

CHAPTER 4

PARTIAL EQUILIBRIUM ANALYSIS IN AGRICULTURAL TRADE LIBERALIZATION

4.1 Introduction

This chapter describes the partial equilibrium analysis approach in agricultural trade liberalization as well as its limitations, and then empirically examines the effects of the tariff reduction formulas proposed by the WTO on Botswana's agricultural sector, producer and consumer welfare, government and export revenue by applying partial equilibrium analysis. Tariff reduction is one of the major areas of global trade liberalization. The Agricultural Trade Policy and Simulation Model (ATPSM) developed by UNCTAD will be used to analyze the effects of such reduction on Botswana's agricultural sector and food security. The chapter concludes by indicating the merits and demerits of partial equilibrium policy analysis as regards trade liberalization policy.

The partial equilibrium analysis approach assumes that the sector/industry under investigation "should not have important linkages with other sectors of the economy or, if it has, the tariff change being considered should be small. Equally, partial equilibrium analysis is not really applicable when we are considering the effects of simultaneous changes in many tariffs (as might be the case when countries form a free trade area or custom union)" (Sodersten and Reed, 1994, p.438). Specifically, partial equilibrium analysis focuses on commodities or a sector. This assumes that the introduction of external shocks like tariff changes in the sector through the application of a partial equilibrium analysis has a minimal impact on the rest of the economy. Based on this assumption, income distribution and welfare effects in the economy, inter- and intra-sectoral linkages cannot be captured using a partial equilibrium model. This is why Chapters 5-8 will demonstrate the existence of sectoral linkages in the economy following external shocks. As agriculture is

an important sector in Botswana and also exhibits relatively strong sectoral income and demand linkages in the economy, an economy-wide SAM-based analysis will be used to demonstrate these inter-relationships.

4.2 Experiences with Partial Equilibrium Analysis in Agricultural Trade Liberalization

Before an examination of the available evidence on trade liberalization based upon partial equilibrium analysis is undertaken, a brief background for the rationale for economic and trade liberalization, especially among low-income countries. Up until the late 1970's many economies of such countries experienced poor performance stemming from, *inter alia*, inappropriate macro-economic and sectoral policies and very costly import substitution strategies. Beginning in the 1980's, several low-income countries therefore witnessed the promotion of export-led development strategies owing partly to disastrous import-substitution strategies, including that of food self-sufficiency (Bhagwati, 1990).

Consistent with the HOS model of comparative cost advantage (see Chapter 3), although traded sectors like agriculture were expected in the 1970's (and even currently) to generate scarce foreign earnings, as well as to contribute to food security and the overall economy in several low-income countries, this was no longer the case, partly because of costly import substitution and inappropriate policies. The strong advocacy of export-led economies was intended to correct this negative trend among developing countries. The majority of these countries are in Sub-Saharan Africa. However, despite economic and trade reforms introduced by most low-income countries, improved market access to industrialized countries still remains a major challenge for most low-income countries.

According to the IMF (2000) and the World Bank (2000) not only did these import substitution strategies reduce the export/GDP ratio for several low-income countries, including most of Sub-Saharan Africa, but serious macro-

economic balances were also experienced. High and chronic budget deficits persisted owing to untargeted subsidies, growing public expenditure as well as overvalued currencies, which penalized the growth of traded good sectors like agriculture. High and runaway inflation as well as unemployment rates became a common feature in several low-income countries.

The provision of public goods was also extremely limited because of chronic budget deficits. As indicated by several annual World Development Reports from the World Bank, as well as reports from the Food Summit (1996, 2001), abject poverty and household food insecurity did not improve during the years of inappropriate policies and import substitution. In fact the number of people living below an income of US \$ 1 per day, especially in Sub-Saharan Africa, has been increasing while income distribution has further worsened (World Bank, 2002).

Since the mid-1980's, most low-income countries have experienced relatively high export/GDP growth, mainly because of trade liberalization in factor and product markets. Over-valued currencies have also been aligned with market forces while exchange and price controls have been phased out in many countries. The removals of controls and currency devaluation have partly benefited traded sectors like agriculture, since previous policies penalized exports. In addition the phasing out of monopolistic state-owned parastatal organizations has also enhanced competition as well as private sector participation in the factor and product markets. As expected, almost all the economic and trade reforms in Africa have been imposed by the IMF and World Bank through the so-called structural adjustment policies/programmes.

In order to improve the positive impact of economic and trade reforms on the macro-economy, sectoral performance, food security, etc, two approaches have been adopted to measure and monitor the desired effects. Partial equilibrium and economy-wide (general equilibrium) approaches have been used to analyze the effects of the reforms and assist informed policy decisions. Below follows a brief account of empirical studies on agricultural

trade liberalization, based upon the partial equilibrium approach in both low-income and industrialized countries.

Using a partial equilibrium analysis of agricultural trade liberalization by both industrialized and developing countries, Tyers and Anderson (1990) found that world commodity prices would increase by about 12 percent as a result of the removal of subsidies, tariffs, quotas, exchange and price controls. While in 1983 the food self-sufficiency indices (SSI) were 109 per cent in the industrial countries and 92 percent in developing nations, after worldwide trade liberalization in all sectors of the economy, it is estimated that the SSI for industrial and low-income countries will be 74 per cent and 118 per cent respectively (Anderson and Tyers, 1990).

The decline in the SSI for industrial countries is partly caused by the reduction in subsidies and tariffs, while the increase in food self-sufficiency in low-income countries could be attributable to higher producer prices and technological innovations. The results of the study by Anderson and Tyers assume complete price transmission in the economy, without restrictions. In essence prices should be determined in a free market without restrictions being placed on information by public policy or imperfect market conditions.

In addition, the study by Anderson and Tyers also anticipates higher commodity price increases in wheat, dairy products, meat and sugar. According to the study, the weighted average increase in world prices for these commodities, after global trade, and macroeconomic, liberalization, will be 12 percent. Another study indicates that with completely free agricultural trade in the European Union, grain prices would increase by about 13 per cent (Lingard and Hubbard, 1991).

It is also reported in partial equilibrium models that price variability will reduce (Sarris & Freebairn, 1991). Whereas before world trade liberalization, the instability in food prices measured by the weighted average of the coefficient of variation is estimated at 34 per cent, Anderson and Tyers (1990) indicate

that when industrial countries and low income nations liberalize their economies fully, the weighted coefficient of variation will drop to about 11 per cent.

Empirical results stemming from these models indicate a very high decline in food price variability for cereals (wheat, coarse grain, and rice), ruminant meat (beef), dairy products and sugar. Cereals constitute the bulk of calories for people in low-income countries; hence a decline in their price variability could increase per capita food consumption (World Food Summit, FAO, 1996; 2001). Part of the reason for the decline of price variability in these commodities is the reduction in protection and subsidies previously offered by industrial countries. High tariffs as well as export subsidies and domestic support measures by industrialized countries have played a major role in distorting trade.

In their paper on measuring the sectoral and economy-wide effects of agricultural incentives in developing countries, Krueger *et al.* (1988), using partial equilibrium analysis based on data from eighteen (18) developing countries, established that producers of export commodities were more discriminated against and heavily taxed than those who produced import competing goods. In fact Krueger, *et al.* (1988), found that between 1975 and 1984, direct protection rates for primary exports were negative in almost all the surveyed countries. Direct nominal protection here does not take into account the social opportunity cost of a country's exchange rate, a macro-economic price. In many countries official and fixed exchange rates have been applied to conduct trade. Based on direct nominal protection, export producers in the surveyed countries received a lower net producer price than the world export price/ border price after transport, marketing and costs were taken into account. Consequently, the direct intervention by governments in most of the surveyed countries actually taxed and discriminated against export producers. For countries like Argentina, Egypt, Cote d'Ivoire, Malaysia, Sri Lanka and Thailand, their direct nominal protection rates for their primary exports were at least 25 per cent negative.

