

# **Trade Liberalization Financing and its Impact on Poverty and Income Distribution in Ghana**

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## Abstract

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Ghana has adopted a Growth and Poverty Reduction Strategy that emphasizes increased focus on poverty reduction in the design and implementation of its policies. This study uses a CGE model, social accounting matrix and data from the 1999 Ghana Living Standards Survey 4 to examine the impact of unilateral partial trade liberalization both in isolation and combined with foreign capital inflows and value-added tax on the poverty and income distributions of various categories of households. Those included were agricultural households, public sector employees, private sector employees, non-farm self-employed workers and non-working persons.

The study found that eliminating trade-related import and export tariffs on agricultural goods and import tariffs on industrial goods in isolation, combined with foreign capital inflows and combined with VAT reduces the incidence, depth and severity of poverty of all categories of households, with the exception of the incidence of poverty of public sector employees and the non-working group when import tariffs on industrial goods are eliminated in isolation. On the other hand, elimination of trade-related export tariffs on industrial goods in isolation and combined with foreign capital inflows increases the incidence, depth and severity of poverty of all categories of households, with the exception of the incidence of poverty of the non-working group. Moreover, elimination of trade-related export tariffs on industrial goods combined with VAT reduces the incidence, depth and severity of poverty of all categories of households.

Income distributions of the private sector employees and the non-working group were found to improve to a larger extent when trade liberalization in isolation is considered. For agricultural households, on the other hand, the income distribution improves to a larger extent when trade liberalization is combined with foreign capital inflows and VAT. Results also indicate that financing of unilateral partial sector-wise trade liberalization through domestic resources (VAT) could have a greater impact on poverty alleviation and improvement in the income distributions of households than the foreign resources (foreign capital inflows).

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# 1. Introduction

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Major macroeconomic shocks have had significant impacts on the level of poverty and the distribution of incomes in many developing countries. Poverty thus persists in a large number of these countries despite considerable development assistance from the international community. The intractability of poverty in all its measures – incidence, depth and severity – is especially acute in sub-Saharan Africa, where a number of countries, including those that embraced the path of economic reforms and stabilization programmes, continue to face declining living standards (De Maio et al., 1999; Easterly, 2001; Hillman, 2002; Fofack, 2002). This has led to increased emphasis on specific poverty reduction measures by the countries themselves and the donor community. A deep analysis of poverty requires a better understanding of the constraints to poverty reduction, the relationships between macroeconomic shocks and their impact at the micro level, the transmission channels through which adjustment policies may affect the poor, and the possible trade-offs that poverty reduction may entail in terms of the allocation of scarce resources and sequencing of policy reforms.

A look at the impact of trade liberalization is particularly important because it is generally believed that expanded trade holds the key to prosperity for developing countries. This perspective holds that if the industrialized countries would eliminate their trade barriers, especially in apparel and agriculture, this would provide a basis for growth in developing countries, pulling hundreds of millions of people out of poverty. According to World Bank (2002), a reduction in world barriers to trade could accelerate growth, provide stimulus to new forms of productivity-enhancing specialization, and lead to a more rapid pace of job creation and poverty reduction around the world. Weisbrot and Baker (2002) have argued, however, that most of the projected gains from trade liberalization do not come from the removal of trade barriers in the industrialized countries – rather the biggest source of gains to developing countries is the removal of their own barriers to trade. In principle, these gains would be available whether the industrialized countries also followed a path of trade liberalization. These authors also look at the reasons why developing countries may not choose to liberalize, in

spite of the potential gains. The two most important considerations are the loss of revenue due to tariff reductions, and the economic and social disruptions caused by rapid displacement of workers from agriculture.

There are other concerns that could be raised with trade liberalization and these relate to adjustment costs of trade liberalization. Ghana, for example, faces adjustment costs from signing an Economic Partnership Agreement (EPA) that includes tariff revenue losses and the costs of fiscal reform; the creation of safety nets to address employment loss; adjustment measures for losses in competitiveness; and the restructuring of domestic production (Patel, 2007). A study by the Commonwealth Secretariat estimates that for all African, Caribbean and Pacific (ACP) countries these adjustment costs will require €9.2 billion in assistance (Grynberg and Clarke, 2006). An EPA has the potential to streamline existing West African regional initiatives and to enhance the credibility of regional integration. Nevertheless, if the current weaknesses stemming from conflicting and overlapping regional trade agendas are not sufficiently addressed before West African countries enter into an EPA, then the conclusion of such an agreement with the EU risks further undermining the development of regional markets (Patel, 2007). This brings forth the question of what type of fiscal reforms should be adopted by developing countries to liberalize their trade and reap the benefits of trade. According to Baker and Weisbrot (2001), this type of fiscal reform could be one in which the lost tariff revenue is replaced by an increase in non-distortionary lump sum taxes. The other alternative is to finance trade liberalization through foreign capital inflows.

Foreign capital inflows comprise remittances from abroad, foreign aid, foreign direct investment (FDI), portfolio investment and commercial bank lending. Remittances from the rest of the world to households directly affect their incomes and can reduce poverty (Gustafsson and Makonnen, 1993; Siddiqui and Kemal, 2002b; Taylor et al., 2005; Adams, 2005; Bhasin and Obeng, 2006). Foreign aid can reduce poverty through its impact on households' incomes via public current spending and capital expenditures (Anderson and Evia, 2003). It is argued that a direct link between FDI and poverty reduction does not exist, although three indirect links are possible. First, FDI-induced increases in national income offer a potential to benefit the poor. Second, well-developed linkages between foreign firms and local suppliers may generate employment opportunities for the poor. Third, FDI may lead to higher wages. FDI can affect households' incomes and reduce poverty through additional private and public investment (Siddiqui and Kemal, 2002a; and Arbenser, 2004).

Trade liberalization in Ghana is characterized by the removal of quantitative restrictions on the current (import licences and banned items) and capital accounts (restrictions on the repatriation of profits), simplification of the tariff structure, and lowering the level and range of tariffs. In this study we concentrate on the level of tariffs and thus define trade liberalization as the removal of import and export tariffs on agricultural and industrial goods as well as the removal of restrictions on the capital account of the balance of payments. Moreover, the trade liberalization is unilateral and partial sector-wise because only one form of trade-related tariff on agricultural and industrial goods is eliminated at a point.



## Research problem

Despite the adoption of trade-related and fiscal reforms in Ghana, growth has not accelerated and poverty remains widespread and pervasive, particularly in the rural areas. Trade and fiscal reforms are recognized as a potent tool for enhancing growth, redistributing income and reducing poverty. It is generally believed that trade liberalization is poverty-alleviating in the long run, although it may be poverty-enhancing in the short run. The impact of trade liberalization on the poor also depends on the sectors in which trade reforms take place. Many multilateral agencies, such as the World Bank and the International Monetary Fund (IMF), have started to condition their funding operations in developing countries on the progress achieved nationally with respect to poverty reduction policies and trade liberalization measures. This requires an assessment and the quantification of the impacts of economic policies on the poor.

Trade liberalization envisages a fall in tax revenue that can be compensated by foreign savings or domestic savings. Foreign capital inflows generally come to the developing countries with conditionality. If the developing country does not want to accept the conditional funding then it may have to finance trade liberalization through domestic resources. One of the ways to do this is to raise the value-added tax (VAT). The study tries to provide answers to the following questions: What is the relationship between trade liberalization and poverty and income distributions in Ghana? Is it poverty-alleviating or poverty-enhancing? What is the contribution of trade liberalization to poverty? What is the contribution of foreign capital inflows to poverty? What is the contribution of VAT to poverty? What is their combined effect on poverty and income distribution?

Computable general equilibrium (CGE) models represent an important tool for such analysis because they can explain the interlinkages among the various sectors of the economy and the agents present in the model. CGE models have therefore been widely used to simulate the impact of macroeconomic policies on income distribution and poverty. For trade liberalization specifically, its impact on poverty and income distribution can be examined by using both social accounting matrixes (SAMs) and CGE models. The SAM is a comprehensive, disaggregated, consistent and complete data system that captures the interdependence that exists within a socioeconomic system.

One can identify three types of CGE models that try to address this question. The first type considers only the representative agent and provides information on inequalities between groups without giving any results in terms of poverty. This strand of literature includes Adelman and Robinson (1979) for Korea; Dervis et al. (1982) and Gunning (1983) for Kenya; Thorbecke (1991) for Indonesia; Morrisson (1991) for Morocco; Chia et al. (1994) for Côte d'Ivoire; and Obi (2007) for Nigeria. The second type of modelling is grounded on the previous one but includes information on intragroup income distributions and endogenizes poverty. Studies here include de Janvry et al. (1991), Decaluwe et al. (1999), Azis and Thorbecke (2001), Aka (2006), and Bhasin and Annim (2005). The third type of modelling is based on the second

type but endogenizes both the intragroup income distributions and poverty. Among those who have taken this approach are Cogneau and Robillard (1999), Decaluwe et al. (1999), and Chitiga et al. (2005).

## Objectives of the study

In this study we use the second type of modelling approach described above. It should be mentioned, however, that this approach by itself will not be able to capture all the channels by which trade liberalization will affect poverty and income distribution because the model being used is a static model. Since the CGE model is a real model, we consider only the real components of foreign capital inflows, e.g., foreign remittances, foreign aid and foreign direct investment. The financial inflows, e.g., portfolio investment and commercial bank lending are not considered in the model.

The basic objective of the study is to assess the impact of partial sector-wise trade liberalization on poverty and income distributions of households in Ghana. Specifically, this is achieved by developing three scenarios: Elimination of import and export tariffs on agricultural and industrial goods (final goods as well as inputs) is considered in the first scenario. In the second scenario, partial sector-wise trade liberalization is combined with foreign capital inflows, while the third scenario combines partial sector-wise trade liberalization with VAT.

## Trade, VAT policy and simulations

Since adopting a more liberal, outward-oriented and private sector-led development strategy in the mid 1980, Ghana has liberalized its imports through the compression of the tariff structure, simplification and reduction of tariff rates, and the removal of non-tariff barriers to imports. It has also liberalized payments arrangements by dismantling foreign exchange controls. In West Africa, the West African Economic and Monetary Union (UEMOA) instituted a common external tariff (CET) of four rates within the range of 0%–20% and Ghana has implemented this CET structure. Trade liberalization has also become a permanent component of the economic policy reform agenda of the Economic Community of West African States (ECOWAS). Unilateral trade liberalization and ECOWAS tariff harmonization programmes have produced a more open trade regime in Ghana. According to Ajakaiye and Oyejide (2005), Ghana is a “relatively open” trade regime with simple average tariff rates of 10%–14% and a maximum ad valorem tariff of 233%. Across the continent, another example is the East African Community CET, which has an upper band of 25%; this rate now determines the Ugandan ad valorem tariff rates. For Ghana to move to the category of “open” trade regime there is a need to reduce the simple average tariff rate by 0%–9% and maximum ad valorem tariff rate to 25% like Uganda. That is why we are advocating complete elimination of import and export tariffs on agricultural and industrial goods in this study.

Ghana also moved from stringent foreign investment control in the 1960s to its active promotion from the late 1980s by enacting or revising investment codes to

liberalize the conditions under which foreign investment would be permitted. These codes guaranteed national treatment for foreign investors post-establishment, plus freedom to transfer capital and earnings, as well as full compensation in the event of expropriation. In addition, all West African countries offer further international protection to foreign investors through their membership in the Multilateral Investment Guarantee Agency (MIGA) and International Centre for the Settlement of Investment Disputes (ICSID). During the 1990s, Ghana attracted substantial FDI inflows into the telecommunications and mining sectors through the privatization of public enterprises. While more and more sectors have been opened to foreign investment, Ghana continues to reserve certain subsectors for its nationals. Moreover, Ghana imposes a limit of 40% on foreign ownership of insurance businesses.

VAT is an important component of tax reforms in developing countries (Goode, 1993). Advocates of the VAT argue that this system of tax on the average raises revenue, reduces misallocation of resources and creates a good audit trail. It also ensures tax neutrality in international trade and is non-cascading compared with the sales tax (Burgess and Stern, 1993). Ghana introduced the VAT in December 1998 to replace the sales tax after the first attempt failed in 1995. It has changed the rate twice since then: From 10% to 12.5% in June 1999, the 2.5% increase representing an education levy to be used for the development of educational institutions; from 12.5% to 15% in August 2004, with that increase slated to support the National Health Insurance Scheme. The threshold has also been lowered from 200 million cedis to 100 million cedis. Since the VAT rate was 10% in 1999 and is now 15%, we increase the VAT rate by 50% in the simulations in this study.

The study constructs 12 simulations to determine the effects of trade policy measures alone and in combination. The first three simulations concern agricultural imports and the second trio turns to agricultural exports. The first simulation simply eliminates trade-related tariffs on agricultural imported goods. The second simulation adds to this a compensating increase in foreign capital inflows equal to the fall in tax revenue of the government that are redistributed to households via transfer payments in proportion to their share in the transfer payments. In the third simulation, trade-related tariffs on agricultural imported goods are eliminated, with a 50% increase in VAT that is redistributed to the households via transfer payments in proportion to their share in the transfer payments. In the fourth simulation, trade-related tariffs on exported agricultural goods are eliminated. In the fifth simulation, trade-related tariffs on agricultural exports are eliminated with a compensating increase in foreign capital inflows equal to the fall in tax revenue of the government that are redistributed to the households via transfer payments in proportion to their share in the transfer payments. In the sixth simulation, trade-related tariffs on exported agricultural goods are eliminated with a 50% increase in VAT that is redistributed to the households via transfer payments in proportion to their share in the transfer payments.

The process is repeated with another six simulations featuring industrial goods – three for imports and three for exports. The seventh simulation eliminates trade-related tariffs on imported industrial goods, while the eighth also eliminates tariffs on imported industrial goods, but compensates with an increase in foreign capital inflows equal to the fall in tax revenue of the government that are redistributed to the households via

transfer payments in proportion to their share in the transfer payments. In the ninth simulation, trade-related tariffs on imported industrial goods are eliminated with a 50% increase in VAT that is redistributed to the households via transfer payments in proportion to their share in the transfer payments.

The tenth simulation eliminates trade-related tariffs on exported industrial goods. In the eleventh simulation, trade-related tariffs on exported industrial goods are eliminated with a compensating increase in foreign capital inflows equal to the fall in tax revenue of the government that are redistributed to the households via transfer payments in proportion to their share in the transfer payments. In the twelfth simulation, trade-related tariffs on industrial exported goods are eliminated with a 50% increase in VAT that is redistributed to the households via transfer payments in proportion to their share in the transfer payments.

## 2. Trade liberalization and poverty reduction in Ghana

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Trade liberalization in Ghana is characterized as the removal of quantitative restrictions on the current and capital accounts, simplification of the tariff structure, and lowering of the level and range of tariffs. Different political regimes and their trade liberalization policies are summarized in Table 1. Between 1961 and 1983, Ghana imposed import controls through import licences. During the early years of this period (1961–1969), a mixed policy was adopted with respect to foreign capital inflows and as a result Ghana was successful in attracting FDI and foreign aid. During the period 1969–1983, however, a more restrictive policy towards foreign capital inflows was adopted and as a result both FDI and foreign aid declined.

Ghana then pursued a more liberalized policy on the current as well as capital accounts of the balance of payments and was again successful in attracting foreign resources. Since 1983, most of the quantitative restrictions, including import licensing, have been eliminated. The tariff structure has been simplified while the level and range of tariffs have been reduced.

Table 1: Political regimes and trade liberalization

Political regime	Time period	Trade and capital flows policy
Nkrumah Regime	1961-1966	Import licences introduced, liberal and restrictive policy for capital flows, FDI increased
National Liberation Council	1966-1969	Controlled trade pursued, liberal policy for capital flows, programme aid increased
Busia Regime	1969-1972	Import controls abolished, export promotion package introduced, restrictive policy for foreign flows, foreign inflows reduced
Acheampong Regime	1972-1978	Import controls tightened, restrictive policy for capital flows, FDI reduced
Akufo Regime	1978-1979	Import controls continued, restrictive policy for capital flows, FDI reduced
Limann Regime	1979-1981	Import controls continued, restrictive policy for capital flows, FDI and foreign aid reduced
Rawlings Regime I	1981-83	Restrictive trade and capital flows policy
Rawlings Regime II	1983-2000	Foreign exchange retention scheme introduced, economic recovery programme initiated, tariff structure simplified and tariffs reduced, import licences abolished, structural adjustment programme initiated, trade and investment programme launched, trade and investment reform programme introduced, liberalized policy for capital flows, foreign capital inflows increased
Kuffour Regime	2000-	Ghana declared as HIPC, Ghana Poverty Reduction Programme launched, tariff structure simplified and tariffs reduced, liberalized policy for capital flows, aid inflows increased, president's special initiatives for cassava, garments and textiles launched, VAT rate increased from 10% to 15%

Source: Author's compilation.

trade barriers, but does maintain absolute and conditional prohibitions on a number of goods for environmental, health, morality, public safety and security reasons under international conventions. Absolute prohibitions cover diseased animals and carcasses, contaminated food, scandalous literature, obscene articles, dangerous weapons and illegal goods. Rough or uncut diamonds are conditionally prohibited and may be imported under licence from the Minister of Finance and Economic Planning. Ghana does not impose tariff quotas on imports and neither trade embargoes nor any local-content requirements for domestic production are applied. Ghana has no legislation on contingency protection measures, such as anti-dumping, countervailing measures and safeguards.

The average export tariff rates and their breakdown according to cocoa and non-cocoa products are presented in Table 3. During the period 1983-1994, the average

## Ghana's tariff structure

Actual import duty schedule/rates of broad import categories are shown in Table 2. Ghana fully implemented the Harmonized Commodity Description and Coding System (HS) of classifying imports and exports to replace the Customs Cooperation Council Nomenclature (CCCN) on 1 January 1990. The introduction of HS increased the number of tariff lines in the Ghanaian Customs Tariff. The general change in tariff rates following harmonization was the reduction of duties on capital goods and raw materials from 15% to 10% in the 1990 budget. Tariffs on consumer and luxury goods of 20% and 25%, respectively, were more than double that on capital goods and raw materials (10%) in 1990. The luxury goods were taxed at a higher rate so as to maximize the revenue of the government. The 1993 budget changed tariff rates on raw materials from a flat rate of 10% to a range from 0%–10%. In the 1997 budget, tariff rates on concessionary goods were reduced from 10% to 0%, consumer goods from 25% to 10%, capital goods from 10% to 5%, and raw materials from a range of 0%–10% to 0%–5%. Tariff rates on luxury goods were reduced from 25% to 20% in 2000. Ghana's tariff structure has "built-in" tariff escalation within certain manufacturing groups, especially textiles, leather, chemicals, basic metals, food, beverages and tobacco.

Under the ECOWAS trade liberalization scheme established in 1990, Ghana provided preferential tariff reductions of 20% on imports of a few goods from some countries that had been granted community status. Products from member states that qualified for preferential treatment attracted rates of 8%, 16% and 20%, whilst similar items from other countries attracted duty rates of 10%, 20% and 25%, respectively. Since 1996, however, most imports from member countries attract duty free rates. Ghana provides duty-free preferences on a range of unprocessed agricultural products and several industrial products imported from producing enterprises, sited within member countries, that are eligible to receive such preferential treatment. Eligibility is based on whether the imports meet the ECOWAS rules of origin and have sourced at least 60% of their raw materials from within the Community.

Quantitative restrictions were implemented through the issue of import licences and banning of items up to the year 1988. The import licensing system was abolished in 1989 but the banning of items continued. Presently, Ghana applies few formal non-tariff

**Table 2: Actual Import Duty Schedule/Rates (%) of Broad Import Categories (1983-2003)**

Item	1983	1984	1985	1986	1987	1988	1989	1990
Concessionary	10-20	10-20	20-25	10-20	10-25	10-25	10	
Consumer Goods	30	30	30	25	35	20	20	20
Capital Goods	30	30	30	20	25	15	15	10
Raw Materials	25-30	25-30	25-30	10-20	15-20	10-15	10-15	10
Luxury	30	30	30	30	30	25	25	25

Item	1991	1992	1993	1994	1995	1996	1997	1998
Concessionary		0	0	0	0	0	10	0
Consumer Goods	20	20	20	25	25	25	10	10
Capital Goods	10	10	10	10	10	10	5	5
Raw Materials	10	10	0-10	0-10	0-10	0-10	0-5	0-5
Luxury	25	25	25	25	25	25	25	25

Item	1999	2000	2001	2002	2003
Concessionary	0	0	0	0	0
Consumer Goods	10	10	10	10	10
Capital Goods	5	5	5	5	5
Raw Materials	0-5	0-5	0-5	0-5	0-5

documentation now required is the exchange control form (A2) and the customs entry form. All primary manufactured exports are dutiable at zero rates. Export duty on cocoa beans is levied at a rate determined annually by the Minister of Finance and Economic Planning. Gold and diamonds from small-scale mining are exported mainly by the Precious Minerals Marketing Corporation. Exports of logs were suspended in 1995, with the aim of promoting timber processing. Raw rattan and bamboo exports are also prohibited. Ghana has no export quotas or voluntary export restraints, and no export subsidies.

