17	-0.18	-0.18	-0.09	–	0.06	0.05	0.06
Industry	**-13.53**	**-4.98**	**-7.73**	**-3.88**	**-4.98**	**7.41**	**9.75**	**-0.72**	**1.81**	**1.57**
Mining	-25.56	-9.47	-21.63	-5.22	-9.47	10.69	3.61	-10.75	4.60	-4.39
Food Manufacturing	-21.42	-3.20	-4.86	-2.86	-3.20	22.70	1.84	-2.05	-0.20	-1.65
Nonfood Manufacturing	-12.10	-7.09	-9.61	-4.55	-7.09	6.20	11.60	0.91	3.51	4.71
Construction	–	-4.17	-4.06	-4.13	-4.17	-6.41	3.66	-1.50	-1.64	-1.46
Electricity, Gas, and Water	–	-2.69	-2.69	-2.66	-2.69	–	3.65	0.31	0.31	0.35
Services	**0.00**	**-1.68**	**-1.59**	**-1.40**	**-1.68**	**-2.76**	**1.44**	**-0.50**	**-0.17**	**-0.18**
Wholesale Trade & Retail	–	-1.19	-1.19	-0.94	-1.19	–	0.88	-0.56	-0.56	-0.26
Other Services	–	-1.91	-1.77	-1.63	-1.91	-2.76	1.86	-0.48	-0.66	-0.13
Government Services	–	–	–	-0.83	–	–	–	–	–	0.00
Total	**-12.08**	**-3.31**	**-5.02**	**-2.60**	**-3.31**	**6.36**	**6.42**	**-0.84**	**0.53**	**0.44**

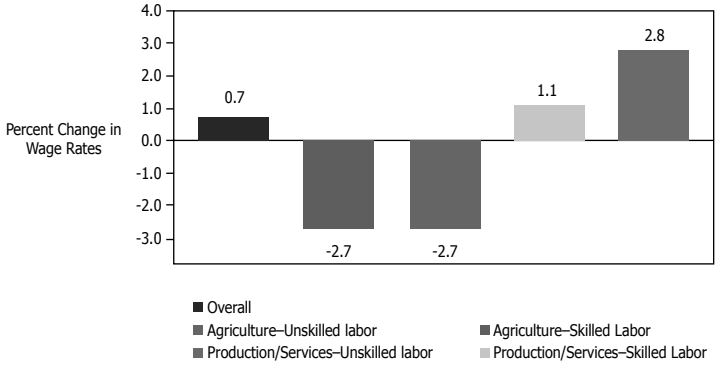
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Effects on Factor Market. Since total sectoral capital is fixed, the factor market effect pertains to labor movement across sectors as a response to changes in the factor price. Detailed effects on the factor market are presented in Table 10.14.

The tariff reduction leads to a general improvement in factor prices. Overall capital return increases by 0.6 percent, while wages increase by 0.7 percent. Capital return across sectors varies significantly. It increases in the nonfood

10 Electricity, gas, and water.

Figure 10.5 **Percentage Change in Average Wage Rates of the Low Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Table 10.14 **Effects of Low Tariff Scenario on Factor Market**

	Value Added Changes (%)				*Change in Labor Demand (%)*			
Sector	*Value added*	*Prices*	*Rate of return to capital*	*Total labor*	*Skilled agriculture*	*Unskilled agriculture*	*Skilled production*	*Unskilled production*
Agriculture	**-1.6**	**-1.0**	**-2.6**	**–**	**–**	**–**	**–**	**–**
Crops	-1.8	-1.1	-2.9	-3.6	-0.2	-0.2	-4.0	-5.6
Livestock	-2.2	-1.5	-3.6	-4.3	-1.0	-1.0	-4.7	-6.3
Fishing	-0.9	-0.9	-1.8	-2.5	0.8	0.8	-2.9	-4.6
Other Agriculture	0.1	0.8	0.8	0.1	3.6	3.6	-0.3	-2.0
Industry	**1.2**	**2.0**	**3.0**	**–**	**–**	**–**	**–**	**–**
Mining	-4.4	-4.3	-8.5	-9.2	–	–	-9.6	-11.1
Food Manufacturing	-1.7	-2.2	-3.8	-4.5	–	–	-4.9	-6.4
Non-food Manufacturing	4.7	6.6	11.6	10.8	–	–	10.4	8.5
Construction	-1.5	-1.2	-2.6	-3.3	–	–	-3.7	-5.3
Electricity, Gas, and Water	0.4	1.8	2.1	1.4	–	–	1.0	-0.7
Services	**-0.2**	**0.4**	**0.2**	**–**	**–**	**–**	**–**	**–**
Wholesale Trade & Retail	-0.3	0.2	-0.1	-0.8	–	–	-1.2	-2.8
Other Services	-0.1	0.5	0.4	-0.3	–	–	-0.8	-2.4
Government services	0.0	0.7	–	0.0	–	–	-0.4	0.0
Total	**0.0**	**0.6**	**0.6**	**–**	**–**	**–**	**–**	**–**
Change in Average Wage	–	–	–	0.7	-2.7	-2.7	1.1	2.8

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

manufacturing sector (11.6 percent), utilities (2.1 percent), other agriculture (0.8 percent), and other services (0.4 percent); and declines in other sectors.

The increase in capital return in the nonfood manufacturing sector (11.6 percent) is higher than the increase in wages for aggregate labor (1.0 percent). This results in factor substitution favoring labor.

Likewise, reallocation effects benefit the industry through the nonfood manufacturing sector, as can be seen in the effects on factors of production shown on Table 10.13. Although the value added and the price of value

added in agriculture decline, overall prices increase by 0.6 percent as a result of expansion in the industry, particularly in nonfood manufacturing. Capital return in industry increases by 3.0 percent, while in the nonfood manufacturing sector it increases by 11.6 percent. The return to capital in agriculture, on the other hand, declines by 2.6 percent.

There are interesting insights that can be observed from the results across different labor types. Agricultural wages decline by 2.7 percent for both skilled and unskilled labor. Other agriculture and fishing sectors cannot absorb displaced agricultural labor from crops and livestock.

Some skilled and unskilled production workers in agriculture move to the nonfood manufacturing and utilities sectors. The same is true for some production workers in the service sector. Skilled production labor increases by 10.4 percent and unskilled labor by 8.5 percent in the nonfood manufacturing sector. In the utilities sector, only skilled production labor increases (by 1.0 percent), as unskilled labor declines by 0.7 percent.

These results suggest that tariff reduction leads to relatively higher demand for skilled labor in industry, particularly in the nonfood manufacturing sector, increasing overall employment and therefore wages of skilled and unskilled production labor. The average wage for skilled production labor increases by 1.1 percent, while the wage increase for unskilled workers is 2.8 percent.

In sum, the simulation results indicate that the nonfood manufacturing sector benefits from both production reallocation and labor movement. The shifts in output, factor price ratios, and factor substitutions tend to favor skilled production workers in the nonfood manufacturing and utilities sectors. Furthermore, the results indicate that tariff reduction leads to higher unemployment and lower wages for agricultural labor.

Effects on Income. Table 10.15 shows the effects of tariff reduction on household income from labor and capital income sources. Other income sources, such as foreign remittances, transfers, and dividends, are omitted in the table because they are all assumed in the simulation to be fixed.

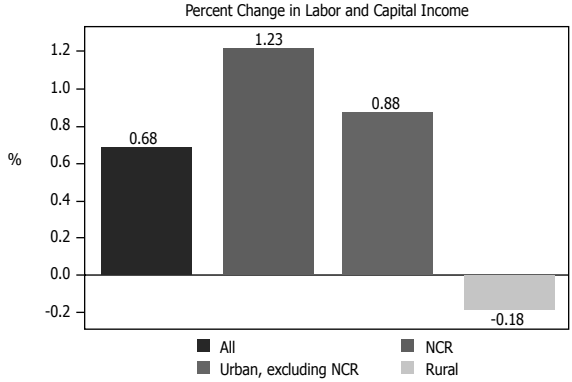
Table 10.15 **Effects of Low Tariff Scenario on Household Factor Income**
(Percentage change from base)

Household Location	*Labor & capital Income from agriculture*	*Labor & capital Income from nonagriculture*	*Total Labor & capital income*
All	-0.5	1.2	0.7
NCR	0.0	1.2	1.2
Urban, excluding NCR	-0.4	1.2	0.9
Rural	-1.1	1.0	-0.2

NCR = National Capital Region
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Labor and capital income increase by 0.7 percent, favoring households in the NCR and other urban areas (Figure 10.6). Household income from agricultural labor and capital, however, declines in both urban and rural areas to 0.4 percent and 1.1 percent, respectively. Factor income from agriculture declines by 0.5 percent because of the drop in agricultural wages of skilled and unskilled agricultural labor as observed earlier. Household income from the nonagricultural sector increases by 1.2 percent from favorable effects, especially in the nonfood manufacturing sector.

Figure 10.6 **Percentage Change in Household Factor Income of the Low Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Higher factor prices in nonagriculture results in higher income for households who depend on industry and services. Rural households, not dependent on agriculture, experience less improvement in nonagricultural factor income compared with households in the NCR and other urban areas. Households in the NCR enjoy the highest increase in income (1.2 percent); total net factor income for households in urban areas outside the NCR improves by 0.9 percent; and rural households experience a decline in total income of 0.2 percent. Overall, the average increase in total factor income is 0.7 percent.

Poverty Impacts. Generally, the level of poverty incidence drops for all groups. Lowering the tariff is predicted to lift abut 1.5 million poor people above the poverty threshold (Table 10.16). The general drop in poverty incidence is due largely to the decline in consumer prices, which lowers the nominal value of the poverty threshold for all groups in all areas. Table 10.12 shows that consumer prices decrease by 3.8 percent as a result of the tariff reduction.

The effects on poverty vary significantly across locations and household types (Figure 10.7 and 10.8), with the variation in the effects on factor income generally favoring households in the NCR. Households in the NCR enjoy the largest reduction in poverty compared with those in other urban and rural areas. Urban areas excluding the NCR also register a decline in poverty incidence The drop is significantly less than in the NCR, though relatively greater than in the rural areas.

Within the NCR, households headed by females with high education (32.8 percent) benefit the most compared with other household types. The lowest decline is in households headed by females with low education (12.3 percent). In contrast, poverty incidence among households headed by males with high education declines by a relatively lower rate (17.2 percent) than among households headed by males with low education (17.6 percent). The above results can be attributed to two factors: reallocation effects toward the nonfood manufacturing sector, which is largely located in the NCR; and nonfood manufacturing exports are dominated by the semiconductor and textile and garments industries whose workforces are mostly women with an above-average level of education.

Table 10.16 **Poverty Incidence in the Low Tariff Scenario**

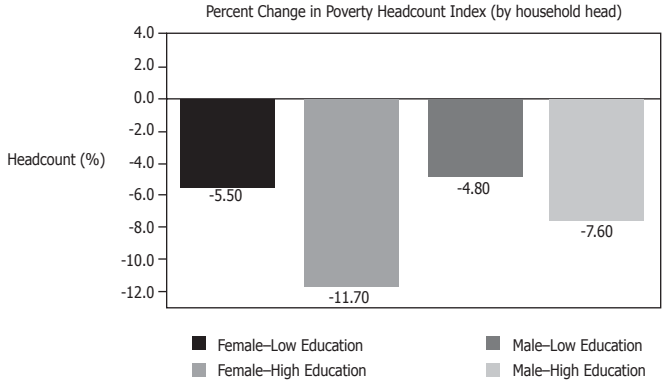
Index	*Total headed households*	*Female headed households (%)*			*Male headed households (%)*		
		Overall	*Low education*	*High education*	*Overall*	*Low education*	*High education*
Philippines							
Headcount	-5.3	-6.2	-5.5	-11.7	-5.2	-4.8	-7.6
Poverty gap	-6.6	-7.6	-7.1	-12.2	-6.5	-6.1	-9.3
Severity	-7.4	-8.4	-8.1	-11.8	-7.3	-7.0	-9.9
National Capital Region							
Headcount	-17.5	-18.3	-12.3	-32.8	-17.4	-17.6	-17.2
Poverty gap	-19.8	-18.3	-17.4	-21.9	-19.9	-20.2	-19.5
Severity	-21.9	-19.0	-18.7	-20.2	-22.3	-23.1	-21.3
All Urban							
Headcount	-6.5	-8.0	-7.0	-13.2	-6.3	-5.8	-8.1
Poverty gap	-7.8	-9.5	-8.6	-16.7	-7.6	-7.0	-10.3
Severity	-8.5	-10.7	-10.3	-14.8	-8.4	-7.9	-10.8
All Rural							
Headcount	-4.1	-4.4	-4.4	-5.0	-4.1	-3.9	-5.3
Poverty gap	-5.7	-6.2	-6.1	-8.2	-5.6	-5.4	-7.2
Severity	-6.6	-7.1	-6.9	-9.5	-6.6	-6.4	-8.3