Besides direct nominal protection, Krueger *et al.* (1988) also measured the indirect macro-economic effects of exchange rate policy on agricultural trade in the countries surveyed. The indirect macro-economic effects on the exchange rate assume the use of the opportunity cost of a country's exchange rate. The results found that between 1975 and 1984, indirect nominal protection rates were higher than direct protection rates in almost all these countries. For countries like Ghana (cocoa) and Zambia (tobacco), the indirect protection rates resulting from overvalued exchange rates were at least 50 per cent negative.

Surprisingly and interestingly when Krueger *et al.* (1988) undertook a similar study on importables, they found that imported products in most of the surveyed countries enjoyed more positive direct protection rates than those domestically produced and yet competing against them. Imported agricultural goods covered in this study included wheat, rice and maize (Krueger, *et al.*, 1988, p.263). For instance in Ghana, Malaysia and the Dominican Republic, rice enjoyed a positive direct protection rate while for wheat this was more prominent in Brazil and Turkey, where the protection rate was above 20 percent. For maize, Zambia exhibited a negative direct protection rate while the Philippines provided a positive protection rate for this commodity. When the indirect protection and direct measures were combined during the period 1975 through 1984, in almost all countries importables faced negative protection, as was the case with agricultural exportables (Krueger *et al.*, 1988, p.264).

On the basis of studies by Krueger *et al.* as well as similar ones on agricultural pricing policies, several concerns regarding equity, welfare and efficiency, and the like could be raised. It is evident that indirect macro-economic policies, such as the exchange rate, import duties, and the inflation rate, tax agriculture more heavily than direct government interventions. Ironically, farmers/producers tend to be preoccupied with direct public intervention and yet empirical evidence shows that indirect protection policies

are crucial to improving real farm incomes. In short, empirical evidence shows that the “economy wide interventions generally dominate the direct effect” in agriculture more extensively than is normally perceived (Krueger *et al.*, 1988, p.266).

Secondly, if exportables are taxed more than importables, as has occurred in many countries over a long period, the effect is that producers of farm exports are penalized and taxed while importers and consumers are subsidized by government intervention price policies. The tendency by governments to protect importables as opposed to exportables has over the years partly discouraged the growth of and investment in the farm export industry, hence the decline, in part, of several economies. This latter policy development has also heavily influenced the implementation of structural adjustment and trade liberalization policies by the World Bank and the International Monetary Fund in order to generate overall economic growth in many developing countries, including those in Sub-Saharan Africa.

Thirdly, government intervention in food price policies has tended to protect imported commodities, while domestic agricultural producers were taxed. The case of wheat, rice and maize in the countries surveyed underscores this finding. Depending on the domestic fiscal and market policies in each country, by and large, the beneficiaries of the positive and direct protection of imported food commodities are traders, millers and consumers. Government policies aimed at domestic food self-sufficiency may normally fail when importables are accorded higher and more positive protection rates than locally produced commodities.

Jean and Matthews (2005) in their analysis of the consequences of agricultural trade liberalization for developing countries observe that whilst most of these nations enjoy comparative advantage in agricultural products, estimates for their welfare gains might be exaggerated. Part of the reason for the potential low gains is, according to the study, due to aggregating developing countries as if they are homogeneous in resource endowment,

etc. Further, the study indicates that estimates for welfare gains by developing countries were based on incomplete tariff data. Most of the developing countries currently export to preferential markets, duty-free or at low tariff rates. As a result models that base their welfare gains for developing countries on tariff reduction could be over-estimating the potential benefits. According to their study, market access for developing countries is constrained more by supply-side measures and non-tariff barriers, especially sanitary and phyto-sanitary (SPS) standards. The strict and costly SPS requirements by the EU and US export markets on agricultural products are a case in point. Further, the removal of trade preferences in markets such as the EU through the Common Agricultural Policy and the US under the African Growth Opportunity Act in compliance with the WTO, will adversely affect African countries as they enjoy zero to low- duty market conditions. In addition, the removal of preferences and other trade distortions could intensify competition between African countries, in particular, with Brazil, India, Australia, and China in agricultural and textiles products. The study therefore cautions against optimistic welfare gains for developing countries.

In a study by the US Congressional Budget Office (2006) on agricultural trade liberalization, the investigation found that overall global welfare would increase by between US \$ 50 billion and US \$ 185 billion if trade distortions in the sector were reduced or removed. These distortions cover domestic support (producer price and input subsidies for farmers), export subsidies and tariffs including other non-tariff barriers that restrict market access. The removal of the trade-distorting measures will also improve resource allocation and efficiency. Most of the gains are to be derived from tariff reduction and other non-tariff barriers like standards, quotas, licenses, sanitary and phyto-sanitary measures. Trade barriers in agriculture are, higher than those of manufactured goods. The study advocates for agricultural liberalization by both developed and developing countries subject to retaining sensitive/special products for food security and other economic reasons. Whilst the retention of sensitive products is recognized, this could work against developing countries, in particular, if industrialized nations identify products of export interest to the

former, i.e. developing countries, as sensitive/special. If this were to occur, potential agricultural exports from developing countries could be adversely affected. It is therefore critical that a thorough examination be made to determine how a product qualifies to be sensitive whilst taking into account factors such as comparative advantage. The study also supports that developing countries be accorded special and differential treatment (SDT) during agricultural trade liberalization. SDT provisions include a longer period to reduce trade distorting measures as well as accessing technical assistance to improve domestic capacity.

Hodge and Charman (2006) in their analysis of the potential impact of the current WTO agricultural negotiations on government strategies in the SADC region conclude that the Swiss formula unlike the Uruguay approach would impose negative welfare effects on members. The Swiss formula advocates for deep cuts in applied tariffs with a maximum of 25 percent while domestic support is also drastically reduced. It should be borne in mind that for most developing countries tariff revenue is a major source of government budget hence major cuts in tariffs could have major socio-economic adverse effects unless there are compensatory mechanisms. The Uruguay formula is conservative and advocates for a reduction of bound tariffs. According to this study, the Uruguay formula provides SADC countries with a policy space to pursue food security objectives whereas the Swiss formula does not. However, as day-to-day international agricultural trade is based on applied tariffs, it is also doubtful if the Uruguay formula could promote both intra and inter-regional trade if applied tariffs are not changed. In this Chapter, the two formulas are also applied to the Botswana situation. The two formulas form part of the tariff reduction approaches in the ongoing WTO negotiations on agriculture.

Before calculating import volumes, tariff revenue and other data such as consumer and producer surplus for selected agricultural products in Botswana using ATPSM, it is also important to show graphically how consumer and producer surplus as well as government revenue are affected when a tariff is

imposed on an agricultural product in order to achieve several social objectives including food self-sufficiency, protecting domestic producers/industries and raising public revenue (Josling, 1969; Josling and Tangemann, 1988; Goldin and Knudsen, 1990). Figure 4.1 shows how demand and supply are affected following the imposition of an import duty/tariff. The border price or efficiency price is used here as a basis for determining the opportunity cost of the country.