## Revenue and expenditure of the Government of Ghana



export tax rate ranged between 28.69% and 5.30%, cocoa tax between 70.18% and 18.28%, and non-cocoa tax between 5.21% and 0%. Export procedures have been simplified over recent years with the abolition of the export licensing system. From 32 separate steps required to export in 1984, only eight are now necessary. The only

Table 3: Export tariff rates (%)

Year	Export tax rate	Cocoa tax rate	Non-cocoa tax rate
1983	28.69	70.18	2.16
1984	21.73	31.08	5.21
1985	27.38	44.51	2.29
1986	18.12	33.17	0.77
1987	18.34	39.77	0.03
1988	11.89	38.51	0.00
1989	11.34	30.08	0.00
1990	8.95	18.28	0.00
1991	8.18	23.54	0.87
1992	8.74	28.49	0.70
1993	5.30	19.91	0.42
1994	14.80	50.08	0.00

Source: Oduro (2000).

The fiscal position of the Ghanaian economy has been the major concern of both the immediate past government and the current government. The underpinning issue to contend with is the nation's ability to restrain its expenditure within the limits of its revenue capacity. The composition of tax revenue and non-tax revenue is presented in Table 4. On average, tax revenue contributes slightly above three-quarters of Ghana's total revenue, with the non-tax element contributing the remaining quarter. In 1999, the share of tax revenue in total revenue was 82.21% and that of the non-tax revenue was 17.79%. The tax revenue comes from direct taxes, indirect taxes and international trade taxes. The non-tax revenue comes from grants, income and fees, and divestiture of public enterprises. Direct taxes are levied on income and property of individuals and businesses. In 1999, direct taxes contributed about 29.72% to the total tax revenue. The major source of direct tax revenue was corporate tax followed by income tax.

Indirect taxes comprise VAT on both domestic and imported products, petroleum tax, and other indirect taxes. The VAT rate was 10% in 1999 and, as noted above, it is now 15%, comprising the basic rate (10%), an educational levy (2.5%) and a national health insurance levy (2.5%). In 1999, indirect taxes contributed 44.12% to the total tax revenue. The major source of indirect tax revenue was VAT followed by petroleum tax. International trade taxes are levied on imports and exports. In 1999, international trade taxes contributed 26.16% to the total tax revenue. The major source

of international trade tax revenue was import duties followed by export duty. Import duties contributed 26.61% and export duties contributed 6.91% towards the total revenue of the government. Grants accounted for 8.04% of the total non-tax revenue in 1999.

The composition of recurrent and capital expenditure is presented in Table 5. In 1999, recurrent expenditure accounted for 62.7% and capital expenditure for 37.3% of the total government expenditure. The recurrent expenditure comprises non-interest

Table 4: Composition of tax and non-tax revenue, 1999–2002 (%)

Components	1999	2000	2001	2002
Direct taxes (% of total tax revenue)	29.72	31.93	32.39	32.70
PAYE	33.82	34.97	31.90	33.23
Self-employed	6.63	5.46	5.36	6.18
Companies	53.95	50.42	45.51	41.55
State enterprise	1.65	1.51	-	-
Others direct taxes	4.05	7.64	17.23	19.04
Indirect taxes (% of total tax revenue)	44.12	45.72	43.69	43.96
VAT (domestic and Import)	53.11	63.02	68.56	61.50
Petroleum tax	30.15	26.35	22.57	28.70
Other Indirect taxes	11.74	10.63	8.87	9.80
International trade taxes (% of total tax revenue)	26.16	22.35	23.92	23.34
Import duties	68.66	81.88	80.87	81.51
Export duties	31.44	18.12	19.13	18.49
Grants (% of total non-tax revenue)	8.04	10.06	18.22	14.75

Source: Ministry of Finance.

goes into salaries. Spending on social programmes for poverty reduction such as health and education has been low, thus constraining poverty reduction efforts. For instance, the levels of spending on health and education at 2.0% and 2.8% of GDP, respectively, are much lower than African averages and a disproportionate amount of the resources is used for personnel emoluments and administration. Capital expenditure comprises domestically financed and foreign financed capital expenditure. In 1999, foreign financed capital expenditure accounted for 21.5% and domestically financed capital expenditure for 15.8% of the capital expenditure.

## Role of foreign resources in Ghana

and interest expenditure. The non-interest expenditure includes the expenditure on wages and salaries, administration and services, subventions, transfers, and utility price subsidies. The interest expenditure includes expenditures incurred on interest payments for domestic and foreign debt. Non-interest expenditure dominates recurrent expenditure, with wages and salaries being the major spending category. In 1999, transfers accounted for only 5.5% of the non-interest recurrent expenditure. The interest payment on domestic debt dominated the interest recurrent expenditure. Government expenditure has been biased in favour of recurrent expenditure, the majority of which

**Table 5: Composition of Recurrent and Capital Expenditure, 1999-2002 (%)**

Components	1999	2000	2001	2002
<b>Recurrent Expenditure (% of Total Expenditure)</b>		<b>62.70</b>	<b>69.90</b>	<b>58.14</b>
<b>76.60</b>				
Non-Interest	41.40	39.90	35.39	53.13
<i>Wages and Salaries</i>	21.50	18.90	25.97	32.85
<i>Administration and Services</i>	9.00	9.30	7.02	11.37
<i>Subventions</i>	5.30	5.90	-	-
<i>Transfers</i>	5.50	5.70	2.40	5.39
<i>Utility Price Subsidies</i>	-	-	-	3.52
Interest	21.30	27.00	22.75	23.47
<i>Domestic</i>	16.20	19.20	18.85	17.30
<i>External</i>	5.20	7.80	3.90	6.18
<b>Capital Expenditure (% of Total Expenditure)</b>		<b>37.30</b>	<b>33.10</b>	<b>41.86</b>
<b>23.40</b>				
Domestic Financed	15.80	15.20	13.03	10.47
Foreign Financed	21.50	17.90	28.83	12.93

Source: Ministry of Finance

A breakdown of foreign resources, shown in Table 6, reveals that foreign borrowing is the most prominent source of foreign resources in Ghana. Foreign borrowing amounted to US\$620.1 million in 1999, and rose to US\$900.2 million in 2002. Private remittances sent to households and firms from abroad increased from US\$472.0 million in 1999 to US\$680.0 million in 2002. Foreign aid has declined continuously since 2000, while FDI has declined since 1999. Portfolio investment, on the other hand, increased from US\$12.0 million in 2000 to US\$94.7 million in 2002. In total, the foreign resources fell from US\$2,004.4 million in 1999 to US\$1,795.4 million in 2002. To overcome this, the government may have to work harder to attract more foreign aid, FDI and portfolio investment to build the capital base of the economy and at the same time reduce poverty. For this to happen, the private sector has to perceive a more attractive environment and greater consistency in the application of policies and regulations.

Table 6 : Composition of foreign resources, 1999–2002 (US\$ million)

Components	1999	2000	2001	2002
Foreign borrowing	620.1	630.9	959.1	900.2
Foreign private remittances	472.0	499.0	709.7	680.0
Foreign aid	451.7	513.0	341.6	194.3
Foreign direct investment	226.7	114.9	89.3	50.0
Portfolio investment	47.5	12.0	26.0	94.7
Commercial bank lending	186.4	40.8	144.3	-123.8
Total foreign resources	2,004.4	1,810.6	2,270.0	1,795.4

Source: Bank of Ghana.

## Poverty reduction in Ghana

Poverty in Ghana has many dimensions. Poor communities are characterized by low incomes, malnutrition, ill health, illiteracy and insecurity. There is also a sense of powerlessness and isolation. These different aspects interact and keep households and communities in persistent poverty. Using Ghana Living Standards Survey data, the Ghana Statistical Service (GSS, 2000) classified the incidence (including extreme poverty), depth and severity of poverty into two broad groups of rural and urban. Each of these groups was in turn subdivided into forest, coastal and savannah regions, with the capital, Accra, standing alone. It (GSS) also included the contribution of the ecological zones to total poverty in the country. Both the food energy intake method and the cost of basic needs method were used in determining the poverty lines used in the construction of the poverty profile.

Upper and lower poverty lines were used, with the latter being the extreme or critical poverty line. A comparison was also made between poverty in 1991/92 and 1998/99. The overall trend in poverty during the 1990s has been broadly favourable in Ghana. Taking the upper poverty line of 900,000 cedis, the percentage of the Ghanaian population defined as poor fell from almost 52% in 1991/92 to just less than 40% in 1998/99. At the national level, the incidence of consumption poverty declined by 12.2% during this seven-year period. The GSS found that poverty is substantially higher in rural areas than urban areas and is disproportionately concentrated in the Rural Savannah. Moreover, the decline is not evenly distributed according to ecological zones or regions.

The reduction in consumption poverty has been highest in Accra and the forest ecological zone. In some areas, poverty has fallen only very marginally, or even increased. In some of these areas, notably in the Rural Savannah, the situation of the very poorest worsened. And even though the incidence of poverty has fallen, the depth of poverty for those who remain poor remains relatively stable. The declines in poverty have been concentrated mostly in Western, Greater Accra, Volta, Ashanti and Brong Ahafo regions. Some regions (Central, Northern, Upper East) have experienced increases in poverty. Upper West and Eastern regions showed only small decreases in poverty. Large poverty reductions occurred among employees in both the formal and

informal private sectors and among public sector wage employees, but export farmers experienced the largest reduction in consumption poverty. Poverty reduction among the large numbers of food crop farmers, on the other hand, has been smaller.

Because poverty is a multidimensional phenomenon, consumption-based measures need to be supplemented by other welfare indicators. Thus, poverty can be analysed in terms of household ownership of durable goods and housing characteristics (drinking water, toilet facilities and use of electricity), as well as human development indicators (health and education). The proportions of Ghanaian households owning most durable goods showed large increases between 1991/92 and 1998/99, with increases being observed in both urban and rural areas. In addition, there were significant improvements during this period in the number of households obtaining their drinking water from a safe source, using adequate toilet facilities, and having access to electricity in both rural and urban areas.

For health services, however, compared with 1991/92, Ghanaians are less likely now to consult well-qualified health personnel or to go to a hospital when they are ill or injured. On the other hand, enrolment rates in primary and secondary school improved quite sharply during this period. Now, more than four out of five Ghanaian children in the relevant age-group are attending primary school. Although the increases in net enrolment rates at secondary level have been much bigger for girls than boys, rates for girls still remain below those for boys.

The incidence of poverty in Ghana is still very high and there is a need to alleviate poverty. In the present study, the monetary poverty line of cedis 665,300 per annum was obtained from the consumption basket of the bottom 20% of the distribution of individuals by their standard of living, which provided 2,900 kilocalories per adult equivalent per day. The commodities included in this consumption basket were about 120 that belong to agricultural, industrial and services sectors.

Traditionally, Ghana has largely relied on public savings and foreign loans and grants to fund its development programmes. For instance, the nation's Medium-Term Development Plan was largely financed by public borrowing from either domestic or foreign sources. Overlooked in all these financing endeavours has been the potential direct financing input from both the private sector and non-profit institutions. The financing strategy of the Ghana Poverty Reduction Strategy (GPRS) addresses this glaring omission by identifying innovative financing mechanisms that embrace the latter groups through a system of structured incentives and strategic partnerships.

For the private sector, three schemes will be implemented. These are the tax-exempt GPRS private sector fund, a long-term savings plan and a non-resident-Ghanaian fund for poverty reduction. The non-profit institutions should formulate GPRS-consistent action plans for poverty reduction and their tax-exempt status will be linked to poverty-related outputs specified in the action plan. Partnerships between government and private sector entities for providing public goods and services such as infrastructure, community facilities and related services will be encouraged. The following types of partnerships will be encouraged: The public sector contracts with a private partner to operate and maintain a publicly-owned facility (waste removal, road maintenance, etc.); and the private partner designs, finances and builds a facility and then leases it to government for a specified time, after which ownership vests with government.

Ghana is likely to enjoy some goodwill from bilateral and multilateral partners that have endorsed the GPRS I and GPRS II. The IMF welcomed the GPRS I and accordingly committed SDR 184.5 million under its Poverty Reduction and Growth Facility (PRGF) in support of the government's economic reform programme for 2003–2005. In addition, the IMF is providing interim assistance under the enhanced HIPC Initiative of SDR 15.15 million. These allocations of IMF aid are likely to be followed by other donors in support of the intended economic reforms.

### 3. Literature review

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Policies of openness through liberalization of trade and investment regimes, and capital movements have been advocated worldwide for their growth and welfare enhancing effects. This perspective is based on the propositions embedded in the well-known economic theories of international trade and investment (i.e., the Ricardian comparative advantage theory, the Heckscher–Ohlin–Samuelson model, the new trade theories à la Krugman, or the model of inter-temporal international borrowing/lending or portfolio allocation models). In these models, the main growth-enhancing effects of openness are assumed to filter through two channels. One is static efficiency gains associated with improved resource allocation for national economies as well as for the world economy as a result of increased specialization. The second encompasses dynamic efficiency gains from such factors as economies of scale, diffusion of information, technology transfers and knowledge spillover effects, as well as inter-temporal trade gains from cross-border borrowing/lending for increased investment and consumption smoothing and portfolio risk diversification.

According to Bourguignon (2002, 2004) absolute poverty reduction could be achieved through two effects: The growth effect, i.e., the effect of the growth rate of the mean income of the population; and the distribution effect, i.e., the change in the income distribution. In order to analyse and understand the impact of openness on poverty and income distribution, both these links have to be scrutinized. The first link is from openness to growth. The main manifestation of openness is through trade and capital movement liberalization, which in turn is presumed to affect growth directly through three sub-channels: Exports, imports and capital inflows. Trade liberalization policies encourage exports, which benefits export industries and contributes to GDP growth. The link between increased imports and growth arises when a country switches from a regime of import substitution to one of trade liberalization; this will, in the short run, hurt the previously protected domestic industries and elicit a fall in fiscal revenues as a result of lower tariffs. In time, however, the initial negative consequences

tariffs. On the other hand, the reduction in the incidence of poverty ranged from 0.7 to 11.3 percentage points and the increase in the incidence of poverty from 6.1 to 16.4 percentage points because of the increase in indirect taxes.

Arbenser (2004) examined the impact of FDI on incomes of households in Ghana using the 1993 SAM. In the model, the author disaggregated households into four groups. Household urban skilled, household urban non-skilled, household rural agriculture and household rural non-agriculture. Three counterfactual simulations were carried out in this study. Simulation 1 consisted of a 50% increase in FDI inflows with endogenous foreign exchange rate and fixed current account balance. The second simulation involved a 50% cut in tariffs with flexible government savings and mobile factors. The third was a mixture of simulations 1 and 2. The study shows that increase in FDI inflow raises household income by more than 1.3%; household urban skilled registered the highest percentage increase in income followed closely by household rural agriculture, while the least income gain accrues to household urban non-skilled. The study also establishes that increased FDI inflow and reduced tariff levels are complementary policies that enhance household welfare.

Bhasin and Annim (2005) used the 1999 SAM for Ghana and a static CGE model to analyse the impact of eliminating trade taxes accompanied by an increase in VAT on the incidence, depth and severity of poverty and income distributions of five categories of households: Agriculture farmers, private sector employees, public sector employees, non-farm self-employed and non-working. The study looked into the impact of two shocks on poverty and income distributions. The first shock takes the form of the elimination of trade-related import taxes on goods and services accompanied by an increase in VAT by 100%. The second shock involves the elimination of export taxes on goods and services accompanied by a 100% increase in VAT. The study showed that the first shock reduces the incidence, depth and severity of poverty, and improves the income distributions of households. In the first simulation, reduction in the incidence of poverty ranges from 0.71 to 1.50 percentage points, the depth of poverty from 0.25 to 0.67 percentage points, and the severity of poverty from 0.25 to 0.38 percentage points. The mean income improvement ranges from 1.31% to 3.86%. Although this result may appear unconventional, it is obtained because of the closure rule that allows a transfer of the VAT revenue to households. The VAT revenue in Ghana could be transferred to households through poverty alleviation programmes. The study also showed that the second type of shock increases the incidence, depth and severity of poverty, and worsens the income distributions of households. In the second simulation, the incidence of poverty increased by 0.18–0.22 percentage points, the depth of poverty by 0.04–0.11 percentage points, and the severity of poverty by 0.03–0.09 percentage points. The mean income reduction ranges from 3.81% to 4.08%.

Using a CGE model and the SAM for 1995, Chitiga et al. (2005) studied the impact of trade liberalization on poverty in Zimbabwe. Their model contained 16 production sectors, four factors of production (skilled labour, unskilled labour, capital and land) and 14,006 households categorized by location and skill. The authors employed a microsimulation through which household data were incorporated into the CGE model and then simulated the model with individual households. The simulation involved total removal of import tariffs, which reduced overall poverty in the economy, more



on output are likely to be more than compensated by a more efficient allocation of resources and benefits of competition, leading to a higher growth path. The third sub-channel operates through the impact of FDI and portfolio and other capital flows on domestic output and growth. If FDI takes the form of “greenfield” investment as opposed to investment through merger and acquisition, much of the capital inflow from transnational corporations (TNCs) tends to be converted directly into factories producing new products.

Winters et al. (2004) hold that trade liberalization could affect poverty through economic growth, households and markets, wages and employment, and government revenue and spending. Trade liberalization and openness stimulate long-run growth and income, sustained growth requires increases in productivity, and macroeconomic volatility may have adverse effects on growth. Trade liberalization could affect poverty through changes in the sources of incomes of households, consumption and investment decisions, transmission of price changes, response of markets, spillover benefits, and the vulnerability of the households. The other channel through which trade liberalization can affect poverty is through wages, employment and transitional unemployment. Finally, trade liberalization affects poverty through changes in government revenue and spending.

The second link is between income distribution and poverty. The income distribution effects induced by a shift in relative product prices in the process of opening up trade are well-known, as postulated in the Stolper-Samuelson theorem of international trade theory. The losers (especially the poor residing in either urban or rural areas) may be vulnerable to these induced effects in addition to changes in absolute and relative prices of wage goods (Williamson, 2002). Thus, trade liberalization can affect poverty directly through relative price changes in factor markets and goods markets. According to the Stolper-Samuelson theorem as applied to within-country inequality, developing countries well-endowed with unskilled labour should experience a decline in income inequality through an increased demand for unskilled labour, while unskilled labour in developed countries would lose out with an adverse effect on equity.

CGE models have been used extensively to investigate the effects of policy change within an economy since they take into account interactions and interdependencies within the economy. Bussolo and Round (2003) used a CGE model and the 1993 SAM for Ghana to investigate the possible effects on poverty of a range of budget-neutral redistributive income transfers. The classification of households was based on agriculture/non-agriculture, Savannah, Forest and Coast. They simulated four financing schemes for short-run and long-run factor market adjustment rules. The results of the study indicated that poverty outcomes were different according to which of the four rules – income taxation, corporate taxation, indirect taxes or tariffs – were chosen and the period under consideration. In this respect, the authors found tariffs as the financing scheme with the largest reduction in poverty, followed by indirect taxes, corporate taxes and household direct taxes in that order under the long-run factor market closure rule. The short-run outcomes were not very clear, except that there appeared to be an increase in overall poverty under the corporate tax financing rule. The reduction in the incidence of poverty ranged from 0.4 to 4.8 percentage points and the increase in the incidence of poverty from 1.3 to 7.6 percentage points as the result of increased

0.19–0.53 percentage points, and the severity of poverty by 0.14–0.27 percentage points. The Gini index shows that inequality increases for all the socioeconomic groups in these simulations.

The studies reported above enable us to develop an appropriate CGE model for Ghana that is consistent with the Ghana Living Standard Survey 4 and the social accounting matrix for Ghana, to adopt the appropriate technique of estimation. This entails a top-down approach using the CGE model on one side (the top dimension) and the household survey on the other (the down dimension) to figure out the consequences of a change in prices and factor returns on the household's income and poverty line, and to analyse the results – e.g., the theoretical framework linking trade liberalization, foreign capital inflows, VAT, and poverty and income distribution. It should be mentioned that the outcome of our simulations will also depend on specific conditions such as property rights, level of indebtedness and the business environment. Since it is difficult to incorporate property rights and business environments in a CGE model, we decide to incorporate the level of indebtedness, which is captured by net foreign borrowing.