Poor people lifted out of poverty (%)	-5.3
Poor people lifted out of poverty	1,453,793

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

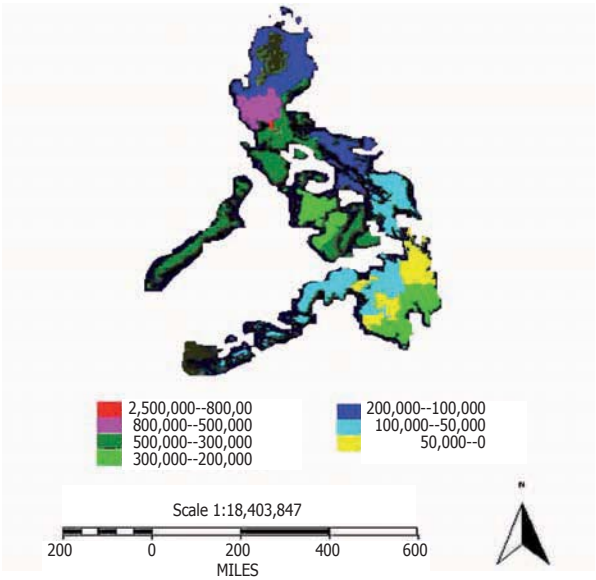
These differentiated effects across households are due largely to the effects on the sources of income of households. It was observed in Table

Figure 10.7 **Percentage Change in the Headcount Index of the Low Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Figure 10.8 **Distribution of Poverty Incidence of the Low Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

10.6 that rural households depend heavily on unskilled agricultural labor and on returns to capital in agriculture. Because agriculture contracts as a result of the reduction in tariffs, unemployment increases and wages drop in agriculture. Therefore, as shown in Table 10.13, income from agricultural labor drops. Furthermore, since agriculture contracts, the rate of return to capital in the sector also drops. This further aggravates the situation in the

rural areas. Thus, the impact of the reduction in tariffs on rural households, although favorable, is marginal compared with the impact on urban areas, particularly in the NCR (Figure 10.8).

Actual Tariff Reduction Scenario

The actual average tariff rates are computed from different harmonized system (HS) lines within an input-output sector using the sum of domestic output and import values (Q + M) as weights (referred to as the base tariff rate). The use of weights (Q + M) tends to overcome the biases associated with using either output weights or import weights singly. Note that the use of import weights tends to result in some downward bias since low tariffs, which are usually associated with a high levels of imports, are given larger weights; high tariff rates that tend to restrict imports are assigned small weights; and prohibitive duties that give rise to zero imports are allotted zero weights.

In contrast, the use of domestic production levels as weights tends to result in some upward bias. Higher levels of domestic production tend to be associated with higher tariff rates as domestic output substitutes for imports with a rise in the rate of import duty, while the opposite is true for low tariff rates. In this paper, the actual tariff rates are derived from the weighted (Q + M) average tariff rates based on the book rates calculated for each year in 1994–2000 (Manasan and Querubin 1997). Thus, the calculated average tariff rate reduction from 1994 to 2000 is around 65 percent.

Macro Effect. The macro effects based on the actual tariff reduction between 1994 and 2000 are reported in Table 10.17. The tariff reduction leads to a drop by 10.4 percent in import prices, in local currency, of all commodities. This eventually reduces consumer prices by 2.9 percent and the local cost of production by 2.6 percent. Since the empirical procedure assumed a fixed nominal exchange rate, the decline in the local cost of production effectively results in a real exchange rate depreciation of 4.1 percent (i.e., Philippine-made products become cheaper abroad). In reaction, export volume increases by 5.4 percent.

Table 10.17 **Macro Effects in the Actual Tariff Scenario**
(Percent)

Change in prices	
Import prices in local currency	-10.40
Consumer prices	-2.87
Local cost of production	-2.59
Real exchange rate change	4.10
Change in import volume	5.28
Change in export volume	5.41
Change in domestic production for local sales	-0.66
Change in consumption (composite) goods	0.47
Change in overall output	0.40

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The drop in import prices also translates into higher import volumes (up by 5.3 percent). The slight decline in domestic production sold on the local market (0.7 percent) indicates some crowding out of domestic production

by imports. However, the net effect on domestic consumption is an increase of 0.5 percent. Despite the crowding out of domestic production for local sales, the slightly higher growth in exports over imports results in some improvement in overall output by 0.4 percent.

Sectoral Effects. Table 10.18 presents the price and volume effects of tariff reduction on the different economic sectors. It is worth noting that import prices fall much more in the industrial sector, particularly in mining and manufacturing. In agriculture, the fishing industry benefits from reduced import prices in the local market. There is also an improvement in the volume of fishing industry exports. In overall production output, Figure 10.9 shows that industry gains from the reduction in import levies, while the agriculture (-1.4 percent) and services sectors (-0.2 percent) contract.

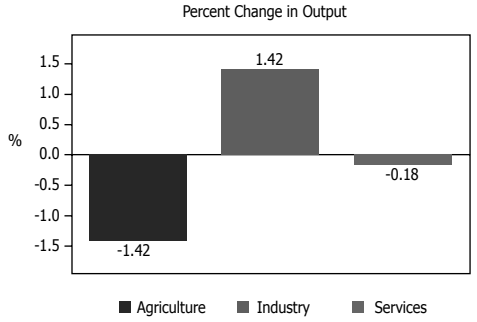
Table 10.18 **Effects of Actual Tariff Scenario on Prices and Volumes**

	Price Changes (%)					*Volume Changes (%)*				
Sector	*Imports*	*Domestic demand*	*Composite demand*	*Output*	*Local*	*Imports*	*Exports*	*Domestic demand*	*Composite demand*	*Outputs*
Agriculture	**-3.14**	**-1.43**	**-1.47**	**-1.32**	**-1.43**	**2.36**	**0.83**	**-1.60**	**-1.52**	**-1.42**
Crops	-5.90	-1.28	-1.38	-1.18	-1.28	7.97	-0.04	-1.66	-1.47	-1.54
Livestock	-0.35	-1.69	-1.66	-1.69	-1.69	-3.76	-1.26	-1.93	-1.97	-1.93
Fishing	-18.48	-2.08	-2.12	-1.64	-2.08	20.50	1.65	-1.51	-1.46	-0.84
Other Agriculture	-0.05	0.23	0.22	0.23	0.23	0.35	–	0.11	0.11	0.11
Industry	**-11.66**	**-4.13**	**-6.51**	**-3.21**	**-4.13**	**6.12**	**8.45**	**-0.53**	**1.54**	**1.42**
Mining	-25.82	-9.37	-21.81	-5.16	-9.37	10.41	2.66	-11.43	4.20	-5.19
Food Manufacturing	-13.95	-2.30	-3.32	-2.06	-2.30	12.77	1.11	-1.67	-0.55	-1.39
Nonfood Manufacturing	-10.43	-6.16	-8.30	-3.96	-6.16	5.41	10.18	0.99	3.16	4.24
Construction	–	-3.44	-3.35	-3.41	-3.44	-5.37	2.92	-1.31	-1.42	-1.28
Electricity, Gas and Water	–	-2.07	-2.07	-2.04	-2.07	–	2.84	0.30	0.30	0.33
Services	**0.00**	**-1.12**	**-1.06**	**-0.93**	**-1.12**	**-1.96**	**0.87**	**-0.40**	**-0.18**	**-0.18**
Wholesale Trade & Retail	–	-0.69	-0.69	-0.54	-0.69	–	0.39	-0.44	-0.44	-0.26
Other Services	–	-1.32	-1.22	-1.13	-1.32	-1.96	1.22	-0.38	-0.50	-0.14
Government Services	–	–	–	-0.41	–	–	–	–	–	0.00
Total	**-10.40**	**-2.59**	**-4.08**	**-2.02**	**-2.59**	**5.28**	**5.41**	**-0.66**	**0.47**	**0.40**

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

It is unsurprising that the import response is greatest for industrial imports, particularly in the nonfood manufacturing sector (which includes semiconductors and textiles and garments, among others). This sector enjoys the highest export growth (10.2 percent) as a result of a drop in local production costs. In contrast, domestic market production volume and prices decline for local sales by (0.5 percent) and (4.1 percent), respectively. Combined with lower import prices, this leads to a general decline in consumer prices (6.5 percent) in the industrial sectors. Consumers substitute a portion of their consumption from agricultural to the relatively cheaper

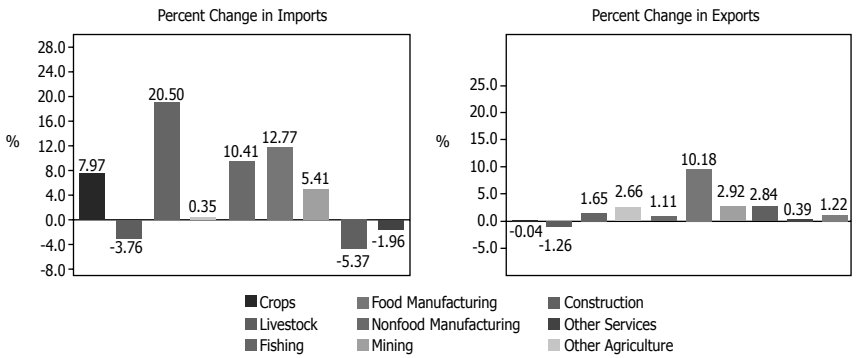
Figure 10.9 **Percentage Change in Volume of Output of the Actual Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

industrial goods. Local producers react to lower prices on the local market by increasing their exports, primarily, once again, in the industrial sector and, especially, in the nonfood manufacturing sector (Figure 10.10 and 10.11). Clearly, reallocation effects favor industry as a whole through the effects on the nonfood manufacturing sector. Overall agricultural output declines by 1.4 percent, industrial output improves by 1.4 percent, while service sector output slides marginally by 0.2 percent.

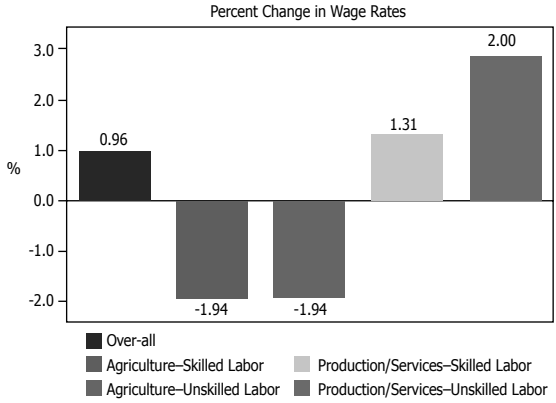
Figure 10.10 **Percentage Change of the Volume of Imports and Exports in the Actual Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Effects on Factor Market. The impact of trade liberalization is also felt in the production and labor sectors. Industry and services enjoy return-to-capital ratio rises from the reduction of import levies–with the highest increases in nonfood manufacturing and utilities. In contrast, both the value added and the price of value added decline for agriculture.

Figure 10.11 **Percentage Change in Average Wage Rates of the Actual Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The reallocation effects benefit industry through the nonfood manufacturing sector, as can be seen in the effects on factors of production shown in Table 10.19. The rate of return to capital increases by 3.0 percent for the whole industry and by 10.8 percent for the nonfood manufacturing sector. Note that the increase in the nonfood manufacturing value-added price is largely due to a reduction in its input costs, as most of these inputs come from within this sector where consumer prices fall most. As industry is relatively more capital intensive than the other sectors, the rate of return to industrial capital increases by 3.0 percent for all industry–almost entirely from the 10.8 percent increase in the returns to capital in the nonfood manufacturing sector. In contrast, the return to capital in agriculture declines by 1.9 percent. Prices for crops and livestock become uncompetitive as the price of imports falls.

There is also an affect on labor, as skilled production and unskilled production workers move toward industry, in particular, toward the nonfood manufacturing sector (Figure 10.12). Skilled and unskilled agricultural labor is, however, employed only in the agricultural sector.

Overall, the average rate of return to capital and wages improve by 0.9 percent and 1.0 percent, respectively.