4.3 Border price and Producer and Consumer Surplus/Welfare

A “border price represents the cost to the economy of producing a good and enables the analyst to determine if the country is an efficient producer of that commodity. According to the logic of the border price paradigm, it is a waste of a country’s resources to produce a good for which it has little or no cost advantage” (Tsakok, 1990, p.27).

Algebraically, the border price, P_b is defined as

$$P_b = e P$$

where e represents the exchange rate. The exchange rate reflects the opportunity cost of a unit of foreign currency to the domestic economy. The exchange rate is important especially where the official exchange rate is overvalued. The exchange rate employed to calculate the border price should reflect the real economic cost of the domestic currency. It is important to capture both the direct and indirect rates of protection, including macro-economic prices such as exchange rates (Krueger *et al.*, 1988). Economy-wide price interventions such as exchange rate policies have been partly responsible for penalizing the growth of an agricultural-led development strategy (Krueger *et al.*, 1988). P stands for the world price in a foreign currency such as the US dollar.

To calculate the border price, P_b , also referred to as the efficiency price/reference price, P_w , it is important to use a long-term trend in order to minimize the effects of short-run price movements. Depending on whether the

traded product is an export or import, adjustments are made for transportation, insurance, marketing margins and the like. For exports, the border price represents the price at the point of export, such as a harbour, less transportation costs from the farm. The resulting border price is also known as the free on board (f.o.b.) price. For imports the border price represents the cost/ world price of the product plus insurance and freight charges. The resulting border price is also known as the cost, insurance and freight (c.i.f.) price.

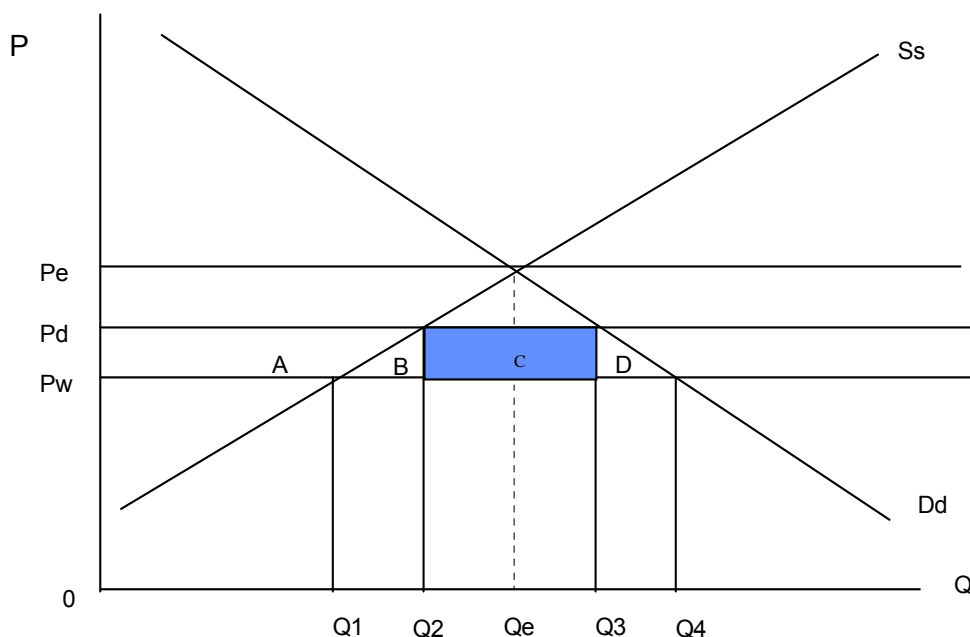


Figure 4.1 An Illustration of the Border Price, P_w in relation to other prices

Here P refers to price and Q to quantity; S_s and D_d , respectively, stand for supply and demand. P_e stands for the equilibrium price while Q_e represents the equilibrium quantity.

In Figure 4.1 the border price, P_b , is the same as the world efficiency price, P_w . The opportunity cost incurred by a country in producing or importing a good is based on this world price or border price. Specifically, this price indicates what the country/society will give up or pay in the event that it produces or imports the good. The country foregoes its scarce resources

(area B in figure 4.1), which could be applied to other uses, by investing/producing the good. These resources include land, investment capital and technology. In this study it is assumed that Botswana, as a small economy, is a price-taker in the global commodity markets.

When the border price is used as a basis for importing a commodity, the relevant cost, insurance, freight (c.i.f.) costs are included in the pricing policy. However, where a country is an exporter, the border price, P_b or P_w , represents the real economic price of the good in the international market less the relevant costs of transportation, etc. Like those who produce the commodity for domestic consumption in the place of imports, exporters of the good will receive the border price or P_w and are paid in equivalent local currency after adjusting for relevant costs.

In Figure 4.1, the government administers the domestic price, P_d , to encourage local producers to enjoy an advantage over their foreign competitors. This price is intended to protect local producers against foreign competition by means of an import duty, which makes the domestic support price, P_d , higher than the world price, P_w . The import duty creates a wedge between the domestic and imported price of the same good. In fact, food self-sufficiency objectives as well as other import substitution strategies normally mean that authorities administer autarky prices so as to provide additional incentives, to local producers, to increase domestic supply. As indicated in Chapter 2, autarky or self-sufficiency prices do not necessarily improve per capita food consumption, especially among poor households.

At the autarky price or protected domestic price, P^d , domestic supply is Q_2 while consumption is Q_3 . At the efficiency price/border price, P_w , domestic supply is Q_1 while consumption is Q_4 . The autarky price favours domestic producers but penalizes consumers as they pay a higher price ($P_d > P_w$) and also consume less ($Q_3 < Q_4$). Studies undertaken in several parts of the world, including Africa, indicate that in most cases a high domestic price or autarky price, P_d , generally benefits only a small number of large-scale farmers who in

most cases are net sellers of agricultural products (Weber, *et al.* 1988; Van Zyl and Van Rooyen, 1991; Sarris, 1997). In figure 4.1, the equilibrium price is P_e while the equilibrium quantity is Q_e . Area C represents government tariff/import revenue.

Consumer surplus covers the area below demand D_d up to the intersection with the price axis, P , but above the world price, P_w . Essentially consumer surplus indicates the advantage or opportunity buyers or consumers would enjoy by purchasing a product at the border/world price, P_w , while some would even be willing to buy at higher prices, including the protected domestic price, P_d . However with the imposition of import duties in order to support local agricultural producers, the consumer surplus/welfare is reduced. The subsequent consumer surplus area is the area below D_d up to the price axis but now above the domestic price, P_d . Consequently, the imposition of an import duty to support local production has reduced the advantage or opportunity that consumers/buyers would otherwise enjoy without government intervention. From the food security perspective, in essence the reduction in the consumer surplus means reducing per capita food consumption, especially among the poor.

In Figure 4.1, producer surplus represents the area above the supply curve, S_s , up to the intersection with the price axis but below the world price/border price, P_w . The area covered by producer surplus indicates the net gain or revenue that domestic producers would enjoy if they sold at world price P_w , with some being willing to sell at even lower prices than the border/world price. Fortunately for the domestic producers owing to government's objective to protect the local industry and sometimes to develop small local farmers, etc., the producer surplus area/net gain is increased to below P_d but is still above S_s . Evidently, the increase in producer surplus implies an increase in net revenue gains/income for domestic producers. However, available evidence shows that the main beneficiaries of a high and protected domestic price are large-scale farmers with resources, technology, access to credit, infrastructure, skills, political power, and so forth. In short, government

support to local producers by imposing import duties leads to adverse equity and food security implications, as poor farmers do not generally have an adequate marketable surplus to benefit from high producer prices.