The studies of Bussolo and Round (2003) and Arbenser (2004) used the 1993 SAM for Ghana, whereas Bhasin and Annim (2005) used the 1999 SAM. The present study adopts the 1999 SAM from Ghana from Bhasin and Annim (2005). The classification of households is also borrowed from Bhasin and Annim (2005). The study of Arbenser (2004) considered only FDI and its impact on income distribution, whereas this study examines the impact of three components (FDI along with foreign remittances and foreign aid and ) of real foreign capital inflows on poverty and income distribution.

There are other differences from existing studies. Bussolo and Round (2003) looked at the impact of budget-neutral financing schemes on poverty, ignoring the effect of reduction in import and export tariffs and capital flows on poverty and income distribution. Bhasin and Annim (2005) combined elimination of import and export tariffs with VAT and considered its impact on poverty and income distribution, but ignored sector-wise elimination of import and export tariffs. Here we look at the impact of partial sector-wise trade liberalization in isolation (elimination of tariffs on agricultural imported and exported goods, and industrial imported and exported goods), and combined with foreign capital inflows and VAT on poverty and income distribution. The CGE model of this study thus differs from those of Bussolo and Round (2003), Arbenser (2004), and Bhasin and Annim (2005) and is more comprehensive.

The conceptual framework linking trade liberalization, real foreign capital inflows, VAT and poverty is illustrated in Tables 7 and 8. Table 7 shows the linkages between a cut in import tariffs on goods and household poverty, and Table 8 summarizes the linkages between a cut in export tariffs on goods and household poverty. The targeted sector is the one in which import and export tariffs are reduced. For example, if the import and export tariffs are cut in the agricultural sector, then the targeted sector is the agricultural sector, whereas if the import and export tariffs are cut in the industrial sector then the targeted sector is the industrial sector. On the other hand, the complementary sector (services sector) expands or contracts with the targeted sector because of production linkages and composite demand for services. The competitive sector is the one that is competing for the factors of production and both the resources move from

so in urban areas, while inequality hardly changed. The decrease in the incidence of poverty ranges from 0.01% to 0.02%, the depth of poverty from 0.003% to 0.01% and the severity of poverty from 0.002% to 0.01%. The Gini index shows that the decrease in inequality ranges from 0.002% to 0.003%.

Aka (2006) used a CGE model to analyse the effects of removing trade taxes and instituting some fiscal reform on inequality and poverty in Côte d'Ivoire. The author used an aggregated SAM with three tradeable sectors and a non-tradeable sector, nine groups of households based on the ENV 1998 survey data, and the SCN 1993 Cote d'Ivoire national accounts. Four simulations were carried out in this study. The first considered the elimination of taxes on agricultural exported goods; the second involved the elimination of taxes on agricultural exported goods combined with an increase of 20% in indirect taxes; the third eliminated taxes on agricultural exported goods combined with elimination of taxes on imported goods, and the fourth involved the third simulation with an increase of 20% in indirect taxes. Poverty increases for all categories of households in simulations one and two. The increase in the incidence of poverty ranges from 0.31 to 4.05 percentage points, the depth of poverty from 0.63 to 1.69 percentage points, and the severity of poverty from 0.48 to 0.92 percentage points in simulations one and two. In simulations three and four, poverty decreases for all the groups, except for other food crop farmers and agricultural workers. Here, the incidence of poverty decreases by 0.01–1.48 percentage points, the depth of by

Table 7: Cut in import tariffs on goods and poverty

	Cut in import tariffs on goods ↓			
Composite prices change ←	Domestic import prices of the targeted sector fall ↓	→ Profitability of the targeted sector increases ↓		
↓	Imports of the targeted sector increase ↓	Production of the targeted sector increases ↓	→ Exports of the targeted sector increase	
↓	Imports of competitive and complementary sectors increase	Production of the complementary sector increases ↓	→ Exports of the complementary sector change	
↓	Production of the competitive sector falls ← ↓	Resources move from the competitive sector to the targeted and complementary sectors ↓		
↓	Exports of the competitive sector fall	Returns to factors increase ↓		
Poverty line decreases ↓		Household income increases ↓	← Reallocation of resources, FDI increases the capital stock of households, remittances increase household income, foreign aid increases household income via transfer payments, VAT increases household income via transfer payments	
→	Incidence, depth and severity of poverty decrease	←		

the competitive sector to the other sectors. For example, if tariff cuts are applied to the agricultural sector then the competitive sector is the industrial sector and vice-versa.

A cut in import tariffs on goods leads to a reduction in the domestic import prices of the targeted sector. Depending on the elasticity of substitution between imports and domestic demand and imports' share in total consumption, demand for imports of the targeted sector increases. Imports of the complementary and competitive sectors also increase because of the production linkages. The reduction in domestic costs caused by a cut in import tariffs increases the profitability of the targeted sector, leading to increased production of the targeted sector. Depending on the elasticity of transformation between exports and domestic supply and exports share in the domestic output, exports of the targeted sector increase. Owing to the production linkages between the targeted and complementary sectors, the production of the complementary sector also increases. The exports of the complementary sector may increase or decrease depending on the elasticity of transformation, exports share in the domestic output, and composite demand for services. With the expansion of the targeted and complementary sectors, resources move from the competitive sector to these two sectors and the production of the competitive sector declines.

Depending on the elasticity of transformation and exports share in the output, exports of the competitive sector decline. This sectoral reallocation of labour and capital thus increases returns to both of these factors. The incomes of all types of households increase because of the increase in factor prices, reallocation of existing resources and inflow of FDI, and remittances received from abroad and transfer payments received from the government that arise because of foreign aid or additional tax revenue (VAT). The cut in import tariffs of the targeted sector may increase or decrease the prices of composite goods depending on the composite supply and demand of goods and services. However, the net effect of the changes in the prices of composite goods is to reduce the poverty line. Higher household incomes and a lower poverty line reduce the incidence, depth and severity of households' poverty.

With a cut in export tariffs on goods, there is an increase in the domestic export prices of the targeted sector. The increase in domestic revenue caused by the cut in export tariffs increases the profitability of the targeted sector, leading to increased production of the targeted sector. Depending on the elasticity of transformation between exports and domestic supply and the share of exports in the domestic output, exports of the targeted sector increase. Demand for imports of the targeted sector increases according to the elasticity of substitution between imports and domestic demand and imports' share in total consumption. Imports of the complementary and competitive sectors also increase because of the production linkages. The production linkages between the targeted and complementary sectors and composite demand for services may cause either an increase or decrease in the production of the complementary sector. The exports of the complementary sector decrease depending on the elasticity of transformation, exports share in the domestic output and the non-tradeable nature of services. Expansion of the targeted sector and expansion or contraction of the complementary sector may move resources from the competitive sector to these two sectors and the production of the competitive sector will decline. Depending on the elasticity of transformation and exports share in the output, exports of the competitive sector decline. This sectoral

reallocation of labour and capital may increase returns to labour and either increase or decrease returns to capital. The incomes of all types of households increase because of these changes in factor prices, reallocation of existing resources, inflow of FDI and remittances received from abroad, and transfer payments received from the government that arise as a result of foreign aid or additional tax revenue (VAT). The cut in export tariffs of the targeted sector may increase or decrease the prices of composite goods depending on the composite supply and demand of goods and services. However, the net effect of the changes in the prices of composite goods is to increase the poverty line. Higher household incomes and higher poverty line may increase or decrease the incidence, depth and severity of households' poverty.

Table 8: Cut in export tariffs on goods and poverty

	Cut in export tariffs on goods ↓		
Composite prices change ↓	←	→ Profitability of the targeted sector increases ↓	
↓	Domestic export prices of the targeted sector increase	Production of the targeted sector increases ↓	→ Imports of the targeted, complementary and competitive sectors increase
↓	Exports of the targeted sector increase ←	Production of the complementary sector changes ↓	→ Exports of the complementary sector fall
↓		Resources move from the competitive sector to the targeted and complementary sectors ↓	
↓	Production of the competitive sector falls ←		
↓	Exports of the competitive sector fall	Returns to factors change ↓	
Poverty line increases ↓		Household income increases ↓	← Reallocation of resources, FDI increases the capital stock of household, remittances increase household income, foreign aid increases household income via transfer payments, VAT increases household income via transfer payments
→	Incidence, depth and severity of poverty may increase or decrease	←	

## 4. Features of the model and methodology

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current transfers from households, government and the rest of the world. The firms pay corporate tax to government that is proportional to their incomes. The disposable income of the firm is obtained after subtracting the corporate tax paid from its income. Savings of the firms are defined as the disposable income of the firms less current transfers from firms to households and the firm's purchases of goods and services. The savings of households and firms are known as private savings.

The income of the government is generated because of remuneration from capital; direct taxes collected from households and firms; VAT on domestic output for domestic use and imported goods and services; trade taxes on imports and exports; and foreign borrowing. Trade taxes on imports are proportional to the value of imports and trade taxes on exports are proportional to the value of exports. VAT is proportional to the value of the composite good. Savings of the government are defined as the income of the government less transfers from government to households and firms and government's purchases of goods and services. The tariffs alter the prices of imported goods for all sectors on which they are applied, thus influencing production as well as consumption. The impact on production is channelled through imported goods used as inputs into the production process as a component of the composite input. In addition, the imported good is also part of the composite good that enters into the households', firms' and government's utility function. The total savings comprise household savings, savings of firms, government savings and foreign savings (foreign capital inflows).

A linear expenditure system (Stone–Geary Function), a modification of the Cobb–Douglas and CES functions, introduces a minimum level of demand for each good and is assumed to describe the household demand for consumer goods. This demand system implies that each socioeconomic group has its own perception of the minimum commodity basket that it needs to satisfy, consistent with the socioeconomic characteristics and the overall standard of living of the group. This minimum basket is bound to be different for different categories of households. Each group is assumed to behave lexicographically in such a way that it first satisfies its minimum consumption



In this paper we use a general equilibrium model based on the works of Decaluwe et al. (1999), Siddiqui and Kemal (2002a), Aka (2006), and Bhasin and Annim (2005). This model represents a small open economy that has no influence on international markets. The model is developed in such a way that it is consistent with Ghana's 1999 SAM and Ghana Living Standard Survey 4 for 1999. The economy is assumed to have three production sectors (agriculture, industry, services), two factors of production (labour and capital) and five categories of households (agricultural households; public sector employees; private sector employees; non-farm self-employed; non-working).

The model is presented in five blocks (production and trade; income, taxes, savings and investment; demand; price; and equilibrium conditions and macroeconomic closure). In the production block, the production process is a two-step nested structure. At the top level, primary inputs (labour and capital) are combined with a Cobb–Douglas technology to make up value added; this is combined within a fixed coefficient Leontief technology with intermediate inputs at the second level to give the output. At any set of prices, producers in each sector maximize profits subject to their technology constraint. This type of production process provides intermediate demand for goods, labour demand and capital demand. The value of the parameter alpha (the elasticity of value added with respect to labour) is determined from the profit maximization rule, and the value of the constant for production function is determined from output. The double Armington assumption is used to distinguish imports and domestically produced goods, implying imperfect substitutability and to differentiate exports from goods for domestic use. The production possibility frontier of the economy is defined by a constant elasticity of transformation (CET) function between domestic supply and export, yielding the export supply function. The value of  $\gamma$  (distributive parameter of the CET function) is determined from the export supply function and the value of  $\theta$  (scale parameter of the CET function) is determined from CET. The value of the elasticity of transformation is determined exogenously.

We define a composite commodity, made up of domestic demand and final imports that is consumed by households, firms and government. We assume constant elasticity of substitution (CES) between domestic demand and final import demand and this provides the import demand function. The value of the parameter delta (distributive parameter of CES function) is determined from cost minimization rule and the value of  $\lambda$  (scale parameter of CES function) is determined from the CES. The value of the elasticity of substitution is determined exogenously. To make the results more robust, we perform a sensitivity analysis.

The households receive their income from primary factor payments, as well as current transfers from firms (dividends), government and the rest of the world. Dividends paid to households are proportional to the income of firms. The households pay income taxes that are proportional to their incomes. The disposable income of the household is obtained after subtracting income tax paid from the total income of the household. We define savings of households as disposable income less current transfers from households to firms and the rest of the world and purchases of goods and services. Firms receive their income because of remuneration from capital, and

for labour and capital, and the wage rate. The investment price index is determined by the price of composite good and goods share in total investment. The price index is determined by the value added price and the share of the good in value added.

The first equilibrium condition implies that the supply of composite goods must equal its demand (intermediate demand, households' consumption demand, firms' consumption demand, government consumption demand and investment demand). The second and third equilibrium conditions imply the equilibrium between the demand for primary factors and their supplies. The supplies of primary factors are fixed exogenously for any given year. Market clearing requires that total factor demand equal supply, and the equilibrating variables are the factor prices. The fourth and fifth equilibrium conditions describe macroeconomic equilibrium conditions for saving-investment balance and the balance of payments. Investment must equal the sum of domestic and foreign savings, and there are no constraints on borrowing from abroad. The exchange rate is fixed and acts as the numeraire; the balance of payments is always in equilibrium, with foreign savings equal to the current account balance.

CGE models are generally over determined and the way to render the model mathematically solvable is referred to as the closure rule. Normally, the choice of closure rule has implications for the workings of the model and the qualitative interpretation of the simulation results (Drud et al., 1985). It is also important to recognize that the choice of model closure rule depends not only on political and economic considerations but also on the nature of the problem at hand (Rattso, 1982; Decaluwe and Martens, 1988). The literature has brought forth three closure rules – external, government and macroeconomic closure. External closure defines how the domestic economy interacts with the rest of the world. Since the Ghanaian economy is a small open economy, the balance of trade (current account balance) is fixed exogenously through foreign savings. Government closure, which determines the manner of government modelling, has been dictated by specific country conditions. In modelling the government sector, we assume that government spending is determined endogenously and the government borrows from the rest of the world. The budget constraint remains the same in case of increases in foreign capital inflows but not in the case of VAT.

As for macroeconomic closure, closure rules must be mentioned with regard to investment-savings and factor market. We use the neoclassical closure indicating that aggregate savings determine aggregate investment and the model is savings driven. The other possibility is to assume that household savings are endogenously determined to achieve a given aggregate investment target, in which case the economy is said to be investment driven. With respect to factor market closure, we assume that all factors are mobile; factor prices adjust endogenously to clear the factors' markets. The other alternative is to assume the Keynesian fixed price regime with unemployment adjusting endogenously to clear the factor markets. Since it is difficult to get data on unemployment, we prefer the neoclassical closure rule with respect to factors' markets. The key parameter values for the static CGE model of Ghana are given in Table 9. The parameter values for constant elasticity of substitution and constant elasticity of transformation were assumed and were based on other developing country studies, whereas the parameter values for the others were calibrated.

The CGE model for Ghana is presented in Appendix A. It contains 51 basic

basket and if there is some discretionary income, it is spent on the purchases of additional quantities of these commodities. The poverty line is determined by a basket of goods reflecting basic needs (BN) consistent with Ravallion's (1994) approach to estimating absolute poverty. The monetary poverty line is obtained by multiplying the BN commodity basket by the respective prices. Since commodity prices are endogenously determined, so is the nominal value of this basket, i.e., the poverty line.

The firms also consume goods and services. The firm maximizes a Cobb–Douglas utility function subject to its income constraint and this yields the firm's demand function for goods and services. The government is viewed as purchasing the various commodities. The government is assumed to maximize a Cobb–Douglas utility function subject to its income constraint, which yields the government demand function for goods and services. The investment in each sector depends on total investment and the price index of investment goods. The demand for investment goods is determined by sectoral investment.

The value added price is determined from total production, its intermediate use and the value added. Since imports are subject to import duties and VAT, the import price is determined by import duties, the VAT on imports, the exchange rate and the world price of imports. The export price is determined by the world price of export, the exchange rate and the export tax. The price of the composite good is determined by the domestic demand for the domestic good, imports and composite good. Market price of domestic goods is determined by the VAT and the producer price of the good. The price of output is determined by the domestic supply of good, exports and the output of good. The rental on capital is influenced by monetary value of value added, demand

Table 9: Parameter values for the static CGE model of Ghana

Parameter	Agriculture	Industry	Services
Factor share of labour ( $\alpha$ ) $\alpha$	0.969	0.610	0.788
Production function constant	526.104	193.130	523.741
Constant elasticity of substitution	0.900	0.660	0.400
Distributive share parameter of CES function ( $\delta$ ) $\Delta$	0.350	0.485	0.365
Scale parameter of CES function ( $\lambda$ ) $\lambda$	1.742	2.071	1.772
Constant elasticity of transformation	2.000	2.000	2.000
Distributive share parameter of CET ( $\gamma$ ) $\gamma$	0.736	0.583	0.986
Scale parameter of CET function ( $\theta$ ) $\theta$	2.532	2.104	16.673

Source: Author's calculations and assumptions.

equations, comprising 10 equations for the production and trade block; 16 for the income, taxes, savings and investment block; eight for demand for the commodities block; 12 for prices; and five for equilibrium conditions and macroeconomic closures. Since there are three production activities and five categories of households, the total number of equations to be solved is 147. There are 147 endogenous variables and 33

exogenous variables, thus containing as many endogenous variables as equations.

The model is calibrated to the 1999 GLSS4 data set. The GAMS software is used to check for the consistency of the data with the equilibrium conditions and to perform the simulations. The benchmark equilibrium must be replicated with the use of calibrated parameters and base-year data. The pre-shock values for the variables are obtained from the solution of the specified model. The post-shock effects of these simulations are used to find the effects on poverty line and the incomes of households. The DAD software is used to evaluate the poverty measures and PCGive software is used to plot the income distributions of households before and after the exogenous shocks. The pre-shock and post-shock poverty levels are obtained using Foster, Greer and Thorbecke (FGT) poverty measures.

$$POV_{k,h} = \int_0^z [(z - y_h)/z]^k f(y_h) dy_h, \quad k= 0,1,2$$

where  $y_h$  is the income of household  $h$ ,  $k$  is a poverty-aversion parameter and  $z$  is the endogenously determined poverty line. The incidence of poverty is indicated by  $k= 0$ . The depth of poverty is indicated by  $k= 1$ , and the severity of poverty by  $k= 2$ . Since CGE models are fully calibrated on the basis of an initial year SAM that provides a set of consistent initial conditions and the SAM does not contain information on intra socioeconomic household group income distribution, it is advisable to generate the intra group income distributions in the same base year as that of the SAM to calibrate the CGE model. Several approaches have been used in the literature to describe and define intragroup distribution of income in a CGE framework. For example, de Janvry et al. (1991) have used both a lognormal and a Pareto distribution function to depict income distribution. Decaluwe et al. (1999) and Aka (2006) have used the beta distribution to represent the intragroup income distributions. Unlike the lognormal, the beta function is much more flexible when it comes to the asymmetric forms it can adopt. However, since we know very little about the probability density functions of the incomes of households, density functions may be interpolated to give a clearer picture of the implied distributional shape. To estimate the density function without imposing too many assumptions about its properties, a non-parametric approach is used in PCGive based on a kernel estimator of density function  $f(Y_h)$ .

The kernel estimator of the density  $f$  is defined by:

$$f(Y_h) = (1/Tu) \sum_{t=1}^T K\{(1/u)(Y_h - y_{ht})\}$$

where  $K\{\}$  is the kernel function and  $u$  is a “window width” or smoothing parameter and corresponds to the width of histogram bars. The kernel  $K$  used is the normal or Gaussian kernel.

## 5. Structure and data of the SAM

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Ghana's macro SAM for 1999 is based on the country's 1993 SAM. We start by considering a disaggregated SAM and then achieve a level of aggregation consistent with the objective of the study. The supply, intermediate use and value added of the agricultural sector are obtained after aggregating the cocoa, agriculture and livestock, forestry and logging, and fishing subsectors. The supply, intermediate use, and value added of industrial sector are obtained after aggregating the mining and quarrying, manufacturing, electricity and water, and construction subsectors. For the services sector, the supply, intermediate use and value added of are aggregated from the subsectors of wholesale, retail trade, hotels and restaurants; transport, storage, and communication; finance, insurance, real estate and business services; government services and private non-profit services; and community, social and personal services. Institutions are grouped into four: Households, firms, government and rest of the world. Households comprise both rural and urban, While firms comprise non-financial corporations, financial corporations and non-profit institutions serving households. Two categories of factors of production are considered , labour and capital. Labour comprises skilled and unskilled. Current and capital accounts of the institutions are considered.

Since the structure of the Ghanaian economy is unlikely to change dramatically in the short or medium term, the 1993 SAM is updated for 1999 using the fixed proportion method. But because we are interested in the behaviour of different categories of household, there is a need to integrate the GLSS 4 data with the SAM for 1999. The contribution of each category of household in the total income and expenditure is determined from the GLSS 4 data set (available on CD-ROM). These proportions are used to reconstruct the household sector within the 1999 SAM at constant 1993 prices. The integrated SAM for 1999 is adopted from Bhasin and Annim (2005). The data for other endogenous variables, which cannot be tracked from SAM, and exogenous variables are collected from *International Financial Statistics*, the State of the Ghanaian Economy, Annual Budget, and *World Development Indicators*.