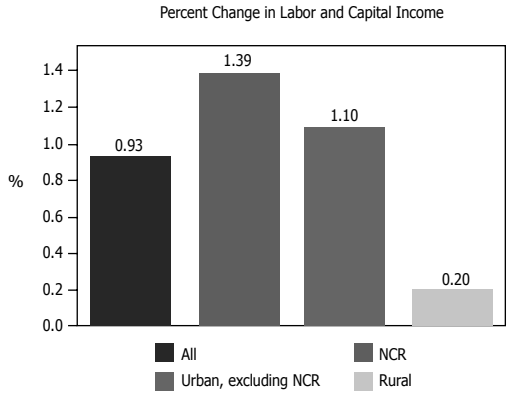
Effects on Income. The weighted average change in labor and capital income from agriculture for rural households is 0.8 percent, and for urban households, excluding the NCR, it is 0.3 percent. On the whole, factor income from agriculture declines by 0.3 percent (Table 10.20). Higher factor prices in nonagriculture results in higher income for households that depend on industry and services. Rural households, not dependent on agriculture, experience a lower improvement in nonagricultural factor income compared

Table 10.19 **Effects of Actual Tariff Scenario on the Factor Market**

	Value Added Changes (%)			*Change in Labor Demand (%)*				
Sector	*Value added*	*Prices*	*Rate of return to capital*	*Total labor*	*Skilled agriculture*	*Unskilled agriculture*	*Skilled production*	*Unskilled production*
Agriculture	**-1.4**	**-0.5**	**-1.9**	**–**	**–**	**–**	**–**	**–**
Crops	-1.5	-0.6	-2.1	-3.0	-0.1	-0.1	-3.4	-4.8
Livestock	-1.9	-1.0	-2.9	-3.8	-0.9	-0.9	-4.1	-5.6
Fishing	-0.8	-0.6	-1.4	-2.3	0.6	0.6	-2.7	-4.1
Other Agriculture	0.1	1.1	1.2	0.2	3.2	3.2	-0.1	-1.6
Industry	**1.0**	**2.1**	**3.0**	**–**	**–**	**–**	**–**	**–**
Mining	-5.2	-5.0	-10	-10.8	–	–	-11.1	-12.5
Food Manufacturing	-1.4	-1.5	-2.8	-3.8	–	–	-4.1	-5.5
Nonfood Manufacturing	4.2	6.3	10.8	9.7	–	–	9.3	7.7
Construction	-1.3	-0.7	-2.0	-2.9	–	–	-3.2	-4.7
Electricity, Gas and Water	0.3	2.0	2.3	1.3	–	–	1.0	-0.6
Services	**-0.2**	**0.6**	**0.4**	**–**	**–**	**–**	**–**	**–**
Wholesale Trade & Retail	-0.3	0.5	0.2	-0.8	–	–	-1.1	-2.6
Other Services	-0.1	0.7	0.6	-0.4	–	–	-0.7	-2.2
Government Services	0.0	1.0	–	0.0	–	–	-0.3	0.0
Total	**0.0**	**0.9**	**0.9**	**–**	**–**	**–**	**–**	**–**
Change in average wage	–	–	–	1.0	-1.9	-1.9	1.3	2.9

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Figure 10.12 **Percentage Change in Household Factor Income of the Actual Tariff Scenario**



NCR = National Capital Region
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

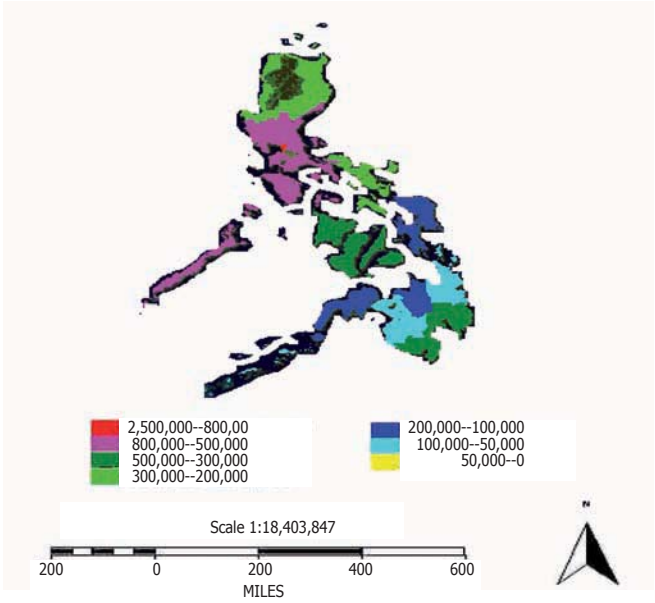
with households in the NCR and other urban areas. The total net factor income effect is 0.9 percent (Figure 10.13). Households in the NCR enjoy the highest increase (1.4 percent). Households in urban areas outside the NCR improve 1.1 percent in their total net factor income. Rural households are the least affected (0.2 percent).

Table 10.20 **Effects of Actual Tariff Scenario on Household Factor Income**
(Percentage change from base)

Household Location	*Labor and capital Income from agriculture*	*Labor & capital Income from nonagriculture*	*Total Labor and capital income*
All	-0.3	1.3	0.9
NCR	0.0	1.4	1.4
Urban, excluding NCR	-0.3	1.4	1.1
Rural	-0.8	1.0	0.2

NCR = National Capital Region
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Figure 10.13 **Distribution of Poverty Incidence of the Actual Tariff Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

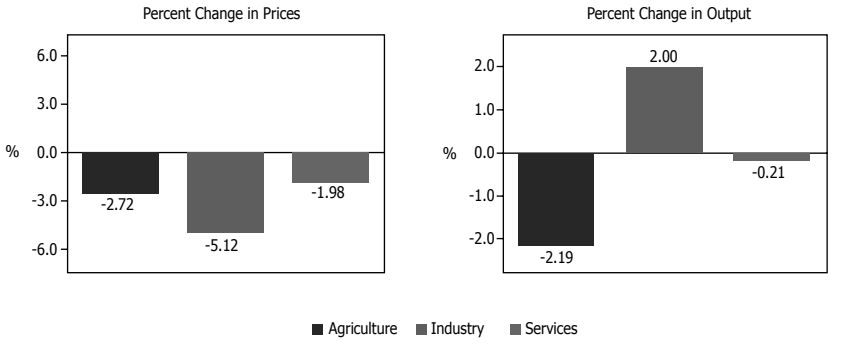
Poverty Impacts. As observed earlier, the effects on poverty vary significantly across locations and household types (Table 10.21). In this actual-tariff scenario, an estimated 1.2 million poor people are lifted out of poverty. As in the low uniform–tariff scenario, Households in the NCR enjoy the largest reduction in poverty compared with those in other urban and in rural areas. Within the NCR, households headed by females with high education, benefit the most compared with other household types (Figure 10.14). This is again largely due to the variation in the effects on factor income that generally favor households in the NCR. Better effects in the NCR are also again attributable to two factors: reallocation effects toward the nonfood manufacturing sector,

Table 10.21 **Poverty Incidences in the Actual Tariff Scenario**

Index	*Total headed households*	*Female headed households (% change)*			*Male headed households (% change)*		
		Overall	*Low education*	*High education*	*Overall*	*Low education*	*High education*
Philippines							
Headcount	-4.3	-5.4	-4.7	-10.6	-4.3	-3.8	-6.4
Poverty gap	-5.4	-6.1	-5.8	-10.0	-5.3	-4.9	-7.6
Severity	-6.0	-6.8	-6.6	-9.5	-5.9	-5.6	-8.1
National Capital Region							
Headcount	-14.9	-16.4	-9.7	-32.8	-14.7	-14.1	-15.5
Poverty gap	-16.8	-15.5	-14.7	-18.7	-17.0	-17.3	-16.6
Severity	-18.8	-16.1	-15.9	-16.3	-19.0	-19.8	-18.2
All Urban							
Headcount	-5.3	-6.3	-5.5	-10.6	-5.2	-4.8	-6.7
Poverty gap	-6.4	-7.8	-7.1	-13.8	-6.3	-5.8	-8.5
Severity	-7.0	-8.8	-8.5	-12.3	-6.9	-6.5	-8.9
All Rural							
Headcount	-3.3	-4.1	-4.0	-5.0	-3.3	-3.1	-4.3
Poverty gap	-4.5	-5.0	-4.8	-6.6	-4.5	-4.3	-5.8
Severity	-5.3	-5.7	-5.5	-7.6	-5.3	-5.1	-6.7
Poor People lifted out of poverty (%)							-4.3
Poor People lifted out of poverty							1,188,692

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Figure 10.14 **Effects in the Price and Volume of Output of the Full Tariff Elimination Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

which is largely located in the NCR; and exports of nonfood manufacturing being dominated by the semiconductor and textile and garments industries–whose workforce are mostly women with above-average levels of education.

Full Tariff–Elimination Scenario

Macro Effects. Table 10.22 presents the macro effects of total tariff elimination based on the assumption of a full liberalization policy.

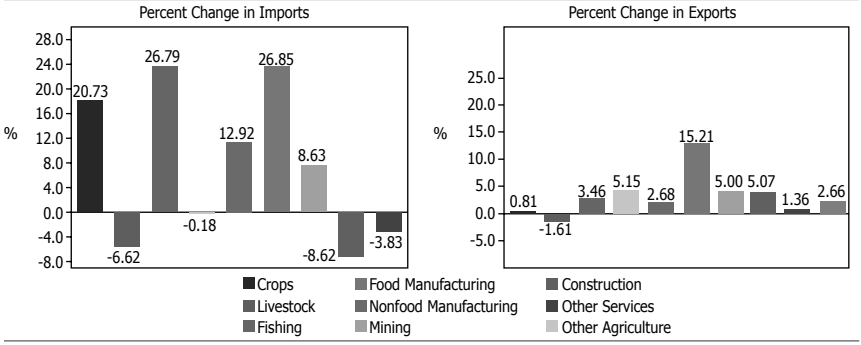
Table 10.22 **Macro Effects in the Full Tariff Scenario**
(Percent)

Change in Prices	
Import prices in local currency	-15.73
Consumer prices	-5.14
Local cost of production	-4.47
Real exchange rate change	6.65
Change in import volume	8.50
Change in export volume	8.54
Change in domestic production for local sales	-1.17
Change in consumption (composite) goods	0.66
Change in prices	0.55

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The elimination of tariffs on all commodities reduces local import prices by 15.7 percent, in which prices in all sectors decrease from 2 to 5 percent (Figure 10.15). However, in terms of output of production, the combined contraction in agriculture (2.2 percent) and services (0.2 percent) is a little higher than the expansion in industry as shown in Figure 10.15.

Figure 10.15 **Percentage Change in the Volume of Imports and Exports of the Full Tariff Elimination Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

At the same time, consumer prices decrease by 5.1 percent. In response, the local cost of production goes down by 4.5 percent because of cheaper imports. As local demand of domestically produced goods falls because of falling prices of imports, the real exchange rate depreciates by 6.7 percent.

Export volume, on the other hand, improves by 8.54 percent. The decline in import prices also translates into an increase in import volume of 8.5 percent. This result suggests that the trade index is vulnerable to changing policies that contract and expand the economy.

The increase in imports increases consumption by 0.7 percent. However, the increase in consumption does not translate into an increase in domestic production; instead, domestic production for local sales decline by 1.2 percent. This indicates that the entry of imported commodities makes it difficult for local firms to increase their selling prices, which in turn affects profit markup and local production.

Despite the crowding-out effects of domestic production for local sales, the slightly higher growth in export volume than in the import volume results in a modest improvement in overall output by 0.6 percent (Table 10.23).