Differential and unequal access to productive resources, infrastructure, and institutions, including political power, may partly explain the inability of several farming households to benefit from high producer prices. In Botswana most small farmers lack capital, draught power for arable farming, technology and skills (National Development Plan 9, 2003). In addition, like most farmers in developing countries, small farmers in Botswana wield limited political influence. Consequently an agricultural pricing policy that assumes that all farmers are net sellers of food or agricultural commodities and therefore will benefit from high producer prices, such as P_d in Figure 4.1, may largely be empirically flawed and ill-advised. In fact poor households do not benefit from high domestic food prices that are intended to replace imports such as the autarky prices (Weber, *et al.* 1988; Van Zyl & Van Rooyen, 1991; Sarris, 1997).

4.4 Application of a Partial Equilibrium Model to Global Trade Liberalization in the Agricultural Sector

The agricultural sector has continually been one of the more contentious industries in international trade primarily because of its strong political and economic linkages in both developed and developing countries. During the Uruguay Round, the sector was excluded from multilateral trade negotiations owing to its political and economic sensitivity. However, during the multilateral trade negotiations leading to the formation of the current World Trade Organization (WTO), the agricultural sector was included in order to integrate the industry into global commerce.

In order to understand and appreciate the likely effects of global trade liberalization of the agricultural sector on the economies of both industrialized and developing/low-income countries, the United Nations Conference on

Trade and Development (UNCTAD) together with the Food and Agriculture Organization (FAO) developed a partial equilibrium model in the early 1990's, to quantify the effects of reforming the sector. The Agricultural Trade Policy Simulation Model (ATPSM) was then created to quantify the effects of global trade liberalization. Below is a brief description of the ATPSM.

ATPSM is a deterministic, comparative static, partial equilibrium model. Hence there are no stochastic shocks or other uncertainties, and there is no specific time dimension to the implementation of the policy measures or to the maturing of their economic effects. The comparative static nature of the model does not imply that the policies take effect instantaneously. Rather, one is comparing two states at a similar point in time: one with the policy change, the other without. Finally, whereas the model aims at estimating far-reaching details of the agricultural economy, it does not deal with the repercussions of barrier reductions on other parts of the national economy. Thus, neither effects on the government budget (except for tariff revenues and subsidies to exports and domestic production) nor on the industrial and service parts of the economy or the labour market are the subjects of analysis. Simplifying the model in these respects allows for a detailed specification of policies regarding numerous commodities in a large number of countries.

The Agricultural Trade Policy and Simulation Model (ATPSM) covers about 176 countries and 36 agricultural product groups. All members of the Organization of Economic Cooperation and Development or OECD are included in the ATPSM; the majority of developing countries including those in Sub-Saharan Africa are also covered by the model. In fact ATPSM covers large economies (US, EU, Japan, etc.) as well as several developed, developing and least-developed countries, most of which are price-takers. Except for the EU, which is treated as one economic bloc, all other countries in the model are covered as individual entities.

Further, in ATPSM, agricultural products are classified into 36 commodity groups covering both basic and food commodities such as meat (bovine,

sheep, pork and poultry), dairy products (fresh milk, dried milk, butter and cheese), cereals (wheat, rice, barley, maize and sorghum), sugar, vegetable oils and oil seeds, pulses and roots and tubers. The other products include fruits (tropical and non-tropical), tropical beverages (cocoa, tea and coffee), tobacco and cotton (UNCTAD, 2005). Botswana and SACU's main agricultural products as well as sensitive commodities are included in the ATPSM database. These products are beef, maize, wheat, dairy products and sugar. In addition, for Botswana poultry and sheep and goat meat are considered as sensitive products, given the high level of domestic production as well as of public and private investment. As a developing country, Botswana has encouraged domestic production in these commodities in order to improve food security and generate scarce employment and income opportunities.

Equation system

After a trade policy change, such as a change in tariffs, export subsidies and / or domestic support, is specified the model calculates the new equilibrium. The equation system for all countries contains four equations

$$\begin{aligned}
 1) \quad \hat{D}_{i,r} &= \eta_{i,i,r} \hat{P}_{ci} + \sum_{\substack{j=1 \\ j \neq i}}^j \eta_{i,j,r} \hat{P}_{c,j} ; \\
 2) \quad \hat{S}_{i,r} &= \varepsilon_{i,i,r} \hat{P}_{pi} + \sum_{\substack{j=1 \\ j \neq i}}^j \varepsilon_{i,j,r} \hat{P}_{p,j} ; \\
 3) \quad \Delta X_{i,r} &= \Delta M_{i,r} - D_{i,r} \hat{D}_{i,r} + S_{i,r} \hat{S}_{i,r} ; \\
 4) \quad \Delta M_{i,r} &= \frac{A_{new}}{1 + A_{new}} D_i \hat{D}_{i,r} - \left(\frac{A_{init}}{1 + A_{init}} - \frac{A_{new}}{1 + A_{new}} \right) D_{i,r} ,
 \end{aligned}$$

$$\text{where } A_y = \left(\frac{\alpha_m \left(\frac{P_d}{P_m} \right)_y}{\alpha_d} \right)_{i,r}^\sigma$$

Source: ATPSM, UNCTAD, 2005

Key: D , S , X and M denote demand, supply, exports and imports, respectively;

\wedge denotes relative changes and Δ absolute changes;

P_c denotes consumer price, P_p producer price, P_d price for domestic supply, P_m price for imports (see below);

ε denotes supply elasticity, η denotes demand elasticity;

l and j are commodities indexes, r is a country index;

$y = \text{init}$ indicates initial values and $y = \text{new}$ indicates values after the policy changes;

σ denotes the Armington elasticity between imports and domestically produced goods.

Equations 1 and 2 specify that the new demand and supply are determined by the price changes and trade policy changes together with the corresponding elasticities and cross-price elasticities. Equation 4 ensures that the relation of imports and domestic supply is determined by the price ratio of domestic supply and imports.

$$\frac{M}{D - M} = \left(\frac{\alpha_m P_d}{\alpha_d P_m} \right)^\sigma$$

Equation 3 clears the market, so that production plus imports equals domestic consumption and exports.

These equations can be transformed into matrix notation and the equation solved arithmetically for world prices by matrix inversion. A market equilibrium requires that, globally, the sum of the change in exports equals the total change in imports for each commodity.

$$5) \quad \sum_{n=1}^N (\Delta X_n - \Delta M_n) = 0;$$

Prices

Domestic prices are all functions of the world market price (see figure 4.1) and the border protection or special domestic support measures. Thus, domestic price data is not required and transaction costs (such as wholesale and retail

margins) are not taken into account. All protection measures are expressed in tariff equivalents.

The relationship between world and domestic prices is complicated by the existence of two-way trade in the one (aggregated) good. In order to accommodate heterogeneous goods with one price, the approach taken here is to estimate a composite price and a composite tariff for determining the domestic consumption and production price, respectively. To derive a composite price, products are divided into three groups: imports; exports; and production supplied to the domestic market (S_d).