The household is an important entity in the analysis of the microeconomic impact of

for non-farm self-employed. As for population shares, agricultural households are the largest group, with 49.2% of the total population.

The monetary poverty line of C665,300 was obtained from the consumption basket of the bottom 20% of the distribution of individuals by their standard of living, which provided 2,900 kilocalories per adult equivalent per day. As noted above, the 120 commodities included in this consumption basket belong to agricultural, industrial and services sectors. Using this approach, we observe that 25.4% of the private sector

Table 10: Factoral source of household income (%)

Household group	Percentage of households	Labour income	Capital income	Income from transfers	Total
Agricultural households	49.2	87.9	1.6	10.5	100.0
Public sector employees	9.4	92.0	2.0	6.0	100.0
Private sector employees	7.9	93.2	1.7	5.1	100.0
Non-farm self-employed	25.6	92.0	2.0	6.0	100.0
Non-working	7.9	90.0	2.0	8.0	100.0

Source: Author's calculations.

employees are below this poverty line, followed by the non-farm self-employed category with 21%.

Table 12 shows the distribution of components of household income as a percentage of GDP. The poorest households are private sector employees and agricultural households are the richest. The highest share of capital income is observed for the non-working group, whereas the lowest share is for private sector employees. Agricultural households have the highest share of labour income in GDP, while private sector employees have the smallest share.

Table 11: Income (in cedis) and demographic characteristics of households

	Agricultural household	Public sector employee	Private sector employee	Non-farm self-employed	Non-working
Mean income - Cedis	2,765,729	2,534,159	2,206,560	2,360,109	2,398,446
Maximum income - Cedis	44,000,000	39,000,000	24,000,000	24,000,000	27,000,000
Minimum income - Cedis	7,665	13,808	12,000	23,865	13,738
Population share	49.2%	9.4%	7.9%	25.6%	7.85%
% Below the poverty line (C665,300)	17.3%	19.3%	25.4%	21%	20%

Source: Author's calculations.

trade liberalization. Household level data were obtained from the 1999 GLSS 4. In Table 10, the composition of household income is related to its main activity. Labour is an important contributor to the earning of incomes of all categories of households. Capital income is the least source of income for all categories of households. Agricultural households receive more income from transfer payments than any of the other four categories of households.

The income and demographic characteristics of households are presented in Table 11. The agricultural households have the highest mean income.<sup>1</sup> The private sector employees have the least mean income, which was below the national mean annual household income of C2,267,000. Agricultural households followed by public sector employees obtained the maximum income, which varied between C24,000,000 and C44,000,000. The minimum income was observed for agricultural households. The range of minimum income was from C7,665 for agricultural households to C23,865

Table 12: Share of components of household income in GDP (%)

Household group	Share of labour income in GDP	Share of capital income in GDP	Share of household income in GDP
Agricultural households	15.76	0.52	16.28
Public sector employees	15.13	0.51	15.64
Private sector employees	13.34	0.43	13.77
Non-farm self-employed	14.08	0.48	14.56
Non-working	13.93	0.58	14.51
Total households	72.24	2.52	74.76

Source: Author's Calculations

## 6. Analysis of simulation results

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households increase. This causes the incidence, depth and severity of poverty for all categories of households to be reduced. The maximum reduction in the incidence of poverty is noticed for the non-farm self-employed, whereas the maximum reduction in the depth and severity of poverty is observed for private sector employees. The least reduction in the incidence of poverty is among public sector employees; the least reduction in the depth of poverty is among agricultural households in the first simulation, and public sector employees in the second and third simulations. The least reduction in the severity of poverty is noticed for agricultural households in the first simulation and for public sector employees in the second and third simulations. The difference between the base and the first simulation captures the effect of the elimination of import tariffs of agricultural goods on poverty. The difference between the first simulation and the second simulation captures the effect of foreign capital inflows on poverty. For the first simulation and the third simulation the difference captures the effect of VAT on poverty. These effects vary across households.

The partial unilateral trade liberalization of imported agricultural goods alone is a poverty alleviating policy. The decline in the incidence of poverty ranges from 0.53 to 1.37 percentage points; the depth of poverty from 0.33 to 0.52 percentage points; and the severity of poverty from 0.19 to 0.30 percentage points. This finding is similar to Chitiga et al. (2005), which showed that the reduction in import tariffs reduces the incidence of poverty by 0.01%–0.02%, the depth of poverty by 0.003%–0.01%, and the severity of poverty by 0.002%–0.01%.

The partial unilateral trade liberalization of imported agricultural goods with increase in foreign capital inflows is also a poverty alleviating policy. The contribution of foreign capital inflows to the reduction in the incidence of poverty amounts to 0.17–0.42 percentage points; the depth of poverty to 0.11–0.18 percentage points; and the severity of poverty to 0.07–0.10 percentage points. This finding is in conformity with studies by Gustafsson and Makonnen (1993), Siddiqui and Kemal (2002a/b), Taylor et al. (2005); Adams (2005), Bhasin and Obeng (2006), Anderson and Evia (2003), and Arbenser (2004), which examine different components of foreign capital inflows.



As described above, in the first simulation, we eliminate the trade-related import tariff on agricultural goods (final goods as well as inputs) and in the second we eliminate the trade-related import tariff on agricultural goods but compensate with an increase in the foreign capital inflows by 0.63% that are redistributed to the households in the form of transfer payments in proportion to their share in the transfer payments. For the third simulation, the trade-related import tariff on agricultural goods is eliminated and the VAT is increased by 50%, with this tax revenue redistributed to the households in the form of transfer payments in proportion to their share in the transfer payments. Table B1 in Appendix B indicates the effects of these simulations on macroeconomic variables.

In these simulations, the elimination of import tariffs on agricultural goods leads to a reduction in the prices of imported agricultural goods. As a result, imports of agricultural goods become cheaper and consumers substitute imported agricultural goods for domestically produced agricultural goods, thereby causing the demand for agricultural imports to increase. Since the industrial goods and services are used in the production of agricultural goods (input-output linkages), it is likely that the imports of industrial goods and services (wholesale and retail trade services) will increase along with the increase in imports of agricultural goods, even though there are no cuts in the import tariffs on industrial goods and services. The reduction in domestic costs caused by a cut in agricultural import tariffs increases the profitability of the agricultural sector. This leads to increased production of agricultural goods, thereby causing the exports of agricultural goods to increase in the first two simulations. Production linkages between the agriculture and services sectors, cause increases in the production of services in the second and third simulations. However, the increased domestic supply of services and the non-tradeable nature of some services reduces exports of services. Since the agricultural and services sectors are expanding in the second and third simulations, the demand for labour and capital in these two sectors is increased. And, as labour and capital move away from the industrial sector, industrial production declines, thereby causing the exports of industrial goods to decline. This sectoral reallocation of labour and capital then increases returns to labour and capital. The incomes of all types of households increase because of increased factor prices, reallocation of existing resources, inflow of FDI and remittances received from abroad, and transfer payments received from the government that arise from foreign aid or additional tax revenue. The cut in import tariffs on agricultural goods reduces the prices of composite goods in agricultural sector and increases the prices of composite goods in the industrial and services sectors. The net effect of these changes on the prices of composite goods is to reduce the poverty line by 2.83%, 2.66% and 2.54% in the first, second and third simulations, respectively. Changes in household incomes and the poverty line determine the net effect on the incidence, depth and severity of household poverty.

Appendix Table B2 presents information on the incidence, depth and severity of poverty for the base year and variations in these measures for the simulations relating to import tariffs on agricultural goods. In the base year, the incidence, depth and severity of poverty are highest among private sector employees. The lowest incidence, depth and severity of poverty occur among agricultural households.<sup>2</sup> In these simulations, changes in the prices of composite goods reduce the poverty line, and incomes of all

sectoral reallocation of labour and capital increases returns to labour and decreases returns to capital. The incomes of all types of households increase because of changes in factor prices, reallocation of existing resources, inflow of FDI and remittances received from abroad, and transfer payments from the government that arise from foreign aid and additional tax revenue. The cut in export tariffs on agricultural goods increases the prices of composite goods in all the three sectors, increasing the poverty line by 0.61%, 0.87% and 0.95% in the fourth, fifth and sixth simulations, respectively. Again, changes in households' incomes and poverty line determine the net effect on the incidence, depth and severity of household poverty.

Table B4 presents information on the incidence, depth and severity of poverty for the base year and variations in these measures for the simulations relating to export tariffs on agricultural goods. In these simulations, changes in the prices of composite goods increase the poverty lines and incomes of all households increase. These changes cause the incidence, depth and severity of poverty for all categories of households to decrease. The maximum reduction in the incidence of poverty is noticed for the non-farm self-employed, whereas the maximum reduction in the depth and severity of poverty is observed for private sector employees. The least reduction in the incidence and severity of poverty is observed for public sector employees, whereas the least reduction in the depth of poverty is for agricultural households in the fourth simulation and public sector employees in the fifth and sixth simulations. The difference between the base and the fourth simulation captures the impact on poverty of the elimination of export tariffs of agricultural goods, and that between the fourth and fifth simulations indicates the effect of foreign capital inflows. The effect of VAT on poverty is reflected in the difference between the fourth and the sixth simulations. These effects vary across households.

The partial unilateral trade liberalization of exported agricultural goods alone is a poverty alleviating policy: The incidence of poverty declines by 0.17–0.65 percentage points; the depth of poverty by 0.15–0.26 percentage points; and the severity of poverty by 0.08–0.15 percentage points. This finding is new. The partial unilateral trade liberalization of exported agricultural goods with increase in foreign capital inflows is also a poverty alleviating policy. The contribution of foreign capital inflows to the reduction in the incidence of poverty ranges from 0.36 to 1.64 percentage points; the depth of poverty from 0.14 to 0.24 percentage points; and the severity of poverty from 0.10 to 0.14 percentage points. This finding is in conformity with the study by Bhasin and Obeng (2006), which shows that the elimination of export taxes on goods and services combined with an increase in remittances reduces the incidence, depth and severity of poverty in Ghana. The partial unilateral trade liberalization of exported agricultural goods with an increase in VAT is also a poverty alleviating policy. VAT helps reduce the incidence of poverty by 0.36–1.64 percentage points; the depth of poverty by 0.19–0.30 percentage points; and the severity of poverty by 0.13–0.18 percentage points. This finding differs from those of Bhasin and Annim (2005) and Aka (2006). Bhasin and Annim (2005) showed that the reduction in export tariffs on goods and services along with increase in VAT by 100% increased the incidence of poverty between 0.18 and 0.22 percentage points, the depth of poverty between 0.04 and 0.11 percentage points, and the severity of poverty between 0.03 and 4.08

Another poverty alleviating policy is the partial unilateral trade liberalization of imported agricultural goods with an increase in VAT. VAT contributes 0.18–0.42 percentage points of the reduction in the incidence of poverty; it also lowers the depth of poverty ranges by 0.17–0.28 percentage points and the severity of poverty by 0.11–0.16 percentage points. This finding is in line with those of Bhasin and Ananim (2005) showing that the reduction in import tariffs on goods and services along with a 100% increase in VAT reduces the incidence of poverty between 0.71 and 1.50 percentage points, the depth of poverty between 0.25 and 0.67 percentage points, and the severity of poverty between 0.25 and 0.38 percentage points. Moreover, this result also conforms with the findings of Aka (2006) that reduction in export tariffs on agricultural goods combined with reduction in tariffs on imported agricultural and industrial goods and increase in VAT reduces the incidence of poverty by 0.01–1.48 percentage points, the depth of poverty by 0.19–0.53 percentage points, and the severity of poverty by 0.14–0.27 percentage points. The new finding of the study is that financing of partial (reduction in import tariffs on agricultural goods) unilateral trade liberalization through domestic resources could have a greater impact on poverty alleviation than the foreign resources.

We eliminate the trade-related export tariff on agricultural goods (final goods as well as inputs) in the fourth simulation, and in the fifth simulation, we compensate for this by an increase in the foreign capital inflows by 0.87% redistributed to the households in the form of transfer payments in proportion to their share in the transfer payments. The sixth simulation eliminates the trade-related export tariff on agricultural goods and increases the VAT by 50%, this tax revenue is redistributed to the households in the form of transfer payments in proportion to their share in the transfer payments. Table B3 indicates the effects of these simulations on macroeconomic variables.

The effect of the imposition of an export tax is to reduce the domestic price of exports from the world price of exports. In these simulations, export tariffs on agricultural goods are eliminated, thus raising the domestic price of agricultural exports to equal their world price. A higher domestic price for agricultural exports increases the profitability of agricultural goods, which leads to increased production of agricultural goods, thereby causing the exports of agricultural goods to increase. An increased production of agricultural goods creates more demand for imported agricultural goods (consumer goods such as rice, sugar, etc.). Since industrial goods and services are used in the production of agricultural goods (input-output linkages), imports of industrial goods (pesticides and other agro-chemical products) and services (wholesale and retail trade services) increase along with the increase in imports of agricultural goods in the fifth and sixth simulations. In the fourth simulation, however, imports of industrial goods decrease and imports of services increase. Production linkages between the agriculture and services sectors prompt an increase in the production of services in the fifth and sixth simulations but not in the fourth. However, exports of services decline because of the increased domestic supply of services and the non-tradeable nature of some services. Since the agricultural and services sectors are expanding, this increases the demand for labour in the agricultural sector and demand for capital in the agriculture and service sectors. As labour and capital move away from the industrial sector, industrial production declines, thereby causing the exports of industrial goods to decline. This

incomes and poverty lines determine the net effect on the incidence, depth and severity of households' poverty.

Table B6 presents information on the incidence, depth and severity of poverty for the base year and variations in these measures for the simulations relating to import tariffs on industrial goods. In these simulations, the incidence, depth and severity of poverty for all categories of households are reduced. The maximum reduction in the incidence of poverty is noticed for the non-farm self-employed, whereas the maximum reduction in the depth and severity of poverty is observed for private sector employees in the seventh simulation and the non-working group in the eighth and ninth simulations. The least reduction in the incidence and severity of poverty is among public sector employees while the least reduction in the depth of poverty occurs among agricultural households in the seventh simulation and public sector employees in the eighth and ninth simulations.

The difference between the base and the seventh simulation captures the effect on poverty of the elimination of import tariffs on industrial goods, while the difference between the seventh simulation and the eighth simulation reflects the impact of foreign capital inflows. The difference between the seventh and ninth simulations captures the effect of VAT on poverty. These effects vary across households. Moreover, it is observed that financing of partial (reduction in import tariffs on industrial goods) trade liberalization through domestic resources could have a greater impact on poverty alleviation than the foreign resources.

The partial unilateral trade liberalization of imported industrial goods alone is a poverty alleviating policy. The decline in the incidence of poverty ranges from 0.00 to 0.39 percentage points; the depth of poverty from 0.08 to 0.14 percentage points; and the severity of poverty from 0.02 to 0.08 percentage points. This finding is similar to that of Chitiga et al. (2005) showing that the reduction in import tariffs reduces the incidence of poverty by 0.01%–0.02%, the depth of poverty by 0.003%–0.01%, and the severity of poverty by 0.002%–0.01%. The partial unilateral trade liberalization of imported industrial goods with increase in foreign capital inflows is also a poverty alleviating policy. The contribution of foreign capital inflows to the reduction in the incidence of poverty ranges from 0.35 to 0.64 percentage points; the depth of poverty from 0.11 to 0.18 percentage points; and the severity of poverty from 0.07 to 0.11 percentage points. This finding is new.

The partial unilateral trade liberalization of imported industrial goods with increase in VAT is another poverty alleviating policy. VAT contributes to the reduction in the incidence of poverty by 0.35–0.85 percentage points, the depth of poverty by 0.19–0.31 percentage points, and the severity of poverty by 0.12–0.18 percentage points. This result is in line with the finding of Bhasin and Annim (2005) that the reduction in import tariffs on goods and services along with increase in VAT by 100% reduces the incidence of poverty by 0.71–1.50 percentage points, the depth of poverty by 0.25–0.67 percentage points, and the severity of poverty by 0.25–0.38 percentage points. This result also agrees with that of Aka (2006) showing that reduction in export tariffs on agricultural goods combined with reduction in tariffs on imported agricultural and industrial goods and increase in VAT reduces the incidence of poverty between 0.01 and 1.48 percentage points, the depth of poverty between 0.19 and 0.53 percentage

percentage points. Aka found that a reduction in export tariffs on agricultural goods combined with increase in indirect taxes would increase the incidence of poverty by 0.31–4.05 percentage points, the depth of poverty by 0.63–1.69 percentage points, and the severity of poverty by 0.48–0.92 percentage points. However, this finding does conform with Bussolo and Round (2003), which showed that an increase in indirect taxes could either increase the incidence of poverty or reduce it. The new finding of the study is that financing of partial (reduction in export tariffs on agricultural goods) unilateral trade liberalization through domestic resources could have a greater impact on poverty alleviation than the foreign resources.

In the seventh simulation, we eliminate the trade-related import tariff on industrial goods (final goods as well as inputs) and in the eighth simulation this is complemented by a compensating increase in the foreign capital inflows by 0.64%, which are redistributed to the households in the form of transfer payments in proportion to their share in the transfer payments. The ninth simulation eliminates the trade-related import tariff on industrial goods and increases the VAT by 50%. This tax revenue is redistributed to the households in the form of transfer payments in proportion to their share in the transfer payments. Table B5 indicates the effects of these simulations on macroeconomic variables.

These three simulations lead to a reduction in the prices of imported industrial goods. As a result, imports of industrial goods become cheaper and consumers substitute imported industrial goods with domestically produced industrial goods, thereby causing the demand for industrial imports to increase. Since the agricultural goods and services are used in the production of industrial goods (input-output linkages), it is likely that the imports of agricultural goods and services (wholesale and retail trade services) will increase along with the increase in imports of industrial goods even though there are no cuts in the import tariffs on agricultural goods and services. The reduction in domestic costs caused by cut in industrial import tariffs increases the profitability of the industrial sector (provided that the revenue effect offsets the cost effect), leading to increased production of industrial goods thereby causing the exports of industrial goods to increase. The production and exports of services also increase because of production linkages between the industrial and services sectors. Since the industrial and services sectors are expanding, the demand for labour and capital in the industrial sector increases, whereas in the services sector the demand for labour increases and the demand for capital decreases. As labour and capital move away from the agricultural sector, agricultural production sector declines, thereby causing the exports of agricultural goods to decline, and this sectoral reallocation of labour and capital causes returns to labour and capital to increase. The incomes of all types of households increase because of increased factor prices, reallocation of existing resources, inflow of FDI and remittances from abroad, and transfer payments received from the government arising from foreign aid and additional tax revenue. The cut in import tariffs on industrial goods reduces the prices of composite goods in the industrial sector and increases the price of composite goods in the agricultural sector. The net effect of these changes in the prices of composite goods is to reduce the poverty lines by 0.26% and 0.07% in the seventh and eighth simulations, respectively, and increase the poverty line by 0.07% in the ninth simulation. Changes in household

incidence and depth of poverty is noticed for private sector employees, whereas the maximum increase in the severity of poverty is observed for public sector employees. The least increase in the depth of poverty is seen for public sector employees in the tenth simulation and for agricultural households in the eleventh. The least increase in the severity of poverty is among agricultural households. The maximum reduction in the incidence, depth and severity of poverty is noticed for the agricultural households. The least reduction in the incidence and severity of poverty is observed for public sector employees and the depth of poverty for private sector employees. The difference between the base and the tenth simulation captures the effect of elimination of export tariffs of industrial goods on poverty. The difference between the tenth and eleventh simulations reflects the effect of foreign capital inflows on poverty, while the difference between the tenth and the twelfth simulations captures the effect of VAT on poverty. These effects vary across households.

The policy of partial unilateral trade liberalization of exported industrial goods alone enhances rather than alleviates poverty. The increase in the incidence of poverty ranges from 0.18 to 0.64 percentage points; the depth of poverty from 0.11 to 0.18 percentage points; and the severity of poverty from 0.08 to 0.12 percentage points. This finding is new. The partial unilateral trade liberalization of exported industrial goods with increase in foreign capital inflows is also a poverty enhancing policy. The contribution of foreign capital inflows to the increase in the incidence of poverty is in the range 0.00–0.42 percentage points; for the depth of poverty it ranges from 0.06 to 0.10 percentage points; and for the severity of poverty, the range is 0.04–0.06 percentage points. This finding does not conform to that of Bhasin and Obeng (2006), which shows that the elimination of export taxes on goods and services combined with an increase in remittances reduces the incidence, depth and severity of poverty in Ghana.