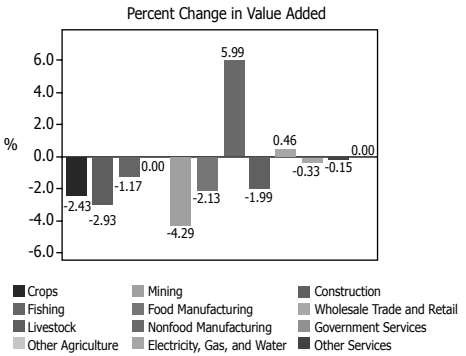
Table 10.23 **Effects of Full Tariff Scenario on Prices and Volumes**

	Price Changes (%)					*Volume Changes (%)*				
Sector	*Imports*	*Domestic demand*	*Composite demand*	*Output*	*Local*	*Imports*	*Exports*	*Domestic demand*	*Composite demand*	*Outputs*
Agriculture	**-6.56**	**-2.95**	**-3.04**	**-2.72**	**-2.95**	**6.97**	**2.17**	**-2.55**	**-2.36**	**-2.19**
Crops	-12.93	-2.75	-2.97	-2.54	-2.75	20.73	0.81	-2.70	-2.26	-2.43
Livestock	-0.61	-3.33	-3.26	-3.33	-3.33	-6.62	-1.61	-2.93	-3.03	-2.93
Fishing	-24.19	-3.82	-3.87	-3.00	-3.82	26.79	3.46	-2.41	-2.35	-1.17
Other Agriculture	-0.26	-0.47	-0.46	-0.47	-0.47	-0.18	–	0.00	-0.01	0.00
Industry	**-17.60**	**-6.60**	**-10.15**	**-5.12**	**-6.60**	**9.88**	**12.84**	**-1.05**	**2.31**	**2.00**
Mining	-29.04	-11.11	-24.72	-6.08	-11.11	12.92	5.15	-11.88	5.80	-4.29
Food Manufacturing	-25.18	-4.37	-6.30	-3.91	-4.37	26.85	2.68	-2.68	-0.51	-2.13
Nonfood Manufacturing	-16.29	-9.26	-12.82	-5.90	-9.26	8.63	15.21	0.85	4.64	5.99
Construction	–	-5.63	-5.48	-5.58	-5.63	-8.62	5.00	-2.05	-2.22	-1.99
Electricity, Gas, and Water	–	-3.71	-3.71	-3.67	-3.71	–	5.07	0.41	0.41	0.46
Services	**0.00**	**-2.38**	**-2.26**	**-1.98**	**-2.38**	**-3.83**	**2.11**	**-0.68**	**-0.20**	**-0.21**
Wholesale Trade & Retail	–	-1.75	-1.75	-1.39	-1.75	–	1.36	-0.77	-0.77	-0.33
Other Services	–	-2.68	-2.48	-2.29	-2.68	-3.83	2.66	-0.64	-0.89	-0.15
Government Services	–	–	–	-1.27	–	–	–	–	–	0.00
Total	**-15.73**	**-4.47**	**-6.67**	**-3.51**	**-4.47**	**8.50**	**8.54**	**-1.17**	**0.66**	**0.55**

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Sectoral Effects. The price and volume effects at the sectoral level show that trade policy reforms change the country's output and export structures. The manufacturing sector, for instance, has a major export component which gains from duty-free status in special economic zones. This explains the sudden shift from consumer goods such as food processing and beverages to intermediate goods such as electronics. From empirical observation, the nonfood manufacturing sector–which includes the semiconductor, textile and garments, petroleum products, and electronic industries, among others–experiences the highest export growth (15.2 percent) as a result of the drop in the local cost of production (Figure 10.16). Because of this, overall output of the sector improves by 6.0 percent while others decline.

Figure 10.16 **Percentage Change in Value Added of the Full Tariff Elimination Scenario**

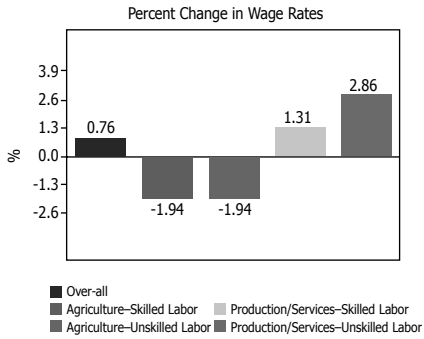


Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Clearly, the reallocation effects favor industry as a whole through the effects on the nonfood manufacturing sector. Output of all industries improves by 2.0 percent. In contrast, agricultural output declines by 3.0 percent, while the service sector slides marginally by 0.2 percent.

Effects on Factor Market. The reallocation effects on the factor market benefit industry through the nonfood manufacturing sector, as can be seen in Table 10.24. The rate of return to capital marginally increases to 3.7 percent, particularly in the nonfood manufacturing sector which increases by 14.7 percent. These increases are caused by declining prices in local production (6.6 percent) and overall composite prices (10.2 percent). Reallocation also increases export volumes by greater percentage points than import volumes. Thus, full implementation of tariff reforms induces a bias toward import substitution and provides strong support to export-oriented activities. The value added of both agriculture and services, on the other hand, is reduced (Figure 10.17). However, due to a marginal gain in prices, the services sector experiences a positive rate of return to capital.

Figure 10.17 **Percentage Change in Average Wages of the Full Tariff Elimination Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

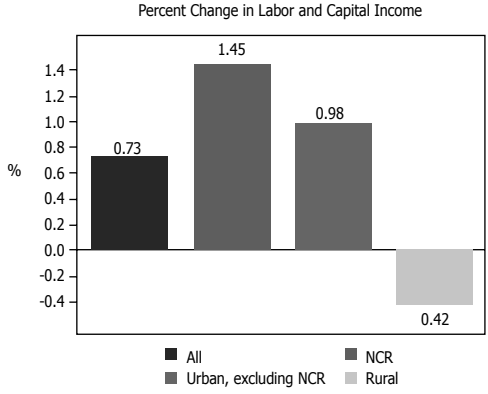
Tariffication and reforms to reduce tariffs induce agricultural labor to transfer to industrial sectors. Full tariff reduction would redirect skilled and unskilled agricultural workers toward industry, in particular toward the nonfood manufacturing sector. Thus, agricultural wages will eventually decline, while production wages will improve (Figure 10.18).

Table 10.24 **Effects of Full Tariff Scenario on Factor Market**

	Value Added Changes (%)			*Change in Labor Demand (%)*				
Sector	*Value added*	*Prices*	*Rate of return to capital*	*Total labor*	*Skilled agriculture*	*Un-skilled agriculture*	*Skilled production*	*Un-skilled production*
Agriculture	**-2.1**	**-1.5**	**-3.6**	**–**	**–**	**–**	**–**	**–**
Crops	-2.4	-1.6	-4.0	-4.7	-0.3	-0.3	-5.3	-7.3
Livestock	-2.9	-2.1	-5.0	-5.7	-1.3	-1.3	-6.3	-8.3
Fishing	-1.2	-1.3	-2.5	-3.2	1.3	1.3	-3.8	-5.8
Other Agriculture	0.0	0.8	0.8	0.0	4.6	4.6	-0.6	-2.7
Industry	**1.5**	**2.4**	**3.7**	**–**	**–**	**–**	**–**	**–**
Mining	-4.3	-4.2	-8.3	-9.0	–	–	-9.5	-11.5
Food Manufacturing	-2.1	-2.9	-5.0	-5.7	–	–	-6.2	-8.3
Nonfood Manufacturing	6.0	8.3	14.7	13.9	–	–	13.2	10.8
Construction	-2.0	-1.8	-3.8	-4.5	–	–	-5.0	-7.1
Electricity, Gas, and Water	0.5	2.1	2.6	1.8	–	–	1.3	-0.9
Services	**-0.2**	**0.4**	**0.2**	**–**	**–**	**–**	**–**	**–**
Wholesale Trade & Retail	-0.3	0.1	-0.2	-1.0	–	–	-1.5	-3.6
Other Services	-0.2	0.5	0.4	-0.4	–	–	-1.0	-3.1
Government Services	0.0	0.8	–	0.0	–	–	-0.6	0.0
Total								
Change in average wage	0.0	0.7	0.7	0.8	-3.7	-3.7	1.3	3.6

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Figure 10.18 **Percentage Change in Household Factor Income of the Full Tariff Elimination Scenario**



NCR = National Capital Region
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

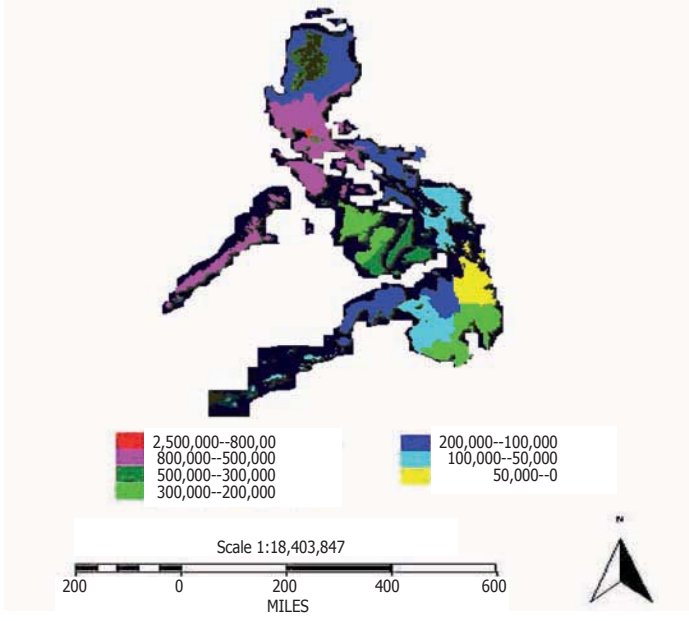
Effects on Income. The weighted average change in labor and capital income from agriculture for rural households is -1.6 percent; for urban households, excluding the NCR, it is 0.5 percent (Table 10.25). Overall, factor income from agriculture declines by 0.7 percent. Higher factor prices in nonagricultural sectors results in higher income for households who depend on industry and services. Rural households not dependent on agriculture experience less improvement in nonagricultural factor income compared with households in the NCR and other urban areas. The total net factor income effect is 0.7 percent. Households in the NCR enjoy the highest increase (1.5 percent) in factor income. Households residing in urban areas outside the NCR improve by 1.0 percent in terms of their factor income. Rural households experience a decline in factor income of 0.4 percent (Figure 10.19).

Table 10.25 **Effects of Full Tariff Scenario on Household Factor Income**
(Percentage change from base)

Household Location	*Labor and capital*	*Labor and capital*	*Total*
	Income from agriculture	*Income from nonagriculture*	*Labor and capital income*
All	-0.7	1.4	0.7
NCR	0.0	1.5	1.5
Urban, excluding NCR	-0.5	1.5	1.0
Rural	-1.6	1.2	-0.4

NCR = National Capital Region
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Figure 10.19 **Distribution of Poverty Incidence of the Full Tariff Elimination Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Poverty Impacts. The effects on poverty vary significantly across locations and household types (Table 10.26). About 2 million poor people are lifted out of poverty when all tariffs are eliminated. As in the previous scenarios involving partial and actual tariff reductions, households in the NCR enjoy the largest reduction in poverty compared with those in other urban and rural areas. Within NCR, households headed by females with high education again benefit the most compared with other household types. This is also largely due to the variation in the effects on factor income that generally favor households in the NCR (Figure 10.20). These are also attributable to the same two factors: reallocation effects toward the nonfood manufacturing sector, which is largely located in the NCR; and domination of exports of nonfood manufacturing by the semiconductor and textile and garments industries whose workforce are mostly women with above average levels of education.

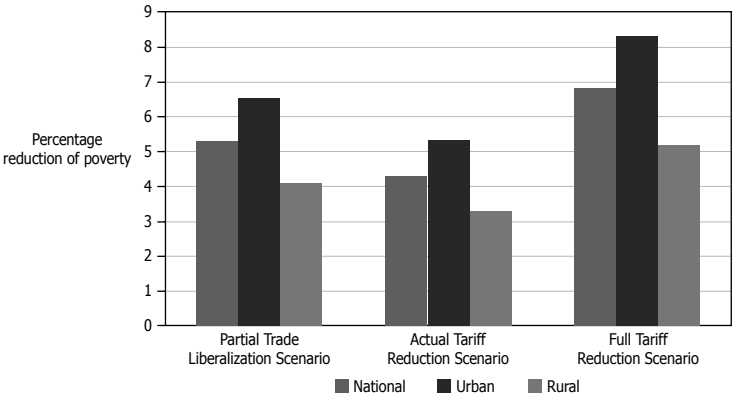
Table 10.26 **Percentage Change of Poverty Incidence in the Full Tariff Scenario**

Index	*Total headed households*	*Female headed households (%)*			*Male headed households (%)*		
		Overall	*Low education*	*High education*	*Overall*	*Low education*	*High education*
Philippines							
Headcount	-6.8	-8.1	-6.9	-16.5	-6.7	-6.0	-10.3
Poverty gap	-8.5	-9.8	-9.2	-15.6	-8.3	-7.8	-11.9
Severity	-9.5	-10.9	-10.5	-15.1	-9.4	-8.9	-12.7
National Capital Region							
Headcount	-22.8	-23.6	-14.5	-45.9	-22.7	-20.9	-24.8
Poverty gap	-25.2	-23.6	-22.7	-27.0	-25.4	-25.8	-24.7
Severity	-27.9	-24.2	-23.8	-25.7	-28.3	-29.2	-27.1
All Urban							
Headcount	-8.3	-10.2	-8.3	-20.9	-8.1	-7.3	-10.9
Poverty gap	-10.0	-12.3	-11.2	-21.3	-9.8	-9.0	-13.4
Severity	-11.0	-13.8	-13.3	-18.9	-10.8	-10.1	-13.9
All Rural							
Headcount	-5.2	-5.8	-5.8	-5.0	-5.2	-4.9	-6.9
Poverty gap	-7.3	-8.0	-7.8	-10.8	-7.2	-6.9	-9.3
Severity	-8.4	-9.2	-8.9	-12.3	-8.4	-8.1	-10.6
Poor People lifted out of poverty (%)							-6.8
Poor People lifted out of poverty							1,857,608

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

In summary, all three simulations show that each trade reform results in a slight improvement in the plight of the poor. Results of applying a low uniform–tariff scheme is not very different from implementing full tariff elimination. Moving from low tariffs to free trade, would result in only a 1.7 percent reduction in poverty or roughly just an additional 500,000 people lifted out of poverty.