First, a domestic market price wedge (t_d) is computed as the weighted average of two tariffs, the export tariff (t_x) and import tariff (t_m), where the weights are exports (X) and imports (M):

$$t_d = (Xt_x + Mt_m) / (M + X).$$

The price for domestic supply is $P_d = P_w(1 + t_d)$, where P_w is the world price, and the price for imports is $P_m = P_w(1 + t_m)$. Then, a composite consumer price is computed as $P_c = (\alpha_m^\sigma P_m^{1-\sigma} + \alpha_d^\sigma P_d^{1-\sigma})^{1-1/\sigma}$. The producer price wedge is computed as the weighted average of the export tariff (t_x) and the domestic market price wedge (t_d), where the weights are exports (X) and domestic supply (S_d) plus the domestic support tariff (t_p): $t_s = (Xt_x + S_d t_d) / (S + t_p)$. The producer price is $P_s = P_w(1 + t_s)$. The calculations of consumer and producer prices are applied both to the baseline and the final tariffs.

A feature of this structure is that if there are no exports, domestic producer prices are determined by the tariff plus the domestic support. If there are no imports the export subsidy effectively determines the producer price. Finally, if two-way trade exists, the share of total production or consumption of the specific good influences the importance of each tariff.

The heterogeneous nature of imports and exports also requires a means of specifying the volume of either imports or exports. In this model imports are specified so that the relationship of imports and domestic supply is determined by the price ratio of domestic supply and imports (equation 4). In essence, this means that imports are not perfect substitutes for domestic products. This product differentiation between domestically produced and imported goods is known as Armington specification. Further, exports are determined as the residual of production, consumption and imports. Elasticities of demand and supply are based on data from the Food Agriculture Organization.

Trade revenue

Once changes in world prices and hence domestic prices are determined from the model solution, volume changes can be derived from equations 1-4. Given the volume responses ΔX , ΔM , ΔS , and ΔD , the trade revenue and welfare effects can be computed. The trade revenue effect of the policy changes is computed for each country and each commodity from:

$$\Delta R_1 = (P_w + \Delta P_w)[(X + \Delta X) - (M + \Delta M)] - P_w(X - M)$$

Secondly, there is a change in quota rents, ΔU , which generates a further trade revenue effect (in each country and each commodity):

$$\Delta R_2 = (U + \Delta U)[X + \Delta X] - UX.$$

The total trade revenue effect is the sum of these components:

$$\Delta R = \Delta R_1 + \Delta R_2.$$

Welfare

The welfare change contains three components. The first two constitute changes in producer surplus (ΔPS) and consumer surplus (ΔCS). These

changes depend on the domestic market price changes and the own-price domestic demand and supply volume responses to these changes. The change in producer surplus is also dependent on the change in quota rent. For each country and commodity:

$$\Delta PS = \Delta P_p [S + 0.5(\Delta S_d)] + \Delta R_2; \quad \Delta CS = -\Delta P_c [D + 0.5(\Delta D_d)];$$

The third component is the change in net government revenue (ΔNGR), consisting of the change in tariff revenue, that in export subsidy expenditure and that in domestic support expenditure. For each country and commodity:

$$\begin{aligned} \Delta NGR &= \Delta TR - \Delta ES - \Delta DS \\ &= \underbrace{(t_w + \Delta t_w)(Q + \Delta Q) - t_w Q}_{\text{Change-in-within-quota-revenue}} + \underbrace{(t_o + \Delta t_o)[(M + \Delta M) - (Q + \Delta Q)] - t_o(M - Q)}_{\text{Change-in-out-of-quota-revenue}} \\ &\quad - \underbrace{[(t_x + \Delta t_x)(X + \Delta X) - t_x X]}_{\text{Change-in-export-subsidy-expenditure}} - \underbrace{[(t_d + \Delta t_d)(S + \Delta S) - t_d S]}_{\text{Change-in-domestic-support-expenditure}} \end{aligned}$$

The sum is the total welfare effect: $\Delta W = \Delta PS + \Delta CS + \Delta NGR$

4.5 ATPSM formulas applied to Liberalize Global Agricultural Trade

Currently, four scenarios/formulas are under consideration by WTO in order to liberalize global agricultural trade. These scenarios were submitted to the WTO Ministerial meeting in Hong Kong, in 2005 but members failed to agree on them. All the formulas/scenarios include a reduction in bound/applied tariff, domestic farm support and export subsidy. Below we describe briefly the elements of each scenario before the ATPSM results are presented and analyzed.

Uruguay

Developed countries are to reduce their bound tariffs in agriculture by 36 percent over six years while export subsidy and domestic support are reduced by 21 and 20 percent respectively over the same period.

Developing countries are to reduce their bound tariffs in agriculture by 24 percent over 10 years while export subsidy and domestic support are reduced by 14 and 13 percent respectively over the same period.

Swiss Formula

By means of the Swiss formula, also known as the ambitious tariff reduction formula, developed countries should have 25 percent as their maximum applied tariff while export subsidy and domestic support are reduced by 100 percent and 95 percent respectively over five years.

Developing countries on the other hand should have 50 percent as their maximum applied tariff while export subsidy and domestic support are to be reduced as in developed countries, i.e., by 100 and 95 percent respectively over the same period. In essence, regarding the differing maximum applied tariff rates between developed and developing countries, the Swiss formula treats the two groups of countries in respect of cuts in export and domestic subsidies as the same.

Cancun/Blended Formula (Derbez)

Under the Cancun/Blended formula, developed countries are to reduce their export subsidy by 80 percent while domestic support is reduced by 60 percent, subject to a maximum of 25 percent of the applied tariff. Forty percent of the tariff lines are subjected to the Uruguay formula while another 40 percent is subject to the Swiss formula. This allows developed countries to include sensitive products under the conservative Uruguay formula while less sensitive products are covered under the radical Swiss formula. Agricultural products of interest as exports to developing countries are likely to face limited market access if developed countries classify them as sensitive imports. The remaining 20 percent of the tariff lines are to be reduced to zero. The Cancun formula is described as blended because it includes components of both the Swiss Formula and the Uruguay approach. Sensitive agricultural products are also

factored in (Special Products). For developed countries sensitive products include sugar, dairy, beef meat and some cereals.

Insofar as developing countries are concerned, they are to reduce the export subsidy by 70 percent while domestic support is cut by 20 percent, subject to a maximum of 50 percent of the applied tariff. As with developed countries, 40 percent of the tariff lines are to be covered by the Uruguay formula while another 40 percent of the tariff lines are subjected to the Swiss formula. About 10 percent of the tariff lines of the most cover sensitive tariff lines are to be reduced by five percent (special products). The remaining 10 percent of tariff lines are to be reduced by five percent. Sensitive agricultural products are also factored into special products. For Botswana, sensitive products include beef, wheat, maize, sugar and dairy products. Other developing countries might include fruits, vegetables, oil seeds, etc. The list of sensitive products remains a point of contention for both the exporting and the importing developing countries.

Harbinson Formula

Developed countries are to reduce export subsidy by 80 percent while domestic support is reduced by 60 percent. Tariff reductions are arranged according to bands. Only bound tariffs are to be reduced.

Developing countries are required to reduce export subsidy by 70 percent while domestic support is reduced by 20 percent. As in developed countries, tariff reductions are arranged according to bands. Only bound tariffs are to be reduced.

Before examining the results of the various scenarios, it should be noted that the application of each formula triggers simultaneous changes in each commodity group by country/region, according to those equations of the model which have been indicated earlier under the description of the ATPSM. As part of the WTO provisions, least developed countries do not make reduction commitments.