However, the partial unilateral trade liberalization of exported industrial goods with an increase in VAT is a poverty alleviating policy. The contribution of VAT to the reduction in the incidence of poverty ranges from 0.35 to 1.08 percentage points; the depth of poverty from 0.25 to 0.40 percentage points; and the severity of poverty ranges from 0.17 to 0.24 percentage points. This finding is also different from that of Bhasin and Annim (2005). These authors show that the reduction in export tariffs on goods and services along with a 100% increase in VAT increases the incidence of poverty by 0.18–0.22 percentage points, the depth of poverty by 0.04–0.11 percentage points, and the severity of poverty by 0.03–4.08 percentage points. On the other hand, this finding does conform to Bussolo and Round (2003), who showed that an increase in indirect taxes could either increase the incidence of poverty or reduce it. The new finding of the study is that financing of partial unilateral trade liberalization (reduction in export tariffs on industrial goods) through domestic resources could have a greater impact on poverty alleviation than the foreign resources.

Given the reliability of data and methodological issues, the study estimated lower and upper bounds for the poverty indexes for the case of elimination of import tariffs on agricultural goods in isolation. Lower and upper bound estimates were derived by assuming that the elasticity parameters (CES and CET) were perhaps 10% lower or 10% higher than the ones used here. Table B9 reports sensitivity results for this particular case. Increasing elasticity parameters by 10% reduces the incidence of

points, and the severity of poverty between 0.14 and 0.27 percentage points. The new finding of the study is that financing of partial (reduction in import tariffs on industrial goods) unilateral trade liberalization through domestic resources could have a greater impact on poverty alleviation than the foreign resources.

Simulation 10 eliminates the trade-related export tariff on industrial goods (final goods as well as inputs), While simulation 11 eliminates the trade-related export tariff on these goods but compensates with a 0.33% increase in the foreign capital inflows, which are redistributed to households in the form of transfer payments in proportion to their share in the transfer payments. Simulation 12 also eliminates the trade-related export tariff on industrial goods, here we increase the VAT by 50%, with this tax revenue redistributed to households in the form of transfer payments in proportion to their share in the transfer payments. The effects of these simulations on macroeconomic variables are summarized in Table B7.

According to these simulations, the elimination of export tariffs on industrial goods raises the domestic price of industrial exports to equal the world price of industrial exports. The higher domestic price for industrial exports increases the profitability of industrial goods, leading to increased production and thereby causing the exports of industrial goods to increase. An increased production of industrial goods creates more demand for imported intermediate industrial goods resulting in increased imports of industrial goods. Since agricultural goods and services are used in the production of industrial goods (input-output linkages), it is likely that the imports of agricultural goods and services (wholesale and retail trade services) will increase along with the increase in imports of industrial goods. The expansion of the industrial sector results in the contraction of the services sector and the production and exports of services decline, while the demand for labour and capital increases. On the other hand, the contraction of the services sector causes the demand for labour to increase and the demand for capital to decrease. At the same time, as labour and capital move away from the agricultural sector, agricultural production declines, thereby causing exports of agricultural goods to decline. Returns to labour and capital increase as a result of the sectoral reallocation of these factors. The incomes of all types of households increase because of changes in factor prices, reallocation of existing resources, inflow of FDI and remittances from abroad, and transfer payments from the government related to foreign aid and additional tax revenue. The cut in export tariffs on industrial goods reduces the prices of composite goods in the industrial sector and increases the prices of composite goods in the agricultural and services sectors, which increases the poverty lines by 2.71%, 2.80% and 3.11% in the tenth, eleventh and twelfth simulations, respectively. Again, changes in households' incomes and poverty lines determine the net effect on the incidence, depth and severity of household poverty.

Table B8 summarizes the results of these simulations. The table shows that the changes in the prices of composite goods increase the poverty lines and increase incomes of all households. These changes cause the incidence, depth and severity of poverty for all categories of households to increase, with the exception of the incidence of poverty of the non-working group in the tenth and eleventh simulations. Contrary to this, these changes cause the incidence, depth and severity of poverty of all categories of households to decrease in the twelfth simulation. The maximum increase in the

poverty estimates by 0.36–1.27 percentage points, the depth of poverty estimates by 0.34–0.57 percentage points, the severity of poverty estimates by 0.20–0.32 percentage points, and the poverty line estimate by 4.72%, whereas the mean income estimates increase by 2.16%–2.54%. On the other hand, reducing elasticity parameters by 10% increases the incidence of poverty estimates by 0.71–1.70 percentage points, the severity of poverty by 0.42–0.66 percentage points, and the depth of poverty by 0.24–0.38 percentage points, while the poverty line estimate declines by 0.77% and the mean income estimates by 1.50%–1.63%.

The reduction in the elasticity parameters of CES and CET thus reverses the impact on poverty, showing that the results are highly sensitive to the values of the parameters for CES and CET. There is a need to look at why the impact on poverty is reversed when the elasticity parameters of CES and CET are reduced. Since there is lower substitutability between exports and domestic supply, on the one hand, and between imports of agricultural goods and domestic demand, on the other, there could be an upward pressure on the domestic demand and domestic supply, which could lead to higher prices for composite goods and as a result the poverty line increases. The cut in the import tariffs of agricultural goods makes the agricultural sector more competitive and attracts capital and labour from the industrial and services sectors; this could lead to lower average wage-rental ratio. The reallocation of resources and a fall in the wage-rental ratio could decrease the incomes of households. Reduction in income and increase in the poverty line could increase the incidence, depth and severity of poverty of households.

The income distributions of the various categories of households for the base year and the 12 simulations are presented in Figures C1 to C20 in Appendix C. In all the simulations, the density functions for all the categories of households shift to the right with higher mean incomes, but the effect on the poverty line differs across the simulations. The poverty lines are reduced in simulations 1, 2, 3, 7 and 8, and increased in simulations 4, 5, 6, 9, 10, 11 and 12. This causes a reduction of the population below the poverty line in each household group in simulations 1, 2, 3, 4, 5, 6, 7, 8, 9 and 12, with the exception of public sector employees and the non-working group in simulation 7, while the population below the poverty line increases in simulations 10 and 11. The income distributions of private sector employees improve to a larger extent in simulations 1, 4 and 7, and for the non-working group in simulation 10 when trade liberalization in isolation is considered. On the other hand, the income distributions of agricultural households improve to a larger extent in simulations 2, 5, 8 and 11 when trade liberalization is combined with foreign capital inflows, as well as in simulations 3, 6, 9 and 12 when trade liberalization is combined with VAT. This finding is in conformity with Arbenser (2004), which shows that increased FDI improves the incomes of households by 1.3%, and with the finding of Bhasin and Obeng (2006) that elimination of import and export taxes on goods and services along with increase in remittances improve the income distributions of households in Ghana in the range of 2.84%–9.93%. Moreover, results also agree with those of Bhasin and Annim (2005) in so far as the effect of reduction in import taxes on goods and services combined with an increase in VAT on the income distribution of households is concerned. The income of households increases in the range of 1.31%–3.86%. On the other hand, Bhasin and Annim (2005) show that reduction in the export taxes on goods and services combined with an increase in VAT worsens the income distribution of households by 3.81%–4.08%.



## **7. Conclusion and policy implications**

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CGE models were used in this study to analyse the impact on poverty of three different types of shocks – partial trade liberalization alone, and combined with foreign capital inflows or with VAT – combined in 12 scenarios. The study applied the scenarios to agricultural trade and industrial trade in turns to determine the incidence, depth and severity of poverty and income distributions of households. The first scenario eliminated trade-related import tariffs on agricultural goods. The second involved the elimination of trade-related import tariffs on agricultural goods accompanied by an increase in real foreign capital inflows by 0.63%, while the third compensated the elimination of trade-related import tariffs on agricultural goods with a 50% increase in VAT. The fourth, fifth and sixth scenarios applied the same sequence of shocks to export tariffs on agricultural goods: The fourth simply eliminated the tariffs, the fifth shock added an increase in real foreign capital inflow by 0.87%, and the sixth shock compensated for the elimination of export tariffs with an increase in VAT by 50%.

The remainder of the scenarios concerned industrial goods. In the seventh scenario trade-related import tariffs on industrial goods were eliminated. The eighth also eliminated these tariffs, but accompanied this measure with an increase in real foreign capital inflows by 0.64%. The ninth scenario took the form of eliminating trade-related import tariffs on industrial goods accompanied by an increase in VAT by 50%. The tenth involved the elimination of export tariffs on industrial goods, while the eleventh and twelfth added, respectively, an increase in real foreign capital inflow by 0.33% and an increase in VAT by 50%.

The study found that elimination of trade-related import and export tariffs on agricultural goods and import tariffs on industrial goods in isolation and combined with foreign capital inflows and VAT reduces the incidence, depth and severity of poverty of all categories of households, with the exception of the incidence of poverty among public sector employees and the non-working group when import tariffs on industrial goods are eliminated in isolation. The elimination of trade-related export tariffs on industrial goods combined with VAT reduces the incidence, depth and severity of poverty of all categories of households. In particular, a regressive tax (VAT) as a revenue

saving and investment decisions in response to these price changes? What is the effect of the transmission of border price changes on the local prices faced by the producers and the households? What type of benefits can producers and consumers get from openness? Producers could benefit by the availability of imported inputs and consumers could benefit from the different varieties of goods that are available for consumption. Households could benefit from spillover effects that occur as a result of backward and forward inter-sector linkages.

But many other questions remain. How is the poverty line affected by the changes in the prices of composite goods? How does trade liberalization affect wages and employment in the labour market? How do foreign capital inflows affect the rental on capital and formation of capital in the capital market? How does the VAT rate affect the prices of imported and domestically produced final goods, intermediate goods and capital goods? How does trade liberalization affect government revenue and to what extent is it financed through foreign capital inflows and VAT? What is the effect of trade liberalization on public spending, e.g., education, health, etc.? It is relatively hard to trace all these effects of trade liberalization on poverty in a single study using CGE model.

Nevertheless, the study shows that financing of partial sector-wise unilateral trade liberalization through domestic resources could have a greater impact on poverty alleviation and improvement in the income distributions of households than the use of foreign resources. This happens when a fall in government revenue resulting from trade liberalization is compensated by a budget-neutral increase in foreign capital inflows that are redistributed to households in the form of transfer payments in proportion to their share in total transfer payments from the government to the households. On the other hand, when trade liberalization is combined with increase in VAT, a fall in government revenue due to trade liberalization is not compensated by a budget-neutral increase in VAT (which may be different from 50%), but a 50% increase in VAT which is the current VAT rate in Ghana is implemented. The increase in the transfer payments to households in the case of VAT is higher than in the case of foreign capital inflows. Thus the increase in the incomes of households is larger in the VAT case compared with the foreign capital inflows case; that is why poverty falls more when VAT increases than when foreign capital inflows increase.

The impact of trade-related fiscal reforms on income distribution differs across households. The income distributions of private sector employees and the non-working group improve to a larger extent when trade liberalization is considered in isolation. On the other hand, the income distributions of agricultural households improve to a larger extent when trade liberalization is combined with foreign capital inflows and VAT.

According to these results, the Government of Ghana should not eliminate the export tariffs on industrial goods in isolation or combined with foreign capital inflows because these measures are not poverty reducing. Rather, the Government should try to finance its unilateral trade liberalization through domestic resources instead of foreign resources in order to have greater impact on poverty reduction and improve the income distributions of households.

replacement makes poor people better off because of the neoclassical assumptions and transfers of VAT revenue to households. On the other hand, elimination of trade-related export tariffs on industrial goods in isolation and combined with foreign capital inflows increases the incidence, depth and severity of poverty of all categories of households, with the exception of the incidence of poverty among the non-working group.

The impact of trade-related fiscal reforms on poverty differs across households. The most significant beneficiaries of the simulations related to the elimination of trade-related import tariffs on agricultural goods are the non-farm self-employed and private sector employees. The most significant beneficiaries of the simulations related to the elimination of trade-related export tariffs on agricultural goods and import tariffs on industrial goods are private sector employees, the non-farm self-employed and the non-working group. Agricultural households are the most significant beneficiaries of the simulation related to the elimination of trade-related export tariffs on industrial goods.

The main transmission mechanism through which trade liberalization affects poverty in our CGE model can be summarized as follows: The price changes generated by trade reforms affect the sources of incomes of households – labour income, capital income and transfer payments from other households, dividends from firms, pensions from the government, and remittances from relatives residing abroad. Among the questions that arise are: How do households adjust their consumption, production,

## Notes

1. Agricultural households have the highest mean household expenditure of C4,526,664. Agricultural households become richer when the household consumption expenditure data are used, as shown in Table 13.

Table 13: Income and demographic characteristics of households using consumption expenditure data

	Agricultural households	Public sector employees	Private sector employees	Non-farm self-employed	Non-working
Mean consumption expenditure – Cedi	4,526,664	3,725,479	3,585,209	3,773,927	3,788,878
Maximum consumption expenditure – Cedi	32,000,000	35,000,000	21,000,000	69,000,000	27,000,000
Minimum consumption expenditure – Cedi	105,665	242,759	379,804	90,414	309,346
Population share	49.2%	9.4%	7.9%	25.6%	7.85%
% Below the poverty line (C665,300)	1.18%	1.96%	2.31%	3.31%	1.91%

Source: Author's calculations.

The incidence of poverty for the agricultural households drops considerably when consumption expenditure data are used rather than income data.

2. In our study, we have shown that the agricultural households are the richest in Ghana. This finding differs from the previous finding of the Ghana Statistical Service (GSS). According to GSS (2000), food crop farmers are the poorest, followed by export farmers. The differences in results can be explained in Table 14.

Table 14: Reasons for the differences between our results and GSS results

Our results	GSS results
Povertyline of Cedis 665,300 used	Povertyline of Cedis 900,000 used
Broad definition of agricultural households that include farming, fishing, animal rearing and hunting occupations	Narrow definition of agricultural farmers that includes only food crop farmers and export farmers (no data exist)
Classification of households is based on Section 4B, Question No. 9.	Classification of the agricultural sector is partly based on Section 4A, Question No. 6.
Components of household income are income from employment, HH agricultural income (2)-corrected, gross non-farm self-employment income (3), actual and imputed rental income, income from remittances, and other income	Components of household income are wage income from employment, household agricultural income, non-farm self-employment income, rental income (actual and imputed), net remittances, and other income
Mean household income Cedis 2,453,000	Mean household income Cedis 2,267,000
Components of household expenditure are food expenditure (actual)-corrected, expenditure on housing, other expenditure (actual)-corrected, expenditure on remittances	Components of household expenditure are food expenditure (actual), food expenditure (imputed), expenditure on housing, other non-food expenditure (actual), and other non-food expenditure (imputed)
Mean household expenditure Cedis 3,880,031	Mean household expenditure Cedis 4,244,000
Income and expenditure data used to calculate poverty indexes	Expenditure data used to calculate poverty indexes
Correct estimates of income and expenditure used	Income and expenditure data drastically reduced for agricultural farmers

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# Appendixes

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## Appendix A : Computable general equilibrium model for Ghana

### 1. Sets definition

- $i \in I = \{AGR, IND, SER\}$ , Goods (AGR: Agriculture, IND: Industry, SER: Services).  
 $j \in J = \{AGR, IND, SER\}$ , Production Sectors  
 $h \in H = \{AGRF, PUBE, PRIE, NFSE, NW\}$ , Households (AGRF: Agricultural household, PUBE: Public sector employee, PRIE: Private sector employee, NFSE: Non-farm self-employed, NW: Non-working)

### 2. Parameters

- $\Lambda_j$  Share of value added in total output  
 $c_j$  Scale coefficient of Cobb-Douglas function  
 $a_{ij}$  Quantity of good  $i$  used in the production of good  $j$   
 $\alpha_j$  Elasticity parameter of Cobb-Douglas function  
 $\ddot{O}_i$  Scale coefficient of CET function  
 $\gamma_i$  Distributive parameter of CET function  
 $R_i$  Transformation parameter of CET function  
 $\eta_i$  Elasticity of transformation  
 $\lambda_i$  Scale coefficient of CES function

$LD_j$	Labour demand of sector $j$	3
$w_j$	Wage rate of sector $j$	3
$w$	Average wage rate	1
$KD_j$	Capital demand of sector $j$	3
$r_j$	Rate of return to capital in sector $j$	3
$r$	Average rental rate	1
$DI_{i,j}$	Intermediate demand for good $i$ in sector $j$	9
$DI_i$	Intermediate demand for good $i$	3
$E_i$	Export supply of good $i$	3
$DS_i$	Domestic supply of good $i$	3
$PE_i$	Domestic export price of good $i$	3
$PL_i$	Producer price of domestic good $i$	3
$Q_i$	Demand for composite good $i$	3
$PC_i$	Price of composite good $i$	3
$M_i$	Import demand of good $i$	3
$DD_i$	Domestic demand of good $i$	3
$PD_i$	Domestic price of good $i$	3
$PM_i$	Domestic import price of good $i$	3
$YH_h$	Income of household $h$	5
$YDH_h$	Disposable income of household $h$	5
$DTH_h$	Direct taxes on household $h$ income	5
$SH_h$	Savings of household $h$	5
$CTFH_h$	Current transfers from firms to household $h$	5
$SH$	Savings of households	1
$YF$	Income of firms	1
$DTF$	Direct taxes on firms income	1
$YDF$	Disposable income of firms	1
$SF$	Savings of firms	1
$TIM_i$	Indirect taxes on imports of good $i$	3
$TIE_i$	Indirect taxes on exports of good $i$	3

$\delta_i$	Distributive parameter of CES function
$\rho_i$	Substitution parameter
$\sigma_i$	Elasticity of substitution
$\Omega_1$	Firms share in total capital income
$\Omega_2$	Government share in total capital income
$s_h$	Share of household $h$ in labour income
$k_h$	Share of household $h$ in total capital income
$ty_h$	Tax rate on household $h$ income
$dvr_h$	Dividend rate for household $h$
$\Psi_h$	Marginal propensity to save of $h$ household
$\Psi_f$	Marginal propensity to save of firms
$\Psi_g$	Marginal propensity to save of government
$ty_f$	Tax rate on firm income
$tm_i$	Tax rate on import of good $i$
$te_i$	Tax rate on export of good $i$
$tx_i$	Value added tax rate on good $i$
$\beta^{c_{ih}}$	Share of good $i$ in household $h$ consumption
$\beta^f_i$	Share of good $i$ in firm consumption
$\beta^g_i$	Share of good $i$ in government consumption
<i>MINIMUM</i>	
$C_{i,h}$	Household minimum consumption of good $i$
$\hat{o}_j$	Share of sector $j$ in total investment
$\mu_i$	Share of good $i$ in value added

### 3. Endogenous variables

#### Number

$XS_j$	Production of sector $j$	3
$VA_j$	Value added of sector $j$	3
$PV_j$	Value added price of sector $j$	3

$TVA_i$	Value added taxes on good $i$	3
$P_i$	Price of aggregate output of good $i$	3
$YG$	Government income	1
$SG$	Savings of government	1
$CTH_h$	Total consumption of household $h$	5
$C_{i,h}$	Consumption of good $i$ of household $h$	15
$CT_i$	Total consumption of good $i$	3
$CF_i$	Firm consumption of good $i$	3
$GC_i$	Government consumption of good $i$	3
$I$	Total investment	1
$S$	Total savings	1
$I_j$	Investment of sector $j$	3
$P_{INV}$	Investment price index	1
$P_{INDEX}$	Price index	1
$B$	Balance of payments	1
$z$	Poverty line	1
<b>Number of endogenous variables</b>		<b>147</b>

#### 4. Exogenous variables

		<b>Number</b>
$LS$	Labour supply	1
$KS$	Capital supply	1
$E$	Nominal exchange rate	1
$PWE_i$	World price of exports of good $i$	3
$PWM_i$	World price of imports of good $i$	3
$CTGH_h$	Current transfers from govt. to household $h$	5
$CTWH_h$	Current transfers from ROW to household $h$	5
$CTHF_h$	Current transfers from household $h$ to firms	5
$CTHW_h$	Current transfers from household $h$ to ROW	5
$CTGF$	Current transfers from govt. to firms	1
14	$YDH_h$ P% ?? $YH_h (1 - ty_h)$	5

<i>CTGF</i>	Current transfers from govt. to firms	1
<i>CTWF</i>	Current transfers from ROW to firms	1
<i>FB</i>	Foreign borrowing	1
<i>FKI</i>	Foreign capital inflows	1
Number of exogenous variables		33