Figure 10.20 **Poverty Reduction of the Full Tariff Elimination Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The marginal reduction in poverty can be attributed to the fact that only the nonfood manufacturing sector benefits greatly from the reduction or elimination of tariffs. The agricultural and services sectors contract as their output, value added, and labor reallocate to the industrial sector. These effects lead to a higher unemployment rate, lower wages, and lower rates of return to capital in agriculture and services. In addition, tariff reduction in agricultural imports depresses domestic agricultural prices. Since a large portion of households belong to rural areas, where agriculture is the major economic activity, these tariff reduction or elimination effects counteract with the benefits gained, resulting in only marginal improvements in household income and poverty incidence.

Summary and Conclusion

The importance of trade liberalization, in the form of tariff reduction, in reducing poverty has received considerable attention from policy makers. Tariff reduction alters relative prices of domestically produced goods and import prices, leading to a reallocation of resources. The effects on the poor can be traced through three transmission mechanisms of household income, consumption, and unemployment.

Tariff reduction has been a major part of the trade liberalization program implemented by the Philippine government since the 1980s. As a result, significant changes have already taken place such as overall reduced tariff, simplified tariff structure, and tariffication of quantitative restrictions. This study examined the tariff reduction effects on the economy and on poverty in the Philippines in 1994–2000.

The study uses PRISM, which is basically a user-friendly CGE-microsimulation model linked to a GIS poverty-mapping application. Detailed individual household data are integrated in the PRISM to capture the interaction between the trade reforms and individual household responses, and their feedback to the general economy.

Three scenarios are examined, namely low uniform–tariff reduction, actual tariff reduction, and full trade liberalization. A number of interesting findings can be summarized as follows:

Tariff reduction reduces both domestic prices of imported and locally produced goods. The decline in import prices results in higher imports, while the drop in local prices increases export competitiveness, which in turn translates into higher exports. Although higher imports put pressure on local production, the export-push effect coming from improved competitiveness offsets the negative effect on output. Thus, overall output increases and the supply of goods available in the market expands, benefiting consumers.

The nonfood manufacturing sector benefits from both output reallocation and labor movement. Furthermore, there are some indications that changes in the output and factor price ratios, as well as factor substitution, favor skilled production workers in nonfood manufacturing, utilities, and other agricultural sectors.

Agricultural wages decline as a result of a drop in agricultural output. The contraction leads to higher unemployment for both skilled and unskilled agricultural labor. Furthermore, the drop results in lower capital return in agriculture that lowers rural households' income. In contrast, the resource reallocation effects favoring industry, particularly the nonfood manufacturing sector, increase the wages of production workers and capital returns in industry. Resource reallocation also reduces unemployment of both skilled and unskilled production labor.

The overall effects improve urban household income in the different regions, including the NCR. There is an apparent bias favoring households in urban areas, due to the production and resource reallocation toward the nonfood manufacturing sector. As poor people mostly live in rural areas, the tariff reductions worsen the income inequality problem. The Gini coefficient deteriorates from 0.4644 before the tariff reduction, to 0.4672 after the tariff cut.

The poverty effects calculated using the FGT indices of poverty incidence, poverty gap, and poverty severity, show some interesting findings. The poverty effects can be examined from two transmission channels of income

and consumption. The income channel comes from factor incomes allocation, while the consumption channel emerges from the effects on the households' consumption basket and the poverty threshold.

The decline in composite prices as a result of tariff reduction leads to a lower poverty threshold for a given commodity basket. As a result, all poverty indices computed show favorable effects. The poverty effects, however, vary considerably across household groups. As urban households, particularly in the NCR, receive the most benefits, the poverty reduction in the NCR is the most apparent. Poverty incidence, poverty gap, and poverty severity in the NCR improve significantly. Poverty incidence in other urban areas outside the NCR also show a sizeable reduction, but still less than in the NCR.

The urban-rural poverty impact is ironic: poverty is reduced the least in rural areas–where most of the poor live. This effect is due to the contraction of rural agriculture and the expansion in urban industry. It is important to note that the goods driving the expansion of nonfood manufacturing exports are semiconductors and garments. These industries are located mainly in export processing zones with a workforce dominated by females with at least a high school diploma or vocational training, or both. It is interesting to relate this with the results that the largest improvement in poverty is observed among households headed by females with high education.

Appendix 10.1

Poverty Reduction Integrated Simulation Model

Guntur Sugiyarto, Caesar Cororaton, Erwin Corong, Joakim Rylander, and Eric B. Suan

Introduction

The Poverty Reduction Integrated Simulation Model, or PRISM, is a user-friendly, online modeling tool that combines a computable general equilibrium (CGE) model with microsimulation at the household level and a geographical information system (GIS) application of poverty mapping for spatial analysis. All complexities of the modeling aspects have been interfaced in a user-friendly way so that users can run simulations and conduct some analyses online with ease. The development of PRISM is under the auspices of the Economics and Research Department of the Asian Development Bank (ADB).

PRISM is a completely new and unique system. It is designed to provide an integrated economic framework for evaluating wide-ranging policy changes, economic shocks to the economy, sectoral effects, factor market effects, household income and consumption effects, and poverty effects. The results are presented in graphs and tables that can be copied to other Window-based applications. Moreover, the poverty impact is also presented in as dynamic and interactive GIS maps to allow spatial analysis to be done intuitively.

The tool allows users to do scenario analysis by changing some policy parameters in the model, running the simulation, and getting the results online. The economy-wide effects of any changes as a result of the simulation are presented in graphs and tables, which can then be copied to other computer applications. In line with ADB's overarching goal of poverty reduction, as well as the Millennium Development Goal No.1 of halving poverty incidence by 2015, the tool provides a framework for poverty impact analysis.

There are similar computer applications that can be used by policy makers to design pro-poor policies such as the one developed by the United Nation University's World Institute for Development Economics Research (UNU-

WIDER).[1] In the UNU-WIDER application, simulations of "what if" on tax policy scenarios can be conducted. PRISM, however, not only simulates "what if" scenarios of important issues and gives a detailed analysis of how many people might be lifted out of poverty, but also displays the geographical location of the poverty impact.

PRISM is easy to understand. It allows users to run their own scenarios or to examine the economy-wide effects of preset scenarios carefully selected for their relevance in each particular country incorporated in the system. Simulations can produce results on, as mentioned above, the overall economy, sectoral outputs, factor market, and household incomes, and, more importantly, on poverty reduction.[2] Furthermore, the poverty impact of any changes introduced in a simulation is interfaced with advanced GIS mapping techniques so that the poverty impact indicators such as the headcount ratio and poverty gap for selected regions, provinces, and districts in each country can be presented interactively on GIS maps. A comparison of poverty impact indicators of two different scenarios is also possible through a dual-window map-viewing facility.

PRISM was developed by using the Philippines' CGE-microsimulation model based on the 1994 Social Accounting Matrix (SAM) and the 1994 Family Income and Expenditure Survey. Incorporation of other countries in the system is possible, especially for those countries which already have CGE models developed such as Bangladesh, the People's Republic of China, Indonesia, Nepal, Pakistan, and Viet Nam.[3] To incorporate other countries in the system, further refinement of the models, including the integration of household data and interfacing of the modeling mechanisms may be necessary, especially given each model is specific to the underlying economy.

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1 The simulation models were developed for five African countries and Russia. African models provide poverty, distribution, and budgetary impacts at specific changes in policy and compare the results with the current state or base scenario (http://www.wider.unu.edu/). The Russian model can track the effects of taxes on the Russian people, i.e., who pays the taxes, who gets the benefits, and who gains and loses.

2 The model is hosted on a production server that maintains the Web and GIS server. The infrastructures that support the production server are Windows 200x, Microsoft SQL Server 2000, GAMS for simulating CGE, Minifold 6 Web GIS, and ESRI ArcView Desktop, ChartFX Graph Generator, Autodesk Map, and MapGuide 6.5 Advanced GIS Analysis.

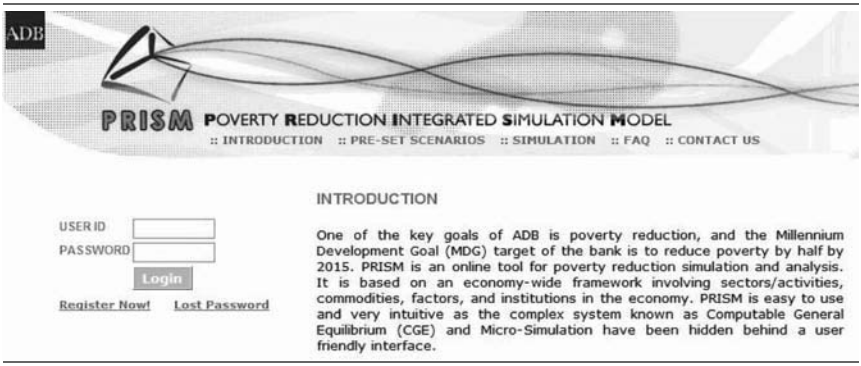
3 Malaysia, Singapore, and Thailand also have CGE models. In general, all countries can be included in the PRISM provided there is a representative CGE model for the country's economy or that CGE model can be developed based on available data.

How to Use PRISM

Setting up User Name and Password

To be able to use the functionality of PRISM in full, users have to register in the system by entering their user identification and password (which are not case sensitive) and clicking the REGISTER NOW menu. The registration is needed to enable the users to receive a confirmation e-mail message when their simulations are done so that they can view the results. Registration also allows the site administrator and ADB to verify the user's identity and to note the frequency and duration of each visit to provide better services. Registration is also important as the system will not allow users to move to the next page until they have finished registering. Figure 10.1.1 shows the registration screen, with the introduction to PRISM.

Appendix Figure 10.1.1 **Registration and Introduction Page**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

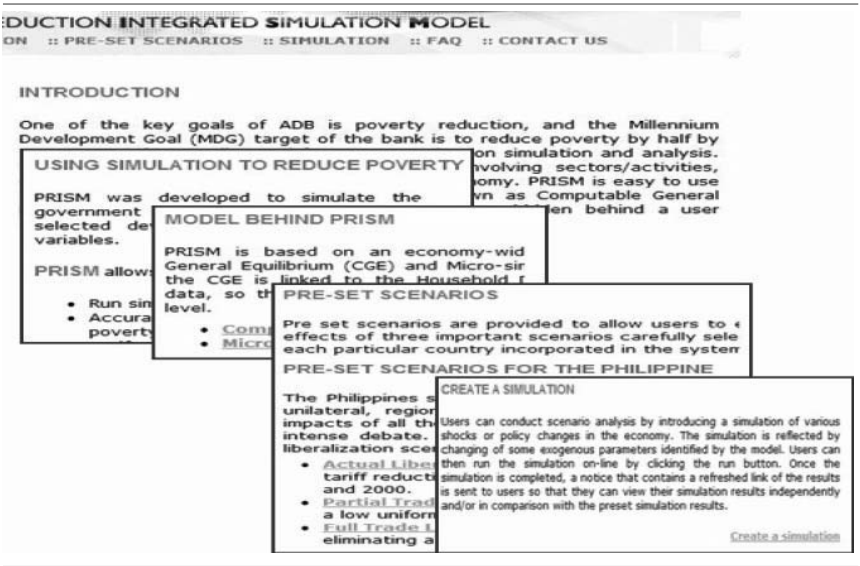
In case users lose or forget their password, they can click on LOST PASSWORD and enter their e-mail address. The lost or forgotten password will then be forwarded by PRISM to the registered e-mail address. Alternatively, users can also use PRISM by typing *adb* in both the USER ID and PASSWORD boxes. If they then decide to run simulations, their results can still be reviewed by logging out and then logging into the system after about 5–10 minutes using the same *adb* user name and password. The simulation results are stored in the *previous simulations file.*

Viewing Preset Scenarios and Exploring

Once the users log in, they can go to the second page of PRISM (Figure 10.1.2) that provides more information about the system including the model behind PRISM, how to create a simulation, and how to view the preset scenarios. For example, clicking the *actual liberalization scenario* of the preset scenarios will

display the effects of the actual reduction in nominal tariff rates on poverty. This is the default scenario.