Country and Product Coverage in ATPSM

The current ATPSM covers 176 countries in terms of which the European Union is treated as one region, while most of the developing countries including Sub-Saharan Africa are also encompassed in the model (ATPSM, UNCTAD, 2005). All members of the industrialized Organization of Economic Cooperation and Development (OECD) together with key trade players like the EU, USA and Japan are included in the current ATPSM.

Regarding product coverage, ATPSM covers 36 agricultural commodity groups. These are classified as:

- ❖ Meat (beef, pork, sheep/goat and poultry products)
- ❖ Dairy (fresh, concentrated/powdered, butter, cheese)
- ❖ Cereals (wheat, maize, rice, barley and sorghum)
- ❖ Vegetables and fruits (tomatoes, tubers, roots, fruits, etc)
- ❖ Sugar
- ❖ Oilseeds (pulses, cotton lint, vegetable oils, etc)
- ❖ Others (coffee, cocoa, chocolate, tobacco, tea, cigarettes, etc.).

Botswana's main traded agricultural products, including those from SACU, are included in the model.

4.6 ATPSM Results on Agricultural Trade Liberalization in Botswana.

The results of the various scenarios cover changes in agricultural exports, imports, government revenue, producer and consumer welfare as well as in overall welfare after global trade liberalization. While all WTO members, except for least-developed countries, are expected to make reduction commitments in tariffs, export subsidy and domestic support, the developed countries, in particular, are required to undertake more cuts so as to improve market access to agricultural exports of interest to both developing and least-developed countries. Commitments to further reductions by developed countries are consistent with the WTO's Doha Development Agenda (WTO, 2001).

The results of four scenarios for Botswana are examined below.

4.6.1 The effects of global agricultural trade liberalization on Botswana’s agricultural export earnings.

ATPSM has been used to assess the impact of proposed tariff reduction formulas on the agricultural export revenue of WTO members. Figure 4.2 below shows the results for Botswana by formula. Figure 4.2 shows a change in agricultural export revenue brought about by each scenario/tariff reduction formula. The results show that the Swiss formula, also known as the Ambitious Scenario, provides Botswana with the largest additional gain in total agricultural export revenue (**US \$ 7.1 million**).

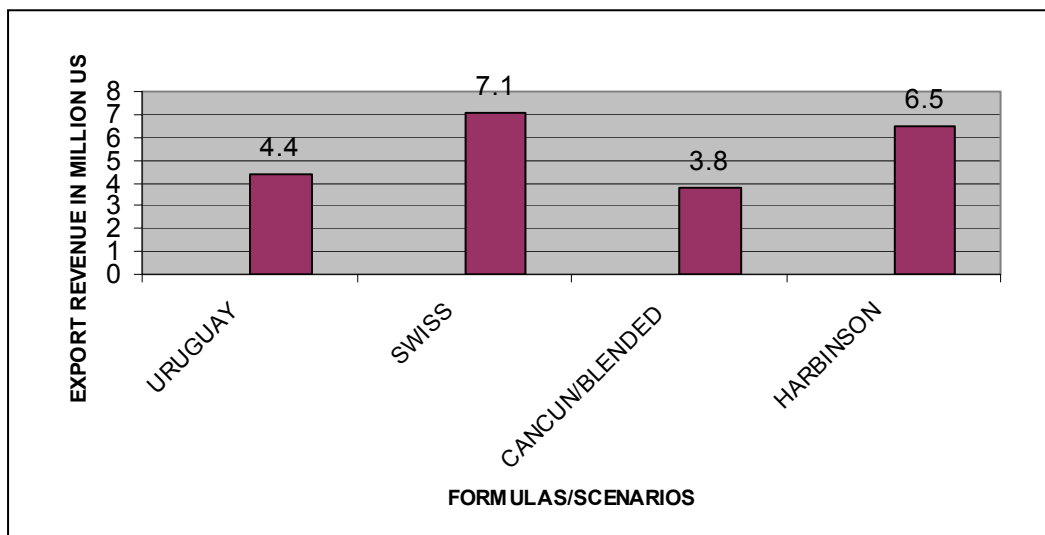


Figure 4.2: Change in Agricultural Export Revenue by Formula in Million US Dollars

The Swiss formula argues for major cuts in applied tariffs, total elimination of export subsidy and to some extent of domestic support in both developed and developing countries. Beef generates almost all the additional agricultural export revenue. This possibly indicates the global competitiveness of the industry after trade-distorting measures such as tariffs and subsidies are reduced. The relatively high competitiveness of beef following global trade liberalization is an indication that the industry enjoys a comparative advantage, which is consistent with the HOS model described in Chapter 3.

The Harbinson formula, a compromise between the Uruguay and Swiss Formula, comes second by providing Botswana with about **US \$ 6.5 million** additional agricultural export revenue. As in the Swiss formula, beef generates almost all the additional agricultural export revenue. This also indicates the global competitiveness of the industry after trade-distorting measures like subsidies are reduced.

The Uruguay formula, also known as the conservative scenario, comes third and generates about **US \$ 4.4 million** additional agricultural export revenue for Botswana. The Uruguay formula is considered as less liberal, especially for agricultural exports from developing countries, since bound tariffs, export subsidy and domestic support do not experience major cuts as is the case with both the Swiss and the Harbinson formulas. As in the other two previous scenarios almost all additional agricultural export revenue under the Uruguay formula stems from beef.

Finally, the Cancun/Blended Formula generates the lowest additional agricultural export revenue for Botswana (**US \$ 3.8 million**). Part of the reason for this lower additional export revenue could be that the Cancun/Blended Formula has factored in sensitive products such as beef, which developed countries could include under the conservative Uruguay component for protection. Almost all additional agricultural export revenue, as in other scenarios, is from beef. As indicated in Chapters 1 and 2, Botswana is semi-arid and mainly suitable for extensive beef production.

4.6.2 The effects of global trade liberalization on Botswana's agricultural import Cost by Formula

As in the case of agricultural export revenue, ATPSM also calculates the potential change in agricultural import cost by country. Figure 4.3 illustrates the change in agricultural imports by scenario in Botswana. The results indicate that under the Swiss formula, Botswana allows the largest inflow of imports (**US \$**

3.7 million), followed by the Harbinson approach (**US \$ 3.5 million**). The Uruguay and the Cancun/Blended formulas provide Botswana with equal inflows of imports (**US \$ 2.3 million**). The Swiss formula, because of its major cuts in applied tariffs and subsidies, opens up markets more than any other formula. Products that experience the largest import flows are concentrated milk, livestock, cereals (maize, wheat), butter, tea, and tobacco. Cereals constitute the main sources of calories and to meet household requirements in these commodities, Botswana depends on imports (see food balance sheets in Chapter 1). Livestock imports here cover live animals which are mainly used for breeding purposes. Unfavourable climatic and physical factors are mainly responsible for the high dependency on imports. Botswana’s food security also depends on accessing competitive imports to meet domestic consumption.