## 5. Equations

Production and trade Number

$$1 \quad XS_j = VA_j / \Pi_j \quad 3$$

$$2 \quad VA_j = c_j LD_j^{\alpha_j} KD_j^{1-\alpha_j} \quad 3$$

$$3 \quad DI_{i,j} = a_{ij} XS_j \quad 9$$

$$4 \quad DI_i = \sum_j DI_{i,j} \quad 3$$

$$5 \quad LD_j = \alpha_j PV_j VA_j / w_j \quad 3$$

$$6 \quad KD_j = (1 - \alpha_j) PV_j VA_j / r_j \quad 3$$

$$7 \quad XS_i = \Pi_i [\gamma_i E_i^R i + (1 - \gamma) \delta S_i^R i] f^R_i \quad 3$$

$$8 \quad E_i = DS_i [(PE_i / PL_i) \{(1 - \gamma) \delta / (\gamma)\}]^{\eta_i} \quad 3$$

$$9 \quad Q_i = \lambda_i [\delta_i M_i^{\tilde{p}} + (1 - \delta) DD_i^{\tilde{p}}] J^{-1/\rho_i} \quad 3$$

$$10 \quad M_i = DD_i [(PD_i / PM_i) \{\delta_i / (1 - \delta)\}]^{\sigma_i} \quad 3$$

## Income, Taxes, Savings and Investment

$$11 \quad YH_h = s_h \sum_j w_j LD_j + k_h \sum_j r_j KD_j + CTGH_h + CTFH_h + CTWH_h \quad 5$$

$$12 \quad CTFH_h = dvr_h YF \quad 5$$

$$13 \quad DTH_h = ty_h YH_h \quad \mathbf{5}$$

14  $YDH_h = YH_h(1 - ty_h)$  5

15  $SH_h = YDH_h - \sum_i PC_i C_{ih} - CTHF_h - CTHW_h$  5

16  $SH = \sum_h SH_h$  1

17  $YF = \Omega_1 \sum_j r_j KD_j + \sum_h CTHF_h + CTGF + CTWF$  1

18  $DIF = ty_f YF$  1

19  $YDF = YF(1 - ty_f)$  1

20  $SF = YDF - \sum_h CTFH_h - \sum_i PC_i CF_i$  1

21  $TIM_i = tm_i e PWM_i M_i$  3

22  $TIE_i = te_i PE_i E_i$  3

23  $TIVA_i = tx_i PC_i Q_i$  3

24  $YG = \Omega_2 \sum_j r_j KD_j + \sum_i TIM_i + \sum_i TIE_i + \sum_i TIVA_i$   
 $+ \sum_h DTH_h + DIF + FB$  1

25  $SG = YG - \sum_h CTGH_h - CTGF - \sum_i PC_i GC_i$  1

26  $S = SH + SF + SG + FKI$  1

**Demand for commodities**

27  $CTH_h = YDH_h - SH_h$  5

28  $PC_i C_{i,h} = PC_i C_{i,h}^{MINIMUM} + \beta^c_{j,h} (CTH_h - \sum_i PC_i C_{i,h}^{MINIMUM})$  15

29  $Z = \sum_i PC_i C_{ih}^{MINIMUM}$  1

30  $CF_i = \beta^f_i (1 - \Psi_f) YDF / PC_i$  3

$$31 \quad GC_i = \beta^g_i (1 - \Psi_g) YG / PC_i \quad 3$$

$$32 \quad CT_i = \sum_h C_{i,h} + CF_i + GC_i \quad 3$$

$$33 \quad I_i = [\phi_i I] / P_{INV} \quad 3$$

$$34 \quad I = \sum_i I_i \quad 1$$

Prices

$$35 \quad PV_i = [P_i \tilde{X}S_i - \sum_j PC_i DI_{i,j}] / VA_i \quad 3$$

$$36 \quad PM_i = PWM_i (1 + tm_i) (1 + tx_i) e \quad 3$$

$$37 \quad PE_i = (PWE_i e) / (1 + te_i) \quad 3$$

$$38 \quad PC_i = (PD_i DD_i + PM_i M_i) / Q_i \quad 3$$

$$39 \quad PD_i = (1 + tx_i) PL_i \quad 3$$

$$40 \quad P_i = (PL_i DS_i + PE_i \tilde{E}_i) X S_i \quad 3$$

$$41 \quad w_j = (PV_j VA_j - r_j KD_j) / LD_j \quad 3$$

$$42 \quad w = \sum w_j / \beta \quad 1$$

$$43 \quad r_j = (PV_j VA_j - w_j LD_j) / KD_j \quad 3$$

$$44 \quad r = \sum r_j / \beta \quad 1$$

$$45 \quad P_{INV} = \Pi [PC_i / \phi_i]^{q_i} \quad 1$$

$$46 \quad PINDEX = \sum_i \mu_i PV_i \quad 1$$

## Equilibrium Conditions and Macroeconomic Closure

$$47 \quad Q_i = DI_i + CT_i + I_i \quad 3$$

$$48 \quad LS = \sum_j LD_j \quad 1$$

$$49 \quad KS = \sum_j KD_j \quad 1$$

$$50 \quad I = S \quad 1$$

$$51 \quad B = e \sum_i PWM_i M_i - e \sum_i PWE_i E_i + \sum_i CTHW_h - \sum_i CTWH_h - CTWF - FB - FKI = 0 \quad 1$$

Number of independent equations 147



## Appendix B: Simulation results, poverty indexes and sensitivity analysis

Table B: Simulation results for the elimination of import ban on agricultural goods

Variable	Baseline	Simulation 1: Elimination of import ban	Simulation 2: Elimination of import ban and 50% increase in agricultural goods and services import tariff	Simulation 3: Elimination of import ban and 50% increase in value added tax	Percentage import decrease	Percentage import decrease
Production of agricultural sector	21,127,666	21,216,111	21,259,217	21,254,644	6.87	6.86
Production of manufacturing sector	1,016,172	1,015,886	1,016,112	1,015,932	-0.17	-0.26
Production of services sector	866,329	867,132	867,526	867,621	6.11	6.26
Government income	611,111	612,122	613,111	613,516	-0.26	7.61
Income of agricultural households	11,111,111	11,111,117	11,111,222	11,111,212	2.54	1.79
Income of public sector employees	21,111,112	21,111,521	21,111,212	21,111,217	1.87	2.62
Income of private sector employees	21,111,111	21,111,211	21,111,211	21,111,217	1.64	2.11
Income of non-formal employees	21,111,111	21,111,211	21,111,211	21,111,211	1.81	2.54
Income of non-working	21,111,111	21,111,211	21,111,217	21,111,211	2.21	1.21

Variable	Overall	Simulation 1: Elimination of Import tariffs on Agricultural goods	Simulation 2: Elimination of Import tariffs on Agricultural Goods and Services through capital inflows	Percentage Increase decrease	Simulation 2: Elimination of Import tariffs on Agricultural Goods and Services through capital inflows	Percentage Increase decrease	Simulation 3: Elimination of Import tariffs on Agricultural Goods and Services through capital inflows	Percentage Increase decrease
Export supply of agricultural goods	1129.45	1129.45	1129.45	0.00	1129.45	0.00	1129.45	-0.00
Export supply of non-agricultural goods	7129.67	7129.67	7129.67	-0.00	7129.67	-0.00	7129.67	-0.00
Export supply of services	65.11	65.06	65.06	-0.01	65.06	-0.01	65.06	-0.01
Import revenue of agricultural goods	111.29	20.659	20.291	99.7	20.291	16.56	20.291	11.12
Import revenue of non-agricultural goods	161.17	162.29	162.91	0.19	162.91	0.77	162.91	1.12
Import revenue of services	616.66	616.79	617.99	0.12	617.99	0.11	618.76	0.02
Labour revenue in agriculture	1291.1	1291.7	1291.6	0.16	1291.6	0.04	1291.5	0.05
Labour revenue in industry	1509	1509	1509	-0.00	1509	-0.00	1509	-0.00
Labour revenue in services	1164	1167	1169	-0.01	1169	0.04	1170	0.15
Capital revenue in agriculture	6.16	6.16	6.16	0.00	6.16	0.00	6.17	0.16

Variable	Overhead	Simulation 1: Elimination of Import tariff on agricultural goods	Percentage Increase decrease	Simulation 2: Elimination of Import tariff on agricultural goods and services increase in foreign capital inflow	Percentage Increase decrease	Simulation 3: Elimination of Import tariff on agricultural goods and services increase in value added tax	Percentage Increase decrease
Capital return to business	75.72	75.54	-0.18	75.66	-0.08	75.61	-0.12
Capital return to services	1.33	1.33	0.00	1.31	-0.02	1.31	0.00
Composite price of agricultural goods	63.76	63.66	-0.10	63.61	-0.15	63.63	-0.13
Composite price of the world goods	63.78	63.78	0.00	63.74	-0.04	63.78	0.00
Composite price of services	64.17	64.19	0.02	64.19	0.02	64.19	0.02
Exchange rate rate	171.91	171.86	-0.05	171.86	-0.05	171.89	-0.02
Exchange rate rate	1.36	1.37	0.01	1.34	-0.02	1.34	-0.02

Table B2: Poverty measurement for five base year and simulation scenarios for import ban on non-agricultural goods

	Agricultural Head of household	Public sector employees	Private sector employees	Non- farm self- employed	Non- farm workers
<b>Incidence of poverty</b>					
(Alpha-0) base	17.20%	19.20%	23.90%	21.04%	20.00%
Simulation 1	18.92% (+0.17%)	18.19% (-0.99%)	24.91% (+1.05%)	19.81% (-1.21%)	19.98% (+0.98%)
Simulation 2	18.95% (+0.04%)	18.51% (+0.11%)	24.10% (-1.20%)	19.45% (-1.56%)	19.94% (-1.06%)
Simulation 3	18.11% (-1.18%)	18.51% (+0.11%)	24.10% (-1.20%)	19.41% (-1.04%)	19.94% (-1.06%)
<b>Depth of poverty</b>					
(Alpha-1) base	1.15%	3.02%	9.26%	3.96%	1.98%
Simulation 1	0.92% (-0.98%)	3.00% (-0.98%)	9.20% (-0.92%)	3.15% (-0.81%)	1.98% (+0.00%)
Simulation 2	0.94% (+0.51%)	3.50% (+0.41%)	9.20% (+0.05%)	3.00% (-0.99%)	1.62% (-0.51%)
Simulation 3	0.94% (+0.01%)	3.49% (-0.99%)	9.12% (-0.19%)	1.98% (-0.98%)	1.92% (-0.06%)

	Agri-cultural Hectare/ha	Public sector employment	Private sector employment	Non-agri sector employment	Non- working
<b>Sensitivity (power)</b>					
<b>(alpha=2) base</b>					
Simulation 1	4.16% 9.97% (+0.19%)	5.50% 5.00% (-0.21%)	5.41% 5.11% (-0.50%)	4.50% 4.75% (+0.25%)	4.50% 4.00% (-0.24%)
Simulation 2	9.31% (+0.25%)	5.00% (-0.20%)	5.04% (+0.01%)	4.00% (-0.50%)	9.50% (+0.94%)
Simulation 3	9.31% (+0.25%)	4.50% (-0.22%)	4.50% (-0.42%)	4.00% (-0.24%)	9.50% (+0.40%)
<b>Mean base income (pesos)</b>					
Simulation 1	2,091,129 2,791,217 (+35%)	2,524,159 2,549,204 (+1%)	2,309,581 2,259,021 (-2%)	2,980,109 2,914,209 (-2%)	2,989,449 2,412,207 (-21%)
Simulation 2	2,991,219 (+45%)	2,591,949 (+1%)	2,249,021 (-1%)	2,409,529 (-1%)	2,452,171 (-18%)
Simulation 3	2,970,559 (+43%)	2,600,554 (+2%)	2,251,919 (-1%)	2,421,009 (-1%)	2,479,119 (-18%)

	Agricultural Household	Public sector employees	Private sector employees	Non-farm self-employed	Non-farm wage labor
Poverty baseline (2004)	665,300	665,300	665,300	665,300	665,300
Simulation 1	616,172 (-7.3%)	616,172 (-7.3%)	616,172 (-7.3%)	616,172 (-7.3%)	616,172 (-7.3%)
Simulation 2	617,603 (-7.36%)	617,603 (-7.36%)	617,603 (-7.36%)	617,603 (-7.36%)	617,603 (-7.36%)
Simulation 3	619,101 (-7.39%)	619,101 (-7.39%)	619,101 (-7.39%)	619,101 (-7.39%)	619,101 (-7.39%)

Table B3: Simulation results for the elimination of export duties on agricultural goods

Variable	Date/Year	Simulation 1: Elimination of export duty on agricultural goods	Percentage Increase or decrease	Simulation 2: Elimination of export duty on agricultural goods and 60% increase in margin applied to flow ex	Percentage Increase or decrease	Simulation 3: Elimination of export duty on agricultural goods and 60% increase in value added ex	Percentage Increase or decrease
Production of agricultural sector	2/1/2006	2,129,87	1.12	2,129,18	1.29	2,129,84	1.21
Production of non-agricultural sector	1/16/73	1,100,93	-6.87	1,100,71	-6.84	1,100,64	-6.89
Production of services sector	1/6/29	161,11	-6.66	162,61	6.16	166,17	6.92
Government Income	6/1/91	649,26	-9.19	666,64	-1.20	667,61	5.71
Income of agricultural households	1/10/6	1,211,2	2.26	1,16,86	9.24	1,12,64	6.11
Income of public sector employees	2/1/12	266,96	2.19	266,19	9.64	266,11	9.66
Income of private sector employees	2/6/10	263,66	2.11	266,61	1.16	266,71	9.16
Income of non-firms self-employed	2/6/21	276,96	2.19	279,39	9.61	276,11	9.66
Income of non-working	2/1/26	277,54	2.29	281,79	9.51	282,62	9.26

Variable	Base level	Simulation 1: Distribution of expenditure on agricultural goods	Percentage increase of decrease	Simulation 2: Distribution of expenditure on agricultural goods and GDP increase in other related ex	Percentage increase of decrease	Simulation 3: Distribution of expenditure on agricultural goods and GDP increase in other related ex	Percentage increase of decrease
Expenditure of agricultural goods	11205	17016	5.11	17116	1.76	17617	1.61
Expenditure of household goods	71267	67112	-6.72	66814	-7.84	66416	-7.11
Expenditure of services	6511	6191	-3.24	6191	-3.24	6191	-3.24
Expenditure of agricultural goods	11124	11656	1.41	11121	1.11	11261	1.22
Expenditure of household goods	61117	58119	-6.24	58266	6.27	61171	6.51
Expenditure of services	61656	61156	6.05	61652	6.76	61152	6.71
Labour income in agriculture	1261	1169	-1.16	1111	-1.19	1166	-1.09
Labour income in industry	1249	1317	6.79	132	-6.61	1317	6.79
Labour income in services	1164	1324	1.67	116	-6.61	1327	6.41
Capital income in agriculture	616	667	1.21	616	1.12	666	1.12



Variable	Baseline	Simulation 1: Contribution of exporters with an agricultural goods and services	Percentage Increase of demand	Simulation 2: Contribution of exporters with goods and services and non-agricultural industrial exporters	Percentage Increase of demand	Simulation 3: Contribution of exporters with goods and services and non-agricultural industrial exporters and non-agricultural industrial exporters	
Capital account balance	75.72	76.61	-0.56	71.94	-0.16	71.97	-0.11
Capital account in services	1.92	1.97	1.11	1.87	1.11	1.84	1.04
Composite price of agricultural goods	6.576	6.579	6.62	6.581	6.617	6.582	1.8
Composite price of industrial goods	6.767	6.715	1.11	6.716	1.27	6.717	1.11
Composite price of services	6.117	6.122	6.61	6.121	6.71	6.121	6.71
Average wage rate	171.21	170.22	3.22	171.72	3.11	170.15	3.11
Average rental rate	1.56	1.61	-0.22	1.59	-1.27	1.59	-1.27

Table 14: Poverty measures for the base year and simulations for export tariffs on agricultural goods

	Agricultural households	Public sector employees	Total sector employees	Non-union employed	Non-union
<b>Incidence of poverty</b>					
(alpha=0) base	17.20%	19.20%	23.90%	21.04%	20.00%
Simulation 4	18.90% (+0.90%)	19.11%	24.14%	20.90%	19.19%
Simulation 5	18.62% (+0.92%)	18.19%	24.91%	19.87%	19.19%
Simulation 6	18.90% (+0.91%)	18.90%	18.00%	18.17%	18.00%
Simulation 8	18.90% (+0.91%)	18.19%	24.91%	19.87%	19.19%
Simulation 9	18.90% (+0.91%)	18.90%	18.00%	18.17%	18.00%
<b>Depth of poverty</b>					
(alpha=1) base	7.19%	9.02%	9.20%	9.90%	7.97%
Simulation 4	7.00% (-0.19%)	9.34%	9.50%	9.90%	7.80%
Simulation 5	8.10% (+0.90%)	9.10%	9.41%	10.21%	10.19%
Simulation 6	8.10% (+0.90%)	9.95%	9.90%	10.97%	10.41%
Simulation 8	8.10% (+0.90%)	9.95%	9.90%	10.4%	7.91%
Simulation 9	8.10% (+0.90%)	9.95%	10.40%	10.40%	10.40%

	Aggregatetotal household income	Public sector employment	Private sector employment	Non- farm employment	Non- farm employment	Non- farm employment
<b>Scenario 1: poverty</b>						
Simulation 2	4.16%	5.90%	5.41%	4.98%	4.90%	4.90%
Simulation 4	4.00%	5.22%	5.00%	5.00%	4.79%	4.79%
Simulation 5	(-0.00%)	-0.00%	(-0.15%)	(-0.11%)	(-0.11%)	(-0.11%)
Simulation 6	3.94%	5.12%	5.16%	4.75%	4.65%	4.65%
	(-0.22%)	(-0.78%)	(-0.25%)	(-0.21%)	(-0.20%)	(-0.20%)
	0.9.00%	5.09%	5.19%	4.72%	4.61%	4.61%
	(-0.20%)	(-0.21%)	(-0.20%)	(-0.24%)	(-0.20%)	(-0.20%)
<b>Simulation 20: income   combo)</b>	2,100,129	2,504,159	2,304,159	2,200,501	2,000,100	2,000,440
<b>Simulation 4</b>	9,940,000	2,500,400	2,000,400	2,415,000	2,450,100	2,450,100
	(-2.00%)	12.94%	12.90%	(-2.24%)	(-2.24%)	(-2.24%)
<b>Simulation 5</b>	9,491,940	2,000,000	2,000,000	2,450,000	2,500,000	2,500,000
	(-4.90%)	(-4.00%)	(-4.00%)	(-0.00%)	(-0.00%)	(-0.00%)
<b>Simulation 6</b>	9,400,120	2,000,000	2,000,000	2,400,000	2,500,000	2,500,000
	(-5.31%)	(-4.00%)	(-4.00%)	(-0.00%)	(-0.00%)	(-0.00%)



Table B3: Simulation results for the elimination of import tariffs on individual goods

Variable	Base level	Simulation 1: Elimination of import tariffs on individual goods	Percentage increase or decrease	Simulation 2: Elimination of import tariffs on individual goods and GDP	Percentage increase or decrease	Simulation 3: Elimination of import tariffs on individual goods and GDP Increase in foreign capital inflow	Percentage increase or decrease
Production of agricultural sector	2,129.66	2085.01	-1.11	2049.16	-1.05	2049.52	-1.06
Production of industrial sector	1,167.72	1,929.66	2.76	1,752.61	2.61	1,752.16	2.69
Production of services sector	664.29	666.11	0.16	666.61	0.26	667.51	0.17
Government income	611.11	611.11	-1.16	612.11	-0.96	613.71	1.17
Income of agricultural households	1,100	1,160	6.62	1,220	2.76	1,275	5.26
Income of public sector employees	211.12	215.79	6.69	219.5	1.91	222.11	2.92
Income of private sector employees	246.10	247.66	6.76	248.66	1.79	249.66	2.66
Income of non-farmable employees	264.21	266.11	6.69	268.11	1.96	271.17	2.87
Income of non-wooding employees	271.66	271.77	6.69	277.91	2.17	281.27	3.66