Appendix Figure 10.1.2 **Example of the Content of Introductory Page**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

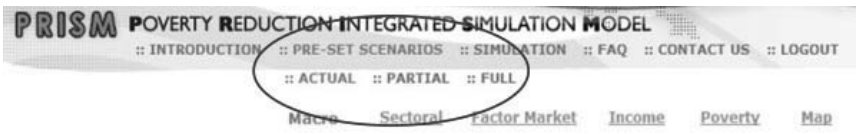
Users can also customize their own scenarios by simply clicking the *create simulation* menu bar and then setting up the scenario. Alternatively, users can click the *simulation* icon on the page heading to bring up the simulation page.

Preset Scenarios

To introduce to the underlying economy concerned, PRISM runs preset scenarios of particular issues relevant to the underlying country. The preset scenarios are designed to be relevant to the country concerned such as trade liberalization in the Philippines. Trade reforms have been ongoing in the Philippines since 1980s, partly as a result of its unilateral, regional, and multilateral trade agenda with other countries. In this context, PRISM provides a tool to systematically examine the economy and poverty impacts of the trade policies.

Figure 10.1.3 shows three different preset scenarios introduced in the model, namely: *Actual Liberalization* that mimics the actual tariff reduction that occurred in the Philippine economy between 1994 and 2000; *Partial Trade Liberalization* that illustrates the impact of a low uniform tariff rate across sectors; and, *Full Trade Liberalization* that depicts the impact of eliminating all tariffs.

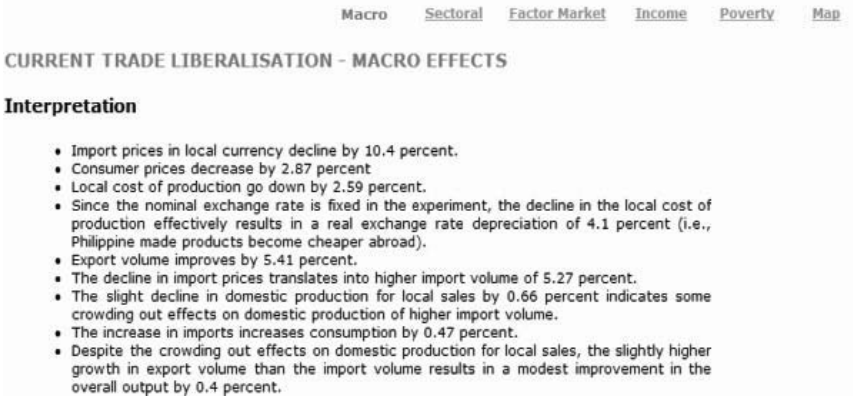
Appendix Figure 10.1.3 **Intro Page to Preset Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Figure 10.1.4 presents the schematic representation of adjustment mechanisms in the underlying model of PRISM. Notice that the impact evaluation of any policy changes introduced in the model is conducted at macro, factor, and household level, which are reflected in macro, sectoral, factor market, income, and poverty effects.

Appendix Figure 10.1.4 **Macro Effects of the Preset Scenario**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

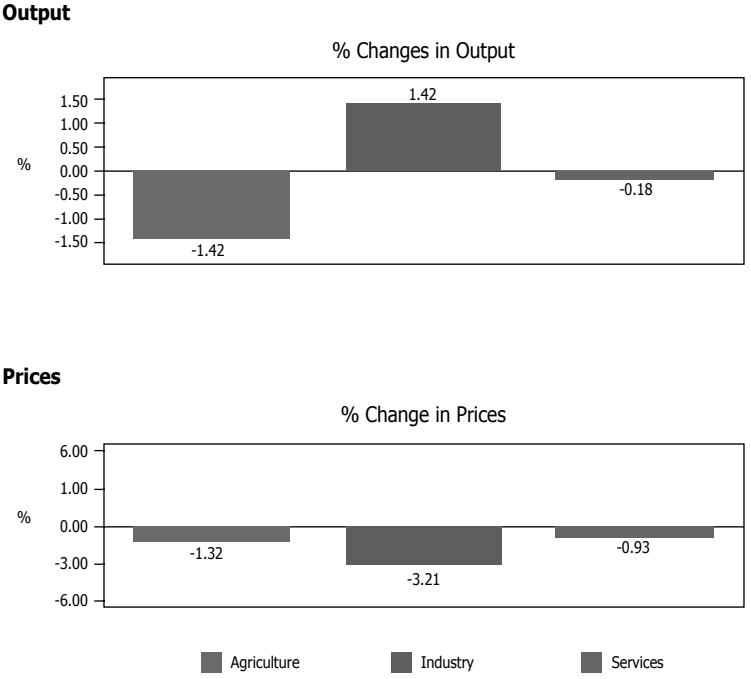
The results of each preset scenario are presented in graphs, tables, and maps. Some highlights of the findings are also included to make them more informative. Clicking on the *macro* option, for instance, will reveal the preset scenario results on overall changes in prices, production, and consumption (See Figure 10.1.4).

To examine the sectoral effect, one simply clicks on *sectoral* for a graphical presentation and tabular result of the changes in outputs, prices, imports, and exports of the selected scenario. The preset scenarios give complete results of changes in tariff rates on the economy such as production, consumption, income (in nominal terms), capital and labor, and poverty (Figures 10.1.5a – 10.1.5f). For the poverty impact, the user can use the dual-window viewing system for comparing two simulations.

Appendix Figure 10.1.5a **Sectoral Effects of the Preset Scenario**

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

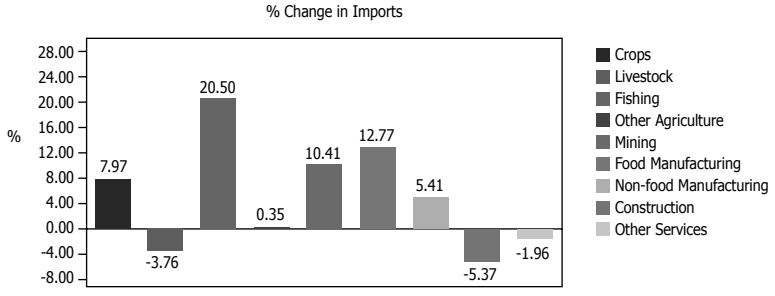
Appendix Figure 10.1.5b **Effects of the Preset Scenario on Output and Prices**



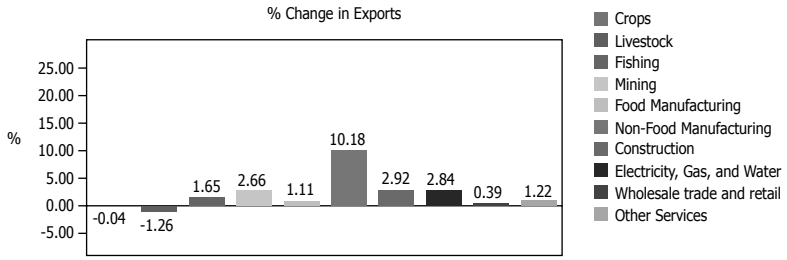
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Appendix Figure 10.1.5c **Effects of the Preset Scenario on Imports and Exports**

Imports



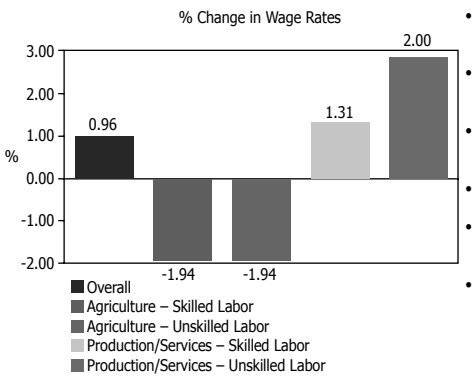
Exports



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Appendix Figure 10.1.5d **Effects of the Preset Scenario on Factor Market**

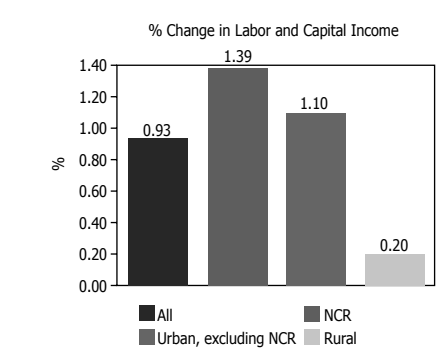
Current Trade Liberalisation - Factor Market



- The reallocation effects benefit the industry through the nonfood manufacturing sector, as can be seen in the effects on factors of production shown in Table 3.
- Both the value added and the price of value added decline for agriculture and increase for industry, particularly for the nonfood manufacturing sector.
- The rate of return to capital increases by 3.0 percent for the whole industry and 10.8 percent for the non-food manufacturing sector.
- The return to capital in agriculture declines by 1.9 percent.
- There is labor movement of skilled production and unskilled production toward industry, in particular toward the nonfood manufacturing sector.
- Agriculture wages decline, while production wages improve.

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

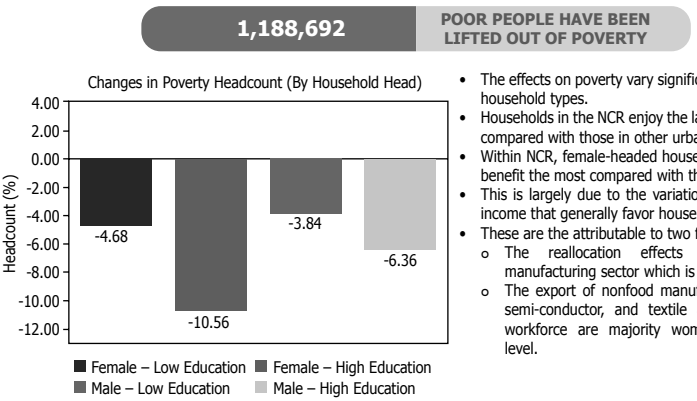
Appendix Figure 10.1.5e **Effects of the Preset Scenario on Income**



- The weighted average change in labor and capital income from agriculture for rural households is -0.8 percent, and for urban households, excluding the NCR, is -0.3 percent.
- On the whole, factor income from agriculture declines by 0.3 percent.
- Higher factor prices in nonagriculture results to higher-income for households who depend on industry and services.
- Rural households, not dependent on agriculture experience a lower improvement in nonagriculture factor income compared to households in the NCR and other urban areas.
- The total net factor income effect is 0.9 percent.
  - Households in the NCR enjoy the highest increase of 1.5 percent.
  - Households residing in urban areas outside the NCR have 1 percent improvement in their total net factor income.

NCR = National Capital Region
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

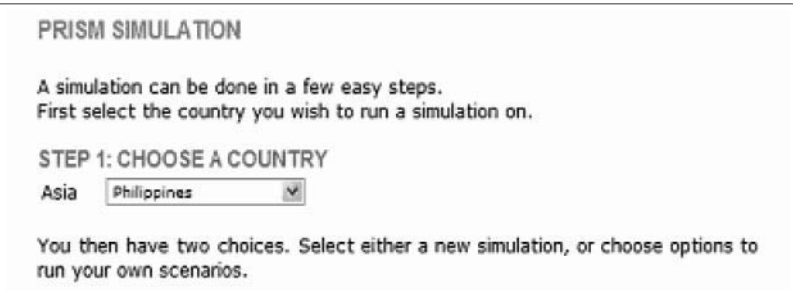
Appendix Figure 10.1.5f **Effects of the Preset Scenario on Poverty**



- The effects on poverty vary significantly across locations and household types.
- Households in the NCR enjoy the largets reduction in poverty compared with those in other urban and rural areas.
- Within NCR, female-headed households with high education benefit the most compared with the other household types.
- This is largely due to the variation in the effects on factor income that generally favor households in the NCR.
- These are the attributable to two factors.
  - The reallocation effects towards the nonfood manufacturing sector which is largely located in the NCR.
  - The export of nonfood manufacturing is dominated by semi-conductor, and textile and garments — whose workforce are majority women with above average level.

Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Appendix Figure 10.1.6 **Selecting a Country of Interest**



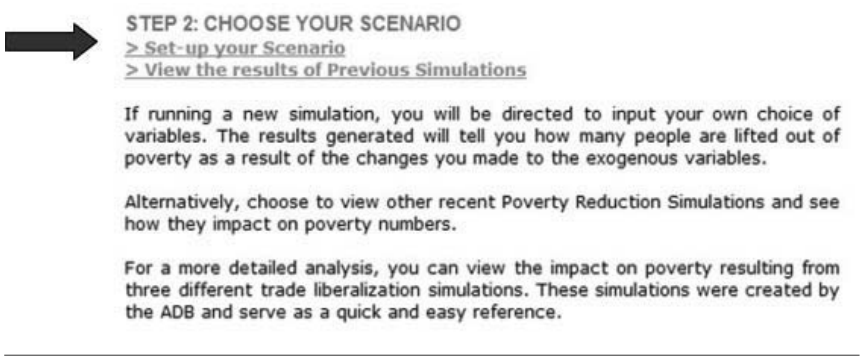
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Getting Started with the PRISM Simulation

PRISM is designed to subsequently incorporate all developing member countries. Therefore, the guideline below is written for a general case, i.e., applicable to other countries selected from the system.