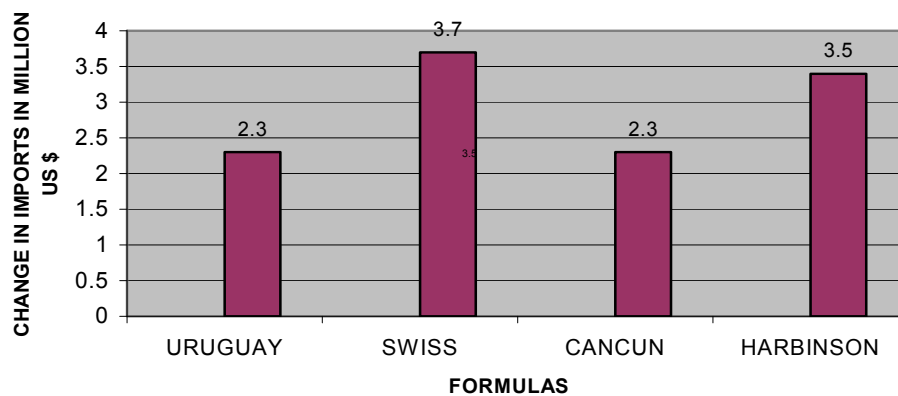


Figure 4.3: The effects of international trade liberalization on Botswana’s agricultural imports by tariff reduction formula (Million US Dollars)

In addition to cereal and dairy imports, all scenarios also indicate an increase in beef imports. Currently, Botswana is self-sufficient in beef and has also been an exporter of the same product for several generations. A food security challenge or dilemma for several decision makers and other relevant stakeholders in the country is whether beef imports should be allowed to improve per capita protein consumption especially among poor households and children or maintain the status quo? Evidently, this could pose major political and economic challenges. Livestock/cattle farmers and export meat-processing plants (like BMC) that depend on income from sales will strongly

resist any liberalization of the beef market as this could adversely affect their economic rents. Cattle farmers include very powerful political individuals or households. Workers who also depend on labour income from the cattle and meat processing industry could join these political heavyweights to resist the liberalization of the beef market. It is therefore evident that the liberalization of the beef industry in Botswana to foreign competition could pose serious political and economic problems, hence the need to exercise extreme caution in order to minimize unforeseen high social costs.

Further, beef liberalization might also be associated with the importation of mad cow disease, a threat that would negatively affect the export-led industry. Unless effective domestic and SACU-wide safeguard mechanisms are implemented, dumping and importation of subsidized beef/meat could also pose additional threats to Botswana's beef sector. Industrialized countries, especially the EU and US, still provide export subsidies to commodities like beef, which if imported into Botswana in large quantities could threaten the domestic industry and adversely affect household food security (Ingco and Nash, 2004). Chapter 6 will therefore also examine the linkages between the cattle industry and the rest of the economy.

On the other hand for poor households and children who face protein food insecurity, the liberalization of the beef industry could increase per capita protein consumption. Protein malnutrition owing to poverty has continued to be one of the main household food insecurity concerns facing Botswana for many years, even though the country is self-sufficient in beef (NDP 9, 2003). Further, the importation of beef could encourage increased domestic meat processing so as to meet local and export market demand. Currently, this segment of the market is curtailed by relatively high domestic beef prices owing mainly to protection by means of tariffs, disease controls and the export monopoly enjoyed by BMC (see Chapter 2).

Welfare Changes

Besides indicating the effects on agricultural exports and imports, the four proposed WTO tariff reduction formulas/scenarios also assess the impacts on producers and consumers' welfare as well as on government tariff revenue. In most developing countries, the agricultural sector is one of the largest employers in the economy while many households/consumers also spend a disproportionate share of their income on food.

Further, many developing countries depend on import tariff revenue in order to finance their government's recurrent and development budgets. In Botswana, about **15-20 percent** of total government revenue is derived from customs/tariff earnings. Agricultural tariff revenue accounts for about **3-5 percent** of the total tariff/customs revenue. Total welfare here is the sum of producers/surplus, consumers' welfare and government revenue. The results in change of welfare by formula are indicated in Figure 4.4 below.

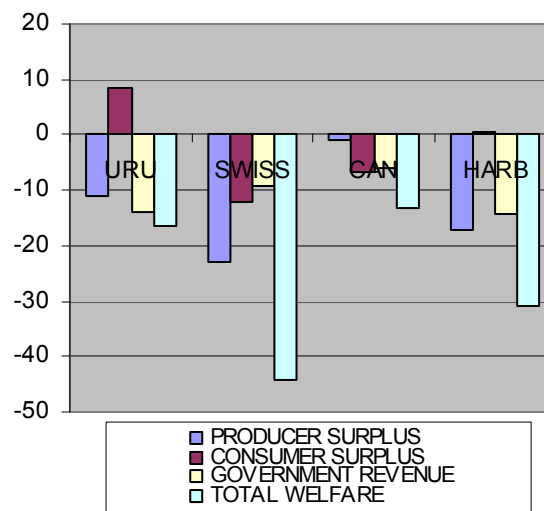


Figure 4.4: The effects of global trade liberalization on welfare in Botswana by tariff reduction formula in Million US Dollars

Based on the welfare results generated by the proposed WTO tariff reduction formulas, we arrive at the following findings covering producer and consumer welfare as well as government revenue.

Change in Producer Surplus in Botswana

Producer surplus or welfare is adversely affected by all formulas. The loss in welfare ranges from a modest negative (-) US \$ 0.8 million under the Cancun/Blended Formula to about - US\$ 22.8 million under the Swiss formula. As indicated earlier, the Swiss formula makes major cuts in applied tariffs, as well as in export subsidy and domestic support, in both developed and developing countries. Producers, including those in Botswana, benefit from the domestic price support provided in industrialized countries, in particular to protect farmers. For instance, beef farmers in Botswana benefit from the producer price subsidies extended to farmers by the EU under the Common Agricultural Policy/CAP. As the Cancun/Blended Formula applies both Uruguay and Swiss components to many tariff lines, it is not surprising that its effect on producers' welfare is less dramatic compared to that of other scenarios.

The effects of the Uruguay and Harbinson formulas are in between those of the Swiss and Cancun scenarios but the loss to producers is still very high. While under the Uruguay approach producers lose about US \$ 11 million worth of income, in the Harbinson scenario producers are US \$ 17 million worse off. Among the major losers are producers in the beef, livestock and sorghum enterprises, but producers of sheep meat, poultry, pork, sugar refiners, pulses and vegetable oils, maize and cotton stand to gain. Beef and livestock producers are adversely affected by major cuts in the current CAP under the EU, in compliance with the WTO provisions under the Agreement on Agriculture (WTO, 1995). The WTO Agreement on Agriculture requires members to reduce trade-distorting measures such as direct producer subsidies in prices and inputs, in order to promote global trade based largely on the comparative advantage/HOS model. Major cuts in CAP support programmes strongly influence Botswana's producer prices as most bovine meat is sold there in the EU.

Potential gains by producers of sheep meat, poultry, pork, sugar refiners, pulses and vegetable oils, maize and cotton could also open up investment

opportunities for some more viable agricultural diversification. The development of sustainable alternative agricultural enterprises following global trade liberalization could also enhance household food security by expanding income and employment opportunities in order to reduce poverty. In essence, additional gains by producers of sheep and pork meat, maize, oil seeds, pulses, etc. imply that global trade liberalization improves the comparative advantage of Botswana in these products, because direct trade-distorting measures are reduced or removed.

Change in Consumer Surplus/ Welfare in Botswana

Figure 4.4 illustrates the change in consumer welfare in Botswana following global trade liberalization in the agricultural sector. Except under the Uruguay and Harbinson's formulas, consumers' surplus/welfare is adversely affected by the Swiss and Cancun/Blended formulas. While in terms of the Uruguay scenario consumers gain about US\$ 8.5 million and a modest US \$ 0.5 million under the Harbinson approach, in terms of the Swiss and Cancun formulas the welfare of consumers of agricultural products in Botswana is negatively affected.