Variable	Base level	Simulation 1: Percentage		Simulation 2: Percentage		Simulation 3: Percentage	
		Elimination of import tariffs on individual goods	Increase or decrease	Elimination of import tariffs on individual goods and 60% increase in value added tax	Increase or decrease	Elimination of import tariffs on individual goods and 60% increase in value added tax	Increase or decrease
Export supply of agricultural goods	4134.05	4208	-0.11	4144	-0.24	4176	-0.71
Export supply of industrial goods	713.67	748	1.72	742.5	1.02	742.1	1.16
Export supply of services	6.511	6.512	0.00	6.512	0.00	6.512	0.00
Import demand of agricultural goods	1111.2	1112.0	0.17	1113.6	1.12	1116.0	2.61
Import demand of industrial goods	461.17	411.0	-0.95	410.71	-0.07	416.17	0.51
Import demand of services	616.65	616.15	-0.08	617.57	0.15	618.16	0.11
Labour demand in agriculture	1.241	1.211	-1.76	1.21	-1.41	1.21	-1.71
Labour demand in industry	1.542	1.711	1.76	1.71	1.76	1.71	1.76
Labour demand in services	1.164	1.116	-0.41	1.12	-0.30	1.12	-0.30
Capital demand in agriculture	6.16	5.91	-0.66	5.91	-0.66	5.96	-0.22
Capital demand in industry	76.72	76.57	-1.12	76.51	-1.07	76.56	-1.61

Variable	Data level	Simulation 7: Distribution of input credits on individual goods	Percentage increase or decrease	Simulation 8: Distribution of input credits on individual goods and services	Percentage increase or decrease	Simulation 9: Distribution of input credits on individual goods and services with relative elasticity	Percentage increase or decrease
Capital share in services	1.92	1.84	-3.64	1.85	-1.79	1.86	-1.51
Composite price of capital and goods	6.576	6.546	6.69	6.541	6.417	6.542	1.64
Composite price of individual goods	6.767	6.674	-1.16	6.679	-1.06	6.646	-1.12
Composite price of services	6.417	6.417	6.66	6.417	6.66	6.417	6.66
Average markup rate	171.91	175.64	6.67	175.24	6.76	175.25	6.41
Average rental rate	1.56	1.67	1.69	1.67	1.69	1.64	1.17

Table 6b: Poverty measures for the base year and simulations for import tariffs on individual goods

	Agricultural households	Total number inpoverty	Total number inpoverty	Non-rural inpoverty	Non-rural inpoverty
<b>Incidence of poverty</b>					
(alpha=0) base	11.20%	19.20%	23.90%	21.04%	20.00%
Simulation 1	11.20%	19.20%	23.10%	20.00%	20.00%
Simulation 2	(-0.00%)	(-0.00%)	(-0.20%)	(-0.97%)	(-0.00%)
Simulation 3	10.00%	13.90%	24.14%	20.19%	19.90%
Simulation 4	(-0.01%)	(-0.20%)	(-0.02%)	(-0.21%)	(-0.04%)
Simulation 5	10.42%	13.90%	24.91%	19.90%	19.90%
Simulation 6	(-0.21%)	(-0.20%)	(-1.05%)	(-1.11%)	(-0.04%)
<b>Depth of poverty</b>					
(alpha=1) base	1.15%	9.02%	9.26%	9.90%	1.90%
Simulation 1	1.01%	9.90%	9.11%	9.49%	1.90%
Simulation 2	(-0.00%)	(-0.10%)	(-0.14%)	(-0.11%)	(-0.11%)
Simulation 3	0.20%	9.91%	9.90%	9.92%	1.11%
Simulation 4	(-0.20%)	(-0.21%)	(-0.21%)	(-0.24%)	(-0.20%)
Simulation 5	0.10%	9.10%	9.40%	9.20%	1.90%
Simulation 6	(-0.90%)	(-0.20%)	(-0.91%)	(-0.97%)	(-0.11%)



	Agricultural household income	1% of sample household	1% of sample household	1% of sample household	Non- farm income	Non- farm income
<b>Scenario 1: poverty (alpha=2) base</b>						
Simulation 1	4.10%	5.20%	5.41%	4.20%	4.20%	4.20%
Simulation 2	4.11%	5.20%	5.20%	4.20%	4.20%	4.20%
Simulation 3	(-0.05%)	(-0.05%)	(-0.05%)	(-0.05%)	(-0.05%)	(-0.05%)
Simulation 4	4.01%	5.20%	5.25%	4.20%	4.15%	4.15%
Simulation 5	(-0.15%)	(-0.10%)	(-0.16%)	(-0.15%)	(-0.15%)	(-0.15%)
Simulation 6	3.90%	5.14%	5.15%	4.10%	4.05%	4.05%
Simulation 7	(-0.20%)	(-0.10%)	(-0.22%)	(-0.15%)	(-0.20%)	(-0.20%)
<b>Scenario 2: income (alpha)</b>						
Simulation 1	2,705,729	2,504,159	2,200,501	2,200,100	2,200,448	2,200,448
Simulation 2	2,720,708	2,511,845	2,222,000	2,170,500	2,414,500	2,414,500
Simulation 3	(0.85%)	(0.85%)	(0.10%)	(0.85%)	(0.85%)	(0.85%)
Simulation 4	2,340,404	2,504,500	2,240,150	2,400,191	2,455,200	2,455,200
Simulation 5	(2.10%)	(1.50%)	(1.15%)	(1.50%)	(1.50%)	(2.91%)
Simulation 6	2,201,200	2,000,151	2,200,901	2,421,204	2,420,190	2,420,190
Simulation 7	(4.20%)	(2.50%)	(2.80%)	(2.80%)	(2.81%)	(9.80%)



Table B1 Simulation results for the elimination of export barriers on industrial goods

Variable	Overhead	Simulation 10: Elimination of export duties on intermediate goods	Percentage Increase of domestic intermediate goods input	Simulation 11: Elimination of export duties on intermediate goods and 50% increase in foreign capital inflow	Percentage Increase of domestic intermediate goods input	Simulation 12: Elimination of export duties on intermediate goods and 50% increase in value added ex border	Percentage Increase of domestic intermediate goods input
Production of agricultural sector	2120.66	1870.6	-11.62	1,888.18	-7.28	1856.16	-12.82
Production of industrial sector	1716.72	1626.12	13.67	1,626.87	13.54	1613.71	13.27
Production of services sector	166.29	157.24	-6.01	157.37	-6.71	155.26	-6.87
Government income	611.21	621.51	-1.57	622.85	-1.81	621.26	-1.57
Income of agricultural households	1100.6	1126.16	1.51	1122.25	2.56	1111.15	6.61
Income of public sector employees	2111.2	2111.1	1.62	2106.22	2.21	2106.9	0.26
Income of private sector employees	206.18	206.11	1.62	205.24	2.11	204.84	0.28
Income of non-formal employees	206.21	204.54	1.61	205.21	2.27	203.91	0.21
Income of non-working	271.56	276.16	1.69	278.01	2.55	281.15	5.05
Export supply of agricultural goods	1124.5	765.64	-16.65	761.22	-16.11	762.66	-16.18

Variable	Base level	Simulation 10: Distribution of expenditure on industrial goods	Percentage of increase of decrease	Simulation 11: Distribution of expenditure on industrial goods and GVCs increase in foreign capital inflow	Percentage of increase of decrease	Simulation 12: Distribution of expenditure on industrial goods and GVCs increase in value added by	Percentage of increase of decrease
Export supply of industrial goods	71967	80714	11.24	86675	20.46	86681	20.11
Export supply of services	6511	6774	4.19	6774	4.19	6774	4.19
Import volume of agricultural goods	10129	10166	0.36	10169	0.37	10172	0.41
Import volume of industrial goods	9117	9258	1.57	9263	1.57	9259	1.57
Import volume of services	61665	61612	-0.09	61675	0.02	61679	0.05
Labour resources in agriculture	1381	1381	0.00	1381	-0.51	1381	-0.51
Labour resources in industry	1489	2111	41.83	2111	27.56	2163	27.87
Labour resources in services	1168	1166	-0.21	1166	1.21	1169	1.11
Capital resources in agriculture	616	631	10.06	632	10.16	636	10.18
Capital resources in industry	7573	8129	7.69	8126	7.61	8129	7.59
Capital resources in services	139	119	-14.39	116	-17.27	111	-18.61

Variable	Data level	Simulation 10: Elimination of export credits on industrial goods	Percentage increase or decrease	Simulation 11: Elimination of export credits on industrial goods and 50% increase in foreign capital inflow	Percentage increase or decrease	Simulation 12: Elimination of export credits on industrial goods and 50% increase in white added ex	Percentage increase or decrease
Composite price of agricultural goods	6.576	6.559	1.39	6.666	1.17	6.663	1.51
Composite price of industrial goods	6.767	6.761	-6.57	6.764	6.42	6.766	6.11
Composite price of services	6.817	6.829	1.87	6.829	1.87	6.829	1.87
Average wage rate	171.31	175.34	1.17	176.61	1.22	176.14	1.06
Average rental rate	1.56	1.51	36.32	1.51	36.32	1.51	36.32

Table 6: % poverty measures for the base year and simulations for export ban on individual goods

	Agricultural households	% of public sector employees	% of non-public sector employees	% of non-working	% of non-working
<b>Income poverty</b>					
(alpha=0) base	17.20%	19.20%	9.90%	10.4%	20.00%
Simulation 1 0	17.01%	1.40%	20.00%	21.21%	20.21%
	(0.20%)	(0.18%)	(0.04%)	(0.80%)	(0.21%)
Simulation 1 1	17.47%	19.46%	20.90%	21.24%	20.00%
	(0.27%)	(0.18%)	(0.22%)	(0.20%)	(0.00%)
Simulation 1 2	18.50%	19.11%	25.00%	20.50%	19.90%
	(1.30%)	(-0.17%)	(10.20%)	(0.45%)	(-0.04%)
<b>Depth of poverty</b>					
(alpha=1) base	7.15%	9.02%	9.20%	9.50%	7.90%
Simulation 1 0	7.20%	9.19%	10.00%	9.70%	8.12%
	(0.05%)	(0.17%)	(0.18%)	(0.14%)	(0.19%)
Simulation 1 1	7.10%	9.01%	9.90%	9.90%	8.00%
	(-0.05%)	(-0.01%)	(0.10%)	(0.07%)	(-0.04%)
Simulation 1 2	8.20%	9.20%	9.12%	9.41%	7.90%
	(1.05%)	(0.14%)	(-0.19%)	(0.15%)	(-0.20%)

Scenario / variable	Aggregated household income	Public sector income	Private sector income	Non- market income	Non- market income
<b>Scenario: poverty</b>					
(higher-2) boom	4.16%	5.90%	5.41%	4.98%	4.98%
Simulation 1 0	4.24% (0.08%)	5.42% (0.47%)	5.51% (0.10%)	5.05% (0.08%)	4.98% (0.08%)
Simulation 1 1	4.18% (0.06%)	5.90% (0.00%)	5.47% (0.06%)	5.01% (0.05%)	4.98% (0.03%)
Simulation 1 2	4.00% (-0.18%)	5.25% (-0.65%)	5.98% (0.51%)	4.98% (0.00%)	4.15% (-0.83%)
<b>Market: income (total)</b>					
Simulation 1 0	2,163,129 (1.51%)	2,524,159 (1.02%)	2,208,281 (1.02%)	2,980,109 (1.02%)	2,980,448 (1.02%)
Simulation 1 1	2,208,902 (2.50%)	2,501,909 (1.23%)	2,254,884 (1.18%)	2,419,889 (1.27%)	2,489,881 (1.25%)
Simulation 1 2	2,982,909 (10.00%)	2,841,189 (-4.48%)	2,259,109 (4.04%)	2,484,190 (14.1%)	2,521,982 (15.10%)





Table 10: Sensitivity analysis for determination of impact of farm size on agricultural bound goods

	Agricultural bound goods	% of total number of jobs/area	Total number of jobs/area	Non-farm self-employed	Non-working
<b>Intermediate propensity</b>					
(alpha=0) base	10.52%	13.75%	24.91%	12.81%	12.86%
10% increase in alcohol tax	15.52%	13.52%	23.04%	12.52%	13.72%
per variable 2	(+0.94%)	(-0.52%)	(-1.21%)	(+0.72%)	(+0.84%)
10% decrease in alcohol tax	11.91%	12.48%	23.00%	21.91%	20.21%
per variable 2	(-0.93%)	(0.11%)	(1.52%)	(1.10%)	(-0.25%)
<b>High propensity</b>					
(alpha=1) base	8.52%	3.88%	9.52%	3.15%	1.52%
10% increase in alcohol tax	8.43%	3.23%	3.16%	1.11%	1.15%
per variable 2	(-0.94%)	(-0.52%)	(+0.51%)	(+0.44%)	(+0.44%)
10% decrease in alcohol tax	7.24%	3.11%	9.52%	3.81%	3.88%
per variable 2	(-0.73%)	(0.45%)	(0.80%)	(0.52%)	(0.50%)
<b>Very high propensity</b>					
(alpha=2) base	2.91%	5.82%	5.11%	4.15%	4.88%
10% increase in alcohol tax	3.17%	4.32%	4.95%	4.47%	3.88%
per variable 2	(+0.20%)	(-0.52%)	(+0.52%)	(+0.32%)	(-0.52%)
10% decrease in alcohol tax	4.21%	5.41%	5.45%	5.88%	4.52%
per variable 2	(+0.44%)	(0.52%)	(0.52%)	(0.52%)	(-0.52%)



## Appendix C: Simulations and the impact on income distribution

Figure 1: Density Functions for Import Tariff on Agricultural Goods  
(Agricultural Households)

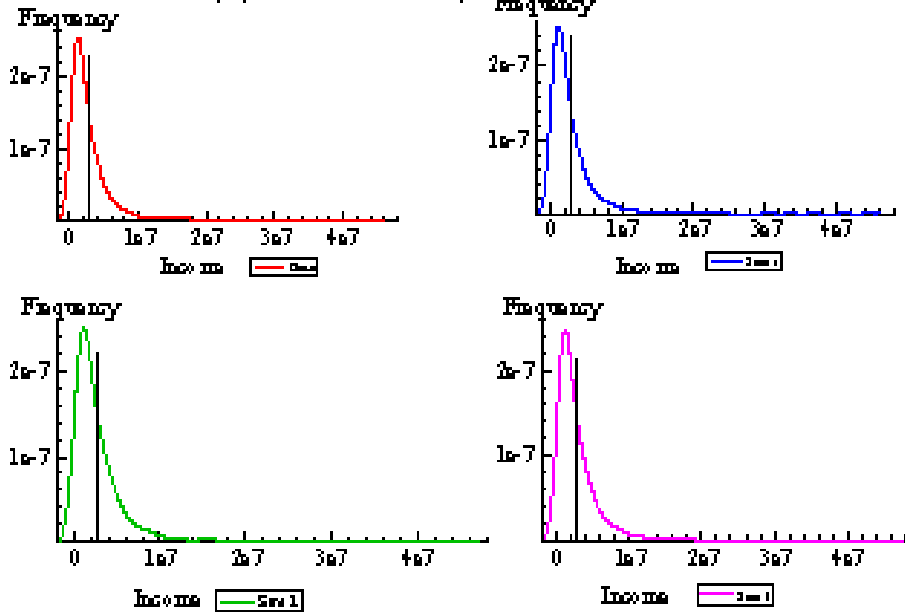


Figure 2: Density Functions for Import Tariffs on Agricultural Goods  
(Public Sector Employees)

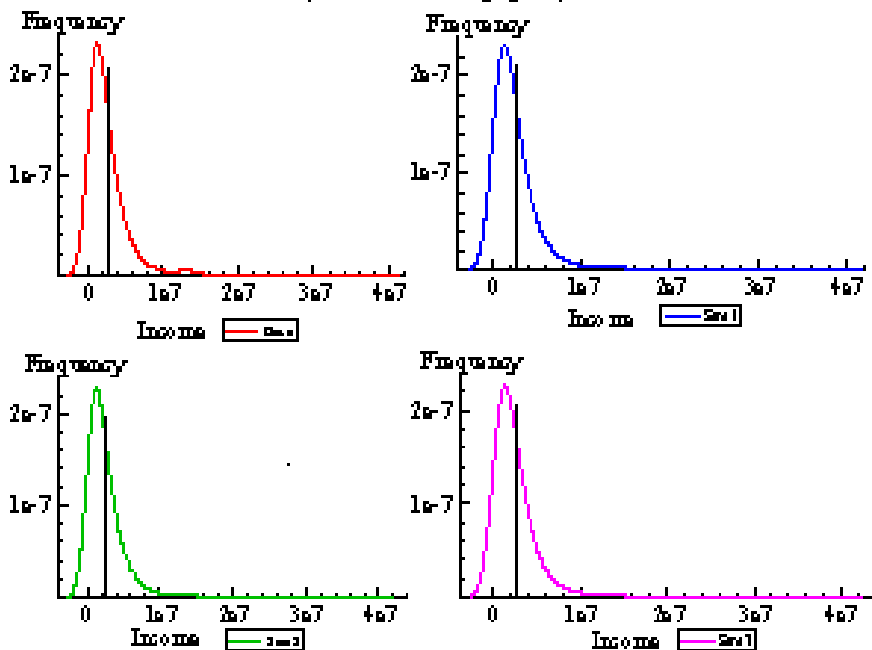


Figure 3 : Density Functions for Import Tariffs on Agricultural Goods (Private Sector Employees)

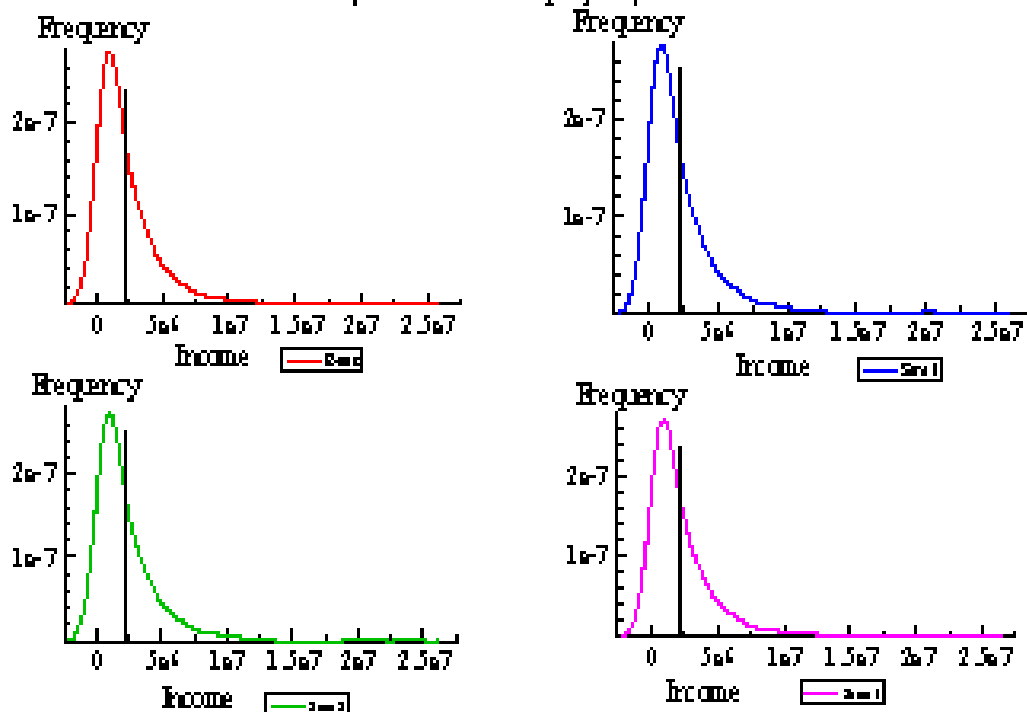


Figure 4 : Density Functions for Import Tariff on Agricultural Goods (Non-farm Self-Employed)

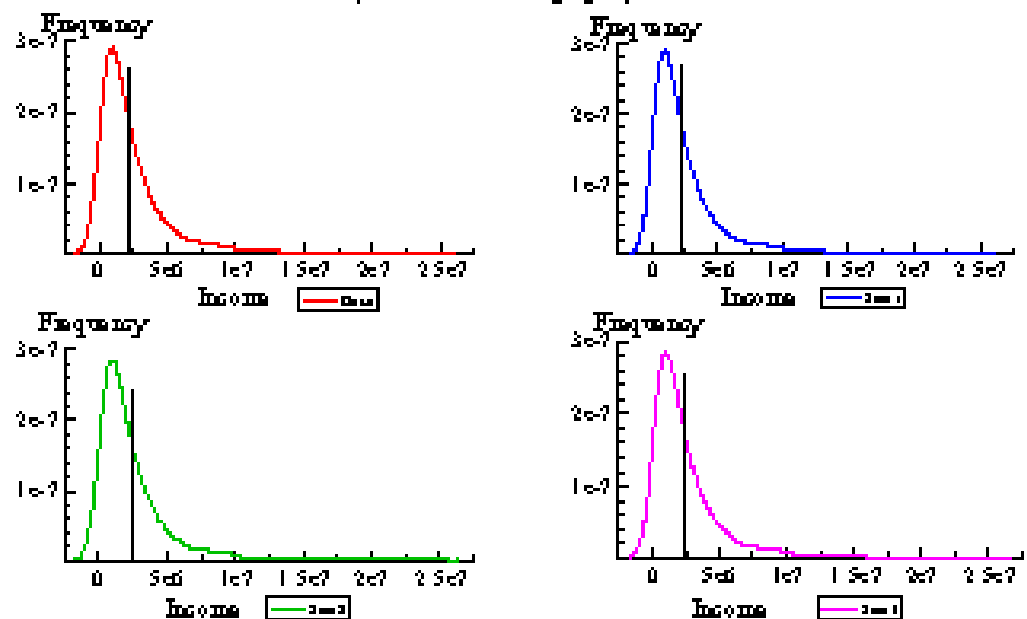


Figure 5 : Density Functions for Import Tariffs on Agricultural Goods (Nonworking)