Step 1: Choose a Country. Users can select the country of interest from the drop-down menu as outlined in the Figure 10.1.7. At the moment, however, the system has only one country, the Philippines, with which users can conduct a simulation analysis.

Appendix Figure 10.1.7 **Starting a Simulation**



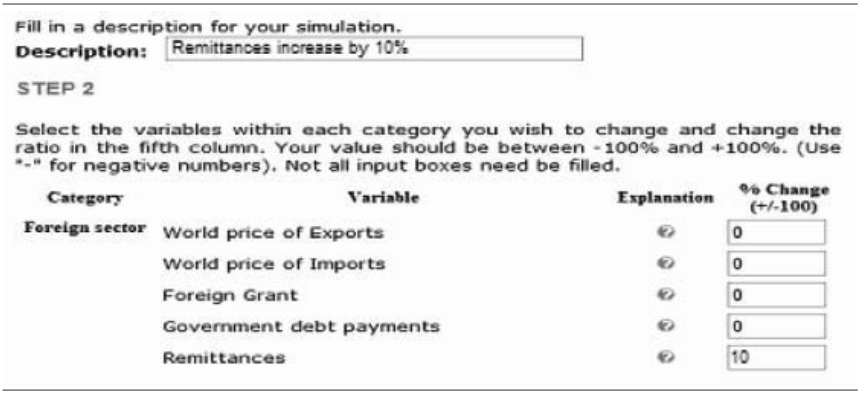
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Step 2: Set Up Your Scenario. After selecting the country (for now, the Philippines), the user can either start setting up a scenario by clicking on *Set up your scenario* or customize different scenarios by following Step 4.

Another option would be to retrieve the previous simulation results conducted by previous users by simply clicking on *View the results of previous simulations*. The previous simulation results are arranged according to dates of completion. The list also includes simulation names and descriptions (or references) to make them easy to identify.

Step 3: Name a Scenario. Each simulation must be given a distinct name and a description, consisting of up to 35 alphanumeric characters, that includes key actions taken in the simulation. The unique name and description will distinguish a specific simulation from previous ones or from others run by the same user and will make it easy for the simulation to be referred to when needed. For example, if John is running a simulation of a 10 percent reduction in indirect tax rates, the name and description such as "John, 10% cut in indirect taxes" can be used. This allows other users with the same interest to view results without running their own simulation. Figure 10.1.8 shows the simulation description box in PRISM.

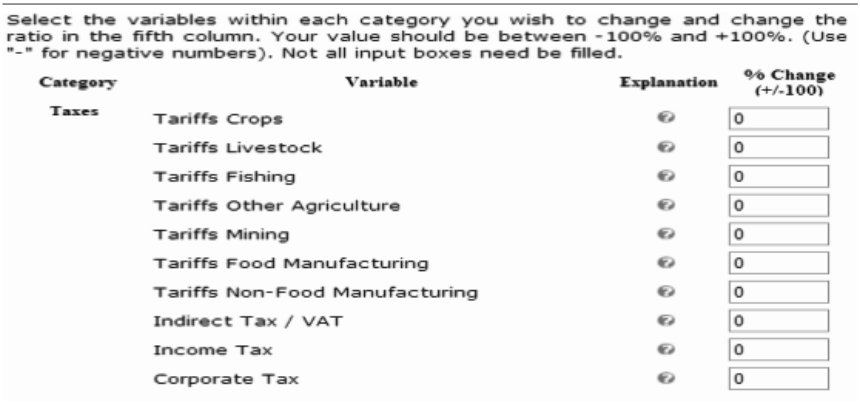
Appendix Figure 10.1.8 **Describing Simulation**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

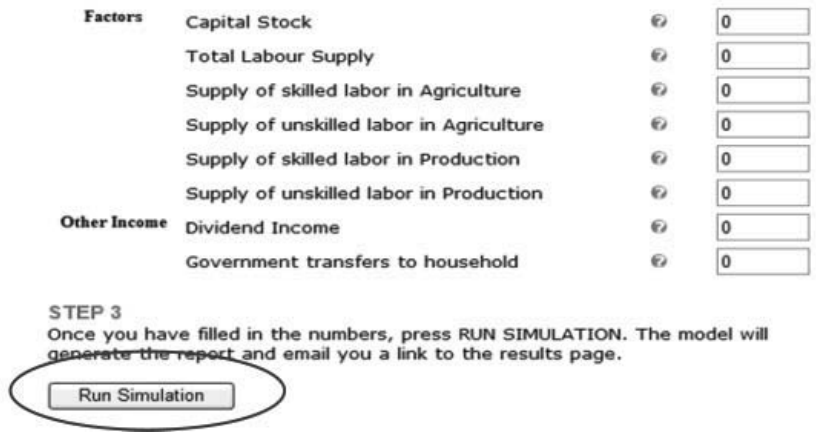
Step 4: Customize a Scenario. To customize a scenario, users can select the policy variables within each category and indicate the changes by entering the percent rate of change in the box provided in Step 2 (see Figures 10.1.9 –10.1.11). The value should be between -100 percent and +100 percent. The negative sign (-) means reducing, while the positive sign (+) indicates increasing any of the variables under review. For instance, to analyze the impact of tariffs on crops to the overall economy by reducing the tariff by 10 percent, the user must enter -10 in the *% change* box beside the *Tariffs Crops* variable. Not all input boxes have to be filled up with an assigned value, as shown in Figure 10.1.9. However, at least one value should be inputted in the box to represent a policy change introduced in the model.

Appendix Figure 10.1.9 **Introducing Policy or Economic Changes**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Appendix Figure 10.1.10 **Running a Simulation**



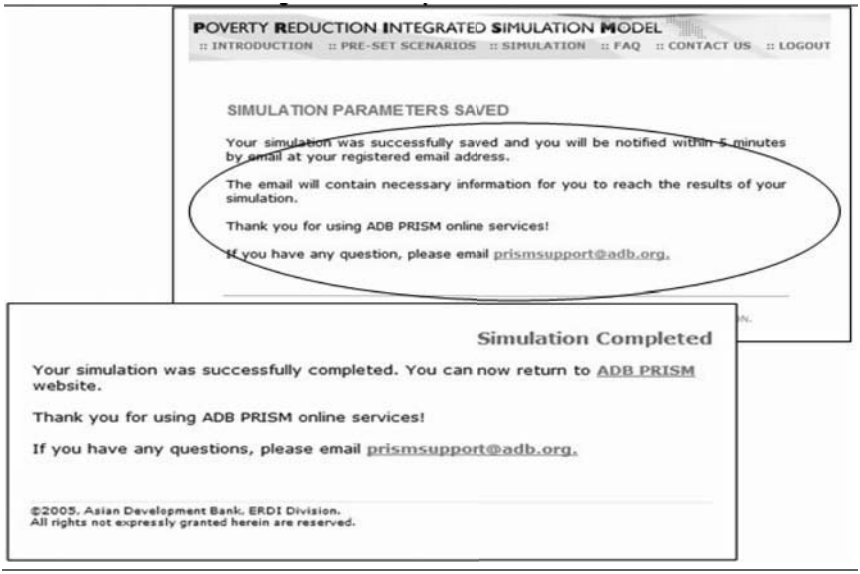
Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The policy variables or parameter changes are divided into four different categories–*Foreign Sector*, *Taxes*, *Factors*, and *Other Income*–to reflect all the important aspects of a fully functioning economy.

Step 5: Run the Simulation. After a scenario is set up, users can run the simulation by simply clicking on *Run Simulation* (Figure 10.1.11). The PRISM system will then confirm that the parameters of change have been saved and immediately start processing the simulation. Detailed descriptions of policy variables that can be changed in the PRISM are presented in Table 1.

PRISM, when made available to the public, can help policy makers demystify some of the model runs. They can use it to carry out sensitivity analyses of their choice (e.g., a 10 percent rather than a 20 percent change in a selected variable). However, it is important to note that there is no single CGE model suitable for all policy simulation options. Many argue that a CGE model should even be developed specifically for each policy concern.. For example, if we change tariffs, taxes, or government debt payments, we cannot get sensible results unless we maintain income-expenditure balance by changing other items in the government's budget. Similarly, increasing skilled labor supply in one sector would affect labor supply in other sectors. The policy options selected in Table 10.1.1 were chosen for their sensible results–i.e., "sensible" in so far as there are no changes in the modeling specifications of the underlying CGE, including in the changing of closure rules. There are in fact more policy simulations that can be conducted using the underlying CGE model used in the PRISM than are listed in the table.

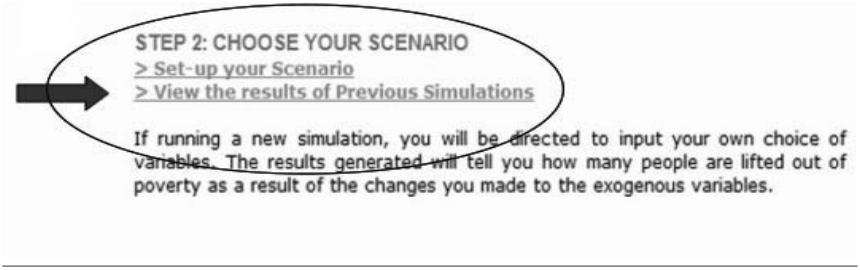
Appendix Figure 10.1.11 **Example of a Notice for Completed Simulation**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Step 6: Complete Simulation. As shown in Figure 10.1.12, a confirmation that the simulation parameters have been saved successfully will be displayed on screen and the system will immediately start processing the data. Normally, processing time is between 3 to 10 minutes, depending on many factors–such as the complexity of the inputted parameters and the number of users accessing the system at the same time. This is of course in addition to general factors such as the number of algorithms needed to find the solution.

Appendix Figure 10.1.12 **Viewing Results of Previous Simulations**

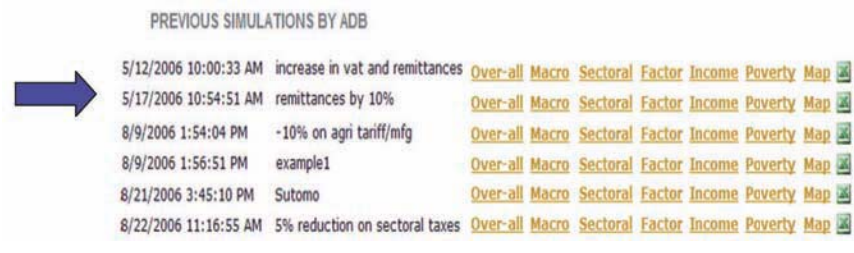


Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

An e-mail message with the subject SIMULATION COMPLETED is sent to the registered e-mail address of the user once the simulation has been completed. This e-mail notification contains a fresh link to the ADB PRISM site, so that users can view all their results by simply clicking on the link.

Past simulations are stored in the system and can be retrieved. Figure 10.1.13 shows how to view simulation results which are stored in previous simulations pages. The description, date, and time of each simulation are logged. Clicking on *View the Results of Previous Simulations* will open the customized simulation results pages. The reference name of each simulation is provided in the list with the latest completed simulation listed at the bottom.

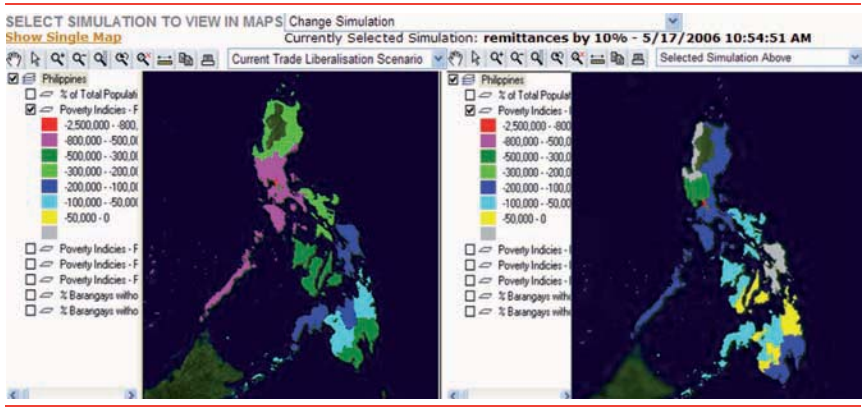
Appendix Figure 10.1.13 **List of Results of Previous Simulations**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The simulation results are grouped according to categories outlined earlier, i.e., *Overall*, *Macro*, *Sectoral*, *Factor*, *Income*, *Poverty*, and *Map*. Users can view the results as graphs and tables in Microsoft Excel. The results can be downloaded and copied to other Windows-based applications (Figure 10.1.14).