If the Swiss formula is applied, consumers lose about US \$ 12 million while in terms of the Cancun/Blended formula consumers experience a US \$ 6.7 million loss in their welfare. The Swiss formula makes major cuts in export and domestic subsidies that in turn increase the price to consumers by reducing supply. In fact the aggregate/world supply curve shifts to the left, owing to the reduction of producer subsidies by major trade players, especially the EU, US and Japan. Unlike the radical Swiss scenario, the Uruguay formula is very conservative in reducing domestic support and helps to maintain relatively high world agricultural production as well as surpluses. As the Cancun/Blended formula contains both Uruguay and Swiss features, the scenario causes less welfare loss for consumers than the Swiss formula. The Harbinson scenario, as indicated earlier, is a compromise between the Swiss and Uruguay formulas, and the modest gain by consumers should not necessarily be surprising.

Among the main beneficiaries are consumers of tobacco, coffee and to some extent sorghum, while buyers of beef and livestock also benefit. However, consumers of dairy products, wheat, maize, rice, sheep, poultry and pig meat as well as of sugar and vegetable oils are the main losers when global trade has been liberalized. Currently in Botswana, while households at a national level on average spend about 24 percent of their disposable income on food, low-income households earning below P 1 500 per month³ spend on average about 36 percent of their disposable income on food, which is dominated by cereals, meat, dairy, vegetables and pulses (HIES 2002/03, CSO, 2004). Except for meat, almost all these other food commodities are imported. Improvement in consumer welfare is clearly an important part of food security, especially in a food deficit country like Botswana. Given the likely high cost of imported food commodities after global trade is liberalized, food deficit countries like Botswana might require temporary food assistance in order to minimize household hardships, especially among the poor. The successful implementation of the WTO provision for Net-Food Importing Countries is critical for Botswana. It is hoped that when operational, the provision could offer food deficit countries with additional food aid/financial assistance so as to enable them to adjust to short-term price shocks to consumers. The implementation of this provision will also complement WTO's provision of special differential treatment (SDT) for developing countries. SDT provisions include provision of technical assistance in order to enable developing countries to be fully integrated into world economy and trade.

Change in Government Revenue

Under all scenarios/formulas, government tariff revenue in Botswana is adversely affected. Reducing tariffs on agricultural imports exerts negative effects on Botswana's government revenue. While the contribution of agricultural tariff revenue to total public revenues is relatively small, development challenges such as poverty, unemployment and HIV/AIDS require

³ 1 Pula is about US \$ 0.18

additional resources. Currently, tariff revenue accounts for about 12 percent of the total budget in Botswana, while customs duties from agricultural products alone account for just fewer than 2 percent of the country's total public revenues (NDP 9, 2003). Consequently, the reduction in agricultural tariffs may not adversely affect the budget, because currently diamonds and other service sectors contribute significantly to government revenue. As tariff revenue, in general, is likely to be adversely affected by global and regional trade liberalization, the government of Botswana has already introduced a value added tax (VAT) to diversify its revenue sources.

The loss of government revenue ranges from about US \$ 5.8 million under the Cancun/Blended formula, US \$ 9.4 million in the Swiss Formula, and US \$ 13.8 million in terms of the Uruguay scenario, to about US \$ 14.3 million if the Harbinson approach is employed.

Change in Total Welfare in Botswana

In all scenarios, total welfare is negative. Total welfare is the sum of the change in producers' surplus, consumers' surplus and government revenue. Figure 4.4 above shows changes in total welfare by formula

The Swiss formula, as one might expect, accounts for the largest loss in total welfare because of its major cuts in tariffs, export subsidy and domestic support. In terms of the Swiss formula, total welfare declines by US \$ 44.2 million, followed by the Harbinson approach where total welfare declines by about US \$ 31 million. If the Cancun/Blended formula is applied, Botswana witnesses the lowest decline in total welfare. Under this formula, the country loses about US \$ 13.3 million worth of total welfare while the Uruguay formula records a total welfare loss of about US \$ 16.4 million.

Overall it would appear that the Cancun/blended formula, if applied to Botswana, leads to a smaller loss in total welfare than other formulas/scenarios.

4.7 Summary: Advantages and Disadvantages of the Partial Equilibrium Approach in Agricultural Trade Liberalization/Policy

Partial equilibrium analysis provides certain key advantages in order to understand agricultural trade liberalization or policy changes. At a sectoral/commodity level, the approach can help to identify constraints and practicable solutions, utilizing minimum cost and data requirements, unlike economy-wide models.

The determination of consumer and producer welfare, government and export revenue, and other statistics using ATPSM has partly made it possible to make comparisons about the likely effects of the various tariff reduction formulas on each country by product. The results from the partial equilibrium analysis assist one to design policies in order to safeguard vulnerable groups (producers and consumers) and sensitive industries/commodities, as well as to put in place measures to minimize adverse effects on government and export revenues. In negotiating for SDT provisions, based on ATPSM results Botswana can collaborate with other similarly affected countries, in order to request for additional financial and technical assistance to protect her small economy for a longer time before fully integrating it into the global economy.

Further, through partial equilibrium analysis or ATPSM, a country can assess the effects of tariff changes at both commodity and sectoral levels. These effects cannot be captured by economy-wide models/general equilibrium approaches. The response by producers to price incentives and other farm inputs, for instance, can be accurately analyzed by using partial equilibrium analysis. Partial equilibrium analysis is less data and skill-intensive than economy-wide models. Data and skills are generally scarce among low-income countries such as Botswana. The reduced demand for advanced analytical skills and detailed data in partial equilibrium analysis could in the medium term save limited resources whose opportunity cost in low-income countries is high.

As will become apparent in subsequent chapters, partial equilibrium analysis has certain disadvantages. Firstly, the approach assumes that the sector under consideration exhibits limited linkages with the rest of the economy. For many low-income countries agriculture is one of the main sectors. In Botswana, the farming sector (despite its low share in the country's GDP), through the circular flow of income and expenditure linkages in the economy, demonstrate strong links with the household, food, non-food manufacturing, transport, finance and external trade sectors (see Chapters 6 and 7).

Secondly, as indicated in Chapter 3, international trade can increase farm incomes of those exporting while those in the non-exporting sector may experience lower per capita income. It is not possible through the application of partial equilibrium analysis to assess the impact of international trade liberalization on income distribution and welfare. For instance, the ATPSM results do not indicate which groups of producers (large-scale or net buyers of food) and consumers (low-income versus high-income) benefit when tariffs regarding the selected agricultural products in Botswana are reduced.

In summary, this chapter has described the utilization of partial equilibrium analysis in agricultural trade liberalization and the application of the ATSPM to Botswana's agricultural sector, as well as indicating the welfare implications of the WTO tariff reduction proposals for the country. Whereas the Swiss formula provided Botswana with the largest potential export revenue and import flows, the formula also lead to the highest loss in total welfare. The Cancun/blended approach, on the other hand, provided the country with the least agricultural export revenue, import flows and loss of total welfare. The Harbinson and the Uruguay formulas gave results that were in between the Swiss and the Cancun approaches. Cautiously and recognizing the development challenges facing Botswana, the Cancun/blended formula appears relevant for the country as it covers sensitive industries that employ many people. The chapter has also examined the advantages and disadvantages of using partial equilibrium analysis in trade liberalization as well as for determining policy in general. Subsequent chapters will deal with

economy-wide policy effects, as opposed to those considered in the partial equilibrium approach.