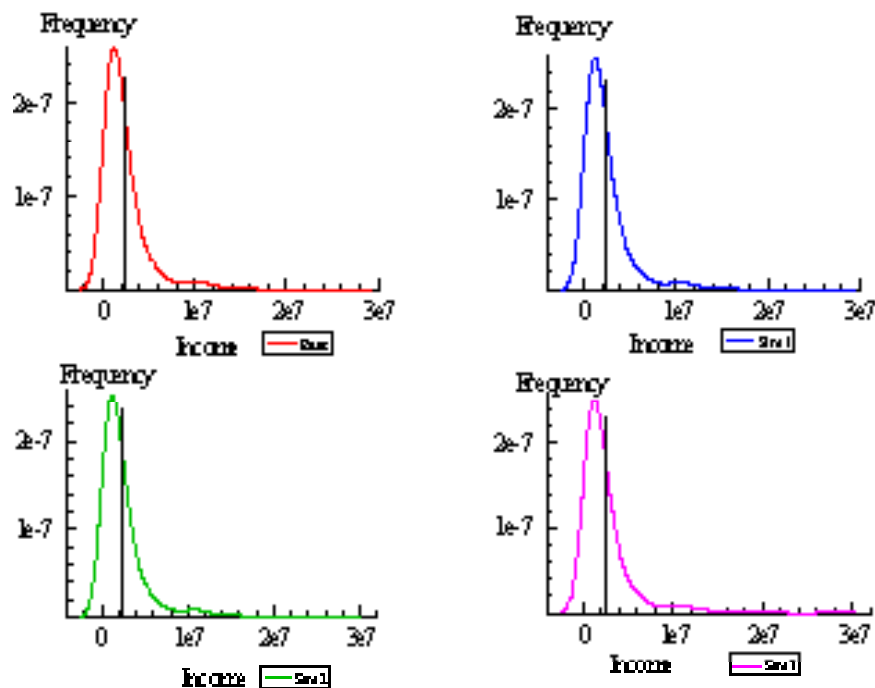


Figure 6 : Density Functions for Export Tariffs on Agricultural Goods (Agricultural Households)

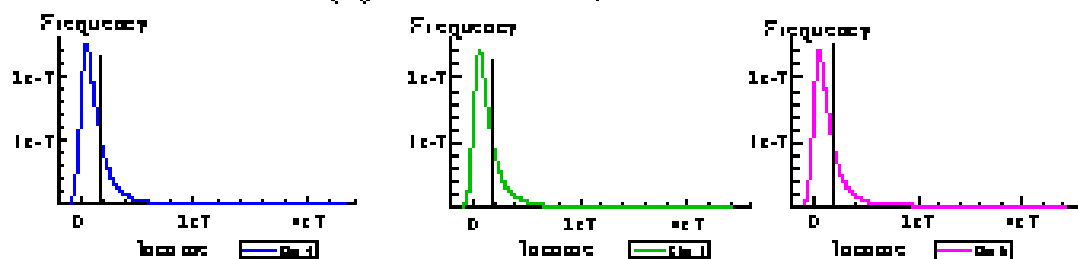


Figure 7 : Density Functions for Export Tariffs on Agricultural Goods (Public Sector Employees)

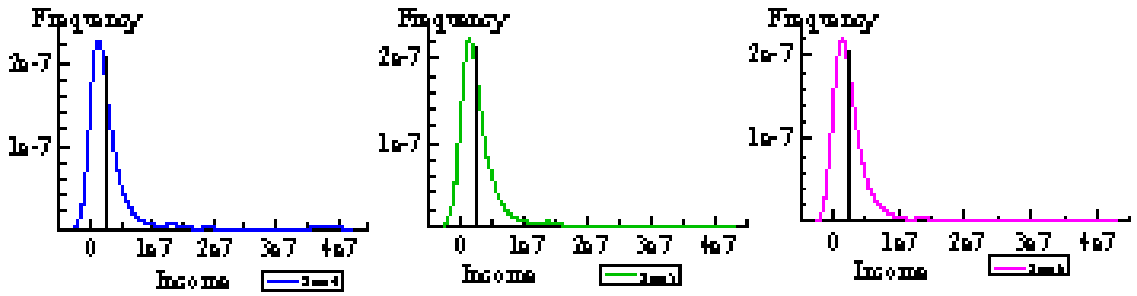


Figure 8 : Density Functions for Export Tariffs on Agricultural Goods (Private Sector Employees)

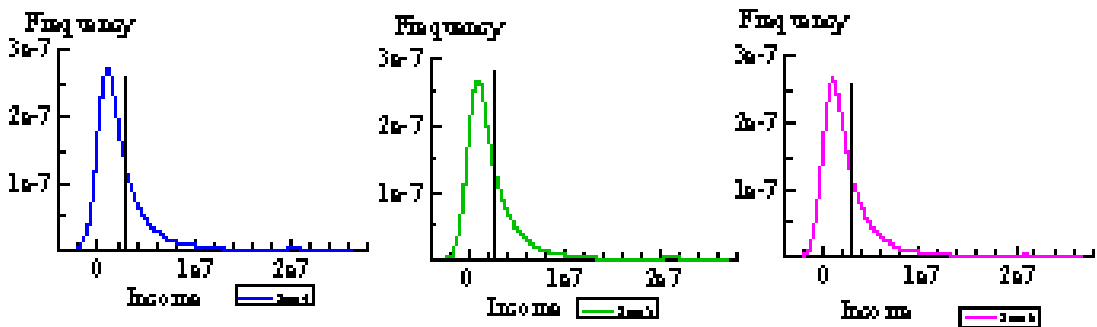


Figure 9 : Density Functions for Export Tariffs on Agricultural Goods (Non-farm Self Employed)

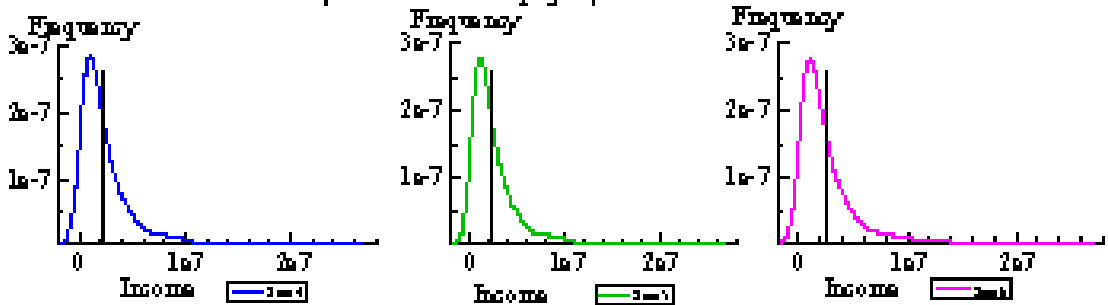


Figure 10 : Density Functions for Export Tariff on Agricultural Goods  
(Non-working)

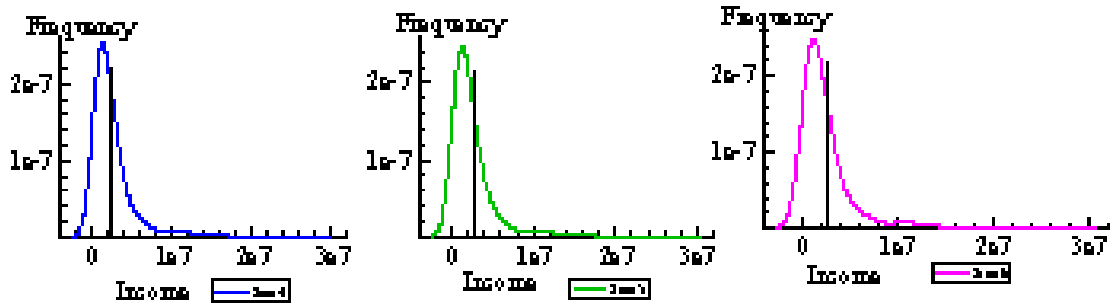


Figure 11 : Density Functions for Import Tariffs on Industrial Goods  
(Agricultural Households)

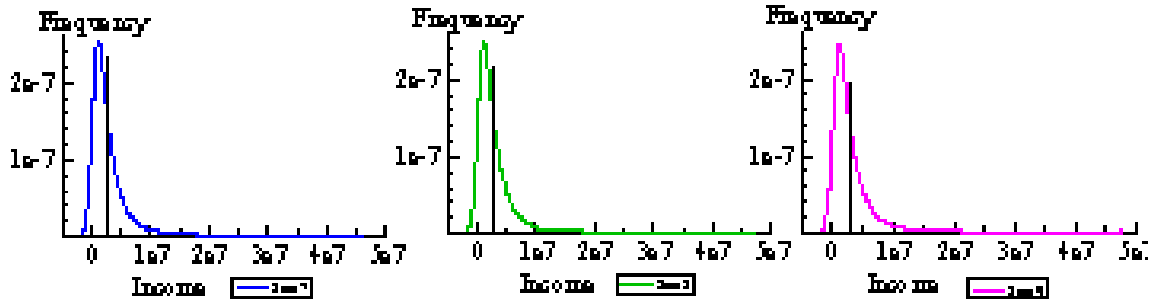


Figure 12 : Density Functions for Import Tariffs on Industrial Goods  
(Public Sector Employees)

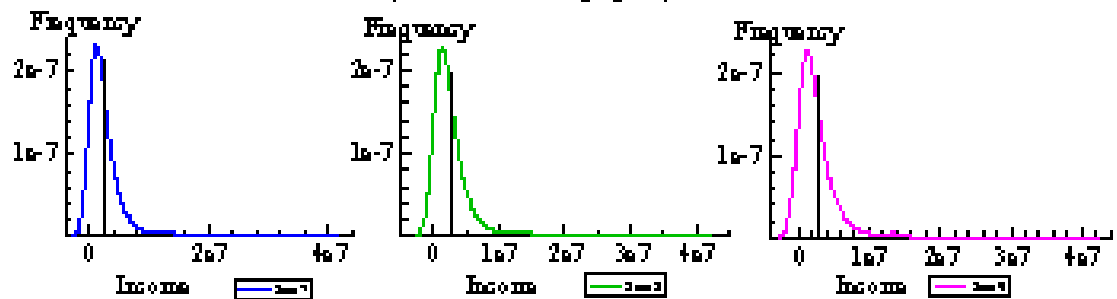


Figure 13 : Density Functions for Import Tariffs on Industrial Goods (Private Sector Employees)

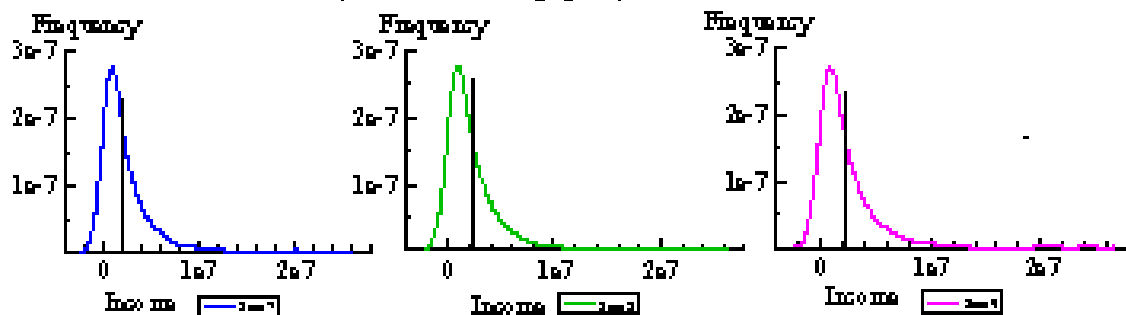


Figure 14 : Density Functions for Import Tariffs on Industrial Goods (Non-farm Self-Employed)

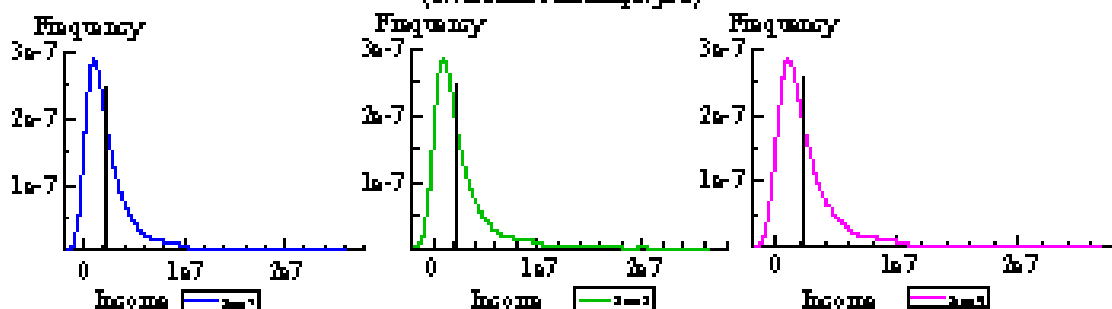


Figure 15 : Density Functions for Import Tariffs on Industrial Goods (Non-working)

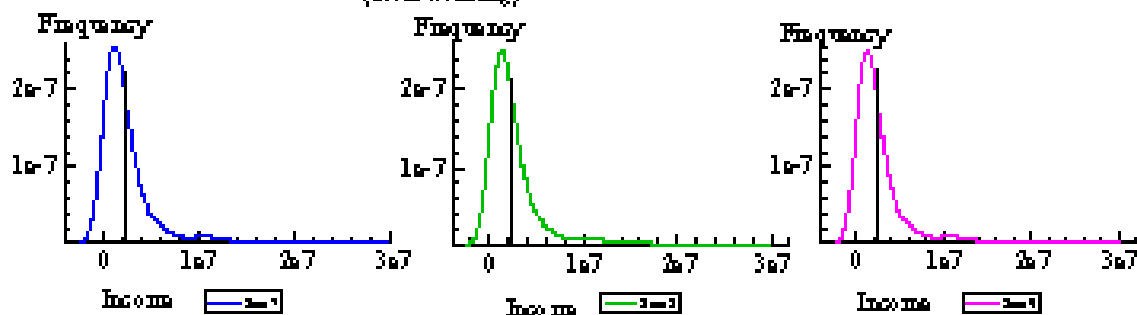




Figure 16 : Density Functions for Export Tariffs on Industrial Goods  
(Agricultural Household Income)

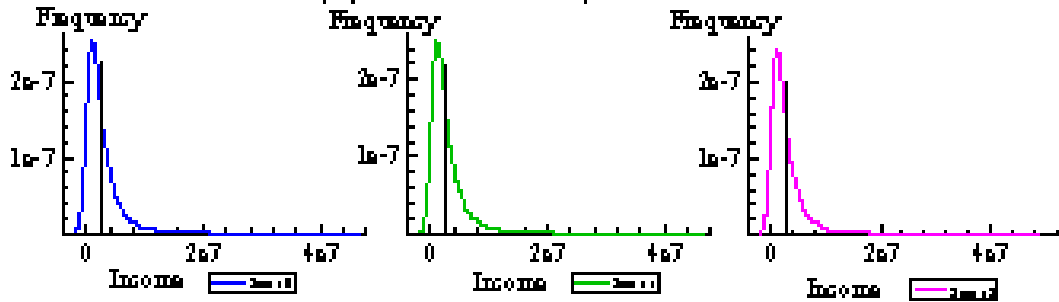


Figure 17 : Density Functions for Export Tariffs on Industrial Goods  
(Public Sector Employees)

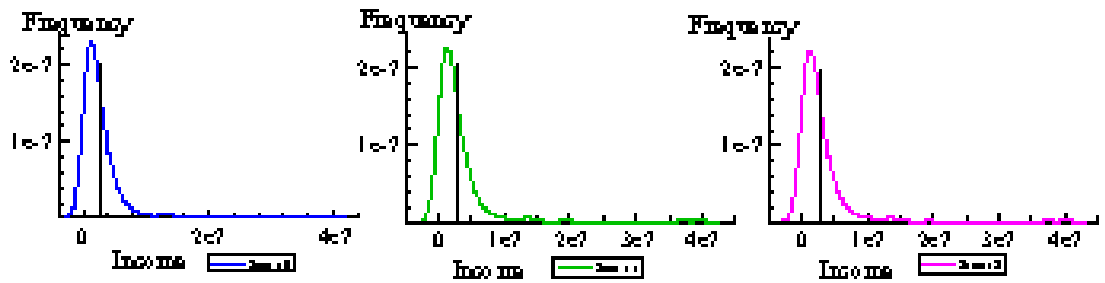


Figure 18 : Density Functions for Export Tariffs on Industrial Goods  
(Private Sector Employees)

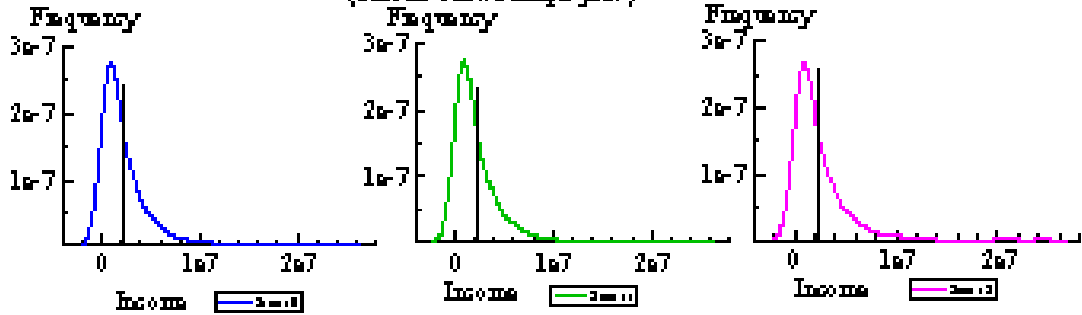


Figure 19 : Density Functions for Export Tariff on Industrial Goods (Non-farm Self-Employed)

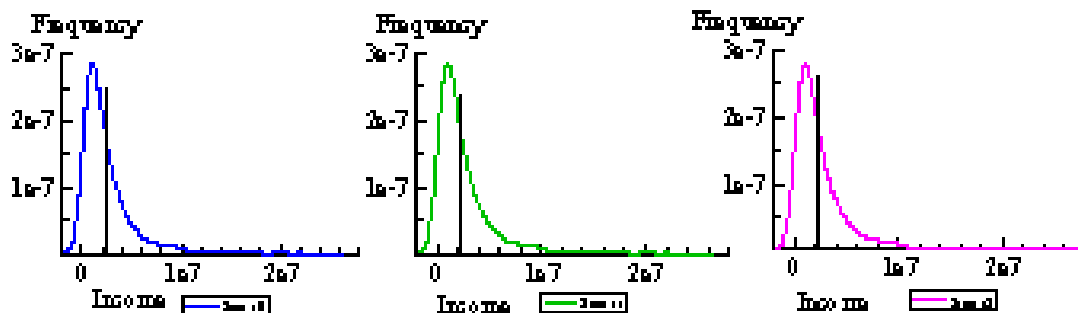
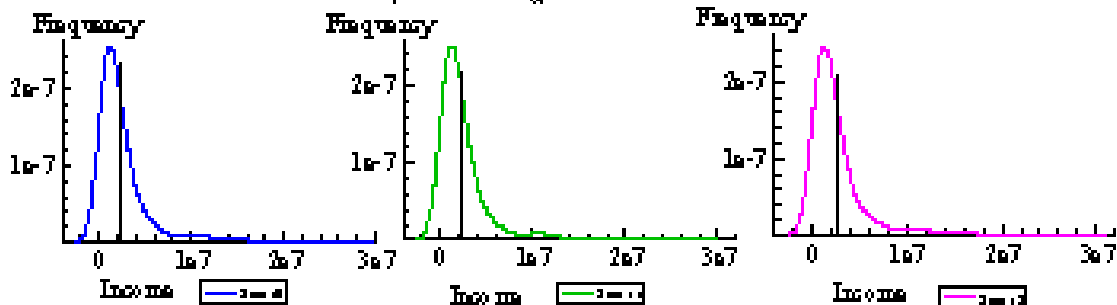


Figure 20 : Density Functions for Export Tariff on Industrial Goods (Non-working)



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