Appendix Figure 10.1.14 **Comparing of Poverty Impacts of Two Simulations**

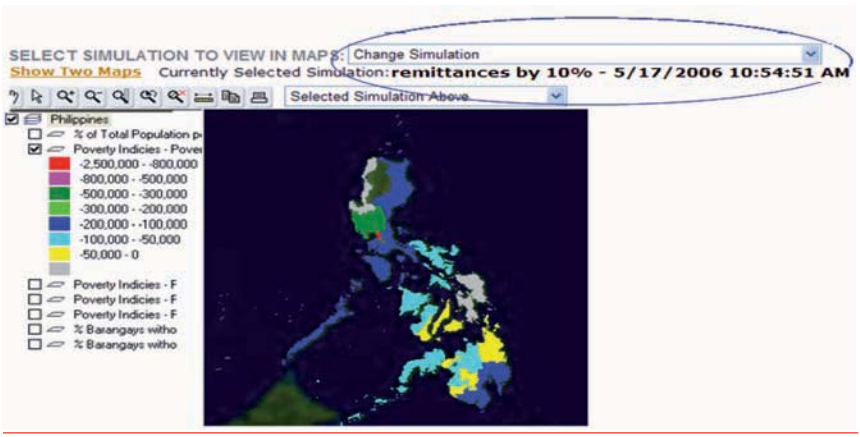


Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

Step 8: View Poverty Maps. As mentioned before, in addition to graphs and tables, the poverty impact of policy changes is also presented in a map. To view the impact as a map, Mapguide ActiveX Control must first be downloaded. This software is legitimate and free, and can be accessed through a download link in the *Help* section of PRISM.

When viewing the maps, the three preset scenarios can be examined, or alternatively, browsed through from the list of previous simulations. By default, PRISM displays two GIS maps side by side for comparing two simulation results, as shown in Figure 10.1.15. Alternatively, PRISM also allows users to view a single map for greater clarity and ease of use, as illustrated in Figure 16. To select a single map view, users click on the *Show Single Map* icon. To go back to double-window viewing, users select *Show Two Maps*. This icon toggles between these viewing options.

Appendix Figure 10.1.15 **Viewing and Customizing a Map on Poverty Impact**

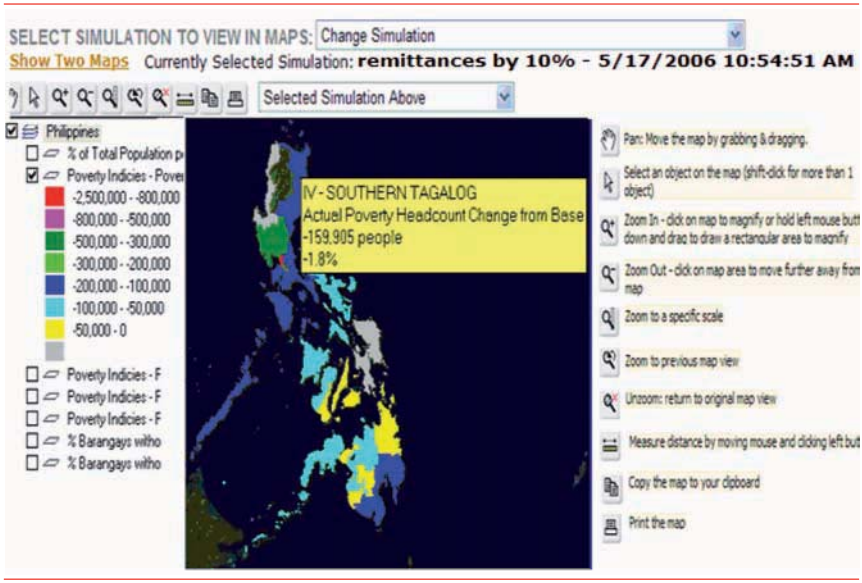


Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

The first drop-down menu lists all results of previous simulations. The next drop-down menu provides the option to map either the customized results or the preset scenarios. Users can choose *Selected Scenario* to map their own scenarios. Figure 10.1.15 shows the selection of a previous simulation of a 30 percent reduction in world prices for mapping. The poverty map results shows that the reduction will benefit 100,000 to 200,000 households in the Luzon area of the Philippines, while 50,000 to 100,000 households were lifted out of poverty in Mindanao and the Visayas.

Step 9: Magnifying the Map. Another feature of the poverty map is to ability to change the viewing scale of the map. Figure 10.1.16 shows how GIS application icons can help to enhance the usability of the mapping function, e.g., by zooming in and out, printing, and measuring the distance from one region to another. A description of each GIS function and how to use them, are available in the *Help* section of the *Mapping* folder.

Appendix Figure 10.1.16 **Magnifying a Map on Poverty Impact**



Source: Poverty Reduction Integrated Simulation Model (PRISM) (Available at http://prism/adb_prism).

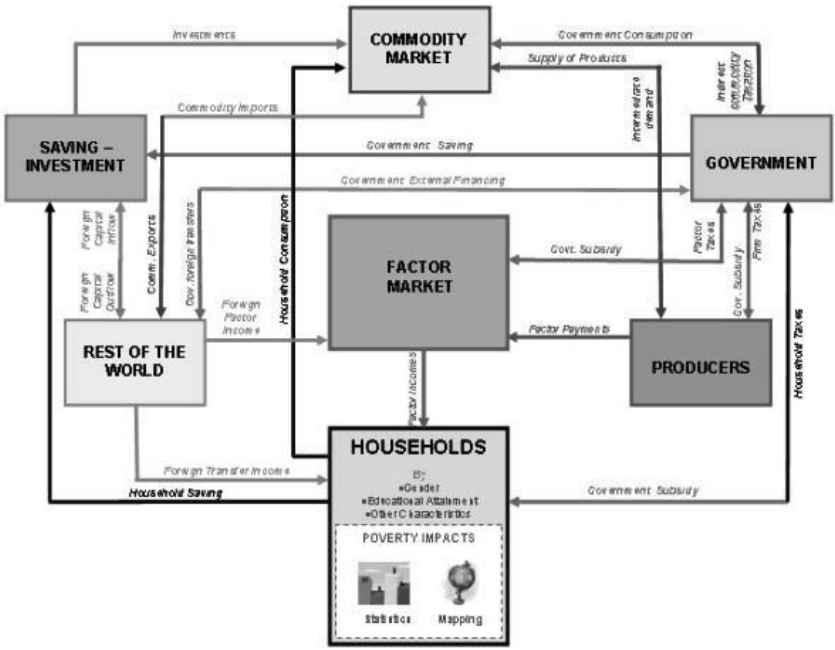
Appendix 10.2

Computable General Equilibrium Model

The Model

A computable general equilibrium (CGE) model captures the complex relationships of agents and sectors in an economy–as depicted in the schematic diagram below. In this modeling framework, households maximize their utility functions subject to their budget constraints. The household utility function was derived from the consumption of domestically produced and imported commodities, while household income was generated from the accumulation of factor income and transfer payments.

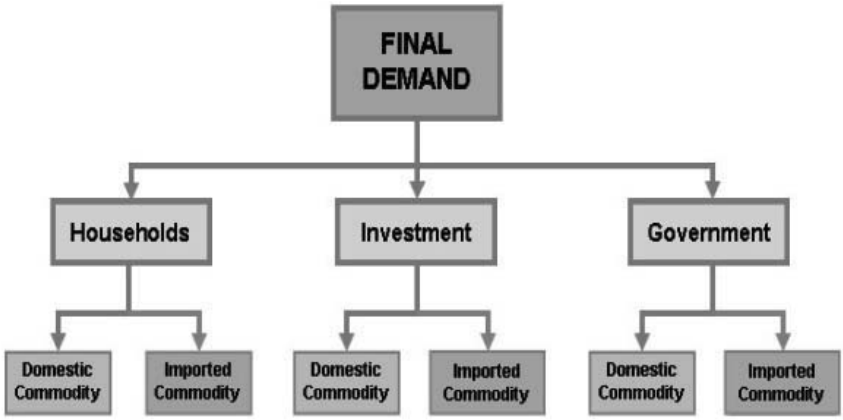
Appendix 10.2.1 **The Interlinked Nature of the Economy**



On the final demand side, total demand in the domestic economy consists of demands for consumption and for investment purposes–both of which are derived from composite commodities. Total consumption is an aggregation of household and government consumptions, while investment is generated by the savings-investment account. Aggregate investment is fixed in quantity,

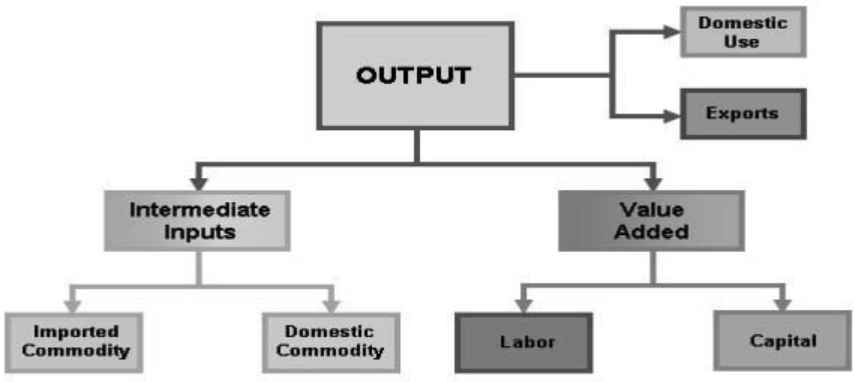
reflecting the investment-driven nature of the economy. Finally, a small-country assumption is adopted for the import side, making the domestic economy a price taker of imported products.

Appendix 10.2.2 **Final Demand in Domestic Economy**



On the supply side, outputs were specified as a multilevel nesting of constant elasticity of substitution (CES) functions. At the top level, the domestic output was specified as an input-output (Leontief) function of intermediate inputs and value added. The intermediate input consumption was set as a CES aggregation of domestically produced and imported commodities, allowing for imperfect substitution between the two commodities (with different degrees of substitution reflected in the values of substitution elasticity). The value added is a CES function of different labor categories and types of capital. Total production is then allocated to domestic demand and exports through a constant elasticity of transformation.

Appendix 10.2.3 **Total Production Function**



Appendix 10.3

Implementation of the CES Function

The Armington (1969) assumption of imperfect substitutability between two products of different origins implies that total domestic demand *Qi* is a constant elasticity of substitution (CES) function of domestically produced and imported commodities:

$$Q_i = A_i\left[\alpha_i M_i^{-\upsilon} + (1-\alpha_i) D_i^{-\rho}\right]^{-\frac{1}{\rho}} \tag{1}$$

with *Di* as demand for the locally manufactured good, *Mi* as the demand for the imported imperfect substitute, *Ai* a scale parameter and the elasticity of substitution given by: $\varepsilon_s = \frac{1}{1+\rho}$. The maximization problem is to minimize cost: *PQiQi* = *PDiDi* + *PMiMi* subject to the Armington function. We obtain the relative demand for imported versus local goods as a function of their relative prices:

$$\frac{M_i}{D_i} = \left[\frac{PD_i}{PM_i}\frac{\alpha_i}{1-\alpha_i}\right]^{\varepsilon_s} \tag{2}$$

Given price normalization, the volumes of demand for both domestic and imported products are directly provided by the social accounting matrix. The only parameters to be calibrated therefore are the share and scale parameters. For a given external estimate of the elasticity of substitution, the share parameter is easily computed by inverting the above import demand equation. The scale parameter is then obtained by inverting the Armington function.

Similarly, export supply may be represented, depending on the destination, by a constant elasticity of transformation function that takes a form similar to that of the CES:

$$X_i = \beta_i\left[\alpha_i \mathrm{E}_i^{-\varphi} + (1-\alpha_i) D_i^{-\varphi}\right]^{-\frac{1}{\varphi}} \tag{3}$$

with $\varepsilon_t = \frac{1}{\varphi+1}$ as the elasticity of transformation, $-\infty \prec \varphi \prec -1$ and $-\infty \prec \varepsilon_t \prec 0$.

Export supply resulting from the maximization of profits to the producers reads as follows:

$$\frac{D_i}{E_i} = \left[\frac{PE_i}{PD_i}\frac{1-\alpha_i}{\alpha_i}\right]^{\varepsilon_t} \tag{4}$$